

BRC CLOSURE PLAN

BMI COMMON AREAS CLARK COUNTY, NEVADA

Prepared for:



**Basic Remediation Company (BRC)
875 West Warm Springs Road
Henderson, Nevada 89015**

Prepared by:

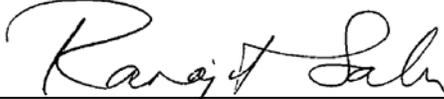
**Basic Remediation Company (BRC)
875 West Warm Springs Road
Henderson, Nevada 89015**

**Environmental Resources Management (ERM)
2525 Natomas Park Drive, Suite 350
Sacramento, CA 95833**

**Daniel B. Stephens & Associates, Inc.
5951 Encina Road, Suite 208
Goleta, CA 93117**

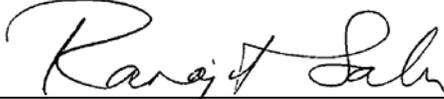
May 2007

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Dr. Ranajit Sahu, C.E.M. (No. EM-1699, Exp. 10/07/2007) May 10, 2007
BRC Project Manager Date

I hereby certify that I have subjected the attached document to quality control review by external reviewer and have also reviewed the document myself.



Dr. Ranajit Sahu, C.E.M. (No. EM-1699, Exp. 10/07/2007) May 10, 2007
BRC Project Manager Date

TABLE OF CONTENTS

<u>SECTION</u>	<u>TITLE</u>	<u>PAGE</u>
LIST OF TABLES		vi
LIST OF FIGURES		vii
ACRONYMS AND ABBREVIATIONS.....		ix
1 INTRODUCTION.....		1-1
1.1	Closure Plan Goal	1-5
1.1.1	Human Health Protection.....	1-5
1.1.2	Protection of Groundwater Quality.....	1-6
1.1.3	Ecological Receptors	1-6
1.2	Document Organization.....	1-7
1.3	Iterative Approach Toward Closure	1-7
1.4	Project Roles and Responsibilities.....	1-8
2 SITE HISTORY		2-1
2.1	Site Ownership.....	2-1
2.1.1	United States Government – 1941 to 1949	2-1
2.1.2	Colorado River Commission – 1949 to 1953	2-20
2.1.3	United States Government	2-23
2.1.4	Stauffer Chemical Company of Nevada / Pioneer Chlor-Alkali Company, Inc.	2-26
2.1.5	Western Electro Chemical Company.....	2-27
2.1.6	National Lead Company/Titanium Metals Corporation	2-29
2.1.7	Chemstar, Inc.	2-32
2.2	Manufacturing Processes Used at the Site.....	2-33
2.3	Disposal Practices on to BMI Common Areas	2-52
2.4	Corporate Succession.....	2-74
2.5	Regulatory Activities	2-77
2.5.1	Introduction.....	2-77
2.5.2	BMI Common Areas.....	2-78
2.5.3	Pioneer Chlor Alkali Company and Stauffer Management Company.....	2-80
2.5.4	Titanium Metals Corporation.....	2-80
2.5.5	Kerr-McGee Chemical Corporation (Tronox)	2-81
2.5.6	Montrose Chemical Corporation.....	2-82
2.5.7	City of Henderson.....	2-82

TABLE OF CONTENTS

<u>SECTION</u>	<u>TITLE</u>	<u>PAGE</u>
3	SITE RELATED CHEMICALS LIST	3-1
4	SITE-WIDE CONCEPTUAL SITE MODEL OVERVIEW	4-1
4.1	Site Summary.....	4-2
4.1.1	Site Description.....	4-3
4.1.2	Geology.....	4-6
4.1.3	Surface Water.....	4-7
4.1.4	Groundwater	4-8
4.2	Source Characterization.....	4-11
4.2.1	Summary of Eastside Area Source Characterization	4-12
4.2.2	Summary of CAMU Area Source Characterization	4-15
4.3	Soil Background Levels.....	4-18
4.3.1	Surficial Soil	4-18
4.3.2	Deep Soil.....	4-20
4.4	Upgradient And Deeper Groundwater.....	4-21
4.5	Migration pathways	4-21
4.5.1	Eastside Area	4-21
4.5.2	CAMU Area.....	4-24
4.6	Environmental Receptor Identification and Discussion	4-26
4.7	Discussion of Site Data Needs (Gaps).....	4-26
5	DATA VERIFICATION AND VALIDATION.....	5-1
5.1	Field Data Verification	5-1
5.2	Laboratory Data Verification.....	5-2
5.3	Laboratory Data Validation	5-2
5.4	Data Review.....	5-3
5.5	Full Data Validation.....	5-3
5.6	Data Validation Report	5-4
5.7	Reconciliation with User Requirements	5-4
6	DATA USABILITY EVALUATION	6-1
6.1	Criterion I: Reports to Risk Assessor	6-1
6.2	Criterion II: Documentation.....	6-2
6.3	Criterion III: Data Sources.....	6-2
6.4	Criterion IV: Analytical Methods and Detection Limits	6-3

TABLE OF CONTENTS

<u>SECTION</u>	<u>TITLE</u>	<u>PAGE</u>
6.5	Criterion V: Data Review	6-3
6.6	Criterion VI: Data Quality Indicators	6-4
7	DATA QUALITY OBJECTIVES	7-1
7.1	Overview of the DQO Process.....	7-1
7.2	Principal Study Questions for the Project.....	7-9
7.2.1	Site Principal Study Questions.....	7-10
8	REMEDIAL ALTERNATIVE STUDIES	8-1
8.1	Eastside Area Soils	8-2
8.2	CAMU Area Slit-Trench Wastes.....	8-2
8.3	Eastside Area Shallow Groundwater and Vadose Zone	8-3
8.4	Eastside Area Deeper Groundwater.....	8-3
8.5	CAMU Area Groundwater.....	8-3
8.6	Other Study Areas or Media	8-3
9	RISK ASSESSMENT METHODOLOGY – HUMAN HEALTH.....	9-1
9.1	Purpose.....	9-1
9.1.1	Human Health Protection.....	9-2
9.2	Overview of the Human Health Risk Assessment Process.....	9-3
9.3	Summary of Conceptual Site Model and Data Usability Evaluation	9-4
9.3.1	Summary of Conceptual Site Model.....	9-4
9.3.2	Summary of Data Usability Evaluation	9-5
9.4	Selection of COPCs for Human Health Risk Assessment.....	9-7
9.4.1	Evaluation of Site Concentrations Relative to Background Conditions.....	9-7
9.4.2	Further Selection of COPCs.....	9-9
9.4.3	Summary and Presentation of COPCs	9-12
9.5	Determination of Representative Exposure Concentrations	9-12
9.5.1	Soil	9-12
9.5.2	Indoor Air.....	9-14
9.5.3	Outdoor Air.....	9-15
9.5.4	Groundwater	9-15
9.5.5	Plant Uptake.....	9-16

TABLE OF CONTENTS

<u>SECTION</u>	<u>TITLE</u>	<u>PAGE</u>
9.6	Methodology for Evaluating Potential Impacts to Groundwater and Surface Water.....	9-16
9.6.1	Soil/Water Partition Equation for Migration to Groundwater	9-16
9.6.2	Surface Runoff Modeling	9-20
9.6.3	Impacts on Las Vegas Wash	9-22
9.7	Tiered Human Health Risk Assessment Approach.....	9-22
9.7.1	Identification of Potentially Exposed Populations and Pathways.....	9-23
9.7.2	Deterministic Human Health Risk Assessment Methodology.....	9-24
9.7.3	Probabilistic Human Health Risk Assessment Methodology	9-27
9.7.4	Radionuclide Risk Assessment Methodology	9-27
9.7.5	Asbestos Risk Assessment Methodology	9-28
9.8	Toxicity Assessment	9-31
9.9	Risk Characterization.....	9-34
9.9.1	Methods for Assessing Cancer Risks.....	9-34
9.9.2	Methods for Assessing Non-Cancer Health Effects	9-35
9.10	Uncertainty Analysis.....	9-36
9.11	Interpretation of Findings	9-36
10	RISK ASSESSMENT METHODOLOGY – ECOLOGICAL.....	10-1

LIST OF APPENDICES

<u>LETTER</u>	<u>TITLE</u>
A	NDEP Comments on the August 2006 BRC Closure Plan, BRC Response to Comments, and Redline/Strikeout Version of the Text

LIST OF TABLES

<u>NUMBER</u>	<u>TITLE</u>
1-1	BRC Project Documents and Their Status
3-1	Project List of Analytes
4-1	BRC Estimates of Volumes Deposited into Upper and Lower Ponds, 1942-1976
4-2	Screening Levels Used in Data Summary Tables and Figures
4-3	Summary of Soils Investigations – All Soil Data
4-4	Summary of Soils Investigations – Surface Soils (0-1' bgs)
4-5	Summary of Soils Investigations – Near-Surface Soils (1-15' bgs)
4-6	Summary of Soils Investigations – Middle Zone Soils (15' bgs to Qa/TMCf)
4-7	Summary of Soils Investigations – Deep Zone Soils (TMCf)
4-8	Summary of Groundwater Results – Third Quarterly Event 2006 – All Data
4-9	Summary of Groundwater Results – Third Quarterly Event 2006 – Upper Unconfined Water-Bearing Zone
4-10	Summary of Groundwater Results – Third Quarterly Event 2006 – Intermediate Water-Bearing Zone
4-11	Summary of Groundwater Results – Third Quarterly Event 2006 – Deep Water-Bearing Zone
4-12	Background Shallow Soil Descriptive Summary Statistics
4-13	Summary of Data Gaps
9-1	Fate and Transport Screening Model Values
9-2	Deterministic Exposure Factors – Construction Workers
9-3	Deterministic Exposure Factors – Commercial/Park Maintenance Workers
9-4	Deterministic Exposure Factors – Trespasser/Recreational User
9-5	Deterministic Exposure Factors – Residential

LIST OF FIGURES

<u>NUMBER</u>	<u>TITLE</u>
1-1	Project Map
1-2	Eastside Portion of the Site
1-3	CAMU Portion of the Site
1-4	Closure Process/Methodology
2-1	Site Location
2-2	Photographs of Site Prior to Development
2-3	Land Holdings Acquired by the U.S. Government
2-4	Land Conveyances from the War Assets Administration to the Colorado River Commission
2-5	Additional Land Transfers to the Colorado River Commission
2-6	Ownership of the Facility after the Completion of the Colorado River Commission Conveyances
2-7	Colorado River Commission Re-Assigned Leases to the General Services Administration
2-8	Land Acquisitions and Conveyances Involving Stauffer Chemical Company
2-9	Land Acquisitions and Conveyances Involving WECCO/American Potash and Chemical Corporation/Kerr-McGee
2-10	Chemstar Facility
2-11	Land Acquisitions and Conveyances Involving TIMET, Allegheny Ludlum Steel Corporation, and National Lead Company
2-12	Basic Magnesium Flow Chart of Operations
4-1	Topographic Surface of the Muddy Creek Formation
4-2	Geologic Block Diagram with View from the Southwest
4-3	Conceptual Diagram of the Interaction of the Alluvial Aquifer and Las Vegas Wash
4-4	Geophysical Survey Transect Locations
4-5	Potentiometric Surface Map of Upper Unconfined Water-Bearing Wells - Third Quarterly Event 2006
4-6	Potentiometric Surface Map of Muddy Creek Formation (MCF) Wells (Deep) - Third Quarterly Event 2006
4-7	Stiff Diagrams for the Aa and Deep Zones
4-8	Hydrogeologic Cross Section Z-Z' Location Map

LIST OF FIGURES

<u>NUMBER</u>	<u>TITLE</u>
4-9	Hydrogeologic Cross Section Z-Z'
4-10	Conceptual Diagram of Eastside Area - Circa 1943
4-11	Conceptual Diagram of Eastside Area - Circa 1968
4-12	Conceptual Diagram of Eastside Area - Circa 1976
4-13	Conceptual Diagram of Eastside Area - Circa 1992
4-14	Conceptual Diagram of Eastside Area - Circa 2005
4-15	Conceptual Diagram of Eastside Area in the Future
4-16	Historical Conceptual Site Model of CAMU Area - Circa 1943
4-17	Historical Conceptual Site Model of CAMU Area - Circa 1976
4-18	Historical Conceptual Site Model of CAMU Area - Circa 2005
4-19	Conceptual Site Model, Future Scenario with CAMU in Place
4-20	Summary of Soils Investigations – Surface Soils (0-1 ft bgs)
4-21	Summary of Soils Investigations – Near-Surface Soils (1-15 ft bgs)
4-22	Summary of Soils Investigations – Middle Zone Soils (15 ft bgs to Qa/TMCF)
4-23	Summary of Soils Investigations – Deep Zone Soils (Muddy Creek Formation)
4-24	Summary of Groundwater Results – Upper Unconfined Water-Bearing Zone
4-25	Summary of Groundwater Results – Intermediate Water-Bearing Zone
4-26	Summary of Groundwater Results – Deep Water-Bearing Zone
4-27	Interim Remedial Measure Areas
4-28	Tronox and AMPAC Perchlorate Groundwater Plume Map
9-1	Conceptual Site Model Diagram for Potential Human Exposures
10-1	Habitat Map

ACRONYMS AND ABBREVIATIONS

Aa	alluvial aquifer
ADD	average daily dose
AMPAC	American Pacific Corporation
Anaconda	Anaconda Copper Mining Company
AOC3	Settlement Agreement and Administrative Order on Consent: BMI Common Areas, Phase 3
ARARs	Applicable or Relevant and Appropriate Requirements
ASTM	American Society for Testing and Materials
ATSDR	Agency for Toxic Substances and Disease Registry
BAT	best available techniques
BEC	Basic Environmental Company
BEP	best environmental practices
bgs	below ground surface
BII	Basic Investment Inc.
BMI	Basic Management Inc.
BPC	British Petroleum Company
BRC	Basic Remediation Company
BRI	Basic Refractories, Inc.
C&C	Coverdale & Colpitts
CAMU	Corrective Action Management Unit
CAP	Corrective Action Plan
CEC	cation exchange capacity
COPCs	chemicals of potential concern
CRC	Colorado River Commission
CSF	cancer slope factor
CSM	Conceptual Site Model
DAF	dilution attenuation factor
DBS&A	Daniel B. Stephens & Associates, Inc.
DPC	Defense Plant Corporation
DQA	data quality assessment
DQIs	data quality indicators

ACRONYMS AND ABBREVIATIONS

DQOs	Data Quality Objectives
DTA	O,O-diethylphosphorodithoioic acid
ECA	Environmental Conditions Assessment
ECAO	Environmental Criteria and Assessment Office
ECI	Environmental Conditions Investigation
ERA	ecological risk assessment
FOD	frequency of detection
FSSOP	Field Sampling and Standard Operating Procedures
ft/ft	foot per foot
GIS	geographic information system
GISdT [®]	Guided Interactive Statistical Decision Tools
gpm	gallons per minute
GWTS	Groundwater Treatment System
H ₂ SO ₄	sulfuric acid
HCl	hydrochloric acid
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
HISSC	Henderson Industrial Site Steering Committee
IEUBK	Integrated Exposure Uptake Biokinetic Model
IPS	Industrial Planning Section
IRIS	Integrated Risk Information System
IRMs	interim remedial measures
Kerr-McGee	Kerr-McGee Chemical Corporation
LADD	lifetime average daily dose
LOQ	limit of quantitation
LOU	Letter of Understanding
MCLs	maximum contaminant limits
MDL	method detection limit
MEL	Magnesium Electron, Ltd.
mg/kg	milligrams per kilogram
mg/L	milligrams per liter

ACRONYMS AND ABBREVIATIONS

MgO	magnesium oxide
Montrose	Montrose Chemical Corporation
NCEA	National Center for Environmental Assessment
NDEP	Nevada Division of Environmental Protection
NFA	No Further Action
NFAD	No Further Action Determination
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OPM	Office of Production Management
PAHs	polycyclic aromatic hydrocarbons
PARCC	precision, accuracy, representativeness, comparability, and completeness
PCBs	polychlorinated biphenyls
pCi/L	picocuries per liter
PEF	Particulate Emission Factor
Pioneer	Pioneer Chlor-Alkali Company
POPs	Persistent Organic Pollutants
PPRTVs	Provisional Peer Reviewed Toxicity Values
ppt	parts per trillion
PRGs	preliminary remediation goals
psi	pounds per square inch
PSQs	Principal Study Questions
Qal	Quaternary alluvium
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RAGS	Risk Assessment Guidance for Superfund
RAS	remedial alternatives study
RFC	Reconstruction Finance Corporation
RfD	reference dose
RIBs	Rapid Infiltration Basins
ROD	Record of Decision
SAR	structure-activity relationship

ACRONYMS AND ABBREVIATIONS

SDG	Sample Delivery Group
SOPs	Standard Operating Procedures
SQL	sample quantitation limits
SRC	Site Related Chemicals
SSLs	soil screening levels
Stauffer	Stauffer Chemical Company
SVOCs	semi-volatile organic compounds
TCE	trichloroethylene
TDS	total dissolved solids
TEFs	toxicity equivalency factors
TEQ	toxic equivalency
TIMET	Titanium Metals Corporation
TOC	total organic carbon
TMCf	Tertiary Muddy Creek formation
TSS	total suspended solids
UCL	upper confidence limit of the mean
USDOE	U.S. Department of Energy
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
USLE	Universal Soil Loss Equation
VOCs	volatile organic compounds
WAA	War Assets Administration
WECCO	Western Electro Chemical Company
WPB	War Production Board
WRF	Water Reclamation Facility

SECTION 1

1 INTRODUCTION

In February 2006, Basic Remediation Company (BRC) and others executed the *Settlement Agreement and Administrative Order on Consent: BMI Common Areas, Phase 3 (AOC3)*¹ with the Nevada Division of Environmental Protection (“NDEP” or “Division”) for certain property located in Clark County, Nevada. This property (the “Site”) covers approximately 2,690 acres: 2,287 acres east of Boulder Highway, 34 acres west of Boulder Highway (“Parcel 9”); and 369 acres contiguous to Parcel 9 (“Parcel 5/6”). Together, these three parcels compose the “Basic Management, Inc. (BMI) Common Areas”, and they lie within the southeastern quadrant of the Las Vegas Valley (Figure 1-1). Figure 1-2 depicts the 2,287 acre tract east of Boulder Highway, and Figure 1-3 depicts the two tracts to the west of Boulder Highway. The Site is shown in context with nearby features such as the BMI industrial complex, neighboring land uses, historic conveyance ditches and the like on Figure 1-1.

The AOC3 defines the overall framework within which the Site is to be characterized and chemical pollutants remediated, as necessary. Among other matters, the AOC3 specifically “governs the performance and/or completion of Environmental Contaminant characterization, the screening and selection of Remedial Actions, and the implementation and long-term Operation and Maintenance of Division-approved Remedial Actions, each and all as necessary to implement the existing Record of Decision (ROD) and future ROD(s) concerning Soil Pollution Conditions and Water Pollution Conditions at the Site.”² The steps and sequence by which these characterization and remedial actions are to be performed are stated in the *Scope of Work*, which is a part of the AOC3. This Closure Plan has been prepared pursuant to the AOC3, and particularly in furtherance of the Scope of Work. This Closure Plan is also responsive to the existing ROD referenced in the AOC3 text quoted above, which is NDEP’s *Record of Decision, Remediation of Soils and Sediments in the Upper and Lower Ponds at the BMI Complex* (November, 2001). BRC has endeavored to limit the extent of technical detail in this Closure Plan – in an effort to improve its readability, accessibility, and to keep the document to a

¹ Periodically, this document will reference other project documents that have been or are being prepared to achieve the goals of this closure effort. While some of these documents have been approved and are, thus, final, others are in development. These latter documents will always be referred to as “Draft” in this Plan. The inclusion of such Draft documents in this Plan does not in any way imply NDEP concurrence or approval of such documents – rather, these references are simply in order to create a manageable narrative.

² AOC3, §1.9

manageable length. Technical details are to be found in the various documents referenced in this Plan.

This revision of the Closure Plan (Revision 1) incorporates NDEP comments dated January 18, 2007 on the August 2006 *BRC Closure Plan*, as well as a completely re-written Section 4, based on a meeting between BRC and NDEP to review these comments. All NDEP comments and BRC's response-to-comments on the August 2006 version of the Closure Plan are provided in Appendix A. As discussed with and requested by the NDEP, detailed responses to each of the Section 4 comments are not provided at this time. However, included in Appendix A is a redline/strikeout version of the text showing the revisions from the August 2006 version of the Closure Plan. Because of the substantial revisions to Section 4, redline/strikeout for this section is based on the revised draft version commented on by NDEP on March 21, 2007.

The Closure Plan contains the history of the Site, its future uses, BRC's characterization and remediation plans with respect to soils and to waters, the objectives and methods of such remediation plans, and various maps, tables, figures and other references as might be useful to the regulator and other stakeholders. This Closure Plan conceptually describes the steps that BRC will undertake to assess risks at the Site and, hence, to make risk-based decisions (including decisions to seek no further action determinations ("NFADs") for discrete parcels within the Site). The term NFAD is defined in the AOC3 in Section XVII. These steps include dividing the Site into discrete exposure areas ("sub-areas"), the identification of possible receptors and pathways, the identification of actual and potentially contaminated media, the definition of risk assessment source terms (such as data collection, and fate and transport modeling), and how risk-based decisions will be made (including the consideration of background data) for the purposes of prompting remediation, determining appropriate uses, seeking NFADs for sub-areas, and Site Closure. In brief, the Closure Plan states why BRC is choosing to progress down certain paths and how BRC is going to proceed through characterization, remediation, and assessment activities to effect Site Closure—the ultimate aim of the AOC3.

The Site is near the BMI Industrial Complex, in Clark County, Nevada, approximately 13 miles southeast of Las Vegas and two miles northeast of the City of Henderson's downtown. The property represents what is known as the BMI Common Areas; as noted above, the total extent of the Site is approximately 2,690 acres and is composed of the properties east of Boulder Highway (2,287 acres), the Parcel 9 area west of Boulder Highway (34 acres), and the Parcel 5/6 and CAMU Area west of Boulder Highway (369 acres). For ease of use, the term "Eastside" area

will be used to denote the areas east of Boulder Highway as well as the Parcel 9 area, which is located immediately adjacent to and west of Boulder Highway. The proposed Corrective Action Management Unit (CAMU)³ area of approximately 114 acres lies within the 369 acre portion west of Boulder Highway.

The Site consists of:

- land on which unlined wastewater effluent ponds (and associated conveyance ditches) were built and into which various industrial plant wastewaters were discharged from 1942 through 1976 (see Figure 1-2);
- land on which lined wastewater effluent ponds were constructed and into which effluent from the Titanium Metals Corporation (TIMET) plant was discharged from 1976 to 2005 (see Figure 1-2);
- land on which the City of Henderson constructed municipal wastewater rapid infiltration basins (“RIBs”— see Figure 1-2);
- land which BMI conveyed to the City of Henderson and upon which the City of Henderson is presently building a wastewater treatment plant (the Water Reclamation Facility [WRF]— see Figure 1-2);
- land on which unlined wastewater effluent ponds were constructed but which were either never used or rarely used (see Figure 1-2);
- land which appears never to have had historical use (see Figure 1-2); and
- land which was used for private, industrial landfills (see Figure 1-3).

The Eastside Area of the Site is shown in Figure 1-2 and the CAMU Area of the Site is shown in Figure 1-3. Figure 1-2 shows the various sub-areas into which the Eastside Area has been subdivided for purposes of focusing the processes of exposure identification, remediation, and, later, development. The rationale for this subdivision is discussed in Section 4. Note that two sub-areas in the Eastside Area are not subject to soils remediation under the AOC3: these are the WRF sub-area, which is owned by the City of Henderson, and the “No Further Action (NFA) Areas”

³ The proposed CAMU is a lined and capped landfill into which the contaminated soils and sediments, from the Eastside Area will be placed and interred.

sub-area, which is owned by the Landwell Company. As noted above, Figures 1-1 and 1-2 also depict the geographic relationship of the Site to the cities of Henderson and Las Vegas. Figure 1-1 shows both the Eastside and CAMU areas as well as other significant features such as the BMI industrial plants, neighboring land uses, historic conveyance ditches, and the like. The Eastside Area is within the City of Henderson's boundary; the CAMU Area is within Clark County. Further detail and maps of the Site are found in Section 4 of this Closure Plan and in the NDEP-approved *Corrective Action Plan* (BRC 2006a).

The CAMU Area has also been sub-divided for ease of discussion into various sub-areas more fully described in the *Draft CAMU Area Conceptual Site Model* (Daniel B. Stephens & Associates, Inc. [DBS&A] and BRC 2007) and in the *Remedial Action Plan* (BRC 2006b), under review by the NDEP. The CAMU sub-area will not be developed (except to contain the CAMU); however, adjoining parts (known as Parcel 5/6) may be redeveloped.

All media—soils, air, and groundwater—are covered by the AOC3. Groundwater and vadose zone contamination, as might exist under the two sub-areas that have been granted NFAs with respect to soils are still subject to the AOC3 and will be remediated, as and if necessary by BRC, to achieve the purpose of the AOC3, which is overall Site Closure.

Over the past 15 years, a multi-phased investigation has been conducted by BRC and others under the oversight of the NDEP to identify the hydrogeology of the Site and the nature and extent of chemical occurrences⁴ in the Site soils and groundwater. This investigation is continuing. Results of the studies conducted to date have been used to construct two Conceptual Site Models (CSM) - one for the Eastside Area and one for the CAMU Area. Section 4 of this Plan contains a summary of both CSMs. After completion of several investigations in the planning stages or underway, BRC will also prepare a more detailed *Draft Eastside Conceptual Site Model* which will contain additional technical detail beyond what has been presented in summary fashion in Section 4 of this Plan for the Eastside Area. BRC has prepared a separate *Draft CAMU-Area Conceptual Site Model*, which has been provided to NDEP for review. NDEP has provided comments, and this document will be revised as needed in the future.

⁴ The term chemical (as in chemical occurrence and chemical concentrations), as used in this sentence and throughout the remainder of this Closure Plan, refers to various organic and inorganic compounds. A complete list of all Site Related Chemicals (SRC) is provided in Section 3 of this Closure Plan.

1.1 CLOSURE PLAN GOAL

The goal of the Closure Plan is to execute the provisions of the AOC3 such that remediation of the Site results in chemical concentrations in Site media which:

1. Do not pose an unacceptable risk to human health and the environment under anticipated future uses, including residential use in the Eastside Area; or
2. Are representative of background conditions at the Site.

Because the owner of the Site plans to redevelop the Eastside Area according to a master-plan which includes residential, commercial, and civic uses, BRC has chosen to use the U.S. Environmental Protection Agency (USEPA) residential standard as the human health risk standard for the Eastside Area, recognizing however that there may be portions of the Eastside Area in which this standard cannot be achieved. Should this occur, BRC will discuss alternative USEPA risk standards with the NDEP for those portions of the Eastside Area so affected.

The CAMU sub-area will be the permanent location for the remediation wastes from the Upper and Lower Ponds and associated conveyance ditches. These wastes will be interred in the proposed CAMU. After construction of the CAMU, this sub-area will essentially include the CAMU and the older Slit Trenches and the closed BMI Landfill. Appropriate long term monitoring will be conducted in this area as required by the NDEP. Details concerning the CAMU are found in the *Remedial Action Plan* (BRC 2006b).

1.1.1 Human Health Protection

For human health protection, BRC's goal is to remediate the Eastside Area sub-areas such that they are suitable for residential uses, assuring health protective conditions at unit 1/8th-acre exposure areas. The 1/8th-acre area corresponds to the size of a typical residential lot size, as presented in USEPA's 1989 *Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual (Part A)* (RAGS). There are only two exceptions to this general goal of residential end use in the Eastside Area, specifically, the "Trails & Recreation" sub-area (see Figure 1-2), and the WRF sub-area.

Risk level and cleanup goals consistent with USEPA precedents and guidelines for residential uses have been established and are discussed in Section 9 of this Plan.

1.1.2 Protection of Groundwater Quality

Characterization and, if necessary, subsequent remediation of groundwater is specified by the AOC3 for the entire Site. Certain groundwater characterization work has been completed by BRC in 2004 (Eastside Area) and 2005 (CAMU Area)⁵; certain work is on-going (*e.g.*, quarterly groundwater monitoring in the Eastside Area; analyses and the construction of a Eastside Area-wide hydrological model); and certain work is planned in the near-term (*e.g.*, determination of upgradient groundwater conditions; aquifer testing, etc.). While the 2004 and 2005 investigations (along with investigations of groundwater conditions by other neighboring property owners) have provided a foundational understanding of groundwater under the Site, data gaps remain. Major data gaps are discussed in Section 4. As further data are collected to close these data gaps, these data will be added to the characterization of groundwater in the respective CSMs, which are intended, like all CSMs, to be “living” documents. Once the groundwater is characterized sufficiently under the Eastside Area and under the CAMU Area, in accordance with the AOC3 BRC will prepare appropriate Remedial Alternatives Study (RAS) documents and submit these to the NDEP for its review. If remediation is necessary of the groundwater(s), such will be performed by BRC, all in accordance with the provisions of the AOC3.

1.1.3 Ecological Receptors

BRC has assessed ecological resources for the Site as a whole and arrived at the conclusion that there are no significant ecological resources present that will be adversely affected by the proposed development. In particular, BRC has evaluated such resources for the sub-area known as the Trails & Recreation sub-area whose development plans have evolved over time. BRC provided the NDEP with substantial documentation during a January 3, 2007 meeting to explain the development plans for this sub-area. These plans indicate that the Trails & Recreation sub-area will receive a substantial amount of fill material and development after remediation is complete. The NDEP believes that these developments do not constitute suitable habitat and hence an ecological risk assessment is not necessary. As noted in Section 10 of this Plan, an ecological risk assessment work plan will be developed if and when impacts and receptors are identified. For example, if it is discovered that off-Site impacts are adversely affecting ecological receptors it may be necessary to develop an ecological risk assessment work plan.

⁵ The details of these investigations will be contained in the respective Draft CSMs being prepared for the Eastside and CAMU areas.

1.2 DOCUMENT ORGANIZATION

Based on suggestions provided by the NDEP to BRC,⁶ this Closure Plan contains the following sections:

1. Introduction
2. Site History
3. Site Related Chemicals List
4. Eastside Area CSM: Overview
5. Data Verification and Validation Reports
6. Data Usability Evaluations
7. Data Quality Objectives, including Principal Study Questions
8. Remedial Alternative Studies
9. Risk Assessment Methods – Human Health
10. Risk Assessment Methods – Ecological

As noted earlier, per the Scope of Work in the AOC3, there are a number of other, free-standing plans pertinent to the characterization and remediation of the Site. A list of these documents and their current status is provided in Table 1-1.

1.3 ITERATIVE APPROACH TOWARD CLOSURE

The characterization, remediation, and assessment processes stipulated in the AOC3 are designed to lead to determinations, by sub-area in the Eastside Area, of no-further action with respect to Eastside Area soils, determinations(s) of no-further action with respect to Site groundwater(s), and ultimately to Site Closure. These determinations will be risk-based. In other words, the decision endpoint in each case is a risk assessment. The processes are specified and depicted in the Scope of Work of the AOC3 and are purposefully iterative in order to achieve a robust and defensible risk assessment result. For example, it can be stated here that the processes leading to

⁶ See Part I Comments from the NDEP to BRC (NDEP, July 11, 2005).

determinations of no-further action in the Eastside Area soils contain an iterative loop (Figure 1-4). In the loop, at a given stage of remediation, risk assessment will not be initiated unless proper data sufficiency, representativeness, and adequacy analysis is first achieved. If necessary, additional data will be gathered or analyzed to meet the goals of data quality required for risk assessment. The risk assessment will, in turn, help to assure that these data characteristics are properly evaluated. Once risk assessment is completed, the assessment will be made as to whether the remediation conducted meets cleanup goals. If cleanup goals are not achieved, additional remediation, associated confirmation sampling, and assessment cycles will be conducted until a decision end point is reached – namely that the cleanup goals are either met (and the NFAD is issued or Site Closure is achieved, as the case may be) or proven infeasible because it is technically impractical or too costly, in which case changes in land use or institutional controls may be considered.

Thus, Figure 1-4 shows the overall sequence of steps that will be taken in order to effect Site closure. This sequence will generally be followed by BRC, and any changes to this sequence that may become necessary will only be made with NDEP concurrence.

1.4 PROJECT ROLES AND RESPONSIBILITIES

Specific roles and responsibilities have been defined for key project personnel to ensure that project goals are achieved. Each defined role will be performed by a responsible, qualified individual. These roles include the Project Program Manager, the Risk Assessment Task Manager, the Hydrogeology Characterization Task Manager, the Project Statistician, and the Construction Manager. The Project Program Manager is Dr. Ranajit (Ron) Sahu, C.E.M., who is responsible for the successful and timely completion of the specified activities. The Program Manager is responsible for assuring that all policies and procedures set forth in the project plans are followed by the project team. Details of team functions and curricula vitae are found in BRC's most current *Soil and Groundwater Clean-Up Team Professional Profiles*, which is submitted to the NDEP on a periodic basis.

SECTION 1 REFERENCES

Basic Remediation Company (BRC). 2006a. Corrective Action Plan (CAP) for the Basic Remediation Company (BRC) Common Areas Remediation Project.

BRC. 2006b. Remedial Action Plan (RAP).

Daniel B. Stephens & Associates, Inc. (DBS&A) and BRC. 2007. Draft CAMU Area Conceptual Site Model.

Nevada Division of Environmental Protection (NDEP). 2001. Record of Decision, Remediation of Soils and Sediments in the Upper and Lower Ponds at the BMI Complex. Henderson, Nevada. November 2.

U.S. Environmental Protection Agency (USEPA). 1989. Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual (Part A). Interim Final. Office of Emergency and Remedial Response, Washington, D.C. USEPA/540/1-89/002. December.

SECTION 2

2 SITE HISTORY

In 1941, approximately 5,000 acres of empty desert in the southeastern quadrant of the Las Vegas Valley was deeded by the United States for use as the site of what was to become the world's largest magnesium plant, a plant that would play a critical role in World War II. Since that time, parts of the original site have remained industrialized, parts of the site have been used for the disposal of a variety of industrial wastes, parts of the site have been abandoned, parts of the site have been converted to other uses, and some parts have remained virgin desert. Over the past 63 years, more than 80 private and public entities have owned or leased or operated facilities on the original site, engaging in a wide range of commercial enterprises from heavy manufacturing of chemicals and metals to warehousing and distribution. The land's uses and ownership are, in a word, complex. But they are, in large part, known.

The land encompassed by the Closure Plan is owned by only one of the many entities that have been involved at the site since 1941, and although the present owner has never been engaged in manufacturing at the site, it is important to establish the historical context for the site as a whole since this context is crucial to understanding the smaller site that is the subject of the Closure Plan. Accordingly, this section provides an overview of the ownership, manufacturing, disposal, and regulatory histories of the original site.

2.1 SITE OWNERSHIP

2.1.1 United States Government – 1941 to 1949

The United States military, in response to the outbreak of war in Europe in 1939, established a substantial aircraft-purchasing program. Magnesium was a crucial component in aircraft production and, by 1940, the demand for magnesium exceeded the supply.¹ The government took action to make certain that the available magnesium was being used appropriately. On February 12, 1941, the Priorities Division of the Office of Production Management (OPM) requested magnesium producers to allocate stocks to defense industries. The next day, the OPM gave complete preferential status to defense needs for magnesium over non-defense orders. In May, the OPM added magnesium to the list of critical materials and placed the material under

¹ Report on Magnesium, p. 8, July 24, 1943. NARA I, RG 46, Box 469, Folder: (General) Magnesium Correspondence. [BR030913-925]

industry-wide control. The OPM issued an “M Order,” making mandatory the curtailment of magnesium for all non-defense uses.²

When in late 1940 President Franklin Roosevelt called for the development of a vast “arsenal of democracy,”³ Howard Eells, President of Basic Refractories, Inc. (BRI), was one of many industrialists that responded. Mr. Eells formed an alliance with a British company, Magnesium Electron, Ltd. (MEL), which operated a magnesium plant in England and was willing to provide technical support for the construction and operation of similar facilities in the United States.⁴

On April 23, 1941, accompanied by Lt. Colonel P. Scheeburger, the Air Corps Chief of the Industrial Planning Section (IPS), Mr. Eells and others affiliated with BRI met with Air Corps personnel and Edgar Lewis, the Special Assistant to the Assistant Secretary of War, and proposed that the company operate a magnesium project.⁵ BRI personnel prepared a compelling proposal, pointing out that there were three necessary requirements to produce magnesium: (1) magnesium oxide (MgO), (2) chlorine (as a gas), and (3) electric power. Mr. Eells felt that the company’s 30 million tons of magnesite deposits in Nye County and hydroelectric power obtained from Boulder Dam could readily fill the need.⁶ He indicated that one of the major problems that existed was a lack of capital.⁷ He proposed construction of a 60,000-ton capacity plant at BRI’s magnesite property in Gabbs as well as a 20,000-ton magnesium plant and a chlorine production facility at a location to be determined. He reiterated that while government funding would be required and assurances regarding patent issues were needed, BRI’s relationship and agreement with MEL eliminated the need for experimentation to develop plant design and production methods.⁸ The Air Corps’ Colonel Hopkins and Mr. Lewis referred Mr. Eells to the Reconstruction Finance Corporation (RFC) for funding to be obtained through its

² Chronological List of OPM Press Releases on Magnesium. NARA I, RG 46, Box 474, Folder: WPB Magnesium. [BR032030-031]

³ FDR Speech, December 29, 1940.

⁴ “Magnesium,” circa 1943. NARA I, RG 46, Box 478, Folder: Las Vegas Basic Magnesium. [BR032509-561, @ BR032536]

⁵ War Department Memo # 231, April 23, 1941. UNLV Special Collections, T-6. [BR000607]

⁶ Magnesium Project, BRI, April 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009407-430]

⁷ Magnesium Project, BRI, April 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009420]

⁸ Magnesium Project, BRI, April 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009421-422]

subsidiary, the Defense Plant Corporation (DPC), and told him what needed to be done before approaching the Air Corps engineers.⁹

BRI was invited to meet with additional Air Corps and War Department personnel on May 21, 1941, at which time the government requested that BRI study the costs associated with its plan and prepare three proposals—one for a 5,600-ton unit, another for two 5,600-ton units, and a third proposal for three 5,600-ton units. The decision as to whether to proceed on a one-, two-, or three-unit facility was to be referred to the Secretary of War with a recommendation by the Air Corps after consideration of capital and production costs, housing, labor, and power. Other action items were identified and the IPS recommended that the plant location should be referred to Washington for approval by a higher authority.¹⁰

BRI submitted a formal request to the Army Air Service to authorize the project the next day.¹¹ The Air Corps forwarded the request to the Patent Liaison Branch asking for direction as to making the patents available to BRI. The Air Corps pointed out that “the Under Secretary of War has directed that the setting up of all magnesium production projects be given the highest priority.”¹²

Negotiations continued and technicians from England came to the United States to assist.¹³ In the meantime, William Knudsen, Director General of the OPM, wrote to the Under Secretary of War advising that annual magnesium metal capacity required for national defense needed to be increased from 30 million to 400 million pounds. Knudsen stated that companies building facilities “will be requested to immediately change their plans to provide the capacities indicated.”¹⁴

By June 12, BRI submitted a detailed plan for three proposals in which BRI also recommended construction of a magnesium refining plant. At the meeting, the IPS told BRI that it needed to

⁹ War Department Memo # 231, April 23, 1941. UNLV Special Collections, T-6. [BR000607]

¹⁰ War Department Memo # 255, May 17, 1941. UNLV Special Collections, T-6. [BR000945] PS, Notes on Basic Refractories, May 21, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010507-512]

¹¹ Eells to Assistant Chief, Materials Division, May 22, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010497-498]

¹² P. Schneeberger to Chief, Patent Liaison Branch, May 28, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010484-485]

¹³ P. Schneeberger to Basic Refractories, June 9, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010462]

¹⁴ Frederick Hopkins to Chief, Industrial Planning Section, June 10, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010452] See also Chronological List of OPM Press Releases on Magnesium. NARA I, RG 46, Box 474, Folder: WPB Magnesium. [BR032030-031]

apply for priority assistance with the OPM so that the company would be able to obtain steel and machine tools. BRI again reiterated its need for working capital. The government requested that BRI furnish a statement regarding assurance that MEL would provide advice and assistance in the plant construction and operation. BMI told IPS that it would form a subsidiary with ownership shared by BRI and MEL. The subsidiary was to be the lessee for the DPC lease that would be negotiated.¹⁵

That same day, Colonel Schneeberger sent a telegram to the Air Corps Facilities Section that the IPS was “definitely assured” that BMI would receive necessary assistance from the British technicians, as well as all designs, plans, drawings, specifications, and process information needed to construct and operate the facility. The Air Corps Experimental Engineering Section was convinced that the plans were sound and approved the proposed installations. Colonel Schneeberger commented on the swiftness that BRI was able to produce plans to increase the size of the project, which had grown from a maximum capacity of 33.6 million to 112 million pounds.¹⁶

On June 23, 1941, MEL documented its commitment to provide the drawings and information needed to construct the plants, and that it would send trained personnel and staff needed to operate the facility. The only caveats were that BRI had to obtain a “complete indemnity” from the United States government against any patent infringement action and the British Air Ministry had to agree to allow the technical staff to leave England.¹⁷ The proposed Basic Magnesium plant was intended to be a duplicate of the British plant¹⁸ and was subject to patents assigned to Magnesium Development Company.¹⁹

Final negotiations continued with a conference held on July 22 to work out details of agreement and compensation terms,²⁰ a request by the Air Corps for additional information regarding land

¹⁵ PS, Notes of Basic Refractories, June 12, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010315-317]

¹⁶ Telegram, Industrial Planning Section, June 12, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010352-359]

¹⁷ C.J.P. Ball, to H.P. Eells, June 23, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010350]

¹⁸ Metallurgical Operations at Basic Magnesium Inc. April 23, 1942, p. 1. NARA II, RG 234, Entry 1065, Box 102, Metals Reserve Company Contract File 1940-1955. [BR004804]

¹⁹ See for instance, Inter-office Memorandum to Chief Patent Liaison Office, June 16, 1941 and attached list of patents. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010421-424] Basic Magnesium and Magnesium Development entered into a license agreement in or about December 1941. Reuben T. Carlson, DPC to Marvin Braverman, April 24, 1942. NARA II, RG 234, Entry 1065, Box 102, Metals Reserve Company Contract File 1940-1955. [BR004811]

²⁰ Memorandum of conference, July 22, 1941. UNLV Special Collections, T-6. [BR000907]

improvements on July 23,²¹ and a meeting with the RFC regarding mining claims on July 24. RFC wanted assurance that there were at least 12 million tons of ore in the claims to be leased to the government.²²

On August 1, 1941, after nearly five months of talks, negotiations with the DPC culminated. Basic Magnesium Inc., (which was formed by BRI and MEL) and the DPC entered into an agreement for the construction and operation of the magnesium facilities, which were designated Plancor 201.²³

Finally authorized, the project gained momentum. On August 4, the War Department informed the DPC that it would reimburse the DPC for the acquisition and installation of the plant facilities²⁴ and several days later the DPC approved Basic Magnesium's request to purchase \$9.5 million of electrical equipment.²⁵ By August 18, the DPC, Bureau of Reclamation, and Basic Magnesium conferred and agreed that DPC would buy water and power services at Lake Mead and Boulder Dam and would construct water lines, power lines, and transformer stations from Lake Mead and Boulder Dam to the plant site, which was to be located southeast of Las Vegas, then a small railroad watering station. The DPC agreed to negotiate power and water contracts, and that power to Gabbs would be provided by constructing a transmission line some 60 miles to connect the plant site to the California Electric Company power system at Millers, Nevada.²⁶

The DPC assigned an engineer to the project, whose general duties included authorization to approve plans, designs, specifications, and construction schedules for the construction of the plant. The DPC engineer was also responsible for approving vendor bills and to oversee the acquisition and installation of machinery and equipment. He was authorized to approve contractors employed by Basic Magnesium, as well as the contracts entered into in conjunction with the construction program.²⁷

²¹ P. Scheeberger to D.W. Stewart, BRI, July 23, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009274]

²² Memorandum of conference, July 24, 1941. UNLV Special Collections, T-6. [BR000904-906]

²³ Agreement, August 1, 1941. NARA II, RG 72, Entry 147, Box 13, Folder: Basic Magnesium. [BR004860-870]

²⁴ Robert Patterson to DPC, August 4, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010246-248]

²⁵ P. Schneeberger to Chief, Facilities Section, Materiel Division, August 13, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009938-939]

²⁶ D.W. Stewart to Assistant to Chief, Materiel Division, August 18, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009933-935]

²⁷ W.L. Drager to Basic Magnesium, October 31, 1941. UNLV Special Collections, T-6. [BR001027] Lewis E. Ashbaugh was appointed on September 4, 1941 and was replaced by Ralph Adams on October 31, 1941. By October 12, 1942, there were twenty-two DPC employees working at the Basic Magnesium plants. In addition, ten Basic

By September 11, the Reclamation Service of Department of Interior made arrangements to buy the power needed for the magnesium plant from the Metropolitan Water Company. After survey and consultation by the engineers of the Reclamation Service, a preliminary “Appendix A” for the magnesium plant was drafted, indicating that a new site had been selected for the magnesium plant.²⁸

Mr. Ells stated that Basic Magnesium was short of technical personnel and preparation of a complete Appendix A “would necessitate a long delay in beginning the project.” Perhaps given the urgency of the wartime situation in Europe and the American military’s pressing need to rearm and modernize, Colonel Schneeberger advised he would authorize the project anyway.²⁹

Colonel Schneeberger followed up with a memo to the Air Corps Facilities Section explaining why the project should not follow usual procedure.³⁰ The Chief of the Facilities Section forwarded the request to the War Department. The War Department concurred that complying with procedure would probably result in a delay, but felt that the decision was up to the Air Corps.³¹ The Facilities Section was willing to grant Colonel Schneeberger and the IPS authority to proceed with the final approval of the project if the DPC concurred.³² The DPC sent IPS a telegram, stating that it would accept the Air Corps’ commitment without preparation of a detailed Appendix A, but that one would be required when the construction was close to completion.³³

The sheer magnitude of the project called for extraordinary planning and organization skills.

- Land acquisition arrangements had to be made.
- The plant site was barren desert.

Magnesium employees were assigned specifically to assist the DPC staff. See: Personnel, Salaried Employees, Defense Plant Corporation, as of October 12, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming. [BR006429]

²⁸ D.A. Graham, Notes on Basic Magnesium, September 11, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009911-912]

²⁹ D.A. Graham, Notes on Basic Magnesium, September 11, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009911-912]

³⁰ P. Schneeberger to Chief, Facilities Section, Materiel Division, September 13, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009902-903]

³¹ Edgar Lewis to W.F. Volandt, September 20, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009890]

³² Letter to W.L. Drager, DPC, September 23, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009878]

³³ John W. Synder, Executive Vice President, DPC, to Major J.L. Bowling, December 2. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009557]

- There was no water at the site. A large water supply line had to be installed from Lake Mead over mountains and some 20 miles to the plant site.
- There was no power at the site. Dual power lines were required from Boulder Dam to the facility.
- There were no local services. Houses, schools, hospital, stores, markets, post office, fire department, churches, sewage facilities, and the like all had to be built.
- The facilities to extract and process ores so that the magnesium plant would have the raw material needed had to be constructed.
- A means to transport the ores from Gabbs to the magnesium plant had to be decided.
- The magnesium production facilities themselves had to be built. These would encompass a massive complex approximately two miles in length, and which would include a chlorine plant, preparation plant, chlorination plant, metals recovery plant, and an electrolysis plant, as well as the support facilities for each.

As it turned out, Colonel Schneeberger's decision to approve the project without a completed Appendix A had far-reaching implications. The DPC typically used the Appendix A to ascertain the soundness of the project plan, check for items overlooked in the planning phase, see if costs were over- or underestimated, and ultimately as a tool to watch over the government's investment. Under normal circumstances, after the project was authorized, the contractor would provide a fully completed Appendix A with its costs substantiated. The Appendix A would be updated as necessary as expenditures were made, and the DPC could readily track the progress of the project and identify any potential problems. Without an Appendix A and a competent operator, mistakes, such as those which were to occur with the magnesium plant's waste effluent system, occurred.

For example, a summary of anticipated costs provided to the IPS on August 1, 1941, included \$204,000 for a waste or "trade" effluent drainage system.³⁴ However, in March 1942, it was "suddenly" discovered that no design work had been done to provide adequate facilities for trade effluent disposal. Basic Magnesium's engineers decided to ask the MEL consultants to

³⁴ D.W. Stewart to Assistant Chief of Material Division, August 1, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009272]

investigate the problem.³⁵ A neutralization plant was designed that was supposed to provide an adequate area to allow for the evaporation of a volume of 5,000 gallons of effluent per minute. However, an error was made in the calculations and the neutralization plant was only one-tenth of the size actually required. Additional waste disposal ponds had to be constructed. To compound the problem, H.C. Mann, the Project Manager, ordered the immediate construction of the ponds—which ultimately encompassed approximately 1,670 acres—and another miscalculation was made. The person making the calculations made “one very bold assumption...which was decidedly in error as later experience has proved. He assumed that there would be no underground percolation.”³⁶

Acquisitions

The site selected for the magnesium plant was situated in the barren desert approximately 13 miles southeast of Las Vegas, Nevada. (See Figures 2-1 and 2-2). The federal government already owned a substantial amount of land in proximity to the selected site. That federal land was withdrawn from entry and made available for use to the DPC for the plant site and for future use if needed. Basic Magnesium deeded the state and private land that it had previously acquired to the DPC on November 27, 1941.³⁷ The land holdings acquired by the government are depicted in Figure 2-3.

Construction on the project began on September 15, 1941, before all of the land had been officially deeded. Within three weeks, the first cost increase request was submitted to the IPS.³⁸ Further problems developed and by November Colonel Schneeberger was informed of “material differences” developing between the American and British personnel and that these differences were delaying the project. In addition, Col. Schneeberger confirmed concern about the purity of the ore deposits at Gabbs and indicated a further survey might be necessary.³⁹

Basic Magnesium’s Director of Plant Protection and Chief Investigator informed Air Corps District Planning Office of “irregularities” in the management of the facility, including: lack of

³⁵ S.J. Fletcher, Neutralization of Effluent Liquor, March 13, 1942. UNLV Special Collections, T-6. [BR033898]

³⁶ E.H. Clary, “Trade Effluent,” in History of Civil Engineering, October 21, 1944. UNLV Special Collections, T-22. [BR033889-910]

³⁷ Map, Basic Magnesium Site and Vicinity, U-41, Issue No. 6, August 24, 1944. [NARA, San Bruno, RG 121, WAA Property Disposal Records, Box 13] See also F. McComthe to Cliff Young, June 15, 1956. [BR001532-533] Ray Pavey to GSA, August 31, 1954. [BR001516-517]

³⁸ P. Schneeberger to Chief, Facilities Section, October 7, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009838-841]

³⁹ P. Schneeberger, Notes on Basic Magnesium, November 10, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009775]

organization and responsibility, misuse of company equipment, extravagant use of Government funds, unqualified people hired to fill key positions at high salaries, and abuse of overtime payment.⁴⁰

On the morning of December 7, 1941, Japan attacked the United States naval base at Pearl Harbor, Hawaii. The Congress immediately approved the President's declaration of war against Japan, and before month's end, Germany and Italy had declared war on the United States. The Plancor 201 project—already a matter of great urgency—had become critical to the war effort of the United States itself.

By early 1942, the DPC had become dissatisfied with the project's progress, and an investigation was initiated. One of the individuals who looked into the matter reported back, describing chaos: "The site was cleared before one final drawing had been made. I have seen construction men leaning over [draftsmen's] shoulders to see the last line drawn; then they'd rush out into the field and put up that much more of it...."⁴¹ The DPC Supervising Engineer, Ralph Adams, was reportedly not up to the task either, as the investigator noted: "If I ever saw a stupid old fuddy-duddy, it's Adams. I'd guess that he's an old-school civil engineer bewildered by a million angles of the most complex scientific project in the world."⁴²

The DPC decided to retain an outside consultant, Coverdale & Colpitts (C&C), to direct, supervise, and coordinate the engineering and construction of the Basic Magnesium facility. C&C entered into an agreement with Basic Magnesium on April 9, 1942, and immediately set about trying to get the project back on track.⁴³ By May 23, the DPC engineer and auditor had determined that the project was over-committed⁴⁴ and, on June 30, when C&C completed its cost estimate for Plancor 201, they informed the IPS that the cost overrun was more than \$20 million. Outraged, the IPS ordered that a conference be arranged with people "competent to discuss the situation at the earliest possible moment to enable this office to take necessary action to protect the government's financial interest and at the same time avoid delay in completion of the

⁴⁰ E.K. Merritt to Industrial Planning Officer, February 6, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009623-624]

⁴¹ Paul Harrison to Donn Sutton, February 12, 1942. NARA I, RG 46, Box 477, Folder: Basic Magnesium Notes. [BR032409-417, @ 32411]

⁴² Paul Harrison to Donn Sutton, February 12, 1942. NARA I, RG 46, Box 477, Folder: Basic Magnesium Notes. [BR032409-417, @ 32414]

⁴³ Letter agreement, April 9, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR008928-932]

⁴⁴ Telegraph, Weber to H.P. Eells, May 23, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR008896]

project.”⁴⁵ The conference was held July 3 at which IPS claimed to be shocked to find out that Basic Magnesium appeared “suddenly to be bankrupt.” The company had no funds with which to meet payroll for the week, and it was IPS’ position was that the problem was the DPC’s. IPS personnel, Lt. Colonels Doolan and Shawhan, stated that the “Government might well be forced to install an interim or temporary receiver until the matter was worked out.”⁴⁶

Searching for solutions, the Air Corps explored the possibility of forcing Basic Magnesium to abandon the English technology for the chemical processing. The IPS ascertained that the agreement contained no provision concerning the process to be used and told the Air Corps that refusal to authorize or approve the purchase of certain types of equipment was a method that they could use to exert control over processes used at the site. The IPS referred the Air Corps to the DPC for a more definitive answer.⁴⁷

While the government explored its options on how and where it could find additional funding for the project, relations between C&C and Basic Magnesium deteriorated. In part, Mr. Eells used the imposition of C&C as construction engineers as the catalyst for his position that the “DPC has taken the completion of the construction of this plant out of the hands of Basic Magnesium, Inc., and is proceeding to construct it itself...”⁴⁸ Mr. Eells claimed that C&C’s role was forced on Basic Magnesium:⁴⁹ he stated, “To show you how sweeping [the DPC’s] responsibility was in the mind of those who directed [C&C’s] appointment, it was stated in one of the meetings in Mr. Husband’s office that I might as well take a holiday.”⁵⁰ On August 15, Mr. Eells pointed out to the War Department that Basic Magnesium lacked the authority and responsibility to fulfill its obligation because C&C did not function as a part of Basic Magnesium’s organization.⁵¹

⁴⁵ Teletype Message P. Schneeberger to Col. F.M. Hopkins, July 2, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR008948-949]

⁴⁶ G.D. Carrington, July 3, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010264-265]

⁴⁷ A.E. Jones to Acting Chief, Industrial Planning Section, June 30, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR008972]

⁴⁸ G.D. Carrington, July 6, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010263]

⁴⁹ S.P. Brown, Notes on Basic Magnesium, July 8, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR008934]

⁵⁰ H.P. Eells to P. Schneeberger, August 1, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR008810-812]

⁵¹ H.P. Eells to P. Schneeberger, August 15, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR008763] See also H.P. Eells to P. Schneeberger, September 3, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR008715]

Allegations of blame for the cost overruns were in no shortage. The Truman Committee⁵² found that there was “entirely too much dependence placed on the overly optimistic estimates of quality and quantity of the magnesite ore deposits...”⁵³ The Committee also commented that BRI’s objective was to commercialize its magnesite deposits and that the company was not acting on patriotic motives to assist in relieving the shortage of magnesium metal.⁵⁴

Apparently it was clear to the government that further intervention was required to keep the magnesium project going. The WPB and the DPC approached the Anaconda Copper Mining Company (Anaconda) on August 5, 1942, and implored Anaconda to take over the operations of Basic Magnesium. At this initial meeting, P.G. Spilsbury represented Anaconda. The WPB briefed him on the “background of the proposition ... that Anaconda consider purchasing the controlling interest ... and take over the operation and management” of Basic Magnesium. The WPB then requested that Mr. Spilsbury talk with Sam Husbands, President of the DPC. Mr. Spilsbury spent an hour with Mr. Husbands who spent the time “reviewing the whole situation and begging [Anaconda] to consider taking over management because of the record which we demonstrated and the faith he had in our ability.”⁵⁵ Mr. Spilsbury related the information regarding the corporate relationship between BRI and MEL, indicating that Basic Magnesium was a “dummy company set up in response to the suggestion of the RFC.”⁵⁶

By mid August 1942, Anaconda had swiftly investigated the development of the Basic Magnesium ore reserves at Gabbs⁵⁷ and had visited the magnesium plant. Clyde E. Weed, Anaconda’s Vice President in Charge of Mining Operations, summarized his observations to J.R. Hobbins, Anaconda’s President, “I do not believe that the organization, as now constituted, can ever operate a plant successfully, and one of the first jobs would be revamping this organization to make it workable.”⁵⁸ He continued, indicating that if Anaconda were to take over the management of the plant, the company would need to obtain several assurances from the DPC. These assurances included that the DPC would have to agree to provide the money to complete

⁵² On March 1, 1941, the U.S. Senate authorized formation of the Committee to Investigate the National Defense Program for the purpose of conducting an inquiry into potential waste and corruption in defense contracts. The committee was commonly known as the Truman Committee.

⁵³ Truman Committee findings. NARA I, RG 46, Box 478, Folder: Las Vegas Basic Magnesium. [BR032557]

⁵⁴ Truman Committee findings. NARA I, RG 46, Box 478, Folder: Las Vegas Basic Magnesium. [BR032559]

⁵⁵ P.G. Spilsbury to J.R. Hobbins, August 5, 1942. [BML008466] Imperial Chemical Industries owned 48 percent of the MEL stock.

⁵⁶ P.G. Spilsbury to J.R. Hobbins, August 5, 1942. [BML008467]

⁵⁷ Reno Sales Memorandum to C.E. Weed, August 17, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming. [BR005870]

⁵⁸ C.E. Weed to J.R. Hobbins, August 17, 1942. [YBD13486]

the construction and to make any changes the company considered necessary. Likewise, Anaconda wanted to “be given a free hand in making decisions, as far as engineering goes, without consulting Defense Plant engineers.... We should be given a free hand in the management in order to develop a proper organization.”⁵⁹ Mr. Weed reported that he and Frederick Laist, Anaconda’s Vice President in Charge of Metallurgical Operations, agreed:

1. That magnesium has a future as a metal.
2. That the process as developed will be successful in making magnesium.
3. That the process is subject to improvement in both metallurgy and costs.
4. That this will give us the opportunity to study the magnesium business, and that at the end of the emergency, the Anaconda would be in position to decide definitely whether they wish to remain in the magnesium business.⁶⁰

Mr. Laist summarized his conclusions to Mr. Hobbins, “Acquisition of the controlling interest in Basic Magnesium seems to be an excellent way of obtaining a position in the magnesium business and learning all about it with a minimum of risk.”⁶¹

Correspondence suggests that the take-over request was a closely held secret while negotiations were underway. On September 1 and 2, Mr. Weed and R.B. Caples, Anaconda’s Manager of its Great Falls (Montana) Reduction Plant, met with Mr. Eells in Cleveland regarding the organization and development of Basic Magnesium. Mr. Eells told them that after the DPC installed C&C, the British interests insisted that Major C.P. Ball and H.C. Mann be in charge of running the Basic Magnesium plant. Major Ball brought a staff of six British engineers to Nevada, and forty-five engineers from the plant were sent to England for six months to study the MEL plant operations. Mr. Eells informed the two Anaconda representatives that Basic Magnesium contracted with the DPC to supply all requirements of magnesite from the Gabbs properties at a royalty of \$0.0025 per pound of magnesium produced. He indicated that if another entity operated the plant, the royalty doubled.⁶²

⁵⁹ C.E. Weed to J.R. Hobbins, August 17, 1942. [YBD13487]

⁶⁰ C.E. Weed to J.R. Hobbins, August 17, 1942. [YBD13488]

⁶¹ Frederick Laist to J.R. Hobbins, August 16, 1942. [BML10204]

⁶² R.B. Caples, Memorandum of Visit with Mr. Howard P. Eells, Jr. at Cleveland, Ohio, September 1st and 2nd, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming. [BR006306-310] Regarding royalty, see also “Legal Summary,” in Engineer’s Final Report, n.d. NARA II, RG 234, Entry 146, Box 114, Folder: DPC Engineers Reports and Appendices, Plancor 201. [BR004114-115]

Negotiations between Anaconda and the DPC continued to progress, and Anaconda evaluated various options for taking over the operations of the plant.⁶³ Reno Sales, Anaconda's Chief Geologist, provided Mr. Weed with mining district maps for the Gabbs area. On September 19, Mr. Weed reported back to Mr. Sales that the maps "came in very handy in our discussion of the Basic Magnesium problems with the DPC. When I have finished with the maps I will return them to you at Butte. We are meeting with the Defense Plant officials again on Monday, and I imagine at that time something very definite will be decided."⁶⁴

On September 28, Mr. Weed wrote to Mr. Sales, "You might be interested to know that the Basic Magnesium set-up is about cleaned up and undoubtedly we are elected to operate the property for the balance of the emergency. Also confidentially, as Mr. Hobbins has not as yet announced it, Frank Case will go there as manager, and Mr. Satterthwaite, Superintendent of the zinc plant at Great Falls, will go there as his assistant."⁶⁵

Basic Magnesium, BRI, MEL, and Anaconda came to an agreement on September 30, 1942.⁶⁶ The DPC agreed to purchase the mining claims in Nye County for \$450,000 and Anaconda agreed to pay \$75,000 for 52,500 shares of Basic Magnesium stock.⁶⁷ The take-over was not made public knowledge until the end of October, when the Secretary of Commerce issued a press release.⁶⁸ The next day Cornelius F. Kelly, chairman of Anaconda's board and chief executive officer of the company, issued a statement that Anaconda's participation in the enterprise "has been undertaken at the invitation of the government and of the English and American interests in Basic Magnesium. Our function is that of management...without responsibility [for what] has occurred prior to our taking over and is undertaken for the purpose of doing what we can at the request of all the interested parties to aid in the war effort."⁶⁹ On November 30, 1942, the Air Corps Facilities Section was informed that it was "officially confirmed that Anaconda own[ed]

⁶³ Memorandum Summarizing Various ideas respecting the Basic Magnesium setup, September 1, 1942. [YBD15148-154] Letter to C.F. Kelley, September 5, 1942. [YBD15131-135]

⁶⁴ C.E. Weed to Reno Sales, September 19, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming. [BR005879]

⁶⁵ C.E. Weed to Reno Sales, September 28, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming. [BR005878]

⁶⁶ Agreed upon procedures, September 30, 1942. [YBD15102-106]

⁶⁷ Excerpt from Minutes of Meeting of Board of Directors of Basic Refractories, October 20, 1942. [YBD15642-646]

⁶⁸ Press Release, RFC 1679, October 26, 1942. NARA I, RG 46, Box 473, Folder: Basic Magnesium D.P.S. Files Rev. [BR031838] See also W.H. Hoover, General Counsel to Richard Inglis, Hauxhurst, Inglis, Sharp & Cull, October 19, 1942. [YBD15737-044]

⁶⁹ "ACM Acquires Interest in Basic Magnesium Inc." *Great Falls Tribune*, October 27, 1942. [BR006300]

controlling interest in BMI.”⁷⁰ Filings with the Nevada Secretary of State’s office reveal that Anaconda representatives, including J.E. Hobbins, Frederick Laist, C.F. Kelly, C.E. Moran, W.K. Daly, J.H. Quayle, Jr., and F.M Brynes, had become officers and/or directors of Basic Magnesium.⁷¹

The effects of Anaconda’s involvement and expertise were readily apparent. For instance, personnel set about determining changes to the organization and processes used that would save money and/or materials at the magnesium plant in Henderson. One of the first steps taken was to remove the English engineers from supervisory positions and thereafter they functioned solely as consultants.⁷² Major process improvements were made after Anaconda assumed control of Basic Magnesium, including the elimination of peat from the flow sheet,⁷³ reducing the chlorine consumption, and reclaiming some of the by-products—particularly cell melt and chlorinator cleanings.⁷⁴ In testimony presented to Congress, Basic Magnesium personnel claimed that over \$1.1 million had been saved through “improvements that have been made or suggested since Anaconda took over the management....”⁷⁵

Anaconda worked diligently with the Air Corps to eliminate items not essential to the operation of the Basic Magnesium facility and to keep construction costs as low as possible. As a part of its on-going assessment of funds expended and anticipated to be spent, Wilbur Jurden, Anaconda’s Chief Engineer, wrote to Major J.L. Bowling of the Army Air Corps, requesting additional funding for emergency construction items essential to bring the plant to its full capacity and to ensure its continued operation.

Additional waste disposal ponds were among these emergency facilities:

The tailings water from the plant contains considerable impurities and injurious chemicals and we are not allowed to let any of this water drain into the Las Vegas Gulch from whence it would

⁷⁰ Jesse Bowling to G.H. Moriarty, December 3, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR008663-664]

⁷¹ Officers, Directors, and Designation of Resident Agent, June 14, 1943. Nevada Secretary of State. [BR039135]

⁷² Roy E. Thomas, Chief Engineer, April 30, 1945. UNLV Special Collections, T-6. [BR008015]

⁷³ Satterthwaite to R.B. Caples, Manager, ACMC, Great Falls, MT, April 17, 1943. Anaconda Document Collection, American Heritage Center, University of Wyoming. [BR006273-274]

⁷⁴ Investigation of Industrial Centralization (Basic Magnesium Plant), Hearings before a Special Committee, 78th Congress, Second Session, Part 5, November 27 and 28, 1944, pp. 457-458, containing text of letter from H.G. Satterthwaite to F.O. Case, November 23, 1944. [BR038409-410]

⁷⁵ Investigation of Industrial Centralization (Basic Magnesium Plant), Hearings before a Special Committee, 78th Congress, Second Session, Part 5, November 27 and 28, 1944, pp. 457-458, containing text of letter from H.G. Satterthwaite to F.O. Case, November 23, 1944. [BR038409-410] An extensive list of cost saving efforts and improvements after Anaconda took over are detailed on pages 457-476 of the hearing transcript. [RB038409-422]

go into Lake Mead. Results of operations to date have shown conclusively that the effluent ponds already constructed are inadequate and unless these additional ponds are constructed and quickly, we may find ourselves faced with a curtailment of production due to the inability to dispose of the effluent water and as production of magnesium is rapidly increasing this situation is becoming worse.⁷⁶

Construction of the effluent ponds began between December 7 and 29, 1942. By April 19, 1943, the ponds had been completed and were in use.

The first metallic magnesium production at the Basic Magnesium plant occurred on August 31, 1942. The plant was in full production by July 12, 1943, and by the end of July 1943, the plant was producing at 110 percent of capacity.⁷⁷ On April 8, 1944, the War Production Board (WPB) ordered Basic Magnesium to curtail production. Between April 20 and May 13, 1944, four units were shut down. On July 26, the WPB ordered a further curtailment with two more units to be shut down. Operations ceased at two more units in October, and by November 15, the remainder of the plant shutdown. The magnesium operations at Henderson ceased “after 807 days of continuous operation” and after having produced 166,322,685 pounds of marketable refined or alloyed magnesium ingots, billets, or slabs.⁷⁸ Production of by-products from August 1942 to November 1944 was:⁷⁹

Liquid chlorine	15,843 tons
Caustic soda	45,314 tons
Flux	1,287 tons
Magnesium chloride	735 tons

Basic Magnesium’s efforts under Anaconda’s control were an extraordinary accomplishment. Frank Case, who had been appointed by Anaconda to serve as General Manager for Basic Magnesium, explained that they strove to make it a viable concern: “We [the management staff]

⁷⁶ Wilbur Jurden, Chief Engineer, Anaconda, to Major J.L. Bowling, Production Division, DPC, April 21, 1943. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009535-545, see BR009540-541 for evaporation pond line item.] Construction of the ponds was completed prior to the submission of the funding request.

⁷⁷ Final Engineer’s Report, Part “C” – Historical. NARA II, RG 234, Entry 146, Box 114, Folder: DPC Engineers Reports and Appendices. [BR004127]

⁷⁸ A Chronological History of Basic Magnesium, November 16, 1944. Anaconda Document Collection, American Heritage Center, University of Wyoming. [BR033096-098]

⁷⁹ Investigation of Industrial Centralization (Basic Magnesium Plant), Hearings before a Special Committee, 78th Congress, Second Session, Part 5, November 27 and 28, 1944, pp. 518-519. [BR038446] Production was given in terms of sales and shipments.

as a group are very optimistic now about our chances of making [Basic Magnesium] a commercial success; a company that can compete with the Dow Company – we might just as well be outspoken about it....”⁸⁰

However, with the demand for magnesium declining, Anaconda decided that it did not want to acquire the Basic Magnesium site,⁸¹ and the DPC therefore engaged J.M. Montgomery & Co., Inc. to supervise the overall management of the facilities.⁸² The Operating Agreement between DPC and Basic Magnesium was terminated on May 16, 1945, together with all of the company’s purchase rights under the Agreement.⁸³

The world-scale magnesium plant and its associated facilities had been constructed from scratch in a period of less than 20 months under very difficult conditions at a cost of over \$130 million. The plant operated from August 1942 until November 1944, when the government ascertained that it had a sufficient magnesium supply and so shut down the magnesium operations. The government’s agreement with Basic Magnesium for the operation of the plant was terminated and, in May 1945, the United States engaged J.M. Montgomery & Co., Inc. to supervise the overall management of the facilities.⁸⁴ Guy F. Atkinson Company replaced J.M. Montgomery & Co. under a Property Protection and Maintenance contract in November 1946.⁸⁵

Lessees

In an effort to recoup some of its investment for building the facility, as well as to ensure production of things still needed for the war effort, the government proceeded to lease portions of site to various companies. The table below depicts these leases:

⁸⁰ Hearing of the Sub-Committee on Light Metals and Aviation of the Special Committee Investigating the War Program, May 11, 1943. NARA I, RG 46, Box 478. [BR032165-166]

⁸¹ Imperial Chemical Industries to J.R. Hobbins, July 12, 1945. [BML1172-173] The letter refers to Anaconda’s loss of interest in magnesium. Anaconda purchased MEL’s shares in Basic Magnesium and the company continued to exist until Anaconda dissolved it in November 1974. Consent to Dissolution, November 14, 1974. Nevada Secretary of State. [BR039210]

⁸² Agreement, May 14, 1945. NARA II, RG 72, Entry 147, Box 13, Folder: Basic Magnesium Plancor 201. [BR004907-913]

⁸³ L.A. Kelly, Counsel, Office of Defense Plants, Memorandum Accompanying SPB-5. Army Corps of Engineers, Sacramento. [BR001551-553]

⁸⁴ Agreement between DPC and J.M. Montgomery, May 14, 1945. [BR004907-913]

⁸⁵ Cost-Plus-A-Fixed-Fee Property Protection and Maintenance Contract, November 29, 1946. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 12]

Company	Lease Area
Allied Productions	Undefined buildings and space
Amecco Chemicals, Inc.	Electrolysis Building No. 2 and adjacent chlorination building
Basic Boat Builders	Lease 480 square feet in Canteen Building S-12
Bureau of Reclamation	A portion of the site on which transformers were located
Carter Printing & Engraving	Print Shop, rooms 14 and 17 in Building K-33 ⁸⁶
City Mercantile Company	Unknown
Coulter, Harden & Company	Purchase of cell melt, rental of equipment and office space in Central Laboratory Building K-33 ⁸⁷
Desert Furniture & Carpet Company	Warehouse space ⁸⁸
Gelatines, Inc.	Peat Building B-5, Peat Building B-6, Peat Slab B-30, Secondary Peat Building B-8, and Canteen S-14
Hardesty Chemical Company	Electrolysis Building No. 2 and adjacent chlorination building
Hodsdon Brothers, Inc.	North portion of the Magnesite Garage T-30, and some equipment ⁸⁹
Industrial & Metallurgical Engineering Company	Space and equipment in Permanent Laboratory Building K-33
Mineral Materials Company	Manganese Ore Company Spur Track
Myers-Thornton Gas Company	Propane storage area ⁹⁰

⁸⁶ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

⁸⁷ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

⁸⁸ Sales Brochure, Plancor 201. n.d.

⁸⁹ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

⁹⁰ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

Company	Lease Area
Nevada Clay Products Company	Buildings B-12, B-22 and certain portions of B-2
Nevada Wholesale Meat Company	Lease 11,000 square feet in Cafeteria Building S-11 ⁹¹
Nevada, New York & Ohio Chemical Company	East end of Preparation Plant Building ⁹² and the east side of Building B-2 ⁹³
O.J. Scherer Company	First leased south half of Change House S-8 and Building K-5. Transferred work to Building T-3. ⁹⁴
Sears Robuck & Company	Warehouse space ⁹⁵
State of Nevada, Employment Service Department	Office space in McNeil Administration Building K-2 ⁹⁶
Stauffer Chemical Company (Stauffer)	Three parcels, space in the permanent laboratory building, parking area, and tank cars
True Gems	Change House Building S-9 ⁹⁷
Underwriters Salvage Company of New York	Leased 9,960 square feet in Building T-4
United States Vanadium Corporation	Refinery Buildings J-1 and J-5, a portion of Flux Plant and equipment, laboratory space, the west half of Change House S-7, shop and maintenance equipment, and three settling ponds. ⁹⁸

⁹¹ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

⁹² See item 1 in John R. Reilly to Irving Gumbo, December 10, 1947. [BR002336]

⁹³ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

⁹⁴ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

⁹⁵ Sales Brochure, Plancor 201. n.d.

⁹⁶ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

⁹⁷ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

⁹⁸ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

Company	Lease Area
Vadelite Corporation	Portions of Administration Building
Western Electro Chemical Company (WECCO)	Salt Storage Building, Acid Tank Neutralization area, Railroad Unloading Platform, Unit 4, Office building in K-36 area, Change House S-2, and Storage Yard (between Tr. 11 and 12 and 8 th and 9 th streets)
Western Mineral & Development Corporation	Laboratory room in Building K-33 ⁹⁹
Mendelsohn, William	Portion of McNeil Administration Building K-2 ¹⁰⁰

In addition, the government leased machinery and/or equipment to Lithalloys Corporation and Bakelite Corporation. It is unknown if the machinery and/or equipment was used on site or moved to another location.

In November 1946, the RFC, as successor to the DPC, transferred the site to the War Assets Administration (WAA).¹⁰¹ Charged with selling off the government-owned wartime facilities, the WAA arranged for a utilization study and appraisal of the plant.

The Government appraiser believed that the best use for the property was as facilities for a diversified chemical industry.¹⁰² Within 1 week after the report was published, the WAA offered the Colorado River Commission (CRC) the opportunity to purchase, lease, or take over the Basic Magnesium plant.¹⁰³ Negotiations were formally initiated and, in a Letter of Intent dated March 17, 1948, the WAA agreed to transfer all the rights and assets (personal and real property) that were associated with the Basic Magnesium project, Plancor 201, to CRC.¹⁰⁴

⁹⁹ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

¹⁰⁰ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

¹⁰¹ Memorandum of Understanding, November 8, 1946. Army Corps of Engineers, Sacramento. [BR001539-546]

¹⁰² Industrial Utilization Study and Facilities Appraisal Report, Volume 1, October 1, 1947 [BR003398]

¹⁰³ Letter to Colorado River Commission, October 7, 1947. NARA, San Bruno, RG 269, Box 21, Basic Magnesium Case Files, Folder: Board Memoranda Plancor 201, (1 of 3). [BR002334-335]

¹⁰⁴ Letter of Intent, March 17, 1948. BMI [BR001408-413]

Conveyances

Date	From	To	Area
6/3/1949	WAA	CRC	See 2- 4
Unknown	WAA	Department of Interior, Bureau of Reclamation	Six parcel located within Section 13, T 22S, R 62E, with electrical transmission facilities. Parcel sizes were 2.726, 8.035, 3.871, 2.42, 12.186, and 19.119 acres. ¹⁰⁵ See Figure 2-4.

2.1.2 Colorado River Commission – 1949 to 1953

Acquisitions

Negotiations between the CRC and the federal government were concluded and the property was transferred to the CRC in a deed dated June 3, 1949.¹⁰⁶ Figure 2-5 depicts the land transferred to the CRC.

Lessees

The CRC’s goals were to obtain the property in order to prevent its cannibalization and to then sell it in such a way to ensure the continued operation of the facilities and encourage industrial development of the area.¹⁰⁷ In the meantime, while it negotiated sales of the property, the CRC continued leasing portions of the facility, as shown in the table below:

¹⁰⁵ See Quitclaim Deed, June 3, 1949, Item 4, pp. 3-5. [BR001605-607]

¹⁰⁶ Quitclaim Deed, June 3, 1949. Army Corps of Engineers, Sacramento. [BR001603-615]

¹⁰⁷ Assignment of Lease. NARA San Bruno, RG 291, Real Property Files, Box 1, Folder: Nev-5, Inspection of Leases. [BR002880]

Company	Area
Combined Metals Reduction Company	Metal Unit 10, Refinery Building J-2, East half of Change House S-7, ¹⁰⁸ Loading Platform J-12 and approximately 88.09 acres of land. As of May 23, 1952, the company was in the process of amending the lease to include Buildings P-1, T-1, T-11, T-18 and additional land. ¹⁰⁹
Daniel Furse and Dante Bagni	Cafeteria
Henderson Riding Club	Land near sewage plant
J.W. Conroy	Buildings T-38 and T-39
Mainor, William	Land near sewage plant
Miller, Haynes & Smith, Inc.	Building K-38
National Lead Company	Metal Units 7, 8, and 9, Change House S-1, Cafeteria Building S-11, Peat Building B-5, S-14, Refinery J-1, Refinery J-5, and approximately 62.12 acres of land.
National Lead Company	Metal Unit 10, Refinery Building J-2, East half of Change House S-7, Canteen S-12, and Loading Platform J-12. (Assigned from Combined Metals Reduction/ Pioche Manganese)
Paraffine Companies, Inc.	Manganese Ore spur and land
Post Transportation Company	One half of Change House S-3 and Land for garage
Stauffer	Chlorine and Caustic plant and land. ¹¹⁰ Approximately 237.476 acres.

¹⁰⁸ Combined Metals to have the right to occupy the west half of Change House S-y when lease with United States Vanadium Corporation expired or was terminated.

¹⁰⁹ Agreement of Sale, CRC to BMI, May 23, 1952. [See BR001362]

¹¹⁰ Agreement of Sale, CRC to BMI, May 23, 1952. [BR001627-644]

Company	Area
Union Pacific Railroad Company	Office space in laboratory Building K-33
US Lime Products Corporation	Portion of preparation plant building B-1 and Building B-21.
US Treasury Department, Bureau of Federal Supply	Approximately three acres located north and east of Gate 4 for storage space for magnesium ingots. ¹¹¹

Conveyances

The CRC subdivided the plant complex into parcels and proceeded to sell them, as follows:

Date	From	To	Area
4/28/1951	CRC	Stauffer	259.196 acres
6/28/1951	CRC	WECCO	Preparation Area ¹¹²
8/21/1951	CRC	Arrowhead Lime and Chemical Company (US Lime)	Preparation Area ¹¹³
11/6/1951	CRC	Hercules Powder Company	Land ¹¹⁴ approximately 36.65 acres
1/24/1952	CRC	OJ Scherer and Associates	Building T-3
1/31/1952	CRC	Stauffer	11.59 acres
3/31/1952	CRC	Stauffer	36.65 acres
8/1/1952	CRC	WECCO	Area subsequently purchased by Navy ¹¹⁵
9/8/1952	CRC	BMI	Common Areas
9/8/1953	CRC	Stauffer	16.517 acres

¹¹¹ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

¹¹² Agreement of Sale, CRC to BMI, May 23, 1952. [BR001627-644]

¹¹³ Agreement of Sale, CRC to BMI, May 23, 1952. [BR001627-644] See also BR002977.

¹¹⁴ Agreement of Sale, CRC to BMI, May 23, 1952. [BR001627-644]

¹¹⁵ Referred to in letter to GSA Regional Director, January 18, 1954. [BR002436-437]

In addition, the CRC indicated that several sales were in process as of May 23, 1952. However, the areas involved are unclear and it is unknown if the transactions were in fact completed.¹¹⁶ These transactions were identified as:

- W.O. Haynes, Inc., Agreement of Sale dated December 17, 1951.
- Molybdenum Corporation of America, Agreement of Sale dated December 31, 1951.
- Manganese Inc., the necessary legal documents relative to sale were in the process of being compiled on May 23, 1952.

With the sale of the parcels to individual companies and the sale of what became known as the Common Areas to a syndicate of tenants that had formed under the name BMI, the CRC had essentially achieved its objective. On January 21, 1953, as a part of its payment to the Federal Government, the CRC re-assigned six leases to the General Services Administration. The transaction thereby made the United States the owner of those facilities again.¹¹⁷

Ownership of the facility after the completion of the CRC conveyances is depicted in Figure 2-6.

Various transactions have occurred since the property was sold by the CRC. The following section is arranged by entity to show these land acquisitions, lessees, and conveyances.

2.1.3 United States Government

Acquisitions

As noted above, the CRC re-assigned six leases to the General Services Administration in January 1953, as a part of its payment to the Federal Government. The transaction made the

¹¹⁶ Agreement of Sale, CRC to BMI, May 23, 1952. [BR001627-644]

¹¹⁷ Assignment of Lease. [BR002880] "Leases" in Office Memorandum, Liquidation of the Colorado River Commission Activities at the Basic Magnesium Project, January 26, 1953. [BR002986-990] See also: Office Memorandum, Robert B. Bradford to Deputy Regional Director, Public Building Service, April 25, 1956. [BR002865] Lease and Option Agreements attached to Richard H. Greenburg, Regional Comptroller, GSA, to Robert J. Moore, BMI, January 30, 1953. [BR002975-983] Transmittal of Notes, Deeds and Leases Assigned to GSA, January 28, 1953. [BR002984-985] Richard H. Greenburg, Regional Comptroller, GSA, to Robert J. Moore, BMI, January 30, 1953. [BR002974] Elmo L. Buttle, Chief, Surplus Real Property Division, October 5, 1953. [BR002971]

United States the owner of those facilities again.¹¹⁸ The land acquisitions and conveyances involving the government are depicted in Figure 2-7.

Date	From	To	Area
1/23/1953	CRC	GSA	Assignment of Leases for Refineries J-1, J-2 and J-5, Metal Units 7-10, Peat Building B-5, Loading Platform J-12, Building S-14, Cafeteria Building S-11, Canteen S-12, Change House S-1 and the east half of S-7.
12/31/1953	WECCO	USA/US Navy	Two parcels 151.3689 and 138.9621 acres ¹¹⁹

Lessees

Company	Lease Area	Term
Pioche Manganese Company	Refinery Building J-2	1953 to 1967 This building was originally leased to predecessor Combined Metals Reduction Company. Pioche Manganese assigned and transferred Refinery Building J-2 to National Lead on July 5, 1956. ¹²⁰
National Lead	Refineries J-1 and J-5	1953 to 1962

¹¹⁸ Assignment of Lease. [BR002880] "Leases" in Office Memorandum, Liquidation of the Colorado River Commission Activities at the Basic Magnesium Project, January 26, 1953. [BR002986-990] See also: Office Memorandum, Robert B. Bradford to Deputy Regional Director, Public Building Service, April 25, 1956. [BR002865] Lease and Option Agreements attached to Richard H. Greenburg, Regional Comptroller, GSA, to Robert J. Moore, BMI, January 30, 1953. [BR002975-983] Transmittal of Notes, Deeds and Leases Assigned to GSA, January 28, 1953. [BR002984-985] Richard H. Greenburg, Regional Comptroller, GSA, to Robert J. Moore, BMI, January 30, 1953. [BR002974] Elmo L. Buttle, Chief, Surplus Real Property Division, October 5, 1953. [BR002971]

¹¹⁹ Agreement of Sale, CRC to BMI, May 23, 1952. [BR001627-644]

¹²⁰ See Letter from Richard Greenburg, GSA, to Robert Moore, BMI, January 30, 1953. [BR002974]

Company	Lease Area	Term
National Lead	Metal Units 7 through 9, Peat Building B-5 and S-14, Change House S-1, Cafeteria Building S-11 and approximately 62.12 acres of land.	1953 to 1967
National Lead	Metal Unit 10, Refinery Building J-2, East half of Change House S-7, Canteen S-12, and Loading Platform J-12.	1953 to 1967 Canteen S-12 and Loading Platform J-12 were originally leased to predecessor Combined Metals Reduction Company. Pioche Manganese assigned and transferred Canteen S-12 and Loading Platform J-12 to National Lead on July 5, 1956. ¹²¹

Conveyances

Date	From	To	Area
3/15/1962	USA	American Potash and Chemical Corporation	Two Parcels, 151.3689 and 138.9621 acres ¹²²
3/2/1962	GSA	National Lead Company	Refineries J-1 and J-5. ¹²³
4/27/1967	GSA	National Lead Company	Assignment of Leases for Refinery J-1, Metal Units 7-10, Peat Building B-5, Loading Platform J-12, Building S-14, Cafeteria Building S-11, Canteen S-12, Change House S-1 and the east half of S-7.

¹²¹ See Letter from Richard Greenburg, GSA, to Robert Moore, BMI, January 30, 1953. [BR002974]

¹²² Deed of Trust, March 15, 1962. [BR002931-940]

¹²³ Referred to in Memorandum by Fred Johnston to Chief, Real Property Division, November 25, 1966. [BR002993-994]

2.1.4 Stauffer Chemical Company of Nevada / Pioneer Chlor-Alkali Company, Inc.

Land acquisitions and conveyances involving Stauffer are depicted in Figure 2-8.

Acquisitions

Date	From	To	Area
11/28/1952	Hercules Powder Co.	Stauffer	114.65 acres
9/1953	BMI	Stauffer	19.70 acres
4/1972	BMI	Stauffer	15.314 acres
8/1984	BMI	Stauffer	7.386 acres
10/19/1988	Stauffer	Pioneer Chlor-Alkali Company (Pioneer)	All properties

Lessees¹²⁴

Company	Lease Area	Term
Chemada Corporation	Unspecified parcel for the purpose of installing a gas turbine power plant. ¹²⁵	September 1968
Chemical Properties, Inc.	Office and truck repair space	November 24, 1984, and for a short period thereafter. ¹²⁶
Montrose Chemical	A series of sub-parcels	1947 until 1983. ¹²⁷
Post Transportation, Bulk Transportation, and Nu-Bulk Transportation	A small portion of the site ¹²⁸	Unclear

¹²⁴ Leasing information from the Pioneer Chlor Alkali Company, Stauffer Management Company, ECA, March 22, 1993. Page numbers are referenced.

¹²⁵ See p. 3-9.

¹²⁶ See p. 3-9.

¹²⁷ See p.3-5. See Figure 3-4 in the ECA for a depiction of the leased area. See also Montrose ECA, p. 21. [B002332]

¹²⁸ See p. 3-5. See Figure 3-4 in the ECA for a depiction of the leased area.

Company	Lease Area	Term
Saguaro Power Corporation	6 acres for a 90-megawatt natural gas-fired cogeneration facility.	This lease was initiated in 1990 by Pioneer. ¹²⁹

Conveyances

Date	From	To	Area
3/18/1981	Stauffer	State of Nevada	41.47 acres for Interstate 515
10/1988	Stauffer	Pioneer	All properties [sale agreement executed 8/88; transaction closed 10/26/88]

In 2003, Bayer CropSciences, Inc. succeeded to certain assets and liabilities of the Stauffer Management Company, an affiliate of the Stauffer Chemical Company.

2.1.5 Western Electro Chemical Company

Land acquisitions and conveyances involving WECCO/American Potash and Chemical Corporation/Kerr-McGee Chemical Corporation (Kerr-McGee) are depicted in Figure 2-9.

Acquisitions

Date	From	To	Area
3/15/1962	USA	American Potash and Chemical Corporation	Two Parcels, 151.3689 and 138.9621 acres ¹³⁰

¹²⁹ See p. 3-9.

¹³⁰ Deed of Trust, March 15, 1962. [BR002931-940]

Lessees

Company	Lease Area	Term
Buckles Construction Company	Portion of Unit 1	August 1973 to June 1989 ¹³¹
Burriss Oil and Chemical Company (also doing business as Basic Resources Company [not affiliated with BMI])	Unclear	May 1979 to May 1983. ¹³²
Delbert Madsen and Estate of Delbert Madsen	Triangular shaped two acre parcel at the northeastern corner of the Kerr-McGee property	June 1976 to at least 1993. ¹³³
Dillon Potter	2 acres southeast of the Southern Nevada Auto Parts lease area ¹³⁴	Unknown
Ebony Construction Company	Portion of Unit 1	1977 and 1978. ¹³⁵
Green Ventures International	Office space	August 1980 to September 1981. ¹³⁶
J.B. Kelley	The area south of the Koch lease	Period of lease unknown. ¹³⁷
Koch Asphalt Company (aka Koch Materials Company)	The area surrounding Building B-3	May 1983 to at least 1993. ¹³⁸

¹³¹ KMCC ECA, p. 7-24. [B002133]

¹³² KMCC ECA, p. 7-21. [B002130]

¹³³ KMCC ECA, p. 7-26. [B002135]

¹³⁴ KMCC ECA, p. 7-28. [B002137]

¹³⁵ KMCC ECA, p. 7-24. [B002133]

¹³⁶ KMCC ECA, p. 7-23. [B002132]

¹³⁷ KMCC ECA, p. 7-21. [B002130] See Plate 7.3 for the location of the operations.

¹³⁸ KMCC ECA, p. 7-21. [B002130]

Company	Lease Area	Term
Nevada Precast Concrete Products	Office space	January 1973 to May 1978. ¹³⁹
Southern Nevada Auto Parts and related companies ¹⁴⁰	10 acres	1972 to at least 1993. ¹⁴¹
State Industries	Unit 1, Buildings T-4, T-5, and T-8	1969 to 1988 ¹⁴²

Conveyances

Date	From	To	Area
12/31/1953	WECCO	USA/US Navy	Two parcels 151.3689 and 138.9621 acres ¹⁴³
1971	Kerr-McGee	Chemstar	Small parcel ¹⁴⁴ See Figure 2-10
1988	Kerr-McGee	Chemstar	Small parcel ¹⁴⁵ See Figure 2-10

In 2006, Kerr-McGee became Tronox LLC.

2.1.6 National Lead Company/Titanium Metals Corporation

TIMET was formed by a joint venture agreement between Allegheny Ludlum Steel Corporation and National Lead Company in 1950.¹⁴⁶ Land acquisitions and conveyances involving the companies are depicted in Figure 2-11.

¹³⁹ KMCC ECA, p. 7-23. [B002132]

¹⁴⁰ Robert and William Ellis leased this area beginning in October 1972 doing business as SNAP-TOW, Southern Nevada Auto Parts, and Pick-A-Part. Ed Smith and Vern Christensen leaseholders since January 1990, doing business as Nevada Recycling (auto salvage yard) on the northern portion of this area.

¹⁴¹ KMCC ECA, pp. 7-26 to 7-28. [B002135-137]

¹⁴² Henderson Steering Committee ECA, p. 16. [B002484]

¹⁴³ Agreement of Sale, CRC to BMI, May 23, 1952. [BR001627-644]

¹⁴⁴ Chemstar Lime Company, ECA, April 15, 1993, p. 8. Site facility boundaries are shown on maps at B002640-2641.

¹⁴⁵ Chemstar Lime Company, ECA, April 15, 1993, p. 8. Site facility boundaries are shown on maps at B002640-2641.

Acquisitions

Date	From	To	Area
8/20/1957	BMI	TIMET	Portion of NW ¼ of Section 13 and Roadways around Building T-3
9/4/1957	A.T. and Mildred Newell	TIMET	Portion of NW ¼ of Section 13
3/2/1962	GSA	National Lead Company	Refineries J-1 and J-5. ¹⁴⁷
4/28/1967	GSA	National Lead Company	Metal Units 7, 8, 9, and 10. Refinery Building J-1, J-2 and J-5. Peat Building B-5 and S-14. Change House S-1 and the East half of Change House S-7. Cafeteria Building S-11 Canteen S-12, and Loading Platform J-12.
12/29/1967 and 1/20/1972	National Lead Company	TIMET	Fourteen parcels, Refinery Building J-2, Canteen S-12 and S-14, Loading Platform J-12, Peat Building B-5, Ingot Refinery J-1, Billet Foundry J-5 and additional land
4/17/1985 8/13/1980 4/13/1972	BMI	TIMET	Parcel 1, 62.8 acres Parcel 2, 204.02 acres Parcel 3, 197.6 acres

Lessees

Company	Lease Area	Term
1400 Corporation	T-52, storage vault. KBMI Radio Tower	1963

¹⁴⁶ Timet, ECA, April 15, 1993., p. 3-1

¹⁴⁷ Referred to in Memorandum by Fred Johnston to Chief, Real Property Division, November 25, 1966. [BR002993-994]

Company	Lease Area	Term
BMI	Fire Station Building S-10 and Building T-1	July 1961
Burriss Oil & Chemical Company	Canteen S-14 and 1.6 acres of vacant land (contiguous)	December 1978
Chemtec Corporation	Building K-55	1975 to 1978. Operations unknown. ¹⁴⁸
City of Henderson	TIMET ball park	April 1959
Coyote Construction (Wirthlin Trenching)	Building S-17 and one acre of land.	1978-1979 operations unknown. ¹⁴⁹
Frank Briscoe Company	B-5, including rail track #5	60 to 90 days in 1980. ¹⁵⁰
John Wiley Jones Company, Inc.	Building T-18 and Unit No. J-2	April 1960
Jones Chemicals, Inc.	Building T-11	January 1963 to at least January 1991
Jones Chemicals, Inc.	Building T-18	April 1964 to at least January 1991
Jones Chemicals, Inc.	Building T-16	Unknown to January 1966
Jones Chemicals, Inc.	Locomotive House Building P-1	January 1966 to at least January 1991
Magnesite Truck Company	Building T-30	Ca. 1951 to possibly late 1956. operations unknown. ¹⁵¹
Musical Arrangements, Inc.	Building K-3	April 1972
National Sound Corporation	Building K-55	1972, for a period of two months. ¹⁵²

¹⁴⁸ TIMET ECA, p. 4-56. [B002860]

¹⁴⁹ TIMET ECA, p. 4-57. [B002861]

¹⁵⁰ TIMET ECA, p. 4-57. [B002861]

¹⁵¹ TIMET ECA, p. 4-58. [B002862]

¹⁵² TIMET ECA, p. 4-56. [B002860]

Company	Lease Area	Term
Per Boy Associates	Southwest quarter Section 7	June 1965
Rosecrest Cabinets	Half of Building K-32	October 1973 to 1989
Skaggs Company, Inc.	Portion of T-2 warehouse	August 1972
State Industries	Outside, east end of Building T-3	1980 for storing non-polychlorinated biphenyls (PCBs)-containing transformers. ¹⁵³
State Stove and Manufacturing Company	Building T-2	1972-1980 for warehousing purposes. ¹⁵⁴
TIMET Employees Federal Credit Union	Building K-32	March 1968
Espy Construction	Areas within the Pabco Road Ponds	Since October 1980. ¹⁵⁵
Henderson Telephone Company	Building K-32	Until 1954. ¹⁵⁶
M. Zenoft (lease assigned to Television Company of America)	Portion of Building K-32	September 1953. ¹⁵⁷

2.1.7 Chemstar, Inc.

United States Lime Corporation leased property at the Basic Magnesium site and began operations in November 1948. In 1950, Arrowhead Lime and Chemical Company purchased the land and improvements on which US Lime was operating. The connection between Arrowhead Lime and US Lime is unclear. However, Chemstar, the current successor to US Lime, indicated that it acquired the rotary kiln building (B-1), the pellet storage bins (B-21) and the adjacent

¹⁵³ TIMET ECA, p. 4-57. [B002861]

¹⁵⁴ TIMET ECA, p. 4-57. [B002861]

¹⁵⁵ TIMET ECA, p. 4-55. [B002859]

¹⁵⁶ TIMET ECA, p. 4-55. [B002859]

¹⁵⁷ TIMET ECA, p. 4-55. [B002859]

open yard in 1950.¹⁵⁸ In 1971 and 1988, two additional parcels were acquired from Kerr-McGee. The three continuous parcels comprise 10.45 acres.¹⁵⁹ The Chemstar facility is depicted in Figure 2-10.

2.2 MANUFACTURING PROCESSES USED AT THE SITE

Information regarding the owners' and/or lessees' manufacturing processes is provided below. It is arranged alphabetically by company name.

1400 Corporation

The company leased facilities from TIMET and operated a radio station. No relevant manufacturing processes appear to have occurred.

Allied Productions, Inc.

Allied Productions leased facilities at the site from the US government. The company produced motion pictures. No relevant manufacturing processes appear to have occurred.

Amecco Chemicals, Inc.

Amecco Chemicals acquired the Hardesty Chemical lease of the electrolysis building #2 and the adjacent chlorination building on September 1, 1947, and began operations at the site on October 1 of that year.¹⁶⁰ In a monthly report on the status of lessees at the Basic Magnesium site, the WAA noted that Amecco had 70 employees at the site.¹⁶¹

Amecco purchased chlorine piped in from Stauffer and produced four chemical products:

- Monochlorobenzene
- Paradichlorobenzene

¹⁵⁸ Chemstar Lime Company, ECA, April 15, 1993, p. 11.

¹⁵⁹ Chemstar Lime Company, ECA, April 15, 1993, p. 8. Site facility boundaries are shown on maps at B002640-2641.

¹⁶⁰ Information from WAA, Washington Credit Division Report, April 30, 1948. [BR002381-391]

¹⁶¹ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

- Orthodichlorobenzene
- Arsenite

In conjunction with its assessment of how to collect on the delinquent rental and utility charges incurred by Hardesty Chemical, the government reported that Amecco was closely associated with Hardesty Chemical. The companies shared the same president; Amecco was a minority owner of Hardesty Chemical preferred stock; and, at least between October 1947 and March 1948, Hardesty Chemical financed Amecco operations. In addition, Raymond T. Heilpern, Vice President and counsel for Amecco, was also an officer, director, and counsel for Hardesty Chemical.¹⁶²

The government ascertained that Amecco was “practically bankrupt,” that Hardesty Chemical was financially able to pay rent and utility charges, legally liable for the rent, “and also for the utility charges on the theory that Amecco was acting in effect as [Hardesty Chemical’s] agent when it incurred the utility charges.”¹⁶³

The WAA also indicated that Raymond Heilpern (counsel for both Amecco and Hardesty Chemical) informed the WAA that Stauffer “was going to finance Amecco’s operations, supplying chlorine on memorandum invoice, even purchasing benzene with Stauffer funds, all in order to keep Amecco going as a consumer of Stauffer’s by-product chlorine.”¹⁶⁴ Stauffer, in a carefully worded letter to the WAA, noted that the company was not going to initiate action in order to obtain repayment of approximately \$22,000 that Amecco owed Stauffer. Moreover, Stauffer informed the WAA that it was working out arrangements for liquidation of the amount over an extended period of time. “We are making this arrangement in part because of our interest in seeing that Amecco Chemicals, Inc., maintains and if possible, increases the scope of its operation at Henderson.”¹⁶⁵

Basic Boat Builders

Basic Boat Builders leased facilities at the site from the US government in which it constructed boats.

¹⁶² WAA, Washington Credit Division Report, April 30, 1948, [BR002381-391]

¹⁶³ WAA, Washington Credit Division Report, April 30, 1948, p. 6. [BR002386]

¹⁶⁴ WAA, Washington Credit Division Report, April 30, 1948, p. 5. [BR002385]

¹⁶⁵ WAA, Washington Credit Division Report, April 30, 1948, Exhibit 2-A. [BR002388]

Basic Magnesium Inc.

The original development of the site was the construction of a magnesium plant and associated facilities. There were two major raw materials used to produce magnesium—magnesite and chlorine—and two primary components to the operations—a chlorine/caustic plant and a magnesium production plant. A flow chart of the operations can be found as Figure 2-12. The following provides a brief overview of the processes used to manufacture magnesium:

Chlorine/Caustic Plant

Sodium chloride (salt) was processed dissolved in the chlorine/caustic plant to form a saturated brine. The saturated brine was then purified by settling out the mud and solid material, and then treated with sodium carbonate. After the sodium carbonate reacted with the calcium and magnesium, those materials were then settled from the brine. The brine was cleaned up and put into a chlorine electrolytic cell where a direct electric current passed through the cell and formed chlorine gas, sodium hydroxide (caustic soda), and by-product hydrogen.

Magnesium Plant

The magnesium plant consisted of ten large buildings, Units 1 through 10, each of which were divided into two rooms—a chlorinator room and an electrolytic cell room.

The chlorinators produced the feed for the electrolytic cells by converting magnesium into magnesium chloride. In this process MgO was mixed together with coal, recycled magnesium chloride, and peat moss to form a pellet. The pellets were dried and fed to the chlorinator. The material was heated to the appropriate temperature, the reaction occurred, and then the molten magnesium chloride was drawn off and transported to the electrolytic cells.

Electrolytic cells contained a molten salt bath consisting of the chloride salts of sodium, potassium, calcium, and magnesium. The cells consisted of steel cathodes and graphite anodes contained in a refractory lined steel box. When a direct current passed through the cell, chlorine gas was drawn to the positively charged anode, and magnesium was drawn to the negatively charged cathode of the cell. The magnesium eventually broke off of the cathode and floated to the top of the cell. Periodically the magnesium was removed from the cell and then cast into ingots or mixed with other metals to make magnesium alloys.

Buckles Construction Company

Buckles Construction Company leased a portion of Unit 1 from Kerr-McGee. The company used the facility for steel fabrication and equipment storage.¹⁶⁶

Bulk Transportation

Bulk Transportation leased facilities from Stauffer. Bulk Transportation transported chlor alkali products from Stauffer, along with similar materials for other companies at the site. Other transportation companies, including Nu-Bulk Transportation and Post Transportation, have also leased the same area from Stauffer and have presumably conducted similar operations, which may have also included truck washing.¹⁶⁷

Bureau of Reclamation

The Bureau of Reclamation leased a portion of the site on which transformers were located and presumably used them for power generation. No manufacturing processes appear to have occurred. However, it is possible that the transformers owned by the Bureau of Reclamation may have leaked PCB's over time.

Burriss Oil and Chemical Company (also doing business as Basic Resources Company)

Burriss Oil/Basic Resources operated an asphalt emulsion batch plant for blending and packaging a variety of asphalt emulsions. The production process involves milling asphalt cement with soap emulsifiers.¹⁶⁸ The companies were Kerr-McGee Lessees.

Carter Printing & Engraving

Carter Printing & Engraving leased facilities from the US government and used them as a print shop.

¹⁶⁶ KMCC ECA, p. 7-24. [B002133]

¹⁶⁷ Stauffer/Pioneer ECA, p. 3-5. [B001671]

¹⁶⁸ KMCC ECA, p. 7-21. [B002130]

Chemada Corporation

Chemada Corporation leased an unspecified parcel from Stauffer for the purpose of installing a gas turbine power plant. Details regarding the company's operations are unknown.¹⁶⁹ The gas turbine was removed prior to 1988.

Chemical Properties, Inc.

Chemical Properties leased office and truck repair space from Stauffer. Details regarding the company's operations are unknown.¹⁷⁰

Chemstar Lime Company

Chemstar Lime Company's predecessors (United States Lime Corporation, United States Lime Division of the Flinkote Company, Genstar Corporation, Genstar Cement & Lime Company, Genstar Lime Company, and Chemstar Inc.) acquired a portion of the site from CRC and expanded operations with property acquired from Kerr-McGee. Production processes used by Chemstar are described in Section 4 of the Phase I Environmental Conditions Assessment (ECA), prepared in 1993. To briefly summarize, lime production encompasses three production stages:

- Mining and rock preparation
- Calcining to convert carbonate rock to calcium and/or magnesium oxides (quicklime)
- Hydrating the quicklime to hydroxides

Chemtec Corporation

Chemtec Corporation leased facilities from TIMET. Details regarding its operations are unknown.

City Mercantile Company

City Mercantile Company leased facilities from the US government. Its operations are unknown.

¹⁶⁹ See p. 3-9.

¹⁷⁰ See p. 3-9.

City of Henderson

The City of Henderson leases an area used as a municipal park from TIMET. No manufacturing processes appear to have occurred.

On September 28, 1992, through condemnation, the City of Henderson acquired from BMI 35.34 acres immediately to the south of the Upper Ponds as the site for a municipal wastewater injection facility (the RIBs), which was in operation from 1992 to at least 2002. On October 6, 2003, as a part of a land exchange, the City acquired approximately 101.638 acres generally located adjacent and west of the Lower Ponds from BMI. In turn, the City conveyed 73.157 acres (including the acreage associated with the RIBs) to LandWell. The City used the land it acquired for a municipal wastewater treatment facility (the City of Henderson WRF), which is presently under construction.

Combined Metals Reduction Company

Combined Metals Reduction Company leased facilities at the site from the CRC. The CRC conveyed the ownership of the property to GSA after the CRC had sold the bulk of its holdings. The Combined Metals Reduction Company assigned the lease to Pioche Manganese Company, which in turn assigned the leased facilities to National Lead Company. Details regarding operations conducted by Combined Metals Reduction Company are unclear, although there is some indication that the company produced ferro-manganese alloys and that its operations may have been similar to those of the Pioche Manganese Company.¹⁷¹

Coulter, Harden & Company

Coulter, Harden & Company leased facilities at the site from the US government. The company processed cell melt refuse.¹⁷²

Coyote Construction (Wirthlin Trenching)

Coyote Construction leased facilities from TIMET. Details regarding its operations are unknown.¹⁷³

¹⁷¹ Henderson Steering Committee ECA, p. 14. [B002482]

¹⁷² Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11] See also, WAA Sales Brochure, Plancor 201. n.d.

¹⁷³ TIMET ECA, p. 4-57. [B002861]

Daniel Furse and Dante Bagni

Daniel Furse and Dante Bagni leased cafeteria space from the CRC. No manufacturing processes appear to have occurred.

Delbert Madsen and Estate of Delbert Madsen

Delbert Madsen and subsequently the Estate of Delbert Madsen leased a triangular shaped 2-acre parcel at the northern most, eastern corner of the Kerr-McGee property.¹⁷⁴ The area was used as a storage and salvage yard for 1940s-vintage transportable government housing, used mobile homes, old vehicles and wrecked vehicles.¹⁷⁵

Desert Furniture & Carpet Company

Desert Furniture & Carpet Company leased warehouse facilities from the US government and used them for furniture storage. No manufacturing processes appear to have occurred.

Dillon Potter

Dillon Potter leased a 2-acre portion of the Kerr-McGee property southeast of the SNAP-TOW lease area. The area was used to maintain a limited number of livestock including horses, pigs, cattle, chickens, and peacocks.¹⁷⁶

Ebony Construction Company

Ebony Construction Company leased a portion of property center of the north side of Unit 1 in 1977 and 1978 from Kerr-McGee. It provided construction management and staging activities.¹⁷⁷ No relevant manufacturing processes appear to have occurred.

Espy Construction

Espy Construction has occupied areas within the Pabco Road Ponds area since October 1980. Espy was used by various plants within the industrial complex to demolish outdated process equipment, build berms for effluent control, and construct evaporation ponds. It is a TIMET lessee.

¹⁷⁴ See KMCC ECA, Plate 7-4.

¹⁷⁵ KMCC ECA, p. 7-26. [B002135]

¹⁷⁶ KMCC ECA, p. 7-28. [B002137]

¹⁷⁷ KMCC ECA, p. 7-24. [B002133]

Frank Briscoe Company

Frank Briscoe Company leased facilities from TIMET and used them for unloading filter media materials.¹⁷⁸

Gelatines, Inc.

Gelatines, Inc. leased facilities from the US government. The company's operations are unknown.

Green Ventures International

Green Ventures International leased facilities from Kerr-McGee and operated an alfalfa sprouts marketing office.¹⁷⁹ No manufacturing processes appear to have occurred.

Hardesty Chemical Company

Hardesty Chemical Company leased electrolysis building #2 and the adjacent chlorination building for operation of a chemical plant from the US government beginning in September 1946. The company produced synthetic detergents, muriatic acid, monochlorobenzene, paradichlorobenzene, and orthodichlorobenzene.¹⁸⁰

Hardesty Chemical sold or assigned its interest in the lease to Amecco Chemicals, Inc. on September 1, 1947, but apparently did not inform or consult the WAA. Amecco wrote to the WAA advising the government that it had "purchased the entire interest of the Hardesty Chemical Co., Inc. in it's (sic) Basic Magnesium Plant operation, including plant, machinery, and chemical stocks and will continue the operation here, commencing October 1st."¹⁸¹ The WAA did not recognize the assignment or purchase of the lease, and as of March 31, 1948, Hardesty Chemical was delinquent on its lease and utility charges and owed the government almost \$50,000. The WAA noted that since the government had agreed to dispose of the entire Basic Magnesium site to the CRC, they felt that the decision regarding Amecco's continuation of

¹⁷⁸ TIMET ECA, p. 4-57. [B002861]

¹⁷⁹ KMCC ECA, p. 7-23. [B002132]

¹⁸⁰ Sales Brochure, Plancor 201. n.d.

¹⁸¹ Information from WAA, Washington Credit Division Report, April 30, 1948. [BR002381-391]

operations should reside with the CRC.¹⁸² See the discussion under Amecco Chemicals, Inc. for additional information.

In its assessment of the delinquent rental and utility payments, the government ascertained that Amecco was “practically bankrupt,” that Hardesty Chemical was financially able to pay rent and utility charges, legally liable for the rent, “and also for the utility charges on the theory that Amecco was acting in effect as [Hardesty Chemical’s] agent when it incurred the utility charges.”¹⁸³ The government also noted that Hardesty Chemical was a subsidiary of W.C. Hardesty Company, Inc., which in turn was a subsidiary of Binney & Smith Company. W.C. Hardesty owned 75 percent of Hardesty Chemical’s preferred stock and Amecco owned the remaining 25 percent. W.C. Hardesty owned 51 percent and Bormar Corporation owned 49 percent of Hardesty Chemical’s common stock.¹⁸⁴

Henderson Riding Club

The Henderson Riding Club leased facilities from the CRC. No manufacturing processes appear to have occurred.

Henderson Telephone Company

The Henderson Telephone Company leased facilities from TIMET. No manufacturing processes appear to have occurred.

Hodsdon Brothers, Inc.

Hodsdon Brothers, Inc. leased facilities from the US government. Details about the company’s operations are unknown.

Industrial & Metallurgical Engineering Company

Industrial & Metallurgical Engineering Company leased facilities from the US government. Details about the company’s operations are unknown.

¹⁸² According to a WAA summary pertaining to Hardesty Chemical operations, Hardesty accepted the RFC’s Letter of Intent in December 1945. The property was delivered to the company in operating condition on September 1, 1946. Information from WAA, Washington Credit Division Report, April 30, 1948. [BR002381-391]

¹⁸³ WAA, Washington Credit Division Report, April 30, 1948, p. 6. [BR002386]

¹⁸⁴ WAA, Washington Credit Division Report, April 30, 1948. [BR002381-391]

J.B. Kelley

J.B. Kelley leased facilities from Kerr-McGee. Details regarding operations are unknown.

J.W. Conroy

J.W. Conroy leased facilities from the CRC. Details regarding operations are unknown.

John Wiley Jones Company, Inc.

John Wiley Jones Company leased facilities from TIMET. The company repackaged chlorinated chemicals for swimming pool maintenance and also manufactured sodium hypochlorite (bleach).

Jones Chemicals, Inc.

Jones Chemical is the successor to John Wiley Jones Company. It leases facilities from TIMET. The company repackages chlorinated chemicals for swimming pool maintenance.

Koch Materials Company (aka Koch Asphalt Company)

Koch Materials Company and/or Koch Asphalt Company leased facilities from Kerr-McGee and operated an asphalt emulsion batch plant for blending and packaging a variety of asphalt emulsions. The production process involved milling asphalt cement with soap emulsifiers.¹⁸⁵

Magnesite Truck Company

Magnesite Truck Company leased facilities from TIMET. Details regarding the company's operations are unknown.¹⁸⁶

Mainor, William

William Mainor leased facilities from the CRC. Details regarding operations are unknown.

Mendelsohn, William

William Mendelsohn leased warehouse space from the US government and used it to store furniture. No manufacturing processes appear to have occurred.

¹⁸⁵ KMCC ECA, p. 7-21. [B002130]

¹⁸⁶ TIMET ECA, p. 4-58. [B002862]

Miller, Haynes & Smith, Inc.

Miller, Haynes & Smith, Inc. leased facilities from the CRC. Details regarding the company's operations are unknown.

Montrose Chemical Corporation of California

In 1947, Stauffer sub-leased approximately 10 acres of land to Montrose Chemical Corporation (Montrose), on which Montrose built an organic chemical manufacturing plant. The company expanded its operations in 1954, when it built a hydrochloric acid (HCl) manufacturing plant to produce industrial grade HCl. Montrose expanded its facilities again in 1977, but ultimately dismantled its entire organic chemical manufacturing plant in 1983.¹⁸⁷ The area that Montrose leased from Stauffer between 1947 and 1983 changed, and ultimately involved twelve parcels totaling, at a maximum, approximately 20 acres.

Information regarding industrial processes and waste generation is presented in detail in Section 4 of the Montrose ECA, prepared in 1993. To briefly summarize, the company manufactured:

- Chloral, 1947-1983
- Chlorobenzene or MCB, 1947-1983
- Polychlorinated Benzenes, 1947-1983
- Dichlorobenzil, 1967-1983
- Muriatic acid, 1947-1983
- Ethyl chloride, 1958-1961

Musical Arrangements, Inc.

Musical Arrangements, Inc. leased facilities from TIMET. The company's operations consisted of making music tapes.¹⁸⁸ No relevant manufacturing processes appear to have occurred.

¹⁸⁷ Montrose ECA, p. 21. [B002332]

¹⁸⁸ TIMET ECA, p. 4-55. [B002859]

Myers-Thornton Gas Company

Myers-Thornton Gas Company leased facilities from the US Government. The company distributed propane. No relevant manufacturing processes appear to have occurred.

National Sound Corporation

National Sound Corporation leased facilities from TIMET. It is believed that no production activities occurred.¹⁸⁹

Nevada Clay Products Company

Nevada Clay Products Company leased facilities from the US government. Details regarding the company's operations are unknown.

Nevada Precast Concrete Products

Nevada Precast Concrete Products leased office space from Kerr-McGee.¹⁹⁰ No manufacturing processes appear to have occurred.

Nevada Wholesale Meat Company

Nevada Wholesale Meat Company leased cafeteria facilities from the US government. No manufacturing processes appear to have occurred.

Nevada, New York & Ohio Chemical Company

Nevada, New York & Ohio Chemical Company leased facilities at the site under a sub-lease obtained from Stauffer during the time that Stauffer was leasing its site from the US government. It appears that the Nevada, New York & Ohio Chemical lease began in January 1946 and the plant closed in July 1947 for renovation. As of October 1947 the plant was inactive due to market conditions.¹⁹¹ It is unknown if the Nevada, New York & Ohio Chemical operations resumed. Nevada, New York & Ohio Chemical produced aluminum chloride.¹⁹²

¹⁸⁹ TIMET ECA, p. 4-56. [B002860]

¹⁹⁰ KMCC ECA, p. 7-23. [B002132]

¹⁹¹ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

¹⁹² Sales Brochure, Plancor 201. n.d.

Nu-Bulk Transportation

Nu-Bulk Transportation leased facilities from Stauffer. Nu-Bulk Transportation transported chlor-alkali products from Stauffer, along with similar materials for other companies at the site. Other transportation companies, including Bulk Transportation and Post Transportation, have also leased the same area from Stauffer and have presumably conducted similar operations.¹⁹³

O.J. Scherer Company

O.J. Scherer Company initially leased Building T-3 until 1951, when it purchased it from CRC. The company subsequently sold it to TIMET. Scherer operated a machine shop, fabricated machinery, and conducted machinery and equipment repair activities.¹⁹⁴

Paraffine Companies, Inc.

Paraffine Companies, Inc. leased facilities from the CRC. Details regarding the company's operations are unknown.

Per Boy Associates

Per Boy Associates leased facilities from TIMET. Details regarding the company's operations are unknown.

Pioche Manganese Company

Combined Metals Reduction Company assigned its lease for facilities at the site to Pioche Manganese Company. Pioche Manganese used a portion of the leased area for manganese slag storage. Pioche processed ore supplied by the nearby Three Kids' Mine. The company operated an arc (carbon electrode) furnace for ore processing. The operations produced manganese and process slag, which was stockpiled in areas north and east of Building J-2.¹⁹⁵

Post Transportation Company

Post Transportation Company leased facilities from the CRC and thereafter from Stauffer Chemical. Post Transportation transported chlor alkali products from Stauffer, along with similar

¹⁹³ Stauffer/Pioneer ECA, p. 3-5. [B001671]

¹⁹⁴ Information from Memorandum John R. Reilly to Irving Gumbel, July 15, 1947. [BR002371-373]

¹⁹⁵ TIMET ECA, p. 3-3. [B002784]

materials for other companies at the site. Other transportation companies, including Bulk Transportation and Nu-Bulk Transportation, have also leased the same area from Stauffer and have presumably conducted similar operations.¹⁹⁶

Rosecrest Cabinets

Rosecrest Cabinets leased facilities from TIMET. Details regarding the company's operations are unknown.

Saguaro Power Corporation

Saguaro Power Corporation leased six acres from Pioneer for the construction and operation of a 90-megawatt natural gas-fired electrical cogeneration facility.¹⁹⁷ The plant was commissioned in 1991 and has been in operation since then. Pioneer receives the steam and Nevada Power Company purchases the electricity.

Sears Robuck & Company

Sears Robuck & Company leased warehouse space from the US government and used it for furniture storage. No manufacturing processes appear to have occurred.

Skaggs Company, Inc.

Skaggs Company, Inc. leased warehouse facilities from TIMET. Details regarding the company's operations are unknown.

Southern Nevada Auto Parts and related companies

Robert and William Ellis leased a 10-acre portion of the Kerr-McGee site doing business as SNAP-TOW, Southern Nevada Auto Parts, and Pick-A-Part. Ed Smith and Vern Christensen have been leaseholders since January 1990, doing business as Nevada Recycling (an auto salvage yard) on the northern portion of this area. Operations at the auto impound yard (SNAP-TOW) consist of storage of wrecked, police impounded, and repossessed vehicles. Activities at the auto

¹⁹⁶ Stauffer/Pioneer ECA, p. 3-5. [B001671]

¹⁹⁷ See p. 3-9.

salvage yard at the northern and western portions of the lease area include buyer dismantling and retrieval of parts.¹⁹⁸

State Industries, Inc.

State Industries leased space from Kerr-McGee for the production of commercial and domestic water heaters.¹⁹⁹ The company also leased a portion of the site from TIMET and used it to store non-PCB-containing transformers.²⁰⁰

State of Nevada, Employment Service Department

The Employment Service Department leased office space from the US government. No manufacturing processes appear to have occurred.

State Stove and Manufacturing Company

State Stove and Manufacturing Company leased warehouse space from TIMET. No manufacturing processes appear to have occurred.

Stauffer Chemical Company of Nevada

Stauffer Chemical Company of Nevada initially leased a portion of the site from the US government. The company subsequently purchased that portion of property as well as additional parcels. Pioneer acquired Stauffer's manufacturing facilities in October 1988.²⁰¹ Production processes used by Stauffer and Pioneer are described in depth in Section 4 of the Phase I ECA, prepared in 1993. To briefly summarize, the Stauffer used five industrial processes for the production of:

- Parachlorothiophenol/Thiophenol
 - Parachlorothiophenol, 1960-1984
 - Thiophenol, 1967-1982
- Trithion/Imidan process, 1958-1984
 - Trithion, 1958-1984 (intermittent)

¹⁹⁸ KMCC ECA, pp. 7-26 to 7-28. [B002135-137]

¹⁹⁹ Henderson Steering Committee ECA, p. 16 [B002484]

²⁰⁰ TIMET ECA, p. 4-57. [B002861]

²⁰¹ Henderson Steering Committee ECA, p. 13. [B002481]

- o Methyl Trithion, 1960-1963
- o O,O-diethylphosphorodithoioic acid (DTA), 1972-1975, 1977-1984
- o Imidan, 1964-1976 (intermittently)
- Benzene Hexachloride process (Lindane), 1946-1958
- Chlor Alkali process, 1945 to present (since October 1988 under Pioneer)
- HCl process, 1945 to present²⁰² (since October 1988 under Pioneer. The HCl unit was owned by Montrose until at least 1997 and leased to Pioneer.)

Operations subsequent to 1988 have been limited to the production of chlorine, sodium hydroxide (caustic soda), sodium hypochlorite (bleach), and muriatic (hydrochloric) acid.

TIMET

TIMET was formed by a joint venture agreement between Allegheny Ludlum Steel Corporation and National Lead Company in 1950.²⁰³ National Lead initially leased facilities at the site from the CRC, which assigned the leases to the GSA after the CRC has sold most of the Basic Magnesium property. TIMET ultimately obtained title to the leased property. Industrial processes and wastes generated are discussed in detail in Section 4 of the TIMET ECA. To summarize, the principal products manufactured by the company are:

- Titanium ingots
- Titanium tetrachloride
- Titanium sponge
- Titanium fines
- Neutralized leach liquor (magnesium chloride sold as a roadway dust suppressant)

The process used to produce titanium starts with the chlorination of rutile (titanium dioxide ore) to produce titanium tetrachloride. The titanium tetrachloride is then purified and reduced to titanium metal with elemental magnesium.

²⁰² Stauffer/Pioneer ECA, p. 1-2. [B001661]

²⁰³ Timet, ECA, April 15, 1993., p. 3-1

TIMET Employees Federal Credit Union

TIMET Employees Federal Credit Union leased office space from TIMET. No relevant manufacturing processes appear to have occurred.

True Gems

True Gems leased facilities from the US government. The company manufactured costume jewelry. No relevant manufacturing processes appear to have occurred.

Underwriters Salvage Company of New York

Underwriters Salvage Company of New York leased space from the US government. The company used the space for warehousing and processing salvaged groceries. No relevant manufacturing processes appear to have occurred.

Union Pacific Railroad Company

Union Pacific Railroad Company leased office space from the CRC. No manufacturing processes appear to have occurred.

United States Vanadium Corporation

United States Vanadium Corporation leased facilities at the site from the US government. The company's operations included chemical beneficiation of tungsten concentrates produced by itself and others in Nevada and California.²⁰⁴ Work as of October 1947 consisted of reclaiming concentrates from the settling ponds and re-running them for scheelite.²⁰⁵ The company produced synthetic scheelite, tungstic acid, molybdenum trisulphate, ammonia parathustate.

U.S. Lime Products Corporation

U.S. Lime Products Corporation appears to have initially leased facilities at the site from the CRC. The company's successors acquired the site. See the discussion under Chemstar Lime Company.

²⁰⁴ Information from WAA, Proposal of USVC lease, February 28, 1946. [BR002359-363]

²⁰⁵ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

U.S. Navy

In 1950, WECCO entered into an agreement with the Navy Department to set up and operate a sodium perchlorate plant in a part of the Basic Magnesium facility. In addition, WECCO agreed to operate a 50-ton per day ammonium perchlorate plant on 290 acres that the Navy acquired from WECCO.²⁰⁶

In 1954, WECCO was absorbed by American Potash & Chemical Corporation and took over all contract rights from WECCO in connection with the Navy facility. WECCO and American Potash & Chemical Corporation had no lease with the Navy; instead the company operated the plant, furnishing ammonium perchlorate on a supply contract for the Navy Department. The supply contract provided that sufficient money be included in the per pound charge of ammonium perchlorate to cover overhead, maintenance, profit, and production costs.²⁰⁷

Through most of its operation, the plant was the sole producer of ammonium perchlorate for defense purposes.²⁰⁸ According to a 1958 appraisal of the Naval Industrial Reserve Plant, the Government, “either directly or indirectly through defense contractors, was the sole purchaser of ammonium perchlorate in volume.”²⁰⁹

The industrial facilities associated with the government-owned WECCO/American Potash & Chemical Corporation facilities consisted of two parts:

- Production equipment situated in buildings owned by the company, which was covered under a Naval Bureau of Ordnance contract, NOrd (F) 1741 (DOD-217).
- Approximately 290 acres of land, plus buildings, equipment, and improvements, which were owned by the Navy Department and built adjacent to WECCO’s property. This portion of the

²⁰⁶ Deed of Conveyance, October 26, 1953. NARA San Bruno, RG 121, Box 23, Folder: N-Nev-5-415 US Naval Industrial Reserve Plant (DOD 473 and DOD 217). [BR002789-793] The Navy vested title to the property to the United States of America on December 31, 1953. Letter to Regional Director, GSA, January 18, 1954. NARA San Bruno, RG 121, Box 4, Folder: R-Nev-5, Basic Magnesium, Western Electrochemical Co. General through Final Disposition. [BR002436-437]

²⁰⁷ Appraisal of US Naval Industrial Reserve Plant (DOD 473 and DOD 217), October 31, 1958. NARA San Bruno, RG 121, Box 22, Folder: N-Nev-5-415 US Naval Industrial Reserve Plant (DOD 473 and DOD 217). [BR002535-537]

²⁰⁸ Appraisal of US Naval Industrial Reserve Plant (DOD 473 and DOD 217), October 31, 1958. NARA San Bruno, RG 121, Box 22, Folder: N-Nev-5-415 US Naval Industrial Reserve Plant (DOD 473 and DOD 217). [BR002583]

²⁰⁹ Appraisal of US Naval Industrial Reserve Plant (DOD 473 and DOD 217), October 31, 1958. NARA San Bruno, RG 121, Box 22, Folder: N-Nev-5-415 US Naval Industrial Reserve Plant (DOD 473 and DOD 217). [BR002584]

facilities was covered under a Naval Bureau of Ordnance contract, NOrd (F) 1740 (DOD-473).

US Treasury Department, Bureau of Federal Supply

The US Treasury Department leased storage space for magnesium ingots.²¹⁰ No manufacturing processes appear to have occurred.

Vadelite Corporation

Vadelite Corporation leased office space from the US government. The company designed prefabricated houses. No relevant manufacturing processes appear to have occurred.

Western Electro Chemical Company/Kerr-McGee Chemical Corporation

WECCO initially leased facilities from the US government. It subsequently purchased the property.

Industrial processes and wastes generated are discussed in the Kerr-McGee ECA, Section 4. To briefly summarize, the facility has three production areas:

- Chlorate/perchlorate-based compounds
 - Sodium chlorate, 1945 to at least 1990
 - Potassium chlorate, 1945-1975
 - Potassium perchlorate, 1945-1983
 - Sodium perchlorate production, 1945 to at least 1990
 - Ammonium perchlorate, 1951 to at least 1990
 - Magnesium perchlorate, 1969-1976
 - Tumbleaf Defoliant®, 1975-1985
- Electrolytic manganese dioxide, 1951 to at least 1990
- Boron and halogenated boron products,
 - Elemental boron, 1972 to the present
 - Boron Trichloride, 1972 to the present
 - Boron Tribromide, 1973 to the present

²¹⁰ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

Western Mineral & Development Corporation

Western Mineral & Development Corporation leased facilities at the site from the US government. The company reportedly processed gypsum and conducted truck repair activities.²¹¹ The company was unable to secure financing, and the extent of its operations is unclear.²¹²

Zenoft, M.

M. Zenoft leased facilities from TIMET for a radio station. The lease was assigned to Television Company of America. No relevant manufacturing processes appear to have occurred.

2.3 DISPOSAL PRACTICES ON TO BMI COMMON AREAS

Information regarding the owners' and/or lessees' disposal practices on to the BMI Common areas is provided below. It is arranged alphabetically by company name. An overview of the source characterization for the Eastside and CAMU areas, based on data collected from investigations conducted since 1996, is presented in Section 4.2.

Amecco Chemicals Inc.

Amecco Chemicals reportedly disposed of wastes in the BMI Landfill. Types and volume of wastes are unknown.²¹³

Basic Magnesium Inc.²¹⁴

All of the wastes deposited in or discharged to the BMI Common Areas from the Basic Magnesium operation can be classified as either: (1) solid material which would go to a landfill, (2) total suspended solids (TSS) and total dissolved solids (TDS) which would go to evaporation ponds, or (3) trace impurities which would be discharged with the dissolved and suspended solids. These wastes can be characterized as salts from the production process (chloride salts of magnesium, sodium, calcium, etc.) and organic and inorganic solids of various types. The solids would have consisted of impurities in the magnesite, compounds formed from the impurities in

²¹¹ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

²¹² Sales Brochure, Plancor 201. n.d.

²¹³ Henderson Steering Committee ECA, p. 40. [B002508]

²¹⁴ In addition to cited sources, see Expert Report of Clifford B. Wilson on Wastes Produced by Basic Magnesium, Inc., March 18, 2004, and Supplemental and Rebuttal Expert Report, Clifford B. Wilson on Wastes Produced by Basic Magnesium, Inc., April 19, 2004.

the acid neutralization process, sodium carbonate formed by the reaction of excess caustic with carbon dioxide, and chlorinated organics formed by the reaction of chlorine with carbon at elevated temperatures. These materials would have left behind a residual evaporite in the soils of the evaporation ponds on the Common Areas. This following briefly examines the types of wastes likely produced by each of the major process steps.

Chlorine/Caustic Plant

In the Chlorine/Caustic plant there were several ways in which wastes occurred:

- The salt arrived in the plant in solid form. To use the material it was necessary to dissolve the salt in water to form a saturated brine solution. Solid impurities in the salt needed to be removed. As a result, mud and other insoluble material were settled out of the brine and were eventually washed, presumably to the Basic Magnesium settling ponds.
- Before the salt brine could be used in the chlorine cells, it had to be purified. Sodium carbonate was introduced into the brine and precipitated calcium as calcium carbonate and magnesium as magnesium carbonate. The material (sludge) was settled out of the brine and discharged to the settling ponds. In addition to the carbonates, the sludge material carried a significant amount of salt with it.
- A certain amount of asbestos waste was generated from this operation. The Hooker electrolytic chlorine cell used an asbestos membrane. Every time the cell was rebuilt, the old membrane was discarded. The total quantity of this was small (100 to 200 tons).
- There is indication that, at least in the early days of the plant, all of the caustic from the chlorine/caustic plant was wasted.²¹⁵ The caustic, when combined with the discharge from the magnesium portion of the operation, precipitated magnesium hydroxide, which resulted in a solution leaving the plant with a pH in the range of 11 and would have resulted in white solids being deposited in the ponds. It appears that through May or June of 1943 all of the caustic was used as cell effluent from the chlorine cells. The caustic that was used for neutralization up through May 1943 was wasted as sodium carbonate. Because this material was cell effluent it also contained a significant amount of salt (15 percent). Beyond that point (*i.e.*, May 1943), the caustic was wasted as a 50 percent caustic solution in water and went to

²¹⁵ Phase I Environmental Conditions Assessment Report, Pioneer Chlor Alkali Company, Inc. Stauffer Chemical Company Site, Weston Managers Designers/Consultants, March 22, 1993, p. 5-4. [B001722]

the evaporation ponds.²¹⁶ It is probable that the wasted caustic was either carbonated by the addition of CO₂ or by the reaction with CO₂ from the atmosphere and was ultimately deposited as sodium carbonate in the pond.

- The caustic evaporator plant began operations in the summer of 1943 and sales of caustic soda from the plant first occurred in August 1943. There would have been losses from this plant, mainly in the form of a “sulfate purge” stream. The sulfate purge stream was generated when sulfate was removed from the caustic that was being evaporated. This stream was purged from the plant and most probably went to the Basic Magnesium ponds. The sulfate purge stream contained sodium sulfate, caustic and salt. The estimate of losses assumes that the caustic soda that was not sold and utilized as a commercial product was wasted. According to hearings conducted after the plant shut down, 45,314 tons of caustic was shipped from the plant at a value of \$775,920.
- The chlorine liquefaction process produced at least two waste streams:
 - A small chlorinated organic stream was generated by the chlorine drying step. Indications are that this was discharged to a small impoundment near the plant.
 - Cleaning up the tail gas from the liquefaction process generated a sodium hypochlorite stream. It was estimated that the loss of chlorine with the tail gas was two percent,²¹⁷ but considering the low pressure (30 pounds per square inch [psi])²¹⁸ used in the liquefaction process, it is likely that the losses were much higher.

The Chlorinators

The chlorinator furnaces were a major source of losses from the magnesium process. Some of these sources include the following:

- The chlorination reaction does not proceed with 100 percent efficiency. As a result, there was a loss of chlorine from the chlorinators.

²¹⁶ Phase I Environmental Conditions Assessment for The Basic Management, Inc. Industrial Complex Clark County, Nevada, Geraghty & Miller, Inc., April 14, 1993, p. 33. [B002501]

²¹⁷ Chlorine & Caustic Plants and Henderson Plant Services, Description of Process and Equipment, Chlorine Plant – Liquefaction quantity flow sheet. [BR002266].

²¹⁸ Chlorine & Caustic Plants and Henderson Plant Services, Description of Process and Equipment, p. 4. [BR002220]

- HCl was generated in the chlorinator. This was a result of the reaction of chlorine and water at the high temperature to form HCl.
- Because of the high temperature in the chlorinator, some of the magnesium chloride evaporated and was carried out of the chlorinator as a vapor.²¹⁹
- The temperatures in the chlorinator along with the presence of chlorine with large amounts of carbon led to the formation of relatively low levels of chlorinated organics.²²⁰ These organics were carried as a vapor out of the chlorinator and most would condense in the chlorinator scrubbers. They were eventually discharged with the cooling water from the scrubbers. In general, these devices are known to produce hexachlorobenzene and chlorinated dibenzofurans as byproducts.
- Impurities coming in with the magnesite (iron oxides, silica, etc.) and the coal tended to build up in the chlorinators. It was necessary to remove the chlorinator from service approximately every three weeks in order to remove this material.²²¹
- Flow sheets indicate that magnesium chloride was recycled from the chlorinators to the pellet production operation. However, because these pellets were dried at high temperature²²² (about 1,800 degrees F), this material can be considered to be a total loss. This is because at that temperature the magnesium chloride break downs and forms HCl.²²³ The acid was discharged through the scrubbers in the pellet production plant.

The Magnesium Cells

The magnesium cells were the heart of the process. This was the point where everything came together to produce the product of the plant. Only minor amounts of waste would have been generated from the cells themselves. Most of the waste materials were in solid form, although there were probably minor amounts of liquid wastes. These wastes included:

²¹⁹ Kh. L. Strelets, *Electrolytic Production of Magnesium*, TT76-50003, U.S. Dept. of Commerce, Technical Information Service, Springfield, Va., translated by J. Schmorak, Keter Publishing House Jerusalem Ltd., 1977, p. 193.

²²⁰ Reference document submitted by the Experts of the European Community and Member States of the European Union on Best available techniques (BAT) and best environmental practices (BEP) for reducing and/or eliminating emissions of by-products POPs to the First Session of the UNEP Expert Group on BAT and BEP, 10-14 March 2003, USA, p. 39.

²²¹ *Engineering and Mining Journal*, October 1943, p. 66.

²²² *Metallurgical Operation at Basic Magnesium, Inc. Las Vegas, Nevada*, April 23, 1942, p. 4. [R004807]

²²³ K. K. Kelly, *Energy requirements and Equilibria in the Dehydration, Hydrolysis, and Decomposition of Magnesium Chloride*, technical paper 676, U.S. Dept. of Interior, Bureau of Mines, Washington, D. C., 1945.

- Cell Mud (sludge) was the material that settled to the bottom of the cell and had to be removed before it caused a deterioration of cell performance. The cell mud generally contained MgO, some magnesium metal, acidic insoluble material and the remainder being cell bath.²²⁴ The material came out as a solid (even though much of it was soluble) and, in all probability, it ended up in the Basic Magnesium landfill.
- Cell Melt had to be periodically removed from the cell. This was typically done to control the composition of the cell melt in the cell. The material also came out as a solid. Most of this material went to make flux. The flux, in turn, went to the casting operation and then eventually ended up as a waste from the casting operation.
- Some waste associated with the gas handling system was probably generated. The chlorine gas coming from the cell was sent to the chlorinator. A certain amount of cell melt salts were present in the cell gas (due to evaporation of the salts from the cell). These would be lost either as a solid in the gas handling system or eventually as an aqueous discharge to the evaporation ponds. There is also indication that gas from the cathode compartment of the cells was scrubbed in a water scrubber. This gas would have contained HCl.
- In addition to the wastes listed above, Magnesium cells are known to produce trace quantities of chlorinated organics. The conditions in the electrolytic cell (*i.e.*, strong chlorine, graphite and a temperature of 700 °C) provide conditions that are capable of producing highly chlorinated organics such as hexachlorobenzene.²²⁵

Magnesium Casting

Essentially all the wastes generated from the casting operations were in solid form. When magnesium is handled in the molten form, a certain amount of burning takes place. Fluxes were used to minimize this burning by protecting the surface of the melt. Fluxes were also utilized to settle impurities out of the metal. The MgO from burning and the fluxes were all heavier than the metal and eventually settled to the bottom of the holding crucible. The sludge from the casting operation was removed from the casting crucibles and most probably went to the landfill.

²²⁴ Kh. L. Strelets, *Electrolytic Production of Magnesium*, TT76-50003, U.S. Dept. of Commerce, Technical Information Service, Springfield, Va., translated by J. Schmorak, Keter Publishing House Jerusalem Ltd., 1977, p. 302-303.

²²⁵ Zero Toxics, *Sources of by-product POPs and their Elimination*, Darryl Luscombe and Pat Costner, Greenpeace International Toxics Campaign, May 2001, p. 14-15.

Typically the losses from the casting of magnesium run in the order of six percent or more of the magnesium metal handled.²²⁶

Flux Plant

The wastes from the flux plant would have been minimal. There are, in general, two types of fluxes. The first of these are blended fluxes, which were made by mixing solid materials (chloride salts) together and then packaging them. The second type of flux is a fused flux, which was made by melting the salts and then grinding (after solidification) or flaking the materials to provide the flux in a form that can be used in the casting operation. Neither of these types of operations produce a significant amount of waste either in solid or liquid form. There were dust collectors associated with the operation that would have captured dusts and discharged them with the liquid effluent from the plant.

TSS and TDS Discharges

There were extensive discharges of suspended solids. A Basic Magnesium internal report generated before the plant started up predicted discharge of an estimated 300 tons per day.²²⁷ Since the plant management's only concern with waste was where they could put it, this number was used to estimate the TSS discharge. Although parts of the operation probably operated and discharged waste more than just during the time of the production magnesium, the estimate of the discharge has been made only on the basis of a stabilized full production capacity. Some portion of these TSS discharges would have been due to impurities contained in the magnesite feed to the plant.

The composition of the TSS and TDS from the Basic Magnesium process would have been a varied mix of materials that included, but were not limited to, the following:

- Arsenic
- Asbestos
- Calcium carbonate

²²⁶ Hearing of the Sub-committee on Light Metals and Aviation of the Special Committee Investigating the War Program, Held in the Office of Mr. F. O. Case, General Manager Basic Magnesium on May 11, 1943 at 2:30 P.M., p. 41. [BR032205]

²²⁷ Basic Magnesium Incorporated Engineering Department, History of Civil Engineering, by E. H. Clary, BMI Internal Report No. 18, Date: April 1, 1942, p. 18. [BR33900]

- Chlorinated hydrocarbons containing hexachlorobenzene, chlorinated dibenzofurans, octachlorostyrene, PCBs, and others
- Magnesium chloride
- Magnesium hydroxide
- Muds
- Other chlorides such as calcium chloride and potassium chloride
- Sodium carbonate
- Sodium chloride
- Sodium hydroxide
- Sodium hypochlorite
- Sodium sulfate
- Sulfuric acid (H₂SO₄)
- Wastes from the magnesite

There were numerous places where these materials entered the waste streams leaving the Basic Magnesium process. The following is a partial list of the places where these wastes entered the streams that eventually ended up in the Basic Magnesium evaporation ponds:

- Cooling water from numerous sources
- Cooling tower blow down
- Dust collector at the Flux Plant
- Dust from chlorine filters and chlorine mains
- Filters and surge tanks at the Brine Preparation plant
- Slurry from the Recovery and Neutralization plant

- Wash Tower at the Preparation Plant
- Wash Tower for cathode exhaust
- Water from the Henderson Sewer treatment plant

Cell Demolition

After the plant operations ceased, the magnesium cells would have eventually been demolished and put into the landfill. The debris from this would have consisted of the bath in the cells, the refractory used in the cell, the anodes and the cathodes used in the cell. The steel shell might have been recovered as recycled steel.

Calculated Waste Totals

Basic Magnesium, Inc

Portion of the Process	Total Tons of Wastes
Liquid Losses	
Material lost to Trade Effluent Ponds	90,429
Magnesium plant losses to Upper Ponds	230,127
Chlorine/caustic plant losses to Upper Ponds	104,803
Chlorine/caustic plant losses to Lower Ponds	10,982
Losses going to Landfill	
Cell Mud	14,824
Solids lost in the chlorinator	24,545
Losses of casting sludge	26,520
Magnesium Cells going to landfill	20,730
Landfill Total	86,619

City of Henderson²²⁸

Sewage treatment facilities (HSTP1) operated by the City of Henderson were constructed in 1958. HSTP1 continued operations until 1985, when it was closed.

HSTP1 received and treated domestic and light industry sewage from the Henderson/Pittman area. It did not receive or treat BMI sewage effluent.

A sewage treatment plant constructed in 1942 received and treated sewage effluent from the BMI industries and the City of Henderson until it closed in or about 1985. BMI operated the plant until 1974, at which time the City of Henderson assumed ownership and control. Sewage at HSTP2 underwent minor treatment and was discharged as raw sewage into the upper ponds. Unlined infiltration basins located near HSTP2 continue to receive treated effluent from the City of Henderson.

Sewage from the Henderson/Pittman area is currently treated through HSTP3, which began operations in November 1983. Sewage is treated and passes through microscreens at HSTP3 before discharge into the infiltration basins. Treated effluent is periodically pumped into the lower ponds whenever the discharge from HSTP3 exceeds its capacity.²²⁹

As noted earlier, the City of Henderson also operated RIBs as injection points for municipal waste water on a portion of the site from 1992 to at least 2002.

Hardesty Chemical Company

Hardesty Chemical Company reportedly disposed of wastes in the BMI Landfill. Types and volume of wastes are unknown.²³⁰

Jones Chemical Company

Jones Chemical Company disposed of wastes to the:

- BMI Landfill

²²⁸ In addition to the cited sources, see Expert Report of Paul D. Fahrenthold, Ph. D., March 18, 2004, and Fahrenthold Supplemental and Rebuttal Expert Report, April 19, 2004.

²²⁹ See Henderson Steering Committee ECA, p. 58-60. [B002526-528]

²³⁰ Henderson Steering Committee ECA, p. 40. [B002508]

- o Wastes included general trash and floor sweeping, sodium carbonate, sodium bicarbonate, diatomaceous earth, tri-sodium phosphate, Borax, Vermiculite clays, sodium chloride, and sodium sulfate.²³¹
- BMI Upper Ponds
 - o Rinse and wash water containing small amounts of chlorides.²³²

Montrose Chemical Corporation of California²³³

Process waste streams generated from the manufacture of all the products produced by Montrose can be classified as H₂SO₄ waste, HCl waste, sodium hypochlorite waste, and sulfonated organics waste. Specific information describing the wastes discharged to the BMI Ponds as of 1971 is provided in the Montrose ECA.²³⁴

Wastes discharged from the Montrose operations were commingled with wastes from Stauffer's operations in plant sewers.²³⁵ Stauffer reports that historically, stormwater and wastewaters from the Stauffer and Montrose operations areas were conveyed to off-site impoundments via a system of ditches.²³⁶ In 1970-1971, the combined effluents were diverted from the Lower to the Upper Ponds through the Beta Ditch Extension.²³⁷

The Montrose ECA indicates that the company disposed of wastes to the:

- Basic Magnesium Landfill
 - o Wastes included still bottom residues, empty DDT paper bags, and miscellaneous equipment and scrap²³⁸

²³¹ Henderson Steering Committee ECA, p. 45. [B002513]

²³² Henderson Steering Committee ECA, p. 58. [B002526]

²³³ In addition to the cited sources, see Expert Report of Paul D. Fahrenthold, Ph. D., March 18, 2004, and Fahrenthold Supplemental and Rebuttal Expert Report, April 19, 2004.

²³⁴ See Montrose ECA, pp. 78-79. [B002389 and B002390] The information is further summarized on individual pages BR 013616 and labeled H-01. Page H-01 also provides information on a non-process stream, demineralizer wastes, also discharged to the BMI Ponds. The Montrose process flow diagrams included in the ECA [B0001623, B0001629, and B0001630] and the data from BR013616 provide the basis for a material balance calculation of the wastewater quantities discharged to the BMI Ponds.

²³⁵ See Montrose ECA, p. 77. [B002388]

²³⁶ The ditches can be found in the Montrose ECA, Figure 5-1 [B001720] and 5-3 [B0001726]

²³⁷ Pioneer/Stauffer ECA, p. 5-7. [B001725]

²³⁸ See Montrose ECA, Section 5.10, p. 76. [B002387]

- Basic Magnesium Ponds via process sewers
 - Wastes included chloride wastes, H₂SO₄ wastes, and process washwaters containing sulfonated metabolites of DDT.²³⁹

Historical records provide additional information about waste disposal practices:

- In September 1957, Stauffer identified sources of contaminants in its and Montrose's effluent. Those items specifically identified as belonging to Montrose are:
 - Dilute HCl from Montrose included all HCl that could not be sold.
 - Spent H₂SO₄ from Montrose Chloral stills – 860 tons per month. The H₂SO₄ content was about 70 percent by weight and thus was equivalent to about 600 tons per month of 100 percent H₂SO₄.
- A November 1970 Stauffer Chemical Company Industrial Waste Survey identified six separate discharge lines from the Stauffer and Montrose facilities.²⁴⁰ Those items specifically identified as belonging to Montrose are:
 - Montrose discharge to the American Potash ponds: consisted principally of a Montrose chemical waste stream and a smaller stream from a H₂SO₄ tank overflow. The total stream was estimated to be 600,000 gallons per day.
 - Main Sewer discharge was a blend of eight streams going to the storm sewer at an estimated 2.4 million gallons per day. The streams included:
 - Once-through cooling water from the Montrose building
 - Caustic waste and Montrose Water: once-through cooling water from Montrose Building 5A. The water was contaminated with the effluent from the caustic sump, which handled waste from the filter and floor washings. The estimated discharge rate was 1.7 million gallons per day.

²³⁹ See Montrose ECA, Section 5.11 and 5.12, pp. 77-83. [B002388-394]

²⁴⁰ Montgomery Research, Inc., Stauffer Chemical Company Industrial Waste Survey, November 1970. [ST013797-830]

Additional information regarding the combined Stauffer and Montrose waste stream can be found in the Stauffer Chemical section.

Calculated Waste Totals

Montrose Chemical Corporation of California

Process Operation	Dates Operation Occurred (Years)	Volume of Waste (Tons)	TDS Concentration in Waste (Percent)	Volume of TDS Waste (Tons)	Distribution of Wastes	
					Upper Ponds (Jan. 1971- Dec. 1975)	Lower Ponds (May 1945- Dec. 1970)
Oliver Filtrate	1/67-12/75	55,232	0.10%	55	31	25
HCl Wastes	1/47-12/75					
Final vent scrubber		1,271,216	0.50%	6,356	1,096	5,260
Acid plant main sewer		317,804	0.50%	1,589	274	1,315
HCl Gas demister		88	35.00%	31	5	26
Benzene wash water		11,035	2.18%	241	41	199
Sulfonated Organics	1/67-12/75					
Sulfonated organics		236,709	2.00%	4,734	2,630	2,104
H ₂ SO ₄ waste		236,709	6.00%	14,203	7,890	6,312
Demineralizer Wash Water	1/47-12/75	235,174	1.50%	3,528	608	2,919
Chloral drying vent scrubber	1/47-12/75	127,122	0.60%	763	132	631

Process Operation	Dates Operation Occurred (Years)	Volume of Waste (Tons)	TDS Concentration in Waste (Percent)	Volume of TDS Waste (Tons)	Distribution of Wastes	
					Upper Ponds (Jan. 1971- Dec. 1975)	Lower Ponds (May 1945- Dec. 1970)
P-1 condensate	1/47-12/75	50,849	0.04%	20	4	17
Poly column & P-10 evactor	1/47-12/75	1,271,216	0.10%	1,271	219	1,052
MCB column evactor	1/47-12/75	1,271,216	0.10%	1,271	219	1,052
Totals				34,062	13,149	20,912

Pioche Manganese Company

Pioche Manganese Company reportedly disposed of wastes in the Basic Magnesium Landfill. Types and volume of wastes are unknown.²⁴¹

State Industries, Inc.²⁴²

State Industries discharged wastes to the:

- Basic Magnesium Ponds, 1970 to 1974
 - o The composition of the waste was steel cleaning and preservation wash liquids. Individual components of the waste included borax, soda ash, phosphate chemicals, and H₂SO₄.²⁴³ Wastewater discharge to ponds at a rate of 35,000 gallons per month.²⁴⁴
 - o Liquid wastes periodically discharged to the Beta Ditch through the acid drain system included neutralized and unneutralized waste cyanide solutions, pickling process wastes, spent H₂SO₄, borax, soda ash, and phosphate chemicals. In addition, State Industries

²⁴¹ Henderson Steering Committee ECA, p. 40. [B002508]

²⁴² In addition to the cited sources, see Expert Report of Paul D. Fahrenthold, Ph. D., March 18, 2004, and Fahrenthold Supplemental and Rebuttal Expert Report, April 19, 2004.

²⁴³ State Industries to W.M. Tebeau, March 23, 1982. [BR014200-203]

²⁴⁴ State Industries to H. LaVerne Rosse, May 18, 1982. [BR014285] J.A. Westphal and W.E. Nork, "Reconnaissance Analysis of Effects of Waste Water Discharge on the Shallow Groundwater Flow System Lower Las Vegas Valley Nevada," April 1972. [BR023990]

discharged surface impoundment contents to the acid drain system on three occasions to facilitate liner repairs.²⁴⁵

- Basic Magnesium landfill: approximately 50 pounds of asbestos pipe wrapping.²⁴⁶

Stauffer Chemical Company of Nevada/Pioneer Chlor-Alkali Company, Inc.²⁴⁷

Stauffer/Pioneer provided information regarding waste disposal to the BMI Common Areas in Section 5.3 of the Stauffer/Pioneer ECA. To briefly summarize, Stauffer/Pioneer disposed of wastes to the:

- Basic Magnesium Landfill, 1945-1979
 - Wastes included concrete cell parts, asbestos shavings, asbestos sludge, graphite anodes, chlorine liquefaction sludge, carbon tetrachloride, and high paraffin fuel oil.
- Basic Magnesium Upper and Lower Ponds and associated conveyance ditches, 1946-1976
 - Wastes included asbestos, industrial effluent, and stormwater. Stormwater (but not industrial effluent) disposal to the Basic Magnesium Ponds continued at least until 1981.

Historical records provide additional information about waste disposal practices:

- In March 1952, Stauffer wrote to the CRC asking permission to “use the one large Northwest evaporation pond inside the BMP fenced area....” The company needed to use the additional pond because the caustic evaporation ponds that it leased from the CRC were “full almost to the point of overflow into the main storm sewer drain ditch.”²⁴⁸
- In September 1957, Stauffer identified sources of contaminants in its and Montrose’s effluent:
 - Sludge from brine area – an average of 380,000 pounds per month.
 - Dilute HCl from Montrose included all HCl that could not be sold.

²⁴⁵ KMCC ECA, p. 7-3 [B002112]

²⁴⁶ Henderson Steering Committee ECA, p. 45. [B002513]

²⁴⁷ In addition to the cited sources, see Expert Report of Paul D. Fahrenthold, Ph. D., March 18, 2004, and Fahrenthold Supplemental and Rebuttal Expert Report, April 19, 2004.

²⁴⁸ A.T Newell to R.J. Moore, March 7, 1952. [ST011629]

- o Spent H₂SO₄ from Montrose Chloral stills – 860 tons per month. The H₂SO₄ content was about 70 percent by weight and thus was equivalent to about 600 tons per month of 100 percent H₂SO₄.
- o Caustic plant sewers – 100 tons of 100 percent sodium hydroxide per month, 50 tons sodium chloride per month, 10,000 pounds of Filter-Aid (based on 400 filter runs), and 7,500 pounds per month MgO (based on 1,500 tons of 100 percent low iron sodium hydroxide at 5 pounds of MgO per ton).
- o Chlorine Area – 1,000 pounds per month of asbestos from cell renewal and 100 percent H₂SO₄ equivalent in H₂SO₄ (dilute), which was on average 52,000 pounds per month for 1957.²⁴⁹
- A November 1970 Stauffer Chemical Company Industrial Waste Survey identified six separate discharge lines from the Stauffer and Montrose facilities.²⁵⁰
 - o Montrose discharge to the American Potash ponds: consisted principally of a Montrose chemical waste stream and a smaller stream from a H₂SO₄ tank overflow. The total stream was estimated to be 600,000 gallons per day.
 - o Chlorine water stream to the East Pond: consisted of three streams from the liquefaction plant. The pH varied on these combined waste stream. The total volume discharged was 80,000 gallons per day.
- Main Sewer discharge was a blend of eight streams going to the storm sewer at an estimated 2.4 million gallons per day. The streams included:
 - o Once-through cooling water from the Montrose building
 - o Effluent from the Cell-Renewal Building, containing asbestos fibers from the cell diaphragms
 - o Effluent from the Brine Plant
 - o Effluent from the Caustic Plant

²⁴⁹ Inter-Office Correspondence, from George R. Stewart to J.F. Orr, September 24, 1957. [ST031129]

²⁵⁰ Montgomery Research, Inc., Stauffer Chemical Company Industrial Waste Survey, November 1970. [ST013797-830]

- o East & West Cooling Tower blowdown
- o Effluent from the Sludge Tank, consisting of contaminated saturated brine solution
- o Effluent from the Boiler Plant
- o Effluent from the Power Plant
- o Effluent from floor drains
 - Power Plant Blowdown: condensate water and blowdown from the #3 cooling tower, which was discharged at a rate of 65,000 gallons per day.
 - Caustic waste and Montrose Water: once-through cooling water from Montrose Building 5A. The water was contaminated with the effluent from the caustic sump, which handled waste from the filter and floor washings. The estimated discharge rate was 1.7 million gallons per day.
 - Agricultural Plant: was excluded from the study, but the report indicated that the waste stream from the agricultural plant flowed into the West Pond.
- Analyses of the wastes streams in this 1970 survey indicated the following:
 - o All samples showed a small concentration of mercury
 - o All samples showed traces of arsenic
 - o All samples showed cadmium
 - o All samples showed chromium 6
 - o Cell renewal samples showed 587 milligrams per liter (mg/L) lead
 - o A combined sample from the Main Sewer, Power Plant Blowdown, and Montrose Water showed <0.05 mg/L lead

Additional information regarding laboratory analyses can be found in Table IV-1 and V-1 of the 1970 report.

- Sometime between 1969 and 1975, Stauffer constructed a series of trenches in an area approximately 2,000 feet west of the BMI landfill. There is no documentation concerning disposal to these “slit trenches,” although anecdotal information (confirmed by field observation) indicates that the features were dug with a backhoe to depths of 15 to 20 feet. Wastes were deposited to approximately 10 feet below ground surface (bgs) and the trenches were then backfilled. Aerial photographs indicate that the trenches were closed in or about 1980.

Wastes generated by Stauffer have been categorized as follows:

Thiophenol/p-Chlorothiophenol Waste

The initial process wastes evaluated were generated by the thiophenol/p-chlorothiophenol process. That process generated phosphoric acid waste, caustic waste and process aqueous waste. The Stauffer Process Flow Diagram, Figure 4-2 of the ECA (B001717) indicates the origin of the waste streams. Their volume is defined on pages B001689-B001691. Phosphoric acid waste stream data were provided for the time period of 1960 to 1970. Those data were used to derive an average waste volume value for each year of production. Those data were used to make the calculations presented below. A further calculation was made that the total mass of the waste stream, including the organic phase, should be counted as non-volatile solids entering the BMI Ponds.

The quantity and composition of aqueous waste from thiophenol/p-chlorothiophenol production was reported in the ECA at B001691. The composition was reported as three percent “other,” interpreted as solids, and 97 percent water.

There are no data on the quantity of or dissolved solid content of the caustic stream generated by the process.

Trithio/Imidan Waste

The Trithio/Imidan waste streams are identified on B001697 as an organic waste, an aqueous waste and a dithio acid, identified previously as DTA. The quantity of aqueous waste was presented on B001698 as 24,700 Tons from the time period 1961-1974. These data were used to calculate the waste generated from the 1958-1975 production time frame.

The organic wastes were buried on-site in the Basic Magnesium Landfill.

The DTA wastes were produced from 1958 through 1975. Data exist which indicate that the waste stream volume was 2,259,000 pounds (B001699) from December 1977 through June 1978. These data were extrapolated to the entire production period.

Chlorine and Caustic Soda Waste

Chlorine and caustic soda were produced at the Magnesium Plant Site from 1942 through the present. While there are a number of waste streams from the process operations, only three were sent to the Basic Magnesium Ponds. In 1976, the chlor-alkali plant became a “zero-discharge” facility, meaning that all wastes were thereafter handled and stored on-site.

The first stream is brine sludge. This stream, shown on Figure 4-6 of the ECA (B001704) is generated from the purification of the brine fed to the electrolysis cells. The volume of the stream is presented in the ECA at B001741 as 113,000 Tons from the period 1946-1980. This value was adjusted for the 1946-1975 time frame.

The second waste from the process discharged to the BMI Ponds was the hypochlorite waste stream. According to Stauffer’s ECA (B001711), hypochlorite waste totaled 8,300 Tons during the 1963-1974 time frame. Extrapolating this value to the 1946-1975 time frame, combined with the concentration of solids in the stream as presented on B001742 produced a value for the waste stream to the BMI Ponds.

The third waste stream is sulfate slurry. This stream is generated by the removal of solids from the ~50 percent caustic soda solution produced in the caustic evaporation process. The destination of this stream in the post 1976 time frame was to CAPD Pond 6 (B001711). The volume of this stream is given at B001745 for the years 1983 and 1987. The sulfate concentration of seven percent is at B001711. The quantity of waste for 1983 and 1987 was used to calculate the production quantity for the entire production time frame at the concentration provided at B001711.

Calculated Waste Totals

Stauffer Chemical Company of Nevada/Pioneer Chlor Alkali Company, Inc.

Process Operation	Dates Operation Occurred (Years)	Volume of Waste (Tons)	TDS Concentration in Waste (Percent)	Volume of TDS Waste (Tons)	Distribution of Wastes	
					Upper Ponds (Jan. 1971- Dec. 1975)	Lower Ponds (May 1945- Dec. 1970)
thiophenol/ p-chlorothiophenol	1/60-12/75					
Phosphoric acid waste		19,636	~100%	0*	-	-
Aqueous process waste		1,206,400	3%	36,192	11,310	24,882
Caustic wastewater		No data			-	-
Trithion/Imidan	1/58-12/75					
Aqueous waste	1/58--12/74	29,992	10%	0**	-	-
Organic waste	Buried on site				-	-
Dithio acid salt	1/58-12/75 (18)	2,259,000 pounds produced from 12/77 to 6/78	27.35%	9,532	2,648	6,884
Chlor-alkali	1/46-12/75 (30)					
Brine sludge				519,842	86,640	433,202

Process Operation	Dates Operation Occurred (Years)	Volume of Waste (Tons)	TDS Concentration in Waste (Percent)	Volume of TDS Waste (Tons)	Distribution of Wastes	
					Upper Ponds (Jan. 1971- Dec. 1975)	Lower Ponds (May 1945- Dec. 1970)
Hypochlorite waste					-	-
Sulfate slurry					-	-
Fume scrubber					-	-
Total				565,566	100,598	464,968

“-” Signifies that this waste stream was not distributed to the Upper or Lower Ponds, or that data were not available.

* According to the Fahrenthold Supplemental and Rebuttal Expert Report, 19 April 2004, these wastes were sent to on-site trenches and pond, and were not distributed to the Upper or Lower Ponds.

** According to the Fahrenthold Supplemental and Rebuttal Expert Report, 19 April 2004, these wastes were sent to on-site leach beds, and were not distributed to the Upper or Lower ponds.

TIMET²⁵¹

TIMET provided detailed information regarding waste disposal to the BMI Common Areas in Section 5 of the TIMET ECA. To briefly summarize, the company discharged wastes to the:

- BMI Landfill
 - Wastes included combustible and non-combustible trash, sludge dryer residue, scrap titanium fines, magnesium cell smut, dust collectors residues, and chlorinator bed dump materials.²⁵²

²⁵¹ In addition to the cited sources, see Expert Report of Paul D. Fahrenthold, Ph. D., March 18, 2004, and Fahrenthold Supplemental and Rebuttal Expert Report, April 19, 2004.

²⁵² Henderson Steering Committee ECA, pp. 45-46. [B002513-514]

- BMI Ponds, 1951 to 1977
 - Wastes included leach liquor, caustic waste, and other process wastes. All discharges from the TIMET plant were commingled with other BMI facilities waste effluents and conveyed in unlined and lined channels to the BMI ponds.²⁵³
 - TIMET disposed of large quantities of its CSD solids in the “OPW” ponds located south of the Spray Wheel and capped this with soils scraped from the southern portions of the Spray Wheel.
 - TIMET Active Ponds, 1976 to 2005 – BMI conveyed to TIMET, property within the BMI Common Areas occupied by several rows of the Upper Ponds. TIMET regraded this property and constructed thereupon lined-evaporation ponds, into which it flowed effluent from its titanium manufacturing process from 1983 to 2005. In 2005, a wastewater treatment plant was constructed by TIMET and BRC within the TIMET plant, which allowed TIMET to terminate effluent discharge to the TIMET Active Ponds. These Ponds were formally taken out of service in June 2005, and the land reconveyed back to an affiliate of BMI.
 - TIMET Spray Wheel, 1983 to 1991 – BMI conveyed property within the BMI Common Areas occupied by a number of Upper and Lower Ponds, transected by the Beta Ditch. TIMET regraded this property and installed an evaporative agricultural-type “Spray Wheel” for the evaporative disposal of aqueous salt waste. The Spray Wheel was in operation from 1983 to 1991, after which it was permanently taken out of service, dismantled, and removed. The property was reconveyed by TIMET to an affiliate of BMI in 2005.

**United States Lime Corporation/ United States Lime Division of the Flinkote Company/
Genstar Corporation/Genstar Cement & Lime Company/Genstar Lime
Company/Chemstar Inc./Chemstar Lime Company²⁵⁴**

Chemstar identified three waste streams that have been discharged to the BMI Ponds:

- Hydrator start-up waste

²⁵³ TIMET ECA, p. 5-1. [B002895]

²⁵⁴ In addition to the cited sources, see Expert Report of Paul D. Fahrenthold, Ph. D., March 18, 2004, and Fahrenthold Supplemental and Rebuttal Expert Report, April 19, 2004.

- Hydration process waste
- Hydrator dust collector waste²⁵⁵

United States Vanadium Company

United States Vanadium Company reportedly disposed of wastes in the BMI Landfill. Types and volume of wastes are unknown.²⁵⁶

Western Electro Chemical/American Potash and Chemical/Kerr-McGee²⁵⁷

Kerr-McGee provided detailed information regarding waste disposal to the BMI Common Areas in Section 5 of the Kerr-McGee ECA. To briefly summarize, WECCO/AP&CC/Kerr-McGee disposed of wastes to the:

- BMI Landfill
 - Wastes included sodium chlorate filter cake, asbestos, elemental carbon powder, dried residues from cleaning of the Kerr-McGee surface impoundments, as well as materials such as paper, cartons, bags, pallets, drums, and plastics²⁵⁸
- Upper and Lower Ponds via the Beta Ditch
 - Chlorate (including sodium chlorate filter cake), perchlorate, and boron process wastes and related waste streams from cooling tower blowdown, boiler blowdown, and housekeeping washings (by Kerr-McGee, predecessors, and tenants) between 1945 and 1976²⁵⁹

In addition to Kerr-McGee's production facilities at the BMI complex, the U.S. Navy owned land and equipment required for the production of ammonium perchlorate. The Navy's ownership began in January 1954 and lasted until February 1962. The ECA for Kerr-McGee

²⁵⁵ See Chemstar ECA, Sections 4-5, pp. 18-66. [B002647-97]

²⁵⁶ Henderson Steering Committee ECA, p. 40. [B002508]

²⁵⁷ In addition to the cited sources, see Expert Report of Paul D. Fahrenthold, Ph. D., March 18, 2004, and Fahrenthold Supplemental and Rebuttal Expert Report, April 19, 2004.

²⁵⁸ KMCC ECA, pp. 7-8 and 7-9 [B002117-118]

²⁵⁹ KMCC ECA, pp. 5-66 [B002038] and 5-68 to 5-69. [B002040-2041] See also Section 7.

reports that during the Navy's period production of ammonium perchlorate, ammonium perchlorate wastes were discharged to the Basic Magnesium Ponds.²⁶⁰

2.4 CORPORATE SUCCESSION

The following section presents an overview of corporate succession from the founding of Basic Magnesium, Inc. to the present:

Basic Magnesium Incorporated

BRI was formed on May 29, 1931, as Basic Dolomite, Inc. an Ohio corporation. The company acquired the raw and clinkered dolomite business of Dolomite Inc. and of Basic Products Company.²⁶¹ On October 15, 1936, Basic Dolomite formed a subsidiary called Basic Ores, Inc., whose operations included mining brucite ore in Nye County, Nevada.²⁶² Basic Dolomite changed its name to BRI in March 1941.²⁶³

BRI changed its subsidiary's name from Basic Ores, Inc. to Basic Magnesium Inc. on November 14, 1941,²⁶⁴ and the parent company took over the former mining operations.

The authorized capital for Basic Magnesium was \$100,000, of which BRI owned 55 percent and MEL 45 percent.²⁶⁵ BRI transferred its magnesite holdings in Nye County in exchange for its 55 percent interest in Basic Magnesium. In exchange for its 45 percent interest in Basic Magnesium, MEL donated its technical skill and expertise and agreed to supply the "know how" for the construction and operation of the magnesium plant project.²⁶⁶ Subsequently, 2.5 percent of the interest held by BRI was transferred to George Thatcher.²⁶⁷

²⁶⁰ KMCC ECA, p. 7-6. [B002215]

²⁶¹ Basic Refractories, Inc., Corporate Background, n.d. NARA I, RG 46, Box 476, Folder: Basic Magnesium Corporate History. [BR032651-657]

²⁶² Articles of Incorporation of Basic Ores, Inc., October 15, 1936. Nevada Secretary of State. [BR039109]

²⁶³ Basic Refractories, Inc., Corporate Background, n.d. NARA I, RG 46, Box 476, Folder: Basic Magnesium Corporate History. [BR032651-657]

²⁶⁴ Certificate of Amendment to Articles of Incorporation, November 14, 1941. Nevada Secretary of State. [BR039125]

²⁶⁵ Dun & Bradstreet report, April 25, 1942. NARA I, RG 46, Box 476, Folder: Basic Magnesium Corporate History. [BR032668-675] Certificate of Amendment to Articles of Incorporation, November 14, 1941. Nevada Secretary of State. [BR039125] Officers, Directors, and Designation of Resident Agent, December 6, 1941. Nevada Secretary of State. [BR039131]

²⁶⁶ "Magnesium," circa 1943. NARA I, RG 46, Box 478, Folder: Las Vegas Basic Magnesium. [BR032509-561, @BR032536]

²⁶⁷ Investigation of Industrial Centralization (Basic Magnesium Plant), Hearings before a Special Committee, 78th Congress, Second Session, Part 5, November 27 and 28, 1944, p. 522. [BR038448]

When it became apparent to the U.S. government in mid-1942 that the operations of the magnesium plant could not succeed under the management of the existing Basic Magnesium Inc., the government approached the Anaconda Copper Company and implored them to take over the operations of Basic Magnesium. Anaconda evaluated the situation and on September 30, 1942, Basic Magnesium, BRI, MEL, and Anaconda reached an agreement.²⁶⁸ The DPC agreed to purchase the mining claims in Nye County for \$450,000 and Anaconda agreed to pay \$75,000 for 52,500 shares of Basic Magnesium stock.²⁶⁹

Anaconda purchased the MEL share holdings in Basic Magnesium in 1951. Anaconda dissolved Basic Magnesium Inc. in November 1974. The Anaconda Company was merged into a wholly-owned subsidiary of the Atlantic Richfield Company on January 12, 1977. Atlantic Richfield Company was purchased by the British Petroleum Company (BPC) in 1999.

Basic Management, Inc.

BMI was formed in 1952 for the purpose of providing utility and other services to companies in the BMI Complex. Basic Environmental Company LLC (BEC) is a limited liability company organized and existing under the laws of the State of Nevada. BEC was formed in March 1999. BEC owns property at issue within or near the BMI Complex. BMI's original shareholders were Stauffer, National Lead, Combined Metals Reduction Company, WECCO and U.S. Lime. BMI is the sole member of BEC.

BMI is a corporation organized and existing under the laws of the State of Nevada. BMI was previously known as Basic Investment Inc. (BII) and was formed in 1993 as a holding company for separate operations of several subsidiaries and/or affiliates (*i.e.*, BEC, The LandWell Company LP, BRC, Basic Land Company, Basic Water Company, and Basic Power Company). BII's original shareholders were Kerr-McGee, TIMET, Pioneer, and Chemical Lime Company of Arizona. In March 1999, BII's name was changed to BMI. In 2000, Pioneer Partners 2000, LLC succeeded to the shares owned by Pioneer. Treco, Inc. succeeded to TIMET's interest in BMI.

Chemstar Lime Company

United States Lime Products Corporation was formed in 1926. The company was purchased by Flintkote Company on June 30, 1958, and became the United States Lime Division of the

²⁶⁸ Agreed upon procedures, September 30, 1942. [YBD15102-106]

²⁶⁹ Excerpt from Minutes of Meeting of Board of Directors of Basic Rrefractories, October 20, 1942. [YBD15642-646]

Flinkote Company. The Genstar Corporation purchased Flintkote in December 1979. Genstar incorporated the Henderson lime plant into the Genstar Cement & Lime Company on July 22, 1981, and into Genstar Lime Company in October 1983. Imasco purchased the parent company, Genstar Corporation, in 1983. Imasco proceeded to sell off the production subsidiaries, and Chemical Lime Company of Forth Worth, Texas and Lime Holding Company purchased Genstar Lime Company on December 6, 1986. Genstar Lime Company changed its name to Chemstar, Inc. in 1986, and to Chemstar Lime Company in 1991.²⁷⁰

Kerr-McGee Chemical Corporation/Tronox LLC

WECCO was formed in 1941. American Potash and Chemical Company merged with WECCO in 1955. Kerr-McGee purchased American Potash and Chemical Company in 1967. In 2005, Kerr-McGee became Tronox LLC.

Montrose Chemical Corporation of California

Montrose was formed in 1946. The company still exists. Stauffer Management Company and Chris-Craft Industries, Inc. each own a 50 percent share in Montrose.²⁷¹

Stauffer Chemical Company of Nevada/Pioneer Chlor-Alkali Company, Inc.

Stauffer Chemical Company of Nevada (a Nevada corporation) was formed sometime prior to 1944, and was owned by Stauffer Chemical Company (a California corporation). Pioneer acquired Stauffer's chlor-alkali manufacturing facilities in October 1988.

TIMET

Titanium Metals Corporation, also known as TIMET was formed from a joint venture agreement between Allegheny Ludlum Steel Corporation and National Lead Company in 1950. TIMET still exists.

²⁷⁰ Chemstar Lime Company ECA, p. 13. [B002644]

²⁷¹ SEC Filing, Annual Report to Stockholders, March 23, 1990.

2.5 REGULATORY ACTIVITIES

2.5.1 Introduction

As described in Section 2.0, the BMI Complex has been the site of many industrial activities including production of magnesium, pesticides, other organic chemicals, titanium, acids, caustics, chlorine and rocket propellants.²⁷² From the 1940's until the 1970's, operating companies in the complex made extensive use of unlined evaporation ponds located adjacent to the plants in the BMI Common Areas.²⁷³ A landfill, reportedly on the site of the war-time Trade Effluent Ponds, accepted organic and inorganic wastes from the operating companies until it ceased operation in 1980.²⁷⁴ Much of this activity went unregulated until the advent of federal and state environmental laws in the 1970's.

In the early 1970's, under the federal National Pollutant Discharge Elimination System (NPDES) program, the industries at the Basic Magnesium Complex curtailed waste discharges to the Basic Magnesium ponds, and lined ponds were constructed by individual companies.²⁷⁵ Later in 1976, the operating companies discontinued the use of the original Lower and Upper ponds in compliance with zero discharge waste requirements.²⁷⁶ Beginning around this time, the USEPA and the NDEP began requiring regular environmental sampling at the Basic Magnesium Complex.²⁷⁷ This sampling resulted in various regulatory actions involving the operating companies and a three phase environmental investigatory process that continues today.

Both the USEPA and the NDEP have been active in environmental regulation of the Basic Magnesium Complex. The principal regulator has been the NDEP. The Bureaus of Water Pollution Control and Solid and Hazardous Waste Management, the Chemical Accident Prevention Program and the Bureau of Corrective Action in the NDEP provide the day-to-day regulation and permitting of environmental activities at the Basic Magnesium Complex. This has

²⁷² NDEP Memorandum "Environmental Studies at the BMI Complex, Henderson, Nevada, December 1998." [BR034398-34401]

²⁷³ Id.

²⁷⁴ Id.

²⁷⁵ Id.

²⁷⁶ Id.

²⁷⁷ Aerial Reconnaissance of Hazardous Waste and Pollution Sources – BMI Industrial Complex – Henderson, Nevada, 1943 – 1979. [B000001-50]

included overseeing of closure of liquid waste disposal ponds, addressing spills and releases and insuring that contaminated groundwater and soils are cleaned up.²⁷⁸

Beginning in 1990, NDEP initiated a three phase environmental investigation and corrective action program for each operating company and for the BMI Common Areas. NDEP entered into consent agreements with each operating company in 1991 covering the plant sites in the complex, and with all the operating companies covering the BMI Common Areas. Phase I, completed in 1993, was a data gathering activity that focused on historical information and liquid and solid waste management practices. The results of these investigations identified data gaps and areas requiring more intensive study during Phase II. Phase II, reflected in a second round of consent agreements, was intended to provide additional information and data and evaluation of remediation alternatives.²⁷⁹ Phase III (*i.e.*, the AOC3) will involve the remediation of the contaminated areas.

2.5.2 BMI Common Areas

The Phase I consent agreement for the BMI Common Areas originally included a definition of the “site” which included areas previously used for waste disposal plus other BMI properties beyond the commonly understood Basic Magnesium complex. BMI, which was not a party to this consent agreement, soon realized that the “site” definition was overly broad, and sought to exclude areas unaffected by waste disposal activities. In April 1992 the NDEP began excluding certain parcels from the 1991 Consent Agreement because they had not been used for waste disposal. These excluded properties include Victory Village, the Henderson Water Treatment Plant with associated easements, a section of Major Avenue, Opportunity Village,²⁸⁰ the BMI properties west of Interstate 95,²⁸¹ “the Storm Channel Easement” and portions of parcel 1A.²⁸² In addition, during the 1990s BMI performed corrective action on particular parcels, leading to NDEP issuance of NFA letters for areas 4A, 4B, 5, 6, 9 North, Warm Springs and Pabco Roads

²⁷⁸ NDEP Memorandum “Environmental Studies at the BMI Complex, Henderson, Nevada, December 1998.” [B018551-18554]

²⁷⁹ Environmental Conditions Investigation Report, BMI Common Areas, Henderson, Nevada (ERM-West, Inc., August 1996). [B011708-11952]

²⁸⁰ Letter from Robert Ritchey to Verne Ross, November 1, 1991, acknowledged by NDEP on January 23, 1992.

²⁸¹ Letter from Jeffrey Denison of NDEP to Mark Paris of BMI, June 19, 1992. [A000640]

²⁸² Letter from Robert Kelso to Gregory Schlink, November 2, 1993.

Right-of-Ways and the Pioneer Detention Basin, excluding them from the Consent Agreement and further remedial action.²⁸³

In 1993, the Henderson Industrial Site Steering Committee (HISSC), a coalition of Basic Magnesium Complex companies, conducted a Phase I investigation that included a review of existing documents and past practices. The results of this investigation were presented in its Phase I ECA, which was submitted to the NDEP in April 1993.²⁸⁴ Based upon its review of the Phase I ECA, the NDEP determined that a Phase II Environmental Conditions Investigation (ECI) was necessary. In an August 1994 Letter of Understanding (LOU), the NDEP identified several study items that, in its opinion, required additional study and investigation during the second phase.²⁸⁵ In February 1996, HISSC entered into a Phase II Consent Agreement, in which a work plan was submitted and approved by the NDEP.²⁸⁶

In 1996, HISSC completed a field investigation. These results were presented in August 1996 in a Draft ECI for the BMI Common Areas.²⁸⁷ Based on the draft ECI, the NDEP requested that HISSC conduct a RAS for the BMI Common Areas. NDEP approved the RAS work plan in July, 1999.

In December 1999, BMI and NDEP entered into a Liability Transfer and Assumption Agreement with the other HISSC parties.²⁸⁸ This agreement gave a BMI subsidiary – BRC – primary responsibility for the cleanup and remediation for soils in the BMI Common Areas. The agreement also gave BRC the power to be the primary negotiator with the NDEP with regard to the clean up of contaminated soil in the BMI Common Areas. In December 2002, a similar agreement was reached between BMI, Montrose, and NDEP with respect to groundwater contamination.

²⁸³ September 30, 1997, Letter from Allen Biaggi to Dan Stewart re: No Further Action for Exclusion Area 6 [A000694-98]; August 18, 1998, Letter from Allen Biaggi of NDEP to Dan Stewart of BMI re: No Further Action for Exclusion Area 5 [A000699]; October 6, 1998, Letter from Allen Biaggi of NDEP to Dan Stewart of BMI re: No Further Action on Pabco/Warm Springs Parcel 4c [A000519-520]; August 19, 1999, Letter from Allen Biaggi of NDEP to Crowley of BMI re: No Further Action for 12.692 acre parcel and 4.99 acre parcel [G006619-6620]

²⁸⁴ Phase I Environmental Conditions Assessment for the Basic Management, Inc. Industrial Complex (Geraghty & Miller, April, 1993). [B002294-2628]

²⁸⁵ NDEP Memorandum “Environmental Studies at the BMI Complex, Henderson, Nevada, December 1998.” [B018551-18554]

²⁸⁶ Consent Agreement between NDEP and BMI, et. al., dated February 23, 1996. [A000285-394]

²⁸⁷ Environmental Conditions Investigation Report, BMI Common Areas, Henderson, Nevada (ERM-West, Inc., August 1996). [B011708-11952]

²⁸⁸ The BMI et. al. Liability Transfer and Assumption Agreement, December 30, 1999. [BR049347-49363]

In 2000 and 2001, BMI submitted a draft RAS, a proposed Corrective Action Plan (CAP) and a Draft Closure Plan for the BMI Common Areas. NDEP issued a ROD for Soils in the BMI Common Areas in November 2001.²⁸⁹ In February 2003, NDEP, BRC and other parties executed the AOC3. All current submittals, including this Closure Plan, are being provided in response to the AOC3.

2.5.3 Pioneer Chlor Alkali Company and Stauffer Management Company

Soon after the USEPA and the NDEP began the requirement for environmental sampling at the BMI Complex, the NDEP issued an August 1979 Violation and Order against Stauffer for groundwater contamination.²⁹⁰ In February 1982 both the NDEP and the Clark County Health District requested data and information regarding environmental conditions at the Stauffer site. In 1983, Stauffer entered into a Consent Agreement with NDEP. In July 1984, the USEPA issued their findings of a Toxic Substances Control Act dioxin investigation.²⁹¹

Pioneer and Stauffer are parties to a 1991 Consent Agreement with the NDEP. Pioneer and Stauffer submitted their Phase I ECA in April 1993. Based upon the ECA, a LOU was executed with the NDEP in August 1994 that identified study areas at the Pioneer facility for further investigation. In a subsequent Consent Agreement, Pioneer and Stauffer agreed to conduct a Phase II ECI of the study areas.²⁹² Pioneer and Stauffer submitted its Phase II ECI in June 1996.²⁹³ In addition, Pioneer and Stauffer have submitted a number of documents to the NDEP regarding various supplemental Phase II environmental studies at the site.

2.5.4 Titanium Metals Corporation

The NDEP began requesting groundwater information from TIMET in 1982.²⁹⁴ The NDEP issued a Finding of Alleged Violation and Order against TIMET in December 1990.²⁹⁵ This was followed by the NDEP revoking TIMET's authority to discharge from their Spray Wheel in

²⁸⁹ Record of Decision, Remediation of Soils and Sediments in the Upper and Lower Ponds at the BMI Complex, Henderson, Nevada, November 2, 2001. [BR005787]

²⁹⁰ Letter from Marvin Tabeau of NDEP to James Wiseman of Stauffer, August 28, 1979. [ST090880]

²⁹¹ USEPA Preliminary TSCA Dioxin Investigation at BMI Complex, Henderson, Nevada, July 10, 1984. [C000784-846]

²⁹² Draft Phase I Environmental Conditions Assessment.

²⁹³ NDEP Memorandum "Environmental Studies at the BMI Complex, Henderson, Nevada, December 1998." [B018441-18554]

²⁹⁴ Id.

²⁹⁵ Letter from Joseph Livak of NDEP to Tom Buck of Timet, December 31 1990. [B021736-21749]

September 1991.²⁹⁶ TIMET also received a Notification of Penalties for Water Pollution Violation in December 1997.²⁹⁷

TIMET signed a Consent Agreement with the NDEP in 1991. TIMET submitted its Phase I ECA in April 1993.²⁹⁸ The NDEP issued a LOU in August 1994 that identified 54 study items at the TIMET facility. The Draft Phase II ECI Work Plan was submitted to the NDEP in June 1996, and the Final Phase II Consent Agreement was signed in June 1996.²⁹⁹ After review and comment, TIMET submitted its final ECI in February 1998.³⁰⁰ This was later approved with conditions in June 1998.³⁰¹ Phase II environmental studies continue at the site.

2.5.5 Kerr-McGee Chemical Corporation (Tronox)

Kerr-McGee signed a 1991 Consent Agreement with the NDEP. Based upon the information found in its Phase I ECA, which was submitted in April 1993, a LOU between Kerr-McGee and the NDEP was established in August 1994.³⁰²

Kerr-McGee signed Consent Agreement in August 1996 that defined the process required for additional study.³⁰³ Kerr-McGee's Work Plan, which included both field activities and file searches, was approved by the NDEP in August 1997.³⁰⁴ The NDEP later approved their Phase II ECI in June 1998 with conditions for further study. Kerr-McGee entered into another Consent Agreement with the NDEP in July 1999 that involved additional sampling toward the development of a RAS.³⁰⁵ Kerr-McGee (now Tronox) has also worked with the NDEP on

²⁹⁶ Letter from John Nelson of NDEP to R.J. Allinger of Timet, September 5, 1991. [B021662]

²⁹⁷ Letter from Joseph Livak of NDEP to John Sanderson of Timet, December 29, 1997. [G002748]

²⁹⁸ Titanium Metals Corporation Phase I Environmental Conditions Assessment, April 1993. [B002758-2984]

²⁹⁹ NDEP Memorandum "Environmental Studies at the BMI Complex, Henderson, Nevada, December 1998." [B018551-18554]

³⁰⁰ Draft Environmental Conditions Investigation Report, Titanium Metals Corporation Facility, Henderson, Nevada (Tetra Tech EM, Inc. February 20, 1998). [B013059-14214]

³⁰¹ NDEP Memorandum "Environmental Studies at the BMI Complex, Henderson, Nevada, December 1998." [B018551-18554]

³⁰² Letter of Understanding between NDEP and Kerr-McGee dated August 14, 1994.

³⁰³ Consent Agreement between Kerr McGee and NDEP dated June 28, 1996. [G013903-13915]

³⁰⁴ NDEP Memorandum "Environmental Studies at the BMI Complex, Henderson, Nevada, December 1998." [B018551-18554]

³⁰⁵ Consent Agreement between Kerr McGee and NDEP, July 26, 1999. [B021792-21884]

perchlorate issues, including a 1999 temporary permit to discharge perchlorate “seep.”³⁰⁶ Phase III remedial and Phase II environmental studies continue at the site.

2.5.6 Montrose Chemical Corporation

Montrose signed a 1991 Consent Agreement with the NDEP. Montrose submitted its Phase I ECA in April 1993.³⁰⁷ Montrose completed its Phase II ECI in August 1997, which covered issues regarding soil contamination at their property.³⁰⁸ Montrose, Pioneer and Stauffer are working jointly with regard to groundwater contamination. A joint report regarding groundwater was submitted to the NDEP in 1998.³⁰⁹ Phase II environmental studies continue at the site.

2.5.7 City of Henderson

The City of Henderson has been involved in many environmental issues regarding the Basic Magnesium Complex. In December 1990, Henderson entered into a LOU with the NDEP regarding contamination of the BMI Complex.³¹⁰ In March 1992, the NDEP issued a violation against Henderson’s wastewater discharge permit.³¹¹ Later that year Henderson entered into an environmental monitoring agreement with BMI.³¹² In June 2001, Henderson was involved in selecting alternative 4B of the RAS for the BMI Common Areas.³¹³

BMI Complex Regulatory Timeline

Date	Action
1972-1973	Under the NPDES program, the industries at BMI curtailed waste discharges to the BMI ponds; lined ponds were constructed by individual companies.
1976	Industries at BMI discontinued the use of the original lower and upper ponds in compliance with zero discharge waste requirements.

³⁰⁶ Letter from Catherine Pool of NDEP to Patrick Corbett of Kerr McGee, November 10, 1999. [G014288-14306]

³⁰⁷ Montrose Chemical Company Phase II Environmental Conditions Assessment, August 11, 1997. [B011953-13058]

³⁰⁸ NDEP Memorandum “Environmental Studies at the BMI Complex, Henderson, Nevada, December 1998.” [B018551-18554]

³⁰⁹ Id.

³¹⁰ Id.

³¹¹ Letter from Joseph Livak of NDEP to Philip Speight of the City of Henderson, March 20, 1992. [A000773-778]

³¹² Monitoring Agreement between the City of Henderson and BMI, December 15, 1992. [B015287-15302]

³¹³ Letter from Monica Simmons of City of Henderson to Alan Biaggi of NDEP, June 14, 2001. [BR005661]

Date	Action
May 1979 – September 1989	USEPA conducts sampling at complex.
August 1979	NDEP issues Violation and Order against Stauffer for organic pollutants found in the groundwater [C000458-460].
March 1980	USEPA requests hazardous waste records for BMI complex [C000482-499].
July 1980	USEPA issues report of hazardous waste and pollution sources at BMI complex [BR001884-1939].
August 1980	USEPA conducts a site inspection of the BMI complex [C000622-631].
June 1981	USEPA issues findings of its “Henderson Industrial Complex Hazardous Waste Investigation” [C001645-1774].
February 1982	NDEP issues order requesting data and information from BMI complex [C000667-670]. Clark County Health District requests asbestos information from Stauffer [A000963-964].
May 1982	NDEP issues order requesting TIMET produce data regarding groundwater.
June 1982	NDEP begins sampling at BMI complex [ST032143-32161].
June 1983	Stauffer enters Consent Agreement with NDEP.
July 1984	USEPA issues findings of TSCA Dioxin Investigation of Stauffer and Montrose [C000784-846].
September 1987	Montrose submits Closure/Post Closure Plan for RCRA ponds [C002068-2095].
December 1990	LOU between NDEP and the City of Henderson regarding BMI contamination [A000942-950]. NDEP issues Finding of Alleged Violation and Order to TIMET for “unlawful discharge of a pollutant without a permit” [B021736-21749].
January 1991	NDEP stays previous order against TIMET.
April 1991	Consent Agreement with NDEP and HISSC companies [A000039-79].

Date	Action
September 1991	NDEP revokes TIMET's authority to discharge from Spray Wheel [B021662].
March 1992	Phase I ECA submitted for BMI Common Areas. NDEP issues a violation to The City of Henderson's wastewater discharge permit [A000773-778].
June 1992	NDEP agrees to exclude BMI properties west of Interstate 95 from the 1991 Consent Agreement [A000640].
January 1992	NDEP agrees to exclude Victory Village, the Henderson Water Treatment Plant and associated easements, a section of Major Avenue and Opportunity Village from the 1991 Consent Agreement.
December 1992	Monitoring Agreement entered into between the City of Henderson and BMI [B015287-15292].
April 1993	Phase I ECA's submitted for Stauffer [B001646-1841], Chemstar Lime [B002629-2713], Kerr-McGee [B001842-2293], Montrose [B002301-2459] and TIMET [B002758-3191].
May 1993	LOU between NDEP and Chemstar regarding environmental assessment activities [A001013-1015].
June 1993	LOU between NDEP and TIMET regarding assessment/remediation activities [A000191-203].
November 1993	NDEP holds a public hearing regarding the ECA for BMI Common Areas [NDEP0003281-3282]. NDEP agrees to exclude the Storm Channel Easement and parts of parcel 1A.
August 1994	NDEP identifies items requiring additional study during the Phase II investigation in LOU with Pioneer and Stauffer. NDEP identifies items requiring additional study during the Phase II investigation in the LOU with TIMET. NDEP identifies items requiring additional study during the Phase II investigation in the LOU with Kerr-McGee [ST039340-39351].
February 1996	Phase II Consent Agreement with HISSC companies [A000284-394].
March 1996	NDEP holds public hearing regarding Phase II Consent Agreement [A000105-142].

Date	Action
June 1996	Phase II ECI submitted for Stauffer [ST047243-47865]. Final Phase II Consent Agreement between NDEP and TIMET [B021792-21884].
July 1996	Phase II Consent Agreement between Kerr-McGee and NDEP [G003514-3515].
August 1996	Phase II ECI for BMI Common Areas submitted to NDEP [B020361-20605] Phase II Consent Agreement between NDEP and Kerr-McGee [G003380-3483].
March 1997	NDEP determines soil characterization in ECI for BMI Common Areas is complete [A001218-1219].
April 1997	NDEP approves Kerr-McGee Work Plan [G003559-3562]
December 1997	NDEP approves RAS work plan for BMI Common Areas [B019962-19963]. NDEP issues Notification of Penalties for Water Pollution Violation against TIMET [G002748].
August 1997	Montrose submits Phase II ECI to NDEP [B011953-13058]. Kerr-McGee submits Phase II ECI to NDEP [B008447-9113].
September 1997	NDEP issues NFAD for Exclusion Area 6 [A000894-900]
February 1998	TIMET submits Phase II ECI to NDEP [B013226-14214]
May 1998	Consent Decree entered in Clark County, Nevada, District Court between NDEP and TIMET [G002697-2699].
June 1998	NDEP approves final Phase II ECI Report with TIMET [NDEP0003084-3090]. NDEP approves final Phase II ECI Report with Kerr-McGee.
August 1998	NDEP issues NFAD for Exclusion Area 5 [A000487-488].
October 1998	NDEP issues NFAD for Warm Springs and Pabco Roads Right-of-Ways [A000519-520].
December 1998	NDEP holds public hearing regarding Phase II ECI investigation for BMI Common Areas [B019551-19554].

Date	Action
July 1999	NDEP issues NFAD to Pioneer for the Pioneer Detention Basin [G006608-6609]. Consent Agreement entered into between NDEP and Kerr-McGee [G013903-13915].
August 1999	NDEP issues NFAD to Kerr-McGee for a 12.692 acre portion of Section 13 and a 4.99 acre portion of Section 12 [G006619-6620].
November 1999	NDEP issues temporary permit for the discharge of perchlorate treated “seep” to Kerr-McGee [G014288-14306].
December 1999	Liability Transfer and Assumption Agreement between BMI <i>et al.</i> (Soils) [BR049347-49363]
January 2000	RAP, Permit for CAMU for BMI Common Areas is submitted to NDEP [G003048-3283].
March 2000	RAS for Soils for BMI Common Areas submitted to NDEP [S003093-3275]. NDEP issues NFAD for Nevada Power Substation Property [BR055966-55976].
April 2000	NDEP holds a public hearing regarding the RAS for BMI Common Areas [BR035143].
June 2000	Presentation of CAP for BMI Common Areas [BR005615-5641].
June 2001	City of Henderson approves Alternative 4B of the RAS [BR005661].
February 2001	BMI submits Site Closure Plan to NDEP (revised July 2001 [S000540-711].
November 2001	NDEP issues ROD for Soils at BMI Common Areas [BR005787-5853].
February 2002	NDEP issues Draft Closure Plan for BMI Common Areas [S0045535620].
December 2002	Liability Transfer and Assumption Agreement between BMI <i>et al.</i> (Groundwater) [BR049507-49515].
August 2003	NDEP proposes Phase III Administrative Order on Consent [BR052900-52791].
February 2006	NDEP, BRC, and others execute the AOC3.
September 2006	NDEP approves BRC’s <i>Corrective Action Plan</i>

SECTION 2 REFERENCES

Primary Sources:

Archival, Corporate, and Agency Records

- “Leases” in Office Memorandum, Liquidation of the Colorado River Commission Activities at the Basic Magnesium Project, January 26, 1953.
- “Magnesium,” circa 1943. NARA I, RG 46, Box 478, Folder: Las Vegas Basic Magnesium.
- A Chronological History of Basic Magnesium, November 16, 1944. Anaconda Document Collection, American Heritage Center, University of Wyoming.
- A.E. Jones to Acting Chief, Industrial Planning Section, June 30, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- A.T Newell to R.J. Moore, March 7, 1952.
- Agreed upon procedures, September 30, 1942.
- Agreement between DPC and J.M. Montgomery, May 14, 1945.
- Agreement of Sale, CRC to BMI, May 23, 1952.
- Agreement, August 1, 1941. NARA II, RG 72, Entry 147, Box 13, Folder: Basic Magnesium.
- Agreement, May 14, 1945. NARA II, RG 72, Entry 147, Box 13, Folder: Basic Magnesium Plancor 201.
- Appraisal of US Naval Industrial Reserve Plant (DOD 473 and DOD 217), October 31, 1958. NARA San Bruno, RG 121, Box 22, Folder: N-Nev-5-415 US Naval Industrial Reserve Plant (DOD 473 and DOD 217).
- Articles of Incorporation of Basic Ores, Inc., October 15, 1936 and subsequent amendments. Nevada Secretary of State.
- Assignment of Lease. NARA San Bruno, RG 291, Real Property Files, Box 1, Folder: Nev-5, Inspection of Leases.
- Basic Refractories, Inc., Corporate Background, n.d. NARA I, RG 46, Box 476, Folder: Basic Magnesium Corporate History.

- C.E. Weed to J.R. Hobbins, August 17, 1942.
- C.E. Weed to Reno Sales, September 19, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming.
- C.E. Weed to Reno Sales, September 28, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming.
- C.J.P. Ball, to H.P. Eells, June 23, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Chronological List of OPM Press Releases on Magnesium. NARA I, RG 46, Box 474, Folder: WPB Magnesium.
- Cost-Plus-A-Fixed-Fee Property Protection and Maintenance Contract, November 29, 1946. NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 12.
- D.A. Graham, Notes on Basic Magnesium, September 11, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- D.W. Stewart to Assistant Chief of Material Division, August 1, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Deed of Conveyance, October 26, 1953. NARA San Bruno, RG 121, Box 23, Folder: N-Nev-5-415 US Naval Industrial Reserve Plant (DOD 473 and DOD 217).
- Deed of Trust, March 15, 1962.
- Dun & Bradstreet report, April 25, 1942. NARA I, RG 46, Box 476, Folder: Basic Magnesium Corporate History.
- E.H. Clary, History of Civil Engineering, October 21, 1944. UNLV Special Collections, T-22.
- E.K. Merritt to Industrial Planning Officer, February 6, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Edgar Lewis to W.F. Vollandt, September 20, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.

- Eells to Assistant Chief, Materials Division, May 22, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Elmo L. Buttle, Chief, Surplus Real Property Division, October 5, 1953.
- Engineer's Final Report, n.d. NARA II, RG 234, Entry 146, Box 114, Folder: DPC Engineers Reports and Appendices, Plancor 201.
- FDR Speech, December 29, 1940.
- Final Engineer's Report, Part "C" – Historical. NARA II, RG 234, Entry 146, Box 114, Folder: DPC Engineers Reports and Appendices.
- Fred Johnston to Chief, Real Property Division, November 25, 1966.
- Frederick Hopkins to Chief, Industrial Planning Section, June 10, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Frederick Laist to J.R. Hobbins, August 16, 1942.
- G.D. Carrington, July 3, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- G.D. Carrington, July 6, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- H.P. Eells to P. Schneeberger, August 1, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- H.P. Eells to P. Schneeberger, August 15, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- H.P. Eells to P. Schneebergr, September 3, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Hearing of the Sub-committee on Light Metals and Aviation of the Special Committee Investigating the War Program, Held in the Office of Mr. F. O. Case, General Manager Basic Magnesium on May 11, 1943 at 2:30 P.M.
- Imperial Chemical Industries to J.R. Hobbins, July 12, 1945.
- Industrial Utilization Study and Facilities Appraisal Report, Volume 1, October 1, 1947

- Information from Memorandum John R. Reilly to Irving Gumbel, July 15, 1947.
- Information from WAA, Proposal of USVC lease, February 28, 1946.
- Information from WAA, Washington Credit Division Report, April 30, 1948.
- Inter-Office Correspondence, from George R. Stewart to J.F. Orr, September 24, 1957.
- Inter-Office Memorandum to Chief Patent Liaison Office, June 16, 1941 and attached list of patents. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Investigation of Industrial Centralization (Basic Magnesium Plant), Hearings before a Special Committee, 78th Congress, Second Session, Part 5, November 27 and 28, 1944, pp. 457-458, containing text of letter from H.G. Satterthwaite to F.O. Case, November 23, 1944.
- J.A. Westphal and W.E. Nork, "Reconnaissance Analysis of Effects of Waste Water Discharge on the Shallow Groundwater Flow System Lower Las Vegas Valley Nevada," April 1972.
- Jesse Bowling to G.H. Moriarty, December 3, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- John R. Reilly to Irving Gumbo, December 10, 1947.
- John W. Synder, Executive Vice President, DPC, to Major J.L. Bowling, December 2. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- L.A. Kelly, Counsel, Office of Defense Plants, Memorandum Accompanying SPB-5. Army Corps of Engineers, Sacramento.
- Lease and Option Agreements attached to Richard H. Greenburg, Regional Comptroller, GSA, to Robert J. Moore, BMI, January 30, 1953.
- Letter agreement, April 9, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Letter of Intent, March 17, 1948.
- Letter to C.F. Kelley, September 5, 1942.
- Letter to Colorado River Commission, October 7, 1947. NARA, San Bruno, RG 269, Box 21, Basic Magnesium Case Files, Folder: Board Memoranda Plancor 201, (1 of 3).

- Letter to Regional Director, GSA, January 18, 1954. NARA San Bruno, RG 121, Box 4, Folder: R-Nev-5, Basic Magnesium, WECCO General through Final Disposition.
- Letter to W.L. Drager, DPC, September 23, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Magnesium Project, BRI, April 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Map, Basic Magnesium Site and Vicinity, U-41, Issue No. 6, August 24, 1944. [NARA, San Bruno, RG 121, WAA Property Disposal Records, Box 13] See also F. McComthe to Cliff Young, June 15, 1956.
- Memorandum of Conference, July 24, 1941. UNLV Special Collections, T-6.
- Memorandum of Understanding, November 8, 1946. Army Corps of Engineers, Sacramento.
- Memorandum Summarizing Various ideas respecting the Basic Magnesium setup, September 1, 1942.
- Metallurgical Operations at Basic Magnesium Inc. April 23, 1942, p. 1. NARA II, RG 234, Entry 1065, Box 102, Metals Reserve Company Contract File 1940-1955.
- Minutes of Meeting of Board of Directors of Basic Refractories, October 20, 1942.
- Montgomery Research, Inc., Stauffer Chemical Company Industrial Waste Survey, November 1970.
- Monthly Report of Status of Lessees for October 1947. NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11.
- P. Scheeberger to D.W. Stewart, BRI, July 23, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- P. Schneeberger to Basic Refractories, June 9, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- P. Schneeberger to Chief, Facilities Section, Materiel Division, August 13, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.

- P. Schneeberger to Chief, Facilities Section, Materiel Division, September 13, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- P. Schneeberger to Chief, Facilities Section, October 7, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- P. Schneeberger to Chief, Patent Liaison Branch, May 28, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- P. Schneeberger, Notes on Basic Magnesium, November 10, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- P.G. Spilsbury to J.R. Hobbins, August 5, 1942.
- Paul Harrison to Donn Sutton, February 12, 1942. NARA I, RG 46, Box 477, Folder: Basic Magnesium Notes.
- Personnel, Salaried Employees, Defense Plant Corporation, as of October 12, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming.
- Press Release, RFC 1679, October 26, 1942. NARA I, RG 46, Box 473, Folder: Basic Magnesium D.P.S. Files Rev.
- PS, Notes of Basic Refractories, June 12, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- PS, Notes on Basic Refractories, May 21, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Quitclaim Deed, June 3, 1949. Army Corps of Engineers, Sacramento.
- R.B. Caples, Memorandum of Visit with Mr. Howard P. Eells, Jr. at Cleveland, Ohio, September 1st and 2nd, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming.
- Ray Pavey to GSA, August 31, 1954.
- Reno Sales Memorandum to C.E. Weed, August 17, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming.

- Report on Magnesium, p. 8, July 24, 1943. NARA I, RG 46, Box 469, Folder: (General) Magnesium Correspondence.
- Reuben T. Carlson, DPC to Marvin Braverman, April 24, 1942. NARA II, RG 234, Entry 1065, Box 102, Metals Reserve Company Contract File 1940-1955.
- Richard Greenburg, GSA, to Robert Moore, BMI, January 30, 1953.
- Robert B. Bradford to Deputy Regional Director, Public Building Service, April 25, 1956.
- Robert Patterson to DPC, August 4, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Roy E. Thomas, Chief Engineer, April 30, 1945. UNLV Special Collections, T-6.
- S.J. Fletcher, Neutralization of Effluent Liquor, March 13, 1942. UNLV Special Collections, T-6.
- S.P. Brown, Notes on Basic Magnesium, July 8, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Sales Brochure, Plancor 201. n.d.
- Satterthwaite to R.B. Caples, Manager, ACMC, Great Falls, MT, April 17, 1943. Anaconda Document Collection, American Heritage Center, University of Wyoming.
- SEC Filing, Annual Report to Stockholders, March 23, 1990.
- State Industries to H. LaVerne Rosse, May 18, 1982.
- State Industries to W.M. Tebeau, March 23, 1982.
- Telegram, Industrial Planning Section, June 12, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Telegraph, Weber to H.P. Eells, May 23, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Teletype Message P. Schneeberger to Col. F.M. Hopkins, July 2, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Transmittal of Notes, Deeds and Leases Assigned to GSA, January 28, 1953.

- Truman Committee findings. NARA I, RG 46, Box 478, Folder: Las Vegas Basic Magnesium.
- W.H. Hoover, General Counsel to Richard Inglis, Hauxhurst, Inglis, Sharp & Cull, October 19, 1942.
- W.L. Drager to Basic Magnesium, October 31, 1941. UNLV Special Collections, T-6.
- WAA, Washington Credit Division Report, April 30, 1948,
- War Department Memo # 231, April 23, 1941. UNLV Special Collections, T-6.
- War Department Memo # 255, May 17, 1941. UNLV Special Collections, T-6.
- Wilbur Jurden, Chief Engineer, Anaconda, to Major J.L Bowling, Production Division, DPC, April 21, 1943. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.

Phase I Environmental Conditions Reports

- Chemstar Lime Company
- Henderson Steering Committee
- Kerr-McGee Chemical Corporation
- Pioneer Chlor Alkali Company, Stauffer Management Company
- Titanium Metals Corporation

Expert Reports

- Expert Report of Clifford B. Wilson on Wastes Produced by Basic Magnesium, Inc., March 18, 2004.
- Supplemental and Rebuttal Expert Report, Clifford B. Wilson on Wastes Produced by Basic Magnesium, Inc., April 19, 2004.
- Expert Report of Paul D. Fahrenthold, Ph. D., March 18, 2004.
- Supplemental and Rebuttal Expert Report, Paul D. Fahrenthold, Ph. D., April 19, 2004.

- Expert Report of Julie A. Corley on United States Government and the Anaconda Copper Mining Company Involvement with the Basic Magnesium Complex, March 19, 2004.
- Supplemental Expert Report of Julie A. Corley on United States Government and the Anaconda Copper Mining Company Involvement with the Basic Magnesium Complex, April 19, 2004.

Secondary Sources:

Journal and Newspaper Articles

- “ACM Acquires Interest in Basic Magnesium Inc.” *Great Falls Tribune*, October 27, 1942.
- Engineering and Mining Journal, October 1943, p. 66.
- K. K. Kelly, *Energy requirements and Equilibria in the Dehydration, Hydrolysis, and Decomposition of Magnesium Chloride*, technical paper 676, U.S. Dept. of Interior, Bureau of Mines, Washington, D. C., 1945.
- Kh. L Strelets, *Electrolytic Production of Magnesium*, TT76-50003, U.S. Dept. of Commerce, Technical Information Service, Springfield, Va., translated by J. Schmorak, Keter Publishing House Jerusalem Ltd., 1977
- Reference document submitted by the Experts of the European Community and Member States of the European Union on best available techniques (BAT) and best environmental practices (BEP) for reducing and/or eliminating emissions of by-products Persistent Organic Pollutants (POPs) to the First Session of the UNEP Expert Group on BAT and BEP, 10-14 March 2003.
- Zero Toxics, Sources of by-product POPs and their Elimination, Darryl Luscombe and Pat Costner, Greenpeace International Toxics Campaign, May 2001, p. 14-15.

SECTION 3

3 SITE RELATED CHEMICALS LIST

Based on a thorough review of the various chemicals (including likely by-products and degradation products) produced, used, handled, generated, or disposed by the manufacturing companies and BMI, BRC has, with the NDEP's oversight, created a comprehensive Site Related Chemicals (SRC) List for the BMI Common Areas. In creating this list, BRC considered:

- All historical uses at the Site;
- The multiplicity of plant source processes and chemicals that have or may have been discharged into the ponds via the conveyance ditches;
- The lack of certainty and specificity of these discharges into known ditches and ponds; and
- Anticipated future uses.

The SRC submittal (BRC Common Areas Site Related Chemicals Tables, 2006) documents the information used in the development of the SRC list, including the lists themselves. Table 3-1 contains the broad suite analytical list for the project, based on the SRC list. This analytical program (or appropriate subsets, based on the NDEP's approval) will be applied to all characterization and confirmation sampling conducted as part of Closure of this Site.

It should be noted that on-going investigations are currently being performed by various companies associated with historical operations at the BMI Complex under the NDEP's supervision. If those investigations identify additional SRCs that might have been discharged to the Upper and Lower Ponds and Ditches, the analytical program and the SRC list itself will be updated as needed to include additional chemicals. Conversely, if investigations show that some chemicals do not occur at the Site, they may be removed, with the NDEP's permission. Or, if subsequent sampling and analysis demonstrates to the NDEP's satisfaction that certain analytical suites can be eliminated without adversely affecting risk assessment reliability, those suites may be eliminated from the analytical program.

As later discussed in Section 9, it is permissible following USEPA's current guidance to eliminate various chemicals from the SRC list, leaving a smaller number of chemicals of potential concern (COPCs) that are analyzed and used in risk assessments. BRC expects that some number of the analytes in the SRC list will be eliminated for risk assessment purposes (*i.e.*,

not be carried over as COPCs) in accordance with this guidance as the project progresses. The selection of COPCs is a function of the risk assessment process. COPC selection will not be conducted prior to initiating a sub-area-specific risk assessment.

SECTION 4

4 SITE-WIDE CONCEPTUAL SITE MODEL OVERVIEW

This section of the Closure Plan presents an overview of the CSM for the Eastside Area and the CSM for the CAMU Area of the Site. The Site boundaries were set and are described by the AOC3. A history of the Site and adjacent industrial plants situated to the southwest is provided in Section 2 of this plan.

Pursuant to the Scope of Work set forth in the AOC3, two comprehensive and detailed CSMs for the Site are to be prepared as separate stand-alone reports. These stand-alone CSMs are for the Eastside Area and for the CAMU Area (as further defined, below). The CAMU Area CSM was submitted to the NDEP in February 2007 and BRC has received requests for certain additional data in this regard from the NDEP. The Eastside Area CSM is under development and will be submitted to the NDEP after various current investigations are implemented and the data thereby collected and incorporated. Both CSMs will be “living documents” and will be updated periodically as new data are collected and analyzed.

The American Society for Testing and Materials (ASTM) guidance E 1689-95, *Standard Guide for Developing Conceptual Site Models for Contaminated Sites* (2003) states the basic activities associated with the development of a CSM, and these include:

- Brief Site Summary
- Site Description, including a description of the limits of the study area
- Source Characterization
- Background Levels for each media of interest
- Migration Pathway Descriptions
- Environmental Receptor Identification
- Discussion of Data Gaps
- Maps, Tables, and Figures

The activities called for in the ASTM guidance are summarized in this section of the Closure Plan.

4.1 SITE SUMMARY

The area known as the “BMI Common Areas” is delineated in Appendix A of the AOC3. The subject Site is near the BMI Industrial Complex, in Clark County, Nevada, approximately 13 miles south of the city of Las Vegas and approximately two miles northeast of the City of Henderson (Figure 2-1). The total extent of the Site, including the Eastside Area (Figure 1-2) and the CAMU Area (Figure 1-3), as delineated in Appendix A of the AOC3, is discussed in Section 1 of this Closure Plan. The Eastside Area (including relevant portions of Parcel 9) covers approximately 2,321 contiguous acres, and the CAMU Area covers approximately 114 acres. The Eastside Area lies to the east of Boulder Highway (except for Parcel 9, which is adjoining and to the west of Boulder Highway) and to the north of Lake Mead Parkway and consists of:

- Land on which unlined wastewater effluent evaporation/infiltration ponds (and associated conveyance ditches) were built and into which various plant wastewaters were discharged from 1942 through 1976;
- Land on which effluent from the TIMET plant was disposed through the use of a spray irrigation wheel;
- Land on which lined wastewater effluent ponds were constructed and into which effluent from the TIMET plant was discharged from 1976 to 2005;
- Land on which the City of Henderson constructed municipal wastewater infiltration basins (*e.g.*, the Southern RIBs);
- Land on which unlined wastewater effluent ponds were constructed but which were never used; and,
- Land that has remained desert.

The CAMU Area consists primarily of land which contains:

- The closed BMI Landfill;
- Land on and under which Stauffer constructed a line of groundwater extraction wells and their associated piping, treatment, and reinjection apparatus;

- Land across which traversed the former Western Ditch that carried effluent from the Plants to the Western Ditch Extension and from there towards the Las Vegas Wash;
- A series of trenches (the "Slit Trenches") into which various wastes and trash were deposited; and,
- Land that appears to have had no historical use.

The CAMU Area will continue to be used as a waste disposal facility. The Eastside Area will be redeveloped to a mixed use, including residential use, in accordance with a master plan.

4.1.1 Site Description

The Site represents a portion of the property known as the BMI Common Areas. The total extent of the property is approximately 2,435 acres and is comprised of: 1) the Eastside Area of approximately 2,321 contiguous acres located east of Boulder Highway and including Parcel 9 (Figure 1-2) and, 2) the CAMU Area of approximately 114 acres (within the 369 acre Parcel 5/6) to the west of Boulder Highway (Figure 1-3). The Site contained a network of ditches, canals, flumes, and unlined ponds that were used for the disposal of aqueous waste from the original magnesium plant and, later, other industrial plants and the municipality adjacent to it. The ponds are sometimes referred to as the "BMI Ponds" or the "evaporation ponds of the BMI Common Areas" or the "Upper Ponds" and "Lower Ponds." The Lower Ponds are topographically lower and located to the north; the Upper Ponds are topographically higher and located to the south. This disposal network comprised less than half of the Site.

This overview of the CSMs describes:

- The entire 2,321 acres of the Eastside Area, bounded on the south by Lake Mead Parkway, on the west by Boulder Highway (except for Parcel 9) and the community of Pittman, and on the north by the Tuscany and Weston Hills communities; and
- The 114 acres which comprises the CAMU Area within the footprint of the property located east of Eastgate Road, west of 4th Street, approximately 1400 feet south of West Warm Springs Road, and north of the properties operated by Pioneer, Stauffer, and Montrose.

Effluent wastes discharged to the ponds of the BMI Common Areas from the war-time Basic Magnesium operations can be characterized as salts from the production process (chloride salts of a variety of metals and radionuclides); organic solids; and inorganic solids and dissolved

components of various types. Chlorinated organic chemicals were included in the effluent. Notable processes that contributed to the waste stream from the plants that succeeded Basic Magnesium included effluents from the manufacture of the following types of products: chlorine and sodium hydroxide (caustic soda); a variety of chlorate, perchlorate compounds, and halogenated boron compounds; manganese dioxide; titanium and related compounds; and a variety of pesticides. Among these wastes were salts; organic and inorganic chemicals; and metals. A more detailed description of these processes and their effluents is found in Section 2. An overview of the contaminants now found on Site is also found below in Section 4.2, "Source Characterization."

Due to the size of the Site and its various historical, present, and prospective uses, BRC has subdivided the 2,321 acre Eastside Area into sub-areas. The rationale for this subdivision is to divide the Site into sub-areas in which acreages of reasonably similar geography, geology, past use, and future use are grouped together. By dividing the Site into various sub-areas, the Site restoration and reclamation can be more focused, and thus achieved in a more precise, cost effective and timely manner. Figure 1-2 depicts the sub-areas that are the focus of this CSM summary for the Eastside Area. These Eastside Area sub-areas are:

- Western Hook (227 acres);
- Trails & Recreation sub-area (151.4 acres);
- City of Henderson WRF Expansion (101.3 acres);
- Galleria North (135.6 acres);
- Sunset North Commercial (57.9 acres);
- Upper Ponds (284.5 acres);
- Spray Wheel (128.7 acres);
- TIMET Ponds (209.9 acres);
- First Eight Rows (208.2 acres);
- Mohawk (49.2 acres);
- Southern RIBs (245.1 acres); and

- No-Further-Action (NFA) Areas (522.2 acres).

With two exceptions (the City of Henderson WRF sub-area and the sub-area named NFA Areas), the sub-areas listed above are included in the Closure Plan as it addresses impacts to soils. The City of Henderson has received a NFA determination from the NDEP for its City of Henderson WRF Expansion sub-area relative to soil impacts, and the owner of the NFA Areas sub-area has received NFA determinations for this sub-area relative to soil impacts.

As noted, all of the Eastside Area sub-areas are planned for redevelopment according to a mixed-use master plan, which will include above- and below-ground utilities (potable water, sewerage, power, gas), roadways, trails, parks, homes, schools, shops, and municipal buildings. Some of the Eastside Area sub-areas will be primarily residential (*e.g.*, Mohawk), some will be primarily commercial (*e.g.*, Sunset North Commercial), one will be exclusively dedicated to trails and parks (*i.e.*, Trails & Recreation sub-area), and some will be a mixture (*e.g.*, Southern RIBs).

Figure 1-3 depicts the sub-areas that are the focus of this CSM summary for the CAMU Area. These CAMU Area sub-areas are:

- Eastern W. Ditch (6.1 acres);
- Northern Landfill Lobe (51.7 acres);
- Northern Lobe of the Borrow Area (9.3 acres);
- Slit Trench Area (27.7 acres);
- Southern Landfill Lobe (8.2 acres);
- Southern Lobe of the Borrow Area (8.5 acres); and
- Western W. Ditch (2.3 acres).

As mentioned above, it is anticipated that the CAMU Area will continue use as a waste disposal area.

All of the sub-areas listed above, including the two in the Eastside Area excluded from the Closure Plan relative to soil impacts, are covered by the AOC3 and are included in the Closure Plan for groundwater impacts.

4.1.2 Geology

4.1.2.1 Regional Geology

Southern Nevada regional geology is typical of the Basin and Range Province morphology of the Western Cordillera of North America. In this region, Cenozoic tectonic extension has resulted in one of the world's most extensive systems of fault-bounded mountains separated by sediment-filled valleys, extending across Idaho, Oregon, Nevada, Utah, Arizona, New Mexico, California, and northern Mexico.

The Basin and Range Province is typified by elongated north-south-trending arid valleys bounded by mountain ranges that also bound adjacent valleys. Basins consist of down-dropped blocks of crust, and the ranges are upthrust slabs with a regional tilt to the east. The normal arrangement in the Basin and Range system is that each valley is bounded on each side by a normal fault that runs parallel to the range. Upthrown sides of Basin and Range normal faults form mountains that rise abruptly and steeply, and the down-dropped sides create low valleys. The fault plane, along which the two sides of the fault move, extends deep in the crust, usually at a nominal angle of 60 degrees. In places, the relief or vertical difference between the two sides is as much as 10,000 feet.

The mountain range rock types in this region consist primarily of consolidated sedimentary and volcanic rocks of Proterozoic and Mesozoic age, with some Precambrian Era rocks. A lesser percentage of the mountain rock types are metamorphic and intrusive igneous rocks. Following uplift, sediments originating from the mountain sources began filling the valleys, with sedimentary rocks of the Cenozoic Era forming the basin stratigraphy. Cenozoic volcanic rocks also comprise portions of selected mountain ranges in the Basin and Range Province.

4.1.2.2 Local Geology

The geology of the Las Vegas Valley has been mapped and described by several researchers, most recently by Page *et al.* (2005). As is common throughout the Las Vegas Valley, Site soils are primarily sand and gravel, with occasional cobbles. This is consistent with the depositional environment of an alluvial fan. The Site is located on alluvial fan sediments, with a surface that slopes to the north-northeast at a gradient of approximately 0.02 foot per foot (ft/ft) towards the Las Vegas Wash. These uppermost alluvial sediments were deposited within the last two million years and are of Quaternary age. The alluvial soils on the Site were deposited from the

McCullough and the River Mountain ranges, located to the southwest and southeast of the Site, respectively. Regional drainage is generally to the east.

The uppermost strata beneath the Site, at the CAMU Area and the Eastside Area, consist primarily of alluvial sands and gravels derived from the River Mountains and from the volcanic source rocks in the McCullough Range. These deposits are of Quaternary age, and are thus mapped and referred to as the Quaternary alluvium (Qal; Carlsen *et al.* 1991). The Qal is typically on the order of 50 feet thick at the Site with variations due, in part, to the non-uniform contact between the Qal and the underlying Tertiary Muddy Creek Formation (TMCf).

The TMCf underlies the Qal. The Muddy Creek formation, of which the TMCf is the uppermost part, is a lacustrine deposition from the Tertiary Age, and it underlies much of the Las Vegas Valley. It is more than 2,000 feet thick in places. The lithology of the TMCf underlying the Site is typically fine-grained (sandy silt and clayey silt), although layers with increased sand content are sporadically encountered. These TMCf materials have typically low permeability, with hydraulic conductivities on the order of 10^{-6} to 10^{-8} centimeters per second (Weston 1993).

The contact between the Qal and the underlying TMCf is not a planar surface (Figure 4-1). The unconformity between these two geologic units is a result of uplift and erosion of the TMCf prior to the deposition of the alluvial sediments that comprise the Qal. As the TMCf was eroded, shallow channels were incised into its surface and filled with the relatively coarse-grained alluvium, resulting in the development of southwest-to-northeast trending paleochannels. Figure 4-2 depicts the relationships between the Qal and the TMCf at the Site.

4.1.3 Surface Water

Surface water flow occurs for brief periods of time during periodic precipitation events and drains to the Las Vegas Wash, which is to the north of the Site's northern border. Four jurisdictional wetlands are present in the northern portion of the Site that contain water during portions of the year. These four wetlands are near larger wetlands associated with the Las Vegas Wash and occupy approximately 13 acres (Figure 4-3). Groundwater seeps have been observed at various locations in the northern portions of the Site closer to the Las Vegas Wash and at nearby off-Site locations. In recent years, the observed seeps have been restricted to the wetland areas. An evaluation of historical aerial photos indicates that seeps have appeared in association with past effluent infiltration at the Eastside Area ponds and with infiltration of municipal wastewater at municipal RIBs on the Eastside Area.

4.1.4 Groundwater

The logs of more than 500 borings installed at the Site were reviewed to evaluate the primary Site geologic units, including their lithology, geometry, and stratigraphy. More than 15 miles of geophysical transects have been shot across the 3.6 square mile Site (Figure 4-4), and these transects have also been evaluated. This evaluation has yielded a good understanding of the depositional environments of the various strata, which control the flow of groundwater and the distribution of chemicals that are found in both soils and groundwater at the Site.

Groundwater is primarily encountered in two distinct layers (shallow and deep) at both the CAMU Area and at the Eastside Area. The shallower layer of groundwater is unconfined and typically encountered in the Qal and the upper portion of the TMCf. The deeper groundwater occurs in the TMCf. The potentiometric surface in the Upper Unconfined Water Bearing Zone generally follows topography, sloping towards the Las Vegas Wash. The depth to groundwater at the Site ranged from approximately eight feet bgs at the northern perimeter of the Eastside Area to 65 feet bgs at the southern border when water level data were collected in 2004 (Eastside Area) and 2005 (CAMU Area). More recent groundwater data from quarterly monitoring in 2006-2007 is under analysis at the present time; however some of these data are also discussed later.

On the eastern side of the Eastside Area, groundwater is not found in the Qal. The shallowest groundwater in this portion of the Eastside Area is encountered within the uppermost fine-grained sediments of the upper TMCf, just below the contact between the Qal and the TMCf (Figure 4-5).

Wells completed in both the Qal and the TMCf water-bearing zones, at both the CAMU Area and the Eastside Area, are generally low producing, as indicated by recovery rates of less than five gallons per minute (gpm) observed after purging monitoring wells installed in 2004 and 2005. (A notable exception is an Eastside Area Upper Unconfined Water Bearing Zone, also referred to as the alluvial aquifer [Aa], groundwater well on the west side of the first eight rows of Upper Ponds, AA-09, just downgradient of the closed TIMET Ponds, that recovered at a rate of 52 gpm during 2004.)

Deep groundwater occurs within the TMCf and is encountered between 335 and 395 feet bgs, as encountered while drilling at the Site during Summer 2004 (Figure 4-6). There is no indication that deep groundwater, which is confined and under pressure, is in contact with the Las Vegas Wash to the north of the Site. To the east of the Site, faulting has been identified that may

provide a pathway of hydraulic connectivity between Deep Zone groundwater and the Las Vegas Wash. The shallower groundwater presents evidence of contact with the Las Vegas Wash gravels. With the exception of the wetlands discussed previously, the potentiometric surface does not emerge as surface water prior to flowing into the Las Vegas Wash. Stiff diagrams for the Aa and the Deep Zone (Figure 4-7) graphically depict cation/anion constituent data. The similarity or dissimilarity of the Aa and the Deep Zone groundwater is a data gap that will be addressed through future investigations.

Between shallow and deep groundwater occur several hundred feet of dry to moist, fine-textured, silts to silty clays comprising the TMCf. This unit, between the Upper Unconfined Water Bearing Zone and the Deep Zone, has been designated as the Middle Zone. Thin sand lenses were sporadically and unpredictably encountered in this upper portion of the TMCf during drilling. Many of the sand lenses were saturated; others were unsaturated. These lenses are typically less than one foot in thickness and the borings studied (through the construction of project cross-section and fence diagrams) do not appear to establish lateral interconnection between Middle Zone lenses observed in individual borings. The lenses were encountered at depths ranging from 55 feet bgs to more than 300 feet bgs (Figure 4-8 and Figure 4-9).

Shallow groundwater quality is classified as brackish, with TDS concentrations averaging approximately 4,090 mg/L. A number of contaminant chemicals are also present.

Figures 4-10 through 4-14 are block diagrams that summarize the features of the Eastside Area depicted between circa 1943 and circa 2005. Figure 4-15 depicts the future scenario following redevelopment of the Site. Figures 4-16 through 4-18 are block diagrams that summarize the features of the CAMU Area circa 1943, 1976, and 2005. Figure 4-19 depicts the future scenario with the CAMU in place.

Water level measurements in monitoring wells in the vicinity of the Site indicate that groundwater in the deep TMCf is under pressure, which causes an upward groundwater gradient. Where the potentiometric head in the shallow zone is lower than the head in the deeper zone, the upward gradient can inhibit downward groundwater flow and contaminant transport from the Qal. However, where the potentiometric head in the shallow zone is greater than the head in the deeper zone, downward groundwater flow and contaminant transport can still occur from the Qal.

In the vicinity of the CAMU Area, groundwater is typically encountered first in the Qal under unconfined conditions. The Qal is unsaturated toward the east, with saturation first noted in the

uppermost TMCf, close to the contact between the Qal and the TMCf. It is thought that the Qal has been dewatered in this area as a result of operation of the Tronox remediation system, located on the property east and adjacent to the CAMU Area. Groundwater extraction has been conducted immediately east of the CAMU Area, at the Tronox facility, since 1987 (Tronox 2006).

As a part of this system, groundwater is extracted and treated for chromium, nitrate, chlorate, perchlorate, and other chemicals present in the influent water. The majority of this treatment occurs on the Tronox plant site at the BMI Complex, east of and adjacent to the CAMU Area. Ferrous sulfate is also added approximately 8,700 feet downgradient at the location known as the Athens Road Lift Station. Approximately 5,500 feet farther downgradient toward the Las Vegas Wash, a line of nine extraction wells, oriented orthogonal to flow of groundwater, captures groundwater that is subsequently treated to remove perchlorate. Water from the perchlorate treatment system is treated to remove solids, disinfected with an ultraviolet (UV) system, and then discharged via pipeline to the Las Vegas Wash. Based on the most recent reporting from Tronox (2006), the maximum groundwater level fluctuation induced by groundwater pumping and downgradient injection of water has been approximately 10 feet.

Another line of remediation extraction wells, known as the Pioneer/Stauffer/Montrose Groundwater Treatment System (GWTS), is installed north and downgradient of the CAMU Area. The GWTS is an 1,800-foot long line of 13 remediation extraction wells installed north and downgradient of the CAMU Area, oriented orthogonal to the flow of groundwater. The GWTS was originally designed to only remove volatile organic compound (VOCs) from groundwater. In correspondence dated January 2005, NDEP noted that the GWTS was to be modified to remove pesticides and semi-volatile organic compounds (SVOCs). NDEP stated that there might be chemicals not treated by the GWTS and that the GWTS might not be capturing all of the impacted groundwater moving through the Pioneer/Stauffer/Montrose facilities area. In this scenario, it is likely that groundwater and contaminants continue to flow north towards the Las Vegas Wash. Subsequent to this January 2005 letter, there has been a substantial and continuing dialogue between the NDEP and Pioneer/Stauffer/Montrose concerning the efficacy of the current GWTS, various operational and design inadequacies, and proposed upgrades to remedy these inadequacies. It is anticipated that this dialogue will lead within the next 36 months to a modification of the GWTS.

The CAMU CSM report presents a full summary of additional features relating to the historical and current groundwater recharge in the Site area.

4.2 SOURCE CHARACTERIZATION

Historical operations and chemical disposal at both the CAMU Area and Eastside Area have resulted in chemical impacts to soil and groundwater. Site investigations to collect and summarize historical operational information (Section 2), and to collect and analyze soil and groundwater quality data, have been conducted 30 times since 1996. All data collected from investigations conducted since 1996 have been subjected to a data validation process to insure that the data are of sufficient quality for use in interpreting Site conditions.

A detailed discussion of the analytical data and impacts to the CAMU Area is presented in the CAMU CSM. The Eastside Area CSM, in preparation, will present a similar detailed discussion of the Eastside Area analytical data and impacts. An overview of the source characterization for each of the two Site Areas is presented below.

A SRC list of laboratory analytes was developed to include every chemical known (including potential chemical byproducts and degradation products) to have been manufactured or used by any of the entities at the BMI industrial site from inception to present. This is discussed in Section 3.

A subset of these analytes have been detected at the Site. Detected analytes were grouped into chemical classes and compared to regulatory-established screening levels in order to put relative concentrations at the Site into a context that has been established by regulatory precedence. In order to provide a manageable, useful, and accurate discussion of the chemical impacts to the Site, the chemicals were grouped into the following classes:

- Aldehydes, asbestos, dioxins and furans, herbicides, metals, organic acids, organochlorine pesticides, organophosphate pesticides, perchlorate, PCBs, radionuclides, SVOCs, and VOCs.

Because asbestos only occurs as a solid, and owing to the fact that there is not a mechanism to transport this compound to greater depths, only surface soils were analyzed for its presence.

Detected pre-remedial Site chemical concentrations are screened against USEPA Region 9 Residential preliminary remediation (PRGs), and soil screening levels (SSLs) using a dilution attenuation factor (DAF) of 1. Except in the Mohawk sub-area, where contaminated soils have been excavated, the data represent pre-remedial conditions. Dioxins/furans toxic equivalency (TEQ) concentrations were compared to the Agency for Toxic Substances and Disease Registry

(ATSDR) screening value of 50 parts per trillion (ppt). The analytical results for naturally occurring constituents, including arsenic, radium-226, and radium-228, were compared to shallow soil background concentrations. Finally, the reporting limits for all reported non-detects in soils were compared with the screening levels noted above in order to evaluate the usefulness of the “non-detect” data.

4.2.1 Summary of Eastside Area Source Characterization

Historical waste disposal practices at the Eastside Area ditches, canals, flumes, and unlined ponds have impacted soil and groundwater in this Area. Table 4-1 presents BRC’s estimate of volumes deposited into the Upper and Lower Ponds from 1942 until 1976, based on a review of historical operating reports, memoranda, and other data.

4.2.1.1 Eastside Area Soil

The analytical data collected during the Site investigations conducted in this Area since 1996 were organized into a relational database that forms the basis of the Eastside Area source characterization. The data were sorted, screened, and statistically analyzed. Table 4-2 presents the screening levels that were used in the data summary tables and figures. Table 4-3 presents the following for each soil analyte on the SRC list:

- Screening levels;
- Maximum background levels;
- Range of detections;
- Number of detections exceeding the screening level;
- Range of non-detections; and
- Number of non-detections exceeding the screening level.

Tables 4-4 through 4-7 present these data categorized by the following soil horizons.

- Surficial soil (one foot bgs or less) (Table 4-4);
- Near-surface soils (between one foot bgs and 15 feet bgs) (Table 4-5)
- Middle zone soils (between 15 feet bgs and the Qal/TMCf interface) (Table 4-6); and

- Deep zone soils (within the TMCf) (Table 4-7).

Figures 4-20 through 4-23 present the soil data showing locations where chemicals exceed screening levels.

Shallow soil chemical data indicate that asbestos was deposited in the sub-areas of Sunset North Commercial, Spray Wheel, First Eight Rows, Mohawk, and the Southern RIBs. For the samples collected and analyzed, the greatest frequency of asbestos detection occurred in the First Eight Rows sub-area.

Soil chemical impacts on the Eastside Area were compared to USEPA Region 9 Residential PRGs, USEPA SSLs (using a DAF of 1), ATSDR TEQs for dioxins/furans, and the provisional background dataset for metals and radiochemicals. The chemical groups and significant individual chemicals detected most often and most frequently at concentrations above screening levels (“exceedances”) were arsenic, dioxins and furans, organochlorine pesticides, perchlorate, and radium-226 and radium-228.

Arsenic concentrations exceeded PRGs in almost all samples at all intervals, as do the activities of radium-226 and radium-228. Comparison of arsenic and the radium-226 and radium-228 isotopes sample concentrations to the background dataset indicates that these chemicals generally occur at concentrations not substantially different from background concentrations in the Site vicinity. However, the existing data indicate that some areas appear to be relatively elevated in concentration compared to background. BRC will continue to evaluate and address these areas, as appropriate, and update the CSM as needed.

Chemical groups that demonstrated a relatively low (and in some cases, no) frequency of exceedance of the soil screening levels included VOCs, SVOCs, PCBs, aldehydes, asbestos, herbicides, organophosphate pesticides, radionuclides (other than radium isotopes), organic acids, and polycyclic aromatic hydrocarbons (PAHs).

As measured by the quantity and type of soil sample chemical analytic results that exceeded the soil screening values, the greatest soil impact on the Eastside Area occurred in the First Eight Rows sub-area, with lesser impacts observed in the remaining sub-areas.

As indicated by frequency of chemical analyte exceedances above the PRG screening level, soil chemical impact is greatest in surface soil samples and decreases with depth into the Qal soils above the Upper Unconfined Water Bearing Zone. Preliminary evaluation of the Eastside Area

soil data has not addressed the potential for leaching of soil chemical constituents to the Upper Unconfined Water Bearing Zone. That evaluation will be reported in the detailed CSM for the Eastside Area. The decline in concentration of detected chemicals with increasing depth in the TMCf soil suggests that the extent of contamination in the unsaturated sediments below the Upper Unconfined Water Bearing Zone is low.

4.2.1.2 Eastside Area Groundwater

Evaluation of Eastside Area groundwater is based on data derived from groundwater monitoring and sampling events conducted in July 2004; as well as more recently in April-June 2006, July-August 2006, and October-November 2006.

Groundwater chemical results were statistically analyzed and compared to (1) maximum contaminant limits (MCLs) where they have been established, (2) secondary water treatment standards, and (3) the USEPA Region 9 PRGs for tap water for a residential water use scenario. Table 4-2 lists the screening levels, and Table 4-8 presents the following for each groundwater analyte on the SRC list, using the most recent 2006 data:

- Screening levels;
- Range of detections;
- Number of detections exceeding the screening level;
- Range of non-detections; and
- Number of analyses with reported detection levels exceeding the screening level.

Tables 4-9 through 4-11 present these data categorized by the following groundwater zones.

- Upper unconfined water-bearing zone (Table 4-9);
- Intermediate water-bearing zone (Table 4-10); and
- Deep water-bearing zone (Table 4-11).

Figures 4-24 through 4-26 present the most recent 2006 groundwater data showing locations where chemicals exceed screening levels.

Generally, water in the Upper Unconfined Water Bearing Zone is classified as brackish, with average TDS concentration of 4,090 mg/L. The Aa water can be further classified as being of calcium-chloride to calcium-sulfate in chemical character. Groundwater within the Upper Unconfined Water Bearing Zone has been impacted by the chemicals historically used in the Plants Area to the west as a result of wastewater disposal to the effluent ditches and ponds. In addition, off-Site sources have been identified for impacted groundwater flowing west of Pabco Road and beneath the Lower Ponds. In addition to perchlorate, groundwater in the Upper Unconfined Water Bearing Zone has been impacted with elevated levels of certain dioxins and furans, certain metals (total chromium, selenium, and copper), certain organochlorine pesticides, certain radionuclides as well as certain SVOCs, and VOCs. Groundwater samples collected from Upper Unconfined Water Bearing Zone groundwater do not exhibit detectable concentrations of PCBs, PAHs, herbicides, organophosphorus pesticides, or organic acids.

4.2.2 Summary of CAMU Area Source Characterization

The revised CAMU CSM document was submitted to the NDEP February 16, 2007. Recently BRC has received comments on this CSM. The following summary is based on this revised draft report, taking into consideration considering NDEP's comments.

4.2.2.1 CAMU Area Soil

Impacts to soil on the CAMU Area have been documented to exist in the North Landfill Lobe, beneath the Western Drainage Ditch (beneath pieces of Western W. Ditch Area and the Eastern W. Ditch Area), and in the Slit Trench Area. These impacts include VOCs, SVOCs, pesticides, metals, Aroclors, PCBs, radiochemicals, and dioxins/furans. Though specific information does not exist on historical waste disposal activities or subsurface investigations at the South Landfill Lobe, it is logical to assume that similar impacts exist here that exist beneath the North Landfill Lobe. Investigations and studies have indicated that limited soil impacts have occurred in the North Borrow Pit Lobe and the South Borrow Pit Lobe. A formal risk assessment has been performed on the soils in these two Borrow Pit Lobes (ERM 2007) and has been approved by the NDEP. The risk assessment indicates that the soils in these two lobes present minimal hazard to human health. An NFAD (with conditions) for these soils has been obtained by BRC. These soils are to be excavated to make room for the below-grade portion of the CAMU. The excavated soils will be used as underlayment with an overlying, approved cap. Excluding the portion of land through which the Western Drainage Ditch traversed and based on the absence of historical waste disposal activities, no impacts to soil are known at the Eastern W. Ditch Area.

4.2.2.2 CAMU Area Off-Site Soil

A variety of chemical manufacturing, storage, handling, distribution, and waste disposal facilities historically operated at facilities south and upgradient of the CAMU Area. Environmental investigation reports document that activities at these facilities have resulted in soil impacts beneath the facilities. These impacts include VOCs, SVOCs, pesticides, and metals; and additional impacts may exist. However, a complete interpretation comparable to the one given the CAMU Area is not possible because of the limited analyte list used for analyzing samples collected from the upgradient locations. It is BRC's understanding that a CSM is in preparation by others covering both upgradient and downgradient areas of the CAMU. BRC will provide the CAMU CSM for this effort.

4.2.2.3 CAMU Area Groundwater

The current data for groundwater within the CAMU Site boundary include:

- Historical one-time groundwater grab samples collected from borings (HLA 1998), performed for Montrose;
- Data collected from groundwater monitoring wells installed in the past (ERM 1999);
- Data collected from groundwater monitoring wells installed during the 2005 CAMU investigation performed for BRC.

Impacts to groundwater have occurred in the Aa beneath and upgradient of the CAMU Area. Chemicals detected in this groundwater in the CAMU Area perimeter wells during the 2005 CAMU investigation include VOCs, SVOCs, pesticides, metals, PCBs, dioxins/furans, TDS, and radionuclides. Chemicals that exceed MCLs in the Aa in both the CAMU Area upgradient and downgradient wells are significantly fewer in both number and type. These exceedances include VOCs, SVOCs, pesticides, dioxins (only in the upgradient wells), and metals. Fewer chemicals were found in the CAMU Area downgradient wells than in the upgradient wells. Notable chemicals detected at concentrations above MCLs in the upgradient wells that were not detected above MCLs in the downgradient wells include vinyl chloride, uranium-238, and PCBs.

Trichloroethylene (TCE) was detected above the MCL in a downgradient well but not in the upgradient wells. Further investigation of upgradient groundwater is needed (and is being conducted by offsite property owners) to characterize upgradient groundwater quality and evaluate the source of the detected TCE. Because it is well-documented that PCE can degrade to

TCE in anaerobic groundwater, it is suspected that TCE may be the biodegradation daughter product of PCE originating from upgradient sources or originating from the BMI Landfill or the CAMU Slit Trench Area.

Based on comparison of soil sample results from the Qal depth interval greater than 10 feet bgs to the DAF-1 soil screening criteria for representative chemicals, impacts to groundwater beneath the CAMU may have resulted from historical disposal of wastes in the CAMU Area in the North Landfill Lobe, the South Landfill Lobe, the Slit Trench Area, the Eastern W. Ditch Area, and the Western W. Ditch Area. These impacts include metals, organochlorine pesticides, PCBs, perchlorate, radiochemicals, SVOCs, and VOCs.

BRC has conducted work to evaluate background levels of metals and radiochemicals in shallow soil. The work is under review, as noted further below. Based on a statistical comparison of the data collected to date with the provisional shallow background soils dataset, the detected metals and radiochemicals may be attributable, in whole or in part, to natural sources and may be representative of background levels. BRC is developing a study to evaluate background concentrations of deeper (greater than 10 feet bgs) Qal and TMCf soils. Additional evaluation of the data will be conducted when this study is completed.

Historically, all of the chemicals found in any of the wells downgradient or cross-gradient from the CAMU Area were also found in the upgradient wells. For chemicals found at the highest concentrations, such as benzene, chlorobenzene, polychlorinated benzenes, and chloroform, historical CAMU Area well concentrations upgradient of the CAMU were typically high. Historical isoconcentration plots indicate that significant groundwater sources exist for these chemicals at off-site, upgradient locations. Isoconcentration plots of the boundary wells based on contemporaneous data collected in 2005 show a repeated pattern that likewise indicates that significant upgradient sources exist for these chemicals.

Impacts to groundwater occurring in the TMCf sand lenses have also occurred. In samples collected from wells located upgradient of the CAMU Area, 21 chemicals were detected at concentrations above the MCLs in TMCf groundwater lenses. These chemicals included VOCs, SVOCs, a pesticide, metals, and a radionuclide (uranium-238). All of the chemicals detected above MCLs in the TMCf groundwater samples were also detected above MCLs in samples collected from CAMU Area upgradient perimeter wells. Many were also detected above MCLs in CAMU Area downgradient perimeter wells.

4.3 SOIL BACKGROUND LEVELS

4.3.1 Surficial Soil

A background soil summary report (for metals, radionuclides, and other inorganics) was completed for the Site by BRC and TIMET in 2007 (BRC and TIMET 2007). The report is currently in review with NDEP, and the data are thus currently considered “provisional” until the report is approved. BRC is also currently considering the applicability and value of a shallow background soils evaluation of pesticides and other compounds that have been detected in Site soils but may be due to offsite sources. BRC will address these issues with NDEP.

The general scope of work included the collection of soil samples from background areas at higher topographic elevations than the Site industrial areas and analysis of these samples for site-related metals, radionuclides, general chemistry ions, and soil characteristics. The definition of “background” for this report is based upon that of the USEPA (2002), which states:

“Substances or locations that are not influenced by the releases from a site and are usually described as naturally occurring or anthropogenic: (1) Naturally occurring substances present in the environment in forms that have not been influenced by human activity. (2) Anthropogenic substances are natural and human-made substances present in the environment as a result of human activities...”

The main objective of this study was the development of a representative background soil data set that could be used to evaluate whether concentrations of site-related chemicals detected in Site soil samples statistically exceed concentrations of these chemicals in background soil.

Soil samples were collected from 11 sampling locations located on undeveloped properties close to the Site. A total of 33 borings were installed at the 11 locations, and 104 independent soil samples were collected for analysis. Soil samples were collected from three depth intervals at each sampling location:

- Surface soil (0 to 0.5 feet bgs); and
- Two subsurface depths (four to six feet and nine to 11 feet bgs).

In addition to data collected for Site-related metals, radionuclides, and anions, data for soil characteristics (soil texture, pH, conductivity, cation exchange capacity [CEC], salinity, total

organic carbon [TOC], and percent moisture) were also collected to evaluate whether the background soil locations are representative of characteristics of Site soils.

Specific goals and comparisons proposed for the background soils study included the collection of data such that:

- The data from the sampled soil units are representative of Site soils;
- The data form a sufficient sample population that can be used to support statistical comparison of on-Site and background data sets;
- The data are sufficient to form more than one background data set, if required based on statistical comparisons of data from different geologic settings;
- The data could be used to evaluate the comparability of background data collected during this study to data collected by Environ for the City of Henderson (Environ 2003); and
- The data could be used to evaluate the comparability of soil originating from geologic units in the northern McCullough Range and the River Mountains.

The background study concluded that the 11 sampling locations represent the range of soils found within the vicinity of the Site. It was also considered reasonable to conclude that the background samples collected reflect background conditions for soils at the Site based on sample location characteristics obtained from published documentation, site inspection, and sample collection. Key results include:

- **Metals and Anions** - A total of 43 metals and anions were analyzed in each sample. Although there were some statistically significant differences, the results of statistical tests comparing groupings of the BRC/TIMET metals data by depth suggest that data for two intervals of subsurface soil (4 to 6 feet bgs, and 9 to 11 feet bgs) can be combined for all metals. Significant differences were found for 24 metals and anions when comparing BRC/TIMET sample results from the surface to the subsurface. These differences are likely the result of background differences associated with the difference in soil type with depth. Because of this difference, surface soil sample results may constitute a different background dataset from deeper subsurface soil sample results. This possibility is being investigated by BRC. A work plan, as discussed below, to investigate background for the deep Qal and TMCf soils is in review and will be submitted to NDEP for review and acceptance.

- Radionuclides - Results of statistical tests comparing radionuclide activities for the different sampling depths indicate that the data for radionuclides from all depths can be pooled and treated as a single data set.
- Other Parameters - Parameters such as pH, conductivity, TOC, and soil texture provide additional insights into the comparability of soil samples collected from site and background areas or different areas within a site. Because the concentrations of metals in solid media (*e.g.*, soils and sediments) may be correlated with grain size or TOC, and because pH can radically affect the mobility of metals, data for these supporting parameters will be collected and used to assist in data evaluation.
- Comparability of McCullough Range and River Mountains Data - The source rocks and soil types for the McCullough Range and River Mountains are similar, and the main factors for soil formation are the same for the alluvial fans derived from both ranges. The heterogeneity of the samples collected on alluvial fan materials from the northern McCullough Range generally encompass the range of concentrations found in the mixed alluvial fan locations, and the River Range alluvial fan locations. Based on a comparison of the BRC/TIMET data set in areas downgradient from the McCullough Range and the River Mountains, with a few exceptions, the concentrations of metals and radionuclides in soil samples are comparable.
- The BRC/TIMET data set will be used for background comparisons in future investigations after approval by NDEP.
- These background locations were not impacted by Site operations.

Table 4-12 presents the range of concentrations of metals, radionuclides, and other parameters that resulted from the background study.

4.3.2 Deep Soil

At present, insufficient background data exist to evaluate whether concentrations of certain Site-related chemicals detected in deeper Site samples statistically exceed concentrations of these chemicals in deeper (as compared to shallow) background soil. In order to address this data gap, in April 2007, a work plan for the evaluation of deeper background soil chemistry was submitted to the NDEP for review and approval (DBS&A 2007). NDEP has provided comments and the plan is in revision by BRC as of this writing. The soil portion of the work plan was written to evaluate deep soil background ranges for metals, radionuclides, general chemistry anions, and

certain soil characteristics. The purpose of the soil component of the work plan is to collect data for metals and radionuclides in deep background soils that are comparable to deep Site soils. These data will be used in Site-to-background statistical comparisons.

This soil portion of the work plan scope will provide the following information needed for soil Site-to-background comparisons:

- Soil chemical data for various depth intervals (*e.g.*, starting at 20 feet bgs and proceeding down at 10-foot intervals for the alluvial soils and for two depth intervals into the shallow Muddy Creek formation). Actual depths will depend on particular locations.
- Soil chemical data for a representative range of soil map units applicable to the Site (*e.g.*, Natural Resources Conservation Service [NRCS] mapped Soil Units 117, 182, and 184).
- Soil chemical data to form an adequate sample population to support future statistical comparison of Site and background sample data sets.
- Soil chemical data to form more than one background data set, if required, based on statistical comparisons of data from different soil mapping units.

As noted, the deeper soil background work plan is currently in revision by BRC.

4.4 UPGRADIENT AND DEEPER GROUNDWATER

The April 2007 work plan for the evaluation of deeper background soil chemistry (Section 4.3.2) also includes well installation for the evaluation of shallow upgradient groundwater conditions along the perimeter of the Eastside Area (DBS&A 2007). Six monitoring wells are proposed to be installed in first-encountered groundwater.

As discussed with NDEP, an evaluation of deeper groundwater conditions will be completed once the evaluation of shallow groundwater, and other related and supporting tasks in progress such as the aquifer testing and numerical modeling, are complete.

4.5 MIGRATION PATHWAYS

4.5.1 Eastside Area

Figures 4-10 through 4-14 were prepared to summarize changes in site operations that occurred over time. By the spring of 1943, the Upper and Lower Ponds were constructed to aid in the

disposal of wastewater as Basic Magnesium's Trade Effluent Ponds, west of present-day Boulder Highway, reached capacity. Wastewater was conveyed to the unlined Upper and Lower Ponds Areas via a series of four unlined ditches. The Western Ditch and Northwest Ditch both conveyed effluent waters to the Lower Ponds. During 1942 until 1976, wastewater was conveyed to the Upper and Lower ponds via the Alpha and Beta Ditches. Once wastewater entered the Alpha or Beta Ditches, it was transferred to the east for management in the Upper Ponds via the Beta Ditch or to the north for management in the Lower Ponds via the Alpha Ditch. Effluent liquids containing chemicals deposited sediment in the pond and ditch bottoms. The Upper Ponds were constructed first, followed by the Lower Ponds to the north shortly thereafter. The ponds were designed in a cascade fashion such that as the nearer (southerly) ponds were filled, the next row (to the north) would fill. Evaporation left evaporative sediments and non-volatile chemicals in the pond cells.

Chemicals not evaporated likely leached from pond and ditch sediments and bottoms through the Eastside Area soils to the underlying groundwater. Rainwater is presumed to have also created a leaching mechanism for dried evaporite sediment. In 1976, the Upper and Lower Ponds were permanently removed from service.

Although more than 100 ponds were built in 1942-43 and have been identified on plans and aerial photographs, there is no documentary, photographic, or visual indication that more than the first eight rows of the Upper Ponds were ever directly in service (*i.e.*, filled with effluent). It appears from the documentary evidence that the large number of ponds constructed resulted from an erroneous assumption made in 1941 or early 1942 when trying to rectify an earlier miscalculation of the evaporative area needed for the magnesium plant's effluent (Clary 1944). The assumption neglected to account for percolation (thus assuming that only evaporation would occur) when considering the fate of effluent discharged to the ponds. As a result, a lesser number of ponds were directly used and filled with effluent than was originally envisioned when the ponds were designed and constructed. The Lower Ponds were in service between 1943 and 1970. The Upper Ponds were in service between 1943 and 1976, when both Upper and Lower Ponds were permanently taken out of service. TIMET operated its lined ponds on-site between 1976 and 2005.

Soluble chemicals leached with percolating waters into the Upper Unconfined Water Bearing Zone where chemical impacts are currently detected in groundwater. Impacts to the Eastside Area groundwater also occurred as the result of the dispersion of chemicals (*e.g.*, perchlorate) in the Tronox groundwater plume to the west and from chemicals (*e.g.*, tetrachloroethylene) from

sources to the southwest of the Eastside Area. Chemicals moved in groundwater in the Upper Unconfined Water Bearing Zone northward toward the Las Vegas Wash with the prevailing groundwater gradient and flow. Site geologic and hydrologic data indicate that the Upper Unconfined Water Bearing Zone is in communication with sediments beneath the Las Vegas Wash and that the Site is contributing chemicals to groundwater in the sediments immediately beneath the Las Vegas Wash.

The less retarded chemicals, such as perchlorate, traveled in groundwater farther, faster, and in greater mass than more retarded chemicals. More sorptive and more retarded chemicals (for example, organochlorine pesticides) migrated less and are currently less widespread in groundwater. Non-soluble chemicals, such as asbestos, moved very little and did not leach.

The distribution of chemicals in groundwater beneath the Eastside Area is consistent with percolation through the unlined ponds and subsequent travel in the groundwater within the Upper Unconfined Water Bearing Zone. However, it is suspected that the observed decline in chemical concentrations with depth in the TMCf is due to minimal leaching of chemicals from the Upper Unconfined Water Bearing Zone to the underlying TMCf. Existing soil data collected from the unsaturated fine-grained sediments of the TMCf beneath the Upper Unconfined Water Bearing Zone reveal limited chemical impact to soil. BRC posits that the existing Site data indicate that the limited impact to the TMCf soils by Site chemicals is indicative of limited leaching into the fine-grained Deep (*i.e.*, TMCf) soils from the overlying perched Aa. As posited by BRC, the limited impact to the Deep soils, the currently observed upward groundwater gradient from the Deep Zone groundwater, and the off-Site, upgradient chemical impacts (*e.g.*, perchlorate) in the Deep Zone groundwater suggest that the Deep Zone confined aquifer (found at a depth of more than 380 feet bgs) may not have been significantly impacted by direct downward leaching of chemicals beneath the Site effluent disposal ponds. However, some downward leaching of chemicals from Site effluent ponds cannot be ruled out. It is possible that some percolation from the Site ponds, along with pathways from upgradient sources, as well as natural sources can, singly or in combination, explain the observed concentrations of contaminants (including very high levels of TDS) in the deep groundwater.

Initial analytical modeling of infiltration into the Upper Unconfined Water Bearing Zone (using historical measurement of pond disposal as calibration), indicate that a mound of significant areal extent and head builds up quickly under a percolation scenario. This suggests the possibility that groundwater flow direction could have been other than northerly when the ponds were in use,

and that significant downward gradients could also have existed, during the time effluent was being disposed to the Eastside Area ponds.

BRC performed interim remedial measures (IRMs), consisting of excavation and removal, transport, and subsequent stockpiling of shallow impacted soils in a secured holding area, within the First Eight Rows sub-area. The IRM excavations were performed as shown in Figure 4-27. The stockpiled soils were placed in secure holding areas and treated with an application of a binding agent to resist the erosive potential of heat, wind, and water. BRC plans to transport and dispose stockpiled soil at the CAMU planned at the former BMI Landfill Site west of Highway 95. Permit applications have been made to the NDEP and other regulatory agencies with jurisdiction for the planned CAMU and are under review and refinement.

4.5.2 CAMU Area

At the CAMU Area, the BMI Landfill received wastes from 1942 until 1980, at which time it was closed and capped (Weston 1993). The North and South Landfill Lobes were covered and capped in order to reduce the potential for chemicals to leach to groundwater. Aerial photographs and historical data reveal that the routing of process effluents from the Pioneer/Stauffer/Montrose site occurred through the Western Drainage Ditch, an unlined surface channel that drained west to the Western Ditch Extension. This practice lasted from 1946 to 1970. The Western Ditch, which is now closed and all liquids removed, eventually flowed north to the Lower Ponds. Periodically, between 1970 and 1980, a variety of process and office wastes were reportedly disposed of in the Slit Trench Area, located immediately south of the BMI Landfill. There appear to be ten slit trenches that were excavated along east-west trends. Aerial photographs show the slit trenches to range in length from approximately 450 to 900 feet. Based on direct field observations during drilling and sampling operations, the trenches vary in depth between approximately 25 and 32 feet. Trench width is estimated to be eight to 10 feet. Anecdotal evidence and soil sampling results that reveal the presence of dioxins and furans suggest that burning of waste occurred in the Landfill Lobes and the Slit Trench Area.

Directly upgradient of the CAMU Area, four companies have operated industrial chemical production facilities since 1942: Basic Magnesium, Stauffer, Montrose, and Pioneer. Basic Magnesium operated a chlor-alkali plant incident to the manufacture of magnesium. Stauffer operated chlor-alkali facilities and an agricultural chemical plant. Montrose operated a hydrochloric acid and an agricultural chemical plant. Pioneer operated (and still operates) chlor-alkali and hydrochloric acid facilities. These operations have been documented to have resulted

in soil and groundwater impacts with TDS, VOCs, SVOCs, pesticides, and metals. Additional upgradient soil impacts may exist.

Chemicals were disposed of in soils and mixed soils/waste in the Northern and Southern Landfill Lobes and in the Slit Trench Area and resulted in direct impacts to soil. Soluble chemicals leached with percolating waters into the Upper Unconfined Water Bearing Zone where chemical impacts are currently detected in groundwater. Volatile chemicals (*e.g.*, tetrachloroethylene) have migrated in the vapor phase to larger volumes of soil, though impacts to groundwater are not widespread. Step-out soil borings in the Slit Trench Area suggest that chemicals have preferentially migrated along the line of trench excavations (nominally east-west) when compared to migration in a direction transverse to the trench lines (nominally north-south).

Soil impacts on the CAMU Area have been documented to exist in the North Landfill Lobe, beneath the Western Drainage Ditch (beneath segments of the Western W. Ditch Area and the Eastern W. Ditch Area), within the Slit Trench Area, and inferred to exist in the South Landfill Lobe because of its similar history to the Northern Landfill Lobe. These impacts include VOCs, SVOCs, PCBs, pesticides, metals, and dioxins/furans. PCBs were detected in four samples in two borings in the Slit Trench Area. Investigations and studies have indicated that only limited soil impacts have occurred in the North Borrow Pit Lobe and the South Borrow Pit Lobe, and as noted above reports of investigations for these areas were submitted by BRC for NFAD issuance by the NDEP, which reviewed the reports and has now issued the NFAD. Because waste disposal activities were not conducted at other locations within the Eastern W. Ditch Area, known soil impacts are limited to the Western Drainage Ditch in this area.

Impacts to the CAMU Area groundwater also occurred as the result of contaminant transport (*e.g.*, perchlorate) from the Tronox groundwater plume to the east and from the American Pacific Corporation (AMPAC) plume (*i.e.*, perchlorate) to the southwest (Figure 4-28). CAMU Area groundwater is also impacted by chemicals detected in groundwater from sources to the south. Chemicals transported with the prevailing groundwater gradient in the Upper Unconfined Water Bearing Zone northward from the upgradient sources at the plants site, beneath the CAMU Area, and towards the Las Vegas Wash.

Operations at the upgradient plants site have impacted soil and groundwater with VOCs, SVOCs, pesticides, and metals. Soil sources that may continue to impact groundwater may still exist at the upgradient plants. Upon entering the groundwater, the chemicals from these off-site locations migrate north beneath the CAMU Area. Data indicate that CAMU Area sources likely

contributed to groundwater impacts. Because detected chemical concentrations are elevated in both upgradient and downgradient CAMU Area monitoring wells, with concentrations being typically higher in the upgradient wells, it is difficult to discern with certainty whether groundwater has been impacted, and to what degree, by releases from the CAMU Area. For chemicals found at the highest concentrations in groundwater, such as benzene, chlorobenzene, polychlorinated benzenes, and chloroform, CAMU Area upgradient wells typically had high concentrations as well. Historical groundwater iso-concentration plots indicate that significant groundwater sources exist for these chemicals at off-site upgradient locations. Iso-concentration plots of the 2005 contemporaneously collected data from the CAMU Area boundary wells show a repeated pattern that likewise indicates that significant upgradient sources exist for these chemicals.

After exiting beneath the CAMU Area, groundwater flows northward from the CAMU Area towards the Pioneer/Stauffer/Montrose GWTS described in Section 4.1.4.

4.6 ENVIRONMENTAL RECEPTOR IDENTIFICATION AND DISCUSSION

Exposures to current receptors are being managed through site access control. Under the prospective redevelopment plan, the Eastside Area of the Site will be used for a variety of purposes, including residential housing, parks, schools, places of worship, commercial and/or light industrial development, and streets. The entire Site will be enhanced by restoration and redevelopment once remediation is complete. Therefore, exposures to ecological receptors will be mitigated or removed. Future receptors identified as “on-site receptors” are defined as receptors located within the current Site boundaries (Figure 1-2), while future “off-site receptors” are those located outside the current Site boundaries. Many potential human receptors are possible at the Site in the period during and after redevelopment. The potentially exposed populations and their potential routes of exposure are discussed in Section 9 of this Closure Plan.

4.7 DISCUSSION OF SITE DATA NEEDS (GAPS)

The CSM represents a functional working description of historical Site operations, potential chemical release sources, chemical impacts to Site soils, the occurrence of groundwater beneath the Site, groundwater flow, chemical impacts to Site groundwater, and the connectivity of Site groundwater to the Las Vegas Wash. This summary of the CSM presents an overview of the Site data that have been gathered over the years by BRC and others. The CSM Summary outlines the present understanding of the Site and the physical processes that have resulted in the observed Site chemical impacts.

It is recognized that data gaps remain, including, for example, those pertaining to off-site sources as potential release mechanisms of chemicals to Site groundwater, and to the quantification of soil and aquifer parameters that control Site groundwater flow and chemical transport. Table 4-13 presents the data that need to be collected and analyzed to further support and update the CSM.

All work will be used to continually update and refine the CSM. As stated at the beginning of this section, two separate, more-detailed CSM documents are in preparation that elaborate upon this CSM summary for each of the Eastside and CAMU areas. The CAMU CSM has been submitted for review to NDEP, comments have been received from NDEP by BRC, and this CSM is being updated. The Eastside Area CSM will be updated upon conclusion of the several field investigations (*e.g.*, aquifer testing, numerical modeling, north-east area investigation, deep soil background investigation, upgradient Qal investigation) presently being formulated/conducted.

As discussed in Section 1, in the future, remediation utilizing soil excavation is planned to remove chemically-impacted soils from the Eastside Area which will then be placed in the CAMU. Subsequent to the excavation, confirmation sampling will be conducted that will compare the resulting spatial distribution of soil impacts to remediation clean-up goals. Based on the results of the confirmatory sampling, the Eastside Area CSM will be updated in the future.

SECTION 4 REFERENCES

- American Society of Testing and Materials (ASTM). 2003. Standard Guide for Developing Site Models for Contaminated Sites. Standard E 1689-95 (Re-approved 2003).
- Basic Remediation Company (BRC) and Titanium Metals Corporation (TIMET). 2007. Background Shallow Soil Summary Report, BMI Complex and Common Areas Vicinity. March 16.
- Carlsen, C.L., R.C. Lunnis, and D.E. Prudie. 1991. Changes in water levels and water quality in shallow groundwater, Pittman-Henderson Area, Clark County, Nevada, Resulting from diversion of industrial cooling water from ditch to pipeline in 1985. U.S. Geological Survey Water-Resources Investigation Report 89-4093. Carson City, Nevada.
- Clary, E.H. 1944. "Trade Effluent," in History of Civil Engineering, October 21, 1944, UNLV Special Collections, T-22 [BR033889-910].
- Daniel B. Stephens & Associates, Inc. (DBS&A). 2007. Revised Work Plan for Determination of Deep Quaternary Alluvium and Upper Muddy Creek Formation Background Soil Chemistry and Upgradient Alluvial Aquifer Conditions, BMI Common Areas and Complex Vicinity. April 9.
- Environ. 2003. Risk Assessment for the Water Reclamation Facility Expansion Site, Henderson, Nevada. Prepared for the City of Henderson, Nevada. October.
- Environmental Resource Management (ERM). 1999. Groundwater Sampling Results, Former BMI Landfill. October.
- ERM. 2007. BRC Human Health Risk Assessment Report, Borrow Area, Clark County, Nevada. March.
- Harding Lawson Associates (HLA). 1998. Groundwater treatment system evaluation, Stauffer Chemical Company/Pioneer Chlor Alkali Company, Inc. Site, Henderson, Nevada. August 3.
- Page, W.R., Lundstrom, S.C., Harris, A.G., Langenheim, V.E., Workman, J.B., Mahan, S.A., Paces, J.B., Dixon, G.L., Rowley, P.D., Burchfiel, B.C., Bell, J.W., and E.I. Smith. 2005. Geologic and Geophysical maps of the Las Vegas 30' x 60' quadrangle, Clark and Nye Counties, Nevada, and Inyo County, California, USGS, report 2814.

Tronox. 2006. Semi-annual Performance Report, Chromium Mitigation Program, Tronox, Henderson, Nevada, July 25.

U.S. Environmental Protection Agency (USEPA). 2002. Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites. Office of Emergency and Remedial Response, Washington, DC. EPA 540-R-01-003. September.

Weston. 1993. Site Conceptual Model, Stauffer/Pioneer/Montrose Site, Henderson, Nevada, September.

SECTION 5

5 DATA VERIFICATION AND VALIDATION

Data verification and validation are key steps in the assessment phase for any environmental data collection project. As defined in USEPA (2002), data verification is the process of evaluating the completeness, correctness and conformance/compliance of a data set against requirements set forth. Data validation is an analyte- and sample-specific process that extends the evaluation of data beyond method, procedural, or contractual compliance (data verification) to determine the analytical quality of a specific data set. Both verification and validation are necessary and are best performed in the order described here. The descriptions are brief, providing guidance on the basic intent of data verification and validation, and forming the basis for more detailed descriptions that will be presented in each sub-area or decision specific closure plans. Data verification will be performed against the analytical methods and operating procedures, at the laboratories that perform the analyses. Individuals designated by the Project Program Manager will perform data validation. Section 1 discusses the project staffing in this regard. Data validation will evaluate the data against the measurement quality objectives described in this Closure Plan and the Quality Assurance Project Plan (QAPP; BRC and MWH 2006). Data reporting from the field and laboratory operations will follow the requirements specified in the QAPP.

5.1 FIELD DATA VERIFICATION

All field personnel will be responsible for following the sampling and documentation procedures described in the work plan so that defensible data are obtained. Project Team Personnel will verify field notes and records against field procedures and data sets to identify any inconsistencies, non-conformance or anomalous data. The quality control (QC) steps required during field operation will also be checked against the applicable procedure. Chain-of-Custody, field logbooks, instrument calibration, and sampling records will be reviewed. The field team will be interviewed to reconcile any inconsistencies as soon as possible after the fieldwork is completed. A systematic effort to identify inconsistencies will be performed before field data are reported. Inconsistencies may result from improper sampling or measurement methodology, data transcription and calculation errors, and loss of data due to natural causes. Anomalies that are identified as a result of sampling, measurement or transcription errors will be identified and corrected; anomalies that cannot be attributed to these causes will be identified in the sample reports but not excluded from the sample sets.

5.2 LABORATORY DATA VERIFICATION

Laboratory personnel will verify analytical data at the time of analysis and reporting and through subsequent reviews of the raw data for any non-conformance to the requirements of the analytical method and laboratory QA/QC procedures. Verification will include reviewing positive and negative control results including method blanks, laboratory control samples, matrix spikes, duplicate, surrogate, tracer, carrier and internal standards. Results will be verified against the Method Detection Limits (MDLs), Minimum Detectable Activity, and Practical Quantitation Limits as well as the method or laboratory established recovery and variability requirements. Analysts may be required to evaluate the selectivity of the results for identification purposes. Laboratory personnel will make a systematic effort to identify any errors before they report the data. Outliers that result from errors found during data verification will be identified and corrected; outliers that cannot be attributed to errors in analysis, transcription, or calculation will be clearly identified in the case narrative section of the analytical data package, but will not be excluded from the data set. Laboratory reports will include certification and signature by lab director along with all additional USEPA Level IV requirements, or, alternatively, the laboratory reports must have sufficient detail to allow the level of review/validation that is required as specified in a sub-area or decision specific QAPP.

5.3 LABORATORY DATA VALIDATION

One or more experienced chemists, who have sufficient background in inorganic and radiochemistry methods and are independent from the activities of this project, will validate all laboratory data. The chemist(s) will be selected by the Project Program Manager. Section 1 discusses the project staffing in this regard. The organic and inorganic data will be validated in accordance with current USEPA National Functional Guidelines (USEPA 1999 and 2004). National Functional Guidelines do not include the radiochemistry anion analysis but this data will undergo a similar review. Radiochemistry data validation will use the U.S. Department of Energy (USDOE) reference document, *Evaluation of Radiochemistry Data Usability* (USDOE 1997). The laboratory will provide data reports at USEPA Level IV so that the raw data is available for full validation. In accordance with the QAPP for this project, 100 percent of the data will undergo Level III data validation, and 10 to 20 percent will undergo Level IV data validation. Full data validation includes all review requirements, thus 100 percent of the data will undergo at least a review. Requirements for cursory (review) and full validation are listed below.

5.4 DATA REVIEW

Data review will be completed on 100 percent of the summary data packages for SRC analyses. No data will be eliminated from this review unless it is selected for full validation. All data will be qualified as necessary in accordance with established criteria. Data review will entail evaluation of USEPA Level III documentation including:

- Narrative, cross-reference, chain-of-custody, and method references;
- Analytical results;
- Surrogate recoveries (as applicable);
- Blank results;
- Laboratory control sample recoveries;
- Duplicate sample results and/or duplicate spike recoveries; and
- Sample spike recoveries.

In cases where the data review indicates uncertainties that require investigation, a full data validation will be performed. The data review process is described in the QAPP and requires verifying the completeness, correctness, and conformance/compliance of the data against acceptance criteria.

5.5 FULL DATA VALIDATION

Full validation will be completed on 10 to 20 percent of the data packages. To perform full data validation, data summary packages of Level IV are required. Level IV data packages consist of the Level III requirements provided above, plus summary of internal standards, initial and continuing calibration recoveries and raw data, initial and calibration blank concentrations and raw data, analytical run logs, sample and standard preparation logs, and all instrument raw data. The data will be validated against the laboratory method requirements and project or work plan specific quality objectives. At a minimum the USEPA National Functional Guidelines steps will be followed.

5.6 DATA VALIDATION REPORT

Based on the outcome of the data verification and data validation procedures, individual sample records may be qualified. Qualifiers (flags) indicate if results are inconsistent, anomalous, outside of tolerance limits, estimated, or rejected. Only rejected data will be considered unusable for decision-making. Flags will follow the National Functional Guidelines, or where none are available (*e.g.*, radiochemistry) will be clearly defined. Data validation reports will include a complete list of applicable Sample Delivery Group (SDG) designations and the number of samples within each SDG along with reconciliation between each sample and SDG. All sensitivity indicators (*e.g.*, Practical Quantitation Limit) will be clearly defined.

5.7 RECONCILIATION WITH USER REQUIREMENTS

After environmental data have been reviewed, verified, and validated in accordance with the procedures described above and in the QAPP, the data must and will be further evaluated to determine whether the Data Quality Objectives (DQOs) have been met. Data will be evaluated according to USEPA's data quality assessment (DQA) process to verify that the type, quality, and quantity of data collected are appropriate for their intended use. DQA methods and procedures are outlined in USEPA *Guidance for Data Quality Assessment, Practical Methods for Data Analysis* (USEPA 2000). The DQA process includes five steps: (1) review the DQOs and sampling design; (2) conduct a preliminary data review; (3) select a statistical test; (4) verify the assumptions of the statistical test; and (5) draw conclusions from the data.

SECTION 5 REFERENCES

- Basic Remediation Company (BRC) and MWH. 2006. BRC Quality Assurance Project Plan. April.
- U.S. Department of Energy (USDOE). 1997. Evaluation of Radiochemical Data Usability. ES/ER/MS-5.
- U.S. Environmental Protection Agency (USEPA). 2000. Guidance for Data Quality Assessment, Practical Methods for Data Analysis. EPA QA/G-9. EPA/600/R-96/084. Office of Environmental Information, Washington, DC. July.
- USEPA. 2002. Guidance on Environmental Data Verification and Validation. EPA QA/G-8. EPA/240/R-02/004. Office of Environmental Information, Washington, DC. November.
- USEPA. 2004. National Functional Guidelines for Inorganic Data Review. USEPA 540-R-04-004. OSWER 9240.1-45. October.

SECTION 6

6 DATA USABILITY EVALUATION

This section describes the procedures used to evaluate the acceptability of data for use in the risk assessment. Overall quality of sample results is a function of proper sample management. Management of samples begins at the time of collection and continues throughout the analysis process. The collection of environmental data will follow the quality assurance/quality control (QA/QC) procedures identified in the QAPP (BRC and MWH 2006a) prepared for the Site. Standard Operating Procedures (SOPs) that are wholly consistent with the risk assessment will be followed to ensure that samples are collected and managed properly and consistently and to optimize the likelihood that the resultant data are valid and representative. Field methods are discussed in the Field Sampling and Standard Operating Procedures (FSSOP) document (BRC and MWH 2006b) and adhere to practices consistent with the policies of the NDEP. All relevant site characterization data will be reviewed for applicability and usability following procedures in USEPA's (1992a,b) *Guidance for Data Usability in Risk Assessment (Parts A and B)* and USEPA's (1989) *Risk Assessment Guidance for Superfund*.

6.1 CRITERION I: REPORTS TO RISK ASSESSOR

Data will be reported in a format that provides adequate data summaries and data documentation for the risk assessment. This criterion is limited to identification of the specific site characterization reports that comprise the site database, and the documentation of the report contents. The report components include:

- a. Site description with detailed map indicating site location (including site boundaries), surrounding structures, terrain features, population or receptors, air and water flow, and information regarding operative industrial processes (*i.e.*, source locations).
- b. Site map with sample locations identified.
- c. Description of sampling design and procedures including rationale.
- d. Description of analytical methods used and detection limits including sample quantitation limits (SQL) and detection limits for non-detect data.
- e. Results given on a per-sample basis, qualified for analytical limitations and error, and accompanied by SQLs. Estimated quantities of compounds/tentatively identified compounds.

- f. Field conditions and physical parameter data as appropriate for the environmental media of interest.
- g. Narrative explanation of qualified data on an analyte and sample basis, indicating direction of bias.
- h. QC data results for audits, blanks, replicates, and spikes from the field and laboratory.
- i. Definitions and descriptions of flagged data.
- j. Hardcopy of diskette results.
- k. Raw data (instrument output, chromatograms, spectra) (laboratory report sheets are usually adequate).

6.2 CRITERION II: DOCUMENTATION

The objective of the documentation review is to ensure that each analytical result can be traced to a sample location and that the procedure(s) used to collect the environmental samples were appropriate. The three acceptable types of documentation used to trace samples and analytical methods are chain-of-custody forms, SOPs, and field and analytical records. All three types will be employed by BRC in this Closure Plan.

The minimum requirement of Criterion II is that sample results must be related to a specific geographic location and documentation of the sample location versus sample result (*i.e.*, chain-of-custody records, SOPs, field and analytical records) must be provided. BRC will comply with this requirement, at a minimum.

6.3 CRITERION III: DATA SOURCES

The objective of the data source review is to ensure that the analytical techniques used for the investigation are appropriate to identify COPCs for each exposure area and environmental medium of interest. Comparability of data from different sources (*e.g.*, different investigations, different analytical methods, etc.) will be evaluated.

The minimum requirements for this criterion are:

- a. Analytical sample data results are produced for each medium within an exposure area,

- b. A broad spectrum analysis is available for at least one sample per medium per exposure area,
- c. [where relevant] Field measurement data for physical characteristics of the Site, medium, or contamination source where deemed critical to the quantitative evaluation of risk (*i.e.*, needed for fate/transport modeling). Examples include particle size, pH, soil porosity, soil moisture content, soil organic carbon content, wind direction/speed, topography, percent vegetative cover.

BRC will comply with these requirements.

6.4 CRITERION IV: ANALYTICAL METHODS AND DETECTION LIMITS

For a chemical result to be usable for assessing risks, the analytical method must appropriately identify the chemical form or species, and the sample detection limit must be at or below a concentration that is associated with risk benchmark levels. When a COPC is reported as not detected, the result can only be used with confidence if the quantitation limits reported are lower than the corresponding concentration of concern. (Note: USEPA provides a minimum recommended requirement that the MDL be no more than 20 percent of the concentration of concern). The minimum requirement for this evaluation step is that documentation that routine (*e.g.*, USEPA or ASTM) methods were used to analyze COPCs in critical samples. BRC will comply with this requirement.

6.5 CRITERION V: DATA REVIEW

This step consists of the assessment of the quality of analytical results, performed by a professional knowledgeable in the necessary analytical procedure(s). The requirement for risk assessment is that only data that have been reviewed according to a specified level or plan (usually specified in DQOs) will be used. Any analytical errors, potential data gaps, and/or limitations in the data to be used must and will be addressed; an explanation for data qualifiers must be included.

All site data must have a sufficient level of review. The appropriate level of review, for each data source, must and will be identified, applied, and documented. The minimum requirement for this data usability evaluation criterion is that there be a “defined level of data review for all data” (USEPA 1992). The level and depth of the data review must and will include and examination of laboratory and method performance for the samples and analytes involved. This examination will include:

- a. Evaluation of data completeness,
- b. Verification of instrument calibration,
- c. Measurement of laboratory precision using duplicates; measurement of laboratory accuracy using spikes,
- d. Examination of blanks for contamination,
- e. Assessment of adherence to method specifications and QC limits, and
- f. Evaluation of method performance in the sample matrix.

6.6 CRITERION VI: DATA QUALITY INDICATORS

The data quality indicators (DQI) address field and analytical data quality aspects as they relate to uncertainties in selection of COPCs, exposure point concentrations, and risk characterization. The DQIs are briefly discussed below.

Completeness is measured, for risk assessment purposes, by the total number of data points available and acceptable for each COPC for each medium of interest. For risk assessment purposes, the adequacy of the number of samples is evaluated in terms of: (1) acceptable uncertainty regarding the identification of COPCs in each environmental medium of interest and within each exposure area; and (2) acceptable uncertainty regarding the estimation of exposure point concentration of each COPC within each exposure area.

Comparability is a critical parameter when considering the combination of data sets from different analyses for the same COPCs. Only comparable data sets can readily be combined for the purpose of generating a single risk assessment decision/calculation. The use of standard sampling and analytical methods simplifies the determination of comparability. All non-routine methods will be specifically evaluated for comparability in the data usability evaluation.

Representativeness of data used in risk assessment will be documented. The results of the risk assessment will be biased to the degree that the data do or do not reflect the chemicals and concentrations present in the exposure area of interest. In cases where sampling was not specifically designed to characterize representative COPCs and exposure concentrations for all potential sub-areas of the Site, it is critical to evaluate what the impact on the risk assessment results may be. In addition to sampling strategy issues, analytical data quality will be assessed in

regard to representativeness. Holding time, sample preservation, extraction procedures, and results from analyses of blanks affect the representativeness of analytical data.

Precision is determined by evaluating: (1) the sampling variability; and (2) the measurement error. Assessment of sampling variability is critical to identifying the appropriate statistical measures and the number of required samples (USEPA 1992). Assessment of measurement error is accomplished by using the results of field duplicate samples. Field duplicates determine total within-batch measurement error (including analytical error if the samples are also analyzed (as laboratory duplicates). The laboratory limits for precision, as measured by the relative percent difference between laboratory control sample analyses, are the laboratory control limits, based on historical data calculated, as specified in the analytical methods.

Accuracy is a measure of overestimation or underestimation of reported concentrations and is evaluated from the results of spiked samples. Accuracy is controlled primarily by the analytical process and is reported as bias. Bias is estimated for the measurement process by calculating the percent recovery (%R) for the spiked or reference compound.

The minimum requirements for the assessment of DQIs are:

- a. Sampling variability must be quantitated for each analyte,
- b. QC samples must be evaluated to identify and quantitate precision and accuracy,
- c. Sampling and analytical precision and accuracy must be quantitated.

BRC will comply with these requirements.

SECTION 6 REFERENCES

Basic Remediation Company (BRC) and MWH. 2006a. BRC Quality Assurance Project Plan, BMI Common Areas, Clark County, Nevada. April.

BRC and MWH. 2006b. BRC Field Sampling and Standard Operating Procedures, BMI Common Areas, Clark County, Nevada. May.

U.S. Environmental Protection Agency (USEPA). 1989. Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual (Part A). Interim Final. Office of Emergency and Remedial Response, Washington, D.C. USEPA/540/1-89/002. December.

USEPA. 1992a. Guidance for Data Usability in Risk Assessment. Part A. Office of Emergency and Remedial Response, Washington D.C. Publication 9285.7-09A. PB92-963356. April.

USEPA. 1992b. Guidance for Data Usability in Risk Assessment. Part B. Office of Emergency and Remedial Response, Washington D.C. Publication 9285.7-09B. PB92-963362. May.

SECTION 7

7 DATA QUALITY OBJECTIVES

This section first provides a general overview of USEPA and NDEP's 7-step DQO process. After that it discusses one of the key decision inputs to the DQO process, namely the Step 2 Principal Study Questions (PSQs) that this closure process will address before Closure is complete for the Eastside Area. The PSQs are the central Eastside Area-wide questions that provide a basis for the overall closure effort. Per discussions with the NDEP, the other steps of the DQO process will be addressed, on an Eastside Area sub-area by sub-area basis (for soils), in the respective sub-area Sampling and Analysis Plans that BRC plans on developing for each sub-area (Figure 1-4) relating to the soils cleanup. It is also possible that there may be other sub-area specific PSQs that may be developed. These too will be addressed in the respective sub-area Sampling and Analysis Plans. Similarly, the other steps of the DQO process for groundwater or other media will be discussed in subsequent Sampling and Analysis plans for those media as they are developed.

7.1 OVERVIEW OF THE DQO PROCESS

The DQO process is a strategic, systematic process for planning scientific data collection efforts. The DQO process helps investigators and decision makers answer the following basic questions:

- Why do we need data?
- What must the data represent?
- How will we use the data?
- How much uncertainty is tolerable?

By using the DQO process, BRC will ensure that the data collected for decision making are of the right type, quantity, and quality. In addition, the DQO process:

- Ensures that limited resources are spent on collecting only those data that will support defensible decisions;
- Allows flexibility in planning because of its iterative nature (sometimes new information or conclusions cause the planning team to cycle back to earlier steps in the process); and

- Promotes multidisciplinary group consensus-building methodology that ensures buy-in from key participants and critical stakeholders.

The DQO process has been widely applied to environmental problems, such as investigating contamination in soil or water, and is set forth in USEPA guidance.

The DQO process, as defined by USEPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4*, consists of seven steps:

Step 1 - State the problem

Step 2 - Identify the decision

Step 3 - Identify the inputs to the decision

Step 4 - Define the study boundaries

Step 5 - Develop decision rules

Step 6 - Specify limits on decision errors

Step 7 - Optimize the process for obtaining data.

Each of these steps, along with sub-activities that comprise each step, are outlined below:

Step 1. State the Problem

The first step in the DQO process is to define the problem that initiated the study. Often, problems can be very complex, requiring investigators to examine a variety of political, economic, scientific, technical, legal, and social factors. This step allows the decision-making team to recognize multiple facets of the problem and consider the perspectives of key stakeholders to ensure all issues are addressed properly and adequately. This includes gathering all available relevant information so that a CSM can be developed and the needs of the site actions can be better defined.

There are four basic activities in this step:

- Identify members of the planning team. The planning team is the group of people who will develop the DQOs for the study. Generally, the team consists of representatives from key groups with a role in data collection or use, and often those with a critical interest or stake in

the problem; the size of the team depends on the scope and complexity of the problem. An example of a team for a Superfund site might be the Remedial Project Manager, a soil scientist, a hydrogeologist, a chemist, a risk assessor, representatives from the site's potentially responsible party, a QA specialist, and a statistician.

- Identify the primary decision maker of the planning team and define each member's role and responsibility during the DQO process. The planning team should have a leader (often the person with the most authority over the study) who is responsible for making final decisions based on the recommendations of the planning team. In the example provided above, the Remedial Project Manager would be the logical choice for the primary decision maker for the study.
- Develop a concise description of the problem. This description provides background information about the problem and allows the team to focus on the fundamental issue to be addressed by the study. Some elements to include for the description might be study objectives, regulatory context, groups who are involved or who have an interest in the study, political issues, funding, previous study results, land usage, and any obvious existing sampling design constraints.
- Specify the available resources and relevant deadlines for the study. The planning team needs to determine the budget, personnel, and resources available for the study, as well as list intermediate and final deadlines that may need to be met.

Step 2. Identify the Decision

The second step in the process is to define the decision statement that the study will attempt to resolve. There are four basic activities in this step:

- Identify the PSQ(s). The PSQ(s) helps the planning team narrow the often complex issues of a problem so that the team may focus their study. The question(s) identifies the unknown conditions or unresolved issues to the problem being investigated. The PSQs identified for this project in order to affect ultimate closure of the Site are discussed later in this section.
- Define the alternative actions that could result from resolution of the PSQ. The planning team identifies what possible actions may be taken to solve the problem. The types of actions also include the alternative that no action will be taken. For example, if the PSQ is "Is the

soil in a particular site contaminated?,” the alternative actions might be to take corrective action or to take no action.

- Combine the PSQ and the alternative actions into a decision statement. The planning team combines the actions and PSQ developed earlier in this step. A standard format for drafting decision statements is: “Determine whether or not [unknown environmental conditions/issues/criteria from the PSQ] require (or support) [taking alternative actions].” For the example used above, the decision statement would be “Determine whether or not the soil is contaminated and requires corrective action.”
- Organize multiple decisions. If several separate decision statements are to be addressed, the planning team must identify the relationships among the decisions, such as the order in which they should be resolved.

Step 3. Identify Inputs to the Decision

In this step, the planning team identifies the different types of information needed to resolve the decision statement. One of the purposes of the DQO process is to assist in new data collection. Historic data are considered in the CSM and new data needs are identified (potentially iteratively) via the CSM data gaps and DQO process. There are four activities in this step:

- Identify the information that will be required to resolve the decision statement. The team determines what environmental variables and other information are needed to resolve the decision statement. They may consider whether they should use modeling or monitoring approaches or a combination of the two. For example, the information may be variables such as levels of arsenic or radium 226 or even pH.
- Determine the sources for each item of information identified. The team identifies the sources of information they need to collect. The team may be able to use data from previous studies or investigations, or they may need to collect new data, or some combination of both.
- Identify the information that is needed to establish action levels. The team defines the basis for the action level, which defines a threshold value for determining which alternative action will be taken. Action levels may be based on regulatory standards, or they may be derived from site- and contaminant-specific criteria such as risk analyses. (This step identifies the basis of the action level; the actual numerical value of the action level is set in Step 5.)

- Confirm that appropriate analytical methods exist to provide the necessary data. The team ensures that there are methods available to provide them with acceptable environmental measurements. The team should list each method with its appropriate MDL and limit of quantitation (LOQ), as well as method performance data. If acceptable methods do not exist, the planning team may need to reconsider the approach for providing inputs, or perhaps reformulate the decision statement in Step 2.

Step 4. Define the Boundaries of the Study

In this step, the planning team defines the spatial and temporal boundaries of the problem. There are five activities in this step:

- Specify the characteristics that define the population of interest. The team defines the attributes of the population so that the focus of the study is unambiguous. Some examples of key attributes of interest in the target population are “concentrations of perchlorate in groundwater” or “arsenic concentrations in soil.”
- Define the spatial boundary of the decision statement. There are two steps to this activity. First, the team defines the geographic area to which the decision applies, such as “a property or site boundary.” Second, by using previously existing information, the team divides the population into strata that have relatively homogeneous characteristics (such as contaminant concentrations). By dividing the population, the team reduces the variability within subsets of data and makes the problem more manageable.
- Define the temporal boundary of the problem. There are two steps to this activity. First, the team determines the time frame to which the decision applies. This means that the team decides the time frame for which they wish to make a decision about using the data to be collected. For example, the data might be used to make a decision about possible contaminant exposures to local residents over a 30-year period. Second, the team needs to decide when they can collect data. The team must consider factors such as seasonal or daily variations in the population to be sampled, as well as weather and temperature conditions that may affect the data collected.
- Define the scale of decision making. The team determines the smallest, most appropriate subsets of the population for which they will make a decision. For example, a population might be the concentrations of arsenic in soil at a 100-acre sub-area of the Site, but the scale

of decision-making might be the top 10 feet of soil in a 1/8th acre area (*e.g.*, the area based on the size of a future residential lot).

- Identify practical constraints on data collection. The team identifies obstacles to data collection, such as the availability of sampling equipment or personnel or gaining permission to investigate private property.

Step 5. Develop a Decision Rule

In this step, the planning team summarizes the attributes of the problem and how the information collected will guide the team to choose a course of action that will solve the problem. There are four main elements to the decision rule: the parameter of interest, the scale of decision making, the action level, and the alternative actions.

The three activities involved in this step are as follows:

- Specify the statistical parameter that characterizes the population (the parameter of interest). The planning team determines the parameter of interest (such as a mean, median, or percentile) whose true value the team would like to know and that the data will estimate. For example, at many Superfund sites, investigators often choose the mean as the parameter of interest when the action level is based on long-term, average health effects.
- Specify the action level for the study. The decision maker chooses the numerical value that would cause one to choose between alternative actions. In some cases, the action value is determined by regulatory standards.
- Develop a decision rule. The decision rule is an “if ... then ...” statement that incorporates the parameter of interest, the scale of decision making, the action level, and the actions that would result from the decision. For example, at a site undergoing remediation, the decision rule might be as follows: “If the mean concentration of lead in a 1/8th -acre plot of soil is less than 400 milligrams per kilogram (mg/kg), then remediation is complete; otherwise, continue remediation.”

Step 6. Specify Tolerable Limits on Decision Errors

In this step, the decision maker chooses tolerable limits on decision errors. These limits are used to establish performance goals for the data collection design. BRC recognizes that this Step may be difficult to implement on a complex site such as BRC. BRC will minimize decision errors by

considering data adequacy in the DQA process. However, in the event that BRC may attempt to minimize decision errors using a typical Step 6 analysis, there are four activities in this step:

- Determine the possible range of the parameter of interest. The team establishes the likely upper and lower bounds of the parameter. To determine the range, the team may examine historical and documented analytical data. For example, previous studies may indicate that the range of PAH concentrations in soil undergoing remediation might be from 50 to 1,000 mg/kg.
- Identify the decision errors and choose the null hypothesis. There are four steps in this activity:
 1. The team determines the two types of decision errors and establishes the true state of nature for each decision error. A decision error occurs when the data erroneously lead the decision maker to conclude that the parameter of interest is on one side of the action level, when in fact the true value of the parameter is on the other side of the action level—in other words, a false positive or a false negative.
 2. The team specifies and evaluates the potential consequences of each decision error.
 3. The team then establishes which decision error has more severe consequences near the action level.
 4. The team defines the null hypothesis (baseline condition) and the alternative hypothesis and assigns the terms “false positive” and “false negative” to the appropriate decision error. Sometimes the choice of a baseline condition is determined by regulations. Other times, there may be a preponderance of evidence or logical reasons why one condition should be chosen as the baseline. If none of these circumstances hold, then the baseline is chosen to be the “worst case” so that the data must show convincing evidence to the contrary, leading to a “better safe than sorry” stance.
- Specify a range of possible parameter values where the consequences of decision errors are relatively minor, a gray region. The gray region is a range of possible parameter values where the consequences of a false negative decision error are relatively minor. The gray region is bounded on one side by the action level and on the other side by that parameter value where the consequences of making a false negative decision error begin to be significant. The decision maker establishes this boundary by examining the consequences of

not rejecting the null hypothesis when it is false. Then, the decision maker places this edge of the gray region where these consequences are severe enough to set a limit on the magnitude of this false negative decision error. Specifying a gray region is necessary because variability in the population and unavoidable imprecision in the measurement system combine to produce variability in the data such that a decision may be “too close to call” when the true parameter value is very near the action level. Therefore, the gray region (or “area of uncertainty”) establishes the minimum distance from the action level where the decision maker would like to begin to control false negative decision errors.

- Assign probability limits to points above and below the gray region that reflect the tolerable probability for the occurrence of decision errors. These limits reflect the decision maker’s tolerable limits to making an incorrect decision. The decision maker selects a possible value of the parameter and then chooses a probability limit based on the evaluation of the seriousness of the potential consequences of making the decision error if the true parameter value is located at that point. At a minimum, the decision maker should specify a false positive decision error limit at the action level and a false negative decision error limit at the other end of the gray region.

The outputs of Step 6 may be shown graphically on a Decision Performance Goal Diagram (which is essentially a statistician’s power curve).

Step 7. Optimize the Design

In this final step, the planning team selects a resource-effective data collection design for collecting data that will satisfy the DQOs. There are six activities in this step:

- Review the DQO outputs and existing environmental data. The team reviews the outputs of the six previous steps and ensures that they are consistent.
- Develop general data collection design alternatives. The team decides what kinds of data collection designs are feasible and appropriate for the Site. In this activity, the team also determines what each design will cost and what types of information will be provided by using the design.

Formulate the mathematical expressions needed to solve the design problems for each data collection design alternative. Three mathematical expressions are needed to optimize the design:

1. A method for testing the statistical hypothesis and for defining the sample size formula (*e.g.*, Student's *t*-test)
 2. A statistical model that describes the relationship of the measured value to the “true” value
 3. A cost function that relates the number of samples to the total cost of sampling and analysis.
- Select the optimal sample size that satisfies the DQOs for each data collection design alternative. Using the equations developed in the previous activity and limits placed on decision errors, the team determines the optimal sample size. If no design fits the specified criteria, the team may have to relax the constraints (such as false negative or false positive error rates or the size of the gray region in Step 6) placed upon the design.
 - Select the most resource-effective data collection design that satisfies all of the DQOs. The team evaluates the design options based on cost and the ability to meet the specified DQOs.
 - Document the operational details and theoretical assumptions of the selected design in the sampling and analysis plan. These details are needed to allow for efficient and valid statistical interpretation of the data which is conducted as part of the DQA, before the data are used in subsequent analyses such as risk assessments.

It is unlikely that BRC will attempt a rigorous, quantitative Step 7 analysis for this project in all instances. If suitable alternatives are available, BRC will evaluate the cost of collecting the requisite data in different ways. For example, typically, soil data will be collected via sampling per the approved SOP followed by fixed laboratory analysis; however, it is possible that for some compounds or in certain situations, alternatives such as field screening may also provide valid data. In such cases, the Step 7 analysis will be based on cost considerations without compromising data objectives.

7.2 PRINCIPAL STUDY QUESTIONS FOR THE PROJECT

This subsection discusses the PSQs that are fundamental to the DQO process. These PSQs are identified below at in 7.2.1. Note that it is possible that additional PSQs could be developed in the future or some of the current PSQs could be combined, as needed. For the purposes of these PSQs, the word “current” is defined as pre-development. This can be any point in time from the present time through the remediation phase, but prior to development. Similarly, “future” is defined as post-remediation. The word “incremental” can mean two different things. In one

context, “incremental” means over background or over upgradient conditions. For example, if risks due to the background level for a particular pollutant in soil is X, then incremental in this context would mean that “risk value over X.” In a second context, “incremental” may mean over some prevailing ambient value. For example, if the US average cancer risk is Y due to all causes, then incremental in this case is “cancer risk over Y.” It will be clear, by context, which meaning of incremental is intended.

In general, each study question concerns the existence of contamination in various media, the remediation that has occurred, the confirmation sampling that has followed, and the desire to clean up the Site to background levels so that incremental risk is small. The decision that will be made could be stated with the following question:

Example PSQ 1 – Are the current incremental risks to human health in sub-area X sufficiently low that they are acceptable? If the incremental risks are not sufficiently low then reasonable further action will be taken, otherwise, no further action will be taken.

It should be noted that this approach to PSQs makes it clear that the final decisions are based on incremental risks, as discussed earlier in the first context. Background comparisons are the essential context to the main and final decisions that are based on incremental human health risk over background. The term “reasonably” used in the example PSQ above recognizes that there is uncertainty, that there are consequences to making an incorrect decision and that there are costs involved in mitigation (soil removal in this case). That is, there is a trade-off between reducing uncertainty (via more data collection requiring more time and money and also prolonging present unremediated conditions) and reduction in decision risk, or between mitigation (which also requires more time and money) and putative reduction in human health risk. BRC may refine this example PSQ, if needed, to handle specific risk endpoints such as 10^{-6} excess cancers risk, a Hazard Index (HI) of 1.0, or a lead threshold of 400 mg/kg, etc., or make the PSQ relate to a specific medium (*e.g.*, surface soil, groundwater, etc.). While this example PSQ could be aimed at the whole Eastside Area rather than a sub-area, it is BRC’s intention to focus the PSQs on each discrete sub-area of the Site.

7.2.1 Site Principal Study Questions

There are six (6) PSQs. These are:

PSQ 1 – Are the current incremental risks to human health in the sub-area under investigation sufficiently low that they are acceptable? If the incremental risks are not sufficiently low, then reasonable further action will be taken; otherwise, no further action will be taken.

PSQ 2 – Are the current concentrations of contaminants associated with groundwater under the Site (*e.g.*, under the Eastside Area), after consideration of groundwater quality upgradient of the Site, sufficiently low that they are acceptable? If the concentrations are not sufficiently low, then reasonable further action will be taken; otherwise, no further action will be taken.

PSQ 3 – Are the current concentrations of contaminants associated with offsite groundwater downgradient of the Site, after consideration of groundwater quality upgradient of the Site, sufficiently low that they are acceptable? If the concentrations are not sufficiently low, then reasonable further action will be taken; otherwise, no further action will be taken.

PSQ 4 – Are the incremental human health risks associated with groundwater at the Site after development is completed (*i.e.*, post-development and under steady state conditions) sufficiently low that they are acceptable? If the incremental risks are not sufficiently low, then reasonable further action will be taken otherwise; no further action will be taken.

PSQ 5 – Are the current incremental ecological risks in the Trails & Recreation sub-area sufficiently low that they are acceptable? If the incremental risks are not sufficiently low, then reasonable further action will be taken; otherwise, no further action will be taken.

PSQ 6 – Are there current incremental ecological risks offsite that are attributable to migration of contaminants from the Site? If so, are these incremental risks sufficiently low that they are acceptable? If the incremental risks are not sufficiently low, then reasonable further action will be taken; otherwise, no further action will be taken.

It should be noted that a PSQ for off-site soils locations has not been developed at this time. BRC is in the process of determining via surface soil sampling in suitable offsite locations, whether any offsite migration of site contaminants may have occurred via the air entrainment and dust deposition pathway. BRC has previously conducted sampling and demonstrated that contaminated sediments have not impacted offsite locations via surface water and attendant sediment flows via the ditches. BRC does not believe that surface water sheet flow can transport site soils and sediments offsite since such water is typically contained in the various ponds and cannot flow downgradient.

Finally, it should be noted, for PSQ6, that this evaluation of incremental offsite ecological risks cannot be conducted by BRC alone since offsite migration of contaminants may have occurred due to the actions of numerous parties. Therefore, PSQ6 will likely be addressed via multi-party investigations, as needed.

SECTION 8

8 REMEDIAL ALTERNATIVE STUDIES

Once site characterization investigations are complete (generally pursuant to NDEP-approved work plans), it is customary, based on the findings of such investigative efforts, to develop a RAS in order to address remedial strategies that may be necessary in order to reduce or eliminate contamination in the study area for the particular media (soils, groundwater, vadose zone, etc.) under evaluation. The RAS, once approved, is documented via issuance of a ROD by the NDEP. The ROD, therefore, chooses among the various alternatives evaluated in the RAS. Alternatives can range from the “No Action” alternative to progressively more involved *in-situ* or *ex-situ* remedial actions, depending on the specifics of the study area and the media in question as well as intended future uses of the study area.

Each RAS alternative is evaluated against all of the criteria consistent with the USEPA guidance (USEPA 1988) for conducting a Feasibility Study. These criteria are as follows:

- a. Overall protection of human health and the environment;
- b. Compliance with ARARs;
- c. Long-term effectiveness and permanence;
- d. Reduction of toxicity, mobility or volume;
- e. Short-term effectiveness;
- f. Implementability;
- g. Cost;
- h. State acceptance; and
- i. Community acceptance.

BRC has followed and intends to follow the same approach for this project.

8.1 EASTSIDE AREA SOILS

As part of the Eastside Area Soils RAS (ERM 2000), various remedial options were identified to achieve the remedial action objectives and site-specific soil cleanup goals. Those remedial options that best addressed the soil conditions and mitigation of future exposures were combined to form remedial alternatives. The remedial alternatives considered in the RAS were as follows:

Alternative 1 - No action

Alternative 2 - Institutional controls / limited action

Alternative 3 - On-Site capping of soils

Alternative 4 - Excavation and disposal of soils at an on-site landfill (located within the Site [Alternative 4A] or at the BMI Complex [Alternative 4B])

Alternative 5 - Excavation and disposal of soils at an off-site landfill

These alternatives were evaluated to assess the relative performance of each alternative with respect to the criteria discussed earlier.

Based on the evaluation of alternatives, Alternative 4B was identified as the preferred remedial alternative to eliminate the potential health risks posed by the presence of chemical constituents in Eastside Area soils. Because of the rapidly expanding residential development surrounding the Eastside Area, and with the input from community stakeholders and the state, Alternative 4B was proposed by BRC as best fitting the USEPA criteria of overall protection of human health and the environment, compliance with ARARs, long-term effectiveness and permanence, reduction of toxicity, mobility or volume, short-term effectiveness, implementability, cost, state acceptance, and community acceptance. The NDEP approved this proposed remedial alternative in its ROD (NDEP 2001), and the Henderson City Council unanimously affirmed it.

8.2 CAMU AREA SLIT-TRENCH WASTES

BRC is currently preparing a RAS for the wastes located in the slit-trench sub-area in the CAMU portion of the Site. Since the CAMU is proposed to be located on this sub-area, BRC is evaluating, with guidance from the NDEP, whether some or a portion of the wastes located in this sub-area should be excavated prior to the construction of the CAMU in this sub-area.

8.3 EASTSIDE AREA SHALLOW GROUNDWATER AND VADOSE ZONE

BRC is currently conducting characterization of shallow (*i.e.*, Aa) groundwater in the Eastside Area as discussed previously in Section 4. Upon completion of these characterization efforts as well as related groundwater modeling studies and studies relating to evaluation of groundwater conditions upgradient of the Eastside Area, BRC will prepare a RAS for shallow groundwater and associated vadose zone for the Eastside Area.

8.4 EASTSIDE AREA DEEPER GROUNDWATER

BRC is currently conducting characterization of deeper groundwater (*i.e.*, TMCf) in the Eastside Area as discussed previously in Section 4. Upon completion of these characterization efforts, BRC will discuss the need to prepare a RAS for deeper groundwater with the NDEP.

8.5 CAMU AREA GROUNDWATER

BRC has conducted an evaluation of groundwater in the CAMU Area in 2005. This is discussed in the *Draft CAMU Area Conceptual Site Model*. Groundwater in this area is contaminated upgradient of the CAMU Area and is presently being remediated (for certain contaminants) by others, downgradient of the CAMU Area. BRC will conduct additional evaluations of impacts to groundwater from the CAMU Area and then discuss RAS options with the NDEP and others presently conducting groundwater remediation in this area.

8.6 OTHER STUDY AREAS OR MEDIA

As noted in Section 4, BRC is in the process of conducting additional evaluations in order to better understand site conditions and to close data gaps. As BRC continues these evaluations, it may become necessary for BRC to address remediation of particular study areas or particular media. If needed, BRC will follow the same basic procedure discussed above. BRC will first complete appropriate characterization pursuant to NDEP-approved work plans, followed by discussions with the NDEP relating to the findings. Finally, if needed, the necessary RAS will be developed.

SECTION 8 REFERENCES

- Environmental Resources Management (ERM). 2000. Remedial Alternatives Study for Soils and Sediments in the Upper and Lower Ponds at the BMI Complex. Henderson, Nevada. March 1.
- Nevada Division of Environmental Protection (NDEP). 2001. Record of Decision, Remediation of Soils and Sediments in the Upper and Lower Ponds at the BMI Complex. Henderson, Nevada. November 2.
- U.S. Environmental Protection Agency (USEPA). 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final. Office of Emergency and Remedial Response, Washington, DC. EPA/540/G-89/004. October.

SECTION 9

9 RISK ASSESSMENT METHODOLOGY – HUMAN HEALTH

As presented in Section 1.1, BRC proposes that risk assessments at the Site be performed after remediation is completed, with the status of completion to be based upon confirmatory field observations and laboratory analyses. By performing risk assessments after remediation, environmental conditions will form a baseline for post-remediation exposures and risks, then and into the future.

9.1 PURPOSE

The purpose of the human health risk assessment is to evaluate the potential for adverse human health impacts that may occur as a result of potential exposures to residual concentrations of chemicals in soil, groundwater, surface water, and air following remediation. Findings of the human health risk assessment are intended to support the site closure process.

This section describes the technical approach, guiding principals, and tasks that will be employed to complete the post-remediation human health risk assessment. BRC's proposed baseline risk assessment approach for the Site follows basic procedures outlined in the USEPA's *Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual* (USEPA 1989) and *Draft Risk Assessment Guidance for Superfund: Volume 3—Part A, Process for Conducting Probabilistic Risk Assessment* (USEPA 2001a). Other guidance documents consulted by BRC in formulating its risk assessment methodology include:

- *Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual. Supplemental Guidance: Standard Default Exposure Factors*. USEPA. 1991a.
- *Guidelines for Exposure Assessment*. USEPA. 1992A.
- *Exposure Factors Handbook*. USEPA. 1997.
- *Soil Screening Guidance for Radionuclides*. USEPA. 2000a.
- *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*. USEPA. 2002a.
- *Technical Support Document for a Protocol to Assess Asbestos-Related Risk. Final Draft*. USEPA. 2003a.

- Nevada Administrative Code Chapter NAC 445A. Adopted Permanent Regulation of the Nevada State Environmental Commission. LCB File No. R119-96. NDEP. 1996.

A full list of guidance documents consulted is provided in the Reference section at the end of this document. It is anticipated that this human health risk assessment methodology will be the primary tool used to guide discussions with the NDEP with regard to the content and level of detail of the human health risk assessment that is needed to support decision-making for the Site.

9.1.1 Human Health Protection

For human health protection, BRC's goal is to remediate the Site soils such that they are suitable for unrestricted residential uses, assuring health protective conditions at 1/8th-acre exposure areas. The 1/8th-acre area corresponds to the size of a typical residential lot size, as presented in USEPA (1989) and is applicable to future Site conditions. There are only two exceptions to this general goal of residential end use, specifically, the areas within the Site that are designated as wetlands, and the adjoining areas where no development is planned (see delineation of Trails & Recreation sub-area on Figure 1-2).

It should be noted that although 1/8th-acre areas are the target for exposure, sampling will not occur on many of these 1/8th-acre exposure areas, instead assumptions of similar populations across the site (or areas larger than 1/8th-acre, as supported by the data) will allow estimates to be applied to 1/8th-acre exposure areas. The decision can hence be made simultaneously for many 1/8th-acre exposure areas based on the data and documentation that the exposure areas can be aggregated.

Project-specific risk level and remediation goals consistent with USEPA precedents and guidelines for residential uses have been established, as summarized later in this section. It should be noted that: 1) all comparisons to risk or chemical-specific goals will be made on an exposure area basis consistent with likely exposure assumptions, and 2) these comparisons shall be demonstrated through the use of statistical modeling to apply to each 1/8th-acre exposure area. The project-specific risk levels and remediation goals are presented below.

9.1.1.1 Risk Level Goals

The following target risk goals have been established for the Site in conjunction with additional chemical-specific goals discussed in Section 9.1.1.2:

1. Post-NFAD chemical and radionuclide concentrations in Site soils are targeted to have an associated residual, cumulative theoretical upper-bound incremental carcinogenic risk level point of departure of 10^{-6} . This is the target risk goal for the project. For cases where NDEP identifies this goal to be unfeasible, it is BRC's understanding that the NDEP will re-evaluate the goal in accordance with USEPA guidance [USEPA 1991b]). In no case will the residual, cumulative theoretical upper bound carcinogenic risk levels exceed those allowed per USEPA guidance.
2. Post-NFAD chemical concentrations in Site soils are targeted to have an associated cumulative, non-carcinogenic HI of 1.0 or less. If the screening HI is determined to be greater than 1.0, target organ-specific HIs will be calculated for primary and secondary organs (see discussion in Section 9.9). The final risk goal will be to achieve target organ-specific non-carcinogenic HIs of less than 1.0.
3. Where background levels exceed risk level goals or chemical-specific remediation goals, metals and radionuclides in Site soils are targeted to have risks no greater than those associated with background conditions.

9.1.1.2 Chemical-Specific Remediation Goals

In addition to the risk goals discussed above, a chemical-specific remediation goal has been established for lead. The target goal for lead is 400 mg/kg for residential land use, which is a residential soil concentration identified by USEPA (based on the Integrated Exposure Uptake Biokinetic Model [IEUBK] model) as protective of a residential scenario (USEPA 2004a).

9.2 OVERVIEW OF THE HUMAN HEALTH RISK ASSESSMENT PROCESS

Pursuant to NAC 445A and consistent with USEPA (2001a), and the National Academy of Science (1994) guidance, BRC proposes to follow a "tiered," or iterative, approach. The tiered approach focuses risk assessments on specific objectives, such as identifying potential areas of concern that need further investigation and/or remediation, and eliminating from further consideration areas that do not pose a risk to human health or the environment. BRC proposes to employ this tiered process for the post-remediation risk assessments, including specifically all pathways identified in Section 9.7.1. Therefore, references in this Closure Plan to "the risk assessment" pertain to each of these iterative risk assessments as they may be conducted at the Site.

The risk assessment process described herein consists of two tiers based on USEPA (2001a) recommendations. The first tier of the risk assessment process is a deterministic risk assessment approach, while the second tier is a probabilistic risk assessment approach. The deterministic risk assessment methodology is described comprehensively in this section. Specific details regarding proposed probabilistic risk assessment methodology will be described in a separate submittal to NDEP following the determination that a probabilistic risk assessment is warranted for a particular site. In preparing the human health risk assessment methodology, every effort has been made to take full advantage of available information to clarify the proposed technical approach. This human health risk assessment methodology is a “living” document—some portions of this document (*e.g.*, probabilistic distributions) will be submitted for insertion into a supplemental human health risk assessment methodology (as needed) as input from the NDEP is incorporated into the document prior to conducting the risk assessment for each sub-area.

9.3 SUMMARY OF CONCEPTUAL SITE MODEL AND DATA USABILITY EVALUATION

9.3.1 Summary of Conceptual Site Model

The CSM is a tool used in risk assessment to describe relationships between chemicals and potentially exposed human receptor populations, thereby delineating the relationships between the suspected sources of chemicals identified at the Site, the mechanisms by which the chemicals might be released and transported in the environment, and the means by which the receptors could come in contact with the chemicals. The CSM provides a basis for defining DQOs, guiding site characterization, and developing exposure scenarios. The site history, land uses, climate, physical attributes, including geology and hydrogeology, and various field investigations are fully described in Section 4, and in the Site-Wide CSM (in preparation).

9.3.1.1 Potential Current Exposure Pathways and Receptors

The Site is currently vacant except for the area of the City of Henderson southern RIBs. The potential on-site and off-site receptors are currently trespassers, occasional on-site workers, and off-site residents.

Risks to current receptors are being managed through site access control. In addition, although current exposures exist at the Site, the risk assessments will be performed after soils remediation is performed, therefore only potential future land-use conditions will be quantitatively evaluated.

9.3.1.2 Potential Future (Redevelopment and Post-Redevelopment) Exposure Pathways and Receptors

Under the current, prospective redevelopment plan, the Site will be used for a variety of purposes, including residential housing, parks, schools, places of worship, commercial and/or light industrial development, and streets. The entire Site will be enhanced by restoration and redevelopment once remediation is complete. To construct parks, civic structures and residences, the land will be cut and/or filled, paved with roads or foundations, and nurtured with imported top soils¹ as needed.

The Site will be redeveloped in several phases. Throughout the redevelopment process, one sub-area of the Site will be redeveloped while another sub-area is redeveloped sequentially. Future receptors identified as “on-site receptors” are defined as receptors located within the current Site boundaries (Figure 1-2), while future “off-site receptors” are those located outside the current Site boundaries. “On-site receptors” are those future receptors that will be located within the sub-area under evaluation. “Off-site receptors” are those future receptors that will be located outside of the sub-area under evaluation that may have complete exposure pathways associated with sources within the sub-area.

Many potential human receptors are possible at the Site in the period during and after redevelopment. The potentially exposed populations and their potential routes of exposure are presented in Figure 9-1 and summarized in Section 9.7.1. Because the background general water quality (*i.e.*, high salt concentrations) of the groundwater beneath the Site and in the surrounding area is poor and because BRC will place institutional controls in the form of a deed restriction to prevent future users from utilizing groundwater beneath the Site, the use of private water wells by residents, businesses, or parks for drinking water, irrigation water, or other non-potable uses (*e.g.*, washing cars, filling swimming pools) will not occur in the post-redevelopment phase. Therefore, exposure pathways relating to this type of use are incomplete.

9.3.2 Summary of Data Usability Evaluation

Section 6 describes the procedures to be used to evaluate the acceptability of data for use in the risk assessment.

¹ Note: Imported soil data will not be included in risk assessment calculations.

In addition to data validation, a QA/QC review of the analytical results will be conducted during the post-remediation field sampling effort. The analytical data will be reviewed for applicability and usability following procedures in the *Guidance for Data Usability in Risk Assessment (Parts A and B)* (USEPA 1992b,c) and USEPA (1989).

9.3.2.1 Overview of the Data Evaluation Process

The primary objective of the data usability evaluation is to identify appropriate data for use in the risk assessment. All relevant site characterization data will be reviewed for applicability and usability following procedures in USEPA's (1992b,c) *Guidance for Data Usability in Risk Assessment (Parts A and B)* and USEPA's (1989) *Risk Assessment Guidance for Superfund*. The USEPA data usability evaluation framework provides the basis for identifying and evaluating uncertainties in the human health risk assessment in regard to the site characterization data. Data usability is the process of assuring or determining that the quality of data generated meets the intended use. USEPA has established a specific guidance framework to provide risk assessors a consistent basis for making decisions about the minimum quality and quantity of environmental analytical data that are sufficient to support risk assessment decisions (USEPA 1992b,c). The USEPA data usability guidance provides an explicit set of data quality criteria that are used to determine the usability of site characterization data in the risk assessment process.

The six USEPA evaluation criteria by which data are judged for usability in risk assessment are:

- Availability of information associated with Site data;
- Documentation;
- Data sources;
- Analytical methods and detection limits;
- Data review; and
- DQIs, including precision, accuracy, representativeness, comparability, and completeness (PARCC).

A summary of these six criteria for determining data usability in the present risk assessment is described in this section. In addition, further details related to data evaluation are described in Section 6.

9.3.2.2 Data Adequacy

The concept of data adequacy incorporates: (i) an analytical program that seeks to quantify all relevant Site chemicals that have the potential to affect risk calculations, and (ii) a spatial density of sampling points that provides confidence that the Site has been sufficiently characterized and that areas requiring remediation have not been missed. The risk assessment analytical program for the Site represents a broad suite of analyses that cover all chemicals that might be conceivably expected to be present at elevated levels at the Site as a result of historical operations on the Site or adjacent to the Site.

An evaluation of the adequacy of the sampling for use in risk assessment will be presented in the risk assessment report. The evaluation may incorporate the results from three analyses. The first qualitatively evaluates whether the sample collection appears to be adequately representative in relation to the CSM. The second analysis addresses data quality using traditional classical statistics-based process. The third analysis presents a probabilistic analysis of the data.

9.4 SELECTION OF COPCs FOR HUMAN HEALTH RISK ASSESSMENT

COPCs will be selected for each exposure area evaluated. The broad suite of analytes presented in the SRC list (Section 3) is considered to be the current list of potential COPCs at the Site, based on site characterization conducted to date. However, in order to ensure that each risk assessment focuses on those substances that contribute the greatest to the overall risk (USEPA 1989); two procedures will be used to identify the COPCs for quantitative evaluation in the risk assessment:

- Identification of chemicals with detected levels which are greater than background concentrations (where applicable), and
- Identification of chemicals that are frequently detected at the Site.

As to the latter, chemicals that are infrequently detected within an area will be discussed on a case-by-case basis with NDEP. The procedure for evaluating COPCs relative to background conditions is presented below.

9.4.1 Evaluation of Site Concentrations Relative to Background Conditions

USEPA (1989, 2002b,c) guidance allows for the elimination of chemicals from further quantitative evaluation if detected levels are not elevated above naturally occurring levels.

Typically for purposes of selecting COPCs for risk assessment, COPCs are chemicals that are shown to be elevated above naturally occurring levels based on statistical analyses. For the purpose of selecting COPCs for each sub-area risk assessment, appropriate statistical methods will be applied for the background analyses. When the results of the statistical analyses indicate that a particular chemical is within background levels, then the chemical will not be identified as a COPC and will not be quantitatively evaluated in the risk assessment. That is, a chemical is selected as a COPC based on background conditions if it is determined to be above background levels based on a weight-of-evidence evaluation of the results of the individual background comparison tests. A chemical will be excluded as a COPC if it is determined to be at or below background levels based on a collective weight of evidence approach. The chemical will, however, be addressed qualitatively in the uncertainty analysis section of the risk assessment report (USEPA 2002b). Also consistent with USEPA guidance (2002b), for chemicals that exceed their respective background levels, risks will be calculated considering both background and site-related risks. In addition, risks associated with background levels will also be presented for comparison purposes.

The comparison of site-related soil concentrations to background levels will be conducted using the existing, provisional soils background data set presented in the *Background Shallow Soil Summary Report, BMI Complex and Common Area Vicinity* (BRC and TIMET 2007, currently in review by the NDEP), which includes both the Environ (2003) dataset and the BRC/TIMET dataset collected in 2005.

Background comparisons will be performed using the Quantile test, Slippage test, the *t*-test, and the Wilcoxon Rank Sum test with Gehan modification. The Quantile test, Slippage test, and Wilcoxon Rank Sum test are nonparametric. That is, the tests are distribution free; thus an assumption of whether the data are normally or lognormally distributed is not necessary. The computer statistical software program, Guided Interactive Statistical Decision Tools (GISdT[®]; Neptune and Company 2007), will be used to perform all statistical comparisons, with a decision error of $\alpha = 0.025$.

The Wilcoxon Rank Sum test performs a test for a difference between the sum of the ranks for two populations. This is a nonparametric method for assessing differences in the centers of the distributions that relies on the relative rankings of data values. Knowledge of the precise form of the population distributions is not necessary. The Wilcoxon Rank Sum test has less power than the two-sample *t*-test when the data are normally distributed, but the assumptions are not as

restrictive. The GISdT[®] version of the Wilcoxon Rank Sum test uses the Mantel approach which is equivalent to using the Gehan ranking system.

The Quantile test addresses tail effects which are not addressed in the Wilcoxon rank-sum test. The Quantile test looks for differences in the right tails (upper-end of the data set) rather than central tendency like the Wilcoxon rank-sum test. The Quantile test will be performed using a defined quantile = 0.80.

The Slippage test looks for a shift to the right in the extreme right-tail of the background data set versus the extreme right-tail of the site data set. This is equivalent to asking if a set of the largest values of the site distribution are significantly larger (in a statistical sense) than the maximum value of the background distribution.

Typically an $\alpha = 0.05$ is used to evaluate a statistically significant result. Since several correlated tests will be conducted, a lower alpha is selected. As more tests are performed, it is more likely that a statistically significant result will be obtained purely by chance. Given the use of multiple statistical tests, an $\alpha = 0.025$ is selected as a reasonable significance level for the COPC selection. Generally, any chemical that resulted in a p value less than 0.025 in one of four tests will be retained as a COPC. Additionally, these tests are set up with one-sided hypotheses. Consequently, not only are differences between the two samples able to be detected, a directional determination can be made as well (*e.g.*, Site is greater than background).

Cumulative probability plots and side-by-side box-and-whisker plots will also be prepared to evaluate whether the Site data and background data are representative of a single population. These plots are qualitatively used in the selection of COPCs. These plots give a visual indication of the similarities between the Site and background data sets. A determination to eliminate a chemical as a COPC on the basis of these visual indications will be made on a case-by-case basis with the NDEP.

9.4.2 Further Selection of COPCs

The COPC selection criteria described in this section will be applied to metals and radionuclide COPCs that are present above background levels, and all other detected chemicals. Initially, as discussed above, the broad-suite analytes will be considered to be potential COPCs at the Site. From this list, a preliminary list of COPCs will be derived for purposes of risk assessment that includes chemicals that are:

- Positively identified in at least one sample in a given medium, including: (1) chemicals with no qualifiers attached (excluding non-detect results with unusually high detection limits, if warranted), and (2) chemicals with qualifiers attached that indicate known identities but estimated concentrations (*e.g.*, J-qualified data);
- Detected at levels significantly elevated above levels of the same chemicals detected in associated blank samples (this protocol includes an analyte if it is known to be site-related and its concentration is greater than five times the maximum amount detected in any blank; if the chemical is a common laboratory contaminant [as defined by USEPA 1989], it is included only if its concentration is greater than 10 times the maximum amount detected in any blank);
- Tentatively identified but presumed to be present because of association with the Site based on historical information; and
- Transformation (*e.g.*, degradation) products of chemicals demonstrated to be present.

In deriving the preliminary list of COPCs, the following criteria established by USEPA (1989) will also be considered:

Historical Information – Chemicals likely to be associated with site activities, based on historical information, will not be eliminated, even if the results of other “COPC reduction” steps indicate that such elimination is warranted.

Concentration and Toxicity - Aspects of concentration and toxicity will be considered prior to eliminating a chemical as a COPC. For example, weight-of-evidence for human toxicity will be considered in conjunction with site exposure concentrations. Thus, Class A carcinogens will be retained as COPCs.

Consistent with ATSDR guidance (De Rosa *et al.* 1997), if the dioxins/furans TEQ concentration does not exceed the ATSDR screening value of 50 ppt for any sample within a sub-area, dioxins/furans will generally not be retained as COPCs for the sub-area. Elimination of dioxins/furans as COPCs based on the ATSDR screening criterion will be subject to NDEP approval on a case-by-case basis. Although the ATSDR screening value was published in 1997 as an interim policy guideline, the value is consistent with a current range of residential cleanup levels identified in a recent review of the scientific evidence for the risks posed by dioxins (Paustenbach *et al.* 2006).

Availability of Toxicity Criteria – Some chemicals have not been assigned toxicity criteria (*i.e.*, cancer slope factor [CSF] or reference dose [RfD]). Prior to eliminating such chemicals, structure-activity relationship (SAR) analysis and applicability of surrogate toxicity values will be considered.

Mobility, Persistence and Bioaccumulation – Chemicals that are highly mobile, are persistent or tend to bioaccumulate will generally be retained as COPCs.

Special Exposure Routes – For some chemicals under special site-specific scenarios, certain exposure routes need to be considered carefully before eliminating COPCs.

Treatability – Chemicals that are difficult to treat should remain as COPCs because of their importance during the selection of remedial alternatives if needed.

Documentation of Rationale – Rationale for the exclusion of any chemicals from the risk assessment will be documented in the risk assessment report.

Need for Further Reduction of COPCs – The need for further reduction of COPCs will be considered prior to applying reduction criteria. It may be appropriate to narrow the number of COPCs included in fate and transport modeling by grouping COPCs with similar fate and transport properties. That is, the modeled behavior of a given COPC will likely reflect that of other COPCs with similar properties. The selection of appropriate COPCs to be included in fate and transport modeling will be discussed with, and approval sought from, NDEP prior to modeling. A discussion of the COPCs that are not included in fate and transport modeling will be presented in the uncertainty section of the risk assessment report.

Approval by the NDEP – NDEP approval will be sought prior to the elimination of any potential COPCs from the risk assessment.

Frequency of detection (FOD) is another criterion that may warrant COPC reduction. Chemicals exhibiting a low FOD within a specific exposure area generally will not contribute significantly to risk and hazard estimates when hot spots are not present. USEPA (1989) suggests that chemicals with a FOD less than or equal to five percent, with the exception of metals and known human carcinogens, may be considered for elimination. Prior to eliminating a COPC based on the FOD criteria, (1) any elevated detection limits will be addressed, and (2) data distributions within sub-areas will be considered (*e.g.*, potential hot spots will be assessed). Additionally, the detection of the COPC in all sampled media will be considered. For example, USEPA

recommends that a chemical infrequently detected in soil should not be eliminated if it is frequently detected in groundwater and exhibits mobility in soil. As stated above, chemicals that are infrequently detected within an exposure area will be addressed on an exposure area-specific basis and will be discussed on a case-by-case basis with NDEP.

9.4.3 Summary and Presentation of COPCs

For each exposure area, a summary of the site COPC data (*i.e.*, chemical, range of concentration, background levels, FOD, retained/eliminated as COPC, and rationale for elimination) will be presented in table form.

9.5 DETERMINATION OF REPRESENTATIVE EXPOSURE CONCENTRATIONS

A representative exposure concentration is a COPC-specific and media-specific concentration value used in the dose equation for each receptor and each exposure pathway. As described below, the methods, rationale, and assumptions employed in deriving the representative exposure concentrations will be consistent with USEPA guidance and will reflect site-specific conditions.

9.5.1 Soil

The risk assessment will incorporate representative exposure concentration estimates (*e.g.*, 95 percent upper confidence limit of the mean [UCL] [USEPA 2002d, Singh *et al.* 1997] as presented below) that specifically relate to potential site-specific human exposure conditions. Representative exposure concentrations may vary across the Site, consistent with the statistical approach presented in the *Statistical Methodology* document (BRC and NewFields 2006).

Under a deterministic risk assessment framework, two approaches for developing representative exposure concentrations for soil in a particular exposure area may be used: 1) 95 percent UCL concentration approach; and 2) geostatistical (block kriging) approach. Both of these methods result in use of a 95 percent UCL of the mean concentration, by either 1) assuming randomness (no spatial correlation) or 2) assuming a spatial correlation structure. Each of these approaches is discussed below. The use of each of these approaches for a particular COPC within an exposure area will be dependent on whether the data are spatially correlated or not, as determined through COPC-specific correlation analyses. Results of correlation analyses will be provided to NDEP for review and comment prior to calculation of representative exposure concentrations.

If the data are spatially uncorrelated for a particular COPC, the 95 percent UCL will be computed to represent the sub-area-wide exposure point concentration. Based on USEPA (1989)

guidance and NDEP's recommendation, non-detects will be assigned a random number between zero and the detection limit. For radionuclide censored data, the actual reported value will be used. Data identified in the data usability evaluation as unusable due to elevated reporting limits will not be used in the calculation of representative exposure concentrations. The formulas for calculating the 95 percent UCL COPC concentration (as the representative exposure concentration) are presented in USEPA (2002d, Singh *et al.* 1997).² The 95 percent UCL statistical calculations will be performed using the computer statistical software program GISdT[®] (Neptune and Company 2007).

For normally distributed data, the normal 95 percent UCL will be used. For non-normal data, the maximum of the three bootstrap 95 percent UCLs will be selected. If the selected 95 percent UCL does not exceed the maximum value (including detects and detection limits) it will be selected as the exposure point concentration, otherwise the maximum value will be used as the exposure point concentration.

If the data are spatially correlated³ for a particular COPC, representative exposure concentrations will be determined on the basis of sub-areas. The size of the exposure area is dependent on the receptor (that is, 1/8th-acre will be used for residential receptors, while 1/2-acre will be used for worker receptors). For this purpose, the sub-area will be covered by a 1/8th-acre or 1/2-acre cell grid network, *i.e.*, each 1/8th-acre or 1/2-acre exposure area is defined as a cell, respectively. The geostatistical block estimation process (known as the block kriging) will be used to estimate the average COPC concentration over each cell along with its standard error. These statistics can be used to calculate the cell-specific UCLs. Under a deterministic risk assessment framework, the maximum UCL across all cells, or block kriging will be applied to the entire sub-area to estimate an overall mean, standard error, and UCL for the sub-area.⁴ One of the advantages of the block kriging is the fact that cells in sparsely sampled locations will have higher standard deviations, even when their estimated average values are low. The UCL at these cells will be elevated. This kriging property provides a further safety factor against not discovering previously unknown hotspots. Subsequent samplings around such cells will confirm the actual status of their contamination.

² Under a probabilistic risk assessment framework, the computed mean concentration and standard error will be used to define the distribution of representative exposure concentration.

³ Upon a thorough inspection of computed omni-directional and directional variograms, the status of spatial correlation of a chemical in a given soil layer will be determined (BRC and NewFields 2006).

⁴ Under a probabilistic risk assessment framework, the mean concentration and standard error from representative cells will be considered for defining the distribution of representative exposure concentration.

Representative exposure concentrations for soil will be based on the potential exposure depth interval for each of the receptors. For commercial workers, maintenance workers, and trespassers or recreational users, who are exposed to surface soils, data from the top two feet of soil will be used (USEPA 2002a). For construction workers and residents exposed to on-site surface and sub-surface soils, data from the surface to ten bgs will be used, unless representative exposure concentrations are greater for the top two foot depth interval. For external radiation exposures, data from the surface to ten feet bgs will be used for all receptors.

9.5.2 Indoor Air

Concentrations of volatile constituents (VOCs, certain SVOCs, and radon) in soil and groundwater that may infiltrate buildings to be constructed at the Site through cracks in the foundations will be estimated using USEPA surface emission isolation flux chamber (flux chamber) measurements collected at the Site in accordance with USEPA guidance (USEPA 1986) and the Flux Chamber SOP (BRC and MWH 2006). The flux chamber is used to measure the emission rates from surfaces emitting gas species. Use of the flux chamber reduces the need for modeling surface flux rates which reduces the uncertainty in the air representative exposure concentrations and the risk characterization. Because the flux chamber measurements will be conducted outdoors on open soil, an “infiltration factor” will be applied to the outdoor flux data to generate data supporting the inhalation of indoor air exposure pathway. The infiltration factor is based on the ASTM *Standard Guide for Risk Based Corrective Action* (2000). The indoor air concentrations will be determined from the following:

$$C_a = \frac{J \times \eta}{L \times ER}$$

where:

- Ca = indoor air concentration (milligram per cubic meter [mg/m³])
- J = measured flux of chemical (mg/m²-min)
- η = foundation crack fraction (unitless)
- L = enclosed space volume/infiltration area ratio (meter [m])
- ER = enclosed space air exchange rate (1/min)

Default parameter values from ASTM (2000) for residential and commercial buildings, where appropriate, will be used where site-specific data are unavailable. These default parameters are presented in Table 9-1. Radon testing will be conducted using static outdoor chambers

in addition to the USEPA surface flux chamber following the procedures presented in the Flux Chamber SOP (BRC and MWH 2006). Maximum flux rates for samples collected from a particular exposure area (*i.e.*, flux chamber sample resulting in the highest risk for the exposure area) will be used in the above equation. The number of surface flux samples and their locations will be proposed in a site-specific work plan for each sub-area.

9.5.3 Outdoor Air

Long-term exposure to COPCs bound to dust particles will be evaluated using the USEPA's Particulate Emission Factor (PEF) approach (USEPA 2002a). The PEF relates concentrations of a chemical in soil to the concentration of dust particles in the air. The Q/C (Site-Specific Dispersion Factor [USEPA 2002a]) values in this equation will be for Las Vegas, Nevada (Appendix D of USEPA 2002a; see Table 9-1). The USEPA guidance for dust generated by construction activities (USEPA 2002a) will be used for short-term construction worker exposures. Input soil concentrations for the model will be the exposure point concentrations as described above.

For exposures to VOCs, volatile SVOCs, and radon in outdoor air, the flux chamber measurements as described above will be used. Outdoor flux data will be divided by the dispersion factor for volatiles (Q/Cvol for Las Vegas; from USEPA 2002a; see Table 9-1) for use in the outdoor air exposure pathway. The same dispersion factor will be used for all scenarios. The dispersion factor for the construction worker will not be adjusted to account for soil intrusion activities. Uncertainties associated with using the default dispersion factor for the construction scenario will be discussed in the uncertainty analysis.

9.5.4 Groundwater

For direct contact with groundwater exposures, the representative exposure concentration will be the lower of the maximum detected concentration or the 95 percent UCL concentration for each detected chemical. Data available from all wells within or immediately adjacent to a particular sub-area will be used in the determination of representative exposure concentrations in groundwater. As noted above at Section 9.5.1, non-detects for COPCs are assigned a random value between zero and the detection limit (except for radionuclide censored data, where the actual reported value will be used).

9.5.5 Plant Uptake

As indicated in Section 9.7.1, and consistent with USEPA guidance (USEPA 1996, 2000a), the consumption of homegrown produce is applicable and will be evaluated for metals, dioxins/furans, PCBs, relevant SVOC, and radionuclide COPCs. In their *Soil Screening Guidance* document (USEPA 1996), USEPA presents generic plant SSLs for six metals (arsenic, cadmium, mercury, nickel, selenium, and zinc), based on plant uptake-response slopes from the *Technical Support Document for the Land Application of Sewage Sludge* (USEPA 1992d). USEPA has not developed plant SSLs for other metals or for organic chemicals. For the six metals assigned a plant uptake SSL, USEPA has concluded that the other soil exposure pathways (*e.g.*, soil ingestion, dermal contact, inhalation) are likely to be adequately protective of the soil-plant-human exposure pathway (USEPA 1996) for mercury, nickel, selenium, and zinc, but not for arsenic and cadmium. Therefore, risks associated with plant uptake will be addressed using USEPA plant SSLs (USEPA 1996) for arsenic and cadmium and mercury, nickel, selenium and zinc will not require quantitative evaluation for the plant uptake pathway. For other metals and organic COPCs, USEPA (2005) guidance will be used, and for radionuclides, USEPA (2000a) guidance will be used. On a site-by-site basis, BRC and the NDEP will mutually agree on which of the soil COPCs will warrant quantitative evaluation for the plant uptake pathway.

9.6 METHODOLOGY FOR EVALUATING POTENTIAL IMPACTS TO GROUNDWATER AND SURFACE WATER

Several vadose zone fate and transport models are available to evaluate the potential for chemicals to migrate from the unsaturated zone (or vadose zone) to groundwater beneath a site. BRC will not use groundwater in its subsequent redevelopment of the Site and will accept a restriction on groundwater use at the Site. As discussed in Section 9.6.3, as a first level screen, surface water concentrations will be considered equal to groundwater concentrations. The following approach and assumptions will be employed for appropriate fate and transport modeling at the Site.

9.6.1 Soil/Water Partition Equation for Migration to Groundwater

In order to determine the potential impacts of residual levels of COPCs in soil on groundwater quality, a simple, yet conservative, approach is used. The modeling consists of a simple soil/water partitioning and groundwater dilution model provided in the USEPA's *Soil Screening Guidance* (1996). The model consists of a series of calculations used to determine COPC concentrations in groundwater that result from their presence in the unsaturated zone. The model

simulates non-dispersive mass transport in soil from an infinite source. It assumes steady-state flow conditions, that all sources will infiltrate and desorb contaminants from the soil, and that the infiltrate will mix completely within the mixing zone (see equation below) beneath the Site resulting in an equilibrium groundwater concentration.

The model used is conservatively simplistic in that it does not account for numerous physical and chemical processes in the calculation of chemical transport that in general tend to retard and reduce chemical concentrations as they move down the soil column. The model and equations presented in this section can be used either to (1) predict groundwater concentrations from measured soil concentrations, or (2) establish target soil concentrations protective of groundwater quality (*e.g.*, values below which leachate hypothetically generated from the soils can not cause groundwater concentrations to become elevated above applicable criteria [*e.g.*, MCLs]). The equations as presented below are designed to predict groundwater concentrations from measured soil concentrations. The equations merely need to be solved in terms of C_p to establish target soil concentrations protective of groundwater quality. Calculated groundwater concentrations will then be added to existing groundwater concentrations to determine compliance with allowable groundwater concentrations.

As part of predicting groundwater concentrations from measured soil concentrations, one first calculates a soil leachate concentration using site-specific input parameters (Sections 9.6.1.1 and 9.6.1.2). The partitioning (or distribution) equation from the USEPA's *Soil Screening Guidance* (Equation 10 from USEPA 1996 [rearranging the guidance document equation]) for migration to groundwater will be used:

$$C_p = \frac{C_t}{\left(K_d + \frac{\theta_w + \theta_a H'}{\rho_b} \right)}$$

where:

- C_p = soil leachate concentration (mg/L)
- C_t = soil concentration (mg/kg)
- K_d = soil-water partition coefficient (L/kg)
- θ_w = water-filled soil porosity ($L_{\text{water}}/L_{\text{soil}}$)
- θ_a = air-filled soil porosity ($L_{\text{air}}/L_{\text{soil}}$)
- H' = Henry's Law Constant (dimensionless)
- ρ_b = dry soil bulk density (kilogram per liter [kg/L])

For organic chemicals, soil organic matter is the primary sorbing component of the soil matrix. For organic compounds, the K_d is estimated using the following equation:

$$K_d = f_{oc} \times K_{oc}$$

where:

- f_{oc} = fraction of organic carbon in soil (mg/mg)
- K_{oc} = organic carbon-water partition coefficient (L/kg)

Chemical property values will be obtained from the USEPA literature (1996, 2000a, 2002a), as well as the National Library of Medicine's on-line Hazardous Substances Database. Where available, soil properties (*e.g.*, fraction of organic carbon, porosity, and dry soil bulk density) will be based on laboratory results associated with soil samples collected from the Site. Model default values (USEPA 1996, 2000a) will be used where site-specific data are unavailable. These default parameters are presented in Table 9-1. For inorganics, K_d values will be selected to represent a range of soil pH (pH = 8 and 6.5), where available. While current soil pH conditions are in the range of 5.9 to 9.3, the lower pH will be evaluated anticipating some decrease in pH after redevelopment.

9.6.1.1 Groundwater Parameters

The groundwater input parameters used in this evaluation will be based on site-specific data. These data will be collected as part of the overall groundwater characterization program for the Site (see Section 4). The hydraulic gradient, or any other parameter, used in any specific area will be based on the most current data set for that area. The input parameter values will be provided to NDEP for review and comment prior to conducting modeling.

The depth of the groundwater mixing zone will be calculated for each exposure area using the following equation provided in the USEPA's *Soil Screening Guidance* (Equation 12 from USEPA 1996):

$$d = (0.0112L^2)^{0.5} + d_a \{1 - \exp[(-L \times I)/K \times i \times d_a]\}$$

where:

- d = depth of mixing zone (m)
- K = hydraulic conductivity (meter per year [m/yr])

- i = hydraulic gradient (meter per meter [m/m])
- d_a = thickness of the aquifer (m)
- I = infiltration rate (m/yr)
- L = source length parallel to groundwater flow (m)

The thickness of the aquifer (d_a) value will be based on stratigraphic data noted in the lithologic map of the Site (prepared as part of the CSM process described in Section 4). The site-specific term representing source length parallel to groundwater flow (L) will be selected based on the known areal extent of a given COPC within a particular exposure area. Each COPC will be modeled separately. The source length parallel to groundwater flow (L) will be dependent on the particular COPC being modeled. The infiltration rate will be based on the water balance that is being developed as part of the groundwater model for the Site.

9.6.1.2 Predicted Groundwater Concentrations

The equation used for estimating groundwater concentrations is (from USEPA 1996 [shown as solved in terms of C_{gw}, below]):

$$C_{gw} = \frac{C_p}{1 + (Kid / IL)}$$

where:

- C_p = chemical concentration in the soil leachate (mg/L)
- C_{gw} = chemical concentration in groundwater (mg/L)
- K = hydraulic conductivity (meters per year [m/yr])
- i = hydraulic gradient (m/m)
- d = depth of mixing zone (m)
- I = infiltration rate (m/yr)
- L = source length parallel to groundwater flow (m)

Where available, site-specific conditions will be incorporated in the model. The input parameters associated with the model are discussed above.

For the purposes of screening analysis, the resultant predicted groundwater concentrations of COPCs from post-remediation soils will be compared to applicable environmental- and health-based standards (e.g., MCLs and ambient water quality criteria for the protection of freshwater organisms). Results of this modeling will be evaluated separately as well as combined with

existing groundwater concentrations to evaluate whether post-remediation COPC concentrations in soil (if any) could potentially impact groundwater to a cumulative extent greater than applicable standards, or--if existing groundwater concentrations are already above these standards--to determine the incremental increase in concentrations.

9.6.1.3 Determination Whether to Proceed to a More Refined Vadose Zone Modeling Effort

The decision of whether the screening level vadose zone modeling results indicate that final Site conditions are protective of groundwater protection will be made based on the predicted groundwater COPC concentrations:

- If predicted COPC concentrations from the modeling and in combination with existing groundwater concentrations are determined to be below applicable environmental- and health-based standards, it will be concluded that additional modeling will generally not be warranted.
- If predicted COPC concentrations from the modeling and/or in combination with existing groundwater concentrations are determined to be above their respective applicable environmental- and health-based standards, a decision will be made to: (1) proceed with additional vadose zone modeling utilizing more refined modeling tools (*e.g.*, VLEACH vertical migration model), (2) re-evaluate the risk goal in accordance with USEPA guidance, or (3) perform additional soil removal and sampling.

The final determination of whether to conduct more refined vadose zone modeling will be made by the NDEP.

9.6.2 Surface Runoff Modeling

Migration of COPCs to surface water bodies by overland flow is quantified by the estimation of surface runoff. Surface runoff is the potential mass of surface soil that is eroded by precipitation and carried via runoff water to a site of deposition. Factors that can affect the amount of soil erosion taking place include type of soil, intensity of rainfall, steepness of the ground slope, amount of vegetative cover, size of the site subjected to erosion, erosion control practices, and distance to the surface water body or wetland where deposition is expected to occur. For the purposes of this assessment, the revised Universal Soil Loss Equation (USLE) will be used to estimate the mass of COPCs in surface soils eroded and transported to the Las Vegas Wash (USEPA 1988; USDA 2004 as referenced by USEPA 2004b). The revised USLE calculates annual soil loss using the following equation:

$$Y(S)_A = R \times K \times ls \times C \times P \times A \times S_d$$

where:

- $Y(S)_A$ = annual soil loss in runoff tonnes/year [1 tonne = 1,000 kilograms]
R = rainfall and runoff factor (in 10^2 m-ton-cm/ha-hour; USDA 1991)
K = the soil erodibility factor (tonnes/hectare per unit R)
ls = topographic factor (unitless)
C = dimensionless cover/management factor (1.0 for no appreciable plant cover)
P = dimensionless erosion control practice factor (1.0 for uncontrolled sites)
A = area of site (ha)
 S_d = dimensionless sediment delivery ratio

For each parameter, site specific information will be incorporated where available. Where data for parameters are not available, default assumptions based upon available information and databases (USDA 2004) will be incorporated. The annual mass of a particular chemical eroded from an area can be calculated based on the soil concentration and the resultant amount of eroded soil.

$$C_m = C_o \times Y(S)_A$$

where:

- C_o = soil concentration (mg/kg)
 C_m = the mass of chemical eroded from a site (mg/yr)

Surface water concentrations for each chemical from surface runoff can then be estimated using the following equation:

$$C_{sw} = \frac{C_m}{V_{sw}}$$

where:

- V_{sw} = annual surface water volume (L/yr)
 C_{sw} = surface water concentration (mg/L)

For each parameter, site specific information will be incorporated where available. Where data for parameters are not available, default assumptions based upon available information and

databases (USDA 2004) will be incorporated. The annual mass of a particular chemical eroded from an area can be calculated based on the soil concentration and the resultant amount of eroded soil.

9.6.3 Impacts on Las Vegas Wash

Potential impacts on the Las Vegas Wash will be evaluated by predicting the impact of groundwater migration and surface runoff, using the equations above. Applicable or Relevant and Appropriate Requirements (ARARs), protective of human health and ecological risk will be identified by BRC and the NDEP and employed by the NDEP as the basis for managing potential risk to Las Vegas Wash. The analysis will initially apply the conservative assumption that predicted groundwater concentrations at the point of infiltration will proceed undiluted and unattenuated up to the point of entry into the Las Vegas Wash. If more refined analyses are warranted, approval from NDEP will be sought prior to conducting those analyses.

Example models that may be considered for refined analyses include MODFLOW, a three dimensional, saturated flow model developed by the U.S. Geological Survey (USGS) with a comprehensive graphical interface, VLEACH, a one-dimensional, finite difference unsaturated (vadose) zone model developed by USEPA, and SESOIL, a one-dimensional vertical transport model for the vadose zone originally developed for USEPA, which can simulate seasonal climatic variations and varying soil properties with depth.

BRC fully recognizes the importance of this pathway, and the need to protect surface water quality from potential Site-related impacts, including those associated with redevelopment of the Site. Therefore, BRC will work closely with the NDEP to ensure the adequate evaluation and mitigation of these potential impacts. Potential impacts on the Las Vegas Wash are being further evaluated by the pending groundwater characterization and modeling program at the Site. The risk assessment will incorporate information obtained by this program when it becomes available.

9.7 TIERED HUMAN HEALTH RISK ASSESSMENT APPROACH

A tiered approach is proposed for the post-remediation risk assessments. The tiered, or iterative, approach for the risk assessments follows the USEPA recommendations (USEPA 2001a). The tiered risk assessment approach is applicable for all COPCs, with the exception of lead and asbestos. As discussed in Section 9.1.1.2, site-specific remediation goals have been established for lead. Because USEPA guidance for probabilistic risk assessment methods for asbestos is not

well established, and because it is not clear how to apply the current asbestos risk assessment approach into a probabilistic assessment, the use of a probabilistic approach for asbestos is too uncertain to use at this time. Therefore, asbestos risks will be evaluated through a deterministic risk assessment only.

9.7.1 Identification of Potentially Exposed Populations and Pathways

The identification of potentially exposed populations and exposure pathways is supported by the CSM. A summary CSM is presented in Section 4. For a complete exposure pathway to exist, each of the following elements must be present (USEPA 1989):

- A source and mechanism for chemical release;
- An environmental transport medium (*i.e.*, air, water, soil);
- A point of potential human contact with the medium; and
- A route of exposure (*e.g.*, inhalation, ingestion, dermal contact).

Figure 9-1 and the following present the primary exposure pathways for each of the potential receptors following remediation at the Site. These populations and complete/potentially complete exposure pathways for each of the receptors will be evaluated in the post-remediation risk assessments, as summarized below.

- Adult and child residents (except at the Trails & Recreation sub-area [as shown on Figure 9-1])
 - incidental soil ingestion*
 - external exposure from soil[†]
 - dermal contact with soil
 - consumption of homegrown produce*
 - outdoor inhalation of dust*[‡]
 - indoor inhalation of dust*[‡]
 - outdoor and indoor inhalation of VOCs and radon from soil and groundwater
- Indoor commercial workers (except at the Trails & Recreation sub-area)
 - incidental soil ingestion*
 - external exposure from soil[†]
 - indoor inhalation of VOCs and radon from soil and groundwater

- Park and landscape maintenance workers (equivalent to outdoor commercial/industrial workers)
 - incidental soil ingestion*
 - external exposure from soil[†]
 - dermal contact with soil
 - outdoor inhalation of dust*[‡]
 - outdoor inhalation of VOCs and radon from soil and groundwater

- Construction workers
 - incidental soil ingestion*
 - external exposure from soil[†]
 - dermal contact with soil
 - outdoor inhalation of dust*[‡]
 - outdoor inhalation of VOCs and radon from soil and groundwater
 - incidental ingestion of groundwater during construction activities*
 - dermal contact with groundwater during construction activities

- Trespassers and recreational users (for potential exposures at the Trails & Recreation sub-area)
 - incidental soil ingestion*
 - external exposure from soil[†]
 - dermal contact with soil
 - outdoor inhalation of dust*[‡]
 - outdoor inhalation of VOCs and radon from soil and groundwater
 - incidental ingestion of surface water*
 - dermal contact with surface water

*Includes radionuclide exposures.

[†]Only radionuclide exposures.

[‡]Includes asbestos exposures.

9.7.2 Deterministic Human Health Risk Assessment Methodology

The deterministic risk assessment will follow procedures outlined in the USEPA's *Risk Assessment Guidance for Superfund: Volume I--Human Health Evaluation Manual* (USEPA 1989). Other guidance documents that will be relied on include:

- *Guidelines for Exposure Assessment*. USEPA. 1992a.
- *Soil Screening Guidance: Technical Background Document*. USEPA 1996.
- *Exposure Factors Handbook, Volumes I-III*. USEPA 1997.
- *Soil Screening Guidance for Radionuclides*. USEPA. 2000a.
- *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*. USEPA 2002a.
- *Technical Support Document for a Protocol to Assess Asbestos-Related Risk. Final Draft*. USEPA. 2003a.
- *Child-Specific Exposure Factors Handbook*. USEPA 2006.
- Nevada Administrative Code Chapter NAC 445A. Adopted Permanent Regulation of the Nevada State Environmental Commission. LCB File No. R119-96. NDEP 1996.

9.7.2.1 Deterministic Exposure Parameters

The exposure parameters proposed to be used in the deterministic risk assessment are presented in Tables 9-2 through 9-5. These generally conservative default values are based on standard USEPA guidance values. Exposure parameters that have significant impact on the results will be discussed in the uncertainty section of the risk assessment.

9.7.2.2 Deterministic Exposure Assessment

Reasonable maximum exposure levels to chemicals will be calculated for each receptor of concern, using the exposure parameters identified in Tables 9-2 through 9-5. Because the risk assessment may also be conducted probabilistically, a deterministic central tendency exposure will not be evaluated. The methodology used to estimate the average daily dose (ADD) of the chemicals via each of the complete exposure pathways will be based on USEPA (1989, 1992a) guidance. For carcinogens, lifetime ADD (LADD) estimates are based on chronic lifetime exposure extrapolated over the estimated average 70-year lifetime (USEPA 1989). This is performed in order to be consistent with cancer slope factors, which are based on chronic lifetime exposures. For non-carcinogens, ADD estimates will be averaged over the estimated exposure period. The generic equation for calculating the ADDs and LADDs is:

$$Dose = \frac{C \times IR \times ED \times EF \times BIO}{BW \times AT \times 365 \text{ d/yr}}$$

where:

- Dose = ADD for non-carcinogens and LADD for carcinogens (in mg/kg-day)
- C = chemical concentration in the contact medium (*e.g.*, mg/kg soil)
- IR = intake rate (*e.g.*, mg/day soil ingestion and dermal contact; m³/day for inhalation)
- ED = exposure duration (years of exposure)
- EF = exposure frequency (number of days per year)
- BW = average body weight over the exposure period (kilograms)
- BIO = relative bioavailability (unitless)
- AT = averaging time; same as the ED for non-carcinogens and 70 years (average lifetime) for carcinogens

With the exception of arsenic, the relative oral bioavailability (BIO) of all COPCs will be 100 percent. For arsenic, consistent with scientific literature recommendations on arsenic bioavailability (Roberts *et al.* 2001; Ruby *et al.* 1999; USEPA 2001b), an arsenic oral bioavailability of 30 percent will be used. The actual oral bioavailability of arsenic (as well as other metals at the Site, for which an oral bioavailability of 100 percent will be used) is likely to be lower than this value. Chemical-specific dermal absorption values from USEPA guidance (USEPA 2004c [Part E RAGS]) will be used in the risk assessments.

Exposure levels of potentially-carcinogenic and non-carcinogenic chemicals will be calculated separately because different exposure assumptions apply (*i.e.*, ADD for non-carcinogens and LADD for carcinogens). Exposure levels will be estimated for each relevant exposure pathway (*i.e.*, soil, air, and water), and for each exposure route (*i.e.*, oral, inhalation, and dermal). For non-carcinogens, ADDs will be derived for both child (zero to six years of age) and adult (seven to 30 years of age) receptors. For chemical carcinogens, LADDs will be derived for both child (zero to six years of age) and adult (seven to 30 years of age) receptors. These age classes are consistent with USEPA (1991a) guidance. Daily doses for the same route of exposure will be summed. The total dose of each chemical is the sum of doses across all applicable exposure routes.

The results of the exposure assessment will be used with information on the toxicity of the COPCs in the risk characterization step of the risk assessment to estimate the potential risks to human health posed by exposure to the COPCs. This process is discussed in Section 9.9.

9.7.2.3 Determination Whether to Proceed to a Probabilistic Risk Assessment

The decision of whether the deterministic risk assessment results indicate that final Site conditions are protective of human health and the environment will be made based on the non-cancer HI and total cancer risk.

- If both the non-cancer HI and the total cancer risk are below their respective acceptable levels (*i.e.*, a target organ HI of 1.0 and a cancer risk point of departure of 10^{-6}), and no hot spots are determined to exist, it will be concluded that probabilistic risk assessment will generally not be warranted.
- If either the non-cancer HI or the total cancer risk is above their respective acceptable levels, a decision will be made to: (1) proceed to a probabilistic risk assessment, (2) re-evaluate the risk goal in accordance with USEPA guidance, or (3) perform additional soil removal and sampling.

In order to assist in the decision to proceed to a probabilistic risk assessment, a quantitative sensitivity analysis will be performed if BRC considers performance of a probabilistic risk assessment warranted. If a probabilistic risk assessment is performed then a global numerical sensitivity analysis will be performed, which will be described in more detail in a separate probabilistic risk assessment methodology submittal to the NDEP. The final determination of whether a probabilistic risk assessment is warranted will be made by the NDEP. If a probabilistic risk assessment is conducted for a particular exposure area, all chemicals will be included (*i.e.*, no further reduction of COPCs will be conducted).

9.7.3 Probabilistic Human Health Risk Assessment Methodology

The probabilistic risk assessment will follow the procedures outlined in USEPA guidance (1989 and 2001a). It should be noted that the use of probabilistic risk assessment methodology is intended to more explicitly identify and quantify the uncertainty and variability that can be expected in the exposure assessment, and consequently, the risks associated with these exposures. As discussed above, specific details regarding proposed probabilistic risk assessment methodology will be described in a separate submittal to the NDEP.

9.7.4 Radionuclide Risk Assessment Methodology

Risks associated with radionuclides will be evaluated separately from chemical contaminants. Recently available USEPA risk assessment methodologies for radionuclides will be used (USEPA

2000a). There are several important differences between evaluating risks pertinent to radionuclides and those pertinent to chemical contaminants. These differences include:

- Exposure estimates are based on units of activity (*e.g.*, pCi) instead of units of mass (*e.g.*, mg) in soil;
- Only the carcinogenic effects of radionuclides due to ionizing radiation are considered. A radionuclide may also have a chemical toxicity (*e.g.* uranium or lead). These risks are addressed separately by using the concentration of mass of chemical in soil, rather than activity; and
- CSFs are based on the total theoretical age-averaged incremental lifetime cancer risk per intake of the radionuclide, or per unit external radiation exposure to gamma-emitting radionuclides. A soil ingestion CSF for adults will be used for all receptors except the resident and trespasser. For residents and trespassers the age-averaged soil ingestion CSF will be used as presented in the radionuclide PRG table (USEPA 2007a). Except for external CSFs, which are presented as risk/year per pCi/g_{soil}, CSFs for radionuclides are not expressed as a function of body weight or time, as are CSFs for chemical contaminants.

Exposure equations and parameter values to be used are the standard deterministic risk assessment exposure parameters based on typical USEPA (2000a, 2007a) default values. The exposure equations will be modified to include radionuclide decay as used in USEPA's radionuclide PRG equations (USEPA 2007a). For exposures not included in this guidance document (*e.g.*, construction worker and trespasser or recreational user exposures to groundwater and surface water, respectively), standard USEPA equations for these pathways will also be used for radionuclide exposures. Default parameter values are presented in Tables 9-2 through 9-5. These factors will also be used in the calculation of a site-specific background radionuclide risk level. The potential risks associated with exposure to radon will be evaluated using the approach for inhalation exposures to radon described in Section 9.5.2 (the equation presented in Section 9.5.2 for VOCs will also be applied for radon). In addition to inclusion in the radionuclide risk estimates, results of the estimated radon indoor air concentrations will be compared to USEPA's recommended action level of 4 picocuries per liter (pCi/L).

9.7.5 Asbestos Risk Assessment Methodology

Although final guidance is unavailable at this time, USEPA recommends that site-specific risk assessments be performed for asbestos (USEPA 2004d). Risks associated with asbestos in soil

will be evaluated using the most recent draft methodology proposed by USEPA (2003a). This methodology is an update of the method described in *Methodology for Conducting Risk Assessments at Asbestos Superfund Sites-Part 1: Protocol* and *Part 2: Technical Background Document* (Berman and Crump 1999a,b). Because the risk assessment methodology for asbestos is unlike that for other COPCs, and the preliminary guidance documents do not include probabilistic methods, asbestos risks will be evaluated using deterministic methods only. Exposure pathways, equations, and parameters to be used will be those presented in USEPA (2003a). Adjustments for exposure duration and exposure intensity, consistent with the methodology, will be made for each of the receptor populations, based on the respective exposure parameters presented in Tables 9-2 through 9-5.

The exposure point concentration for asbestos are based on the pooled analytical sensitivity of the dataset. The pooled analytical sensitivity is calculated as follows:

$$\text{Pooled Analytical Sensitivity} = 1 / \left[\sum_i (1 / \text{analytical sensitivity for trial } i) \right]$$

Two estimates of the asbestos concentration will be evaluated, best estimate and upper bound as defined in the draft methodology (USEPA 2003a). The best estimate concentration is similar to a central tendency estimate, while the upper bound concentration is comparable to a reasonable maximum exposure estimate. The best estimate asbestos concentration is the number of asbestos fibers detected multiplied by the pooled analytical sensitivity:

$$\text{Estimated Bulk Conc. (} 10^6 \text{ s/gPM10)} = \text{Long fiber count} \times \text{Pooled analytical sensitivity}$$

The upper bound estimate is the 95 percent upper confidence bound of the mean of the assumed underlying Poisson distribution used to model the number of structures found, multiplied by the pooled analytical sensitivity. In Microsoft® Excel, the 95 percent upper confidence bound of the mean may be calculated utilizing the following equation:

$$95\% \text{ UCL of Poisson Distribution (} 10^6 \text{ s/gPM10)} = \text{CHIINV}(1 - \alpha, 2 \times (\text{Long fiber count} + 1)/2)$$

The intent of the risk assessment methodology is to predict the amount of airborne asbestos which can be inhaled by a receptor. In order to quantify the airborne asbestos concentration, the estimated dust levels or PEFs are used:

$$\text{Est. Airborne Conc. (s/cm}^3 \text{)} = \text{Est. Bulk Conc. (} 10^6 \text{ s/gPM10)} \times \text{Est. Dust Level (} \mu\text{g/cm}^3 \text{)}$$

In addition, it will be assumed that asbestos only occurs at the soil surface (zero to two inches), unless it is plausible that it exists at deeper depths based on available sample data or information for a particular exposure scenario. This will be determined on a case-by-case basis with NDEP.

For assessing asbestos risks, Table 8-2 (Based on Optimum Risk Coefficients) of USEPA (2003a) will be used. Table 8-2 presents best estimate risks optimized based upon separation of fiber type, size and endpoint (mesothelioma/lung cancer), thereby reducing apparent variation between the studies utilized. The values in Table 8-2 will be used because they are the authors “best” estimates of potency based upon all the available data (whereas the “conservative values” presented in Table 8-3 present only the most conservative, and best “behaved” data). As described in USEPA (2003a), because the asbestos risks to male and female smokers/non-smokers are different, population averaged risks will be evaluated based on Eqn. 8-1 of USEPA (2003a):

$$URF = 0.5 \times ((0.786 \times (NSM + NSF)) + ((0.214 \times (SM + SF)) \times CF)$$

where:

- URF = Population Averaged Unit Risk Factor [s/cm^3]⁻¹; *g.*, mg/kg, milligrams per cubic meter [mg/m^3])
- NSM = risk for male non-smokers
- NSF = risk for female non-smokers
- SM = risk for male smokers
- SF = risk for female smokers
- NFM = risk for female non-smokers
- CF = factor to convert risk from risk per 100,000 to risk per 1,000,000

This equation considers male smokers, male non-smokers, female smokers, and female non-smokers. In addition, because both chrysotile and amphibole have been detected in the general area (for example, from the City of Henderson WRF sampling), both could be expected to occur at the Site. Therefore, both amphibole and chrysotile fibers will be evaluated in the risk assessments, regardless as to whether either is detected within an exposure area (as calculated using the 95 percent UCL of the mean of the assumed underlying Poisson distribution).

To interpret measurements of asbestos in soils, it is necessary to establish the relationship between the asbestos concentrations observed in soils and concentrations that will occur in air when such soil is disturbed by natural or anthropogenic forces. This is because asbestos is a

hazard when inhaled (see, for example, Berman and Crump 2001). In fact, the Modified Elutriator Method (Berman and Kolk 2000), which will be the method employed to perform the risk assessments, was designed specifically to facilitate prediction of airborne asbestos exposures based on bulk measurements (see, for example, Berman and Chatfield 1990).

9.8 TOXICITY ASSESSMENT

This section identifies how toxicity values to be used for the risk assessment will be obtained. Toxicity values are published by the USEPA in the on-line Integrated Risk Information System [IRIS]; USEPA 2007b). CSFs are chemical-specific and experimentally derived potency values that are used to calculate the risk of cancer resulting from exposure to potentially carcinogenic chemicals. A higher value implies a more potent carcinogenic potential. RfDs are experimentally derived “no-effect” levels used to quantify the extent of toxic effects other than cancer due to exposure to chemicals. With RfDs, a lower value implies a more potent toxicant. These criteria are generally developed by USEPA risk assessment work groups and listed in the USEPA risk assessment guidance documents and databases. Toxicity criteria will not be developed *de novo* by BRC for elements or compounds that do not have criteria published in the above sources. Should COPCs be found which do not have established toxicity criteria; these will be discussed on a case-by-case basis with NDEP and qualitatively addressed in the uncertainty analysis of the risk assessment report. Where appropriate, and only as approved by NDEP, non-carcinogenic surrogate RfDs may be applied.

Like any biological reaction, the toxicity of a chemical on humans can be described as a range of possible outcomes (severities and levels that cause an endpoint of concern). The uncertainty in the toxicity outcomes or values is an important source of uncertainty in most risk assessments and would be an appropriate parameter to be modeled probabilistically. However, for the purposes of both the deterministic and probabilistic assessments, the toxicity values used will be point estimates (deterministic). Available toxicity values for all Site COPCs to be used in the risk assessment will be obtained from the USEPA. The following hierarchy for selecting toxicity criteria will be used (based on USEPA 2003b):

1. IRIS
2. USEPA’s Provisional Peer Reviewed Toxicity Values (PPRTVs)
3. National Center for Environmental Assessment (NCEA, or other current USEPA sources)

4. Health Effects Assessment Summary Tables (HEAST)
5. USEPA Criteria Documents (*e.g.*, drinking water criteria documents, drinking water Health Advisory summaries, ambient water quality criteria documents, and air quality criteria documents)
6. ATSDR toxicological profiles
7. USEPA's Environmental Criteria and Assessment Office (ECAO)
8. Peer-reviewed scientific literature

For carcinogens, the USEPA weight-of-evidence classification will be identified for each carcinogenic COPC. Available RfDs will be obtained for all COPCs, including carcinogens. A list of COPC-specific non-carcinogenic and carcinogenic toxicity criteria, current at the time of the post-remediation risk assessment, will be submitted to NDEP for approval prior to initiation of each risk assessment. Radionuclides toxicity criteria will be obtained from the USEPA's *Preliminary Remediation Goals for Radionuclides* (USEPA 2007a). For some radionuclides, two different toxicity criteria are available: for that radionuclide only, and for the radionuclide and associated short-lived radioactive decay products (*i.e.*, those decay products with radioactive half-lives less than or equal to six months). To be conservative, the toxicity criteria that include radioactive decay products will be used, even though toxicity criteria are available for some of their respective radioactive decay products, which are also assessed separately.

Although route-to-route extrapolation is generally inappropriate without adequate toxicological information, in this case route-to-route extrapolation will be applied based on USEPA's approach (USEPA 2004e). The uncertainties associated with this approach will be addressed in the risk assessment report. CSFs that account for risks from associated short-lived radioactive decay products (*i.e.*, radon) will be used in the risk assessment.

Although USEPA has developed toxicity criteria for the oral and inhalation routes of exposure, it has not developed toxicity criteria for the dermal route of exposure. Typically, a simple route-to-route (oral-to-dermal) extrapolation is assumed such that the available oral toxicity criteria are used to quantify potential systemic effects associated with dermal exposure. However, as noted in USEPA's *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)* (USEPA 2004c), there is uncertainty associated with this approach because the oral toxicity criteria are based on an

administered dose and not an absorbed dose. In general, USEPA (2004c) recommends an adjustment to the oral toxicity criteria to convert an administered dose into an absorbed dose. The adjustment accounts for the absorption efficiency of the chemical in the “critical study” that is the basis of the oral toxicity criterion. If the oral absorption in the critical study is 100 percent, then the absorbed dose is equivalent to the administered dose and no adjustment is necessary. If the oral absorption of a chemical in the critical study is poor (less than 50 percent), then the absorbed dose is much smaller than the administered dose. In this situation, an adjustment to the oral toxicity criteria is recommended.

For the dioxins/furans, the USEPA toxicity equivalency procedure, developed to describe the cumulative toxicity of these compounds, will be applied. This procedure involves assigning individual toxicity equivalency factors (TEFs) to the 2,3,7,8 substituted dioxin/furan congeners. TEFs are estimates of the toxicity of dioxin-like compounds relative to the toxicity of 2,3,7,8-TCDD, which is assigned a TEF of 1.0. Calculating the TEQ of a mixture involves multiplying the concentration of individual congeners by their respective TEF. One-half the detection limit will be used for calculating the TEQ for individual congeners that are non-detect in a particular sample. The sum of the TEQ concentrations for the individual congeners is the TEQ concentration for the mixture. TEFs from USEPA (2000b) will be used in the risk assessment.

For carcinogenic PAHs, provisional USEPA guidance for estimating cancer risks will be used (USEPA 1993). The procedure uses information from the scientific literature to estimate the carcinogenic potency of several PAHs relative to benzo(a)pyrene. These relative potencies may be used to modify the CSF developed for benzo(a)pyrene for each PAH, or to calculate benzo(a)pyrene equivalent concentrations for each of the PAH’s (which would then be used with the benzo(a)pyrene CSF). The former approach will be used in the risk assessment. If one carcinogenic PAH is considered a COPC then all seven carcinogenic PAHs will be considered COPCs, regardless of whether or not they are detected at the Site. Although route-to-route extrapolation is inappropriate without adequate toxicological information, route-to-route extrapolation will be applied based on USEPA’s approach.

The USEPA has not derived toxicity criteria to evaluate the potential non-cancer health hazards associated with exposure to the carcinogenic PAH COPCs. For the human health risk assessment, a toxicological surrogate (*i.e.*, pyrene) will be used to quantify the potential non-carcinogenic effects of the carcinogenic PAHs. This surrogate was selected from a list of six PAHs for which non-cancer oral toxicity criteria have been assigned by the USEPA based on a careful consideration of their relevant toxicity data, target organ(s), dose-response information,

and structure-activity relationships. From the available oral non-cancer toxicity data reported by the USEPA, the most sensitive target organs are the liver, kidney, and blood (hematological effects) (IRIS, USEPA 2007b; ATSDR 1990, 1995; ORNL 1993). For the carcinogenic PAHs, the non-cancer target organs were found to be the same and the reported toxicological thresholds for these effects are generally in the range for those reported for the non-cancer PAHs (ATSDR 1995). Although naphthalene (2-ring structure) has the most stringent oral non-cancer toxicity criterion (0.02 mg/kg day), pyrene (4-ring structure; oral RfD of 0.03 mg/kg-day) was selected to be the best surrogate due to (1) non-cancer toxicity endpoints are more consistent with those for carcinogenic PAHs and (2) the greater number of rings in the pyrene chemical structure.

The National Research Council of the National Academies published its technical review of the *Health Implications of Perchlorate Ingestion* in January 2005. From this review USEPA has established a final RfD of 0.0007 mg/kg-day, which is currently contained in the IRIS database (USEPA 2007b). This value will be employed in the risk assessment.

9.9 RISK CHARACTERIZATION

In the last step of a risk assessment, the estimated rate at which a person intakes a COPC is compared with information about the toxicity of that COPC to estimate the potential risks to human health posed by exposure to the COPC. This step is known as risk characterization. In the risk characterization, cancer risks will be evaluated separately from non-cancer adverse health effects. The methods used for assessing cancer risks and non-cancer adverse health effects are discussed below.

9.9.1 Methods for Assessing Cancer Risks

In the risk characterization, carcinogenic risk will be estimated as the incremental probability of an individual developing cancer over a lifetime as a result of a chemical exposure. Carcinogenic risks will be evaluated by multiplying the estimated average exposure rate (*i.e.*, LADD calculated in the exposure assessment) by the chemical's CSF. The CSF converts estimated daily doses averaged over a lifetime to incremental risk of an individual developing cancer. According to USEPA (1989), this approach is appropriate for theoretical upper-bound incremental lifetime cancer risks of less than 1×10^{-2} . The following equations will be used to calculate chemical-specific risks and total risks:

$$Risk = LADD \times CSF$$

where:

LADD = lifetime average daily dose (mg/kg-d)
CSF = cancer slope factor (mg/kg-d)⁻¹

and

$$\text{Total Carcinogenic Risk} = \Sigma \text{Individual Risk}$$

It will be assumed that cancer risks from various exposure routes are additive. Thus, the result of the assessment is necessarily a high-end estimate of the total carcinogenic risk. High-end carcinogenic risk estimates will be evaluated by NDEP in light of site-specific risk management decision criteria.

The equation used to calculate asbestos risks, which will be evaluated separately, is:

$$\text{Risk} = \text{Estimated Airborne Concentration (s/cm}^3) \times \text{Adjusted URF (s/cm}^3)^{-1}$$

9.9.2 Methods for Assessing Non-Cancer Health Effects

Non-cancer adverse health effects are estimated by comparing the estimated average exposure rate (*i.e.*, ADDs estimated in the exposure assessment) with an exposure level at which no adverse health effects are expected to occur for a long period of exposure (*i.e.*, the RfDs).

ADDs and RfDs are compared by dividing the ADD by the RfD to obtain the ADD:RfD ratio, as follows:

$$\text{Hazard Quotient} = \frac{\text{ADD}}{\text{RfD}}$$

where:

ADD = average daily dose (mg/kg-d)
RfD = reference dose (mg/kg-d)

The ADD-to-RfD ratio is known as a hazard quotient. If a person's average exposure is less than the RfD (*i.e.*, if the hazard quotient is less than 1), the chemical is considered unlikely to pose a significant non-carcinogenic health hazard to individuals under the given exposure conditions. Unlike carcinogenic risk estimates, a hazard quotient is not expressed as a probability. Therefore, while both cancer and non-cancer risk characterizations indicate a relative potential for adverse

effects to occur from exposure to a chemical, a non-cancer adverse health effect estimate is not directly comparable with a cancer risk estimate.

If more than one pathway is evaluated, the hazard quotients for each pathway, for all COPCs, will be summed to determine whether exposure to a combination of pathways poses a health concern. This sum of the hazard quotients is known as an HI.

$$\text{Hazard Index} = \Sigma \text{Hazard Quotients}$$

A total HI that includes all COPCs and all exposure pathways will be presented in the risk assessment. The NDEP non-cancer risk management target is an HI value of less than or equal to 1.0.

For any HI that exceeds 1.0, the potential for adverse health effects will be further evaluated by considering the target organs upon which each chemical could have an adverse effect. Target organ-specific HIs will be assessed only after approval by NDEP. The target organ specific HIs will be summed for all relevant COPCs. The segregation of HI by target organ is consistent with USEPA guidance for non-carcinogens, including metals (USEPA 1989, 2001c, 2005).

9.10 UNCERTAINTY ANALYSIS

Consistent with USEPA (1989) guidance, for the deterministic risk assessment, a qualitative discussion of the uncertainties associated with the estimation of risks for the Site will be presented in the risk assessment report. The uncertainty analysis will discuss uncertainties associated with each step of the risk assessment, including site characterization data, data usability, selection of COPCs, representative exposure concentrations, fate and transport modeling, exposure assessment, toxicity assessment, and risk characterization. For both non-carcinogens and carcinogens, the relative contribution of specific COPCs and pathways to total risk and HI will be identified. If a probabilistic risk assessment is performed the uncertainty analysis will be performed quantitatively. Details will be provided in a separate probabilistic risk assessment methodology submittal to the NDEP.

9.11 INTERPRETATION OF FINDINGS

The risk characterization results will be presented in tabular format in the risk assessment report. Key exposure (*e.g.*, estimated intakes, important modeling assumptions, summary of exposure pathways for each receptor) and toxicity information (*e.g.*, CSFs, RfDs, target organs) will be provided. In addition, the risk characterization results will be placed into proper perspective,

including a discussion of the concept of *de minimis* risk. The cancer risk assessment results will be presented for both total cancer risk and background cancer risk estimates, as well as presentation of the percent contribution of the background cancer risk to the total cancer risk. In addition, those COPCs and exposure pathways having the greatest influence on the risk assessment results will be identified. As appropriate, graphical presentation of the results will also be included in the risk assessment report. In addition, the format and content of risk assessment reports will follow the guidelines presented in USEPA's *Risk Assessment Guidance for Superfund: Volume I Human Health Evaluation Manual—Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments* (USEPA 2001c) and USEPA's Reviewers Checklist (USEPA 1989) to ensure that essential issues are adequately addressed in each risk assessment.

In addition to the above, upon completion of the final cycles of cleanup and sampling, the updated site geographic information system (GIS) database will be used to generate area-wide, layer-specific 1/8th-acre cell average concentrations and their corresponding estimation standard deviations. This process will be performed for the risk-driver chemicals that represent 90 percent of the total cancer risk and non-cancer HI based on the methodology provided in Section 9.9 above.

Having the mean and standard deviation of concentrations of the risk-driver chemicals within each cell, large number of sets of chemical concentrations of targeted contaminants will be randomly selected. For this purpose, each concentration will be selected from a normal distribution, associated with the given risk driver. Having a complete set of selected chemical concentrations of risk drivers, the cumulative cancer risks and non-cancer hazards are calculated for each set. After an appropriately large number of these parametric Monte Carlo simulated sets (*e.g.*, 1,000 simulated sets), the upper 95-percentile of the total cancer risks and non-cancer hazards will be determined for each cell. The results of these computations will be provided as area-wide, layer-specific mosaic-colored maps of the upper 95-percentile total cancer risks and non-cancer hazards. These maps will provide a comprehensive depiction of extent of risks over various depths of the entire area.

SECTION 9 REFERENCES

- Agency for Toxic Substances and Disease Registry (ATSDR). 1990. Toxicological Profile for Polycyclic Aromatic Hydrocarbons. U.S. Department of Health and Human Services, Public Health Service.
- Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological Profile for Polycyclic Aromatic Hydrocarbons. U.S. Department of Health and Human Services, Public Health Service. August.
- American Society for Testing and Materials (ASTM). 2000. Standard Guide for Risk-Based Corrective Action. E2081-00.
- Berman, D.W. and Chatfield, E.J. 1990. Interim Superfund Method for the Determination of Asbestos in Ambient Air. Part 2: Technical Background Document, Office of Solid Waste and Remedial Response, U.S. EPA, Washington, D.C., EPA/540/2-90/005b, May.
- Berman, D.W. and K. Crump. 1999a. Methodology for Conducting Risk Assessments at Asbestos Superfund Sites—Part 1: Protocol. Interim Version. Prepared for USEPA Region 9, February 15.
- Berman, D.W. and K. Crump. 1999b. Methodology for Conducting Risk Assessments at Asbestos Superfund Sites—Part 2: Technical Background Document. Interim Version. Prepared for USEPA Region 9, February 15.
- Berman, D.W. and Crump, K.S. 2001. Technical Support Document for a Protocol to Assess Asbestos-Related Risk. Prepared for Mark Raney, Volpe Center, U.S. Department of Transportation, 55 Broadway, Kendall Square, Cambridge, MA 02142. Under EPA Review.
- Berman, D.W. and Kolk, A. 2000. Modified Elutriator Method for the Determination of Asbestos in Soils and Bulk Material. May (Revision 1).
- Basic Remediation Company (BRC) and MWH. 2006. BRC Field Sampling and Standard Operating Procedures, BMI Common Areas, Clark County, Nevada. May.

BRC and NewFields Companies, LLC. 2006. Statistical Methodology Report, BMI Common Areas (Eastside), Henderson, Nevada. [currently under NDEP review]

BRC and Titanium Metals Corporation (TIMET). 2007. Background Shallow Soil Summary Report, BMI Complex and Common Areas Vicinity. March 16.

De Rosa, C.T., Brown, D., Dhara, R. *et al.* 1997. Dioxin and Dioxin-Like Compounds in Soil, Part 1: ATSDR Interim Policy Guidance. *Toxicology and Industrial Health* 13 759-768.

Environ. 2003. Risk Assessment for the Water Reclamation Facility Expansion Site, Henderson, Nevada. Prepared for the City of Henderson, Nevada. October.

National Academy of Science (NAS). 1994. Science and Judgment in Risk Assessment. National Research Council. National Academy Press, Washington, D.C.

Neptune and Company. 2007. Guided Interactive Statistical Decision Tools (GISdT). www.gisdt.org.

Nevada Division of Environmental Protection (NDEP). 1996. Nevada Administrative Code Chapter NAC 445A. Adopted Permanent Regulation of the Nevada State Environmental Commission. LCB File No. R119-96.

Oak Ridge National Laboratory (ORNL). 1993. Toxicity Summary for Pyrene. Chemical Hazard Evaluation Group, Biomedical and Environmental Information Analysis section, Health Sciences Research Division, Oak Ridge, TN, August.

Paustenbach, D.J., Fehling, K, Scott, P., Harris, M., and B.D Kerger. 2006. Identifying soil cleanup criteria for dioxins in urban residential soils: how have 20 years of research and risk assessment experience affected the analysis? *Journal of Toxicology and Environmental Health, Part B*, 9:87–145.

Roberts *et al.* 2001. Measurement of Arsenic Bioavailability in Soil Using a Primate Model. *Toxicological Sciences*, 67, 2: 303-310.

- Ruby, M.V., R. Schoof, W. Brattin, M. Goldale, G. Post, M. Harnios, D. E. Mosby, S. W. Casteel, W. Berti, M. Carpenter, D. Edwards, D. Cragin, and W. Chappell. 1999. Advances in evaluating the oral bioavailability of inorganics in soil for use in human health risk assessment. *Environ. Sci. Technol.* 33(21):3697-3705.
- Singh, A.K., Singh, A, and Engelhardt, M. 1997. The Lognormal Distribution in Environmental Applications. EPA Technology Support Center Issue. Office of Research and Development and Office of Solid Waste and Emergency Response, December.
- U.S. Department of Agriculture (USDA). 1991. Guides for Erosion and Sediment Control. Soil Conservation Service.
- USDA. 2004. Revised Universal Soil Loss Equation. <http://msa.ars.usda.gov/ms/oxford/nsl/rusle/>.
- U.S. Environmental Protection Agency (USEPA). 1986. Measurement of Gaseous Emission Rates From Land Surfaces Using an Emission Isolation Flux Chamber, Users Guide. EPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada, EPA Contract No. 68-02-3889, Radian Corporation, February.
- USEPA. 1988. Superfund Exposure Assessment Manual. Office of Remedial Response, Washington, DC. OSWER Directive 9285.51. EPA/540/1 88/001. April.
- USEPA. 1989. Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual (Part A). Interim Final. Office of Emergency and Remedial Response, Washington, D.C. USEPA/540/1-89/002. December.
- USEPA. 1991a. Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual. Supplemental Guidance ‘Standard Default Exposure Factors’. Office of Emergency and Remedial Response, Washington, D.C. OSWER Directive 9285.3-03. March.
- USEPA. 1991b. Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. Memorandum from D.R. Clay, Assistant Administrator, USEPA. OSWER Directive 9355.0-30, April.

USEPA. 1992a. Guidelines for Exposure Assessment. Federal Register, 57(104):22888-22938. May 29.

USEPA. 1992b. Guidance for Data Usability in Risk Assessment. Part A. Office of Emergency and Remedial Response, Washington D.C. Publication 9285.7-09A. PB92-963356. April.

USEPA. 1992c. Guidance for Data Usability in Risk Assessment. Part B. Office of Emergency and Remedial Response, Washington D.C. Publication 9285.7-09B. PB92-963362. May.

USEPA. 1992d. Technical Support Document for Land Application of Sewage Sludge, Volume I and II. EPA 822/R-93-001a. Office of Water.

USEPA. 1993. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. Office of Research and Development, Washington, DC. EPA/600/R-93/089. July.

USEPA. 1996. Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response, Washington, DC. USEPA/540/R-96/018. April.

USEPA. 1997. Exposure Factors Handbook. Office of Research and Development, Washington DC. USEPA/600/P-95/002Fa-c. August.

USEPA. 2000a. Soil Screening Guidance for Radionuclides. Office of Radiation and Indoor Air, Washington, DC. USEPA/540-R-00-007 and USEPA/540-R-00-006.

USEPA. 2000b. Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds. Part II: Health Assessment for 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) and Related Compounds. National Center for Environmental Assessment, Washington, DC. EPA/600/P-00/001Ae. May.

USEPA. 2001a. Risk Assessment Guidance for Superfund: Volume 3—Part A, Process for Conducting Probabilistic Risk Assessment. Draft. Office of Solid Waste and Emergency Response, Washington, DC.

USEPA. 2001b. Inorganic Arsenic – Report of the Hazard Identification Assessment Review Committee. Memorandum, From: J. Chen, S. Malish, T. McMathon, Risk Assessment and Science Support Branch; to: N. Cook, Chief, Risk Assessment and Science Support Branch. August 21.

USEPA. 2001c. Risk Assessment Guidance for Superfund: Volume I Human Health Evaluation Manual—Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments. Office of Emergency and Remedial Response, Washington, DC. Publication 9285.7-47. December.

USEPA. 2002a. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Office of Solid Waste and Emergency Response, Washington, DC. OSWER 9355.4-24. December.

USEPA. 2002b. Memorandum on Role of Background in the CERCLA Cleanup Program, from USEPA Office of Emergency and Remedial Response Director Michael B. Cook to Superfund National Policy Managers and all Regions, dated 1 May. OSWER 9285.6-07P.

USEPA. 2002c. Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites. Office of Emergency and Remedial Response, Washington, DC. EPA 540-R-01-003. September.

USEPA. 2002d. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. Office of Emergency and Remedial Response, Washington, DC. OSWER 9285.6-10. December.

USEPA. 2003a. Proposed Methodology for Conducting Risk Assessments at Asbestos Superfund Sites. Office of Emergency and Remedial Response, Washington, DC. January.

USEPA. 2003b. Memorandum on Human Health Toxicity Values in Superfund Risk Assessments, from Michael B. Cook, Director, Office of Superfund Remediation and Technology Innovation to Superfund Remediation Policy Managers, Regions 1 - 10, dated 5 December. OSWER Directive 9285.7-53.

USEPA. 2004a. Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK). Office of Solid Waste and Emergency Response.

USEPA. 2004b. National Pollutant Discharge Elimination System (NPDES). http://cfpub1.epa.gov/npdes/linkresult.cfm?program_id=0&link_category=4&view=link.

USEPA. 2004c. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. Office of Emergency and Remedial Response, Washington, DC. EPA/540/R/99/005. July.

USEPA. 2004d. Memorandum on Clarifying Cleanup Goals and Identification of New Assessment Tools for Evaluating Asbestos at Superfund Cleanups, from Michael B. Cook, Director, Office of Superfund Remediation and Technology Innovation to Superfund Remediation Policy Managers, Regions 1 - 10, dated 10 August. OSWER Directive 9345.4-05.

USEPA. 2004e. Preliminary Remediation Goals (PRGs), Region 9. Website: www.epa.gov/region09/waste/sfund/prg/index/.

USEPA. 2005. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. Office of Solid Waste and Emergency Response, Washington DC. EPA530-R-05-006. September.

USEPA. 2006. Child-Specific Exposure Factors Handbook. Interim Report. National Center for Environmental Assessment, Office of Research and Development, Washington, DC. EPA/600/R/06/096A. September.

USEPA. 2007a. Preliminary Remediation Goals for Radionuclides. USEPA on-line database: <http://epa-prgs.ornl.gov/radionuclides/>.

USEPA. 2007b. Integrated Risk Information System. USEPA on-line database: <http://www.epa.gov/iris/index.html>.

SECTION 10

10 RISK ASSESSMENT METHODOLOGY – ECOLOGICAL

The purpose of an ecological risk assessment (ERA) is to evaluate the potential for adverse ecological impacts that may occur as a result of potential exposures to residual concentrations of chemicals following remediation. The biotic setting is important for determining if an ERA is necessary, placing the findings of the ERA in perspective, and, given the number of species and the complexity of biological communities, scoping the ERA effort. A current habitat map is provided in Figure 10-1.

The Las Vegas Wash is located north of the Site and has been identified as a key regional conservation priority (Audubon International's 2000 *Ecological Design for Village East, North of Sunset Road, Henderson, Nevada*. Prepared for the Landwell Company). The primary source of the perennial surface water for the Las Vegas Wash is treated wastewater. The Wash supports both desert riparian and perennial freshwater aquatic/emergent habitats that provide refuge and foraging habitat for a variety of wildlife species (Figure 10-1). In addition, the Las Vegas Wash serves as the major wildlife movement corridor in the area because of its dependable water source, visual shielding from surrounding development, and vegetation structure.

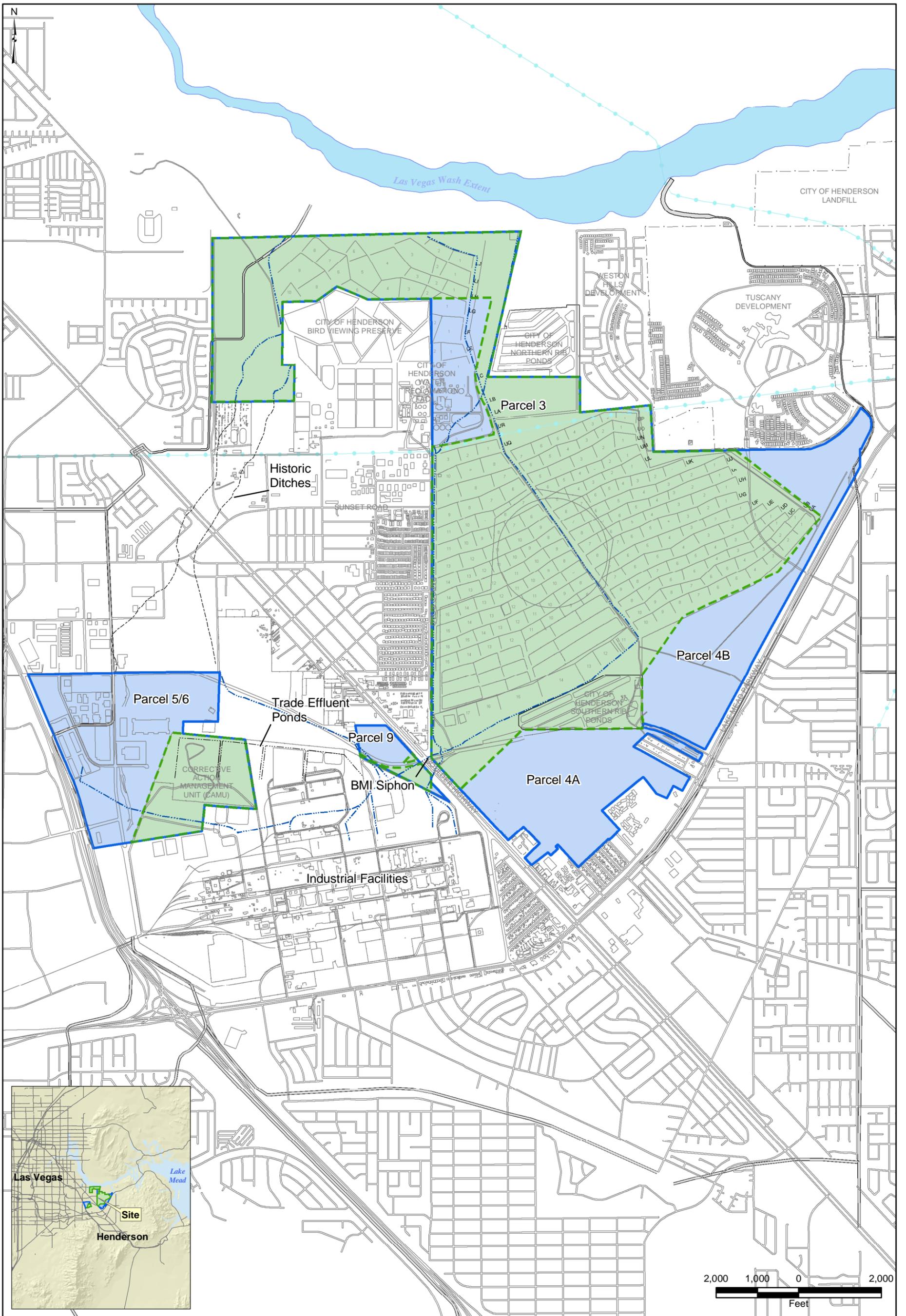
In addition to the Las Vegas Wash, the City of Henderson's Birding Preserve is the only other permanent surface water in the vicinity of the Site. As with the Las Vegas Wash, the primary source of the perennial surface water for the Henderson Birding Preserve is treated wastewater. The City of Henderson's Birding Preserve supports freshwater aquatic/emergent wetland habitat and will likely continue to support minimally disturbed wetland communities. This birding preserve supports abundant and diverse bird populations.

Much of the area surrounding the Site currently supports or is planned to support residential, commercial, or industrial uses. These areas are not intended to and do not support habitat attractive to support native plant and wildlife populations. These areas are landscaped with a variety of native and non-native ornamental plants. Wildlife that may be observed in these areas are likely to be transient, introduced species that are tolerant of human activity and typical of highly disturbed areas (*e.g.*, European starling, rock dove).

The entire Site is to be developed to support residential and mixed commercial and civic land use. The current development plans for the Site indicate that the Trails & Recreation sub-area will receive a substantial amount of fill material and be developed for non-residential uses after

remediation is complete. Based on discussions between BRC and NDEP, it is currently the belief that these developments do not constitute suitable habitat in this sub-area or in any of the other sub-areas and hence an ERA is not necessary. An ERA work plan will be developed if and when impacts and receptors are identified. For example, if it is discovered that off-Site impacts are adversely affecting ecological receptors it may be necessary to develop an ERA work plan. This work plan will incorporate appropriate USEPA ecological risk guidance documents, as well as those that the NDEP may develop.

FIGURES

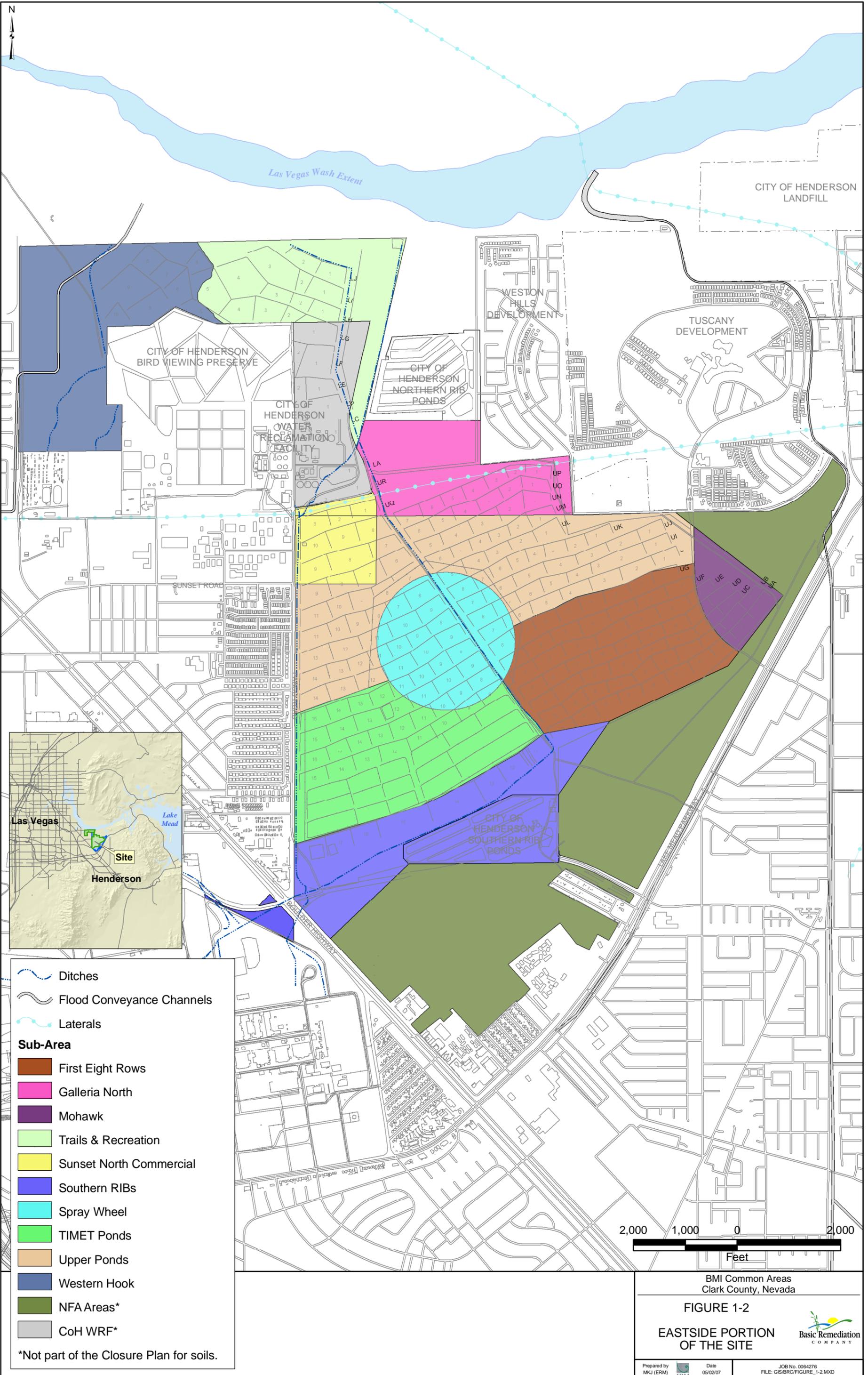


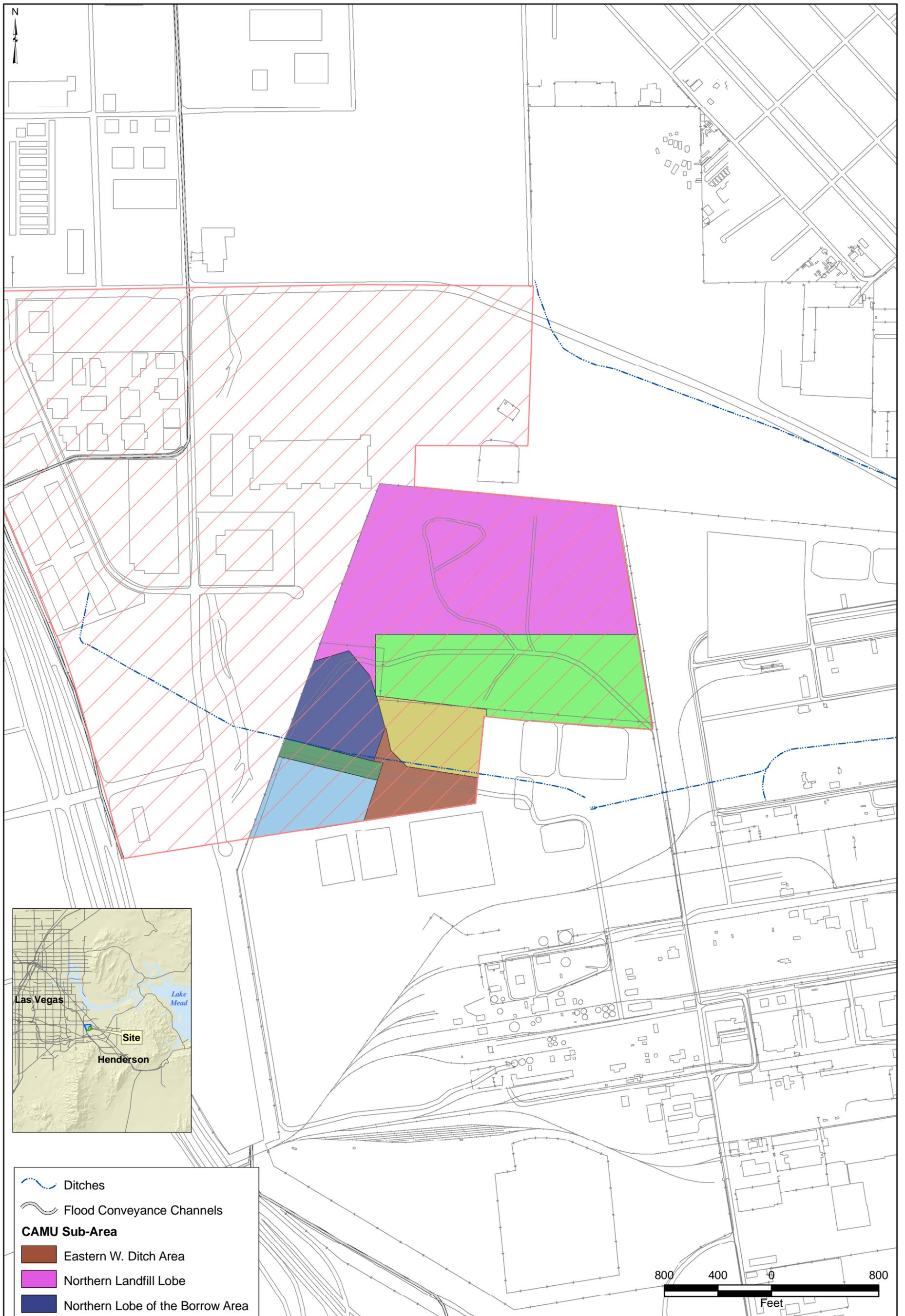
- Site Soil Boundary
- Site AOC3 Boundary

BMI Common Areas
Clark County, Nevada

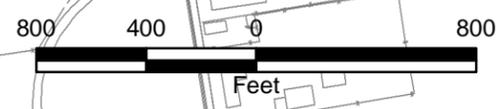
FIGURE 1-1
PROJECT MAP

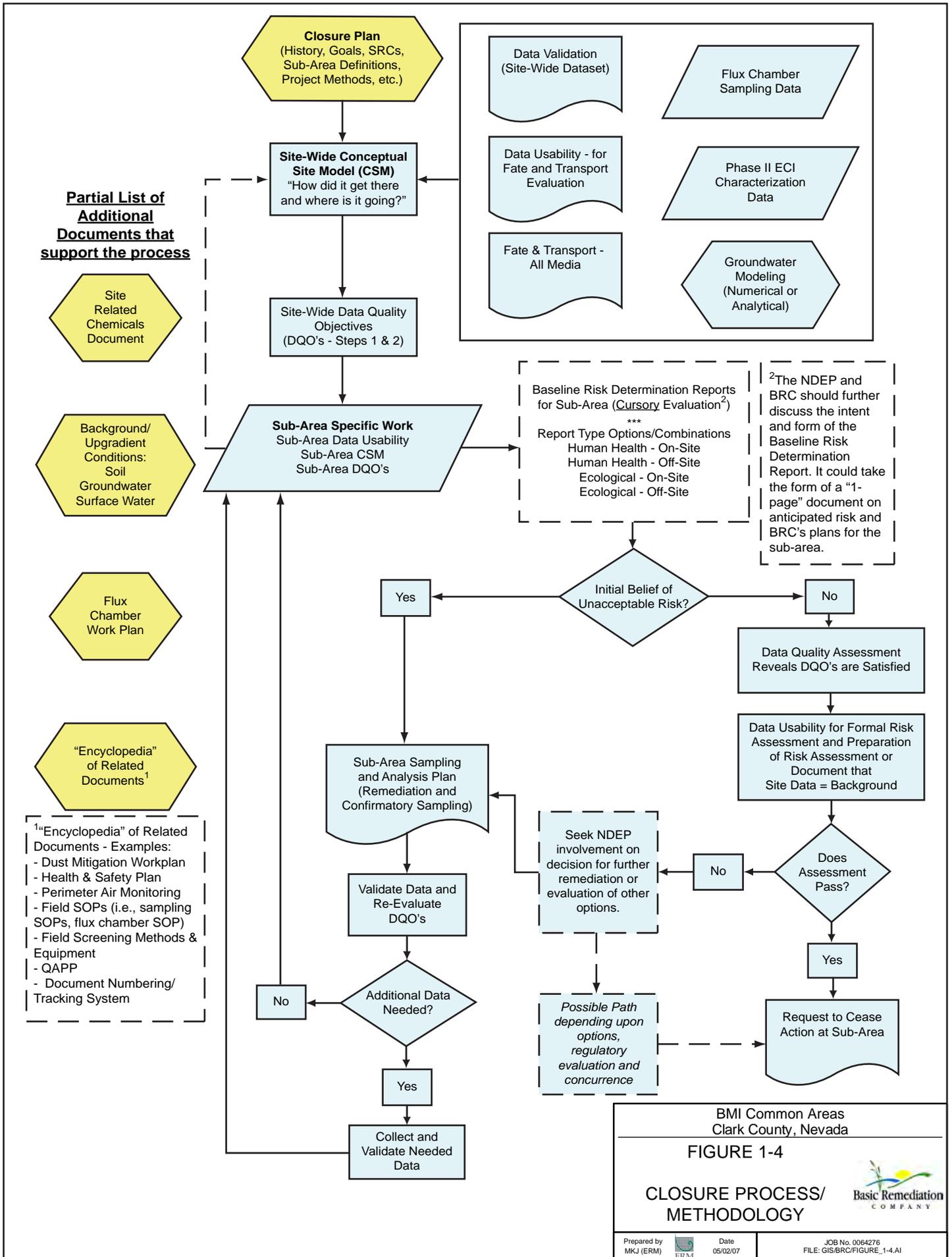


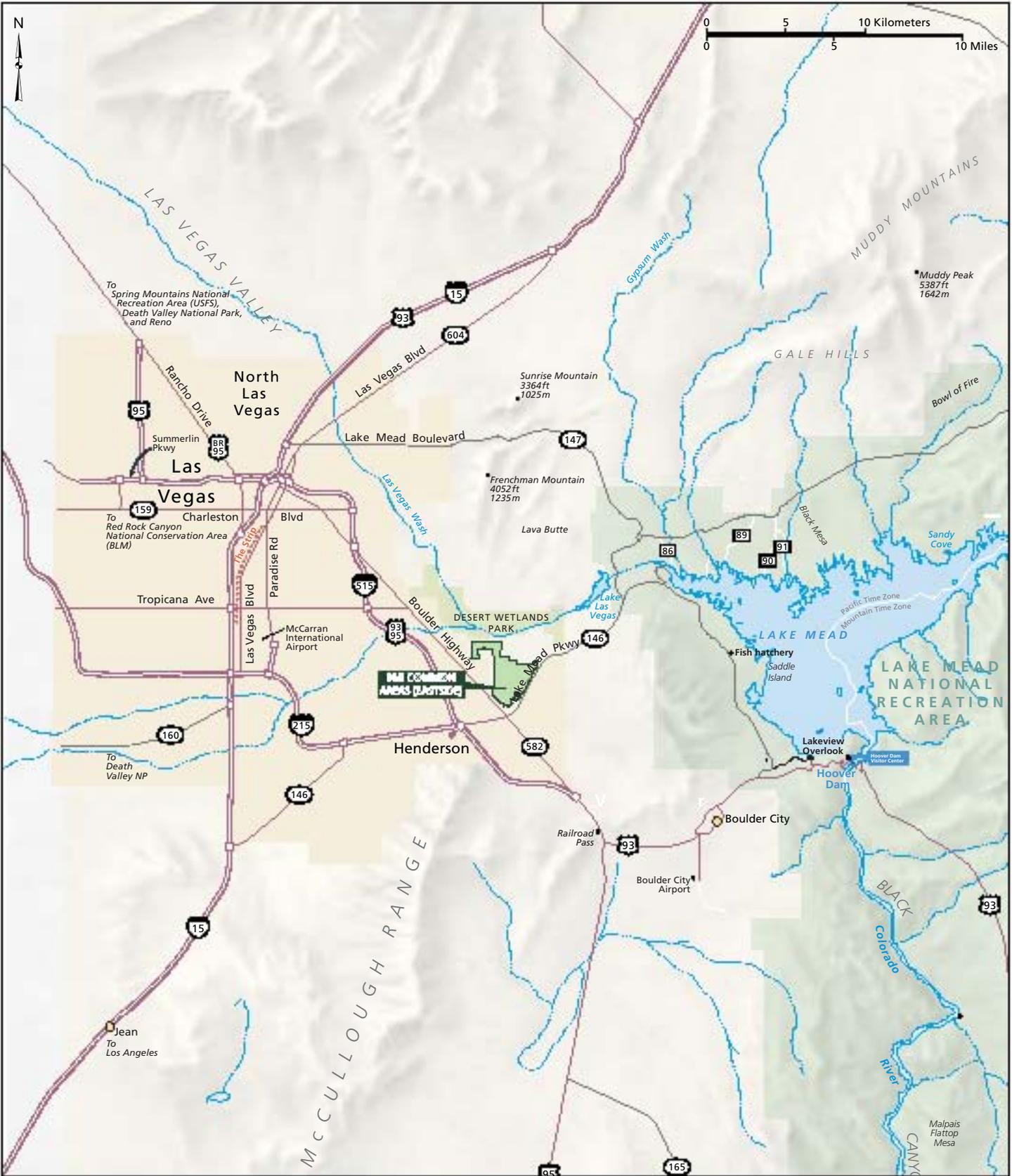




-  Ditches
-  Flood Conveyance Channels
- CAMU Sub-Area**
-  Eastern W. Ditch Area
-  Northern Landfill Lobe
-  Northern Lobe of the Borrow Area
-  Slit Trench Area
-  Southern Landfill Lobe
-  Southern Lobe of the Borrow Area
-  Western W. Ditch Area







BMI Common Areas
Clark County, Nevada

FIGURE 2-1
SITE LOCATION



Prepared by MKJ (ERM)	Date 05/03/07	JOB No. 0064276 FILE: GIS/BRC/FIGURE_2-1.AI
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Modified from the National Park Service Lake Mead National Recreation Area General Park Map

TRACTOR AND CARRYALL CLEARING
BRUSH ON PLANT SITE.



PANORAMA - WEST VIEW SHOWING
FIRST STAGES OF BRUSH CLEA



TRACTORS, SHOVELS, AND
TRUCKS AT WORK ON ACTUAL
PLANT SITE.



BMI Common Areas
Clark County, Nevada

FIGURE 2-2

PHOTOGRAPHS OF SITE
PRIOR TO DEVELOPMENT
SITE LOCATION

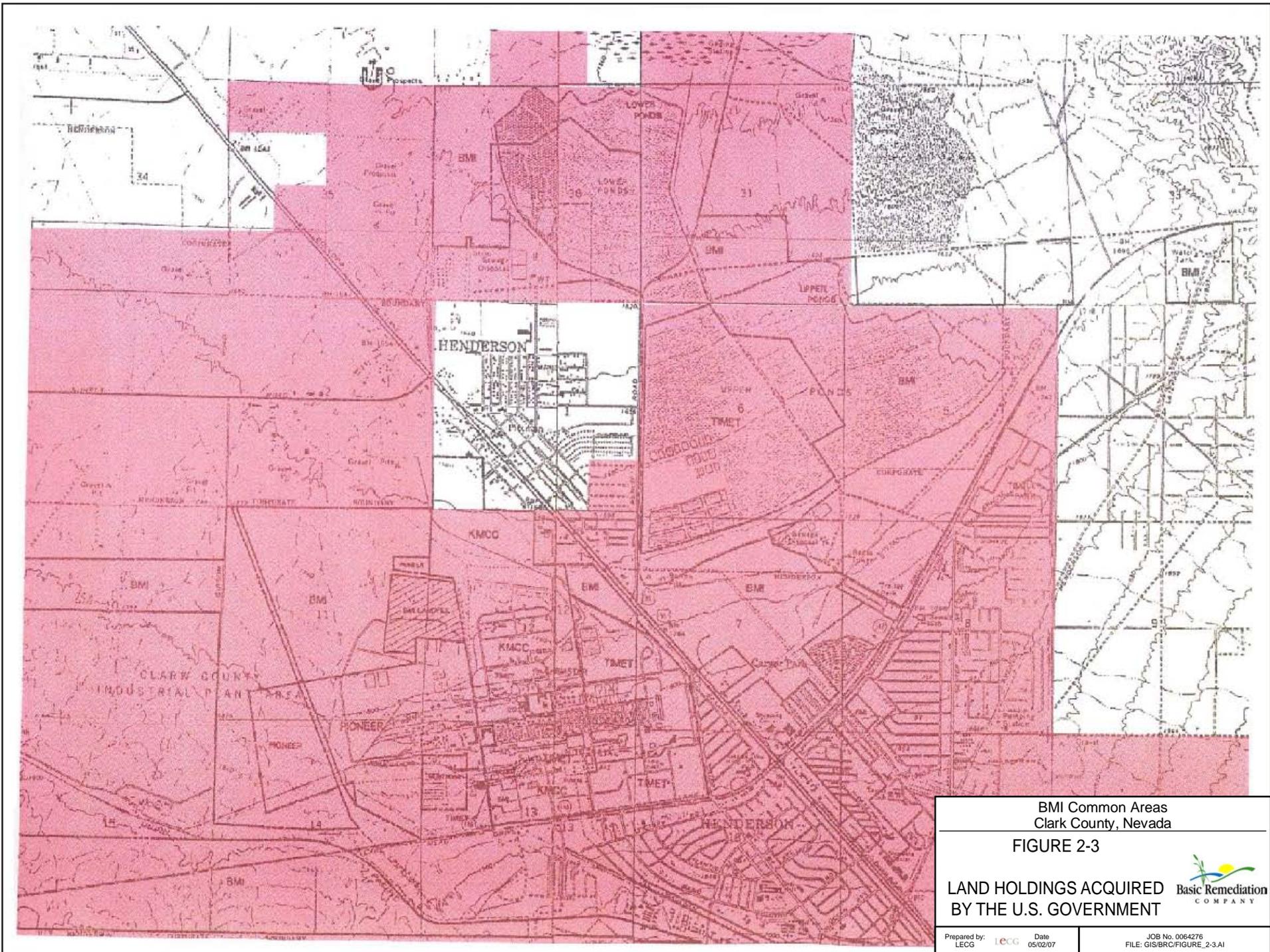


Prepared by
MKJ (ERM)



Date
05/02/07

JOB No. 0064276
FILE: GIS/BRC/FIGURE_2-2.AI



BMI Common Areas
 Clark County, Nevada

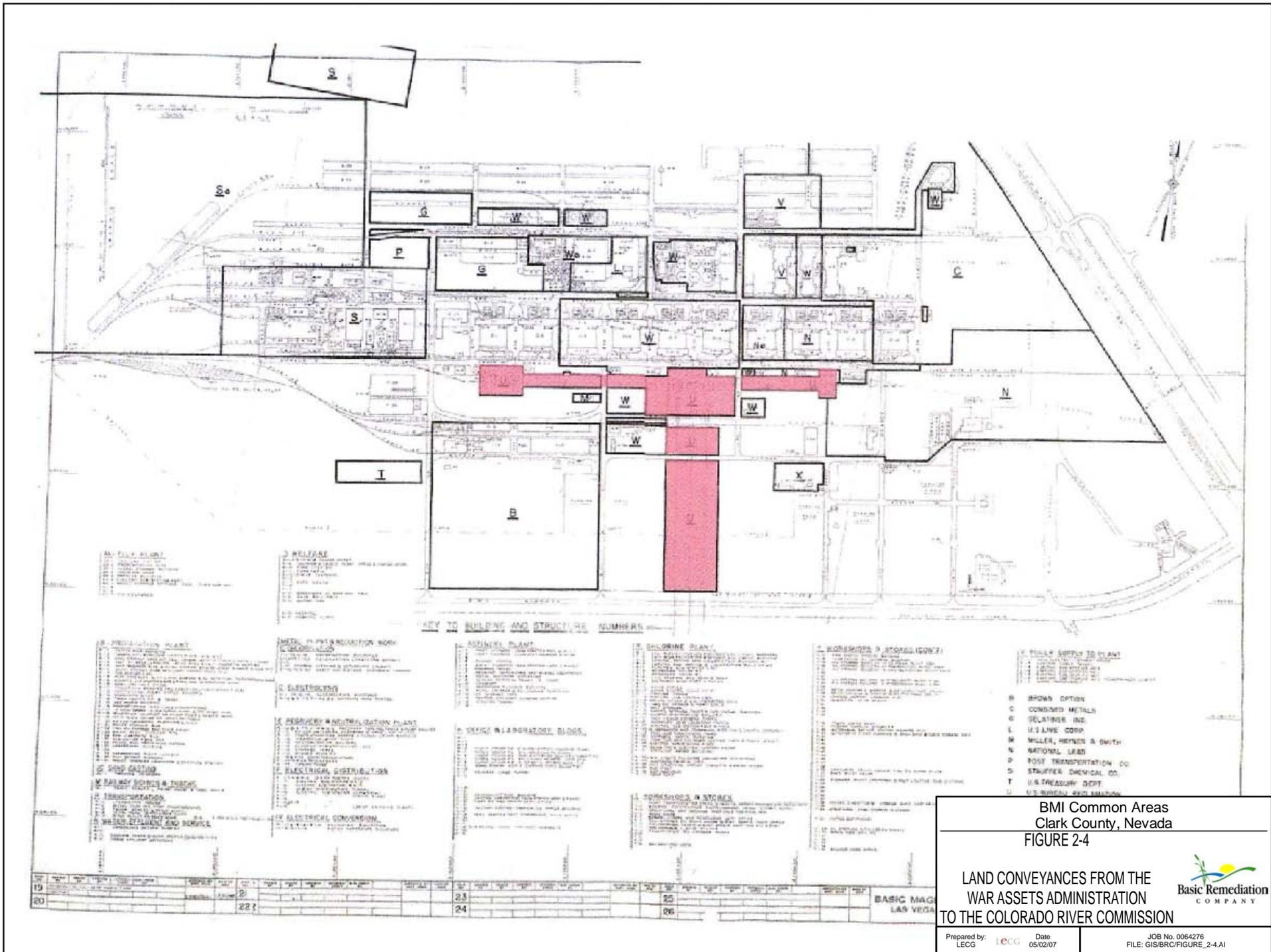
FIGURE 2-3

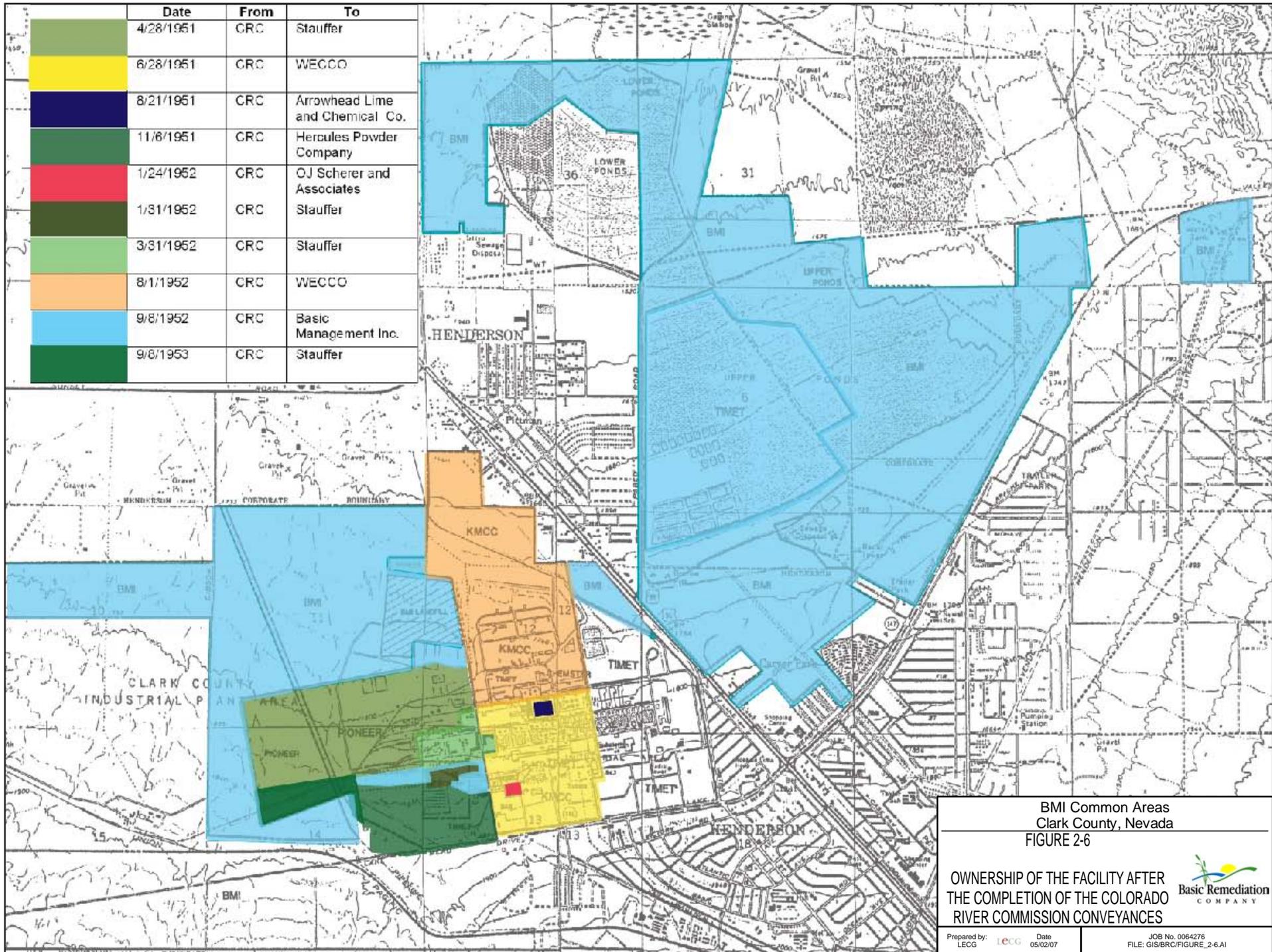
LAND HOLDINGS ACQUIRED
 BY THE U.S. GOVERNMENT



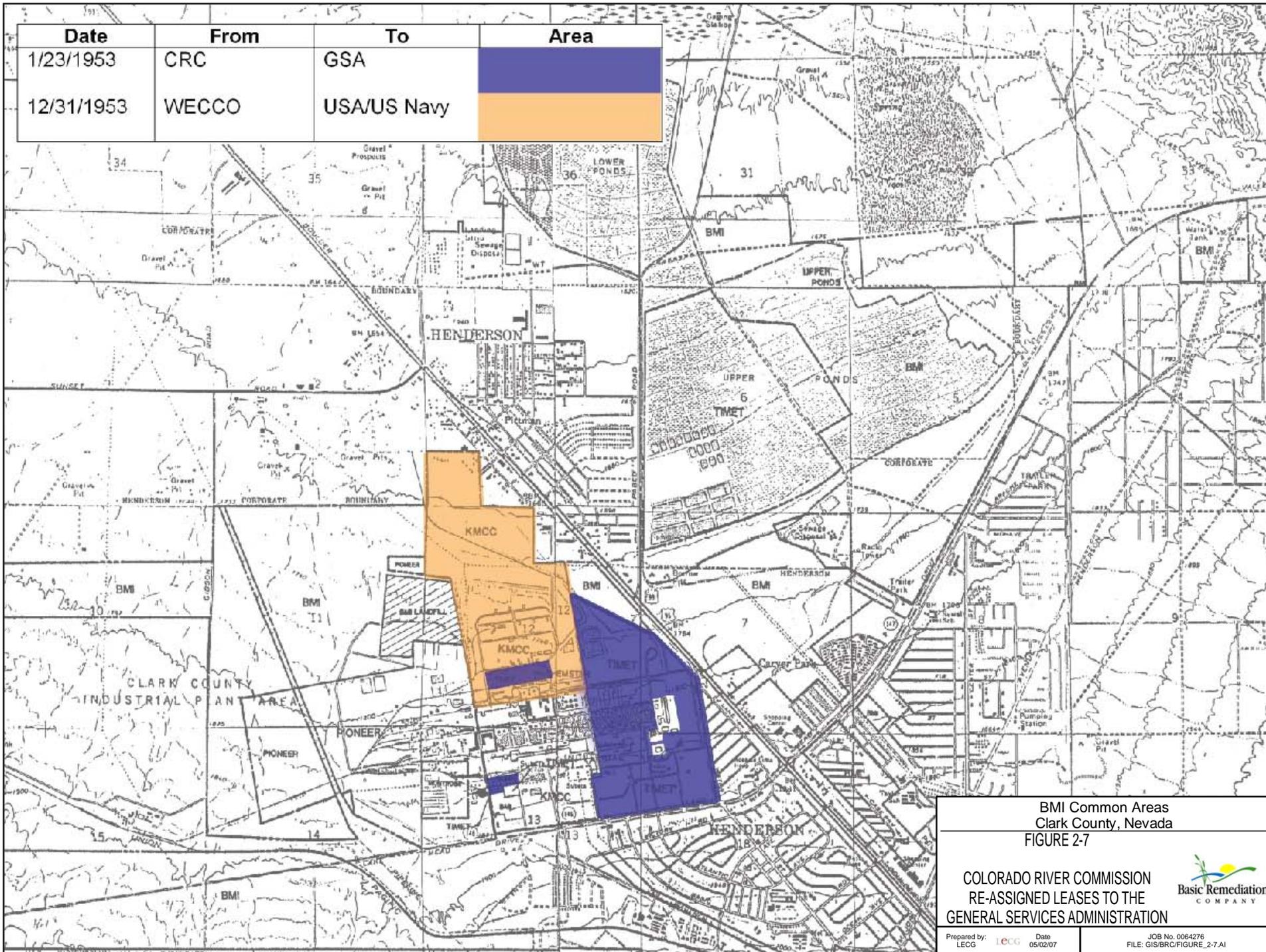
Prepared by: LECC
 Date: 05/02/07

JOB No. 0064276
 FILE: GIS/BRC/FIGURE_2-3.A1





Date	From	To	Area
1/23/1953	CRC	GSA	
12/31/1953	WECCO	USA/US Navy	

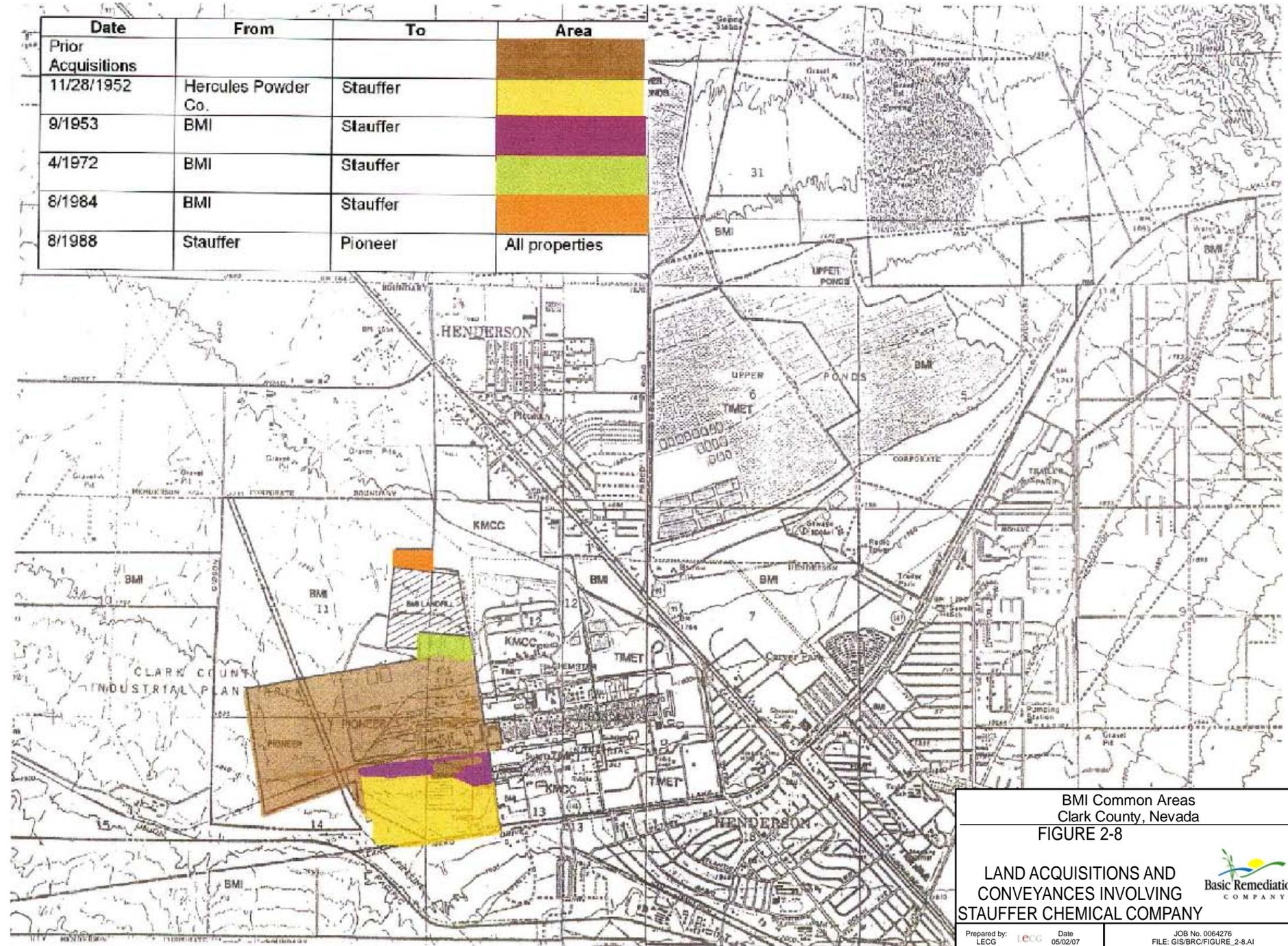


BMI Common Areas
Clark County, Nevada
FIGURE 2-7

COLORADO RIVER COMMISSION
RE-ASSIGNED LEASES TO THE
GENERAL SERVICES ADMINISTRATION



Date	From	To	Area
Prior Acquisitions			
11/28/1952	Hercules Powder Co.	Stauffer	
9/1953	BMI	Stauffer	
4/1972	BMI	Stauffer	
8/1984	BMI	Stauffer	
8/1988	Stauffer	Pioneer	All properties



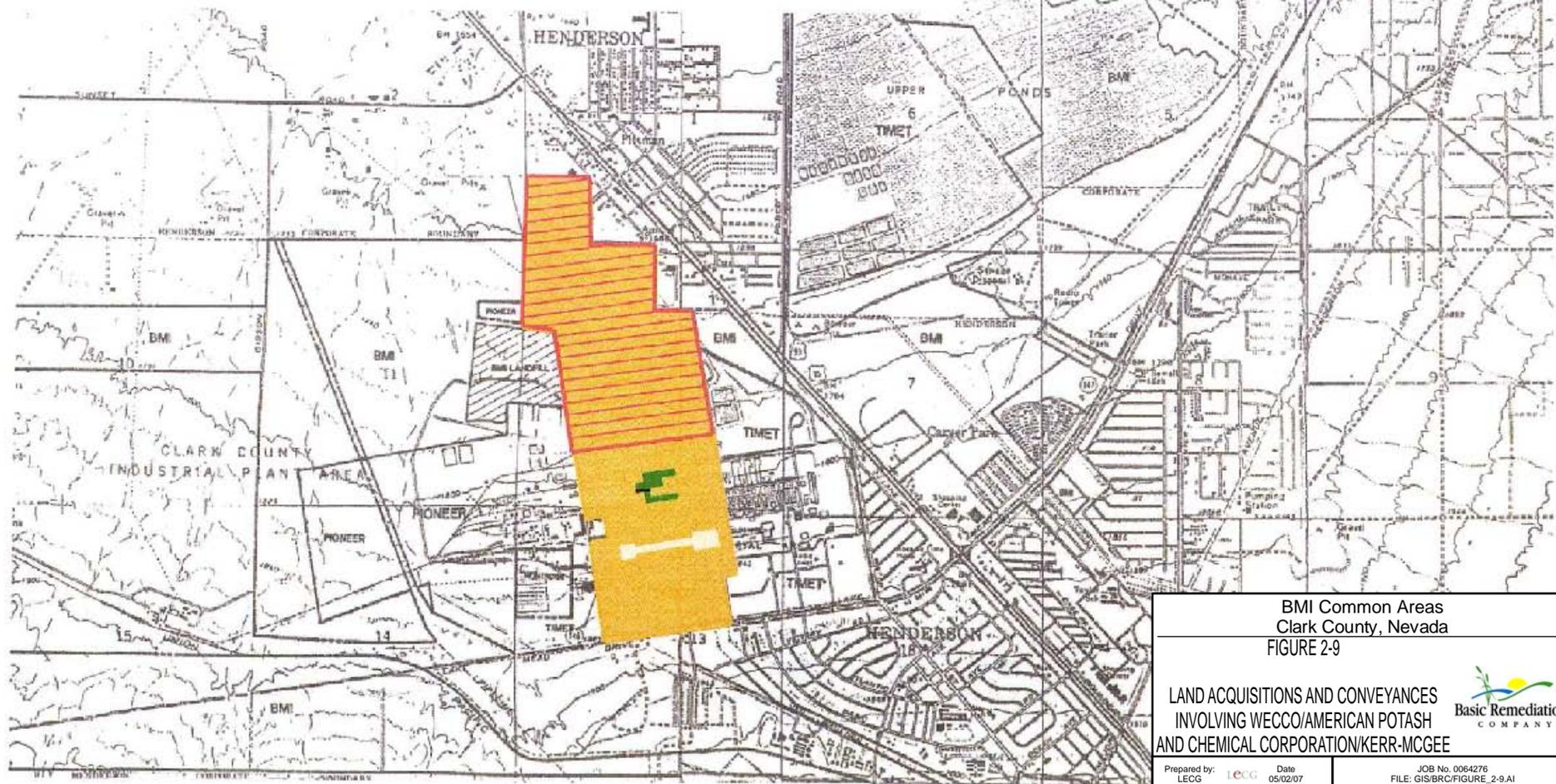
BMI Common Areas
Clark County, Nevada
FIGURE 2-8

**LAND ACQUISITIONS AND
CONVEYANCES INVOLVING
STAUFFER CHEMICAL COMPANY**


Basic Remediation
COMPANY

Prepared by: LECG	Date: 05/02/07	JOB No. 0064276 FILE: GIS/BC/FIGURE_2-8.A1
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Date	From	To	Area
Prior Acquisitions			[Orange hatched area]
12/31/1953	WECCO	USA/US Navy	
3/15/1962	USA	American Potash & Chemical Corp.	[Green area]
1971	Kerr McGee	Chemstar	
1988	Kerr McGee	Chemstar	[Brown area]



BMI Common Areas
Clark County, Nevada
FIGURE 2-9

LAND ACQUISITIONS AND CONVEYANCES
INVOLVING WECCO/AMERICAN POTASH
AND CHEMICAL CORPORATION/KERR-MCGEE

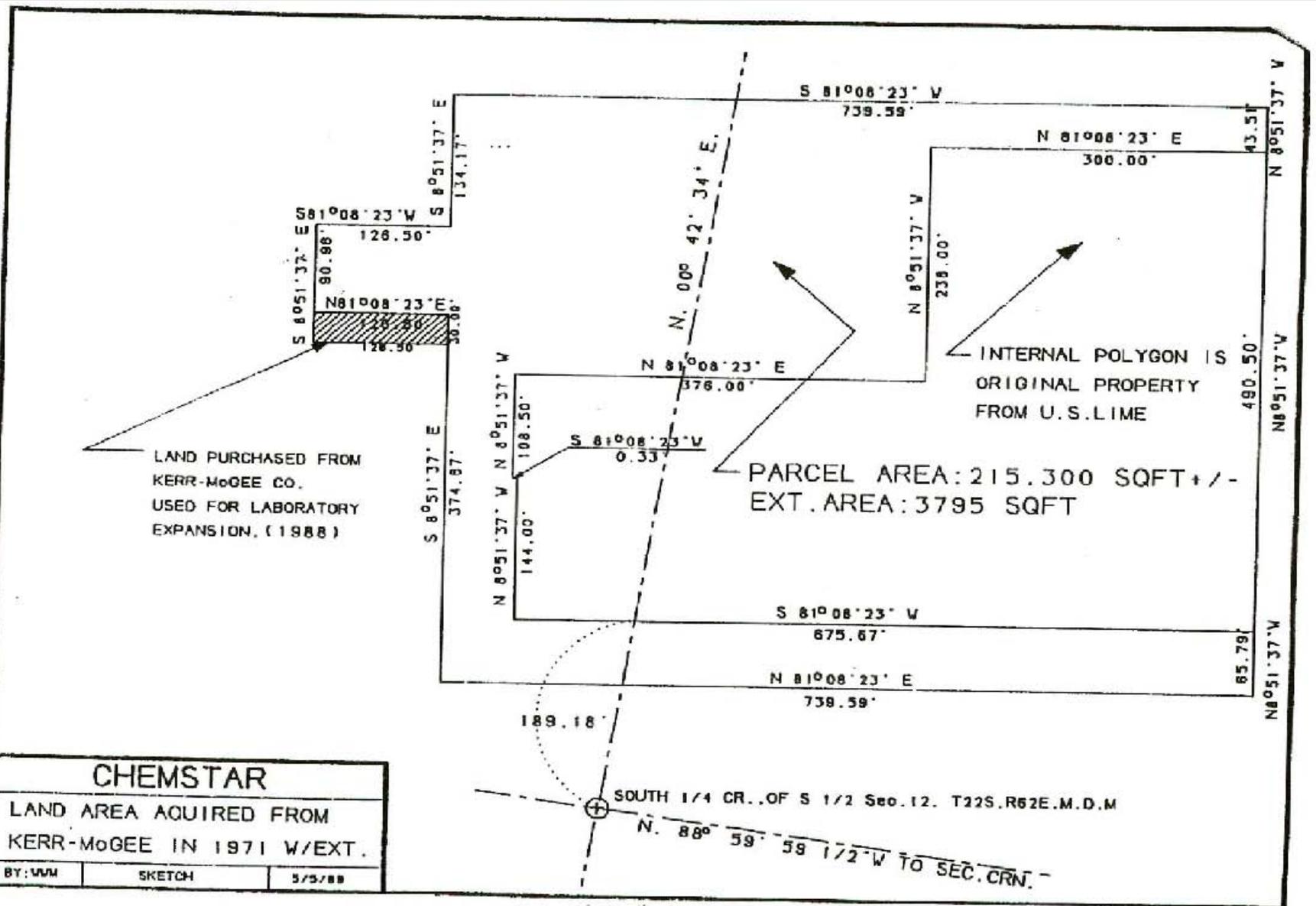


B002641

CHEMSTAR
 LAND AREA ACQUIRED FROM
 KERR-MoGEE IN 1971 W/EXT.

BY: UVM	SKETCH	5/5/88
---------	--------	--------

LAND PURCHASED FROM
 KERR-MoGEE CO.
 USED FOR LABORATORY
 EXPANSION. (1988)



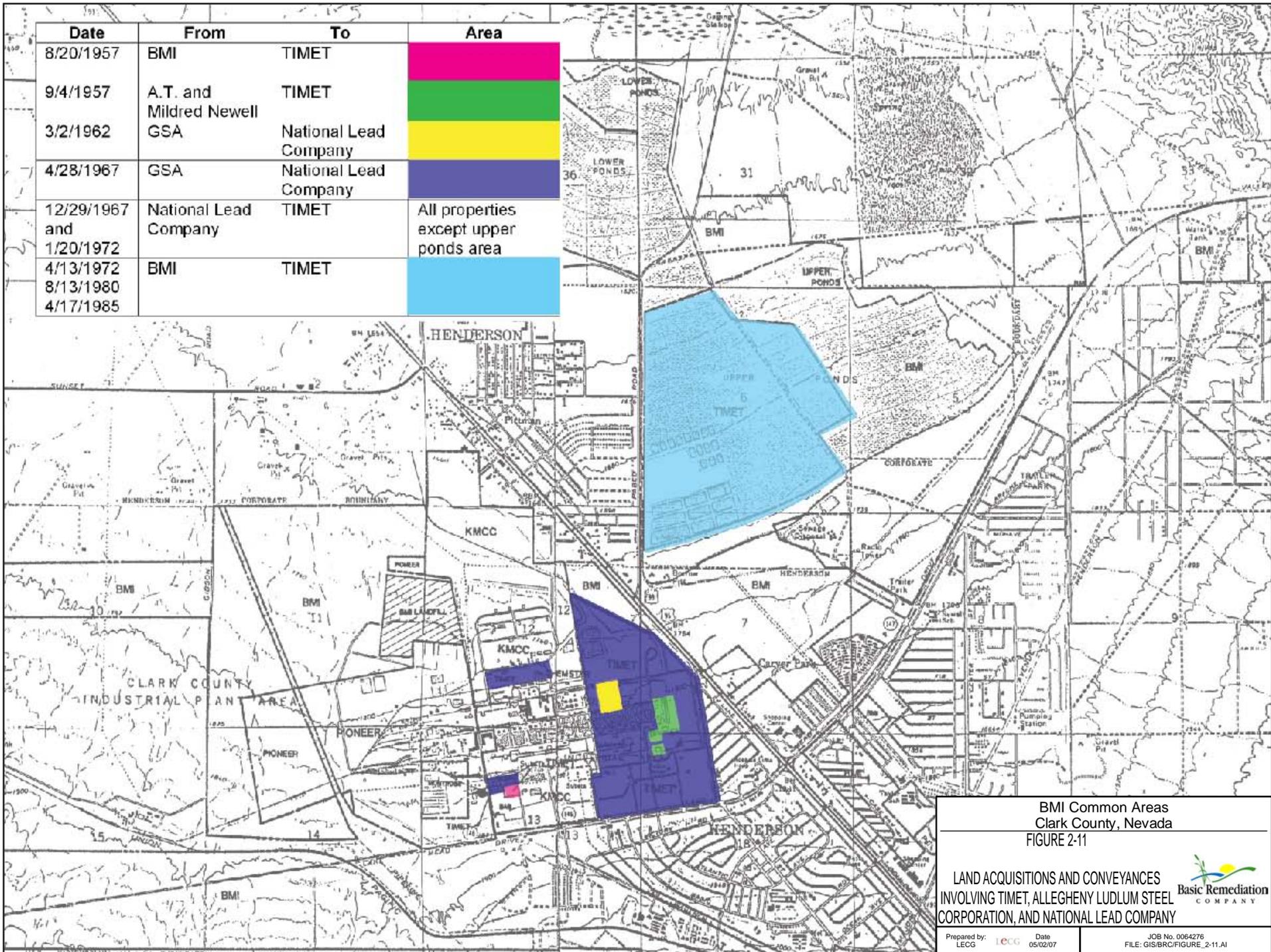
BMI Common Areas
 Clark County, Nevada

FIGURE 2-10

CHEMSTAR FACILITY



Prepared by: LECG Date: 05/02/07
 JOB No. 0064276
 FILE: GISBRCFIGURE_2-10.A1

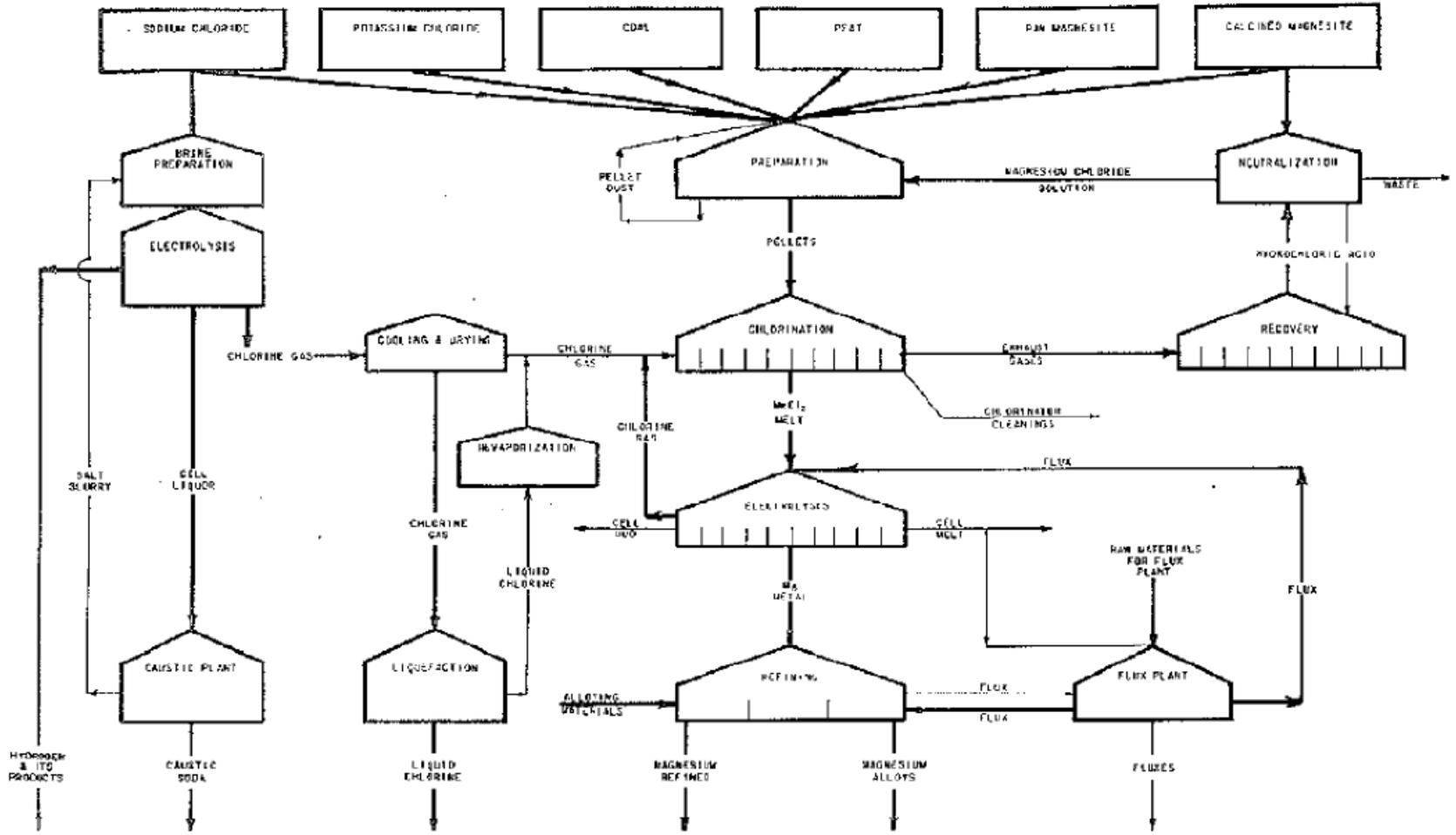


BMI Common Areas
Clark County, Nevada
FIGURE 2-11

LAND ACQUISITIONS AND CONVEYANCES
INVOLVING TIMET, ALLEGHENY LUDLUM STEEL
CORPORATION, AND NATIONAL LEAD COMPANY



FLOW DIAGRAM - MAGNESIUM PLANT



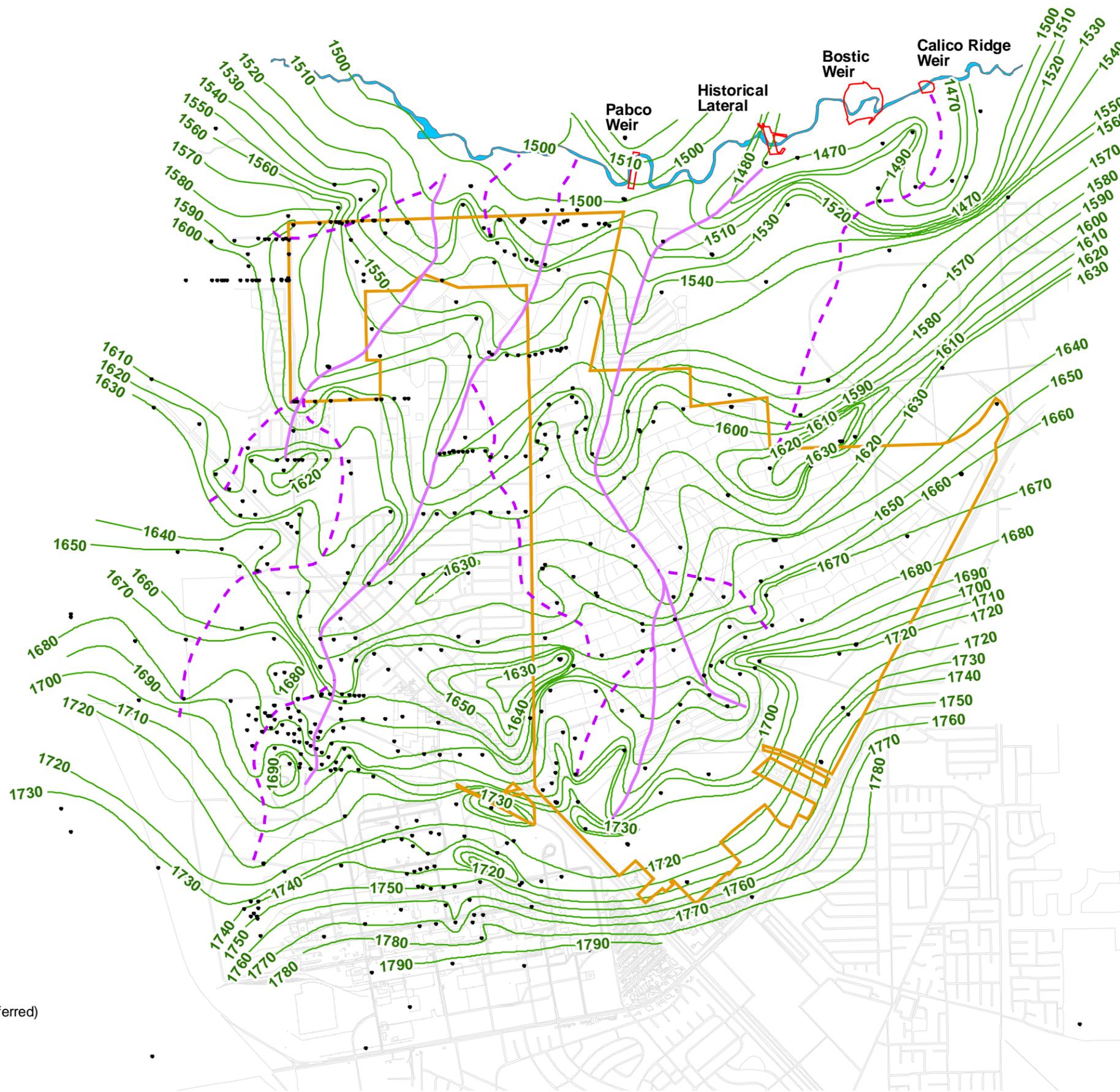
BR003262

BMI Common Areas
Clark County, Nevada

FIGURE 2-12

BASIC MAGNESIUM FLOW CHART OF OPERATIONS 

Prepared by: LECG	Date: 05/02/07	JOB No. 0064276 FILE: GIS/BRO/FIGURE_2-12.A1
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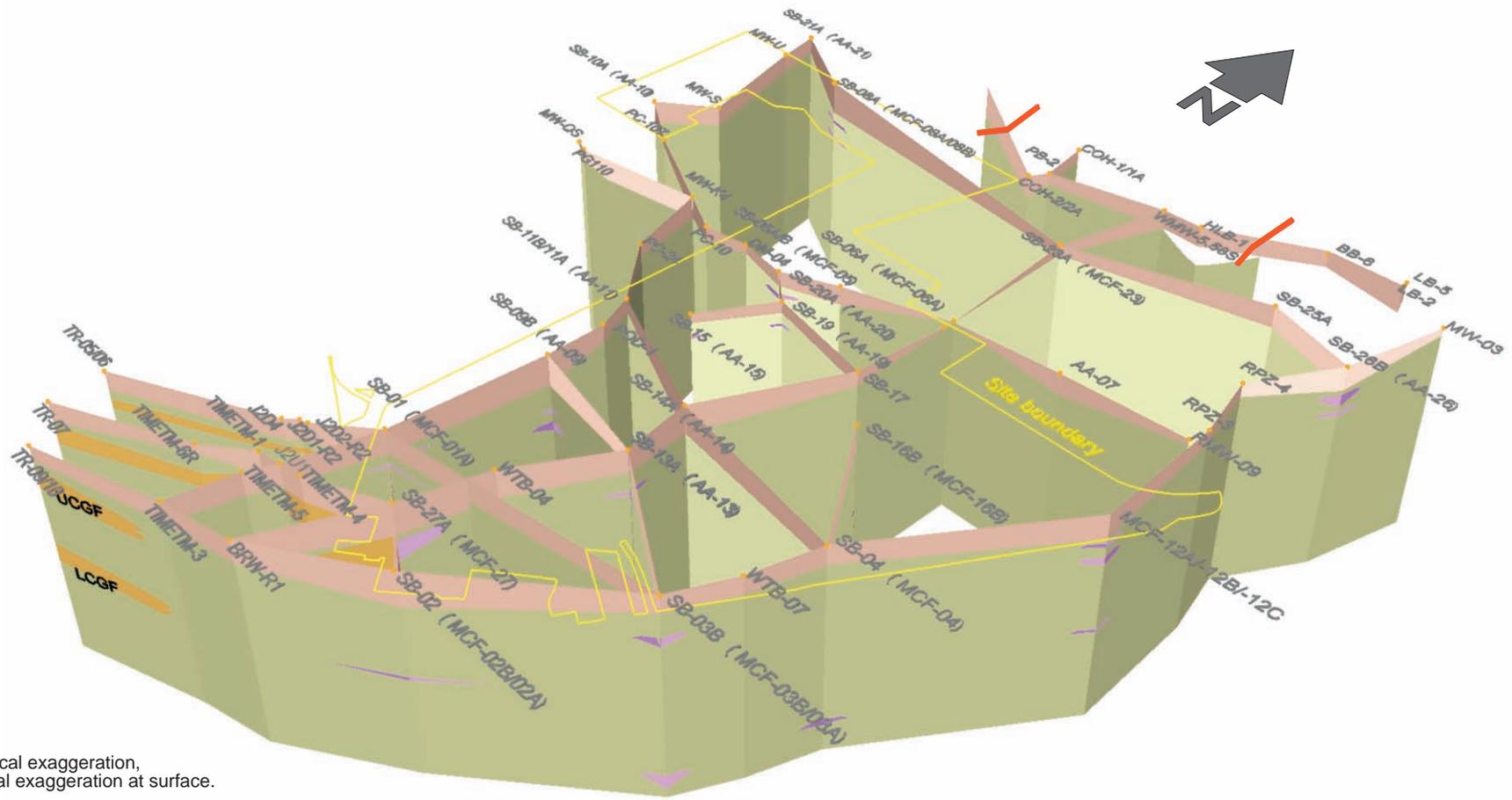
Note:
 Although work is ongoing to further delineate the paleochannels, the channels depicted are thought to be the primary subsurface features.



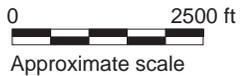
0 1,250 2,500
 Feet

- Site
- Data point used in contouring
- Muddy Creek contour
- - - Paleochannels (dashed where inferred)

BMI Common Areas Clark County, Nevada FIGURE 4-1		
TOPOGRAPHIC SURFACE OF THE MUDDY CREEK FORMATION		 Basic Remediation COMPANY
Prepared by DWR & TNB (DBS&A)	Date 04/23/07	PROJECTS/BRC/ES06.0018.00_BRC_EAST_CSM_SUMMARY/ GISMXDS/TOP_MUDDY_CREEK_4-23-07_11X17.MXD



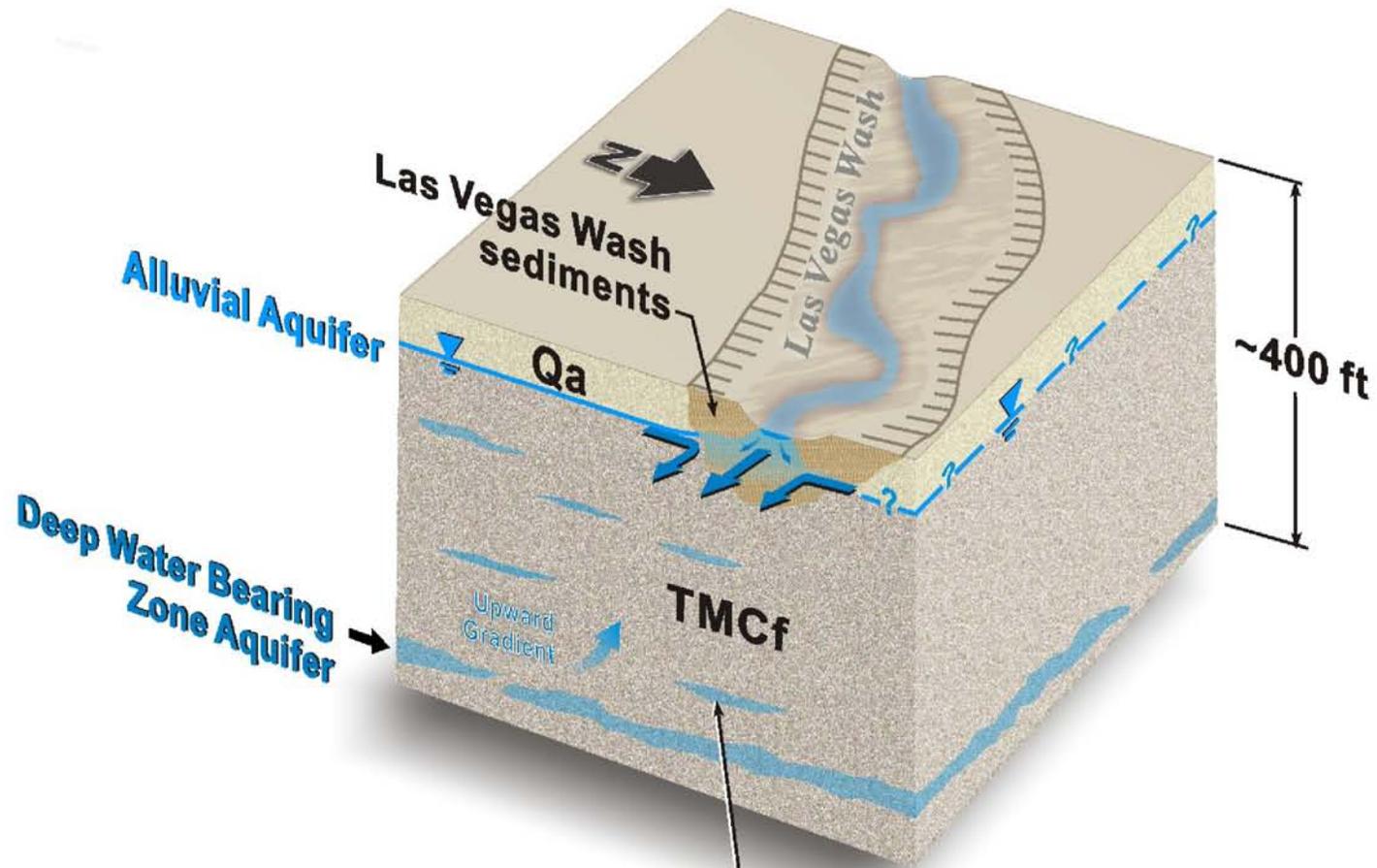
Note:
 10X vertical exaggeration,
 no vertical exaggeration at surface.



Explanation

- | | | |
|--|---|--|
|  Qa |  Coarse interbeds |  Weir |
|  TMCf |  Upper and lower coarse grained facies (UCGF) (LCGF) | |

BMI Common Areas Clark County, Nevada		
FIGURE 4-2		
GEOLOGIC BLOCK DIAGRAM WITH VIEW FROM THE SOUTHEAST		
Prepared by DWR & JD (DBS&A)	Date 04/23/07	S:\PROJECTS\BRC\ES06\0018_00_BRC_EAST_CSM_SUMMARY\ VR_DRAWINGS\ES06_0018_02W_GEOLOGIC_BLOCK_DIAGRAM.CDR

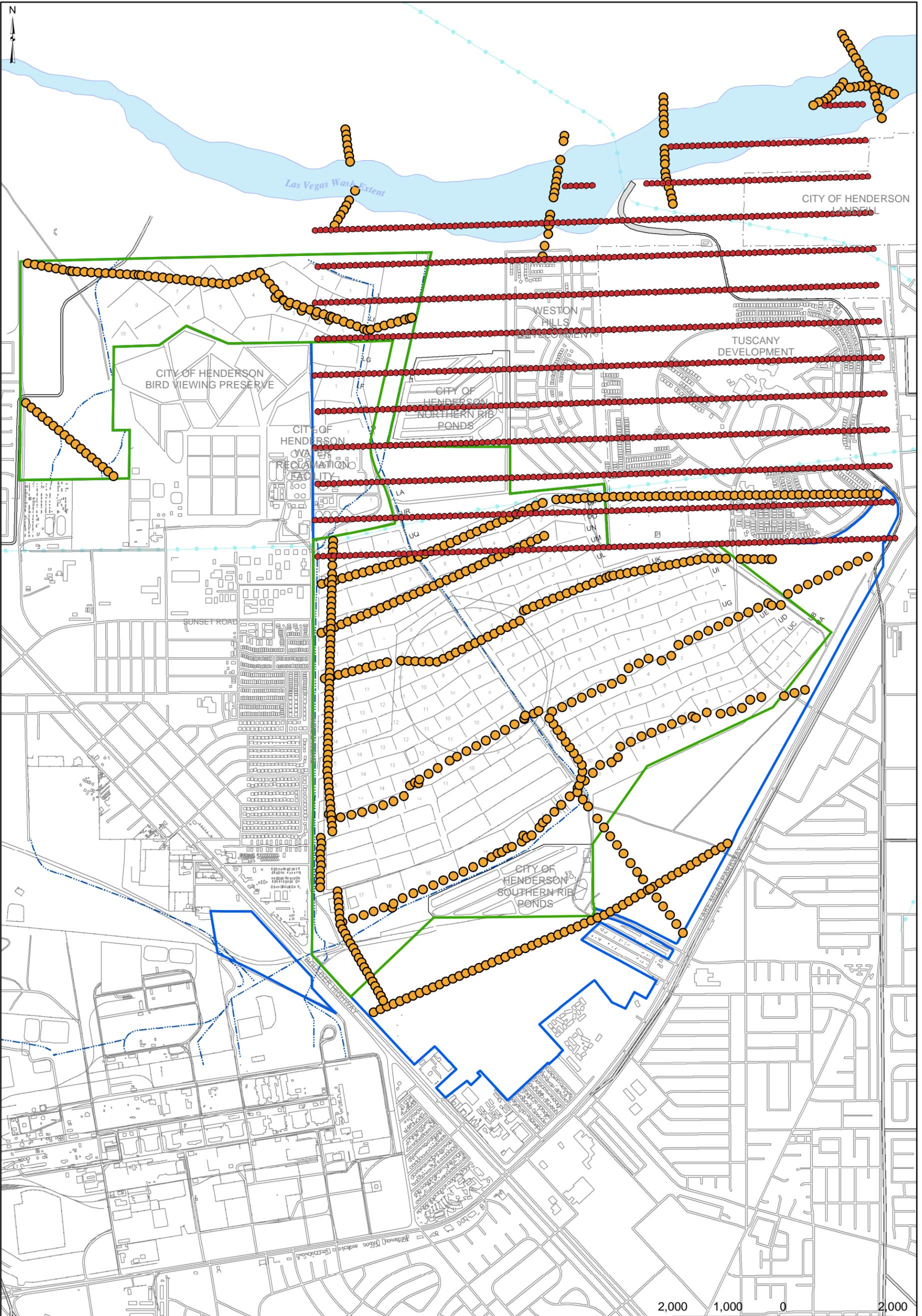


Explanation

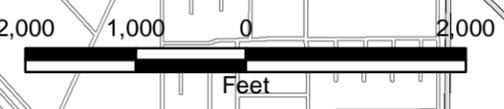
- Qa** Quaternary Alluvium
- TMCf** Upper Muddy Creek

Sporadic water-bearing sandy lenses (under pressure)

BMI Common Areas Clark County, Nevada FIGURE 4-3		
CONCEPTUAL DIAGRAM OF THE INTERACTION OF THE ALLUVIAL AQUIFER AND LAS VEGAS WASH		
Prepared by DWR & JD (DBS&A)	Date 04/23/07	S:\PROJECTS\BRC\ES06\0018.00_BRC_EAST_CSM_SUMMARY\VR_DRAWINGS\ES06_0018_02W_DETAIL_OF_WASH.CDR 



 Site AOC3 Boundary	 Geophysical Investigation Location (2003)
 Site Soil Boundary	 Geophysical Investigation Location (2005)
 Ditches	
 Flood Conveyance Channels	
 Laterals	

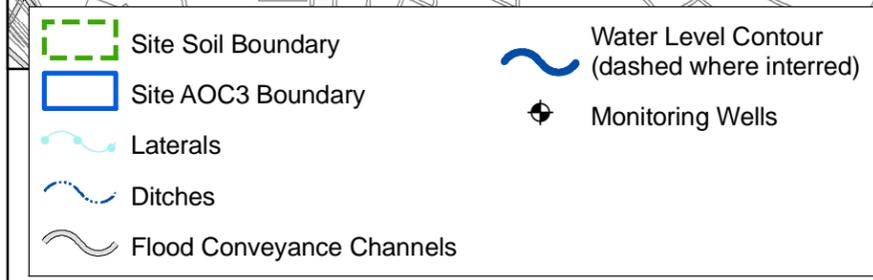
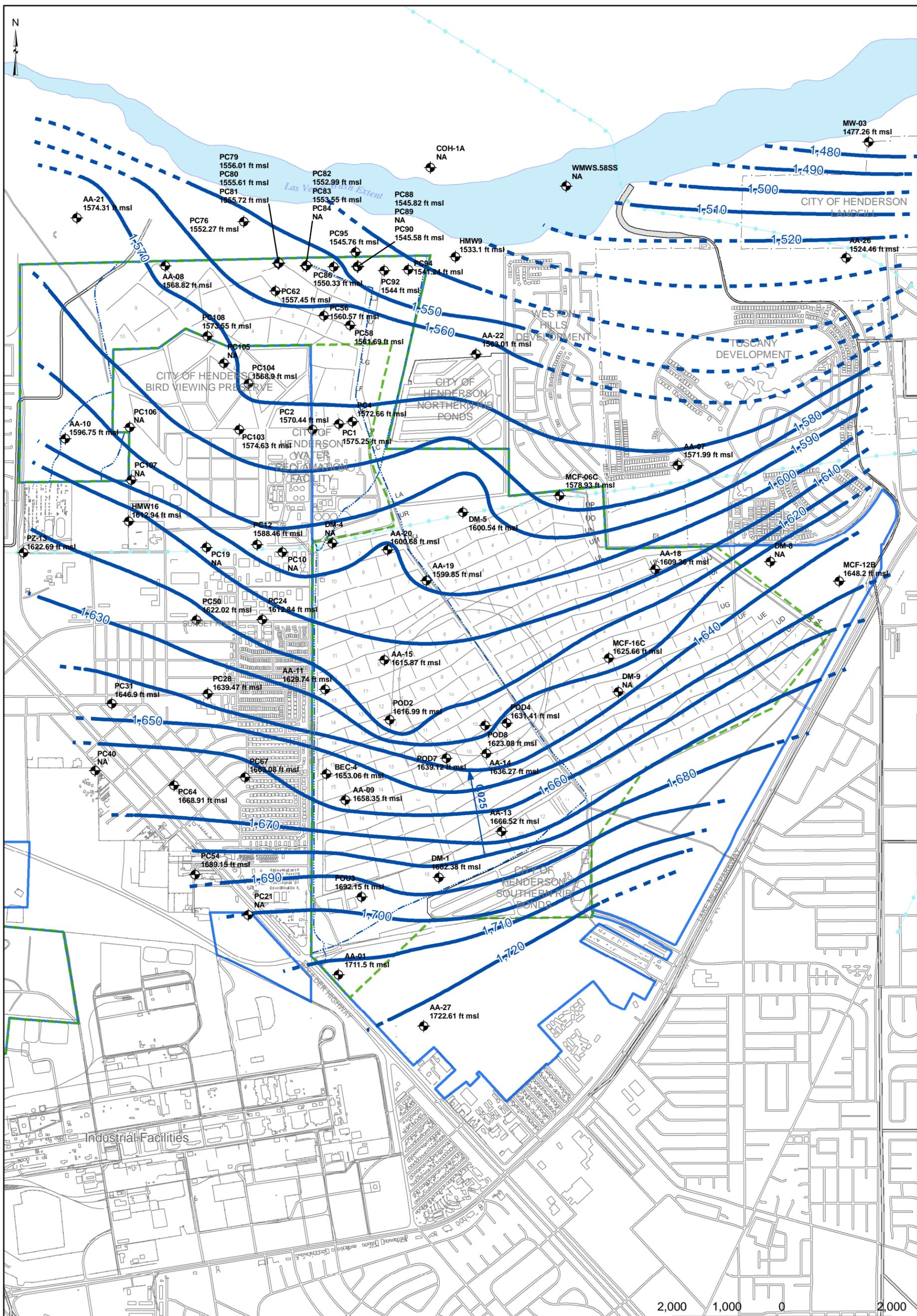


BMI Common Areas
Clark County, Nevada
FIGURE 4-4

GEOPHYSICAL SURVEY TRANSECT LOCATIONS



Prepared by MKJ (ERM)	Date 05/03/07	JOB No. 0064276 FILE: GIS/ERC/FIGURE_4-4.MXD
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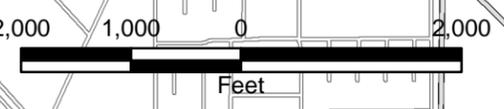
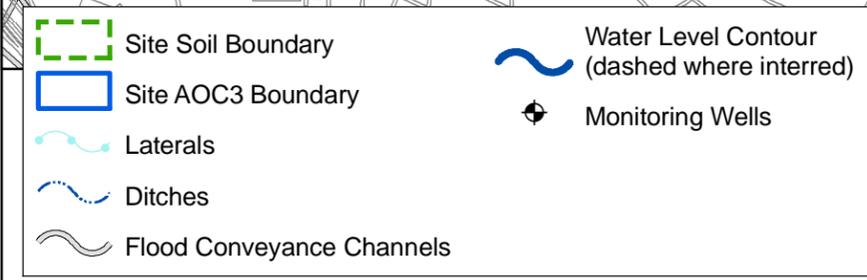
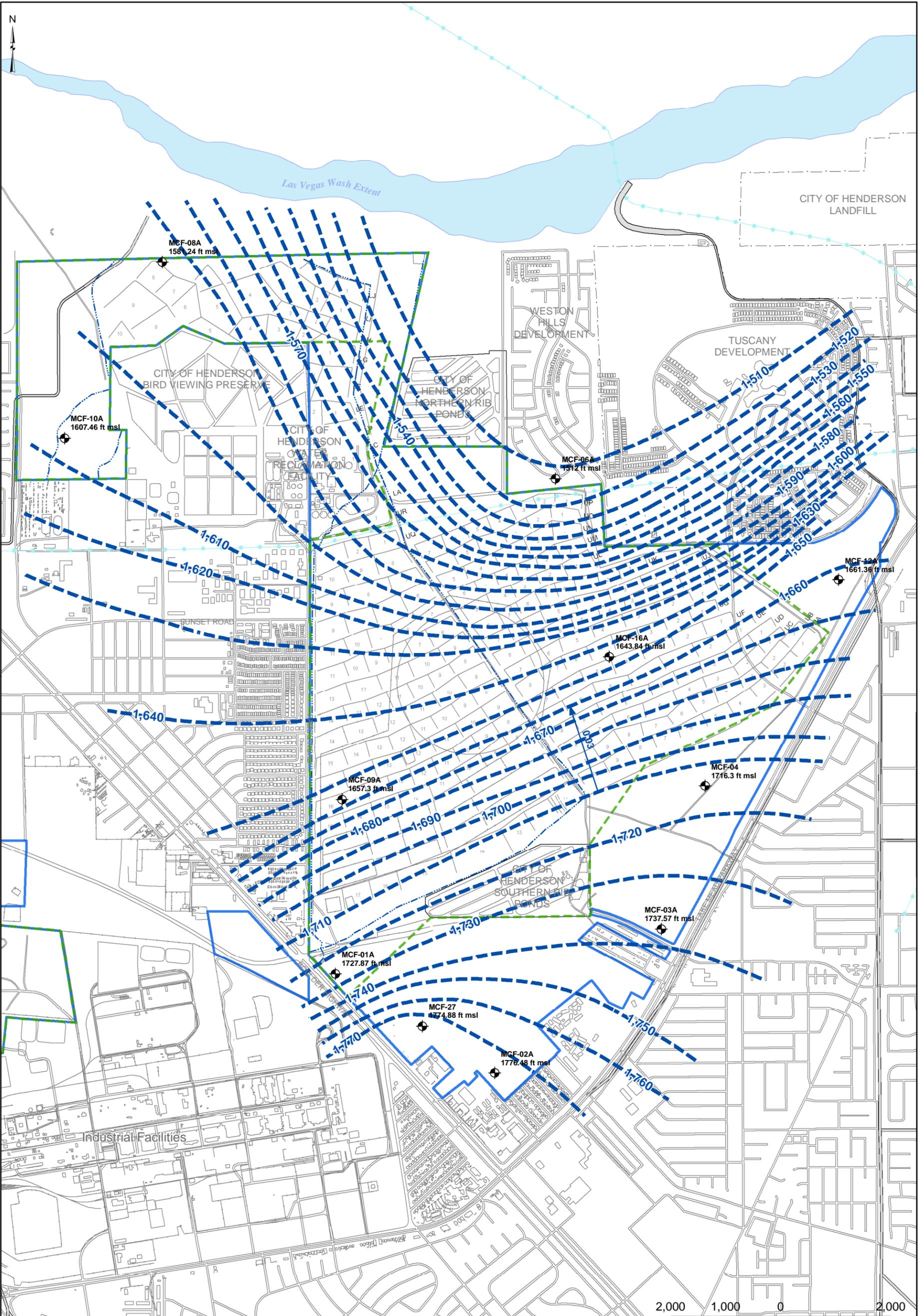


2,000 1,000 0 2,000
Feet

BMI Common Areas
Clark County, Nevada
FIGURE 4-5

**POTENTIOMETRIC SURFACE
MAP OF UPPER UNCONFINED
WATER-BEARING WELLS
THIRD QUARTERLY EVENT 2006**

Prepared by MKJ (ERM)	Date 05/03/07	JOB No. 0064276 FILE: GIS/ERC/FIGURE_4-5.MXD
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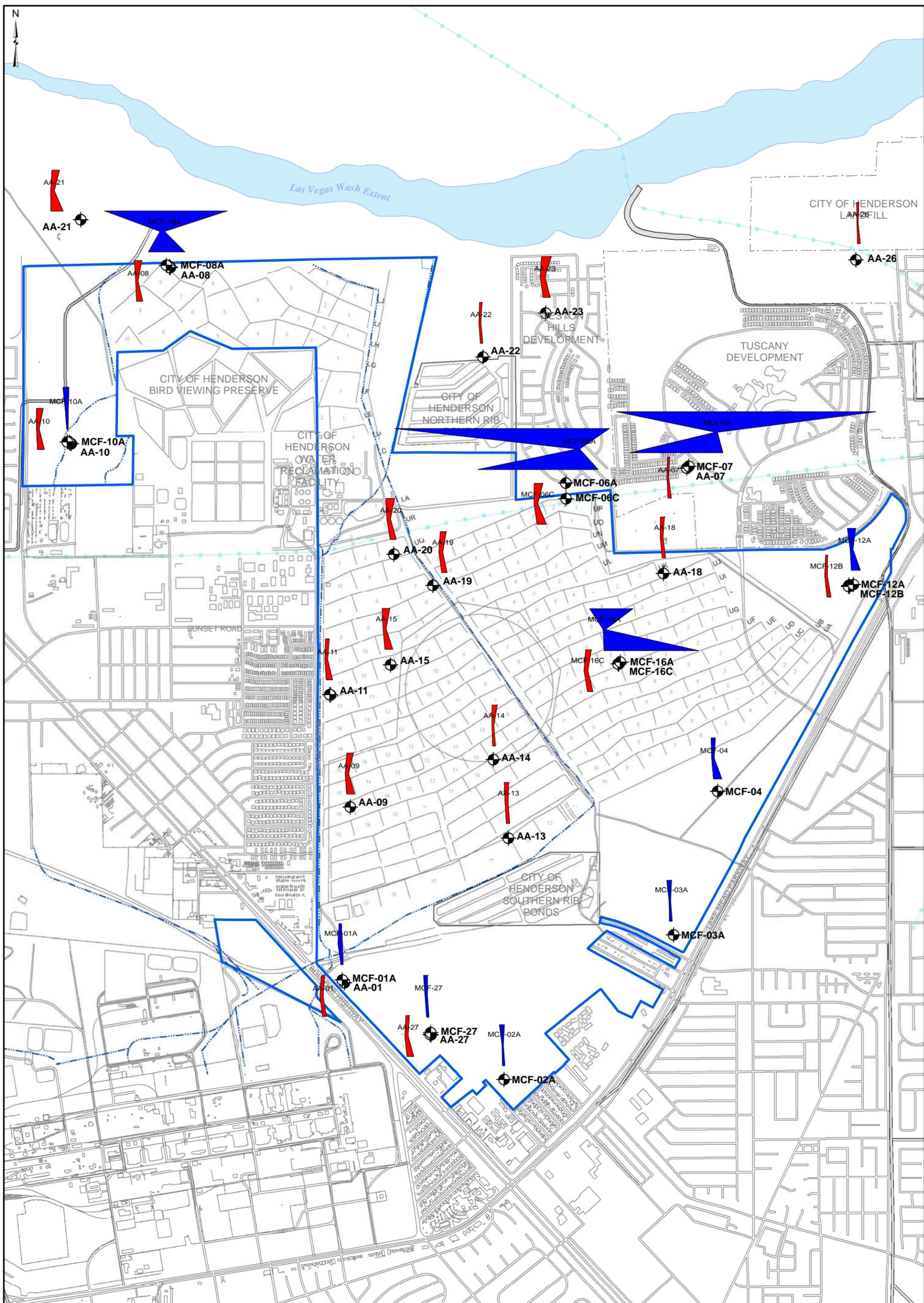


BMI Common Areas
Clark County, Nevada
FIGURE 4-6

POTENTIOMETRIC SURFACE
MAP OF MUDDY CREEK
FORMATION (MCF) WELLS (DEEP)
THIRD QUARTERLY EVENT 2006

Prepared by: MKJ (ERM) Date: 05/03/07

JOB No. 0064276
FILE: GIS/ERC/FIGURE_4-6.MXD



Site AOC3 Boundary

Ditches

Flood Conveyance Channels

Laterals

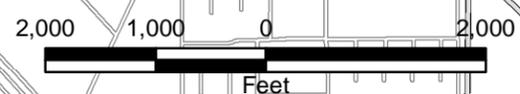
Note: Stiff diagrams are based on 2004 Hydrogeologic Investigation data.

Monitoring Well Location

Na+K Cl
Ca HCO₃+CO₃
Mg SO₄

Blue = Deep Zone

Red = Aa



BMI Common Areas
Clark County, Nevada

FIGURE 4-7

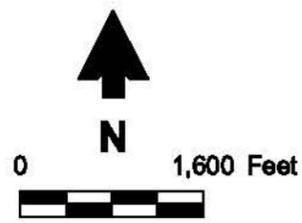
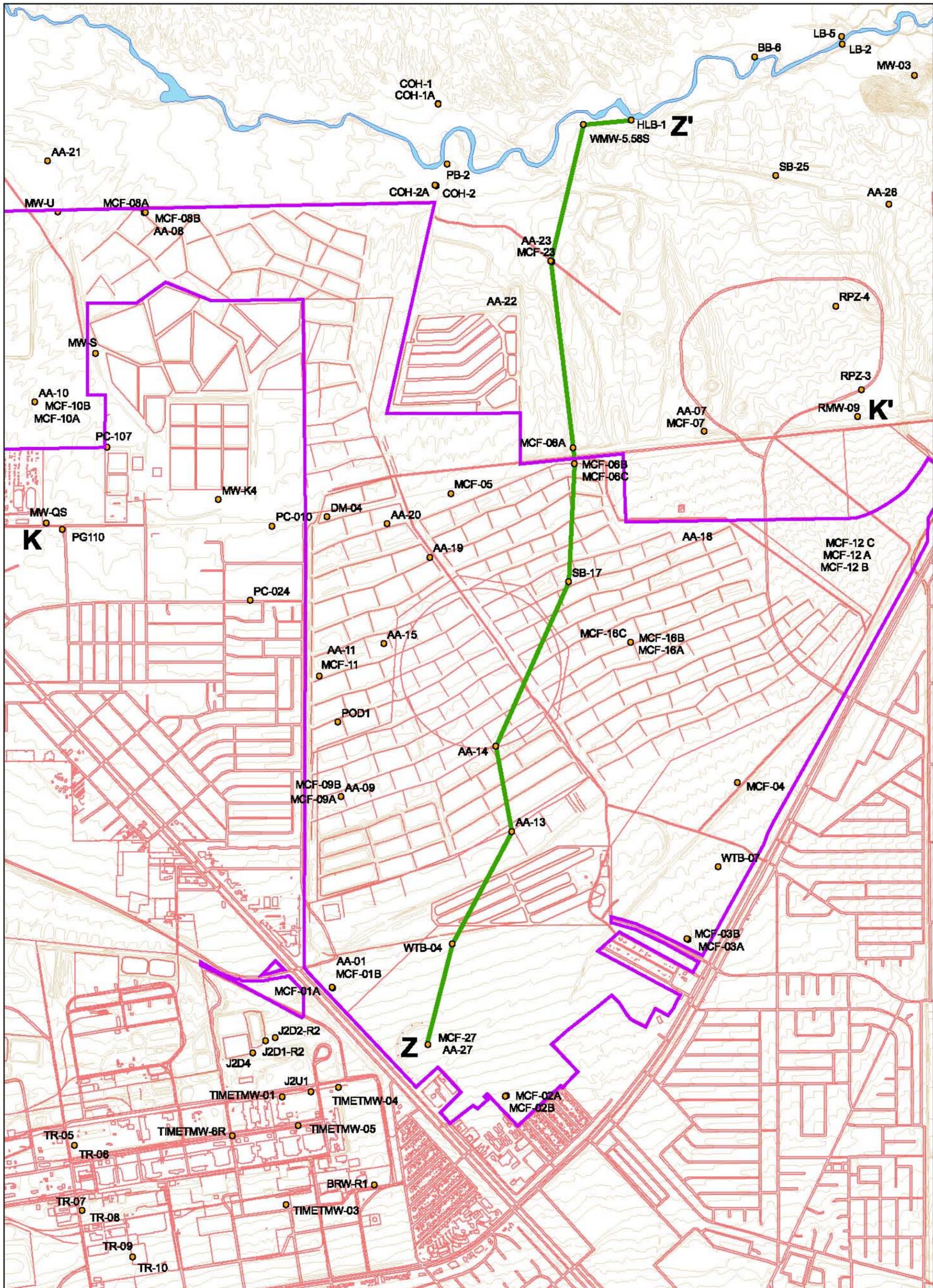
STIFF DIAGRAMS
FOR THE Aa AND
DEEP ZONES



Prepared by
MKJ (ERM)

Date
05/02/07

JOB No. 0064276
FILE: GIS/ERC/FIGURE_4-7.MXD



Explanation

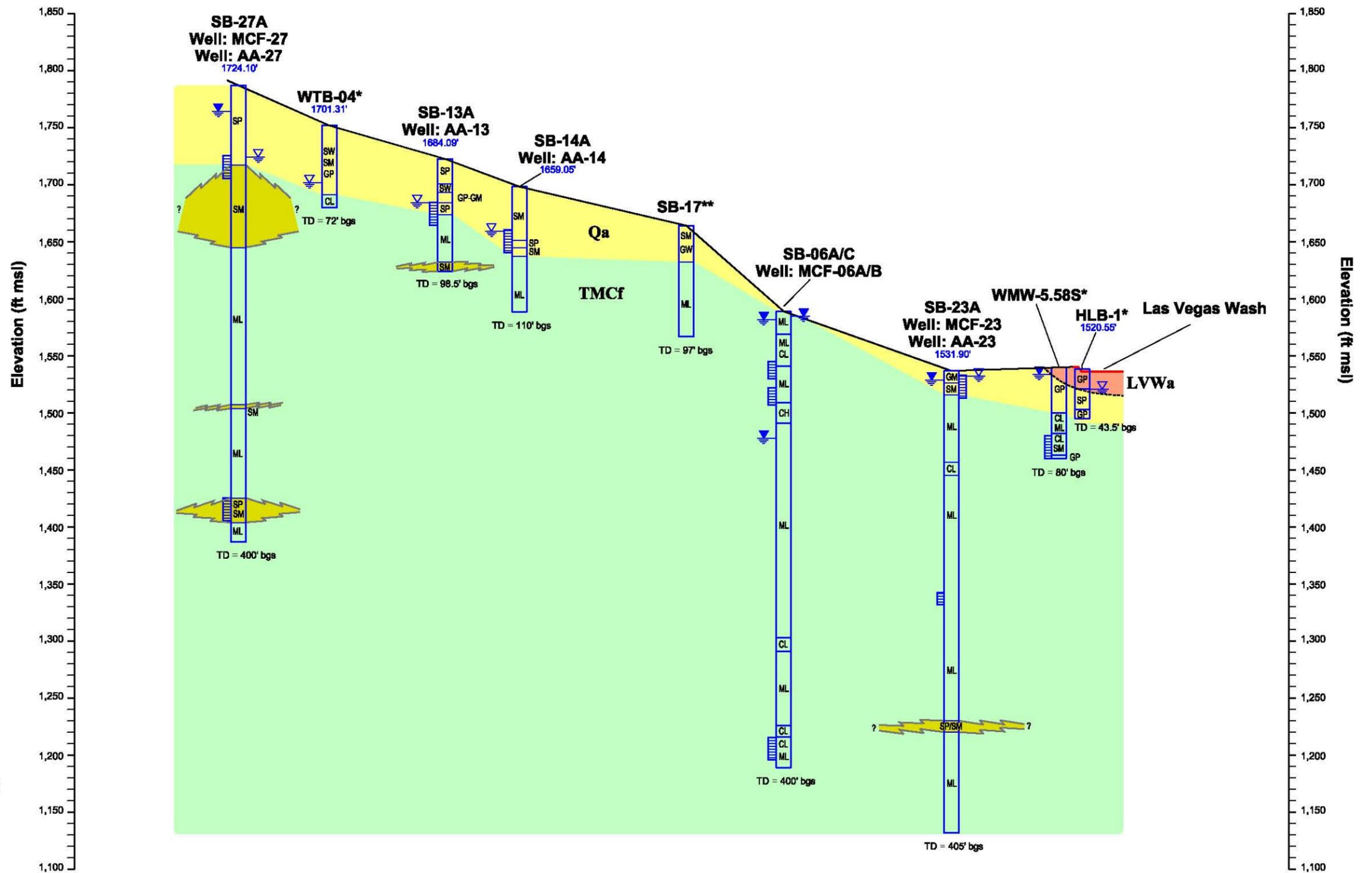
- Site boundary
- Monitoring wells
- Cross section location
- Roads, buildings, and other structures
- Contours
- Las Vegas wash

BMI Common Areas Clark County, Nevada FIGURE 4-8		
HYDROLOGIC CROSS SECTION Z-Z' LOCATION MAP		
Prepared by DWR & JD (DBSA)	Date 04/23/07	S:\PROJECTS\BRC\ES06.0018.00_BRC_EAST_CSM_SUMMARY IGIS\MXD\CROSS_SEC.LOCATION.Z-Z'.4-23-07.MXD



South
Z

North
Z'



Explanation

-  Well & well screen
-  Water level for wells completed in Qa (2004)
-  Water level for wells completed in TMCf (2004)
-  Las Vegas Wash Alluvial sediments
-  Quaternary alluvium
-  Tertiary Muddy Creek Formation
-  Sandy unit facies change
-  Dashed where contact inferred

0 2000 ft
20X vertical exaggeration

Note: Groundwater elevations measured in July 2004

- * Groundwater elevations in these wells were not measured contemporaneously with the other wells
- ‡ No well was installed at the SB-17 location because groundwater was not encountered

BMI Common Areas
Clark County, Nevada

FIGURE 4-9

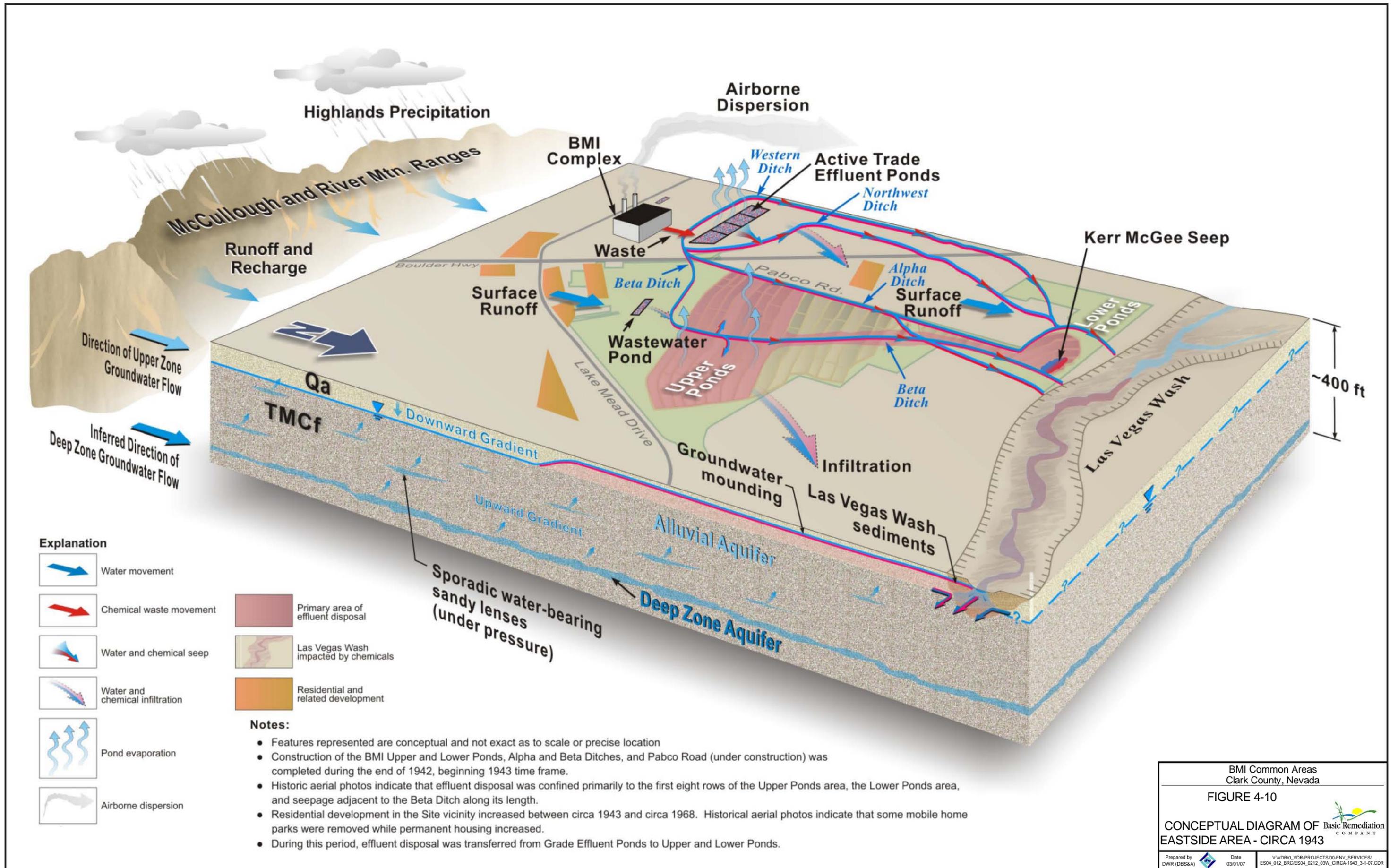
HYDROGEOLOGIC
CROSS SECTION Z-Z'



Prepared by
DWR & JLD (DBS&A)

Date
04/23/07

T:\VDR\0-VDR-PROJECTS\00-ENV_SERVICES\
ES04-0212\ES04_0212_22F_Z-Z'.DWG



Explanation

-  Water movement
-  Chemical waste movement
-  Water and chemical seep
-  Water and chemical infiltration
-  Pond evaporation
-  Airborne dispersion

-  Primary area of effluent disposal
-  Las Vegas Wash impacted by chemicals
-  Residential and related development

Notes:

- Features represented are conceptual and not exact as to scale or precise location
- Construction of the BMI Upper and Lower Ponds, Alpha and Beta Ditches, and Pabco Road (under construction) was completed during the end of 1942, beginning 1943 time frame.
- Historic aerial photos indicate that effluent disposal was confined primarily to the first eight rows of the Upper Ponds area, the Lower Ponds area, and seepage adjacent to the Beta Ditch along its length.
- Residential development in the Site vicinity increased between circa 1943 and circa 1968. Historical aerial photos indicate that some mobile home parks were removed while permanent housing increased.
- During this period, effluent disposal was transferred from Grade Effluent Ponds to Upper and Lower Ponds.

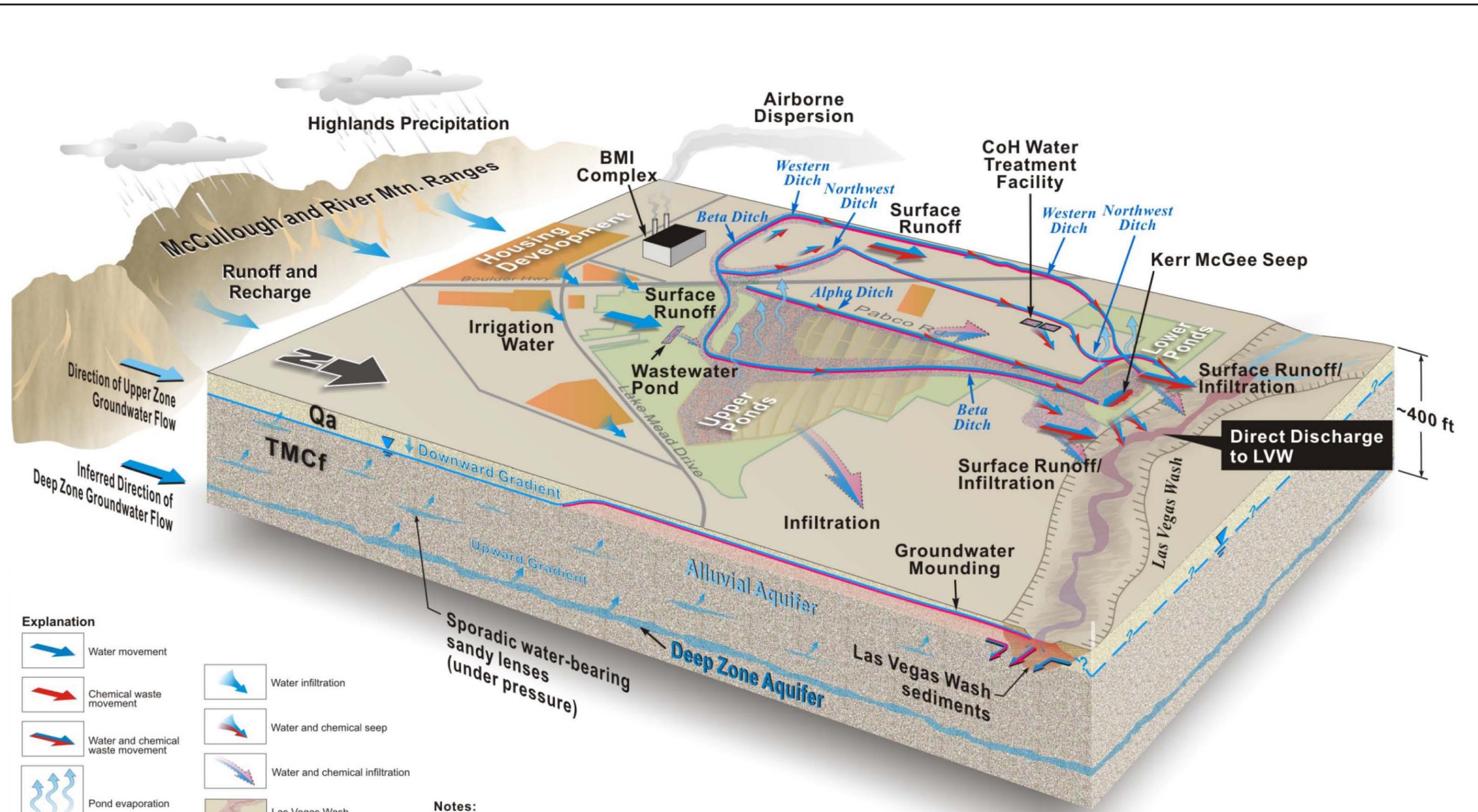
BMI Common Areas
Clark County, Nevada

FIGURE 4-10

CONCEPTUAL DIAGRAM OF EASTSIDE AREA - CIRCA 1943



Prepared by: DWR (DBS&A) Date: 03/01/07 V:\VDR\0_VDR-PROJECTS\00-ENV-SERVICES\ES04_012_BRC\ES04_0212_03W_CIRCA-1943_3-1-07.CDR



Explanation

-  Water movement
-  Chemical waste movement
-  Water and chemical waste movement
-  Pond evaporation
-  Airborne dispersion
-  Water infiltration
-  Water and chemical seep
-  Water and chemical infiltration
-  Las Vegas Wash impacted by chemicals
-  Residential and related development

Notes:

- Features represented are conceptual and not exact as to scale or precise location
- Historic aerial photos indicate that effluent disposal was confined primarily to the first eight rows of the Upper Ponds area, the Lower Ponds area, and seepage adjacent to the Alpha and Beta Ditches along their length.
- Preliminary analytic modeling indicates that mounding of the water table aquifer would have occurred as the result of infiltration beneath evaporation and wastewater ponds. This groundwater mounding would have similarly occurred beneath infiltrating ponds throughout the BMI Complex.

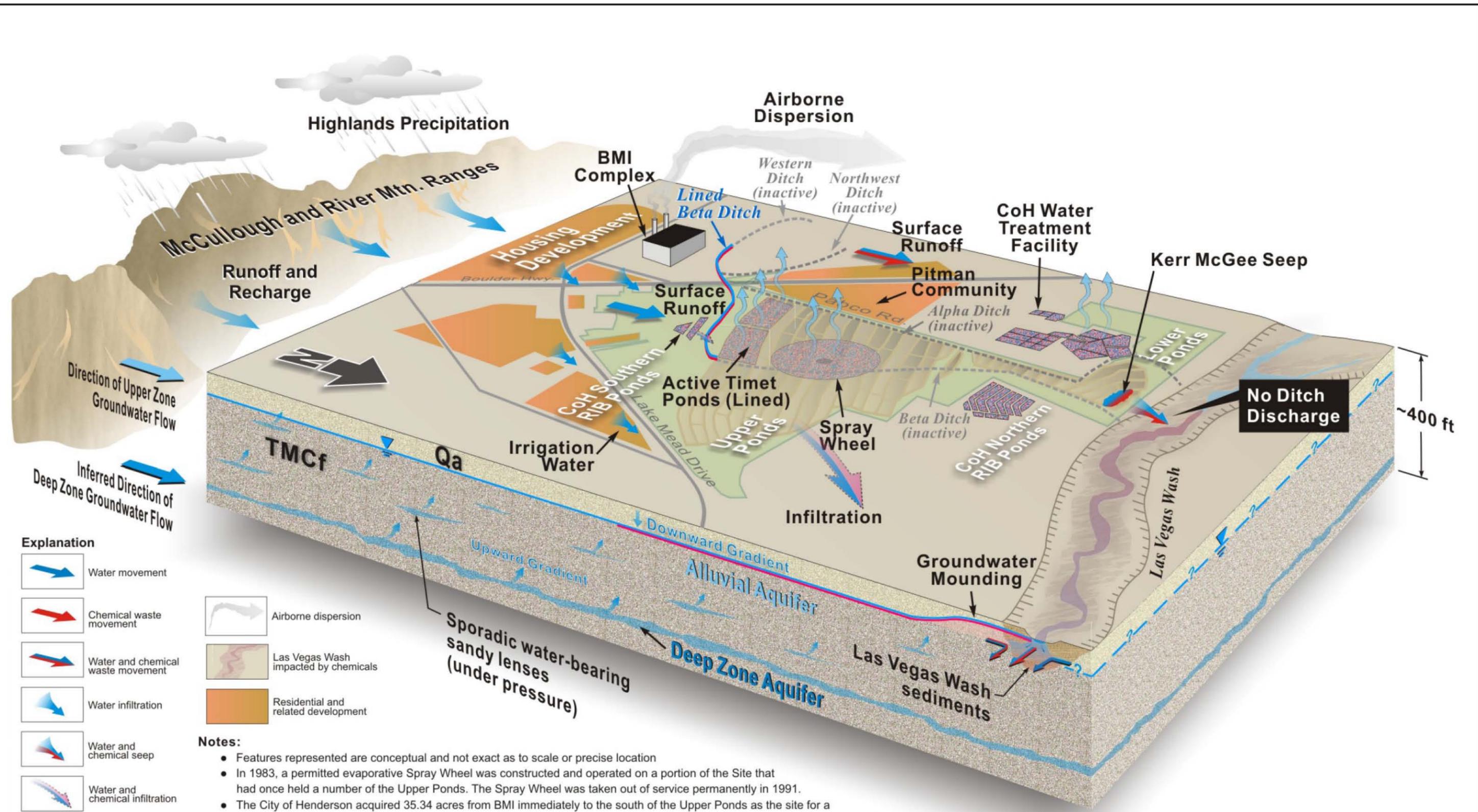
BMI Common Areas
Clark County, Nevada

FIGURE 4-11

CONCEPTUAL DIAGRAM OF EASTSIDE AREA - CIRCA 1968



Prepared by DWR (DBS&A)	Date 03/01/07	V:\VDR10_VDR-PROJECTS\00-ENV_SERVICES\ ES04_012_BRC\ES04_0212_04W_CIRCA-1968_3-1-07.CDR
----------------------------	------------------	--



Explanation

- Water movement
- Chemical waste movement
- Water and chemical waste movement
- Water infiltration
- Water and chemical seep
- Water and chemical infiltration
- Pond evaporation

- Airborne dispersion
- Las Vegas Wash impacted by chemicals
- Residential and related development

Notes:

- Features represented are conceptual and not exact as to scale or precise location
- In 1983, a permitted evaporative Spray Wheel was constructed and operated on a portion of the Site that had once held a number of the Upper Ponds. The Spray Wheel was taken out of service permanently in 1991.
- The City of Henderson acquired 35.34 acres from BMI immediately to the south of the Upper Ponds as the site for a municipal wastewater injection facility (the Rapid Infiltration Basins [RIBs]), which was in operation from 1992 to at least 2002. The Northern RIBs first appear on the aerial photos in 1987.
- On October 6, 2003, as a part of a land exchange, the City of Henderson acquired approximately 101.6 acres generally located adjacent and southwest of the Lower Ponds from BMI for the construction of a wastewater treatment facility (WRF).
- Preliminary analytic modeling indicates that mounding of the water table aquifer would have occurred as the result of infiltration beneath the Rapid Infiltration Basins (RIBs). This groundwater mounding would have similarly occurred beneath infiltrating ponds (and possibly beneath the spray wheel) throughout the BMI Complex.
- All operating effluent ponds and ditches lined in accordance with NPDES Permit.

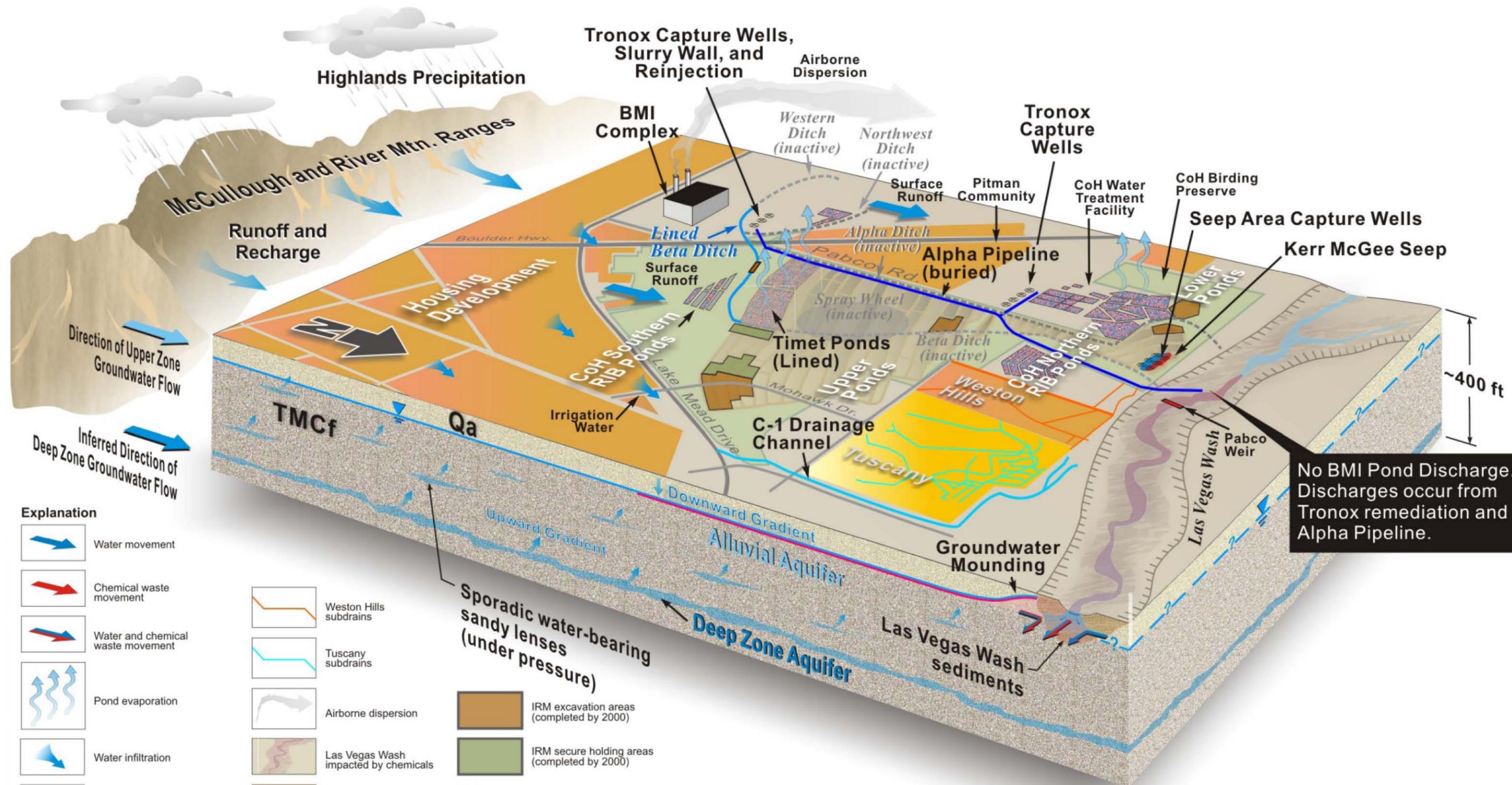
BMI Common Areas
Clark County, Nevada

FIGURE 4-13

CONCEPTUAL DIAGRAM OF EASTSIDE AREA - CIRCA 1992

Prepared by: DWB (DBS&A) Date: 03/01/07

V:\VDR\0_VDR-PROJECTS\00-ENV-SERVICES\ES04_012_BRC\ES04_0212_06W_CIRCA-1992_3-1-07.CDR



Explanation

- Water movement
- Chemical waste movement
- Water and chemical waste movement
- Pond evaporation
- Water infiltration
- Water and chemical seep
- Water and chemical infiltration

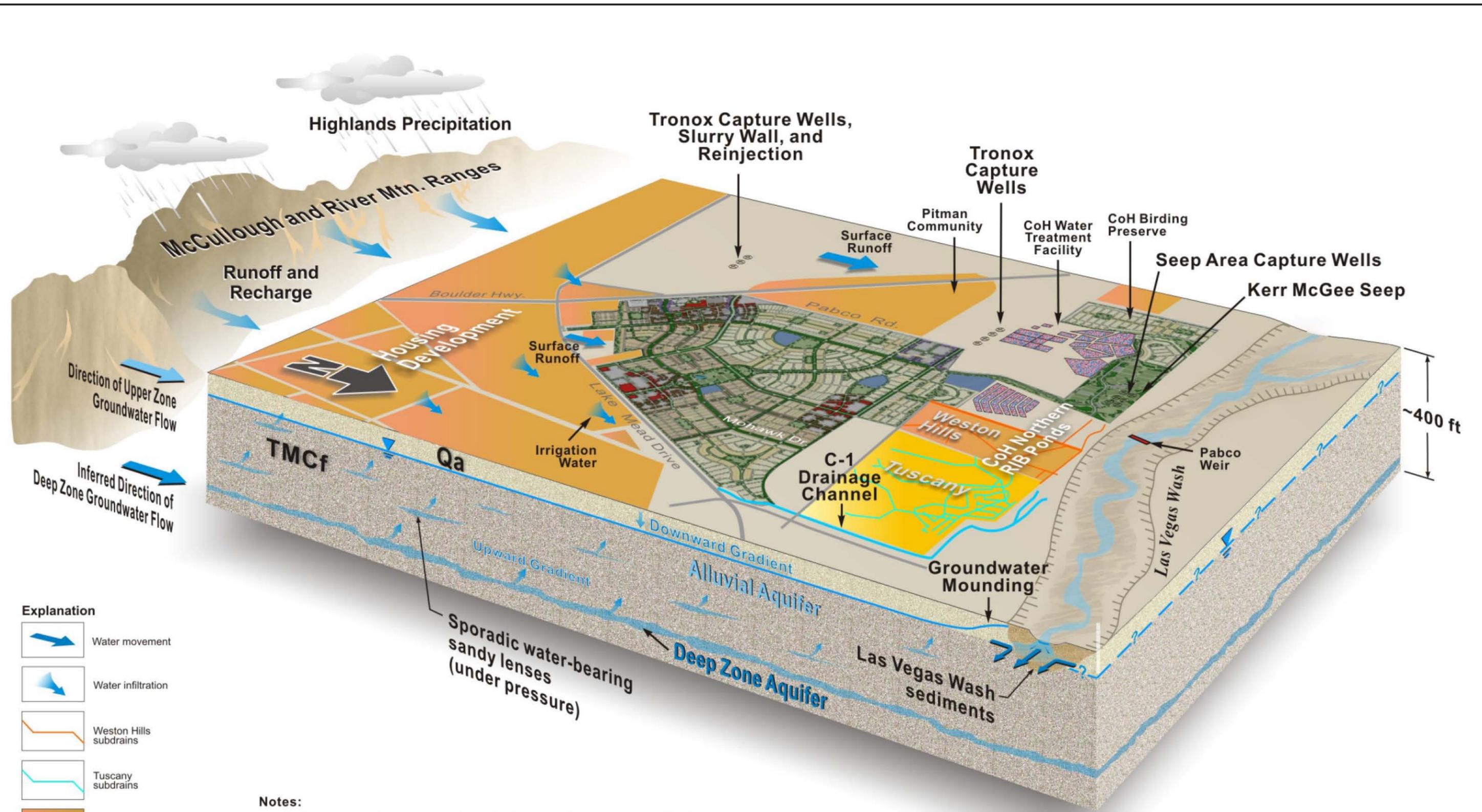
- Weston Hills subdrains
- Tuscany subdrains
- Airborne dispersion
- Las Vegas Wash impacted by chemicals
- Residential and related development
- Residential and golf course

- IRM excavation areas (completed by 2000)
- IRM secure holding areas (completed by 2000)

Notes:

- Features represented are conceptual and not exact as to scale or precise location
- By 1980, nine TIMET lined evaporation ponds were in use. They were taken out of service in May, 2005.
- Subdrains are located beneath the Tuscany and Weston Hills Residential Developments
- Tronox Chrome Treatment Line (CTL) wells began operation January, 1999; Tronox Plant slurry wall was installed October, 2001; Tronox Athens Road wells and Alpha Pipeline became fully operational October, 2002; Tronox Seep capture began November, 1999.

No BMI Pond Discharge. Discharges occur from Tronox remediation and Alpha Pipeline.



Explanation

- Water movement
- Water infiltration
- Weston Hills subdrains
- Tuscany subdrains
- Residential and related development
- Residential and golf course

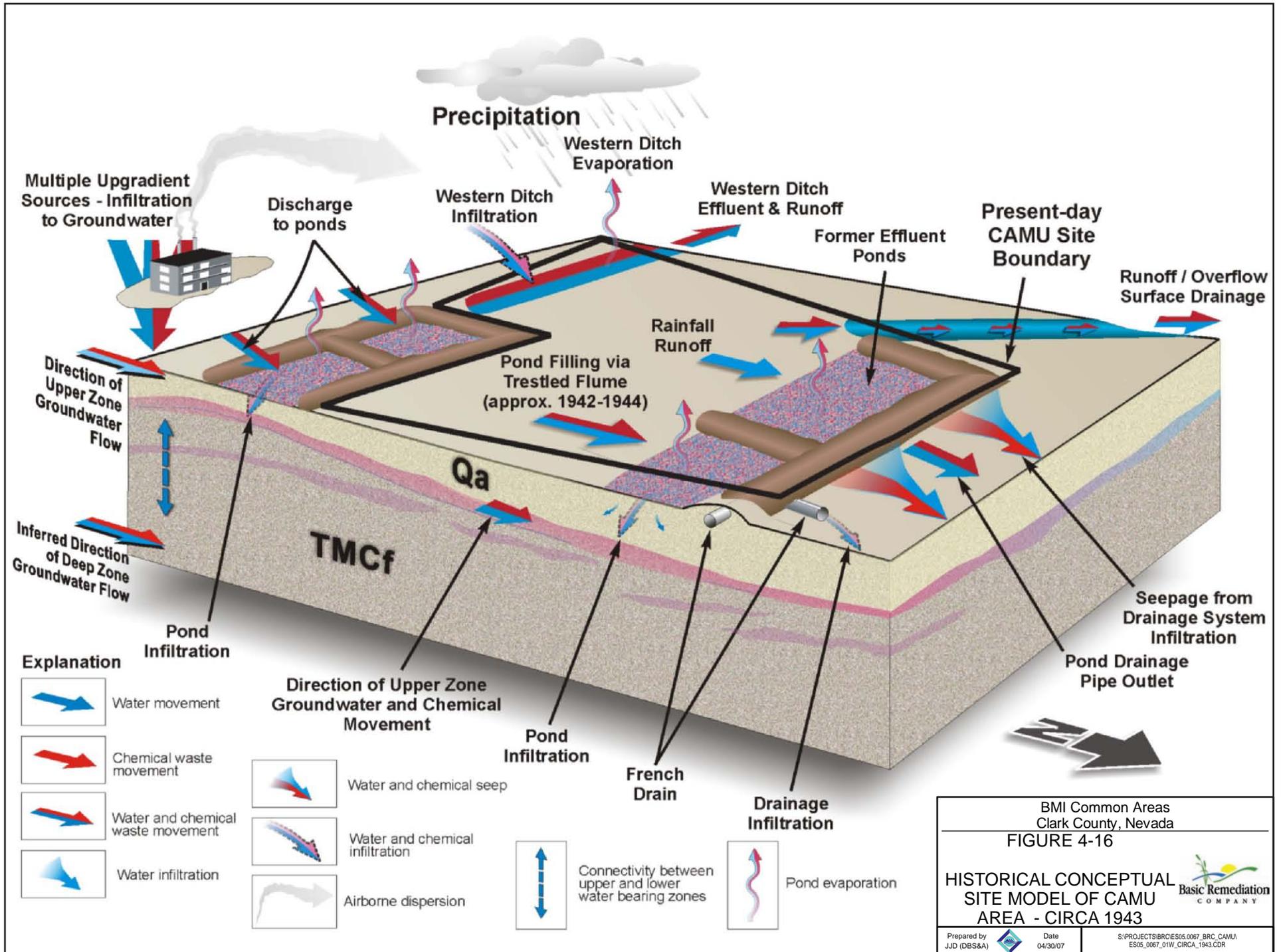
- Notes:**
- Features represented are conceptual and not exact as to scale or precise location
 - By 1980, nine TIMET lined evaporation ponds were in use. They were taken out of service in May, 2005.
 - Subdrains are located beneath the Tuscany and Weston Hills Residential Developments
 - Tronox Chrome Treatment Line (CTL) wells began operation January, 1999; Tronox Plant slurry wall was installed October, 2001; Tronox Athens Road wells and Alpha Pipeline became fully operational October, 2002; Tronox Seep capture began November, 1999.

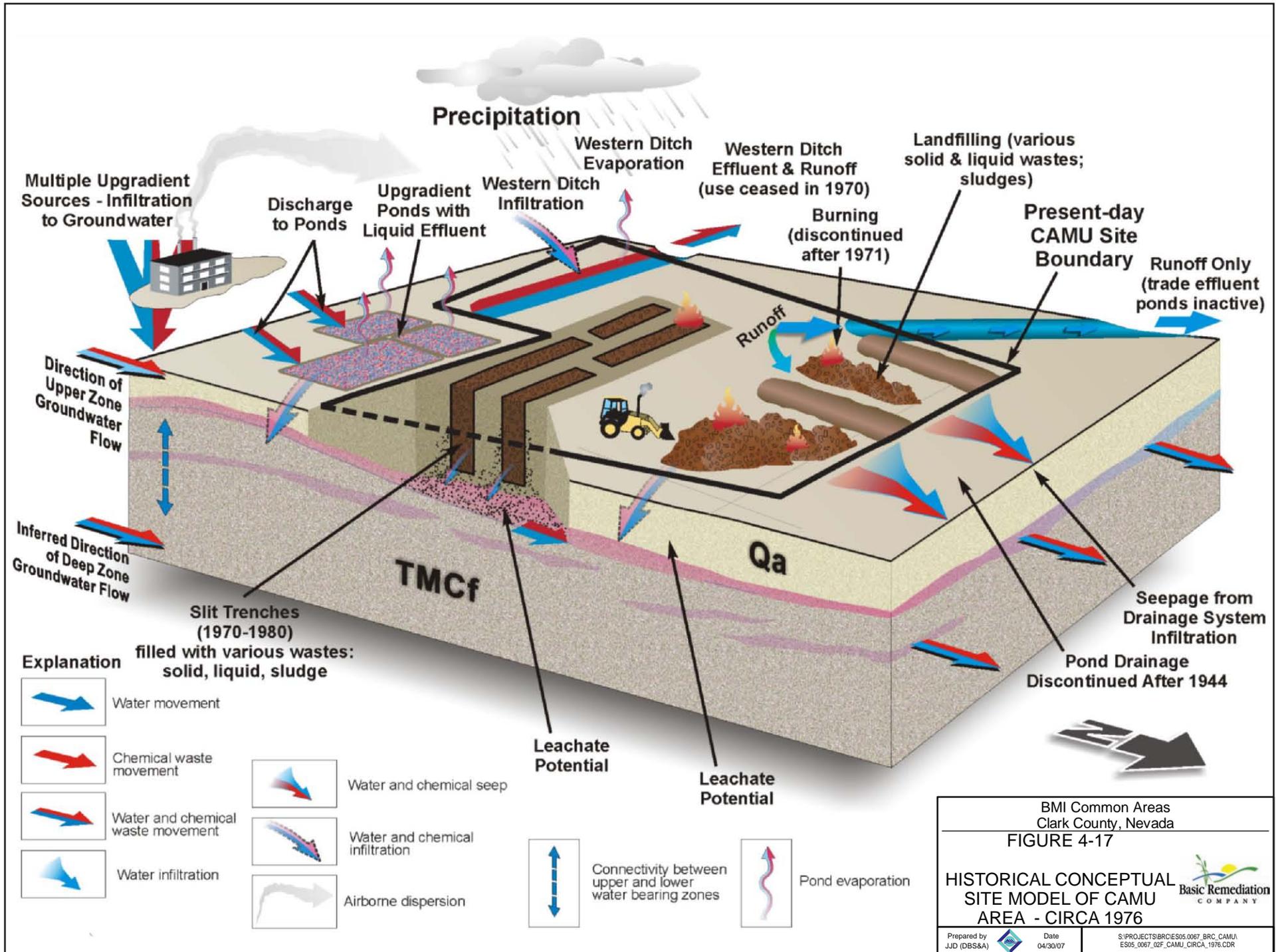
BMI Common Areas
Clark County, Nevada

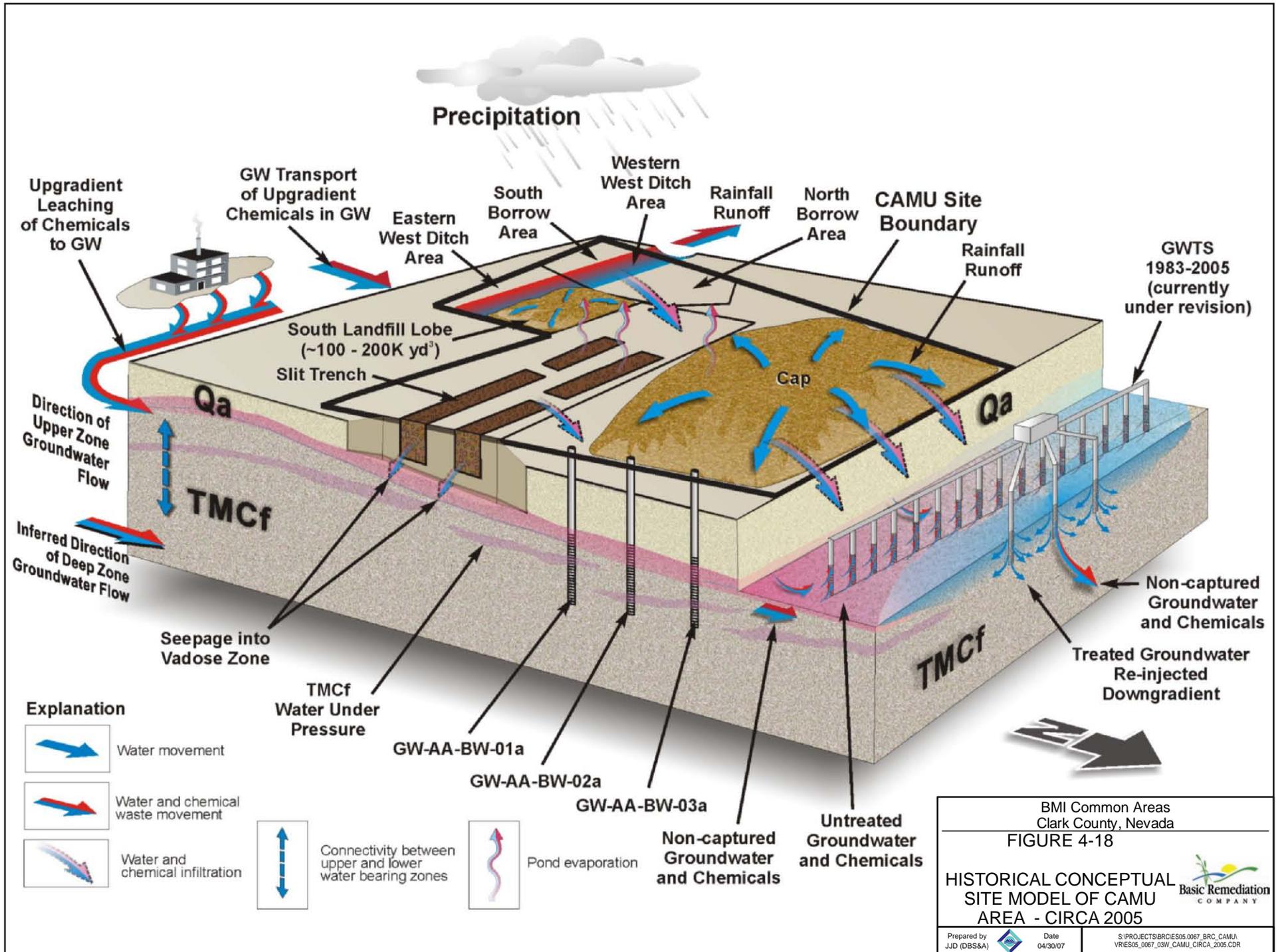
FIGURE 4-15

CONCEPTUAL DIAGRAM
OF EASTSIDE AREA
IN THE FUTURE

Prepared by: DWR (DBS&A) Date: 03/01/07 V:\VDR0_VDR-PROJECTS\00-ENV_SERVICES\ES04_012_BRCE\ES04_0212_08W_FUTURE_CONFIG_4-6-07.CDR







Explanation



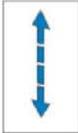
Water movement



Water and chemical waste movement



Water and chemical infiltration



Connectivity between upper and lower water bearing zones



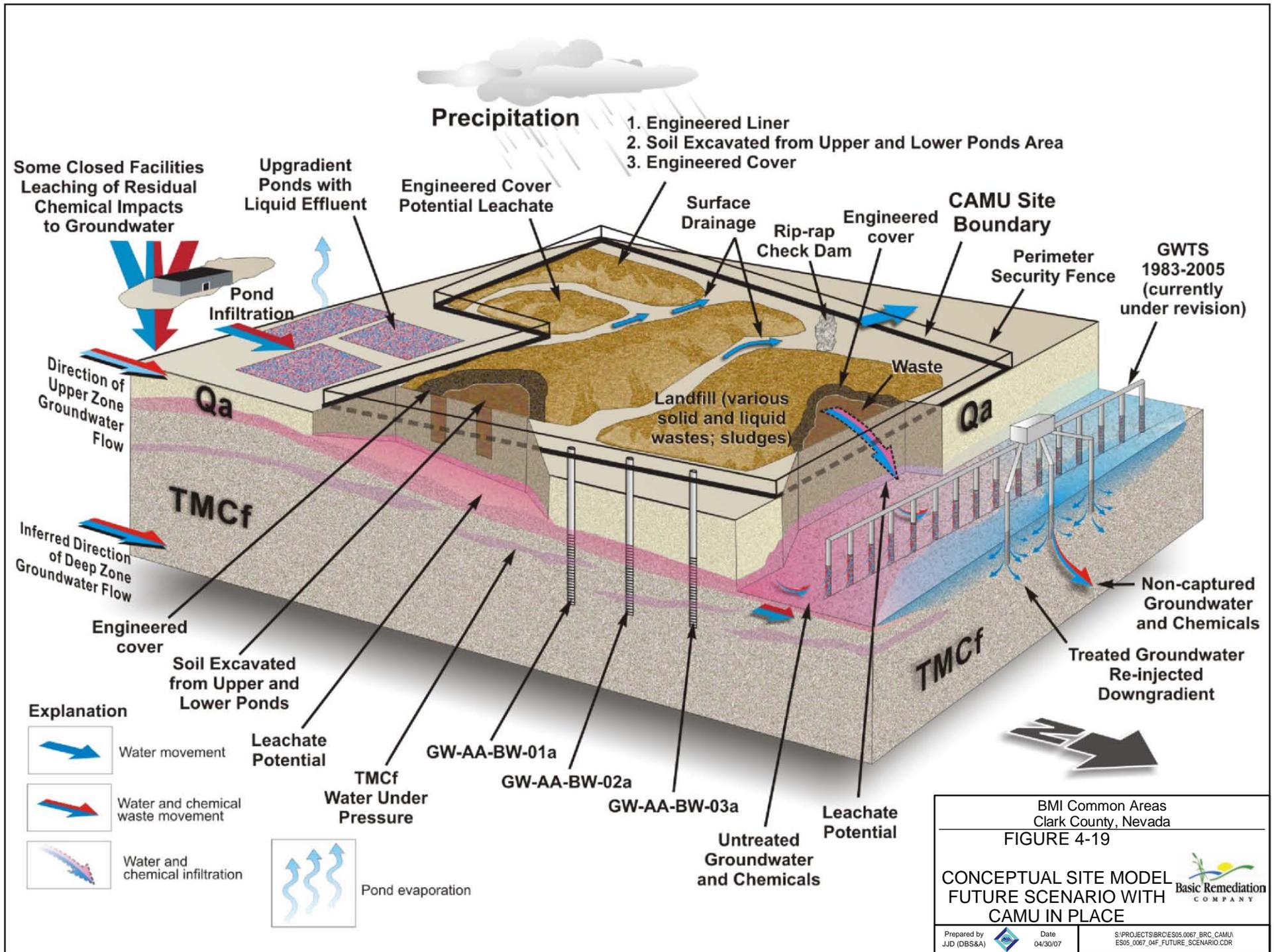
Pond evaporation

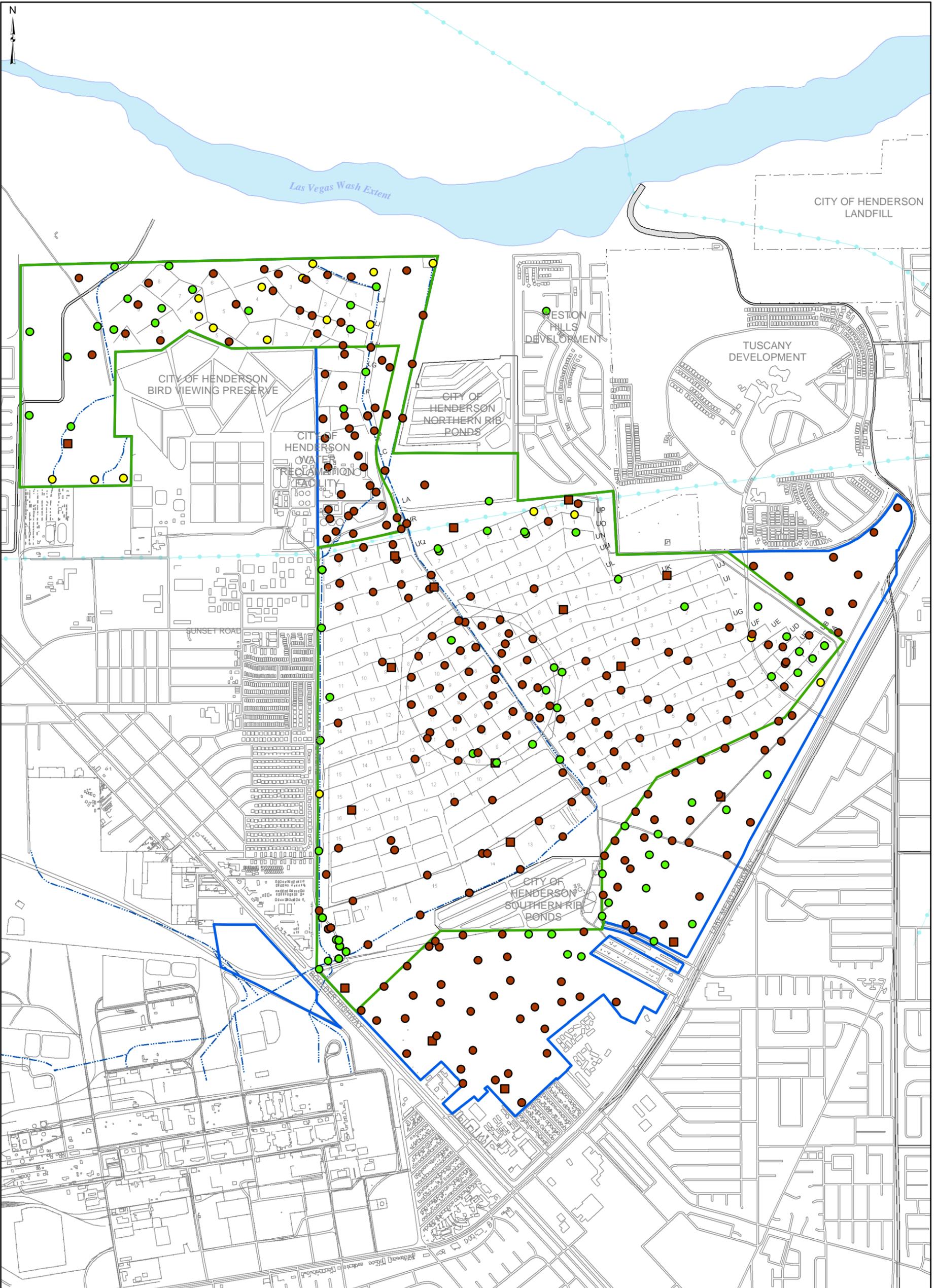
BMI Common Areas
Clark County, Nevada

FIGURE 4-18

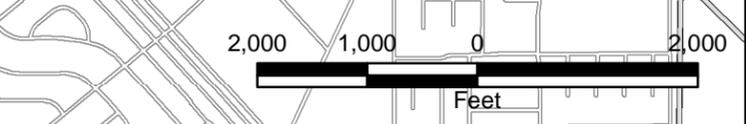
HISTORICAL CONCEPTUAL SITE MODEL OF CAMU AREA - CIRCA 2005

Prepared by JJD (DBS&A) Date 04/30/07 S:\PROJECTS\BRC\ES05.0067_BRC_CAMU\VR\ES05_0067_03W_CAMU_CIRCA_2005.CDR





 Site Soil Boundary	Soil Sample Location
 Site AOC3 Boundary	 No analytes exceed a screening level
 Ditches	 Only arsenic exceeds screening level
 Flood Conveyance Channels	 Multiple analytes exceed a screening level
 Laterals	Analytical Suite Differentiation
	 Partial Analyte List
	 Full analyte list



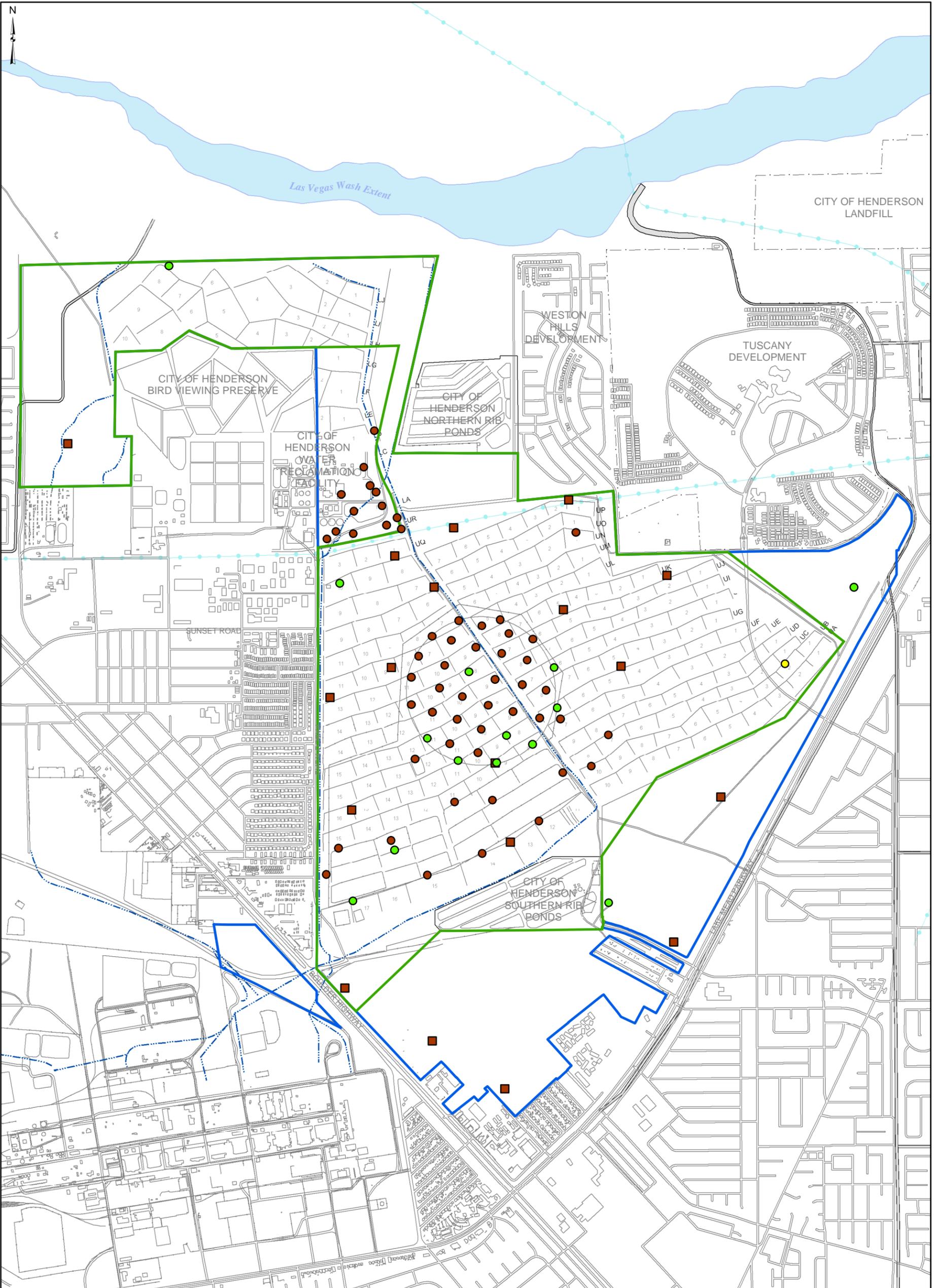
Note: See Table 4-2 for the list of screening levels used. Only the USEPA Region 9 residential soil PRGs and background levels were used. The SSL DAF 1 levels were not used for this figure.

BMI Common Areas
Clark County, Nevada
FIGURE 4-21

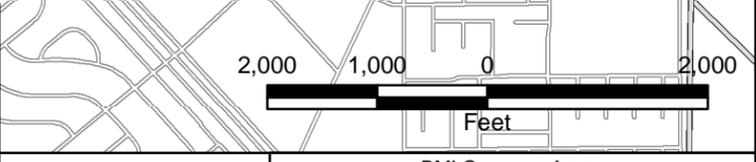
SUMMARY OF SOILS INVESTIGATIONS NEAR-SURFACE SOILS (1-15 FT bgs)



Prepared by: MKJ (ERM) Date: 05/08/07 JOB No. 0064276
FILE: GIS/BRC/FIGURE_4-21.MXD



 Site Soil Boundary	Soil Sample Location
 Site AOC3 Boundary	 No analytes exceed a screening level
 Ditches	 Only arsenic exceeds screening level
 Flood Conveyance Channels	 Multiple analytes exceed a screening level
 Laterals	Analytical Suite Differentiation
	 Partial Analyte List
	 Full analyte list



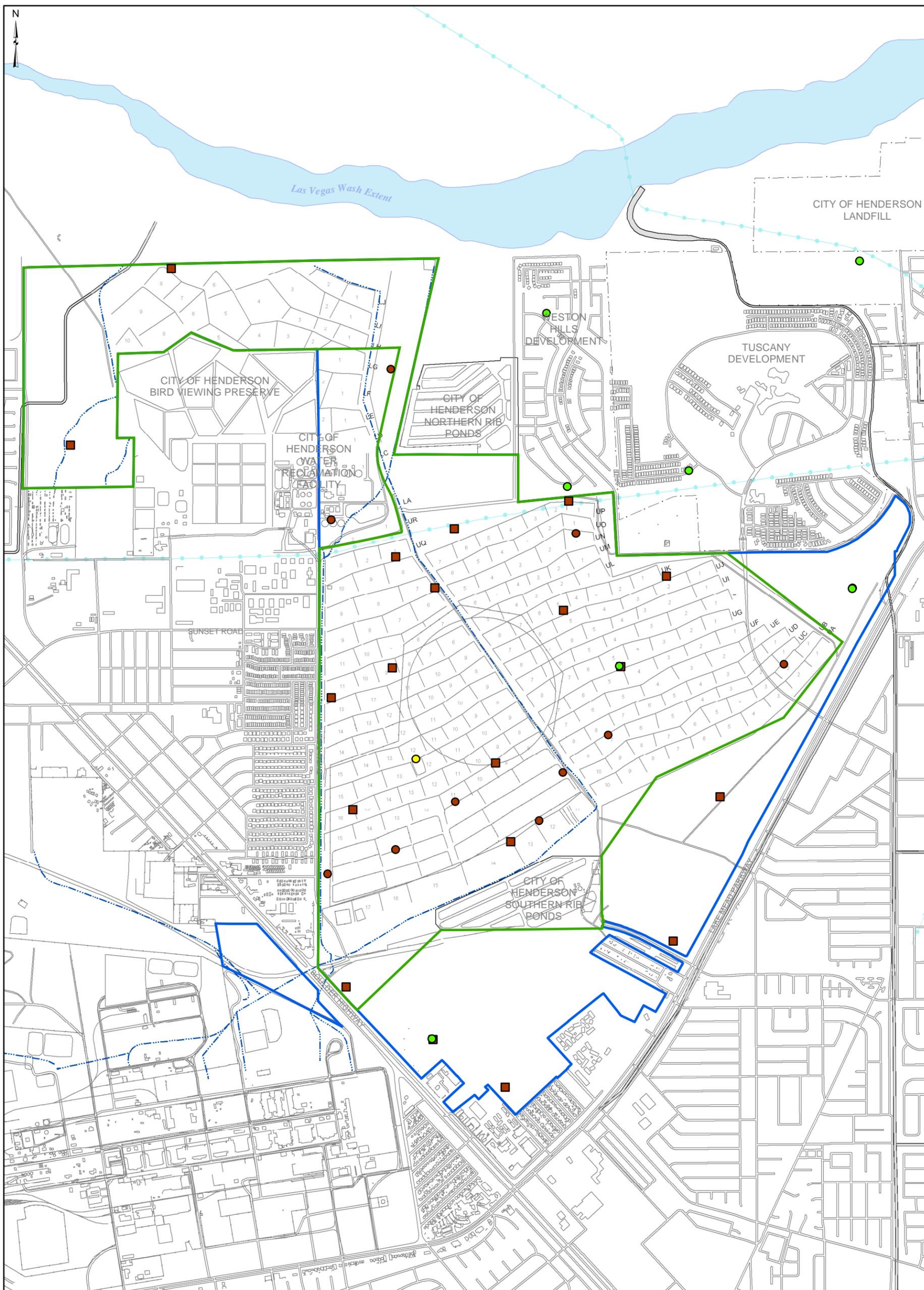
Note: See Table 4-2 for the list of screening levels used. Only the USEPA Region 9 residential soil PRGs and background levels were used. The SSL DAF 1 levels were not used for this figure.

BMI Common Areas
Clark County, Nevada
FIGURE 4-22

**SUMMARY OF SOILS INVESTIGATIONS
MIDDLE ZONE SOILS
(15 FT bgs to Qa/TMCF)**

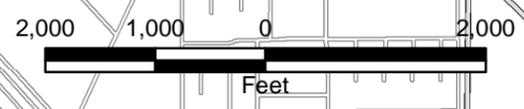


Prepared by MKJ (ERM)	Date 05/08/07	JOB No. 0064276 FILE: GIS/BRC/FIGURE_4-22.MXD
--------------------------	------------------	--



- Site Soil Boundary
- Site AOC3 Boundary
- Ditches
- Flood Conveyance Channels
- Laterals

- Soil Sample Location**
- No analytes exceed a screening level
 - Only arsenic exceeds screening level
 - Multiple analytes exceed a screening level
- Analytical Suite Differentiation**
- Partial Analyte List
 - Full analyte list



Note: See Table 4-2 for the list of screening levels used. Only the USEPA Region 9 residential soil PRGs and background levels were used. The SSL DAF 1 levels were not used for this figure.

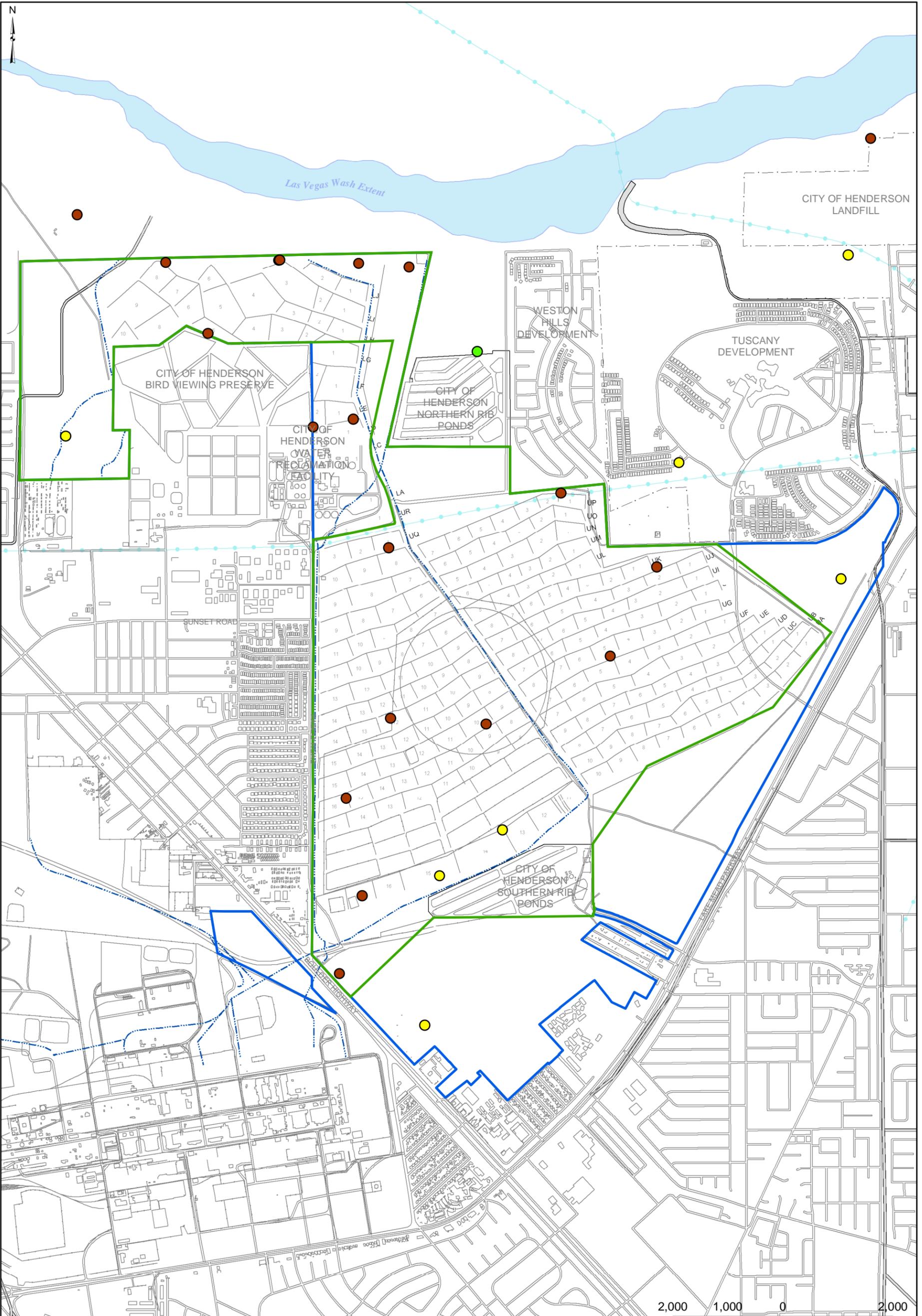
BMI Common Areas
Clark County, Nevada
FIGURE 4-23

**SUMMARY OF SOILS INVESTIGATIONS
DEEP ZONE SOILS (MUDDY CREEK FORMATION)**

Prepared by
MKJ (ERM)

Date
05/08/07

JOB No. 0064276
FILE: GIS/BRC/FIGURE_4-23.MXD



 Site Soil Boundary	Groundwater Sample Location
 Site AOC3 Boundary	 No analytes exceed MCL
 Ditches	 Less than 5 analytes exceed MCL
 Flood Conveyance Channels	 5 or more analytes exceed MCL
 Laterals	

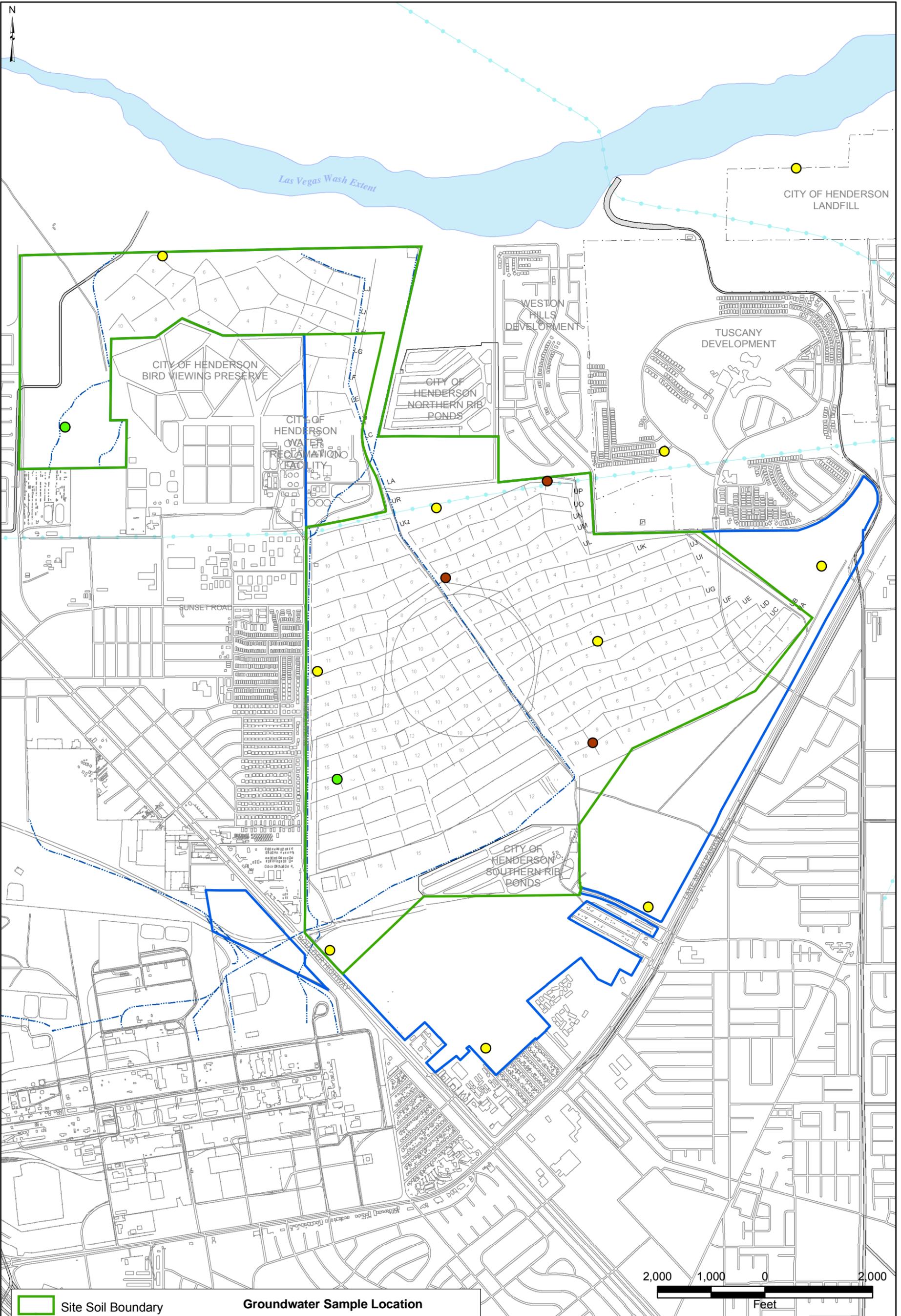
Note: The groundwater results used are from the 2006 3rd Quarterly monitoring event. See Table 4-2 for the list of MCLs used. Locations with no MCL exceedances had 2 to 4 tap water PRG exceedances; locations with less than 5 MCL exceedances had 2 to 12 PRG exceedances; and locations with 5 or more MCL exceedances had 8 to 24 PRG exceedances

BMI Common Areas
Clark County, Nevada
FIGURE 4-24

SUMMARY OF GROUND-WATER RESULTS - UPPER UNCONFINED WATER-BEARING ZONE



Prepared by: MKJ (ERM) Date: 05/08/07 JOB No. 0064276
FILE: GIS/BRC/FIGURE_4-24.MXD



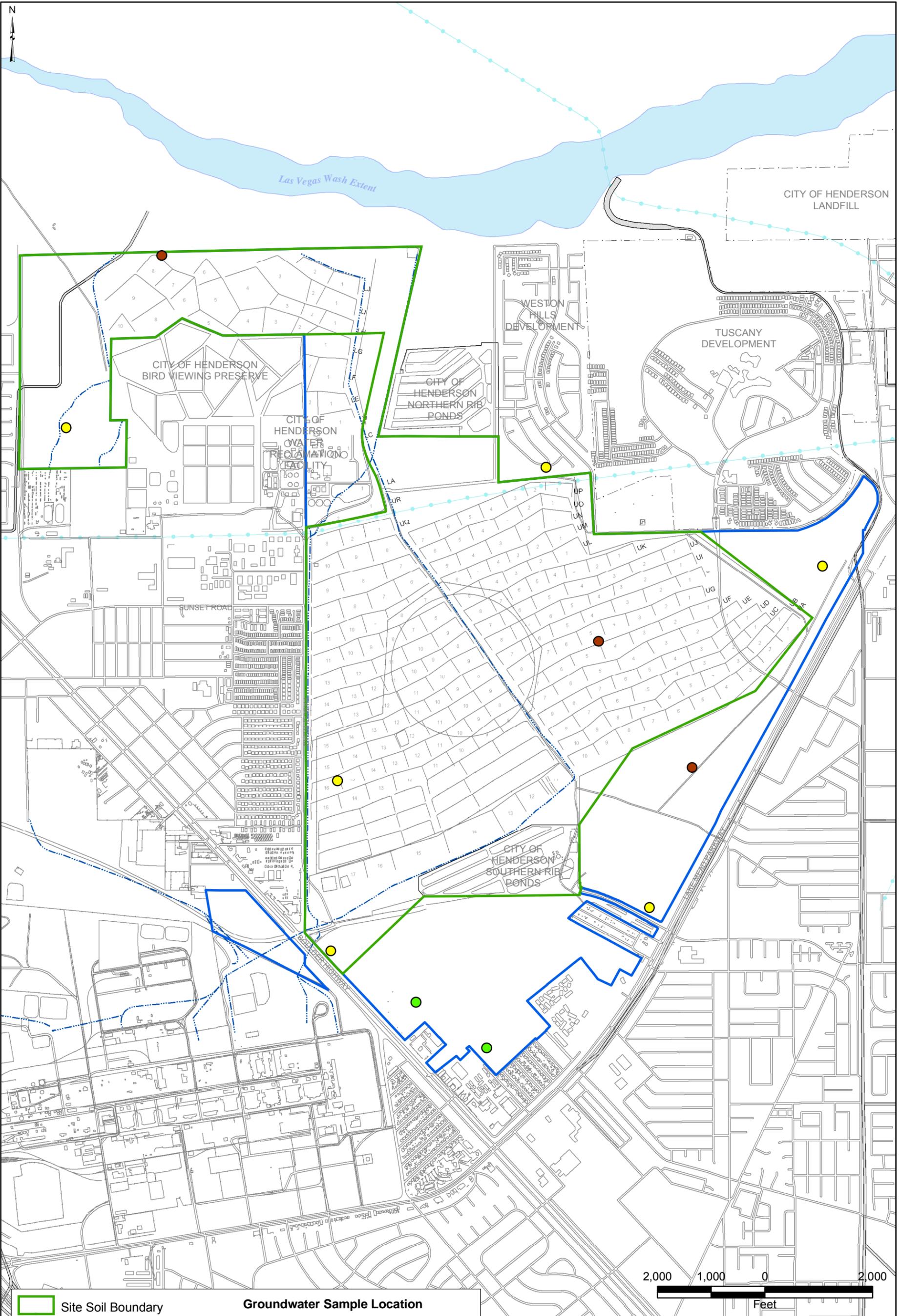
 Site Soil Boundary	Groundwater Sample Location
 Site AOC3 Boundary	 No analytes exceed MCL
 Ditches	 Less than 5 analytes exceed MCL
 Flood Conveyance Channels	 5 or more analytes exceed MCL
 Laterals	

Note: The groundwater results used are from the 2006 3rd Quarterly monitoring event. See Table 4-2 for the list of MCLs used. Locations with no MCL exceedances had 2 to 4 tap water PRG exceedances; locations with less than 5 MCL exceedances had 2 to 12 PRG exceedances; and locations with 5 or more MCL exceedances had 8 to 24 PRG exceedances

BMI Common Areas
Clark County, Nevada
FIGURE 4-25
SUMMARY OF GROUND-WATER RESULTS – INTERMEDIATE WATER-BEARING ZONE



Prepared by MKJ (ERM) Date 05/08/07
JOB No. 0064276
FILE: GIS/BRC/FIGURE_4-25.MXD



 Site Soil Boundary	Groundwater Sample Location
 Site AOC3 Boundary	 No analytes exceed MCL
 Ditches	 Less than 5 analytes exceed MCL
 Flood Conveyance Channels	 5 or more analytes exceed MCL
 Laterals	

Note: The groundwater results used are from the 2006 3rd Quarterly monitoring event. See Table 4-2 for the list of MCLs used. Locations with no MCL exceedances had 2 to 4 tap water PRG exceedances; locations with less than 5 MCL exceedances had 2 to 12 PRG exceedances; and locations with 5 or more MCL exceedances had 8 to 24 PRG exceedances

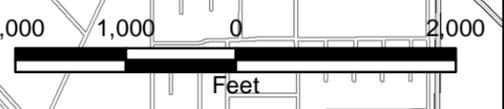
BMI Common Areas
Clark County, Nevada
FIGURE 4-26
SUMMARY OF GROUNDWATER RESULTS – DEEP WATER-BEARING ZONE

Prepared by: MKJ (ERM) Date: 05/08/07 JOB No. 0064276
FILE: GIS/BRC/FIGURE_4-26.MXD





- Interim Remedial Measure Areas
- Excavated Soil Holding Areas
- Site AOC3 Boundary
- 'Soil' Sub-Areas
- Ditches
- Flood Conveyance Channels
- Laterals

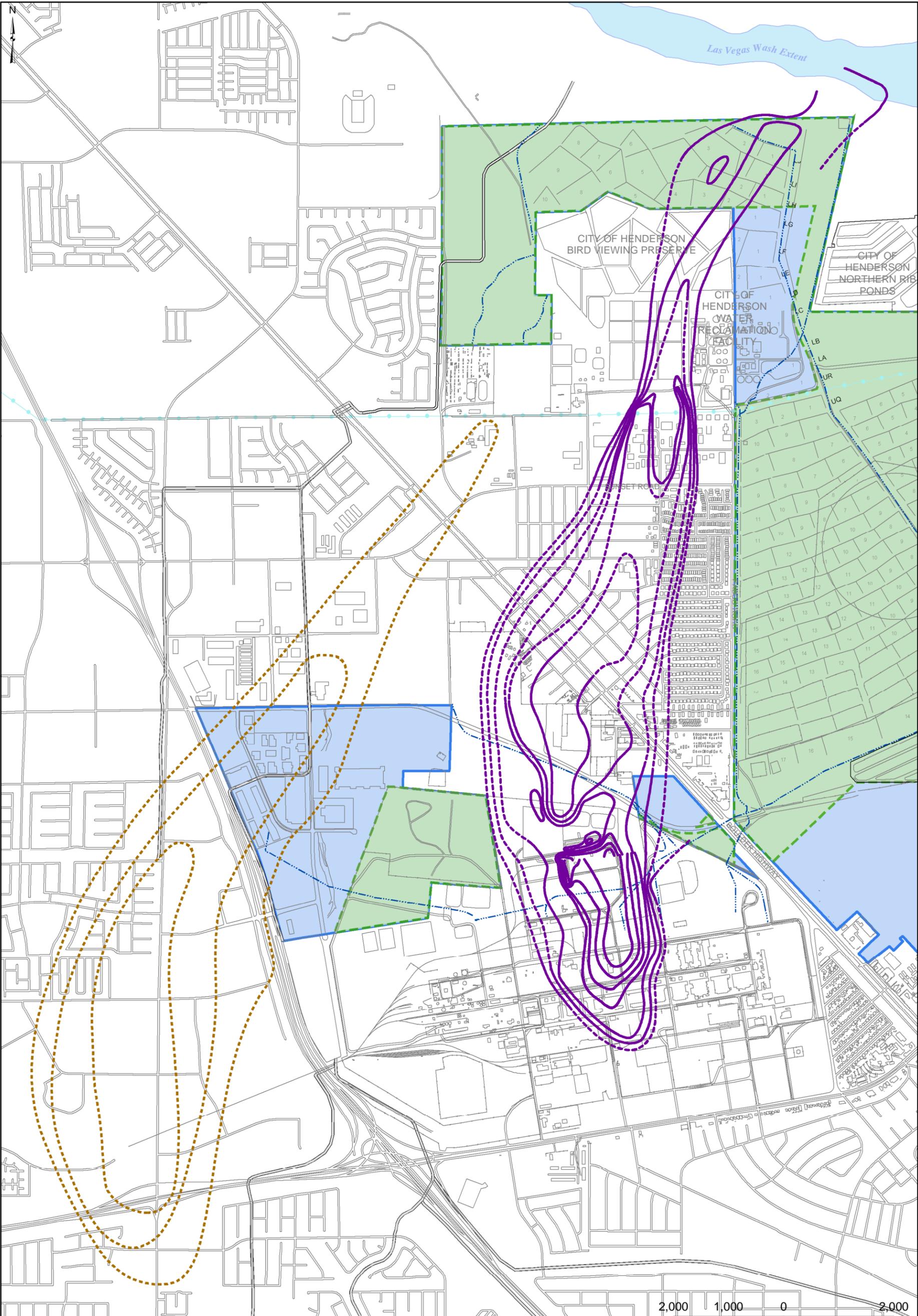


BMI Common Areas
Clark County, Nevada

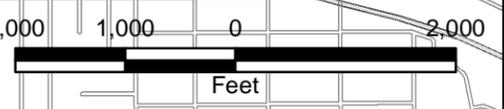
FIGURE 4-27

INTERIM REMEDIAL MEASURE AREAS





-  AMPAC Perchlorate Concentration Contours (mg/L) - 2001
(Dashed Where Approximate or Inferred)
-  Tronox Perchlorate Concentration Contour (mg/L) - 4th Quarter 2006
(Dashed Where Approximate or Inferred)
-  Site Soil Boundary
-  Site AOC3 Boundary



BMI Common Areas
Clark County, Nevada
FIGURE 4-28

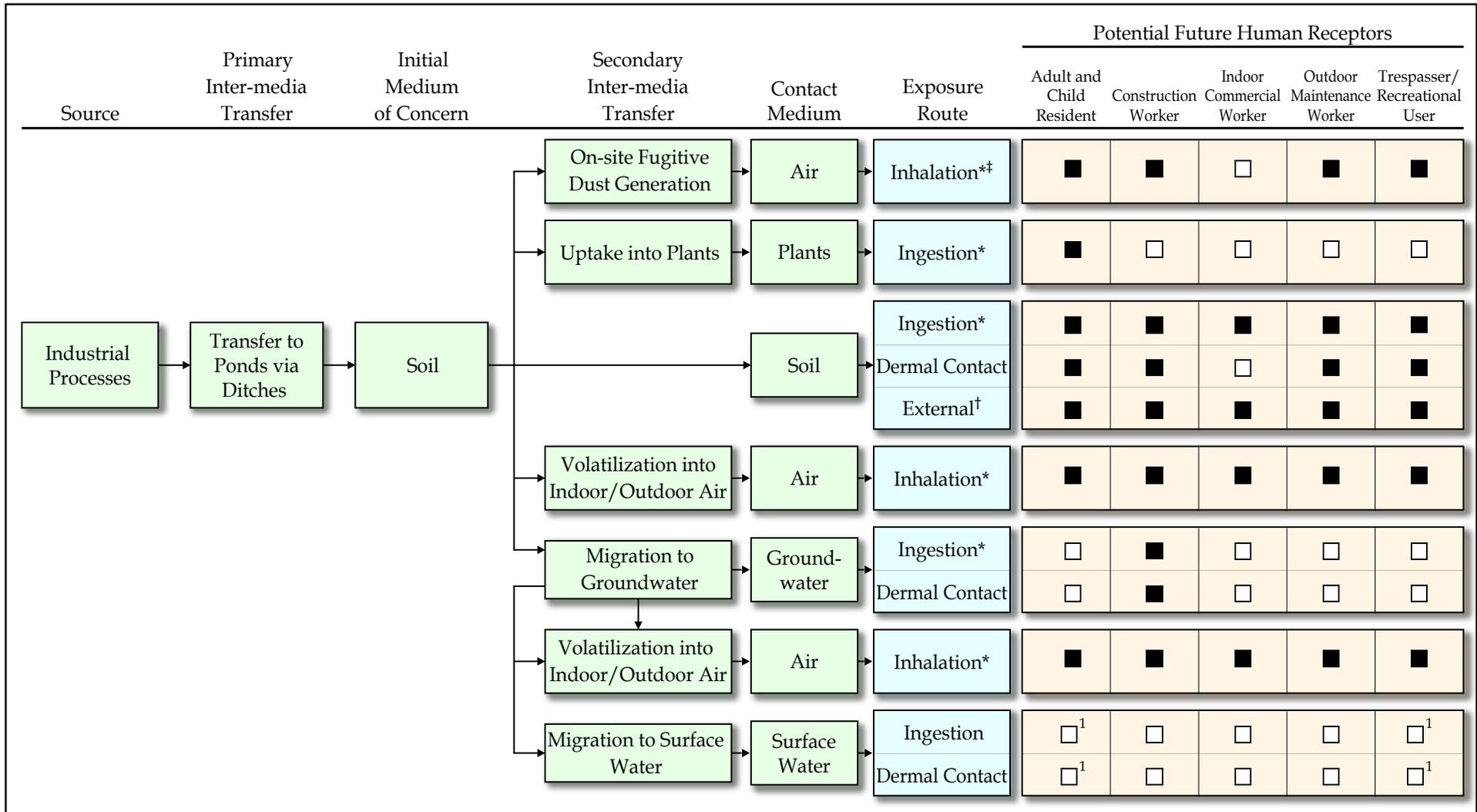
**TRONOX AND AMPAC
PERCHLORATE GROUND-
WATER PLUME MAP**

Prepared by
MKJ (ERM)

Date
05/03/07

JOB No. 0064276
FILE: GIS/BRC/FIGURE_4-28.MXD





□ - Incomplete or insignificant exposure pathway.

■ - Complete or potentially complete exposure pathway.

¹Potentially complete exposure pathway following discharge to Las Vegas Wash and Lake Mead.

*Includes radionuclide exposures.

†Only radionuclide exposures.

‡Includes asbestos exposures.

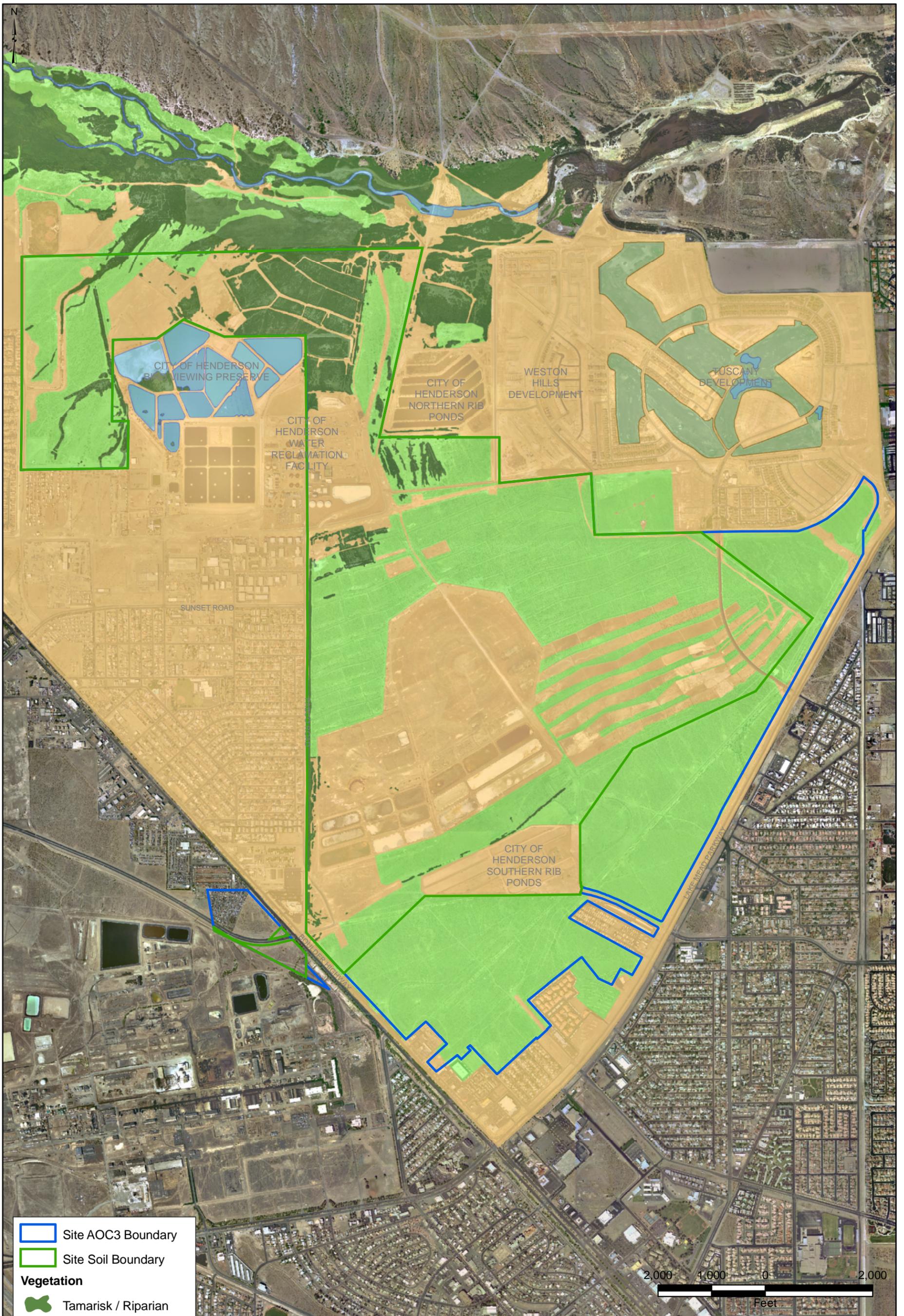
BMI Common Areas (Eastside)
Clark County, Nevada

FIGURE 9-1

CONCEPTUAL SITE MODEL
DIAGRAM FOR POTENTIAL
HUMAN EXPOSURES



Prepared by: MKJ (ERM) Date: 05/03/07 JOB No. 0064276
FILE: GIS/BRC/FIGURE_9-1.AI



Site AOC3 Boundary
 Site Soil Boundary
Vegetation
 Tamarisk / Riparian
 Creosote / Sage Brush
 Barren / Urban
 Golf Course
 Open Water

Fall 2006 aerial photo from the Clark County Nevada.

BMI Common Areas
Clark County, Nevada

FIGURE 10-1
HABITAT MAP



TABLES

TABLE 1-1
BRC PROJECT DOCUMENTS AND THEIR STATUS
BRC CLOSURE PLAN
(Page 1 of 1)

Document	Status
Remedial Alternatives Study – Eastside Soils (RAS)	Approved By NDEP
Record of Decision for RAS	Approved By NDEP
Settlement Agreement and Administrative Order on Consent: BMI Common Areas, Phase 3 (AOC3)	Approved By NDEP
Site Related Chemicals (SRC) List	Approved By NDEP
Health and Safety Plan	
Quality Assurance Project Plan (QAPP)	Approved By NDEP
Field Sampling Standard Operating Procedures (FSSOP)	Approved By NDEP
Community Involvement Plan (CIP)	Approved By NDEP
Project Factsheet 2006	Approved By NDEP
Shallow-Soils Background Report (with TIMET)	In NDEP Review
Statistical Analysis Methodology Report	Approved By NDEP
Offsite Dust Sampling Work Plan	Approved By NDEP
Data Validation Summary Reports DVSRs (legacy)	Approved By NDEP [1]
Responses to Older NDEP Comments	Submitted To NDEP
Waste Sampling and Analysis Plan	Approved By NDEP
Closure Plan (this Plan)	In NDEP Review
Corrective Action Plan (CAP) (including Dust Mitigation Plan and Perimeter Air Monitoring Plan)	Approved By NDEP
Eastside Groundwater Monitoring Plan	Approved By NDEP
Eastside Conceptual Site Model	In Preparation
Eastside Subarea Sampling and Analysis Plans (including CSM, DQO, Data Usability)	In Preparation
Groundwater Modeling Work Plan	Approved By NDEP
Remedial Action Plan (RAP)	In NDEP Review
CAMU-Area Conceptual Site Model	Reviewed By NDEP
Slit Trench RAS	In Preparation
Borrow Pit Risk Assessment Work Plan	Approved By NDEP
Borrow Pit Risk Assessment	Approved By NDEP
Eastside Aquifer Testing Workplan	Approved By NDEP
North-East Area Workplan	In Revision By BRC
Deep Soils Background and Upgradient Qa Workplan	In Revision By BRC
Quarterly Groundwater Monitoring Reports	Various [2]
Parcel 4A/4B Workplan	Approved By NDEP
Project Tracking Schedule	Updated Periodically

[1] All of the legacy DVSRs have been approved by the NDEP. As new data are generated, the accompanying DVSR is submitted to NDEP for review and approval.

[2] NDEP has provided comments on the first three reports which are being addressed by BRC; the fourth report is in preparation.

TABLE 3-1
PROJECT LIST OF ANALYTES
BRC CLOSURE PLAN
(Page 1 of 9)

Parameter of Interest	Analytical Method	Compound List
Ions	EPA 300.0	Bromide
		Bromine
		Chlorate
		Chloride
		Chlorine (soluble)
		Chlorite
		Fluoride
		Nitrate (as N)
		Nitrite (as N)
		Orthophosphate
	EPA 377.1	Sulfite
	EPA 314.0	Perchlorate
Dissolved Gases	RSK 175	Ethane
		Ethylene
		Methane
Chlorinated Compounds	EPA 551.1	Chloral
		Dichloroacetaldehyde
Polychlorinated Dibenzodioxins/ Dibenzofurans	EPA 8290	1,2,3,4,6,7,8,9-Octachlorodibenzofuran
		1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin
		1,2,3,4,6,7,8-Heptachlorodibenzofuran
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin
		1,2,3,4,7,8,9-Heptachlorodibenzofuran
		1,2,3,4,7,8-Hexachlorodibenzofuran
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin
		1,2,3,6,7,8-Hexachlorodibenzofuran
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin
		1,2,3,7,8,9-Hexachlorodibenzofuran
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin
		1,2,3,7,8-Pentachlorodibenzofuran
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin
		2,3,4,6,7,8-Hexachlorodibenzofuran
		2,3,4,7,8-Pentachlorodibenzofuran
		2,3,7,8-Tetrachlorodibenzofuran
2,3,7,8-Tetrachlorodibenzo-p-dioxin		
Asbestos	Elutriator/TEM	Asbestos
General Chemistry Parameters	EPA 350.2	Ammonia (as N)
	EPA 9010/9014	Cyanide (Total)
	EPA 345.1	Iodine
	EPA 9045C	pH in soil
	EPA 9040B	pH in water
	EPA 376.1/376.2	Sulfide
	Mod. EPA 415.1	Total inorganic carbon
	EPA 351.2	Total Kjeldahl nitrogen (TKN)
EPA 415.1	Total organic carbon (TOC)	
Metals	EPA 6020/6010B	Aluminum
		Antimony
		Arsenic
		Barium
		Beryllium

TABLE 3-1
PROJECT LIST OF ANALYTES
BRC CLOSURE PLAN
(Page 2 of 9)

Parameter of Interest	Analytical Method	Compound List
Metals (continued)	EPA 6020/6010B	Boron
		Cadmium
		Calcium
		Chromium
		Cobalt
		Copper
		Iron
		Lead
		Lithium
		Magnesium
		Manganese
		Molybdenum
		Nickel
		Niobium
		Palladium
		Phosphorus
		Platinum
		Potassium
		Selenium
		Silicon
		Silver
		Sodium
		Strontium
		Sulfur
		Thallium
		Tin
		Titanium
		Tungsten
	Uranium	
	Vanadium	
	Zinc	
Zirconium		
	EPA 7196A	Chromium (VI)
	EPA 7470/7471A	Mercury
Organophosphorous Pesticides	EPA 8141A	Azinphos-ethyl
		Azinphos-methyl
		Carbophenothion
		Chlorpyrifos
		Coumaphos
		Demeton-O
		Demeton-S
		Diazinon
		Dichlorvos
		Dimethoate
		Disulfoton
		EPN
		Ethoprop
		Ethyl parathion
Fampphur		
Fenthion		

TABLE 3-1
PROJECT LIST OF ANALYTES
BRC CLOSURE PLAN
(Page 3 of 9)

Parameter of Interest	Analytical Method	Compound List
Organophosphorous Pesticides (continued)	EPA 8141A	Malathion
		Methyl carbophenothion
		Methyl parathion
		Mevinphos
		Naled
		O,O,O-Triethyl phosphorothioate (TEPP)
		Phorate
		Phosmet
		Ronnel
		Stiropfos (Tetrachlorovinphos)
		Sulfotep
Chlorinated Herbicides	EPA 8151A	2,4,5-T
		2,4,5-TP (Silvex)
		2,4-D
		2,4-DB
		Dalapon
		Dicamba
		Dichloroprop
		Dinoseb
		MCPA
		MCPP
		Organic Acids
Benzenesulfonic acid		
O,O-Diethylphosphorodithioic acid		
O,O-Dimethylphosphorodithioic acid		
Nonhalogenated Organics	EPA 8015B	Ethylene glycol
		Ethylene glycol monobutyl ether
		Methanol
		Propylene glycol
Organochlorine Pesticides	EPA 8081A	2,4-DDD
		2,4-DDE
		4,4-DDD
		4,4-DDE
		4,4-DDT
		Aldrin
		alpha-BHC
		alpha-Chlordane
		beta-BHC
		Chlordane
		delta-BHC
		Dieldrin
		Endosulfan I
		Endosulfan II
		Endosulfan sulfate
		Endrin
		Endrin aldehyde
		Endrin ketone
gamma-BHC (Lindane)		

TABLE 3-1
PROJECT LIST OF ANALYTES
BRC CLOSURE PLAN
(Page 4 of 9)

Parameter of Interest	Analytical Method	Compound List
Organochlorine Pesticides (continued)	EPA 8081A	gamma-Chlordane
		Heptachlor
		Heptachlor epoxide
		Methoxychlor
		Toxaphene
Polychlorinated Biphenyls	EPA 8082	Aroclor 1016
		Aroclor 1221
		Aroclor 1232
		Aroclor 1242
		Aroclor 1248
		Aroclor 1254
		Aroclor 1260
		PCB-77
		PCB-81
		PCB-105
		PCB-114
		PCB-118
		PCB-123
		PCB-126
		PCB-156
		PCB-157
		PCB-167
		PCB-169
PCB-189		
Polynuclear Aromatic Hydrocarbons	EPA 8310¹	Acenaphthene
		Acenaphthylene
		Anthracene
		Benzo(a)anthracene
		Benzo(a)pyrene
		Benzo(b)fluoranthene
		Benzo(g,h,i)perylene
		Benzo(k)fluoranthene
		Chrysene
		Dibenzo(a,h)anthracene
		Indeno(1,2,3-cd)pyrene
		Phenanthrene
		Pyrene
		Radionuclides
EPA 901.1/ HASL GA-01-R	Gross beta	
	Actinium-228	
	Bismuth-212	
	Bismuth-214	
	Cobalt-57	
	Cobalt-60	
	Lead-210	
	Lead-211	
Lead-212		
Lead-214		

TABLE 3-1
PROJECT LIST OF ANALYTES
BRC CLOSURE PLAN
(Page 5 of 9)

Parameter of Interest	Analytical Method	Compound List
Radionuclides (continued)	EPA 901.1/ HASL GA-01-R	Potassium-40
		Thallium-208
		Thorium-227
		Thorium-234
	HASL A-01-R	Thorium-232
		Thorium-228
		Thorium-230
		Uranium-233/234
		Uranium 235/236
		Uranium-238
	EPA 903.0 / 903.1	Radium-226
	EPA 904.0	Radium-228
	Quantitate from Parent or Daughter Radionuclide	Actinium-227 (from Th-227)
		Bismuth-210 (from Pb-210)
		Bismuth-211 (from Pb-211)
		Polonium-210 (from Pb-210)
		Polonium-212 (from Bi-212)
		Polonium-214 (from Bi-214)
		Polonium-216 (from Pb-212)
		Polonium-218 (from Pb-214)
		Protactinium-231 (from U-235)
		Protactinium-234 (from Th-234)
		Radium-223 (from Th-227)
		Radium-224 (from Pb-212)
Thallium-207 (from Pb-211)		
Thorium-231 (from U-235)		
Radon	FLUX	Radon-220
		Radon-222
Aldehydes	EPA 8315A	Acetaldehyde
		Chloroacetaldehyde
		Dichloroacetaldehyde
		Formaldehyde
Semivolatile Organic Compounds	EPA 8270C ²	Trichloroacetaldehyde
		1,2,4,5-Tetrachlorobenzene
		1,2-Diphenylhydrazine
		1,4-Dioxane
		2,2'/4,4'-Dichlorobenzil
		2,4,5-Trichlorophenol
		2,4,6-Trichlorophenol
		2,4-Dichlorophenol
		2,4-Dimethylphenol
		2,4-Dinitrophenol
		2,4-Dinitrotoluene
		2,6-Dinitrotoluene
		2-Chloronaphthalene
		2-Chlorophenol
		2-Methylnaphthalene
		2-Nitroaniline
2-Nitrophenol		
3,3-Dichlorobenzidine		

TABLE 3-1
PROJECT LIST OF ANALYTES
BRC CLOSURE PLAN
(Page 6 of 9)

Parameter of Interest	Analytical Method	Compound List
Semivolatile Organic Compounds (continued)	EPA 8270C ²	3-Nitroaniline
		4,4'-Dichlorobenzil
		4-Bromophenyl phenyl ether
		4-Chloro-3-methylphenol
		4-Chlorophenyl phenyl ether
		4-Chlorothioanisole
		4-Chlorothiophenol
		4-Nitroaniline
		4-Nitrophenol
		Acenaphthene
		Acenaphthylene
		Acetophenone
		Aniline
		Anthracene
		Azobenzene
		Benzo(a)anthracene
		Benzo(a)pyrene
		Benzo(b)fluoranthene
		Benzo(g,h,i)perylene
		Benzo(k)fluoranthene
		Benzoic acid
		Benzyl alcohol
		bis(2-Chloroethoxy)methane
		bis(2-Chloroethyl) ether
		bis(2-Chloroisopropyl) ether
		bis(2-Ethylhexyl) phthalate
		bis(Chloromethyl) ether
		bis(p-Chlorophenyl) sulfone
		bis(p-Chlorophenyl)disulfide
		Butylbenzyl phthalate
		Carbazole
		Chrysene
		Dibenzo(a,h)anthracene
		Dibenzofuran
		Dichloromethyl ether
		Diethyl phthalate
		Dimethyl phthalate
		Di-n-butyl phthalate
		Di-n-octyl phthalate
		Diphenyl disulfide
		Diphenyl sulfide
		Diphenyl sulfone
		Fluoranthene
		Fluorene
Hexachlorobenzene		
Hexachlorobutadiene		
Hexachlorocyclopentadiene		
Hexachloroethane		
Hydroxymethyl phthalimide		
Indeno(1,2,3-cd)pyrene		

TABLE 3-1
PROJECT LIST OF ANALYTES
BRC CLOSURE PLAN
(Page 7 of 9)

Parameter of Interest	Analytical Method	Compound List
Semivolatile Organic Compounds (continued)	EPA 8270C ²	Isophorone
		m,p-Cresol
		Naphthalene
		Nitrobenzene
		N-nitrosodi-n-propylamine
		N-nitrosodiphenylamine
		o-Cresol
		Octachlorostyrene
		p-Chloroaniline (4-Chloroaniline)
		p-Chlorobenzenethiol
		Pentachlorobenzene
		Pentachlorophenol
		Phenanthrene
		Phenol
		Phthalic acid
		Pyrene
		Pyridine
		Thiophenol
Tentatively Identified Compounds (TICs)		
Volatile Organic Compounds	EPA 8260B	1,1,1,2-Tetrachloroethane
		1,1,1-Trichloroethane
		1,1,2,2-Tetrachloroethane
		1,1,2-Trichloroethane
		1,1-Dichloroethane
		1,1-Dichloroethene
		1,1-Dichloropropene
		1,2,3-Trichlorobenzene
		1,2,3-Trichloropropane
		1,2,4-Trichlorobenzene
		1,2,4-Trimethylbenzene
		1,2-Dichlorobenzene
		1,2-Dichloroethane
		1,2-Dichloroethene
		1,2-Dichloropropane
		1,3,5-Trichlorobenzene
		1,3,5-Trimethylbenzene
		1,3-Dichlorobenzene
		1,3-Dichloropropene
		1,3-Dichloropropane
		1,4-Dichlorobenzene
		2,2-Dichloropropane
		2,2-Dimethylpentane
		2,2,3-Trimethylbutane
		2,3-Dimethylpentane
		2,4-Dimethylpentane
		2-Chlorotoluene
		2-Hexanone
		2-Methylhexane
		2-Nitropropane
3,3-Dimethylpentane		

TABLE 3-1
PROJECT LIST OF ANALYTES
BRC CLOSURE PLAN
(Page 8 of 9)

Parameter of Interest	Analytical Method	Compound List
Volatile Organic Compounds (continued)	EPA 8260B	3-Ethylpentane
		3-Methylhexane
		4-Chlorobenzene
		4-Chlorotoluene
		4-Methyl-2-pentanone (MIBK)
		Acetone
		Acetonitrile
		Benzene
		Bromobenzene
		Bromodichloromethane
		Bromoform
		Bromomethane
		Carbon disulfide
		Carbon tetrachloride
		Chlorobenzene
		Chlorobromomethane
		Chlorodibromomethane
		Chloroethane
		Chloroform
		Chloromethane
		cis-1,2-Dichloroethene
		cis-1,3-Dichloropropene
		Cymene (Isopropyltoluene)
		Dibromochloroethane
		Dibromochloromethane
		Dibromochloropropane
		Dibromomethane
		Dichloromethane (Methylene chloride)
		Dimethyldisulfide
		Ethanol
		Ethylbenzene
		Freon-11 (Trichlorofluoromethane)
		Freon-113 (1,1,2-Trifluoro-1,2,2-trichloroethane)
		Freon-12 (Dichlorodifluoromethane)
		Heptane
		Isoheptane
		Isopropylbenzene
		m,p-Xylene
		Methyl ethyl ketone (2-Butanone)
		Methyl iodide
		MTBE (Methyl tert-butyl ether)
		n-Butyl benzene
		n-Propylbenzene
Nonanal		
o-Xylene		
sec-Butylbenzene		
Styrene		
tert-Butyl benzene		
Tetrachloroethene		
Toluene		
trans-1,2-Dichloroethene		

TABLE 3-1
PROJECT LIST OF ANALYTES
BRC CLOSURE PLAN
(Page 9 of 9)

Parameter of Interest	Analytical Method	Compound List
Volatile Organic Compounds (continued)	EPA 8260B	trans-1,3-Dichloropropene
		Trichloroethene
		Vinyl acetate
		Vinyl chloride
		Xylenes (total)
		Tentatively Identified Compounds (TICs)
Water Quality Parameters	EPA 120.1	Conductivity
	EPA 130.2	Hardness, total
	EPA 160.1	Total dissolved solids
	EPA 160.2	Total suspended solids
	EPA 310.1	Alkalinity, Total (as CaCO ₃)
		Bicarbonate alkalinity
Carbonate alkalinity		
Flashpoint	EPA 1010	Flammables
Total Petroleum Hydrocarbons	EPA 8015	Diesel
		Gasoline
		Grease
		Mineral Spirits
White Phosphorus	EPA 7580M	White phosphorus
Methyl Mercury	EPA 1630	Methyl mercury

Notes:

The laboratory will be instructed to report the top 25 Tentatively Identified Compounds (TICs) under Method 8260B and 8270C.

¹For polynuclear aromatic hydrocarbons, Method 8270C is the primary analytical method, but Method 8310 may be used if necessary.

²Method 3540 for extraction and Method 3640 for cleanup are to be used as appropriate.

TABLE 4-1
BRC ESTIMATES OF VOLUMES DEPOSITED INTO UPPER AND LOWER PONDS, 1942-1976
BRC CLOSURE PLAN
(Page 1 of 1)

Area / Spatial Composite	Area (Sq. Yds.)	Depth (Ft.) (Average)	Volume (Cubic Yds.)
Alpha Ditch	70,199	1.0	23,397
Beta Ditch	79,453	4.0	105,927
IRM Soil Holding Areas			
From IRM soil holding area in pond PUA-04	10,880	4.0	14,506
From IRM soil holding area in pond PUB-04	14,230	4.0	18,971
From IRM soil holding area in pond PUB-05	14,985	4.1	20,602
From IRM soil holding area in pond PUB-10	14,202	6.4	30,375
From IRM soil holding area in pond PUC-03	13,029	4.0	17,371
From IRM soil holding area in pond PUC-04	12,596	4.6	19,504
From IRM soil holding area in pond PUD-03	13,908	4.0	18,542
Mohawk Sub-Area			
From ponds PUE-01, PUE-02, PUF-01, and PUF-02	63,412	0	0
Trails & Recreation Sub-Area			
From ponds PLH-01, PLI-01, PLI-02, PLJ-01, and PLJ-02	87,058	0	0
From ponds PLH-02, PLH-03, PLH-04, and PLI-03	117,264	0	0
From ponds PLG-02 through PLG-05	96,184	0	0
Western Hook Sub-Area			
From ponds PLD-10, PLE-08, PLE-09, PLF-05 through PLF-08, and PLG-06	191,676	0.5	31,943
Spray Wheel Sub-Area			
From ponds PUE-08, PUE-09, PUF-08, and PUF-09	48,927	2.0	32,614
From ponds PUF-07, PUG-08, and PUH-07	45,260	2.0	30,170
Former Espey Construction Site	6,216	2.0	4,146
Other TIMET Debris Areas	34,776	2.0	23,196
TIMET Abandoned Test Pit	3,887	3.0	3,887
TIMET OPW Ponds (TIMET Ponds Sub-Area)			
From ponds OPW-6 through OPW-11	32,960	4.5	49,436
From ponds OPW-13 through OPW-20	41,382	4.5	62,067
From pond OPW-12	5,421	4.5	8,130
TIMET Ponds Sub-Area			
From pond SC-1	41,624	18.5	256,656
From pond SW-2	18,682	4.5	28,021
From pond SW-3	19,312	4.5	28,965
From pond SW-4	23,958	18.5	147,726
From pond SW-5	18,828	4.5	28,239
From pond SW-6	19,650	4.5	29,473
From pond SW-7	23,377	18.5	144,145
From pond SW-8	19,650	22.5	147,363
From pond SW-9	20,667	4.5	30,997
From pond SW-10	25,507	5.5	46,758
From pond SW-11	23,861	5.5	43,741
From pond SW-12	25,265	5.5	46,314
From pond HP-2	24,974	4.5	37,458
From pond HP-3	49,320	4.5	73,972
From pond HP-4	22,845	4.5	34,264
From pond HP-5	49,513	4.5	74,262
First Eight Rows Sub-Area			
From ponds PUA-05 through PUA-10	67,102	0.6	12,920
From ponds PUB-06 through PUB-09	54,615	2.0	37,565
From ponds PUC-05 through PUC-08	66,385	2.6	56,782
From ponds PUD-04 through PUD-09	83,035	0.3	28,245
From ponds PUE-03 through PUE-07	94,070	0.9	25,589
From ponds PUF-03 through PUF-06	66,474	0.1	9,788
From ponds PUG-04 through PUG-07	65,344	0.7	15,004
Total:			1,875,634

NE = No Estimate.

TABLE 4-2
SCREENING LEVELS USED IN DATA SUMMARY TABLES AND FIGURES
BRC CLOSURE PLAN
(Page 1 of 8)

Parameter of Interest	Analytical Method	Compound List	Screening Level			
			Soil		Groundwater	
			Residential PRG (mg/kg) ^a	SSL (DAF = 1) (mg/kg) ^b	MCL (mg/L) ^c	Alternative Criteria (mg/L) ^d
Ions	EPA 300.0	Bromide	--	--	--	--
		Bromine	--	--	--	--
		Chlorate	--	--	--	--
		Chloride	--	--	250	--
		Chlorine (soluble)	--	--	--	--
		Chlorite	--	--	1.0	--
		Fluoride	3,666	--	4.0	2.2
		Nitrate (as N)	--	--	10	10
		Nitrite (as N)	--	--	1	1.0
		Orthophosphate	--	--	--	--
		Sulfate	--	--	250	--
	EPA 377.1	Sulfite	--	--	--	--
	EPA 314.0	Perchlorate	7.8	--	0.0245 ^g	0.018 ^h
Dissolved Gases	RSK 175	Ethane	--	--	--	--
		Ethylene	--	--	--	--
		Methane	--	--	--	--
Chlorinated Compounds	EPA 551.1	Chloral	--	--	--	--
		Dichloroacetaldehyde	--	--	--	--
PCDDs/PCDFs	EPA 8290	OCDF	--	--	--	--
		OCDD	--	--	--	--
		1,2,3,4,6,7,8-HpCDF	--	--	--	--
		1,2,3,4,6,7,8-HpCDD	--	--	--	--
		1,2,3,4,7,8,9-HpCDF	--	--	--	--
		1,2,3,4,7,8-HxCDF	--	--	--	--
		1,2,3,4,7,8-HxCDD	--	--	--	--
		1,2,3,6,7,8-HxCDF	--	--	--	--
		1,2,3,6,7,8-HxCDD	--	--	--	--
		1,2,3,7,8,9-HxCDF	--	--	--	--
		1,2,3,7,8,9-HxCDD	--	--	--	--
		1,2,3,7,8-PeCDF	--	--	--	--
		1,2,3,7,8-PeCDD	--	--	--	--
		2,3,4,6,7,8-HxCDF	--	--	--	--
		2,3,4,7,8-PeCDF	--	--	--	--
		2,3,7,8-TCDF	--	--	--	--
2,3,7,8-TCDD	3.9 E-6	--	3.0 E-8	4.5 E-10		
		TCDD TEQ	50 ppt ^f	--	--	--
Asbestos	Elutriator/TEM	Asbestos	--	--	7 MFL	--
General Chemistry Parameters	EPA 350.2	Ammonia (as N)	--	--	--	--
	EPA 335.1/335.2	Cyanide (Total)	1,222	--	0.2	0.73
	EPA 345.1	Iodine	--	--	--	--
	EPA 9045C	pH in soil	--	--	--	--
	EPA 9040B	pH in water	--	--	6.5-8.5	6.5-9 ⁱ
	EPA 376.1/376.2	Sulfide	--	--	--	--
	Mod. EPA 415.1	Total inorganic carbon	--	--	--	--
	EPA 351.2	Total Kjeldahl nitrogen (TKN)	--	--	--	--
EPA 415.1	Total organic carbon (TOC)	--	--	--	--	
Metals	EPA 6020/6010B	Aluminum	76,142	--	0.05	36
		Antimony	31	0.30	0.006	0.015
		Arsenic	0.39	1.0	0.01	0.00004
		Barium	5,375	82	2	2.6
		Beryllium	154	3.0	0.004	0.073
		Boron	16,000	--	--	7.3
		Cadmium	37	0.40	0.005	0.018
		Calcium	--	--	--	--

TABLE 4-2
SCREENING LEVELS USED IN DATA SUMMARY TABLES AND FIGURES
BRC CLOSURE PLAN
(Page 2 of 8)

Parameter of Interest	Analytical Method	Compound List	Screening Level				
			Soil		Groundwater		
			Residential PRG (mg/kg) ^a	SSL (DAF = 1) (mg/kg) ^b	MCL (mg/L) ^c	Alternative Criteria (mg/L) ^d	
Metals (Continued)	EPA 6020/6010B	Chromium	100,000	--	0.1	55	
		Cobalt	903	--	--	0.73	
		Copper	3,129	--	1.3	1.5	
		Iron	23,463	--	0.3	11	
		Lead	400	--	0.015	--	
		Lithium	1,564	--	--	0.73	
		Magnesium	--	--	--	--	
		Manganese	1,762	--	0.05	0.88	
		Molybdenum	391	--	--	0.18	
		Nickel	1,564	7.0	--	0.73	
		Niobium	--	--	--	--	
		Palladium	--	--	--	--	
		Phosphorus	--	--	--	--	
		Platinum	--	--	--	--	
		Potassium	--	--	--	--	
		Selenium	391	0.30	0.05	0.18	
		Silicon	--	--	--	--	
		Silver	391	2.0	0.1	0.18	
		Sodium	--	--	--	--	
		Strontium	46,924	--	--	22	
		Sulfur	--	--	--	--	
		Thallium	5.2	--	0.002	0.0024	
		Tin	46,924	--	--	22	
		Titanium	100,000	--	--	146	
		Tungsten	--	--	--	--	
		Uranium	16	--	0.03	0.0073	
		Vanadium	78	300	--	0.036	
		Zinc	23,463	620	0.5	11	
		Zirconium	--	--	--	--	
		EPA 7196A/7199	Chromium (VI)	30	2.0	--	0.11
		EPA 7470/7471A	Mercury	23	--	0.002	0.011
	Organo-phosphorous Pesticides	EPA 8141A	Azinphos-ethyl	--	--	--	--
Azinphos-methyl			--	--	--	--	
Carbophenothion			--	--	--	--	
Chlorpyrifos			183	--	--	0.11	
Coumaphos			--	--	--	--	
Demeton-O			2.4	--	--	0.0015	
Demeton-S			2.4	--	--	0.0015	
Diazinon			55	--	--	0.033	
Dichlorvos			1.7	--	--	0.00023	
Dimethoate			12	--	--	0.0073	
Disulfoton			2.4	--	--	0.0015	
EPN			0.61	--	--	--	
Ethoprop			--	--	--	0.00036	
Ethyl parathion			367	--	--	0.22	
Fampphur			--	--	--	--	
Fenthion			--	--	--	--	
Malathion			1,222	--	--	0.73	
Methyl carbophenothion			--	--	--	--	
Methyl parathion			15	--	--	0.0091	
Mevinphos			--	--	--	--	
Naled	122	--	--	0.073			

TABLE 4-2
SCREENING LEVELS USED IN DATA SUMMARY TABLES AND FIGURES
BRC CLOSURE PLAN
(Page 3 of 8)

Parameter of Interest	Analytical Method	Compound List	Screening Level			
			Soil		Groundwater	
			Residential PRG (mg/kg) ^a	SSL (DAF = 1) (mg/kg) ^b	MCL (mg/L) ^c	Alternative Criteria (mg/L) ^d
Organo-phosphorous Pesticides (Continued)	EPA 8141A	O,O,O-Triethyl phosphorothioate (TEPP)	--	--	--	--
		Phorate	12	--	--	0.0073
		Phosmet	1,222	--	--	0.73
		Ronnel	3,055	--	--	1.8
		Stirophos (Tetrachlorovinphos)	20	--	--	0.0028
		Sulfotep	31	--	--	0.018
Chlorinated Herbicides	EPA 8151A	2,4,5-T	611	--	0.05	0.36
		2,4,5-TP (Silvex)	489	--	0.05	0.29
		2,4-D	686	--	0.07	0.36
		2,4-DB	489	--	--	0.29
		Dalapon	1,833	--	0.2	1.1
		Dicamba	1,833	--	--	1.1
		Dichloroprop	--	--	--	--
		Dinoseb	61	--	0.007	0.036
		MCPA	31	--	--	0.018
		MCPP	61	--	--	0.036
Organic Acids	HPLC	4-Chlorobenzene sulfonic acid	--	--	--	--
		Benzenesulfonic acid	--	--	--	--
		O,O-Diethylphosphorodithioic acid	--	--	--	--
		O,O-Dimethylphosphorodithioic acid	--	--	--	--
Nonhalogenated Organics	EPA 8015B	Ethylene glycol	100,000	--	--	73
		Ethylene glycol monobutyl ether	30,552	--	--	18
		Methanol	30,552	--	--	18
		Propylene glycol	30,034	--	--	18
Organochlorine Pesticides	EPA 8081A	2,4-DDD	--	--	--	--
		2,4-DDE	--	--	--	--
		4,4-DDD	2.4	0.8	--	0.00028
		4,4-DDE	1.7	3.0	--	0.00020
		4,4-DDT	1.7	2.0	--	0.00020
		Aldrin	0.029	0.02	--	0.000004
		alpha-BHC	0.090	0.00003	--	0.00001
		alpha-Chlordane	1.6	0.5	0.002	0.00019
		beta-BHC	0.32	0.0001	--	0.00004
		Chlordane	1.6	0.5	0.002	0.00019
		delta-BHC	--	--	--	--
		Dieldrin	0.030	0.0002	--	0.000004
		Endosulfan I	367	0.9	--	0.22
		Endosulfan II	367	0.9	--	0.22
		Endosulfan sulfate	--	--	--	--
		Endrin	18	0.05	0.002	0.011
		Endrin aldehyde	--	--	--	--
		Endrin ketone	--	--	--	--
		gamma-BHC (Lindane)	0.44	0.0005	0.0002	0.00005
		gamma-Chlordane	1.6	0.5	0.002	0.00019
		Heptachlor	0.11	1.0	0.0004	0.00001
		Heptachlor epoxide	0.053	0.03	0.0002	0.00001
		Methoxychlor	306	8.0	0.04	0.18
Toxaphene	0.44	2.0	0.003	0.00006		
Polychlorinated Biphenyls	EPA 8082	Aroclor 1016	3.9	--	0.0005	0.0010
		Aroclor 1221	0.22	--	0.0005	0.00003
		Aroclor 1232	0.22	--	0.0005	0.00003
		Aroclor 1242	0.22	--	0.0005	0.00003
		Aroclor 1248	0.22	--	0.0005	0.00003
		Aroclor 1254	0.22	--	0.0005	0.00003

TABLE 4-2
SCREENING LEVELS USED IN DATA SUMMARY TABLES AND FIGURES
BRC CLOSURE PLAN
(Page 4 of 8)

Parameter of Interest	Analytical Method	Compound List	Screening Level			
			Soil		Groundwater	
			Residential PRG (mg/kg) ^a	SSL (DAF = 1) (mg/kg) ^b	MCL (mg/L) ^c	Alternative Criteria (mg/L) ^d
Polychlorinated Biphenyls (Continued)	EPA 8082	Aroclor 1260	0.22	--	0.0005	0.00003
		PCB-77	--	--	--	--
		PCB-81	--	--	--	--
		PCB-105	--	--	--	--
		PCB-114	--	--	--	--
		PCB-118	--	--	--	--
		PCB-123	--	--	--	--
		PCB-126	--	--	--	--
		PCB-156	--	--	--	--
		PCB-157	--	--	--	--
		PCB-167	--	--	--	--
		PCB-169	--	--	--	--
		PCB-189	--	--	--	--
Polynuclear Aromatic Hydrocarbons	EPA 8310	Acenaphthene	3,682	29	--	0.37
		Acenaphthylene	--	--	--	--
		Anthracene	21,896	590	--	1.8
		Benzo(a)anthracene	0.62	0.08	--	0.00009
		Benzo(a)pyrene	0.062	0.4	0.0002	0.00001
		Benzo(b)fluoranthene	0.62	0.2	--	0.00009
		Benzo(g,h,i)perylene	--	--	--	--
		Benzo(k)fluoranthene	6.2	2.0	--	0.00092
		Chrysene	62	8.0	--	0.0092
		Dibenzo(a,h)anthracene	0.062	0.08	--	0.00001
		Indeno(1,2,3-cd)pyrene	0.62	0.7	--	0.00009
		Phenanthrene	--	--	--	--
		Pyrene	2,316	210	--	0.18
Radionuclides ^e	EPA 900.0 or EPA 9320	Gross alpha	--	--	15 ^l	--
		Gross beta	--	--	-- ^k	--
	EPA 901.1/ HASL GA-01-R	Actinium-228	732	--	--	24
		Bismuth-212	22,600	--	--	67
		Bismuth-214	8,190	--	--	248
		Cobalt-57	8.7	8.4	--	46
		Cobalt-60	0.036	0.12	--	3.0
		Lead-210	0.15	0.0006	--	0.038
		Lead-211	>100,000	>100,000	--	116
		Lead-212	3,640	>100,000	--	1.9
		Lead-214	46,300	>100,000	--	138
		Potassium-40	0.11	--	--	1.9
		Thallium-208	22,600	--	--	--
		Thorium-227	113	3,340	--	1.0
		Thorium-234	1,330	4,130	--	2.1
	HASL A-01-R	Thorium-232	3.1	0.30	--	0.47
		Thorium-228	0.15	3.3	--	0.16
		Thorium-230	3.5	0.30	--	0.52
		Uranium-233/234	4.0	112	--	0.67
		Uranium 235/236	0.20	0.039	--	0.66
		Uranium-238	0.74	0.006	--	0.55
	EPA 903.0 / 903.1	Radium-226	0.012	0.016	5 ^l	0.00082
	EPA 904.0	Radium-228	0.068	0.059	5 ^l	0.046
Quantitate from Parent or Daughter Radionuclide	Actinium-227 (from Th-227)	0.10	--	--	0.10	
	Bismuth-210 (from Pb-210)	4,800	--	--	0.86	
	Bismuth-211 (from Pb-211)	>100,000	--	--	--	
	Polonium-210 (from Pb-210)	38	--	--	0.13	
	Polonium-212 (from Bi-212)	--	--	--	--	

TABLE 4-2
SCREENING LEVELS USED IN DATA SUMMARY TABLES AND FIGURES
BRC CLOSURE PLAN
(Page 5 of 8)

Parameter of Interest	Analytical Method	Compound List	Screening Level			
			Soil		Groundwater	
			Residential PRG (mg/kg) ^a	SSL (DAF = 1) (mg/kg) ^b	MCL (mg/L) ^c	Alternative Criteria (mg/L) ^d
Radionuclides ^c (Continued)	Quantitate from Parent or Daughter Radionuclide	Polonium-214 (from Bi-214)	>100,000	--	--	--
		Polonium-216 (from Pb-212)	>100,000	--	--	--
		Polonium-218 (from Pb-214)	>100,000	--	--	--
		Protactinium-231 (from U-235)	0.46	--	--	0.28
		Protactinium-234 (from Th-234)	348	--	--	19
		Radium-223 (from Th-227)	90	284	--	0.20
		Radium-224 (from Pb-212)	741	3,920	--	0.0010
		Thallium-207 (from Pb-211)	>100,000	--	--	--
Radon	FLUX/EPA AC	Radon-220	>100,000	--	--	--
		Radon-222	>100,000	119	--	1.3
Aldehydes	EPA 8315A	Acetaldehyde	11	--	--	0.0017
		Chloroacetaldehyde	--	--	--	--
		Dichloroacetaldehyde	--	--	--	--
		Formaldehyde	9,166	--	--	5.5
Semivolatile Organic Compounds	EPA 8270C	Trichloroacetaldehyde	--	--	--	--
		1,2,4,5-Tetrachlorobenzene	18	--	--	0.011
		1,2-Diphenylhydrazine	0.61	--	--	0.00008
		1,4-Dioxane	44	--	--	0.0061
		2,4,5-Trichlorophenol	6,110	14	--	3.6
		2,4,6-Trichlorophenol	6.1	0.008	--	0.0036
		2,4-Dichlorophenol	183	0.05	--	0.11
		2,4-Dimethylphenol	1,222	0.4	--	0.73
		2,4-Dinitrophenol	122	0.01	--	0.073
		2,4-Dinitrotoluene	0.72	0.00004	--	0.00010
		2,6-Dinitrotoluene	0.72	0.00003	--	0.00010
		2-Chloronaphthalene	4,937	--	--	0.49
		2-Chlorophenol	63	0.2	--	0.030
		2-Methylnaphthalene	--	--	--	--
		2-Nitroaniline	183	--	--	0.11
		2-Nitrophenol	--	--	--	--
		3,3-Dichlorobenzidine	1.1	0.0003	--	0.00015
		3-Nitroaniline	18	--	--	0.0032
		4,4'-Dichlorobenzil	--	--	--	--
		4-Bromophenyl phenyl ether	--	--	--	--
		4-Chloro-3-methylphenol	--	--	--	--
		4-Chlorophenyl phenyl ether	--	--	--	--
		4-Chlorothiophenol	--	--	--	--
		4-Chlorothiophenol	--	--	--	--
		4-Nitroaniline	23	--	--	0.0032
		4-Nitrophenol	--	--	--	--
		Acetophenone	--	--	--	--
		Aniline	85	--	--	0.012
		Azobenzene	4.4	--	--	0.00061
		Benzoic acid	100,000	20	--	146
		Benzyl alcohol	18,331	--	--	11
		Benzyl butyl phthalate	12,221	810	--	7.3
		bis(2-Chloroethoxy)methane	--	--	--	--
		bis(2-Chloroethyl) ether	0.22	0.00002	--	0.00001
		bis(2-Chloroisopropyl) ether	2.9	--	--	0.00027
		bis(2-Ethylhexyl) phthalate	35	--	0.006	0.0048
bis(Chloromethyl) ether	0.0002	--	--	5.2 E-8		
bis(p-Chlorophenyl) sulfone	--	--	--	--		
bis(p-Chlorophenyl)disulfide	--	--	--	--		

TABLE 4-2
SCREENING LEVELS USED IN DATA SUMMARY TABLES AND FIGURES
BRC CLOSURE PLAN
(Page 6 of 8)

Parameter of Interest	Analytical Method	Compound List	Screening Level			
			Soil		Groundwater	
			Residential PRG (mg/kg) ^a	SSL (DAF = 1) (mg/kg) ^b	MCL (mg/L) ^c	Alternative Criteria (mg/L) ^d
Semivolatile Organic Compounds (Continued)	EPA 8270C	Carbazole	24	0.0	--	0.0034
		Dibenzofuran	145	--	--	0.012
		Dichloromethyl ether	--	--	--	--
		Diethyl phthalate	48,882	--	--	29
		Dimethyl phthalate	100,000	--	--	365
		Di-n-butyl phthalate	6,110	270	--	3.6
		Di-n-octyl phthalate	2,444	10,000	--	1.5
		Diphenyl disulfide	--	--	--	--
		Diphenyl sulfide	--	--	--	--
		Diphenyl sulfone	183.3	--	--	0.1
		Fluoranthene	2,294	210	--	1.5
		Fluorene	2,747	28	--	0.24
		Hexachlorobenzene	0.30	0.1	0.001	0.00004
		Hexachlorobutadiene	6.2	0.1	--	0.00086
		Hexachlorocyclopentadiene	365	20	0.05	0.22
		Hexachloroethane	35	0.02	--	0.0048
		Hydroxymethyl phthalimide	--	--	--	--
		Isophorone	512	0.03	--	0.071
		m,p-Cresol	306	--	--	1.8
		Naphthalene	56	4.0	--	0.0062
		Nitrobenzene	20	0.007	--	0.0034
		N-nitrosodi-n-propylamine	0.069	0.000002	--	0.00001
		N-nitrosodiphenylamine	99	0.06	--	0.014
		o-Cresol	3,055	0.8	--	1.8
		Octachlorostyrene	--	--	--	--
		p-Chloroaniline (4-Chloroaniline)	244	0.03	--	0.15
		p-Chlorobenzenethiol (see 4-Chlorothiophenol)	--	--	--	--
		Pentachlorobenzene	49	--	--	0.029
		Pentachlorophenol	3.0	0.001	0.001	0.00056
		Phenol	18,331	5.0	--	11
Phthalic acid	61,103	--	--	36.5		
Pyridine	61	--	--	0.036		
Thiophenol	--	--	--	--		
Tentatively Identified Compounds (TICs)	--	--	--	--		
Volatile Organic Compounds	EPA 8260B	1,1,1,2-Tetrachloroethane	3.2	--	--	0.00043
		1,1,1-Trichloroethane	1,200	0.1	0.2	3.2
		1,1,2,2-Tetrachloroethane	0.41	0.0002	--	0.00006
		1,1,2-Trichloroethane	0.73	0.0009	0.005	0.00020
		1,1-Dichloroethane	506	1.0	--	0.81
		1,1-Dichloroethene	124	0.003	0.007	0.34
		1,1-Dichloropropene	--	--	--	--
		1,2,3-Trichlorobenzene	--	--	--	--
		1,2,3-Trichloropropane	0.034	--	--	0.00001
		1,2,4-Trichlorobenzene	62	0.3	0.07	0.0072
		1,2,4-Trimethylbenzene	52	--	--	0.012
		1,2-Dichlorobenzene	600	0.9	0.6	0.37
		1,2-Dichloroethane	0.28	0.001	0.005	0.00012
		1,2-Dichloroethene (see cis-, trans-)	--	--	--	--
		1,2-Dichloropropane	0.34	0.001	0.005	0.00016
		1,3,5-Trichlorobenzene	--	--	--	--
		1,3,5-Trimethylbenzene	21	--	--	0.012
		1,3-Dichlorobenzene	531	--	--	0.18
		1,3-Dichloropropene (see cis-, trans-)	--	--	--	--
		1,3-Dichloropropane	105	--	--	0.12

TABLE 4-2
SCREENING LEVELS USED IN DATA SUMMARY TABLES AND FIGURES
BRC CLOSURE PLAN
(Page 7 of 8)

Parameter of Interest	Analytical Method	Compound List	Screening Level			
			Soil		Groundwater	
			Residential PRG (mg/kg) ^a	SSL (DAF = 1) (mg/kg) ^b	MCL (mg/L) ^c	Alternative Criteria (mg/L) ^d
Volatile Organic Compounds (Continued)	EPA 8260B	1,4-Dichlorobenzene	3.4	0.1	0.075	0.00050
		2,2-Dichloropropane	--	--	--	--
		2,2-Dimethylpentane	--	--	--	--
		2,2,3-Trimethylbutane	--	--	--	--
		2,3-Dimethylpentane	--	--	--	--
		2,4-Dimethylpentane	--	--	--	--
		2-Chlorotoluene	158	--	--	0.12
		2-Hexanone	--	--	--	--
		2-Methylhexane	--	--	--	--
		2-Nitropropane	--	--	--	0.000012
		3,3-Dimethylpentane	--	--	--	--
		3-Ethylpentane	--	--	--	--
		3-Methylhexane	--	--	--	--
		4-Chlorotoluene	--	--	--	--
		4-Methyl-2-pentanone (MIBK)	5,281	--	--	2.0
		Acetone	14,127	0.8	--	5.5
		Acetonitrile	424	--	--	0.10
		Benzene	0.64	0.002	0.005	0.00035
		Bromobenzene	28	--	--	0.020
		Bromodichloromethane	0.82	0.03	0.08 ^m	0.00018
		Bromoform	62	0.04	0.08 ^m	0.0085
		Bromomethane	3.9	0.01	--	0.0087
		Carbon disulfide	355	2.0	--	1.0
		Carbon tetrachloride	0.25	0.003	0.005	0.00017
		Chlorobenzene	151	0.07	0.1	0.11
		Chlorobromomethane	--	--	--	--
		Chlorodibromomethane (see Dibromochloromethane)	1.1	0.02	0.08 ^m	0.00013
		Chloroethane	3.0	--	--	0.0046
		Chloroform	0.22	0.03	0.08 ^m	0.00017
		Chloromethane	47	--	--	0.16
		cis-1,2-Dichloroethene	43	0.02	0.07	0.061
		cis-1,3-Dichloropropene	0.78	0.0002	--	--
		Cymene (Isopropyltoluene)	--	--	--	--
		Dibromochloroethane	--	--	--	--
		Dibromochloromethane	--	--	0.08 ^m	0.00013
		Dibromochloropropane	0.46	--	0.0002	0.00005
		Dibromomethane	67	--	--	0.061
		Dichloromethane (Methylene chloride)	9.1	0.001	0.005	0.0043
		Dimethylsulfide	--	--	--	--
		Ethanol	--	--	--	--
		Ethylbenzene	395	0.7	0.7	1.3
		Freon-11 (Trichlorofluoromethane)	386	--	--	1.3
		Freon-113 (1,1,2-Trifluoro-1,2,2-trichloroethane)	5,600	--	--	59
		Freon-12 (Dichlorodifluoromethane)	94	--	--	0.39
		Heptane	--	--	--	--
		Isoheptane	--	--	--	--
		Isopropylbenzene	572	--	--	0.66
		m,p-Xylene (see Xylenes (total))	--	--	--	--
		Methyl ethyl ketone (2-Butanone)	22,311	--	--	7.0
		Methyl iodide	--	--	--	--
MTBE (Methyl tert-butyl ether)	17	--	--	0.006		
n-Butylbenzene	240	--	--	0.24		
n-Propylbenzene	240	--	--	0.24		
Nonanal	--	--	--	--		

TABLE 4-2
SCREENING LEVELS USED IN DATA SUMMARY TABLES AND FIGURES
BRC CLOSURE PLAN
(Page 8 of 8)

Parameter of Interest	Analytical Method	Compound List	Screening Level			
			Soil		Groundwater	
			Residential PRG (mg/kg) ^a	SSL (DAF = 1) (mg/kg) ^b	MCL (mg/L) ^c	Alternative Criteria (mg/L) ^d
Volatile Organic Compounds (Continued)	EPA 8260B	o-Xylene (see Xylenes (total))	--	--	--	--
		sec-Butylbenzene	220	--	--	0.24
		Styrene	1,700	0.2	0.1	1.6
		tert-Butylbenzene	390	--	--	0.24
		Tetrachloroethene	0.48	0.003	0.005	0.00010
		Toluene	520	0.6	1	0.72
		trans-1,2-Dichloroethene	69	0.03	0.1	0.12
		trans-1,3-Dichloropropene	0.78	0.0002	--	--
		Trichloroethene	0.053	0.003	0.005	0.00003
		Vinyl acetate	426	8.0	--	0.41
		Vinyl chloride	0.079	0.0007	0.002	0.00002
		Xylenes (total)	271	10	10	0.21
		Tentatively Identified Compounds (TICs)		--	--	--
Water Quality Parameters	EPA 120.1	Conductivity	--	--	--	--
	EPA 130.2	Hardness, total	--	--	--	--
	EPA 160.1	Total dissolved solids	--	--	--	1,900 / 2,400 ⁿ
	EPA 160.2	Total suspended solids	--	--	--	--
	EPA 310.1	Alkalinity, Total (as CaCO ₃)	--	--	--	--
		Bicarbonate alkalinity	--	--	--	--
		Carbonate alkalinity	--	--	--	--
Hydroxide alkalinity		--	--	--	--	
Flashpoint	EPA 1010	Flammables	--	--	--	--
Total Petroleum Hydrocarbons	EPA 8015	Diesel	--	--	--	--
		Gasoline	--	--	--	--
		Grease	--	--	--	--
		Mineral Spirits	--	--	--	--
White Phosphorus	EPA 7580M	White phosphorus	1.6	--	--	0.00073
Methyl Mercury	EPA 1630	Methyl mercury	6.1	--	--	0.0036

a - From USEPA Region 9 preliminary remediation goals (PRG) table, October 2004 (and the 2007 USEPA radionuclide PRG webpage; <http://epa-prgs.ornl.gov/radionuclides>). Values used are residential soil PRGs.

d - From USEPA Region 9 preliminary remediation goals (PRG) table, October 2004 (and the 2007 USEPA radionuclide PRG webpage; <http://epa-prgs.ornl.gov/radionuclides>). Value used is the soil screening level with a dilution attenuation factor of 1.

c - USEPA Maximum Contaminant Levels (MCLs).

d - Unless otherwise noted the Alternative Criteria used are from USEPA Region 9 preliminary remediation goals (PRG) table, October 2004 (and the 2007 USEPA radionuclide PRG webpage; <http://epa-prgs.ornl.gov/radionuclides>). Values used are tap water PRGs.

e - Radionuclide units are in pCi/g (or pCi/L in water).

f - Agency for Toxic Substances and Disease Registry (ATSDR) screening value of 50 parts per trillion (ppt).

g - An MCL for perchlorate has not been promulgated. The USEPA Drinking Water Equivalent Level of 24.5 µg/L was used.

h - Nevada provisional action level of 18 µg/l.

i - A NDEP water quality standard was used for Class A (municipal or domestic supply) waters for pH and total phosphorus based on Nevada Administrative Code (NAC) 445A.118 through 445A.225.

j - The MCL for Alpha Particles was used as comparison to Gross Alpha results. The MCL excludes the contributions from radon and uranium. The Gross Alpha concentrations were not adjusted due to contributions from radon nor uranium prior to comparison to MCL.

k - The MCL for Beta particles photon emitters is 4 millirems per year and was not used to compare to Gross Beta concentrations.

l - The constituent is regulated under the MCL for the combined concentration of radium-226 and radium-228. For comparison to the MCL, concentrations of both constituents are summed.

m - The constituent is regulated under the MCL for Total Trihalomethanes (TTHM). For comparison to the MCL for TTHM, concentrations of all TTHM constituents need to be considered.

n - Nevada Requirement to Maintain Existing Higher Quality level of 1,900 / 2,400 mg/L for total dissolved solids (Nevada Administrative Code [NAC] 445A.199 / NAC 445A 200/201).

Shaded cells indicate compounds that are not on the current groundwater monitoring analyte list.

-- = Not applicable or no value has been established.

SSL = soil screening level.

DAF = dilution attenuation factor.

MCL = maximum contaminant level.

TABLE 4-3
SUMMARY OF SOILS INVESTIGATIONS - ALL SOIL DATA
BRC CLOSURE PLAN
(Page 1 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd	
Ions	Bromide	mg/kg	139	14	10%	0.34	3.7	2.5	132	--	--	--	--	--	--	--	--	--	
	Bromine	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Chlorate	mg/kg	367	174	47%	0.003	260	0.003	4.7	--	--	--	--	--	--	--	--	--	
	Chloride	mg/kg	444	438	99%	1.1	20900	1.5	10	--	--	--	--	--	--	1110	104	0	
	Chlorine (soluble)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Chlorite	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Fluoride	mg/kg	139	113	81%	0.18	16.7	1	1.8	3,666	0	0	--	--	--	2.5	65	0	
	Nitrate (as N)	mg/kg	139	103	74%	0.1	259	0.2	21	--	--	--	--	--	--	102	1	0	
	Nitrite (as N)	mg/kg	139	44	32%	0.13	4.8	0.2	2.1	--	--	--	--	--	--	0.21	39	55	
	Orthophosphate	mg/kg	139	22	16%	0.79	198	0.92	71.4	--	--	--	--	--	--	--	--	--	
	Sulfate	mg/kg	210	208	99%	3.7	31300	100	746	--	--	--	--	--	--	4130	26	0	
	Sulfite	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perchlorate	mg/kg	772	608	79%	0.0052	830	0.00449	34	7.8	73	2	--	--	--	--	--	--		
Dissolved Gases	Ethane	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Ethylene	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Methane	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Chlorinated Compounds	Chloral	mg/kg	3	0	0%	--	--	0.07	0.07	--	--	--	--	--	--	--	--	--	
	Dichloroacetaldehyde	mg/kg	3	0	0%	--	--	0.07	0.07	--	--	--	--	--	--	--	--	--	
PCDDs/PCDFs	OCDF	mg/kg	316	206	65%	5.3 E-6	1.7 E+0	2.3 E-7	6.5 E-6	--	--	--	--	--	--	--	--	--	
	OCDD	mg/kg	316	198	63%	1.9 E-6	7.7 E-2	2.7 E-7	1.6 E-5	--	--	--	--	--	--	--	--	--	
	1,2,3,4,6,7,8-HpCDF	mg/kg	316	195	62%	2.9 E-6	4.2 E-1	1.1 E-7	2.2 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,4,6,7,8-HpCDD	mg/kg	316	161	51%	8.0 E-7	6.8 E-2	7.3 E-8	2.0 E-5	--	--	--	--	--	--	--	--	--	
	1,2,3,4,7,8,9-HpCDF	mg/kg	316	162	51%	1.9 E-6	1.6 E-1	5.7 E-8	3.4 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,4,7,8-HxCDF	mg/kg	263	119	45%	2.5 E-6	8.6 E-3	7.8 E-8	2.9 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,4,7,8-HxCDD	mg/kg	263	26	10%	1.4 E-7	1.5 E-4	4.7 E-8	3.6 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,6,7,8-HxCDF	mg/kg	263	105	40%	1.4 E-6	2.0 E-3	4.9 E-8	2.6 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,6,7,8-HxCDD	mg/kg	263	56	21%	2.7 E-7	2.2 E-4	6.2 E-8	3.2 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,7,8,9-HxCDF	mg/kg	263	45	17%	3.4 E-7	3.6 E-4	5.8 E-8	3.5 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,7,8,9-HxCDD	mg/kg	263	44	17%	3.4 E-7	1.8 E-4	7.0 E-8	3.2 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,7,8-PeCDF	mg/kg	263	103	39%	1.2 E-6	2.1 E-3	3.8 E-8	2.7 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,7,8-PeCDD	mg/kg	263	25	10%	1.8 E-7	1.3 E-4	6.5 E-8	5.1 E-6	--	--	--	--	--	--	--	--	--	
	2,3,4,6,7,8-HxCDF	mg/kg	263	66	25%	8.6 E-7	3.4 E-4	5.1 E-8	3.2 E-6	--	--	--	--	--	--	--	--	--	
	2,3,4,7,8-PeCDF	mg/kg	263	85	32%	6.7 E-7	8.6 E-4	4.0 E-8	2.8 E-6	--	--	--	--	--	--	--	--	--	
	2,3,7,8-TCDF	mg/kg	263	131	50%	5.3 E-7	1.7 E-3	3.4 E-8	9.4 E-7	--	--	--	--	--	--	--	--	--	
2,3,7,8-TCDD	mg/kg	263	33	13%	1.0 E-7	2.7 E-5	4.0 E-8	1.0 E-6	3.9 E-6	4	0	--	--	--	--	--	--		
TCDD TEQ	mg/kg	317	219	69%	3.2 E-7	6.7 E-3	2.4 E-7	4.1 E-6	5.0 E-5 ^f	26	0	--	--	--	--	--	--		
Asbestos	Asbestos	fibers	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
General Chemistry Parameters	Ammonia (as N)	mg/kg	139	4	3%	0.58	1.7	0.5	1.2	--	--	--	--	--	--	--	--	--	
	Cyanide (Total)	mg/kg	664	57	9%	0.27	12.7	0.13	1.6	1,222	0	0	--	--	--	--	--	--	
	Iodine	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	pH in soil	SU	364	364	100%	1.63	13.9	--	--	--	--	--	--	--	--	--	--	--	
	pH in water	SU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Sulfide	mg/kg	139	9	6%	12.8	34.2	10.1	23.3	--	--	--	--	--	--	--	--	--	
	Total inorganic carbon	mg/kg	163	160	98%	568	55400	500	646	--	--	--	--	--	--	--	--	--	
	Total Kjeldahl nitrogen (TKN)	mg/kg	139	43	31%	27.8	319	2.5	28.6	--	--	--	--	--	--	--	--	--	
	Total organic carbon (TOC)	mg/kg	192	144	75%	500	41500	500	1567	--	--	--	--	--	--	--	--	--	
Metals	Aluminum	mg/kg	735	735	100%	3800	24200	--	--	76,142	0	--	--	--	--	15300	31	--	
	Antimony	mg/kg	928	420	45%	0.1	490	0.0005	6.2	31	21	0	0.30	232	432	0.5	182	365	
	Arsenic	mg/kg	1319	1203	91%	0.012	3900	1	26	0.39	1201	116	1.0	1198	114	7.2	431	53	
	Barium	mg/kg	1168	1166	100%	0.22	18900	33	38	5,375	28	0	82	1109	0	836	82	0	
	Beryllium	mg/kg	823	795	97%	0.00079	23	0.1	2.6	154	0	0	3.0	15	0	0.89	97	3	
	Boron	mg/kg	411	210	51%	3.1	119	4.2	27.6	16,000	0	0	--	--	--	11.6	82	174	
	Cadmium	mg/kg	1101	613	56%	0.03	41	0.0005	13	37	1	0	0.40	57	474	0.1291	316	487	
	Calcium	mg/kg	673	672	100%	25.9	193000	530	530	--	--	--	--	--	--	82800	24	--	

TABLE 4-3
SUMMARY OF SOILS INVESTIGATIONS - ALL SOIL DATA
BRC CLOSURE PLAN
(Page 2 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd	
Metals (Continued)	Chromium	mg/kg	1184	1160	98%	0.0096	3830	20	26	100,000	0	0	--	--	--	16.7	374	24	
	Cobalt	mg/kg	664	647	97%	1.3	230	0.01	6.7	903	0	0	--	--	--	16.3	9	0	
	Copper	mg/kg	825	824	100%	0.012	1940	2.6	2.6	3,129	0	0	--	--	--	30.5	93	0	
	Iron	mg/kg	801	801	100%	1300	116000	--	--	23,463	28	--	--	--	--	19700	165	--	
	Lead	mg/kg	1271	1267	100%	0.0063	33000	2.5	3.6	400	91	0	--	--	--	35.1	252	0	
	Lithium	mg/kg	411	408	99%	7	400	6.6	8.4	1,564	0	0	--	--	--	26.5	69	0	
	Magnesium	mg/kg	992	991	100%	15	124000	265	265	--	--	--	--	--	--	17500	86	0	
	Manganese	mg/kg	1107	1107	100%	0.27	57000	--	--	1,762	89	--	--	--	--	1090	121	--	
	Molybdenum	mg/kg	736	676	92%	0.12	512	0.01	5.2	391	1	0	--	--	--	2	55	39	
	Nickel	mg/kg	827	827	100%	0.011	916.7	--	--	1,564	0	--	--	7.0	816	--	30	42	--
	Niobium	mg/kg	411	133	32%	0.81	18.6	1.5	13.8	--	--	--	--	--	--	2.8	58	243	
	Palladium	mg/kg	411	404	98%	0.14	62	0.27	1	--	--	--	--	--	--	1.5	17	0	
	Phosphorus	mg/kg	411	407	99%	154	2840	334	1730	--	--	--	--	--	--	2010	8	0	
	Platinum	mg/kg	411	12	3%	0.01	0.11	0.1	0.3	--	--	--	--	--	--	0.099	1	399	
	Potassium	mg/kg	602	536	89%	8.38	12400	50	530	--	--	--	--	--	--	3890	51	0	
	Selenium	mg/kg	1133	295	26%	0.04	20.8	0.005	59.1	391	0	0	0.30	151	835	0.6	49	633	
	Silicon	mg/kg	411	411	100%	110	4280	--	--	--	--	--	--	--	--	4150	1	--	
	Silver	mg/kg	1077	573	53%	0.03	56	0.001	26	391	0	0	2.0	45	139	0.2609	113	422	
	Sodium	mg/kg	673	672	100%	28.7	20400	530	530	--	--	--	--	--	--	1320	42	0	
	Strontium	mg/kg	411	411	100%	37.6	31600	--	--	46,924	0	--	--	--	--	808	16	--	
	Sulfur	mg/kg	272	252	93%	219	8060	508	1030	--	--	--	--	--	--	--	--	--	
	Thallium	mg/kg	860	243	28%	0.04	330	0.0005	8.5	5.2	32	87	--	--	--	1.8	56	121	
	Tin	mg/kg	410	366	89%	0.16	4	0.13	2.9	46,924	0	0	--	--	--	0.8	62	28	
	Titanium	mg/kg	730	729	100%	94.1	2000	542	542	100,000	0	0	--	--	--	1010	44	0	
	Tungsten	mg/kg	411	331	81%	0.15	6.2	0.13	1.4	--	--	--	--	--	--	2.5	8	0	
	Uranium	mg/kg	411	411	100%	0.43	105	--	--	16	6	--	--	--	--	2.7	55	--	
	Vanadium	mg/kg	1150	1150	100%	0.035	7780	--	--	78	147	--	300	79	--	59.1	233	--	
	Zinc	mg/kg	769	767	100%	0.03	1300	5	35.1	23,463	0	0	620	1	0	121	18	0	
	Zirconium	mg/kg	406	406	100%	1.5	162	--	--	--	--	--	--	--	--	179	0	--	
	Chromium (VI)	mg/kg	735	56	8%	0.005	29	0.005	0.93	30	0	0	2.0	5	0	0.32	15	413	
	Mercury	mg/kg	803	207	26%	0.0083	4.4	0.0001	0.98	23	0	0	--	--	--	0.11	62	18	
	Organo-phosphorous Pesticides	Azinphos-ethyl	mg/kg	325	0	0%	--	--	0.033	0.14534	--	--	--	--	--	--	--	--	--
		Azinphos-methyl	mg/kg	395	1	0.3%	0.0094	0.0094	0.0042	0.14534	--	--	--	--	--	--	--	--	--
Carbophenothion		mg/kg	325	1	0.3%	0.10638	0.10638	0.033	0.14534	--	--	--	--	--	--	--	--	--	
Chlorpyrifos		mg/kg	395	4	1%	0.0013	0.0043	0.0029	0.14534	183	0	0	--	--	--	--	--	--	
Coumaphos		mg/kg	395	0	0%	--	--	0.0025	0.14534	--	--	--	--	--	--	--	--	--	
Demeton-O		mg/kg	325	0	0%	--	--	0.013	0.14534	2.4	0	0	--	--	--	--	--	--	
Demeton-S		mg/kg	325	0	0%	--	--	0.013	0.14534	2.4	0	0	--	--	--	--	--	--	
Diazinon		mg/kg	395	0	0%	--	--	0.002	0.14534	55	0	0	--	--	--	--	--	--	
Dichlorvos		mg/kg	395	5	1%	0.0021	0.011	0.0045	0.14534	1.7	0	0	--	--	--	--	--	--	
Dimethoate		mg/kg	395	1	0.3%	0.13	0.13	0.0038	0.14534	12	0	0	--	--	--	--	--	--	
Disulfoton		mg/kg	448	2	0.4%	0.004	0.0057	0.0021	0.15	2.4	0	0	--	--	--	--	--	--	
EPN		mg/kg	325	1	0.3%	0.0029	0.0029	0.013	0.14534	0.61	0	0	--	--	--	--	--	--	
Ethoprop		mg/kg	395	2	1%	0.005	0.0057	0.0012	0.14534	--	--	--	--	--	--	--	--	--	
Ethyl parathion		mg/kg	448	0	0%	--	--	0.0015	0.14534	367	0	0	--	--	--	--	--	--	
Famphur		mg/kg	448	0	0%	--	--	0.0026	0.14534	--	--	--	--	--	--	--	--	--	
Fenthion		mg/kg	395	1	0.3%	0.0065	0.0065	0.0059	0.14534	--	--	--	--	--	--	--	--	--	
Malathion		mg/kg	395	4	1%	0.0018	0.0075	0.005	0.14534	1,222	0	0	--	--	--	--	--	--	
Methyl carbophenothion		mg/kg	139	0	0%	--	--	0.033	0.12	--	--	--	--	--	--	--	--	--	
Methyl parathion		mg/kg	448	2	0.4%	0.002	0.003	0.005	0.14534	15	0	0	--	--	--	--	--	--	
Mevinphos		mg/kg	395	1	0.3%	0.0049	0.0049	0.0035	0.14534	--	--	--	--	--	--	--	--	--	
Naled	mg/kg	395	0	0%	--	--	0.033	0.14534	122	0	0	--	--	--	--	--	--		

TABLE 4-3
SUMMARY OF SOILS INVESTIGATIONS - ALL SOIL DATA
BRC CLOSURE PLAN
(Page 3 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd
Organo-phosphorous Pesticides (Continued)	O,O,O-Triethyl phosphorothioate (TEPP)	mg/kg	209	0	0%	--	--	0.0022	0.048	--	--	--	--	--	--	--	--	--
	Phorate	mg/kg	448	3	1%	0.0046	0.0076	0.0022	0.14534	12	0	0	--	--	--	--	--	--
	Phosmet	mg/kg	325	0	0%	--	--	0.067	0.25	1,222	0	0	--	--	--	--	--	--
	Ronnel	mg/kg	395	4	1%	0.0019	0.0058	0.0038	0.25	3,055	0	0	--	--	--	--	--	--
	Stirophos (Tetrachlorovinphos)	mg/kg	395	9	2%	--	--	0.0027	0.14534	20	0	0	--	--	--	--	--	--
	Sulfotep	mg/kg	395	6	2%	0.0013	0.0058	0.002	0.14534	31	0	0	--	--	--	--	--	--
Chlorinated Herbicides	2,4,5-T	mg/kg	192	0	0%	--	--	0.02	0.064	611	0	0	--	--	--	--	--	--
	2,4,5-TP (Silvex)	mg/kg	192	0	0%	--	--	0.02	0.064	489	0	0	--	--	--	--	--	--
	2,4-D	mg/kg	192	0	0%	--	--	0.081	0.26	686	0	0	--	--	--	--	--	--
	2,4-DB	mg/kg	139	0	0%	--	--	0.081	0.19	489	0	0	--	--	--	--	--	--
	Dalapon	mg/kg	139	0	0%	--	--	0.04	0.093	1,833	0	0	--	--	--	--	--	--
	Dicamba	mg/kg	139	0	0%	--	--	0.04	0.093	1,833	0	0	--	--	--	--	--	--
	Dichloroprop	mg/kg	139	0	0%	--	--	0.081	0.19	--	--	--	--	--	--	--	--	--
	Dinoseb	mg/kg	192	0	0%	--	--	0.012	0.08	61	0	0	--	--	--	--	--	--
	MCPA	mg/kg	139	0	0%	--	--	8.1	19	31	0	0	--	--	--	--	--	--
	MCPP	mg/kg	--	--	--	--	--	--	--	61	--	--	--	--	--	--	--	--
Organic Acids	4-Chlorobenzene sulfonic acid	mg/kg	142	1	1%	6.5	6.5	1	1	--	--	--	--	--	--	--	--	--
	Benzenesulfonic acid	mg/kg	141	0	0%	--	--	1	1	--	--	--	--	--	--	--	--	--
	O,O-Diethylphosphorodithioic acid	mg/kg	142	0	0%	--	--	1	1	--	--	--	--	--	--	--	--	--
	O,O-Dimethylphosphorodithioic acid	mg/kg	142	2	1%	6.5	14	1	5	--	--	--	--	--	--	--	--	--
Nonhalogenated Organics	Ethylene glycol	mg/kg	139	1	1%	64	64	34	750	100,000	0	0	--	--	--	--	--	--
	Ethylene glycol monobutyl ether	mg/kg	3	0	0%	--	--	0.052	0.057	30,552	0	0	--	--	--	--	--	--
	Methanol	mg/kg	139	4	3%	7.1	8800	50	130	30,552	0	0	--	--	--	--	--	--
	Propylene glycol	mg/kg	139	0	0%	--	--	50	750	30,034	0	0	--	--	--	--	--	--
Organochlorine Pesticides	2,4-DDD	mg/kg	326	16	5%	0.0023	0.82	0.0017	0.18	--	--	--	--	--	--	--	--	--
	2,4-DDE	mg/kg	465	79	17%	0.0019	16	0.0017	9.7	--	--	--	--	--	--	--	--	--
	4,4-DDD	mg/kg	1298	72	6%	0.0018	48	0.0005	20	2.4	3	28	0.8	6	46	--	--	--
	4,4-DDE	mg/kg	1298	602	46%	0.00091	420	0.0005	0.33	1.7	93	0	3.0	82	0	--	--	--
	4,4-DDT	mg/kg	1299	448	34%	0.0012	220	0.00061	8.3	1.7	59	4	2.0	51	4	--	--	--
	Aldrin	mg/kg	1297	1	0.1%	0.004	0.004	0.00066	10.55	0.029	0	98	0.02	0	102	--	--	--
	alpha-BHC	mg/kg	1299	98	8%	0.00069	4.4	0.00076	10.55	0.090	18	61	0.00003	98	1201	--	--	--
	alpha-Chlordane	mg/kg	1298	53	4%	0.0024	0.53	0.00045	10.55	1.6	0	0	0.5	0	0	--	--	--
	beta-BHC	mg/kg	1298	342	26%	0.00075	3.1	0.00071	10.55	0.32	6	50	0.0001	342	956	--	--	--
	Chlordane	mg/kg	968	6	1%	0.023	80	0.0017	240	1.6	0	0	0.5	0	0	--	--	--
	delta-BHC	mg/kg	1296	44	3%	0.0007	1.7	0.00044	10.55	--	--	--	--	--	--	--	--	--
	Dieldrin	mg/kg	1298	22	2%	0.0015	0.7	0.00058	14	0.030	4	103	0.0002	22	1276	--	--	--
	Endosulfan I	mg/kg	1297	172	13%	0.00064	310	0.0005	1000	367	0	0	0.9	0	0	--	--	--
	Endosulfan II	mg/kg	1298	24	2%	0.002	0.46	0.00063	20	367	0	0	0.9	0	0	--	--	--
	Endosulfan sulfate	mg/kg	1298	8	1%	0.002	0.02	0.00053	20	--	--	--	--	--	--	--	--	--
	Endrin	mg/kg	1298	14	1%	0.0019	0.72	0.00056	20	18	0	1	0.05	2	93	--	--	--
	Endrin aldehyde	mg/kg	1298	23	2%	0.0018	0.019	0.0011	20	--	--	--	--	--	--	--	--	--
	Endrin ketone	mg/kg	945	12	1%	0.0019	0.03	0.00053	10.55	--	--	--	--	--	--	--	--	--
	gamma-BHC (Lindane)	mg/kg	1296	50	4%	0.0013	19	0.00059	10.55	0.44	3	46	0.0005	50	1246	--	--	--
	gamma-Chlordane	mg/kg	1298	70	5%	0.00089	22	0.00097	34	1.6	0	0	0.5	0	0	--	--	--
	Heptachlor	mg/kg	1294	11	1%	0.0037	3.1	0.0006	10.55	0.11	4	74	1.0	2	39	--	--	--
	Heptachlor epoxide	mg/kg	1298	9	1%	0.0019	0.065	0.00047	10.55	0.053	1	87	0.03	1	103	--	--	--
	Methoxychlor	mg/kg	1298	64	5%	0.0054	110	0.0013	370	306	0	1	8.0	3	30	--	--	--
Toxaphene	mg/kg	1297	0	0%	--	--	0.016	1000	0.44	0	122	2.0	0	90	--	--	--	
Polychlorinated Biphenyls	Aroclor 1016	mg/kg	727	0	0%	--	--	0.0015	79	3.9	0	26	--	--	--	--	--	
	Aroclor 1221	mg/kg	727	0	0%	--	--	0.0015	79	--	--	--	--	--	--	--	--	
	Aroclor 1232	mg/kg	727	0	0%	--	--	0.0015	79	--	--	--	--	--	--	--	--	
	Aroclor 1242	mg/kg	727	0	0%	--	--	0.0015	79	--	--	--	--	--	--	--	--	
	Aroclor 1248	mg/kg	727	0	0%	--	--	0.0015	79	--	--	--	--	--	--	--	--	
	Aroclor 1254	mg/kg	727	13	2%	0.03	11	0.0015	79	0.22	5	52	--	--	--	--	--	

TABLE 4-3
SUMMARY OF SOILS INVESTIGATIONS - ALL SOIL DATA
BRC CLOSURE PLAN
(Page 4 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd	
Polychlorinated Biphenyls (Continued)	Aroclor 1260	mg/kg	727	9	1%	0.025	4.3	0.0094	79	--	--	--	--	--	--	--	--	--	
	PCB-77	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-81	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-105	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-114	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-118	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-123	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-126	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-156	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-157	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-167	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-169	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-189	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Polynuclear Aromatic Hydrocarbons	Acenaphthene	mg/kg	940	2	0.2%	0.53	6	0.041	8	3,682	0	0	29	0	0	--	--	--	
	Acenaphthylene	mg/kg	940	1	0.1%	0.38	0.38	0.03	8	--	--	--	--	--	--	--	--	--	
	Anthracene	mg/kg	940	1	0.1%	2.8	2.8	0.03	8	21,896	0	0	590	0	0	--	--	--	
	Benzo(a)anthracene	mg/kg	942	27	3%	0.017	5.8	0.015	8	0.62	1	187	0.08	15	843	--	--	--	
	Benzo(a)pyrene	mg/kg	942	9	1%	0.02	4.1	0.015	8	0.062	7	862	0.4	4	302	--	--	--	
	Benzo(b)fluoranthene	mg/kg	934	8	1%	0.018	4.3	0.015	8	0.62	1	198	0.2	4	854	--	--	--	
	Benzo(g,h,i)perylene	mg/kg	940	2	0.2%	0.062	2.1	0.03	8	--	--	--	--	--	--	--	--	--	
	Benzo(k)fluoranthene	mg/kg	920	2	0.2%	0.026	3.8	0.015	8	6.2	0	1	2.0	1	7	--	--	--	
	Chrysene	mg/kg	942	45	5%	0.021	5.3	0.015	8	62	0	0	8.0	0	0	--	--	--	
	Dibenzo(a,h)anthracene	mg/kg	940	1	0.1%	0.94	0.94	0.03	8	0.062	1	873	0.08	1	868	--	--	--	
	Indeno(1,2,3-cd)pyrene	mg/kg	940	4	0.4%	0.022	2.2	0.015	8	0.62	1	199	0.7	1	67	--	--	--	
	Phenanthrene	mg/kg	942	36	4%	0.054	18	0.03	8	--	--	--	--	--	--	--	--	--	
	Pyrene	mg/kg	942	37	4%	0.038	10	0.03	8	2,316	0	0	210	0	0	--	--	--	
Radionuclides	Gross alpha	pCi/g	142	132	93%	10.3	146	20.6	39.2	--	--	--	--	--	--	--	--	--	
	Gross beta	pCi/g	142	130	92%	18.9	103	15.8	41.9	--	--	--	--	--	--	--	--	--	
	Actinium-228	pCi/g	254	204	80%	0.56	12.1	0.1	1.99	732	0	0	--	--	--	3.4	5	0	
	Bismuth-212	pCi/g	232	53	23%	0.74	2.9	-0.49	3.1	22,600	0	0	--	--	--	1.82	13	72	
	Bismuth-214	pCi/g	254	236	93%	0.46	35.6	0.65	4.56	8,190	0	0	--	--	--	1.62	56	1	
	Cobalt-57	pCi/g	161	11	7%	0.004	0.065	-0.057	0.07	8.7	0	0	8.4	0	0	0.08	0	0	
	Cobalt-60	pCi/g	161	12	7%	0.002	0.06	-0.1	0.18	0.036	3	30	0.12	0	2	0.164	0	1	
	Lead-210	pCi/g	232	25	11%	0.86	11.3	-0.9	5.6	0.15	25	194	0.0006	25	198	2.2	20	69	
	Lead-211	pCi/g	--	--	--	--	--	--	--	>100,000	--	--	>100,000	--	--	0.4	--	--	
	Lead-212	pCi/g	254	234	92%	0.25	11.9	0.19	1.56	3,640	0	0	>100,000	0	0	2.11	7	0	
	Lead-214	pCi/g	254	237	93%	0.56	43.3	0.69	1.47	46,300	0	0	>100,000	0	0	1.72	56	0	
	Potassium-40	pCi/g	254	234	92%	5.4	37	6.5	28.3	0.11	234	20	--	--	--	35	2	0	
	Thallium-208	pCi/g	254	222	87%	0.118	3.93	-0.07	0.58	22,600	0	0	--	--	--	0.72	7	0	
	Thorium-227	pCi/g	--	--	--	--	--	--	--	113	--	--	3,340	--	--	0.4	--	--	
	Thorium-234	pCi/g	233	134	58%	0.79	39	0.1	5.4	1,330	0	0	4,130	0	0	2.5	45	3	
	Thorium-232	pCi/g	328	328	100%	0.13	18.2	--	--	3.1	6	--	0.30	325	--	2.23	14	--	
	Thorium-228	pCi/g	336	334	99%	0.28	9.58	0.17	1.12	0.15	334	2	3.3	6	0	2.28	14	0	
	Thorium-230	pCi/g	338	320	95%	0.367	46.7	0.9	1.7	3.5	34	0	0.30	320	18	3.01	40	0	
	Uranium-233/234	pCi/g	338	337	100%	0.151	33.3	1.55	1.55	4.0	17	0	112	0	0	2.84	34	0	
	Uranium 235/236	pCi/g	338	192	57%	0.004	2.7	-0.02	0.4	0.20	28	2	0.039	173	104	0.21	18	2	
	Uranium-238	pCi/g	336	335	100%	0.118	33.5	--	--	0.74	281	0	0.006	335	0	2.37	51	0	
	Radium-226	pCi/g	338	295	87%	-0.61	36.5	-1.75	4.11	0.012	293	42	0.016	293	42	2.36	68	1	
	Radium-228	pCi/g	337	326	97%	0.2	101	-0.22	2	0.068	326	10	0.059	326	10	2.94	13	0	
	Actinium-227 (from Th-227)	pCi/g	--	--	--	--	--	--	--	0.10	--	--	--	--	--	0.4	--	--	
	Bismuth-210 (from Pb-210)	pCi/g	139	20	14%	0.86	11.3	-0.9	5.6	4,800	20	107	--	--	--	2.2	16	21	
	Bismuth-211 (from Pb-211)	pCi/g	--	--	--	--	--	--	--	>100,000	--	--	--	--	--	0.4	--	--	
Polonium-210 (from Pb-210)	pCi/g	139	20	14%	0.86	11.3	-0.9	5.6	38	0	0	--	--	--	2.2	16	21		
Polonium-212 (from Bi-212)	pCi/g	139	43	31%	0.47	1	-0.31	1.08	--	--	--	--	--	--	1.17	0	0		

TABLE 4-3
SUMMARY OF SOILS INVESTIGATIONS - ALL SOIL DATA
BRC CLOSURE PLAN
(Page 6 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd	
Semivolatile Organic Compounds (Continued)	Carbazole	mg/kg	887	0	0%	--	--	0.17	8	24	0	0	0.0	0	878	--	--	--	
	Dibenzofuran	mg/kg	887	0	0%	--	--	0.056	8	145	0	0	--	--	--	--	--	--	
	Dichloromethyl ether	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Diethyl phthalate	mg/kg	940	3	0.3%	0.083	0.26	0.041	8	48,882	0	0	--	--	--	--	--	--	
	Dimethyl phthalate	mg/kg	940	0	0%	--	--	0.025	8	100,000	0	0	--	--	--	--	--	--	--
	Di-n-butyl phthalate	mg/kg	942	10	1%	0.036	16	0.0625	8	6,110	0	0	270	0	0	--	--	--	--
	Di-n-octyl phthalate	mg/kg	940	1	0.1%	1.6	1.6	0.041	8	2,444	0	0	10,000	0	0	--	--	--	--
	Diphenyl disulfide	mg/kg	411	0	0%	--	--	0.33	1.7	--	--	--	--	--	--	--	--	--	--
	Diphenyl sulfide	mg/kg	411	0	0%	--	--	0.33	1.7	--	--	--	--	--	--	--	--	--	--
	Diphenyl sulfone	mg/kg	411	0	0%	--	--	0.33	1.7	183.3	0	0	--	--	--	--	--	--	--
	Fluoranthene	mg/kg	942	38	4%	0.036	16	0.051	8	2,294	0	0	210	0	0	--	--	--	--
	Fluorene	mg/kg	940	1	0.1%	1.3	1.3	0.057	8	2,747	0	0	28	0	0	--	--	--	--
	Hexachlorobenzene	mg/kg	942	90	10%	0.052	230	0.043	6	0.30	80	779	0.1	86	779	--	--	--	--
	Hexachlorobutadiene	mg/kg	957	3	0.3%	0.074	1.4	0.005	8	6.2	0	1	0.1	1	867	--	--	--	--
	Hexachlorocyclopentadiene	mg/kg	940	0	0%	--	--	0.031	8.3	365	0	0	20	0	0	--	--	--	--
	Hexachloroethane	mg/kg	940	0	0%	--	--	0.17	8	35	0	0	0.02	0	931	--	--	--	--
	Hydroxymethyl phthalimide	mg/kg	411	0	0%	--	--	0.33	1.7	--	--	--	--	--	--	--	--	--	--
	Isophorone	mg/kg	887	0	0%	--	--	0.033	8	512	0	0	0.03	0	878	--	--	--	--
	m,p-Cresol	mg/kg	940	1	0.1%	0.075	0.075	0.065	8	306	0	0	--	--	--	--	--	--	--
	Naphthalene	mg/kg	955	1	0.1%	2.1	2.1	0.005	8	56	0	0	4.0	0	5	--	--	--	--
	Nitrobenzene	mg/kg	940	0	0%	--	--	0.035	8	20	0	0	0.007	0	931	--	--	--	--
	N-nitrosodi-n-propylamine	mg/kg	940	1	0.1%	1	1	0.024	8	0.069	1	867	0.000002	1	929	--	--	--	--
	N-nitrosodiphenylamine	mg/kg	940	0	0%	--	--	0.17	8	99	0	0	0.06	0	931	--	--	--	--
	o-Cresol	mg/kg	940	0	0%	--	--	0.042	8	3,055	0	0	0.8	0	21	--	--	--	--
	Octachlorostyrene	mg/kg	272	0	0%	--	--	0.33	1.7	--	--	--	--	--	--	--	--	--	--
	p-Chloroaniline (4-Chloroaniline)	mg/kg	942	1	0.1%	1.2	1.2	0.17	52	244	0	0	0.03	1	932	--	--	--	--
	p-Chlorobenzenethiol	mg/kg	411	0	0%	--	--	0.33	1.7	--	--	--	--	--	--	--	--	--	--
	Pentachlorobenzene	mg/kg	464	24	5%	0.052	2.1	0.33	1.7	49	0	0	--	--	--	--	--	--	--
	Pentachlorophenol	mg/kg	942	4	0.4%	0.48	1.5	0.026	130	3.0	0	197	0.001	4	929	--	--	--	--
	Phenol	mg/kg	942	1	0.1%	0.12	0.12	0.059	8	18,331	0	0	5.0	0	2	--	--	--	--
	Phthalic acid	mg/kg	467	8	2%	0.082	3	0.33	8.3	61,103	0	0	--	--	--	--	--	--	--
	Pyridine	mg/kg	484	0	0%	--	--	0.5	5.1	61	0	0	--	--	--	--	--	--	--
Thiophenol	mg/kg	411	0	0%	--	--	0.33	1.7	--	--	--	--	--	--	--	--	--	--	
Tentatively Identified Compounds (TICs)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Volatile Organic Compounds	1,1,1,2-Tetrachloroethane	mg/kg	482	0	0%	--	--	0.0045	0.044	3.2	0	0	--	--	--	--	--	--	
	1,1,1-Trichloroethane	mg/kg	786	12	2%	0.0002	0.019	0.00044	0.044	1,200	0	0	0.1	0	1	--	--	--	
	1,1,2,2-Tetrachloroethane	mg/kg	786	0	0%	--	--	0.00044	0.044	0.41	0	0	0.0002	0	777	--	--	--	--
	1,1,2-Trichloroethane	mg/kg	786	0	0%	--	--	0.00043	0.044	0.73	0	0	0.0009	0	727	--	--	--	--
	1,1-Dichloroethane	mg/kg	786	0	0%	--	--	0.00038	0.044	506	0	0	1.0	0	0	--	--	--	--
	1,1-Dichloroethene	mg/kg	783	0	0%	--	--	0.0013	0.044	124	0	0	0.003	0	724	--	--	--	--
	1,1-Dichloropropene	mg/kg	429	0	0%	--	--	0.0045	0.02	--	--	--	--	--	--	--	--	--	--
	1,2,3-Trichlorobenzene	mg/kg	429	0	0%	--	--	0.0045	0.1	--	--	--	--	--	--	--	--	--	--
	1,2,3-Trichloropropane	mg/kg	482	0	0%	--	--	0.0045	0.1	0.034	0	6	--	--	--	--	--	--	--
	1,2,4-Trichlorobenzene	mg/kg	958	22	2%	0.0011	41	0.0045	6	62	0	0	0.3	14	393	--	--	--	--
	1,2,4-Trimethylbenzene	mg/kg	429	15	3%	0.00034	0.0015	0.0046	0.02	52	0	0	--	--	--	--	--	--	--
	1,2-Dichlorobenzene	mg/kg	1085	37	3%	0.00033	770	0.0045	6	600	1	0	0.9	7	11	--	--	--	--
	1,2-Dichloroethane	mg/kg	786	3	0.4%	0.0013	0.0086	0.00043	0.044	0.28	0	1	0.001	3	724	--	--	--	--
	1,2-Dichloroethene	mg/kg	409	1	0.2%	0.0027	0.0027	0.0049	0.017	--	--	--	--	--	--	--	--	--	--
	1,2-Dichloropropane	mg/kg	786	2	0.3%	0.00083	0.0061	0.00021	0.044	0.34	0	1	0.001	1	725	--	--	--	--
	1,3,5-Trichlorobenzene	mg/kg	412	0	0%	--	--	0.0045	0.053	--	--	--	--	--	--	--	--	--	--
	1,3,5-Trimethylbenzene	mg/kg	429	1	0.2%	0.00083	0.00083	0.0045	0.1	21	0	0	--	--	--	--	--	--	--
	1,3-Dichlorobenzene	mg/kg	1085	8	1%	0.00047	71	0.0045	6	531	0	0	--	--	--	--	--	--	--
	1,3-Dichloropropene (see cis-, trans-)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	1,3-Dichloropropane	mg/kg	429	0	0%	--	--	0.0045	0.02	105	0	0	--	--	--	--	--	--	--

TABLE 4-3
SUMMARY OF SOILS INVESTIGATIONS - ALL SOIL DATA
BRC CLOSURE PLAN
(Page 8 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd
Volatile Organic Compounds (Continued)	o-Xylene	mg/kg	658	17	3%	0.00035	0.036	0.0045	0.02	--	--	--	--	--	--	--	--	--
	sec-Butylbenzene	mg/kg	429	0	0%	--	--	0.0045	0.02	220	0	0	--	--	--	--	--	--
	Styrene	mg/kg	733	0	0%	--	--	0.00037	0.02	1,700	0	0	0.2	0	0	--	--	--
	tert-Butylbenzene	mg/kg	429	0	0%	--	--	0.0045	0.02	390	0	0	--	--	--	--	--	--
	Tetrachloroethene	mg/kg	799	72	9%	0.00022	1.7	0.00036	0.044	0.48	1	0	0.003	15	657	--	--	--
	Toluene	mg/kg	799	150	19%	0.00045	0.09	0.00054	0.044	520	0	0	0.6	0	0	--	--	--
	trans-1,2-Dichloroethene	mg/kg	514	0	0%	--	--	0.00032	0.044	69	0	0	0.03	0	6	--	--	--
	trans-1,3-Dichloropropene	mg/kg	786	0	0%	--	--	0.00031	0.044	0.78	0	0	0.0002	0	1	--	--	--
	Trichloroethene	mg/kg	786	148	19%	0.00012	0.13	0.00031	0.044	0.053	1	0	0.003	50	579	--	--	--
	Vinyl acetate	mg/kg	717	0	0%	--	--	0.00053	0.2	426	0	0	8.0	0	0	--	--	--
	Vinyl chloride	mg/kg	786	0	0%	--	--	0.00079	0.044	0.079	0	1	0.0007	0	783	--	--	--
	Xylenes (total)	mg/kg	553	23	4%	0.001	0.082	0.0011	0.088	271	0	0	10	0	0	--	--	--
	Tentatively Identified Compounds (TICs)		mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Water Quality Parameters	Conductivity	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Hardness, total	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Total dissolved solids	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Total suspended solids	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Alkalinity, Total (as CaCO ₃)	mg/kg	71	51	72%	25	750	25	25	--	--	--	--	--	--	--	--	--
	Bicarbonate alkalinity	mg/kg	262	242	92%	18	770	--	--	--	--	--	--	--	--	--	--	--
	Carbonate alkalinity	mg/kg	262	62	24%	1	96	25	25	--	--	--	--	--	--	--	--	--
Hydroxide alkalinity	mg/kg	71	0	0%	--	--	--	--	--	--	--	--	--	--	--	--	--	
Flashpoint	Flammables	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons	Diesel	mg/kg	100	0	0%	--	--	25	5200	--	--	--	--	--	--	--	--	--
	Gasoline	mg/kg	100	3	3%	0.12	95	0.1	40	--	--	--	--	--	--	--	--	--
	Grease	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Mineral Spirits	mg/kg	99	0	0%	--	--	25	5200	--	--	--	--	--	--	--	--	--
White Phosphorus	White phosphorus	mg/kg	--	--	--	--	--	--	--	1.6	--	--	--	--	--	--	--	--
Methyl Mercury	Methyl mercury	mg/kg	--	--	--	--	--	--	--	6.1	--	--	--	--	--	--	--	--

a - Range of detections include estimated values of detect results between the detection limit and reporting limit. As such some minimum detected concentrations may be below the minimum reporting limit. In these cases the respective sample results are flagged in the data set.

b - The quantitation limits shown include samples which had detections. For screening purposes, the detection limit was used for comparison to the screening levels.

c - From USEPA Region 9 preliminary remediation goals (PRG) table, October 2004 (and the 2007 USEPA radionuclide PRG webpage; <http://epa-prgs.ornl.gov/radionuclides>). Values used are residential soil PRGs.

d - From USEPA Region 9 preliminary remediation goals (PRG) table, October 2004 (and the 2007 USEPA radionuclide PRG webpage; <http://epa-prgs.ornl.gov/radionuclides>). Value used is the soil screening level with a dilution attenuation factor of 1.

e - Values used are the maximum from the provisional soils background data set presented in the Background Shallow Soil Summary Report, BMI Complex and Common Area Vicinity (BRC/TIMET 2007, currently in review by the NDEP).

f - Agency for Toxic Substances and Disease Registry (ATSDR) screening value of 50 parts per trillion (ppt).

SSL = soil screening level.

DAF = dilution attenuation factor.

-- = Not applicable or no value has been established.

TABLE 4-4
SUMMARY OF SOILS INVESTIGATIONS - SURFACE SOILS (0-1 FT bgs)
BRC CLOSURE PLAN
(Page 1 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd	
Ions	Bromide	mg/kg	22	1	5%	1.3	1.3	2.5	2.9	--	--	--	--	--	--	--	--	--	
	Bromine	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Chlorate	mg/kg	152	95	63%	0.003	260	0.003	2.3	--	--	--	--	--	--	--	--	--	
	Chloride	mg/kg	86	80	93%	1.2	8430	1.5	10	--	--	--	--	--	--	1110	8	0	
	Chlorine (soluble)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Chlorite	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Fluoride	mg/kg	22	12	55%	0.24	6.4	1	1.1	3,666	0	0	--	--	--	2.5	3	0	
	Nitrate (as N)	mg/kg	22	17	77%	0.1	259	0.2	0.21	--	--	--	--	--	--	102	1	0	
	Nitrite (as N)	mg/kg	22	3	14%	0.17	0.36	0.2	0.23	--	--	--	--	--	--	0.21	2	3	
	Orthophosphate	mg/kg	22	9	41%	0.89	3.7	0.92	5.4	--	--	--	--	--	--	--	--	--	
	Sulfate	mg/kg	33	32	97%	3.7	10000	100	100	--	--	--	--	--	--	4130	1	0	
	Sulfite	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perchlorate	mg/kg	405	350	86%	0.0111	830	0.0208	34	7.8	63	2	--	--	--	--	--	--		
Dissolved Gases	Ethane	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Ethylene	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Methane	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Chlorinated Compounds	Chloral	mg/kg	3	0	0%	--	--	0.07	0.07	--	--	--	--	--	--	--	--	--	
	Dichloroacetaldehyde	mg/kg	3	0	0%	--	--	0.07	0.07	--	--	--	--	--	--	--	--	--	
PCDDs/PCDFs	OCDF	mg/kg	226	184	81%	5.7 E-6	1.7 E+0	2.3 E-7	6.5 E-6	--	--	--	--	--	--	--	--	--	
	OCDD	mg/kg	226	178	79%	1.9 E-6	7.7 E-2	5.4 E-7	1.6 E-5	--	--	--	--	--	--	--	--	--	
	1,2,3,4,6,7,8-HpCDF	mg/kg	226	178	79%	2.9 E-6	4.2 E-1	1.1 E-7	2.2 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,4,6,7,8-HpCDD	mg/kg	226	152	67%	8.0 E-7	6.8 E-2	1.6 E-7	2.0 E-5	--	--	--	--	--	--	--	--	--	
	1,2,3,4,7,8,9-HpCDF	mg/kg	226	154	68%	1.9 E-6	1.6 E-1	5.7 E-8	3.4 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,4,7,8-HxCDF	mg/kg	173	108	62%	2.5 E-6	8.6 E-3	1.0 E-7	2.9 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,4,7,8-HxCDD	mg/kg	173	24	14%	1.4 E-7	1.5 E-4	8.4 E-8	3.6 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,6,7,8-HxCDF	mg/kg	173	97	56%	1.4 E-6	2.0 E-3	6.2 E-8	2.6 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,6,7,8-HxCDD	mg/kg	173	52	30%	2.7 E-7	2.2 E-4	9.6 E-8	3.2 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,7,8,9-HxCDF	mg/kg	173	41	24%	3.4 E-7	3.6 E-4	1.2 E-7	3.5 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,7,8,9-HxCDD	mg/kg	173	40	23%	3.4 E-7	1.8 E-4	7.0 E-8	3.2 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,7,8-PeCDF	mg/kg	173	95	55%	1.2 E-6	2.1 E-3	5.1 E-8	2.7 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,7,8-PeCDD	mg/kg	173	23	13%	1.8 E-7	1.3 E-4	6.5 E-8	5.1 E-6	--	--	--	--	--	--	--	--	--	
	2,3,4,6,7,8-HxCDF	mg/kg	173	61	35%	8.6 E-7	3.4 E-4	6.8 E-8	3.2 E-6	--	--	--	--	--	--	--	--	--	
	2,3,4,7,8-PeCDF	mg/kg	173	79	46%	6.7 E-7	8.6 E-4	7.3 E-8	2.8 E-6	--	--	--	--	--	--	--	--	--	
	2,3,7,8-TCDF	mg/kg	173	117	68%	5.5 E-7	1.7 E-3	4.6 E-8	9.4 E-7	--	--	--	--	--	--	--	--	--	
	2,3,7,8-TCDD	mg/kg	173	30	17%	1.0 E-7	2.7 E-5	4.2 E-8	1.0 E-6	3.9 E-6	3	0	--	--	--	--	--	--	
	TCDD TEQ	mg/kg	227	195	86%	3.2 E-7	6.7 E-3	2.4 E-7	4.1 E-6	5.0 E-5 ^f	24	0	--	--	--	--	--	--	
Asbestos	Asbestos	fibers	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
General Chemistry Parameters	Ammonia (as N)	mg/kg	22	2	9%	0.75	1.7	0.5	0.57	--	--	--	--	--	--	--	--	--	
	Cyanide (Total)	mg/kg	344	44	13%	0.27	12.7	0.13	1.6	1,222	0	0	--	--	--	--	--	--	
	Iodine	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	pH in soil	SU	147	147	100%	1.63	10	--	--	--	--	--	--	--	--	--	--	--	
	pH in water	SU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Sulfide	mg/kg	22	1	5%	12.8	12.8	10.1	11.4	--	--	--	--	--	--	--	--	--	
	Total inorganic carbon	mg/kg	22	22	100%	1890	18700	--	--	--	--	--	--	--	--	--	--	--	
	Total Kjeldahl nitrogen (TKN)	mg/kg	22	5	23%	77.9	182	2.5	28.6	--	--	--	--	--	--	--	--	--	
	Total organic carbon (TOC)	mg/kg	33	23	70%	611	7800	500	1567	--	--	--	--	--	--	--	--	--	
Metals	Aluminum	mg/kg	322	322	100%	3800	19000	--	--	76,142	0	--	--	--	--	15300	5	--	
	Antimony	mg/kg	445	194	44%	0.14	490	0.0005	6.2	31	16	0	0.30	140	223	0.5	114	166	
	Arsenic	mg/kg	694	636	92%	0.012	3900	1	26	0.39	634	58	1.0	633	57	7.2	239	37	
	Barium	mg/kg	547	546	100%	0.22	18900	33	33	5,375	23	0	82	528	0	836	59	0	
	Beryllium	mg/kg	372	363	98%	0.00079	23	0.1	2.6	154	0	0	3.0	12	0	0.89	57	2	
	Boron	mg/kg	114	40	35%	3.1	36.9	4.2	27.2	16,000	0	0	--	--	--	11.6	5	67	
	Cadmium	mg/kg	515	280	54%	0.03	41	0.0005	13	37	1	0	0.40	29	229	0.1291	183	234	
	Calcium	mg/kg	156	155	99%	25.9	80300	530	530	--	--	--	--	--	--	82800	0	0	

TABLE 4-4
SUMMARY OF SOILS INVESTIGATIONS - SURFACE SOILS (0-1 FT bgs)
BRC CLOSURE PLAN
(Page 2 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd	
Metals (Continued)	Chromium	mg/kg	559	546	98%	0.0096	3830	20	26	100,000	0	0	--	--	--	16.7	236	13	
	Cobalt	mg/kg	294	286	97%	1.3	22.3	5.1	6.7	903	0	0	--	--	--	16.3	3	0	
	Copper	mg/kg	369	368	100%	0.012	740	2.6	2.6	3,129	0	0	--	--	--	30.5	54	0	
	Iron	mg/kg	333	333	100%	1300	116000	--	--	23,463	16	--	--	--	--	19700	82	--	
	Lead	mg/kg	646	646	100%	0.0063	33000	--	--	400	78	--	--	--	--	35.1	203	--	
	Lithium	mg/kg	114	112	98%	8.2	30.1	6.6	8.4	1,564	0	0	--	--	--	26.5	2	0	
	Magnesium	mg/kg	364	363	100%	15	23000	265	265	--	--	--	--	--	--	17500	8	0	
	Manganese	mg/kg	564	564	100%	0.27	57000	--	--	1,762	74	--	--	--	--	1090	97	--	
	Molybdenum	mg/kg	322	282	88%	0.12	7.2	0.22	4.6	391	0	0	--	--	--	2	20	27	
	Nickel	mg/kg	372	372	100%	0.011	916.7	--	--	1,564	0	--	--	7.0	365	--	30	30	--
	Niobium	mg/kg	114	64	56%	0.85	11.2	2.5	12.9	--	--	--	--	--	--	2.8	34	44	
	Palladium	mg/kg	114	112	98%	0.14	1.3	0.27	0.88	--	--	--	--	--	--	1.5	0	0	
	Phosphorus	mg/kg	114	114	100%	420	2290	--	--	--	--	--	--	--	--	2010	4	--	
	Platinum	mg/kg	114	8	7%	0.01	0.087	0.1	0.3	--	--	--	--	--	--	0.099	0	106	
	Potassium	mg/kg	145	136	94%	15.8	7060	50	530	--	--	--	--	--	--	3890	7	0	
	Selenium	mg/kg	530	153	29%	0.04	9	0.005	59.1	391	0	0	0.30	80	374	0.6	25	264	
	Silicon	mg/kg	114	114	100%	174	2920	--	--	--	--	--	--	--	--	4150	0	--	
	Silver	mg/kg	474	253	53%	0.03	56	0.001	26	391	0	0	2.0	34	73	0.2609	63	209	
	Sodium	mg/kg	156	155	99%	28.7	20400	530	530	--	--	--	--	--	--	1320	3	0	
	Strontium	mg/kg	114	114	100%	82.2	968	--	--	46,924	0	--	--	--	--	808	1	--	
	Sulfur	mg/kg	92	82	89%	219	928	508	1030	--	--	--	--	--	--	--	--	--	
	Thallium	mg/kg	421	148	35%	0.05	110	0.0005	6.7	5.2	24	48	--	--	--	1.8	41	79	
	Tin	mg/kg	114	107	94%	0.3	2.6	0.17	1.2	46,924	0	0	--	--	--	0.8	40	5	
	Titanium	mg/kg	322	322	100%	207	2000	--	--	100,000	0	--	--	--	--	1010	29	--	
	Tungsten	mg/kg	114	100	88%	0.25	6.2	0.41	1.4	--	--	--	--	--	--	2.5	6	0	
	Uranium	mg/kg	114	114	100%	0.43	6.3	--	--	16	0	--	--	--	--	2.7	1	--	
	Vanadium	mg/kg	537	537	100%	0.035	7780	--	--	78	110	--	--	300	62	--	59.1	160	--
	Zinc	mg/kg	344	344	100%	0.03	1300	--	--	23,463	0	--	--	620	1	--	121	11	--
	Zirconium	mg/kg	109	109	100%	1.7	162	--	--	--	--	--	--	--	--	179	0	--	
	Chromium (VI)	mg/kg	270	28	10%	0.005	1.5	0.005	0.48	30	0	0	2.0	0	0	0.32	8	118	
	Mercury	mg/kg	385	122	32%	0.01	4.4	0.0001	0.25	23	0	0	--	--	--	0.11	42	9	
	Organo-phosphorous Pesticides	Azinphos-ethyl	mg/kg	140	0	0%	--	--	0.033	0.13698	--	--	--	--	--	--	--	--	--
Azinphos-methyl		mg/kg	167	0	0%	--	--	0.0042	0.13698	--	--	--	--	--	--	--	--	--	
Carbophenothion		mg/kg	140	1	1%	0.10638	0.10638	0.033	0.13698	--	--	--	--	--	--	--	--	--	
Chlorpyrifos		mg/kg	167	2	1%	0.0013	0.0043	0.0029	0.13698	183	0	0	--	--	--	--	--	--	
Coumaphos		mg/kg	167	0	0%	--	--	0.0025	0.13698	--	--	--	--	--	--	--	--	--	
Demeton-O		mg/kg	140	0	0%	--	--	0.013	0.13698	2.4	0	0	--	--	--	--	--	--	
Demeton-S		mg/kg	140	0	0%	--	--	0.013	0.13698	2.4	0	0	--	--	--	--	--	--	
Diazinon		mg/kg	167	0	0%	--	--	0.002	0.13698	55	0	0	--	--	--	--	--	--	
Dichlorvos		mg/kg	167	1	1%	0.0082	0.0082	0.0045	0.13698	1.7	0	0	--	--	--	--	--	--	
Dimethoate		mg/kg	167	0	0%	--	--	0.0038	0.13698	12	--	0	--	--	--	--	--	--	
Disulfoton		mg/kg	220	0	0%	--	--	0.0021	0.15	2.4	--	0	--	--	--	--	--	--	
EPN		mg/kg	140	1	1%	0.0029	0.0029	0.013	0.13698	0.61	0	0	--	--	--	--	--	--	
Ethoprop		mg/kg	167	0	0%	--	--	0.0013	0.13698	--	--	--	--	--	--	--	--	--	
Ethyl parathion		mg/kg	220	0	0%	--	--	0.0015	0.13698	367	0	0	--	--	--	--	--	--	
Famphur		mg/kg	220	0	0%	--	--	0.0026	0.13698	--	--	--	--	--	--	--	--	--	
Fenthion		mg/kg	167	0	0%	--	--	0.0059	0.13698	--	--	--	--	--	--	--	--	--	
Malathion		mg/kg	167	1	1%	0.0029	0.0029	0.005	0.13698	1,222	0	0	--	--	--	--	--	--	
Methyl carbophenothion		mg/kg	22	0	0%	--	--	0.033	0.069	--	--	--	--	--	--	--	--	--	
Methyl parathion		mg/kg	220	2	1%	0.002	0.003	0.005	0.13698	15	0	0	--	--	--	--	--	--	
Mevinphos		mg/kg	167	0	0%	--	--	0.0035	0.13698	--	--	--	--	--	--	--	--	--	
Naled	mg/kg	167	0	0%	--	--	0.033	0.13698	122	0	0	--	--	--	--	--	--		

TABLE 4-4
SUMMARY OF SOILS INVESTIGATIONS - SURFACE SOILS (0-1 FT bgs)
BRC CLOSURE PLAN
(Page 3 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd	
Organo-phosphorous Pesticides (Continued)	O,O,O-Triethyl phosphorothioate (TEPP)	mg/kg	49	0	0%	--	--	0.0022	0.027	--	--	--	--	--	--	--	--	--	
	Phorate	mg/kg	220	0	0%	--	--	0.0022	0.13698	12	--	0	--	--	--	--	--	--	
	Phosmet	mg/kg	140	0	0%	--	--	0.067	0.14	1,222	0	0	--	--	--	--	--	--	
	Ronnel	mg/kg	167	1	1%	0.0019	0.0019	0.0038	0.14	3,055	0	0	--	--	--	--	--	--	
	Stirophos (Tetrachlorovinphos)	mg/kg	167	1	1%	--	--	0.0027	0.13698	20	0	0	--	--	--	--	--	--	
	Sulfotep	mg/kg	167	1	1%	0.0058	0.0058	0.002	0.13698	31	0	0	--	--	--	--	--	--	
Chlorinated Herbicides	2,4,5-T	mg/kg	75	0	0%	--	--	0.02	0.064	611	0	0	--	--	--	--	--	--	
	2,4,5-TP (Silvex)	mg/kg	75	0	0%	--	--	0.02	0.064	489	0	0	--	--	--	--	--	--	
	2,4-D	mg/kg	75	0	0%	--	--	0.081	0.26	686	0	0	--	--	--	--	--	--	
	2,4-DB	mg/kg	22	0	0%	--	--	0.081	0.091	489	0	0	--	--	--	--	--	--	
	Dalapon	mg/kg	22	0	0%	--	--	0.04	0.046	1,833	0	0	--	--	--	--	--	--	
	Dicamba	mg/kg	22	0	0%	--	--	0.04	0.046	1,833	0	0	--	--	--	--	--	--	--
	Dichloroprop	mg/kg	22	0	0%	--	--	0.081	0.091	--	--	--	--	--	--	--	--	--	--
	Dinoseb	mg/kg	75	0	0%	--	--	0.012	0.08	61	0	0	--	--	--	--	--	--	--
	MCPA	mg/kg	22	0	0%	--	--	8.1	9.1	31	0	0	--	--	--	--	--	--	--
	MCPP	mg/kg	--	--	--	--	--	--	--	61	--	--	--	--	--	--	--	--	--
Organic Acids	4-Chlorobenzene sulfonic acid	mg/kg	22	0	0%	--	--	1	1	--	--	--	--	--	--	--	--	--	
	Benzenesulfonic acid	mg/kg	21	0	0%	--	--	1	1	--	--	--	--	--	--	--	--	--	
	O,O-Diethylphosphorodithioic acid	mg/kg	22	0	0%	--	--	1	1	--	--	--	--	--	--	--	--	--	
	O,O-Dimethylphosphorodithioic acid	mg/kg	22	0	0%	--	--	1	5	--	--	--	--	--	--	--	--	--	
Nonhalogenated Organics	Ethylene glycol	mg/kg	22	0	0%	--	--	34	520	100,000	--	0	--	--	--	--	--	--	
	Ethylene glycol monobutyl ether	mg/kg	3	0	0%	--	--	0.052	0.057	30,552	0	0	--	--	--	--	--	--	
	Methanol	mg/kg	22	0	0%	--	--	50	57	30,552	--	0	--	--	--	--	--	--	
	Propylene glycol	mg/kg	22	0	0%	--	--	50	520	30,034	0	0	--	--	--	--	--	--	
Organochlorine Pesticides	2,4-DDD	mg/kg	145	16	11%	0.0023	0.82	0.0017	0.18	--	--	--	--	--	--	--	--	--	
	2,4-DDE	mg/kg	167	68	41%	0.0019	16	0.0017	9.7	--	--	--	--	--	--	--	--	--	
	4,4-DDD	mg/kg	679	55	8%	0.0018	48	0.0005	20	2.4	2	23	0.8	5	39	--	--	--	
	4,4-DDE	mg/kg	679	449	66%	0.001	420	0.0005	0.31	1.7	81	0	3.0	71	0	--	--	--	
	4,4-DDT	mg/kg	679	342	50%	0.0012	220	0.00061	8.3	1.7	51	4	2.0	43	4	--	--	--	
	Aldrin	mg/kg	679	1	0.1%	0.004	0.004	0.00066	10.55	0.029	0	77	0.02	0	79	--	--	--	
	alpha-BHC	mg/kg	679	57	8%	0.00079	4.4	0.00076	10.55	0.090	16	49	0.00003	57	622	--	--	--	
	alpha-Chlordane	mg/kg	679	42	6%	0.003	0.53	0.00045	10.55	1.6	0	0	0.5	0	0	--	--	--	
	beta-BHC	mg/kg	679	265	39%	0.00082	3.1	0.00071	10.55	0.32	5	41	0.0001	265	414	--	--	--	
	Chlordane	mg/kg	469	6	1%	0.023	80	0.0017	240	1.6	0	0	0.5	0	0	--	--	--	
	delta-BHC	mg/kg	678	32	5%	0.0019	1.7	0.00044	10.55	--	--	--	--	--	--	--	--	--	
	Dieldrin	mg/kg	679	17	3%	0.0015	0.28	0.00058	14	0.030	3	82	0.0002	17	662	--	--	--	
	Endosulfan I	mg/kg	679	109	16%	0.00064	310	0.0005	1000	367	0	0	0.9	0	0	--	--	--	
	Endosulfan II	mg/kg	679	14	2%	0.002	0.46	0.00063	20	367	0	0	0.9	0	0	--	--	--	
	Endosulfan sulfate	mg/kg	679	7	1%	0.002	0.02	0.00053	20	--	--	--	--	--	--	--	--	--	
	Endrin	mg/kg	679	11	2%	0.0019	0.22	0.00056	20	18	0	1	0.05	1	74	--	--	--	
	Endrin aldehyde	mg/kg	679	18	3%	0.0018	0.019	0.0011	20	--	--	--	--	--	--	--	--	--	
	Endrin ketone	mg/kg	450	9	2%	0.0019	0.03	0.00053	10.55	--	--	--	--	--	--	--	--	--	
	gamma-BHC (Lindane)	mg/kg	679	22	3%	0.0013	19	0.00059	10.55	0.44	3	38	0.0005	22	657	--	--	--	
	gamma-Chlordane	mg/kg	679	48	7%	0.00089	22	0.00097	34	1.6	0	0	0.5	0	0	--	--	--	
	Heptachlor	mg/kg	676	8	1%	0.0037	1.6	0.0006	10.55	0.11	3	62	1.0	1	34	--	--	--	
	Heptachlor epoxide	mg/kg	679	6	1%	0.0026	0.065	0.00047	10.55	0.053	1	72	0.03	1	82	--	--	--	
	Methoxychlor	mg/kg	679	24	4%	0.0061	110	0.0013	370	306	0	1	8.0	2	25	--	--	--	
Toxaphene	mg/kg	679	0	0%	--	--	0.016	1000	0.44	0	98	2.0	0	74	--	--	--		
Polychlorinated Biphenyls	Aroclor 1016	mg/kg	332	0	0%	--	--	0.011	79	3.9	0	21	--	--	--	--	--	--	
	Aroclor 1221	mg/kg	332	0	0%	--	--	0.011	79	--	--	--	--	--	--	--	--	--	
	Aroclor 1232	mg/kg	332	0	0%	--	--	0.011	79	--	--	--	--	--	--	--	--	--	
	Aroclor 1242	mg/kg	332	0	0%	--	--	0.011	79	--	--	--	--	--	--	--	--	--	
	Aroclor 1248	mg/kg	332	0	0%	--	--	0.011	79	--	--	--	--	--	--	--	--	--	
	Aroclor 1254	mg/kg	332	12	4%	0.03	11	0.0094	79	0.22	5	36	--	--	--	--	--	--	

TABLE 4-4
SUMMARY OF SOILS INVESTIGATIONS - SURFACE SOILS (0-1 FT bgs)
BRC CLOSURE PLAN
(Page 4 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd	
Polychlorinated Biphenyls (Continued)	Aroclor 1260	mg/kg	332	7	2%	0.056	4.3	0.0094	79	--	--	--	--	--	--	--	--	--	
	PCB-77	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-81	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-105	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-114	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-118	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-123	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-126	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-156	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-157	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-167	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-169	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-189	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Polynuclear Aromatic Hydrocarbons	Acenaphthene	mg/kg	467	2	0.4%	0.53	6	0.041	5	3,682	0	0	29	0	0	--	--	--	
	Acenaphthylene	mg/kg	467	1	0.2%	0.38	0.38	0.03	5	--	--	--	--	--	--	--	--	--	
	Anthracene	mg/kg	467	1	0.2%	2.8	2.8	0.03	5	21,896	0	0	590	0	0	--	--	--	
	Benzo(a)anthracene	mg/kg	467	25	5%	0.034	5.8	0.015	5	0.62	1	125	0.08	14	414	--	--	--	
	Benzo(a)pyrene	mg/kg	467	5	1%	0.02	4.1	0.015	5	0.062	4	434	0.4	2	172	--	--	--	
	Benzo(b)fluoranthene	mg/kg	463	6	1%	0.018	4.3	0.015	5	0.62	1	136	0.2	3	429	--	--	--	
	Benzo(g,h,i)perylene	mg/kg	467	2	0.4%	0.062	2.1	0.03	5	--	--	--	--	--	--	--	--	--	
	Benzo(k)fluoranthene	mg/kg	451	2	0.4%	0.026	3.8	0.015	5	6.2	0	0	2.0	1	1	--	--	--	
	Chrysene	mg/kg	467	41	9%	0.021	5.3	0.015	5	62	0	0	8.0	0	0	--	--	--	
	Dibenzo(a,h)anthracene	mg/kg	467	1	0.2%	0.94	0.94	0.03	5	0.062	1	440	0.08	1	438	--	--	--	
	Indeno(1,2,3-cd)pyrene	mg/kg	467	3	1%	0.044	2.2	0.015	5	0.62	1	138	0.7	1	39	--	--	--	
	Phenanthrene	mg/kg	467	34	7%	0.054	18	0.03	5	--	--	--	--	--	--	--	--	--	
	Pyrene	mg/kg	467	34	7%	0.038	10	0.03	5	2,316	0	0	210	0	0	--	--	--	
Radionuclides	Gross alpha	pCi/g	24	22	92%	16.2	59	28.2	33.6	--	--	--	--	--	--	--	--	--	
	Gross beta	pCi/g	24	22	92%	20.5	53.4	35.7	39.5	--	--	--	--	--	--	--	--	--	
	Actinium-228	pCi/g	82	80	98%	0.8	12.1	1.4	1.68	732	0	0	--	--	--	3.4	5	0	
	Bismuth-212	pCi/g	71	24	34%	0.83	2.9	0.41	2.4	22,600	0	0	--	--	--	1.82	13	32	
	Bismuth-214	pCi/g	82	80	98%	0.65	35.6	0.76	0.82	8,190	0	0	--	--	--	1.62	9	0	
	Cobalt-57	pCi/g	33	7	21%	0.01	0.065	-0.021	0.046	8.7	0	0	8.4	0	0	0.08	0	0	
	Cobalt-60	pCi/g	33	4	12%	0.005	0.055	-0.032	0.18	0.036	2	11	0.12	0	2	0.164	0	1	
	Lead-210	pCi/g	71	2	3%	1.27	2.1	-0.9	3.5	0.15	2	66	0.0006	2	66	2.2	0	21	
	Lead-211	pCi/g	--	--	--	--	--	--	--	>100,000	--	--	>100,000	--	--	0.4	--	--	
	Lead-212	pCi/g	82	80	98%	0.85	11.9	1.4	1.56	3,640	0	0	>100,000	0	0	2.11	7	0	
	Lead-214	pCi/g	82	80	98%	0.56	43.3	0.87	0.99	46,300	0	0	>100,000	0	0	1.72	9	0	
	Potassium-40	pCi/g	82	80	98%	5.4	37	22	23.9	0.11	80	2	--	--	--	35	1	0	
	Thallium-208	pCi/g	82	80	98%	0.31	3.93	0.4	0.54	22,600	0	0	--	--	--	0.72	7	0	
	Thorium-227	pCi/g	--	--	--	--	--	--	--	113	--	--	3,340	--	--	0.4	--	--	
	Thorium-234	pCi/g	61	34	56%	1.1	39	0.13	1.5	1,330	0	0	4,130	0	0	2.5	10	0	
	Thorium-232	pCi/g	132	132	100%	0.79	10.81	--	--	3.1	5	--	0.30	132	--	--	2.23	13	--
	Thorium-228	pCi/g	139	139	100%	0.681	9.58	--	--	0.15	139	--	3.3	6	--	--	2.28	13	--
	Thorium-230	pCi/g	141	135	96%	0.367	46.7	1.08	1.56	3.5	11	0	0.30	135	6	3.01	11	0	
	Uranium-233/234	pCi/g	141	141	100%	0.151	33.3	--	--	4.0	3	--	112	0	--	2.84	6	--	
	Uranium 235/236	pCi/g	141	72	51%	0.004	2.7	-0.02	0.22	0.20	13	1	0.039	58	53	0.21	9	1	
	Uranium-238	pCi/g	139	139	100%	0.118	33.5	--	--	0.74	104	--	0.006	139	--	2.37	15	--	
	Radium-226	pCi/g	140	120	86%	-0.61	36.5	-1.75	4.11	0.012	119	19	0.016	119	19	2.36	18	1	
	Radium-228	pCi/g	139	139	100%	0.55	8.44	--	--	0.068	139	--	0.059	139	--	2.94	9	--	
	Actinium-227 (from Th-227)	pCi/g	--	--	--	--	--	--	--	0.10	--	--	--	--	--	0.4	--	--	
	Bismuth-210 (from Pb-210)	pCi/g	22	1	5%	1.27	1.27	-0.9	1.8	4,800	1	18	--	--	--	2.2	0	0	
Bismuth-211 (from Pb-211)	pCi/g	--	--	--	--	--	--	--	>100,000	--	--	--	--	--	0.4	--	--		
Polonium-210 (from Pb-210)	pCi/g	22	1	5%	1.27	1.27	-0.9	1.8	38	0	0	--	--	--	2.2	0	0		
Polonium-212 (from Bi-212)	pCi/g	22	12	55%	0.53	0.87	0.26	0.69	--	--	--	--	--	--	1.17	0	0		

TABLE 4-4
SUMMARY OF SOILS INVESTIGATIONS - SURFACE SOILS (0-1 FT bgs)
BRC CLOSURE PLAN
(Page 6 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd	
Semivolatile Organic Compounds (Continued)	Carbazole	mg/kg	414	0	0%	--	--	0.17	6.68	24	0	0	0.0	0	412	--	--	--	
	Dibenzofuran	mg/kg	414	0	0%	--	--	0.056	5	145	0	0	--	--	--	--	--	--	
	Dichloromethyl ether	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Diethyl phthalate	mg/kg	467	2	0.4%	0.083	0.14	0.041	5	48,882	0	0	--	--	--	--	--	--	
	Dimethyl phthalate	mg/kg	467	0	0%	--	--	0.025	5	100,000	0	0	--	--	--	--	--	--	--
	Di-n-butyl phthalate	mg/kg	467	8	2%	0.036	10	0.0625	5	6,110	0	0	270	0	0	--	--	--	--
	Di-n-octyl phthalate	mg/kg	467	1	0.2%	1.6	1.6	0.041	5	2,444	0	0	10,000	0	0	--	--	--	--
	Diphenyl disulfide	mg/kg	114	0	0%	--	--	0.33	1.7	--	--	--	--	--	--	--	--	--	--
	Diphenyl sulfide	mg/kg	114	0	0%	--	--	0.33	1.7	--	--	--	--	--	--	--	--	--	--
	Diphenyl sulfone	mg/kg	114	0	0%	--	--	0.33	1.7	183.3	0	0	--	--	--	--	--	--	--
	Fluoranthene	mg/kg	467	36	8%	0.036	16	0.051	5	2,294	0	0	210	0	0	--	--	--	--
	Fluorene	mg/kg	467	1	0.2%	1.3	1.3	0.057	5	2,747	0	0	28	0	0	--	--	--	--
	Hexachlorobenzene	mg/kg	467	78	17%	0.052	120	0.043	5	0.30	68	360	0.1	74	360	--	--	--	--
	Hexachlorobutadiene	mg/kg	470	3	1%	0.074	1.4	0.005	5	6.2	0	0	0.1	1	436	--	--	--	--
	Hexachlorocyclopentadiene	mg/kg	467	0	0%	--	--	0.031	8.3	365	0	0	20	0	0	--	--	--	--
	Hexachloroethane	mg/kg	467	0	0%	--	--	0.17	5	35	0	0	0.02	0	465	--	--	--	--
	Hydroxymethyl phthalimide	mg/kg	114	0	0%	--	--	0.33	1.7	--	--	--	--	--	--	--	--	--	--
	Isophorone	mg/kg	414	0	0%	--	--	0.033	5	512	0	0	0.03	0	412	--	--	--	--
	m,p-Cresol	mg/kg	467	1	0.2%	0.075	0.075	0.065	5	306	0	0	--	--	--	--	--	--	--
	Naphthalene	mg/kg	470	1	0.2%	2.1	2.1	0.005	5	56	0	0	4.0	0	1	--	--	--	--
	Nitrobenzene	mg/kg	467	0	0%	--	--	0.035	5	20	0	0	0.007	0	465	--	--	--	--
	N-nitrosodi-n-propylamine	mg/kg	467	1	0.2%	1	1	0.024	5	0.069	1	438	0.000002	1	464	--	--	--	--
	N-nitrosodiphenylamine	mg/kg	467	0	0%	--	--	0.17	5	99	0	0	0.06	0	465	--	--	--	--
	o-Cresol	mg/kg	467	0	0%	--	--	0.042	5	3,055	0	0	0.8	0	15	--	--	--	--
	Octachlorostyrene	mg/kg	92	0	0%	--	--	0.33	1.7	--	--	--	--	--	--	--	--	--	--
	p-Chloroaniline (4-Chloroaniline)	mg/kg	467	1	0.2%	1.2	1.2	0.17	10	244	0	0	0.03	1	464	--	--	--	--
	p-Chlorobenzenethiol	mg/kg	114	0	0%	--	--	0.33	1.7	--	--	--	--	--	--	--	--	--	--
	Pentachlorobenzene	mg/kg	167	24	14%	0.052	2.1	0.33	1.7	49	0	0	--	--	--	--	--	--	--
	Pentachlorophenol	mg/kg	467	4	1%	0.48	1.5	0.026	25	3.0	0	134	0.001	4	461	--	--	--	--
	Phenol	mg/kg	467	1	0.2%	0.12	0.12	0.059	5	18,331	0	0	5.0	0	0	--	--	--	--
	Phthalic acid	mg/kg	167	5	3%	0.082	3	0.33	8.3	61,103	0	0	--	--	--	--	--	--	--
	Pyridine	mg/kg	183	0	0%	--	--	0.5	5.1	61	0	0	--	--	--	--	--	--	--
Thiophenol	mg/kg	114	0	0%	--	--	0.33	1.7	--	--	--	--	--	--	--	--	--	--	
Tentatively Identified Compounds (TICs)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Volatile Organic Compounds	1,1,1,2-Tetrachloroethane	mg/kg	170	0	0%	--	--	0.0045	0.044	3.2	0	0	--	--	--	--	--	--	
	1,1,1-Trichloroethane	mg/kg	221	11	5%	0.00054	0.019	0.00044	0.044	1,200	0	0	0.1	0	1	--	--	--	
	1,1,2,2-Tetrachloroethane	mg/kg	221	0	0%	--	--	0.00044	0.044	0.41	0	0	0.0002	0	219	--	--	--	--
	1,1,2-Trichloroethane	mg/kg	221	0	0%	--	--	0.00043	0.044	0.73	0	0	0.0009	0	198	--	--	--	--
	1,1-Dichloroethane	mg/kg	221	0	0%	--	--	0.00038	0.044	506	0	0	1.0	0	0	--	--	--	--
	1,1-Dichloroethene	mg/kg	221	0	0%	--	--	0.0013	0.044	124	0	0	0.003	0	198	--	--	--	--
	1,1-Dichloropropene	mg/kg	117	0	0%	--	--	0.0045	0.0086	--	--	--	--	--	--	--	--	--	--
	1,2,3-Trichlorobenzene	mg/kg	117	0	0%	--	--	0.0045	0.0086	--	--	--	--	--	--	--	--	--	--
	1,2,3-Trichloropropane	mg/kg	170	0	0%	--	--	0.0045	0.044	0.034	0	5	--	--	--	--	--	--	--
	1,2,4-Trichlorobenzene	mg/kg	470	18	4%	0.0011	6.2	0.0045	5	62	0	0	0.3	13	260	--	--	--	--
	1,2,4-Trimethylbenzene	mg/kg	117	7	6%	0.00034	0.001	0.0046	0.0086	52	0	0	--	--	--	--	--	--	--
	1,2-Dichlorobenzene	mg/kg	442	23	5%	0.00033	4.8	0.0045	5	600	0	0	0.9	5	7	--	--	--	--
	1,2-Dichloroethane	mg/kg	221	3	1%	0.0013	0.0086	0.00043	0.044	0.28	0	1	0.001	3	195	--	--	--	--
	1,2-Dichloroethene	mg/kg	111	1	1%	0.0027	0.0027	0.005	0.017	--	--	--	--	--	--	--	--	--	--
	1,2-Dichloropropane	mg/kg	221	2	1%	0.00083	0.0061	0.00021	0.044	0.34	0	1	0.001	1	196	--	--	--	--
	1,3,5-Trichlorobenzene	mg/kg	114	0	0%	--	--	0.0045	0.053	--	--	--	--	--	--	--	--	--	--
	1,3,5-Trimethylbenzene	mg/kg	117	0	0%	--	--	0.0045	0.0086	21	--	0	--	--	--	--	--	--	--
	1,3-Dichlorobenzene	mg/kg	442	2	0.5%	0.00047	2	0.0045	5	531	0	0	--	--	--	--	--	--	--
	1,3-Dichloropropene (see cis-, trans-)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	1,3-Dichloropropane	mg/kg	117	0	0%	--	--	0.0045	0.0086	105	0	0	--	--	--	--	--	--	--

TABLE 4-4
SUMMARY OF SOILS INVESTIGATIONS - SURFACE SOILS (0-1 FT bgs)
BRC CLOSURE PLAN
(Page 8 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd
Volatile Organic Compounds (Continued)	o-Xylene	mg/kg	145	9	6%	0.0004	0.036	0.0045	0.0095	--	--	--	--	--	--	--	--	--
	sec-Butylbenzene	mg/kg	117	0	0%	--	--	0.0045	0.0086	220	0	0	--	--	--	--	--	--
	Styrene	mg/kg	168	0	0%	--	--	0.00037	0.0095	1,700	0	0	0.2	0	0	--	--	--
	tert-Butylbenzene	mg/kg	117	0	0%	--	--	0.0045	0.0086	390	0	0	--	--	--	--	--	--
	Tetrachloroethene	mg/kg	226	18	8%	0.00022	0.014	0.00036	0.044	0.48	0	0	0.003	6	180	--	--	--
	Toluene	mg/kg	226	55	24%	0.00053	0.09	0.00056	0.044	520	0	0	0.6	0	0	--	--	--
	trans-1,2-Dichloroethene	mg/kg	129	0	0%	--	--	0.00032	0.044	69	0	0	0.03	0	6	--	--	--
	trans-1,3-Dichloropropene	mg/kg	221	0	0%	--	--	0.00031	0.044	0.78	0	0	0.0002	0	0	--	--	--
	Trichloroethene	mg/kg	221	55	25%	0.00023	0.13	0.00031	0.044	0.053	1	0	0.003	26	143	--	--	--
	Vinyl acetate	mg/kg	165	0	0%	--	--	0.00053	0.019	426	0	0	8.0	0	0	--	--	--
	Vinyl chloride	mg/kg	221	0	0%	--	--	0.00079	0.044	0.079	0	1	0.0007	0	221	--	--	--
	Xylenes (total)	mg/kg	195	14	7%	0.0014	0.082	0.0011	0.088	271	0	0	10	0	0	--	--	--
	Tentatively Identified Compounds (TICs)		mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Water Quality Parameters	Conductivity	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Hardness, total	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Total dissolved solids	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Total suspended solids	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Alkalinity, Total (as CaCO ₃)	mg/kg	11	9	82%	25	440	25	25	--	--	--	--	--	--	--	--	--
	Bicarbonate alkalinity	mg/kg	42	40	95%	25	464	--	--	--	--	--	--	--	--	--	--	--
	Carbonate alkalinity	mg/kg	42	10	24%	5	36	25	25	--	--	--	--	--	--	--	--	--
Hydroxide alkalinity	mg/kg	11	0	0%	--	--	--	--	--	--	--	--	--	--	--	--	--	
Flashpoint	Flammables	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons	Diesel	mg/kg	92	0	0%	--	--	25	5200	--	--	--	--	--	--	--	--	--
	Gasoline	mg/kg	92	2	2%	0.16	95	0.1	26	--	--	--	--	--	--	--	--	--
	Grease	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Mineral Spirits	mg/kg	92	0	0%	--	--	25	5200	--	--	--	--	--	--	--	--	--
White Phosphorus	White phosphorus	mg/kg	--	--	--	--	--	--	--	1.6	--	--	--	--	--	--	--	--
Methyl Mercury	Methyl mercury	mg/kg	--	--	--	--	--	--	--	6.1	--	--	--	--	--	--	--	--

a - Range of detections include estimated values of detect results between the detection limit and reporting limit. As such some minimum detected concentrations may be below the minimum reporting limit. In these cases the respective sample results are flagged in the data set.

b - The quantitation limits shown include samples which had detections. For screening purposes, the detection limit was used for comparison to the screening levels.

c - From USEPA Region 9 preliminary remediation goals (PRG) table, October 2004 (and the 2007 USEPA radionuclide PRG webpage; <http://epa-prgs.ornl.gov/radionuclides>). Values used are residential soil PRGs.

d - From USEPA Region 9 preliminary remediation goals (PRG) table, October 2004 (and the 2007 USEPA radionuclide PRG webpage; <http://epa-prgs.ornl.gov/radionuclides>). Value used is the soil screening level with a dilution attenuation factor of 1.

e - Values used are the maximum from the provisional soils background data set presented in the Background Shallow Soil Summary Report, BMI Complex and Common Area Vicinity (BRC/TIMET 2007, currently in review by the NDEP).

f - Agency for Toxic Substances and Disease Registry (ATSDR) screening value of 50 parts per trillion (ppt).

SSL = soil screening level.

DAF = dilution attenuation factor.

-- = Not applicable or no value has been established.

TABLE 4-5
SUMMARY OF SOILS INVESTIGATIONS - NEAR-SURFACE SOILS (1-15 FT bgs)
BRC CLOSURE PLAN
(Page 1 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd
Ions	Bromide	mg/kg	17	4	24%	1.7	3.7	2.5	132	--	--	--	--	--	--	--	--	--
	Bromine	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Chlorate	mg/kg	115	63	55%	0.0044	76	0.003	2.2	--	--	--	--	--	--	--	--	--
	Chloride	mg/kg	131	131	100%	1.1	10700	--	--	--	--	--	--	--	--	1110	46	--
	Chlorine (soluble)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Chlorite	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Fluoride	mg/kg	17	16	94%	0.18	6.9	1	1	3,666	0	0	--	--	--	2.5	5	0
	Nitrate (as N)	mg/kg	17	16	94%	0.79	37.6	21	21	--	--	--	--	--	--	102	0	0
	Nitrite (as N)	mg/kg	17	4	24%	0.25	0.73	0.2	2.1	--	--	--	--	--	--	0.21	4	3
	Orthophosphate	mg/kg	17	4	24%	0.81	2.8	5.1	5.4	--	--	--	--	--	--	--	--	--
	Sulfate	mg/kg	41	41	100%	12.8	3060	--	--	--	--	--	--	--	--	4130	0	--
	Sulfite	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perchlorate	mg/kg	134	124	93%	0.0282	96.9	0.04	0.054	7.8	10	0	--	--	--	--	--	--	
Dissolved Gases	Ethane	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Ethylene	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Methane	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chlorinated Compounds	Chloral	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Dichloroacetaldehyde	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PCDDs/PCDFs	OCDF	mg/kg	48	14	29%	5.3 E-6	1.0 E-3	2.3 E-7	4.6 E-6	--	--	--	--	--	--	--	--	--
	OCDD	mg/kg	48	12	25%	5.5 E-6	1.1 E-4	5.0 E-7	5.4 E-6	--	--	--	--	--	--	--	--	--
	1,2,3,4,6,7,8-HpCDF	mg/kg	48	10	21%	3.2 E-6	3.5 E-4	1.1 E-7	1.9 E-6	--	--	--	--	--	--	--	--	--
	1,2,3,4,6,7,8-HpCDD	mg/kg	48	5	10%	3.2 E-6	3.6 E-5	1.7 E-7	2.7 E-6	--	--	--	--	--	--	--	--	--
	1,2,3,4,7,8,9-HpCDF	mg/kg	48	6	13%	3.1 E-6	1.2 E-4	1.4 E-7	1.8 E-6	--	--	--	--	--	--	--	--	--
	1,2,3,4,7,8-HxCDF	mg/kg	48	7	15%	2.8 E-6	1.2 E-4	1.4 E-7	2.8 E-6	--	--	--	--	--	--	--	--	--
	1,2,3,4,7,8-HxCDD	mg/kg	48	1	2%	5.2 E-6	5.2 E-6	8.5 E-8	1.5 E-6	--	--	--	--	--	--	--	--	--
	1,2,3,6,7,8-HxCDF	mg/kg	48	6	13%	3.1 E-6	8.2 E-5	7.8 E-8	1.5 E-6	--	--	--	--	--	--	--	--	--
	1,2,3,6,7,8-HxCDD	mg/kg	48	3	6%	3.4 E-6	9.2 E-6	8.7 E-8	2.1 E-6	--	--	--	--	--	--	--	--	--
	1,2,3,7,8,9-HxCDF	mg/kg	48	3	6%	3.4 E-6	1.3 E-5	8.0 E-8	2.3 E-6	--	--	--	--	--	--	--	--	--
	1,2,3,7,8,9-HxCDD	mg/kg	48	3	6%	3.1 E-6	8.8 E-6	8.4 E-8	1.7 E-6	--	--	--	--	--	--	--	--	--
	1,2,3,7,8-PeCDF	mg/kg	48	5	10%	2.9 E-6	7.2 E-5	1.3 E-7	1.8 E-6	--	--	--	--	--	--	--	--	--
	1,2,3,7,8-PeCDD	mg/kg	48	1	2%	6.3 E-6	6.3 E-6	7.4 E-8	1.5 E-6	--	--	--	--	--	--	--	--	--
	2,3,4,6,7,8-HxCDF	mg/kg	48	4	8%	5.0 E-6	2.1 E-5	7.2 E-8	1.5 E-6	--	--	--	--	--	--	--	--	--
	2,3,4,7,8-PeCDF	mg/kg	48	4	8%	7.2 E-6	3.8 E-5	8.4 E-8	1.6 E-6	--	--	--	--	--	--	--	--	--
	2,3,7,8-TCDF	mg/kg	48	9	19%	5.3 E-7	2.8 E-5	5.2 E-8	6.8 E-7	--	--	--	--	--	--	--	--	--
	2,3,7,8-TCDD	mg/kg	48	1	2%	1.7 E-6	1.7 E-6	4.0 E-8	5.1 E-7	3.9 E-6	0	0	--	--	--	--	--	--
	TCDD TEQ	mg/kg	48	15	31%	6.6 E-7	6.4 E-5	3.0 E-7	2.5 E-6	5.0 E-5 ^f	1	0	--	--	--	--	--	--
	Asbestos	Asbestos fibers	fibers	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
General Chemistry Parameters	Ammonia (as N)	mg/kg	17	0	0%	--	--	0.51	0.54	--	--	--	--	--	--	--	--	--
	Cyanide (Total)	mg/kg	199	7	4%	0.27	2.5	0.13	0.65	1,222	0	0	--	--	--	--	--	--
	Iodine	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	pH in soil	SU	117	117	100%	2.02	12	--	--	--	--	--	--	--	--	--	--	--
	pH in water	SU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Sulfide	mg/kg	17	0	0%	--	--	10.1	10.8	--	--	--	--	--	--	--	--	--
	Total inorganic carbon	mg/kg	19	19	100%	3020	26400	--	--	--	--	--	--	--	--	--	--	--
	Total Kjeldahl nitrogen (TKN)	mg/kg	17	6	35%	49.3	213	2.5	2.7	--	--	--	--	--	--	--	--	--
	Total organic carbon (TOC)	mg/kg	28	19	68%	500	3650	500	577	--	--	--	--	--	--	--	--	--
Metals	Aluminum	mg/kg	289	289	100%	5150	17000	--	--	76,142	0	--	--	--	--	15300	1	--
	Antimony	mg/kg	341	188	55%	0.1	290	0.1	1.3	31	5	0	0.30	65	119	0.5	54	109
	Arsenic	mg/kg	447	399	89%	0.65	219	1	22	0.39	399	48	1.0	397	47	7.2	88	16
	Barium	mg/kg	443	442	100%	9.4	15200	38	38	5,375	5	0	82	430	0	836	21	0
	Beryllium	mg/kg	327	324	99%	0.2	11.1	0.42	0.56	154	0	0	3.0	3	0	0.89	20	0
	Boron	mg/kg	197	85	43%	3.1	26.3	5.1	27.6	16,000	0	0	--	--	--	11.6	17	107
	Cadmium	mg/kg	426	301	71%	0.05	3.8	0.2	12	37	0	0	0.40	23	118	0.1291	123	125
	Calcium	mg/kg	290	290	100%	53.9	77700	--	--	--	--	--	--	--	--	82800	0	--

TABLE 4-5
SUMMARY OF SOILS INVESTIGATIONS - NEAR-SURFACE SOILS (1-15 FT bgs)
BRC CLOSURE PLAN
(Page 2 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd
Metals (Continued)	Chromium	mg/kg	447	436	98%	1.2	2080	21	24	100,000	0	0	--	--	--	16.7	79	11
	Cobalt	mg/kg	259	251	97%	2.4	230	5.1	6.3	903	0	0	--	--	--	16.3	6	0
	Copper	mg/kg	332	332	100%	5.8	508.9	--	--	3,129	0	--	--	--	--	30.5	19	--
	Iron	mg/kg	308	308	100%	7220	25800	--	--	23,463	4	--	--	--	--	19700	63	--
	Lead	mg/kg	447	447	100%	0.65	8320	--	--	400	13	--	--	--	--	35.1	46	--
	Lithium	mg/kg	197	196	99%	7.9	36.6	8.4	8.4	1,564	0	0	--	--	--	26.5	5	0
	Magnesium	mg/kg	377	377	100%	39.2	15700	--	--	--	--	--	--	--	--	17500	0	--
	Manganese	mg/kg	365	365	100%	105	25000	--	--	1,762	14	--	--	--	--	1090	23	--
	Molybdenum	mg/kg	289	275	95%	0.16	110	0.3	5.2	391	0	0	--	--	--	2	10	10
	Nickel	mg/kg	331	331	100%	6.6	164.3	--	--	1,564	0	--	7.0	329	--	30	12	--
	Niobium	mg/kg	197	60	30%	0.81	18.6	1.5	13.8	--	--	--	--	--	--	2.8	22	131
	Palladium	mg/kg	197	197	100%	0.25	2.3	--	--	--	--	--	--	--	--	1.5	4	--
	Phosphorus	mg/kg	197	197	100%	429	2840	--	--	--	--	--	--	--	--	2010	2	--
	Platinum	mg/kg	197	2	1%	0.039	0.049	0.1	0.28	--	--	--	--	--	--	0.099	0	195
	Potassium	mg/kg	266	262	98%	13.7	4480	50	530	--	--	--	--	--	--	3890	4	0
	Selenium	mg/kg	443	98	22%	0.08	2.5	0.5	12	391	0	0	0.30	40	345	0.6	14	291
	Silicon	mg/kg	197	197	100%	116	2210	--	--	--	--	--	--	--	--	4150	0	--
	Silver	mg/kg	443	263	59%	0.03	30.6	0.067	24	391	0	0	2.0	11	66	0.2609	34	156
	Sodium	mg/kg	290	290	100%	145	3150	--	--	--	--	--	--	--	--	1320	16	--
	Strontium	mg/kg	197	197	100%	92.2	814	--	--	46,924	0	--	--	--	--	808	1	--
	Sulfur	mg/kg	180	170	94%	220	8060	508	551	--	--	--	--	--	--	--	--	--
	Thallium	mg/kg	311	86	28%	0.04	330	0.1	6.5	5.2	8	31	--	--	--	1.8	13	34
	Tin	mg/kg	197	192	97%	0.23	4	0.25	1	46,924	0	0	--	--	--	0.8	9	2
	Titanium	mg/kg	284	283	100%	270	1280	542	542	100,000	0	0	--	--	--	1010	8	0
	Tungsten	mg/kg	197	173	88%	0.23	5.4	0.19	1.4	--	--	--	--	--	--	2.5	1	0
	Uranium	mg/kg	197	197	100%	0.48	1.9	--	--	16	0	--	--	--	--	2.7	0	--
	Vanadium	mg/kg	435	435	100%	3.1	4100	--	--	78	34	--	300	17	--	59.1	59	--
Zinc	mg/kg	301	299	99%	17	190	5	35.1	23,463	0	0	620	0	0	121	2	0	
Zirconium	mg/kg	197	197	100%	3	113	--	--	--	--	--	--	--	--	179	0	--	
Chromium (VI)	mg/kg	308	19	6%	0.006	29	0.005	0.44	30	0	0	2.0	5	0	0.32	7	195	
Mercury	mg/kg	258	64	25%	0.0083	1.3	0.0074	0.98	23	0	0	--	--	--	0.11	19	9	
Organo-phosphorous Pesticides	Azinphos-ethyl	mg/kg	75	0	0%	--	--	0.033	0.1385	--	--	--	--	--	--	--	--	--
	Azinphos-methyl	mg/kg	104	0	0%	--	--	0.0042	0.1385	--	--	--	--	--	--	--	--	--
	Carbophenothion	mg/kg	75	0	0%	--	--	0.033	0.1385	--	--	--	--	--	--	--	--	--
	Chlorpyrifos	mg/kg	104	1	1%	0.0018	0.0018	0.003	0.1385	183	0	0	--	--	--	--	--	--
	Coumaphos	mg/kg	104	0	0%	--	--	0.0025	0.1385	--	--	--	--	--	--	--	--	--
	Demeton-O	mg/kg	75	0	0%	--	--	0.013	0.1385	2.4	0	0	--	--	--	--	--	--
	Demeton-S	mg/kg	75	0	0%	--	--	0.013	0.1385	2.4	0	0	--	--	--	--	--	--
	Diazinon	mg/kg	104	0	0%	--	--	0.002	0.1385	55	0	0	--	--	--	--	--	--
	Dichlorvos	mg/kg	104	2	2%	0.0021	0.011	0.0045	0.1385	1.7	0	0	--	--	--	--	--	--
	Dimethoate	mg/kg	104	0	0%	--	--	0.0038	0.1385	12	0	0	--	--	--	--	--	--
	Disulfoton	mg/kg	104	1	1%	0.0057	0.0057	0.0021	0.1385	2.4	0	0	--	--	--	--	--	--
	EPN	mg/kg	75	0	0%	--	--	0.013	0.1385	0.61	0	0	--	--	--	--	--	--
	Ethoprop	mg/kg	104	0	0%	--	--	0.0012	0.1385	--	--	--	--	--	--	--	--	--
	Ethyl parathion	mg/kg	104	0	0%	--	--	0.0015	0.1385	367	0	0	--	--	--	--	--	--
	Famphur	mg/kg	104	0	0%	--	--	0.0026	0.1385	--	--	--	--	--	--	--	--	--
	Fenthion	mg/kg	104	1	1%	0.0065	0.0065	0.0059	0.1385	--	--	--	--	--	--	--	--	--
	Malathion	mg/kg	104	2	2%	0.0018	0.0075	0.0051	0.1385	1,222	0	0	--	--	--	--	--	--
	Methyl carbophenothion	mg/kg	17	0	0%	--	--	0.033	0.07	--	--	--	--	--	--	--	--	--
	Methyl parathion	mg/kg	104	0	0%	--	--	0.005	0.1385	15	0	0	--	--	--	--	--	--
	Mevinphos	mg/kg	104	1	1%	0.0049	0.0049	0.0035	0.1385	--	--	--	--	--	--	--	--	--
Naled	mg/kg	104	0	0%	--	--	0.033	0.1385	122	0	0	--	--	--	--	--	--	

TABLE 4-5
SUMMARY OF SOILS INVESTIGATIONS - NEAR-SURFACE SOILS (1-15 FT bgs)
BRC CLOSURE PLAN
(Page 3 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd	
Organo-phosphorous Pesticides (Continued)	O,O,O-Triethyl phosphorothioate (TEPP)	mg/kg	46	0	0%	--	--	0.0022	0.028	--	--	--	--	--	--	--	--	--	
	Phorate	mg/kg	104	1	1%	0.0076	0.0076	0.0023	0.1385	12	0	0	--	--	--	--	--	--	
	Phosmet	mg/kg	75	0	0%	--	--	0.068	0.14	1,222	0	0	--	--	--	--	--	--	
	Ronnel	mg/kg	104	1	1%	0.0058	0.0058	0.0039	0.14	3,055	0	0	--	--	--	--	--	--	
	Stirophos (Tetrachlorovinphos)	mg/kg	104	1	1%	--	--	0.0027	0.1385	20	0	0	--	--	--	--	--	--	
	Sulfotep	mg/kg	104	3	3%	0.0013	0.0042	0.002	0.1385	31	0	0	--	--	--	--	--	--	--
Chlorinated Herbicides	2,4,5-T	mg/kg	17	0	0%	--	--	0.02	0.022	611	0	0	--	--	--	--	--	--	
	2,4,5-TP (Silvex)	mg/kg	17	0	0%	--	--	0.02	0.022	489	0	0	--	--	--	--	--	--	
	2,4-D	mg/kg	17	0	0%	--	--	0.081	0.086	686	0	0	--	--	--	--	--	--	
	2,4-DB	mg/kg	17	0	0%	--	--	0.081	0.086	489	0	0	--	--	--	--	--	--	
	Dalapon	mg/kg	17	0	0%	--	--	0.04	0.043	1,833	0	0	--	--	--	--	--	--	
	Dicamba	mg/kg	17	0	0%	--	--	0.04	0.043	1,833	0	0	--	--	--	--	--	--	--
	Dichloroprop	mg/kg	17	0	0%	--	--	0.081	0.086	--	--	--	--	--	--	--	--	--	--
	Dinoseb	mg/kg	17	0	0%	--	--	0.012	0.027	61	0	0	--	--	--	--	--	--	--
	MCPA	mg/kg	17	0	0%	--	--	8.1	8.6	31	0	0	--	--	--	--	--	--	--
	MCPP	mg/kg	--	--	--	--	--	--	--	61	--	--	--	--	--	--	--	--	--
Organic Acids	4-Chlorobenzene sulfonic acid	mg/kg	17	0	0%	--	--	1	1	--	--	--	--	--	--	--	--	--	
	Benzenesulfonic acid	mg/kg	17	0	0%	--	--	1	1	--	--	--	--	--	--	--	--	--	
	O,O-Diethylphosphorodithioic acid	mg/kg	17	0	0%	--	--	1	1	--	--	--	--	--	--	--	--	--	
	O,O-Dimethylphosphorodithioic acid	mg/kg	17	0	0%	--	--	1	5	--	--	--	--	--	--	--	--	--	
Nonhalogenated Organics	Ethylene glycol	mg/kg	17	1	6%	64	64	51	530	100,000	0	0	--	--	--	--	--	--	
	Ethylene glycol monobutyl ether	mg/kg	--	--	--	--	--	--	--	30,552	--	--	--	--	--	--	--	--	
	Methanol	mg/kg	17	0	0%	--	--	51	54	30,552	0	0	--	--	--	--	--	--	
	Propylene glycol	mg/kg	17	0	0%	--	--	51	530	30,034	0	0	--	--	--	--	--	--	
Organochlorine Pesticides	2,4-DDD	mg/kg	181	0	0%	--	--	0.0017	0.018	--	--	--	--	--	--	--	--	--	
	2,4-DDE	mg/kg	198	10	5%	0.0019	0.1	0.0017	0.018	--	--	--	--	--	--	--	--	--	
	4,4-DDD	mg/kg	441	11	2%	0.0018	4.1	0.00065	8	2.4	1	5	0.8	1	7	--	--	--	
	4,4-DDE	mg/kg	441	125	28%	0.00091	96	0.0009	0.33	1.7	12	0	3.0	11	0	--	--	--	
	4,4-DDT	mg/kg	442	74	17%	0.0015	82	0.00071	0.33	1.7	8	0	2.0	8	0	--	--	--	
	Aldrin	mg/kg	440	0	0%	--	--	0.00067	5	0.029	0	21	0.02	0	21	--	--	--	
	alpha-BHC	mg/kg	442	19	4%	0.00069	3.1	0.00078	5	0.090	2	12	0.00003	19	423	--	--	--	
	alpha-Chlordane	mg/kg	441	8	2%	0.0024	0.11	0.00046	5	1.6	0	0	0.5	0	0	--	--	--	
	beta-BHC	mg/kg	441	59	13%	0.00075	0.91	0.00074	5	0.32	1	9	0.0001	59	382	--	--	--	
	Chlordane	mg/kg	345	0	0%	--	--	0.005	97	1.6	0	0	0.5	0	0	--	--	--	
	delta-BHC	mg/kg	440	8	2%	0.0007	0.013	0.00045	5	--	--	--	--	--	--	--	--	--	
	Dieldrin	mg/kg	441	5	1%	0.003	0.7	0.00059	6.5	0.030	1	21	0.0002	5	436	--	--	--	
	Endosulfan I	mg/kg	440	63	14%	0.00075	89	0.00051	5	367	0	0	0.9	0	0	--	--	--	
	Endosulfan II	mg/kg	441	5	1%	0.0022	0.017	0.00064	8	367	0	0	0.9	0	0	--	--	--	
	Endosulfan sulfate	mg/kg	441	1	0.2%	0.0063	0.0063	0.00054	8	--	--	--	--	--	--	--	--	--	
	Endrin	mg/kg	441	3	1%	0.0059	0.72	0.00057	8	18	0	0	0.05	1	19	--	--	--	
	Endrin aldehyde	mg/kg	441	3	1%	0.0022	0.01	0.0012	8	--	--	--	--	--	--	--	--	--	
	Endrin ketone	mg/kg	332	2	1%	0.0039	0.0099	0.00054	0.1	--	--	--	--	--	--	--	--	--	
	gamma-BHC (Lindane)	mg/kg	440	7	2%	0.0044	0.0094	0.0006	5	0.44	0	8	0.0005	7	433	--	--	--	
	gamma-Chlordane	mg/kg	441	21	5%	0.0011	5	0.00098	5	1.6	0	0	0.5	0	0	--	--	--	
	Heptachlor	mg/kg	440	3	1%	0.063	3.1	0.00061	5	0.11	1	12	1.0	1	5	--	--	--	
	Heptachlor epoxide	mg/kg	441	2	0.5%	0.0019	0.0055	0.00048	5	0.053	0	15	0.03	0	21	--	--	--	
	Methoxychlor	mg/kg	441	11	2%	0.0054	42	0.0013	41	306	0	0	8.0	1	5	--	--	--	
Toxaphene	mg/kg	440	0	0%	--	--	0.016	410	0.44	0	22	2.0	0	16	--	--	--		
Polychlorinated Biphenyls	Aroclor 1016	mg/kg	238	0	0%	--	--	0.0015	31	3.9	0	5	--	--	--	--	--	--	
	Aroclor 1221	mg/kg	238	0	0%	--	--	0.0015	31	--	--	--	--	--	--	--	--	--	
	Aroclor 1232	mg/kg	238	0	0%	--	--	0.0015	31	--	--	--	--	--	--	--	--	--	
	Aroclor 1242	mg/kg	238	0	0%	--	--	0.0015	31	--	--	--	--	--	--	--	--	--	
	Aroclor 1248	mg/kg	238	0	0%	--	--	0.0015	31	--	--	--	--	--	--	--	--	--	
	Aroclor 1254	mg/kg	238	1	0.4%	0.04	0.04	0.0015	31	0.22	0	16	--	--	--	--	--	--	

TABLE 4-5
SUMMARY OF SOILS INVESTIGATIONS - NEAR-SURFACE SOILS (1-15 FT bgs)
BRC CLOSURE PLAN
(Page 4 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd
Polychlorinated Biphenyls (Continued)	Aroclor 1260	mg/kg	238	2	1%	0.025	0.34	0.0095	31	--	--	--	--	--	--	--	--	--
	PCB-77	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-81	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-105	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-114	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-118	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-123	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-126	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-156	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-157	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-167	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-169	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-189	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Polynuclear Aromatic Hydrocarbons	Acenaphthene	mg/kg	349	0	0%	--	--	0.042	8	3,682	0	0	29	0	0	--	--	--
	Acenaphthylene	mg/kg	349	0	0%	--	--	0.031	8	--	--	--	--	--	--	--	--	--
	Anthracene	mg/kg	349	0	0%	--	--	0.03	8	21,896	0	0	590	0	0	--	--	--
	Benzo(a)anthracene	mg/kg	351	2	1%	0.017	0.18	0.015	8	0.62	0	61	0.08	1	319	--	--	--
	Benzo(a)pyrene	mg/kg	351	1	0.3%	0.034	0.034	0.015	8	0.062	0	320	0.4	0	71	--	--	--
	Benzo(b)fluoranthene	mg/kg	347	2	1%	0.039	0.24	0.015	8	0.62	0	61	0.2	1	315	--	--	--
	Benzo(g,h,i)perylene	mg/kg	349	0	0%	--	--	0.03	8	--	--	--	--	--	--	--	--	--
	Benzo(k)fluoranthene	mg/kg	345	0	0%	--	--	0.015	8	6.2	0	1	2.0	0	6	--	--	--
	Chrysene	mg/kg	351	3	1%	0.037	0.77	0.015	8	62	0	0	8.0	0	0	--	--	--
	Dibenzo(a,h)anthracene	mg/kg	349	0	0%	--	--	0.03	8	0.062	0	320	0.08	0	319	--	--	--
	Indeno(1,2,3-cd)pyrene	mg/kg	349	1	0.3%	0.022	0.022	0.015	8	0.62	0	60	0.7	0	27	--	--	--
	Phenanthrene	mg/kg	351	2	1%	0.38	1.2	0.03	8	--	--	--	--	--	--	--	--	--
	Pyrene	mg/kg	351	3	1%	0.067	0.77	0.03	8	2,316	0	0	210	0	0	--	--	--
Radionuclides	Gross alpha	pCi/g	17	15	88%	23.9	42.5	34	37.1	--	--	--	--	--	--	--	--	--
	Gross beta	pCi/g	17	16	94%	34.2	49.1	37.7	37.7	--	--	--	--	--	--	--	--	--
	Actinium-228	pCi/g	58	56	97%	0.9	2.31	1.22	1.76	732	0	0	--	--	--	3.4	0	0
	Bismuth-212	pCi/g	47	8	17%	0.74	1.32	0.36	2.4	22,600	0	0	--	--	--	1.82	0	27
	Bismuth-214	pCi/g	58	56	97%	0.46	3.7	0.65	0.75	8,190	0	0	--	--	--	1.62	3	0
	Cobalt-57	pCi/g	28	4	14%	0.004	0.013	-0.021	0.034	8.7	0	0	8.4	0	0	0.08	0	0
	Cobalt-60	pCi/g	28	8	29%	0.002	0.06	-0.065	0.053	0.036	1	4	0.12	0	0	0.164	0	0
	Lead-210	pCi/g	47	1	2%	0.86	0.86	-0.092	3.1	0.15	1	44	0.0006	1	45	2.2	0	21
	Lead-211	pCi/g	--	--	--	--	--	--	--	>100,000	--	--	>100,000	--	--	0.4	--	--
	Lead-212	pCi/g	58	56	97%	0.82	1.85	1.33	1.35	3,640	0	0	>100,000	0	0	2.11	0	0
	Lead-214	pCi/g	58	56	97%	0.65	4.8	0.74	0.91	46,300	0	0	>100,000	0	0	1.72	3	0
	Potassium-40	pCi/g	58	56	97%	19.8	33.8	24.5	24.8	0.11	56	2	--	--	--	35	0	0
	Thallium-208	pCi/g	58	56	97%	0.33	0.624	0.39	0.5	22,600	0	0	--	--	--	0.72	0	0
	Thorium-227	pCi/g	--	--	--	--	--	--	--	113	--	--	3,340	--	--	0.4	--	--
	Thorium-234	pCi/g	58	28	48%	0.79	3.3	0.38	1.5	1,330	0	0	4,130	0	0	2.5	4	0
	Thorium-232	pCi/g	65	65	100%	0.82	2.08	--	--	3.1	0	--	0.30	65	--	2.23	0	--
	Thorium-228	pCi/g	66	66	100%	1.15	2.46	--	--	0.15	66	--	3.3	0	--	2.28	1	--
	Thorium-230	pCi/g	66	63	95%	0.75	23.9	0.93	1.21	3.5	6	0	0.30	63	3	3.01	6	0
	Uranium-233/234	pCi/g	66	66	100%	0.55	18.8	--	--	4.0	3	--	112	0	--	2.84	4	--
	Uranium 235/236	pCi/g	66	41	62%	0.041	1.06	0.002	0.4	0.20	5	1	0.039	41	16	0.21	2	1
	Uranium-238	pCi/g	66	65	98%	0.66	17.4	--	--	0.74	58	0	0.006	65	0	2.37	6	0
	Radium-226	pCi/g	66	59	89%	0.03	6.06	0.25	1.32	0.012	59	7	0.016	59	7	2.36	10	0
	Radium-228	pCi/g	66	65	98%	0.2	101	-0.22	-0.22	0.068	65	--	0.059	65	--	2.94	1	0
	Actinium-227 (from Th-227)	pCi/g	--	--	--	--	--	--	--	0.10	--	--	--	--	--	0.4	--	--
	Bismuth-210 (from Pb-210)	pCi/g	17	1	6%	0.86	0.86	-0.092	1.9	4,800	1	14	--	--	--	2.2	0	0
	Bismuth-211 (from Pb-211)	pCi/g	--	--	--	--	--	--	--	>100,000	--	--	--	--	--	0.4	--	--
Polonium-210 (from Pb-210)	pCi/g	17	1	6%	0.86	0.86	-0.092	1.9	38	0	0	--	--	--	2.2	0	0	
Polonium-212 (from Bi-212)	pCi/g	17	8	47%	0.47	0.84	0.23	0.68	--	--	--	--	--	--	1.17	0	0	

TABLE 4-5
SUMMARY OF SOILS INVESTIGATIONS - NEAR-SURFACE SOILS (1-15 FT bgs)
BRC CLOSURE PLAN
(Page 6 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd
Semivolatile Organic Compounds (Continued)	Carbazole	mg/kg	349	0	0%	--	--	0.17	8	24	0	0	0.0	0	344	--	--	--
	Dibenzofuran	mg/kg	349	0	0%	--	--	0.057	8	145	0	0	--	--	--	--	--	--
	Dichloromethyl ether	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Diethyl phthalate	mg/kg	349	1	0.3%	0.26	0.26	0.042	8	48,882	0	0	--	--	--	--	--	--
	Dimethyl phthalate	mg/kg	349	0	0%	--	--	0.025	8	100,000	0	0	--	--	--	--	--	--
	Di-n-butyl phthalate	mg/kg	351	2	1%	7.5	16	0.063	8	6,110	0	0	270	0	0	--	--	--
	Di-n-octyl phthalate	mg/kg	349	0	0%	--	--	0.042	8	2,444	0	0	10,000	0	0	--	--	--
	Diphenyl disulfide	mg/kg	197	0	0%	--	--	0.33	0.36	--	--	--	--	--	--	--	--	--
	Diphenyl sulfide	mg/kg	197	0	0%	--	--	0.33	0.36	--	--	--	--	--	--	--	--	--
	Diphenyl sulfone	mg/kg	197	0	0%	--	--	0.33	0.36	183.3	0	0	--	--	--	--	--	--
	Fluoranthene	mg/kg	351	2	1%	0.67	1.9	0.052	8	2,294	0	0	210	0	0	--	--	--
	Fluorene	mg/kg	349	0	0%	--	--	0.058	8	2,747	0	0	28	0	0	--	--	--
	Hexachlorobenzene	mg/kg	351	12	3%	0.44	230	0.044	6	0.30	12	309	0.1	12	309	--	--	--
	Hexachlorobutadiene	mg/kg	361	0	0%	--	--	0.005	8	6.2	0	1	0.1	0	321	--	--	--
	Hexachlorocyclopentadiene	mg/kg	349	0	0%	--	--	0.031	8	365	0	0	20	0	0	--	--	--
	Hexachloroethane	mg/kg	349	0	0%	--	--	0.17	8	35	0	0	0.02	0	344	--	--	--
	Hydroxymethyl phthalimide	mg/kg	197	0	0%	--	--	0.33	0.36	--	--	--	--	--	--	--	--	--
	Isophorone	mg/kg	349	0	0%	--	--	0.034	8	512	0	0	0.03	0	344	--	--	--
	m,p-Cresol	mg/kg	349	0	0%	--	--	0.065	8	306	0	0	--	--	--	--	--	--
	Naphthalene	mg/kg	359	0	0%	--	--	0.005	8	56	0	0	4.0	0	4	--	--	--
	Nitrobenzene	mg/kg	349	0	0%	--	--	0.036	8	20	0	0	0.007	0	344	--	--	--
	N-nitrosodi-n-propylamine	mg/kg	349	0	0%	--	--	0.024	8	0.069	0	319	0.000002	0	343	--	--	--
	N-nitrosodiphenylamine	mg/kg	349	0	0%	--	--	0.17	8	99	0	0	0.06	0	344	--	--	--
	o-Cresol	mg/kg	349	0	0%	--	--	0.043	8	3,055	0	0	0.8	0	6	--	--	--
	Octachlorostyrene	mg/kg	180	0	0%	--	--	0.34	0.36	--	--	--	--	--	--	--	--	--
	p-Chloroaniline (4-Chloroaniline)	mg/kg	351	0	0%	--	--	0.17	52	244	0	0	0.03	0	346	--	--	--
	p-Chlorobenzenethiol	mg/kg	197	0	0%	--	--	0.33	0.36	--	--	--	--	--	--	--	--	--
	Pentachlorobenzene	mg/kg	197	0	0%	--	--	0.33	0.36	49	0	0	--	--	--	--	--	--
	Pentachlorophenol	mg/kg	351	0	0%	--	--	0.25	130	3.0	0	62	0.001	0	346	--	--	--
	Phenol	mg/kg	351	0	0%	--	--	0.06	8	18,331	0	0	5.0	0	2	--	--	--
Phthalic acid	mg/kg	197	1	1%	1.2	1.2	0.33	1.8	61,103	0	0	--	--	--	--	--	--	
Pyridine	mg/kg	201	0	0%	--	--	0.5	0.73	61	0	0	--	--	--	--	--	--	
Thiophenol	mg/kg	197	0	0%	--	--	0.33	0.36	--	--	--	--	--	--	--	--	--	
Tentatively Identified Compounds (TICs)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Volatile Organic Compounds	1,1,1,2-Tetrachloroethane	mg/kg	210	0	0%	--	--	0.0046	0.01	3.2	0	0	--	--	--	--	--	
	1,1,1-Trichloroethane	mg/kg	443	0	0%	--	--	0.00044	0.01	1,200	0	0	0.1	0	0	--	--	
	1,1,2,2-Tetrachloroethane	mg/kg	443	0	0%	--	--	0.00044	0.01	0.41	0	0	0.0002	0	438	--	--	
	1,1,2-Trichloroethane	mg/kg	443	0	0%	--	--	0.00043	0.01	0.73	0	0	0.0009	0	418	--	--	
	1,1-Dichloroethane	mg/kg	443	0	0%	--	--	0.00038	0.01	506	0	0	1.0	0	0	--	--	
	1,1-Dichloroethene	mg/kg	441	0	0%	--	--	0.0013	0.01	124	0	0	0.003	0	416	--	--	
	1,1-Dichloropropene	mg/kg	210	0	0%	--	--	0.0046	0.01	--	--	--	--	--	--	--	--	
	1,2,3-Trichlorobenzene	mg/kg	210	0	0%	--	--	0.0046	0.01	--	--	--	--	--	--	--	--	
	1,2,3-Trichloropropane	mg/kg	210	0	0%	--	--	0.0046	0.01	0.034	0	0	--	--	--	--	--	
	1,2,4-Trichlorobenzene	mg/kg	362	1	0.3%	41	41	0.0046	6	62	0	0	0.3	1	123	--	--	
	1,2,4-Trimethylbenzene	mg/kg	210	4	2%	0.00037	0.0015	0.0046	0.01	52	0	0	--	--	--	--	--	
	1,2-Dichlorobenzene	mg/kg	531	11	2%	0.0011	770	0.0046	6	600	1	0	0.9	2	4	--	--	
	1,2-Dichloroethane	mg/kg	443	0	0%	--	--	0.00043	0.01	0.28	0	0	0.001	0	418	--	--	
	1,2-Dichloroethene	mg/kg	198	0	0%	--	--	0.0051	0.016	--	--	--	--	--	--	--	--	
	1,2-Dichloropropane	mg/kg	443	0	0%	--	--	0.00021	0.01	0.34	0	0	0.001	0	418	--	--	
	1,3,5-Trichlorobenzene	mg/kg	198	0	0%	--	--	0.0046	0.0081	--	--	--	--	--	--	--	--	
	1,3,5-Trimethylbenzene	mg/kg	210	1	0.5%	0.00083	0.00083	0.0046	0.01	21	0	0	--	--	--	--	--	
	1,3-Dichlorobenzene	mg/kg	531	5	1%	0.0012	71	0.0046	6	531	0	0	--	--	--	--	--	
	1,3-Dichloropropene (see cis-, trans-)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	1,3-Dichloropropane	mg/kg	210	0	0%	--	--	0.0046	0.01	105	0	0	--	--	--	--	--	

TABLE 4-5
SUMMARY OF SOILS INVESTIGATIONS - NEAR-SURFACE SOILS (1-15 FT bgs)
BRC CLOSURE PLAN
(Page 8 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd
Volatile Organic Compounds (Continued)	o-Xylene	mg/kg	411	5	1%	0.00035	0.0028	0.0046	0.01	--	--	--	--	--	--	--	--	--
	sec-Butylbenzene	mg/kg	210	0	0%	--	--	0.0046	0.01	220	0	0	--	--	--	--	--	--
	Styrene	mg/kg	443	0	0%	--	--	0.00037	0.01	1,700	0	0	0.2	0	0	--	--	--
	tert-Butylbenzene	mg/kg	210	0	0%	--	--	0.0046	0.01	390	0	0	--	--	--	--	--	--
	Tetrachloroethene	mg/kg	448	12	3%	0.00027	1.7	0.00036	0.01	0.48	1	0	0.003	3	406	--	--	--
	Toluene	mg/kg	448	72	16%	0.00045	0.012	0.00054	0.01	520	0	0	0.6	0	0	--	--	--
	trans-1,2-Dichloroethene	mg/kg	263	0	0%	--	--	0.00044	0.01	69	0	0	0.03	0	0	--	--	--
	trans-1,3-Dichloropropene	mg/kg	443	0	0%	--	--	0.00031	0.01	0.78	0	0	0.0002	0	0	--	--	--
	Trichloroethene	mg/kg	443	63	14%	0.00012	0.023	0.00031	0.01	0.053	0	0	0.003	24	355	--	--	--
	Vinyl acetate	mg/kg	431	0	0%	--	--	0.00056	0.015	426	0	0	8.0	0	0	--	--	--
	Vinyl chloride	mg/kg	443	0	0%	--	--	0.00079	0.01	0.079	0	0	0.0007	0	440	--	--	--
	Xylenes (total)	mg/kg	235	5	2%	0.001	0.0093	0.0011	0.016	271	0	0	10	0	0	--	--	--
	Tentatively Identified Compounds (TICs)		mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Water Quality Parameters	Conductivity	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Hardness, total	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Total dissolved solids	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Total suspended solids	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Alkalinity, Total (as CaCO ₃)	mg/kg	24	18	75%	28	670	25	25	--	--	--	--	--	--	--	--	--
	Bicarbonate alkalinity	mg/kg	93	87	94%	18	670	--	--	--	--	--	--	--	--	--	--	--
	Carbonate alkalinity	mg/kg	93	20	22%	3	96	25	25	--	--	--	--	--	--	--	--	--
Hydroxide alkalinity	mg/kg	24	0	0%	--	--	--	--	--	--	--	--	--	--	--	--	--	
Flashpoint	Flammables	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons	Diesel	mg/kg	4	0	0%	--	--	26	260	--	--	--	--	--	--	--	--	--
	Gasoline	mg/kg	4	1	25%	0.12	0.12	0.1	0.1	--	--	--	--	--	--	--	--	--
	Grease	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Mineral Spirits	mg/kg	4	0	0%	--	--	26	260	--	--	--	--	--	--	--	--	--
White Phosphorus	White phosphorus	mg/kg	--	--	--	--	--	--	--	1.6	--	--	--	--	--	--	--	--
Methyl Mercury	Methyl mercury	mg/kg	--	--	--	--	--	--	--	6.1	--	--	--	--	--	--	--	--

a - Range of detections include estimated values of detect results between the detection limit and reporting limit. As such some minimum detected concentrations may be below the minimum reporting limit. In these cases the respective sample results are flagged in the data set.

b - The quantitation limits shown include samples which had detections. For screening purposes, the detection limit was used for comparison to the screening levels.

c - From USEPA Region 9 preliminary remediation goals (PRG) table, October 2004 (and the 2007 USEPA radionuclide PRG webpage; <http://epa-prgs.ornl.gov/radionuclides>). Values used are residential soil PRGs.

d - From USEPA Region 9 preliminary remediation goals (PRG) table, October 2004 (and the 2007 USEPA radionuclide PRG webpage; <http://epa-prgs.ornl.gov/radionuclides>). Value used is the soil screening level with a dilution attenuation factor of 1.

e - Values used are the maximum from the provisional soils background data set presented in the Background Shallow Soil Summary Report, BMI Complex and Common Area Vicinity (BRC/TIMET 2007, currently in review by the NDEP).

f - Agency for Toxic Substances and Disease Registry (ATSDR) screening value of 50 parts per trillion (ppt).

SSL = soil screening level.

DAF = dilution attenuation factor.

-- = Not applicable or no value has been established.

TABLE 4-6
SUMMARY OF SOILS INVESTIGATIONS - MIDDLE ZONE SOILS (15 FT bgs to Qa/TMCf)
BRC CLOSURE PLAN
(Page 1 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd	
Ions	Bromide	mg/kg	45	7	16%	0.34	1.2	2.6	3.9	--	--	--	--	--	--	--	--	--	
	Bromine	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Chlorate	mg/kg	45	6	13%	1.2	9.9	2	3.1	--	--	--	--	--	--	--	--	--	
	Chloride	mg/kg	165	165	100%	4.6	10000	--	--	--	--	--	--	--	--	1110	42	--	
	Chlorine (soluble)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Chlorite	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Fluoride	mg/kg	45	41	91%	0.28	11.3	1	1.5	3,666	0	0	--	--	--	2.5	26	0	
	Nitrate (as N)	mg/kg	45	35	78%	0.12	47.7	0.2	0.31	--	--	--	--	--	--	102	0	0	
	Nitrite (as N)	mg/kg	45	23	51%	0.13	3.6	0.21	0.31	--	--	--	--	--	--	0.21	19	9	
	Orthophosphate	mg/kg	45	6	13%	0.79	198	5.1	71.4	--	--	--	--	--	--	--	--	--	
	Sulfate	mg/kg	74	74	100%	16.5	24100	--	--	--	--	--	--	--	--	4130	6	--	
	Sulfite	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perchlorate	mg/kg	95	69	73%	0.0052	5.7	0.02	0.0618	7.8	0	0	--	--	--	--	--	--		
Dissolved Gases	Ethane	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Ethylene	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Methane	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Chlorinated Compounds	Chloral	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Dichloroacetaldehyde	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
PCDDs/PCDFs	OCDF	mg/kg	40	7	18%	5.9 E-6	1.4 E-2	3.0 E-7	4.8 E-6	--	--	--	--	--	--	--	--	--	
	OCDD	mg/kg	40	7	18%	7.0 E-6	4.0 E-4	2.7 E-7	5.4 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,4,6,7,8-HpCDF	mg/kg	40	6	15%	2.9 E-6	4.0 E-3	1.2 E-7	1.0 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,4,6,7,8-HpCDD	mg/kg	40	3	8%	2.7 E-6	4.2 E-4	7.3 E-8	1.4 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,4,7,8,9-HpCDF	mg/kg	40	2	5%	6.8 E-6	1.6 E-3	1.2 E-7	1.9 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,4,7,8-HxCDF	mg/kg	40	4	10%	2.7 E-6	1.6 E-3	7.8 E-8	2.2 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,4,7,8-HxCDD	mg/kg	40	1	3%	6.3 E-5	6.3 E-5	4.7 E-8	8.8 E-7	--	--	--	--	--	--	--	--	--	
	1,2,3,6,7,8-HxCDF	mg/kg	40	2	5%	5.1 E-6	1.1 E-3	4.9 E-8	1.9 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,6,7,8-HxCDD	mg/kg	40	1	3%	1.2 E-4	1.2 E-4	6.2 E-8	8.3 E-7	--	--	--	--	--	--	--	--	--	
	1,2,3,7,8,9-HxCDF	mg/kg	40	1	3%	1.8 E-4	1.8 E-4	5.8 E-8	9.2 E-7	--	--	--	--	--	--	--	--	--	
	1,2,3,7,8,9-HxCDD	mg/kg	40	1	3%	1.0 E-4	1.0 E-4	7.0 E-8	7.9 E-7	--	--	--	--	--	--	--	--	--	
	1,2,3,7,8-PeCDF	mg/kg	40	3	8%	3.7 E-6	8.9 E-4	3.8 E-8	1.9 E-6	--	--	--	--	--	--	--	--	--	
	1,2,3,7,8-PeCDD	mg/kg	40	1	3%	8.1 E-5	8.1 E-5	8.1 E-8	1.3 E-6	--	--	--	--	--	--	--	--	--	
	2,3,4,6,7,8-HxCDF	mg/kg	40	1	3%	2.8 E-4	2.8 E-4	5.1 E-8	1.6 E-6	--	--	--	--	--	--	--	--	--	
	2,3,4,7,8-PeCDF	mg/kg	40	2	5%	5.9 E-6	4.8 E-4	4.0 E-8	1.1 E-6	--	--	--	--	--	--	--	--	--	
	2,3,7,8-TCDF	mg/kg	40	5	13%	6.8 E-7	4.7 E-4	3.4 E-8	4.0 E-7	--	--	--	--	--	--	--	--	--	
	2,3,7,8-TCDD	mg/kg	40	2	5%	5.9 E-7	2.1 E-5	4.2 E-8	5.6 E-7	3.9 E-6	1	0	--	--	--	--	--	--	
	TCDD TEQ	mg/kg	40	8	20%	1.1 E-6	8.4 E-4	2.4 E-7	2.8 E-6	5.0 E-5 ^f	1	0	--	--	--	--	--	--	
Asbestos	Asbestos fibers	fibers	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
General Chemistry Parameters	Ammonia (as N)	mg/kg	45	2	4%	0.58	0.96	0.51	0.77	--	--	--	--	--	--	--	--	--	
	Cyanide (Total)	mg/kg	61	2	3%	0.44	3.3	0.14	0.77	1,222	0	0	--	--	--	--	--	--	
	Iodine	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	pH in soil	SU	45	45	100%	7.6	9.6	--	--	--	--	--	--	--	--	--	--	--	
	pH in water	SU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Sulfide	mg/kg	45	2	4%	12.9	19.3	10.2	15.4	--	--	--	--	--	--	--	--	--	
	Total inorganic carbon	mg/kg	51	50	98%	568	42900	546	546	--	--	--	--	--	--	--	--	--	
	Total Kjeldahl nitrogen (TKN)	mg/kg	45	13	29%	27.8	211	2.6	3.9	--	--	--	--	--	--	--	--	--	
Total organic carbon (TOC)	mg/kg	57	39	68%	500	39300	500	566	--	--	--	--	--	--	--	--	--		
Metals	Aluminum	mg/kg	64	64	100%	3880	17600	--	--	76,142	0	--	--	--	--	15300	2	--	
	Antimony	mg/kg	81	18	22%	0.22	1.8	0.17	1.5	31	0	0	0.30	12	50	0.5	7	50	
	Arsenic	mg/kg	110	101	92%	2.2	39	5	5	0.39	101	9	1.0	101	9	7.2	40	0	
	Barium	mg/kg	110	110	100%	17	2300	--	--	5,375	0	--	82	102	--	836	1	--	
	Beryllium	mg/kg	64	58	91%	0.19	1.1	0.4	0.66	154	0	0	3.0	0	0	0.89	1	0	
	Boron	mg/kg	45	30	67%	3.2	81.5	5.1	5.7	16,000	0	0	--	--	--	11.6	8	0	
	Cadmium	mg/kg	93	20	22%	0.03	0.62	0.5	2.8	37	0	0	0.40	2	73	0.1291	4	73	
	Calcium	mg/kg	165	165	100%	28.4	186000	--	--	--	--	--	--	--	--	82800	7	--	

TABLE 4-6
SUMMARY OF SOILS INVESTIGATIONS - MIDDLE ZONE SOILS (15 FT bgs to Qa/TMCf)
BRC CLOSURE PLAN
(Page 2 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd	
Metals (Continued)	Chromium	mg/kg	110	110	100%	4.4	72	--	--	100,000	0	--	--	--	--	16.7	24	--	
	Cobalt	mg/kg	51	51	100%	3.2	10.7	--	--	903	0	--	--	--	--	16.3	0	--	
	Copper	mg/kg	64	64	100%	7.4	1940	--	--	3,129	0	--	--	--	--	30.5	4	--	
	Iron	mg/kg	93	93	100%	3660	26600	--	--	23,463	4	--	--	--	--	19700	8	--	
	Lead	mg/kg	110	108	98%	3	310	2.5	2.5	400	0	0	--	--	--	35.1	3	0	
	Lithium	mg/kg	45	45	100%	7	153	--	--	1,564	0	--	--	--	--	26.5	8	--	
	Magnesium	mg/kg	184	184	100%	17.7	79500	--	--	--	--	--	--	--	--	17500	19	--	
	Manganese	mg/kg	110	110	100%	66	3300	--	--	1,762	1	--	--	--	--	1090	1	--	
	Molybdenum	mg/kg	65	62	95%	0.22	4.6	0.01	4.2	391	0	0	--	--	--	2	4	1	
	Nickel	mg/kg	64	64	100%	5.8	20	--	--	1,564	0	--	7.0	62	--	30	0	--	
	Niobium	mg/kg	45	5	11%	1.2	3.9	1.5	7.7	--	--	--	--	--	--	2.8	2	23	
	Palladium	mg/kg	45	45	100%	0.34	6.5	--	--	--	--	--	--	--	--	1.5	4	--	
	Phosphorus	mg/kg	45	44	98%	382	2330	334	334	--	--	--	--	--	--	2010	2	0	
	Platinum	mg/kg	45	0	0%	--	--	0.1	0.15	--	--	--	--	--	--	0.099	0	45	
	Potassium	mg/kg	136	83	61%	8.38	5930	50	530	--	--	--	--	--	--	3890	3	0	
	Selenium	mg/kg	93	24	26%	0.14	0.58	0.5	5	391	0	0	0.30	14	69	0.6	0	37	
	Silicon	mg/kg	45	45	100%	171	2440	--	--	--	--	--	--	--	--	4150	0	--	
	Silver	mg/kg	93	28	30%	0.05	0.87	0.058	1.2	391	0	0	2.0	0	0	0.2609	3	44	
	Sodium	mg/kg	165	165	100%	120	2650	--	--	--	--	--	--	--	--	1320	9	--	
	Strontium	mg/kg	45	45	100%	72.1	3210	--	--	46,924	0	--	--	--	--	808	4	--	
	Sulfur	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Thallium	mg/kg	68	6	9%	0.05	1.9	0.52	6.2	5.2	0	4	--	--	--	1.8	1	4	
	Tin	mg/kg	45	32	71%	0.16	1.6	0.13	2.9	46,924	0	0	--	--	--	0.8	5	8	
	Titanium	mg/kg	64	64	100%	94.1	1310	--	--	100,000	0	--	--	--	--	1010	5	--	
	Tungsten	mg/kg	45	27	60%	0.22	3.2	0.2	1	--	--	--	--	--	--	2.5	1	0	
	Uranium	mg/kg	45	45	100%	0.64	10	--	--	16	0	--	--	--	--	2.7	5	--	
	Vanadium	mg/kg	110	110	100%	15.8	170	--	--	78	1	--	300	0	--	59.1	10	--	
	Zinc	mg/kg	64	64	100%	16.4	123	--	--	23,463	0	--	620	0	--	121	1	--	
	Zirconium	mg/kg	45	45	100%	1.5	31.3	--	--	--	--	--	--	--	--	179	0	--	
	Chromium (VI)	mg/kg	90	7	8%	0.016	0.022	0.005	0.62	30	0	0	2.0	0	0	0.32	0	45	
	Mercury	mg/kg	93	14	15%	0.01	0.096	0.0075	0.1	23	0	0	--	--	--	0.11	0	0	
	Organo-phosphorous Pesticides	Azinphos-ethyl	mg/kg	51	0	0%	--	--	0.034	0.137	--	--	--	--	--	--	--	--	--
		Azinphos-methyl	mg/kg	64	1	2%	0.0094	0.0094	0.0044	0.137	--	--	--	--	--	--	--	--	--
Carbophenothion		mg/kg	51	0	0%	--	--	0.034	0.137	--	--	--	--	--	--	--	--	--	
Chlorpyrifos		mg/kg	64	0	0%	--	--	0.0031	0.137	183	0	0	--	--	--	--	--	--	
Coumaphos		mg/kg	64	0	0%	--	--	0.0027	0.137	--	--	--	--	--	--	--	--	--	
Demeton-O		mg/kg	51	0	0%	--	--	0.013	0.137	2.4	0	0	--	--	--	--	--	--	
Demeton-S		mg/kg	51	0	0%	--	--	0.013	0.137	2.4	0	0	--	--	--	--	--	--	
Diazinon		mg/kg	64	0	0%	--	--	0.0021	0.137	55	0	0	--	--	--	--	--	--	
Dichlorvos		mg/kg	64	0	0%	--	--	0.0048	0.137	1.7	0	0	--	--	--	--	--	--	
Dimethoate		mg/kg	64	0	0%	--	--	0.004	0.137	12	0	0	--	--	--	--	--	--	
Disulfoton		mg/kg	64	0	0%	--	--	0.0022	0.137	2.4	0	0	--	--	--	--	--	--	
EPN		mg/kg	51	0	0%	--	--	0.013	0.137	0.61	0	0	--	--	--	--	--	--	
Ethoprop		mg/kg	64	0	0%	--	--	0.0032	0.137	--	--	--	--	--	--	--	--	--	
Ethyl parathion		mg/kg	64	0	0%	--	--	0.0016	0.137	367	0	0	--	--	--	--	--	--	
Famphur		mg/kg	64	0	0%	--	--	0.0027	0.137	--	--	--	--	--	--	--	--	--	
Fenthion		mg/kg	64	0	0%	--	--	0.0062	0.137	--	--	--	--	--	--	--	--	--	
Malathion		mg/kg	64	0	0%	--	--	0.0053	0.137	1,222	0	0	--	--	--	--	--	--	
Methyl carbophenothion		mg/kg	45	0	0%	--	--	0.034	0.091	--	--	--	--	--	--	--	--	--	
Methyl parathion		mg/kg	64	0	0%	--	--	0.0053	0.137	15	0	0	--	--	--	--	--	--	
Mevinphos		mg/kg	64	0	0%	--	--	0.0037	0.137	--	--	--	--	--	--	--	--	--	
Naled	mg/kg	64	0	0%	--	--	0.034	0.14	122	0	0	--	--	--	--	--	--		

TABLE 4-6
SUMMARY OF SOILS INVESTIGATIONS - MIDDLE ZONE SOILS (15 FT bgs to Qa/TMCf)
BRC CLOSURE PLAN
(Page 3 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd	
Organo-phosphorous Pesticides (Continued)	O,O,O-Triethyl phosphorothioate (TEPP)	mg/kg	58	0	0%	--	--	0.0023	0.036	--	--	--	--	--	--	--	--	--	
	Phorate	mg/kg	64	0	0%	--	--	0.0024	0.137	12	0	0	--	--	--	--	--	--	
	Phosmet	mg/kg	51	0	0%	--	--	0.068	0.18	1,222	0	0	--	--	--	--	--	--	
	Ronnel	mg/kg	64	0	0%	--	--	0.0041	0.18	3,055	0	0	--	--	--	--	--	--	
	Stirophos (Tetrachlorovinphos)	mg/kg	64	4	6%	--	--	0.0029	0.137	20	0	0	--	--	--	--	--	--	
	Sulfotep	mg/kg	64	0	0%	--	--	0.0021	0.137	31	0	0	--	--	--	--	--	--	--
Chlorinated Herbicides	2,4,5-T	mg/kg	45	0	0%	--	--	0.02	0.031	611	0	0	--	--	--	--	--	--	
	2,4,5-TP (Silvex)	mg/kg	45	0	0%	--	--	0.02	0.031	489	0	0	--	--	--	--	--	--	
	2,4-D	mg/kg	45	0	0%	--	--	0.082	0.12	686	0	0	--	--	--	--	--	--	
	2,4-DB	mg/kg	45	0	0%	--	--	0.082	0.12	489	0	0	--	--	--	--	--	--	
	Dalapon	mg/kg	45	0	0%	--	--	0.041	0.062	1,833	0	0	--	--	--	--	--	--	
	Dicamba	mg/kg	45	0	0%	--	--	0.041	0.062	1,833	0	0	--	--	--	--	--	--	--
	Dichloroprop	mg/kg	45	0	0%	--	--	0.082	0.12	--	--	--	--	--	--	--	--	--	
	Dinoseb	mg/kg	45	0	0%	--	--	0.012	0.039	61	0	0	--	--	--	--	--	--	
	MCPA	mg/kg	45	0	0%	--	--	8.2	12	31	0	0	--	--	--	--	--	--	
	MCPP	mg/kg	--	--	--	--	--	--	--	61	--	--	--	--	--	--	--	--	--
Organic Acids	4-Chlorobenzene sulfonic acid	mg/kg	46	0	0%	--	--	1	1	--	--	--	--	--	--	--	--	--	
	Benzenesulfonic acid	mg/kg	46	0	0%	--	--	1	1	--	--	--	--	--	--	--	--	--	
	O,O-Diethylphosphorodithioic acid	mg/kg	46	0	0%	--	--	1	1	--	--	--	--	--	--	--	--	--	
	O,O-Dimethylphosphorodithioic acid	mg/kg	46	0	0%	--	--	1	1	--	--	--	--	--	--	--	--	--	
Nonhalogenated Organics	Ethylene glycol	mg/kg	45	0	0%	--	--	51	670	100,000	0	0	--	--	--	--	--	--	
	Ethylene glycol monobutyl ether	mg/kg	--	--	--	--	--	--	--	30,552	--	--	--	--	--	--	--	--	
	Methanol	mg/kg	45	2	4%	64	8800	51	77	30,552	0	0	--	--	--	--	--	--	
	Propylene glycol	mg/kg	45	0	0%	--	--	51	670	30,034	0	0	--	--	--	--	--	--	
Organochlorine Pesticides	2,4-DDD	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	2,4-DDE	mg/kg	45	1	2%	0.024	0.024	0.0017	0.0026	--	--	--	--	--	--	--	--	--	
	4,4-DDD	mg/kg	110	4	4%	0.0019	0.0024	0.00069	0.0075	2.4	0	0	0.8	0	0	--	--	--	
	4,4-DDE	mg/kg	110	23	21%	0.0021	0.29	0.00094	0.006	1.7	0	0	3.0	0	0	--	--	--	
	4,4-DDT	mg/kg	110	21	19%	0.0028	0.11	0.00075	0.006	1.7	0	0	2.0	0	0	--	--	--	
	Aldrin	mg/kg	110	0	0%	--	--	0.00071	0.0075	0.029	0	0	0.02	0	0	--	--	--	
	alpha-BHC	mg/kg	110	9	8%	0.0034	0.02	0.00082	0.0075	0.090	0	0	0.00003	9	101	--	--	--	
	alpha-Chlordane	mg/kg	110	3	3%	0.0085	0.042	0.00048	0.006	1.6	0	0	0.5	0	0	--	--	--	
	beta-BHC	mg/kg	110	13	12%	0.0018	0.093	0.00076	0.005	0.32	0	0	0.0001	13	97	--	--	--	
	Chlordane	mg/kg	91	0	0%	--	--	0.005	0.03	1.6	0	0	0.5	0	0	--	--	--	
	delta-BHC	mg/kg	110	4	4%	0.009	0.018	0.00047	0.005	--	--	--	--	--	--	--	--	--	
	Dieldrin	mg/kg	110	0	0%	--	--	0.00062	0.0075	0.030	0	0	0.0002	0	110	--	--	--	
	Endosulfan I	mg/kg	110	0	0%	--	--	0.00054	0.0075	367	0	0	0.9	0	0	--	--	--	
	Endosulfan II	mg/kg	110	2	2%	0.005	0.016	0.00068	0.0075	367	0	0	0.9	0	0	--	--	--	
	Endosulfan sulfate	mg/kg	110	0	0%	--	--	0.00057	0.0075	--	--	--	--	--	--	--	--	--	
	Endrin	mg/kg	110	0	0%	--	--	0.0006	0.0075	18	0	0	0.05	0	0	--	--	--	
	Endrin aldehyde	mg/kg	110	2	2%	0.0025	0.0028	0.0012	0.0075	--	--	--	--	--	--	--	--	--	
	Endrin ketone	mg/kg	96	1	1%	0.012	0.012	0.00057	0.0075	--	--	--	--	--	--	--	--	--	
	gamma-BHC (Lindane)	mg/kg	109	9	8%	0.0026	0.049	0.00063	0.0075	0.44	0	0	0.0005	9	100	--	--	--	
	gamma-Chlordane	mg/kg	110	0	0%	--	--	0.001	0.02	1.6	0	0	0.5	0	0	--	--	--	
	Heptachlor	mg/kg	110	0	0%	--	--	0.00064	0.05	0.11	0	0	1.0	0	0	--	--	--	
	Heptachlor epoxide	mg/kg	110	1	1%	0.0027	0.0027	0.0005	0.0075	0.053	0	0	0.03	0	0	--	--	--	
	Methoxychlor	mg/kg	110	10	9%	0.012	0.24	0.0014	0.03	306	0	0	8.0	0	0	--	--	--	
Toxaphene	mg/kg	110	0	0%	--	--	0.02	0.1	0.44	0	0	2.0	0	0	--	--	--		
Polychlorinated Biphenyls	Aroclor 1016	mg/kg	90	0	0%	--	--	0.012	0.051	3.9	0	0	--	--	--	--	--	--	
	Aroclor 1221	mg/kg	90	0	0%	--	--	0.012	0.051	--	--	--	--	--	--	--	--	--	
	Aroclor 1232	mg/kg	90	0	0%	--	--	0.012	0.051	--	--	--	--	--	--	--	--	--	
	Aroclor 1242	mg/kg	90	0	0%	--	--	0.012	0.051	--	--	--	--	--	--	--	--	--	
	Aroclor 1248	mg/kg	90	0	0%	--	--	0.012	0.051	--	--	--	--	--	--	--	--	--	
	Aroclor 1254	mg/kg	90	0	0%	--	--	0.01	0.051	0.22	0	0	--	--	--	--	--	--	

TABLE 4-6
SUMMARY OF SOILS INVESTIGATIONS - MIDDLE ZONE SOILS (15 FT bgs to Qa/TMCf)
BRC CLOSURE PLAN
(Page 4 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd	
Polychlorinated Biphenyls (Continued)	Aroclor 1260	mg/kg	90	0	0%	--	--	0.01	0.051	--	--	--	--	--	--	--	--	--	
	PCB-77	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-81	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-105	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-114	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-118	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-123	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	PCB-126	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-156	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-157	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-167	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-169	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-189	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Polynuclear Aromatic Hydrocarbons	Acenaphthene	mg/kg	64	0	0%	--	--	0.044	0.41	3,682	0	0	29	0	0	--	--	--	
	Acenaphthylene	mg/kg	64	0	0%	--	--	0.032	0.41	--	--	--	--	--	--	--	--	--	
	Anthracene	mg/kg	64	0	0%	--	--	0.031	0.41	21,896	0	0	590	0	0	--	--	--	
	Benzo(a)anthracene	mg/kg	64	0	0%	--	--	0.015	0.41	0.62	0	0	0.08	0	51	--	--	--	
	Benzo(a)pyrene	mg/kg	64	2	3%	0.83	1.8	0.015	0.41	0.062	2	50	0.4	2	6	--	--	--	
	Benzo(b)fluoranthene	mg/kg	64	0	0%	--	--	0.015	0.41	0.62	0	0	0.2	0	51	--	--	--	
	Benzo(g,h,i)perylene	mg/kg	64	0	0%	--	--	0.031	0.41	--	--	--	--	--	--	--	--	--	
	Benzo(k)fluoranthene	mg/kg	64	0	0%	--	--	0.015	0.41	6.2	0	0	2.0	0	0	--	--	--	
	Chrysene	mg/kg	64	1	2%	0.43	0.43	0.015	0.41	62	0	0	8.0	0	0	--	--	--	
	Dibenzo(a,h)anthracene	mg/kg	64	0	0%	--	--	0.031	0.41	0.062	0	54	0.08	0	52	--	--	--	
	Indeno(1,2,3-cd)pyrene	mg/kg	64	0	0%	--	--	0.015	0.41	0.62	0	0	0.7	0	0	--	--	--	
	Phenanthrene	mg/kg	64	0	0%	--	--	0.031	0.41	--	--	--	--	--	--	--	--	--	
	Pyrene	mg/kg	64	0	0%	--	--	0.031	0.41	2,316	0	0	210	0	0	--	--	--	
Radionuclides	Gross alpha	pCi/g	45	41	91%	18.6	52	26.1	39.2	--	--	--	--	--	--	--	--	--	
	Gross beta	pCi/g	45	45	100%	23.1	48.5	--	--	--	--	--	--	--	--	--	--	--	
	Actinium-228	pCi/g	58	39	67%	0.99	1.88	0.33	1.78	732	0	0	--	--	--	3.4	0	0	
	Bismuth-212	pCi/g	58	18	31%	0.75	1.43	0.16	3.1	22,600	0	0	--	--	--	1.82	0	12	
	Bismuth-214	pCi/g	58	48	83%	0.67	4.43	0.79	1.11	8,190	0	0	--	--	--	1.62	10	0	
	Cobalt-57	pCi/g	45	0	0%	--	--	-0.026	0.031	8.7	0	0	8.4	0	0	0.08	0	0	
	Cobalt-60	pCi/g	45	0	0%	--	--	-0.073	0.071	0.036	0	4	0.12	0	0	0.164	0	0	
	Lead-210	pCi/g	58	5	9%	3.4	6.9	-0.5	3.4	0.15	5	45	0.0006	5	48	2.2	5	10	
	Lead-211	pCi/g	--	--	--	--	--	--	--	>100,000	--	--	>100,000	--	--	0.4	--	--	
	Lead-212	pCi/g	58	48	83%	0.45	1.69	1.29	1.53	3,640	0	0	>100,000	0	0	2.11	0	0	
	Lead-214	pCi/g	58	48	83%	0.67	4.7	0.69	1.28	46,300	0	0	>100,000	0	0	1.72	8	0	
	Potassium-40	pCi/g	58	48	83%	10.5	35.8	22.7	28.3	0.11	48	10	--	--	--	35	1	0	
	Thallium-208	pCi/g	58	47	81%	0.2	0.6	0.3	0.58	22,600	0	0	--	--	--	0.72	0	0	
	Thorium-227	pCi/g	--	--	--	--	--	--	--	113	--	--	3,340	--	--	0.4	--	--	
	Thorium-234	pCi/g	58	29	50%	1.08	4.5	0.1	2.35	1,330	0	0	4,130	0	0	2.5	6	0	
	Thorium-232	pCi/g	75	75	100%	0.13	2.15	--	--	3.1	0	--	0.30	74	--	2.23	0	--	
	Thorium-228	pCi/g	75	75	100%	0.49	2.13	--	--	0.15	75	--	3.3	0	--	2.28	0	--	
	Thorium-230	pCi/g	75	67	89%	0.75	4.6	0.9	1.52	3.5	2	0	0.30	67	8	3.01	2	0	
	Uranium-233/234	pCi/g	75	75	100%	0.58	4.6	--	--	4.0	1	--	112	0	--	2.84	3	--	
	Uranium 235/236	pCi/g	75	46	61%	0.01	0.2	0.001	0.1	0.20	1	0	0.039	41	16	0.21	0	0	
	Uranium-238	pCi/g	75	75	100%	0.56	4.45	--	--	0.74	64	--	0.006	75	--	2.37	4	--	
	Radium-226	pCi/g	75	60	80%	0.08	4.06	0.11	1.53	0.012	60	15	0.016	60	15	2.36	7	0	
	Radium-228	pCi/g	75	73	97%	0.81	3.5	0.49	1.16	0.068	73	2	0.059	73	2	2.94	1	0	
	Actinium-227 (from Th-227)	pCi/g	--	--	--	--	--	--	--	0.10	--	--	--	--	--	0.4	--	--	
	Bismuth-210 (from Pb-210)	pCi/g	45	1	2%	3.4	3.4	-0.5	3.2	4,800	1	37	--	--	--	2.2	1	5	
	Bismuth-211 (from Pb-211)	pCi/g	--	--	--	--	--	--	--	>100,000	--	--	--	--	--	0.4	--	--	
Polonium-210 (from Pb-210)	pCi/g	45	1	2%	3.4	3.4	-0.5	3.2	38	0	0	--	--	--	2.2	1	5		
Polonium-212 (from Bi-212)	pCi/g	45	20	44%	0.48	0.92	0.11	0.86	--	--	--	--	--	--	1.17	0	0		

TABLE 4-6
SUMMARY OF SOILS INVESTIGATIONS - MIDDLE ZONE SOILS (15 FT bgs to Qa/TMCf)
BRC CLOSURE PLAN
(Page 6 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd	
Semivolatile Organic Compounds (Continued)	Carbazole	mg/kg	64	0	0%	--	--	0.18	0.51	24	0	0	0.0	0	63	--	--	--	
	Dibenzofuran	mg/kg	64	0	0%	--	--	0.06	0.51	145	0	0	--	--	--	--	--	--	
	Dichloromethyl ether	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	Diethyl phthalate	mg/kg	64	0	0%	--	--	0.044	0.51	48,882	0	0	--	--	--	--	--	--	
	Dimethyl phthalate	mg/kg	64	0	0%	--	--	0.027	0.51	100,000	0	0	--	--	--	--	--	--	
	Di-n-butyl phthalate	mg/kg	64	0	0%	--	--	0.067	0.51	6,110	0	0	270	0	0	--	--	--	
	Di-n-octyl phthalate	mg/kg	64	0	0%	--	--	0.044	0.51	2,444	0	0	10,000	0	0	--	--	--	
	Diphenyl disulfide	mg/kg	45	0	0%	--	--	0.34	0.51	--	--	--	--	--	--	--	--	--	
	Diphenyl sulfide	mg/kg	45	0	0%	--	--	0.34	0.51	--	--	--	--	--	--	--	--	--	
	Diphenyl sulfone	mg/kg	45	0	0%	--	--	0.34	0.51	183.3	0	0	--	--	--	--	--	--	
	Fluoranthene	mg/kg	64	0	0%	--	--	0.055	0.51	2,294	0	0	210	0	0	--	--	--	
	Fluorene	mg/kg	64	0	0%	--	--	0.061	0.51	2,747	0	0	28	0	0	--	--	--	
	Hexachlorobenzene	mg/kg	64	0	0%	--	--	0.046	0.51	0.30	0	51	0.1	0	51	--	--	--	
	Hexachlorobutadiene	mg/kg	64	0	0%	--	--	0.043	0.51	6.2	0	0	0.1	0	51	--	--	--	
	Hexachlorocyclopentadiene	mg/kg	64	0	0%	--	--	0.033	2.5	365	0	0	20	0	0	--	--	--	
	Hexachloroethane	mg/kg	64	0	0%	--	--	0.18	0.51	35	0	0	0.02	0	63	--	--	--	
	Hydroxymethyl phthalimide	mg/kg	45	0	0%	--	--	0.34	0.51	--	--	--	--	--	--	--	--	--	
	Isophorone	mg/kg	64	0	0%	--	--	0.035	0.51	512	0	0	0.03	0	63	--	--	--	
	m,p-Cresol	mg/kg	64	0	0%	--	--	0.069	1	306	0	0	--	--	--	--	--	--	
	Naphthalene	mg/kg	64	0	0%	--	--	0.043	0.51	56	0	0	4.0	0	0	--	--	--	
	Nitrobenzene	mg/kg	64	0	0%	--	--	0.038	0.51	20	0	0	0.007	0	63	--	--	--	
	N-nitrosodi-n-propylamine	mg/kg	64	0	0%	--	--	0.026	0.51	0.069	0	51	0.000002	0	63	--	--	--	
	N-nitrosodiphenylamine	mg/kg	64	0	0%	--	--	0.18	0.51	99	0	0	0.06	0	63	--	--	--	
	o-Cresol	mg/kg	64	0	0%	--	--	0.045	0.51	3,055	0	0	0.8	0	0	--	--	--	
	Octachlorostyrene	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	p-Chloroaniline (4-Chloroaniline)	mg/kg	64	0	0%	--	--	0.18	0.51	244	0	0	0.03	0	63	--	--	--	
	p-Chlorobenzenethiol	mg/kg	45	0	0%	--	--	0.34	0.51	--	--	--	--	--	--	--	--	--	
	Pentachlorobenzene	mg/kg	45	0	0%	--	--	0.34	0.51	49	0	0	--	--	--	--	--	--	
	Pentachlorophenol	mg/kg	64	0	0%	--	--	0.27	2.5	3.0	0	0	0.001	0	63	--	--	--	
	Phenol	mg/kg	64	0	0%	--	--	0.063	0.51	18,331	0	0	5.0	0	0	--	--	--	
	Phthalic acid	mg/kg	46	2	4%	0.85	0.89	0.34	1	61,103	0	0	--	--	--	--	--	--	
	Pyridine	mg/kg	45	0	0%	--	--	0.67	1	61	0	0	--	--	--	--	--	--	
Thiophenol	mg/kg	45	0	0%	--	--	0.34	0.51	--	--	--	--	--	--	--	--	--		
Tentatively Identified Compounds (TICs)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Volatile Organic Compounds	1,1,1,2-Tetrachloroethane	mg/kg	46	0	0%	--	--	0.0049	0.012	3.2	0	0	--	--	--	--	--		
	1,1,1-Trichloroethane	mg/kg	62	0	0%	--	--	0.00047	0.012	1,200	0	0	0.1	0	0	--	--		
	1,1,2,2-Tetrachloroethane	mg/kg	62	0	0%	--	--	0.00047	0.012	0.41	0	0	0.0002	0	61	--	--		
	1,1,2-Trichloroethane	mg/kg	62	0	0%	--	--	0.00046	0.012	0.73	0	0	0.0009	0	52	--	--		
	1,1-Dichloroethane	mg/kg	62	0	0%	--	--	0.00041	0.012	506	0	0	1.0	0	0	--	--		
	1,1-Dichloroethene	mg/kg	62	0	0%	--	--	0.0014	0.012	124	0	0	0.003	0	52	--	--		
	1,1-Dichloropropene	mg/kg	46	0	0%	--	--	0.0049	0.012	--	--	--	--	--	--	--	--		
	1,2,3-Trichlorobenzene	mg/kg	46	0	0%	--	--	0.0049	0.012	--	--	--	--	--	--	--	--		
	1,2,3-Trichloropropane	mg/kg	46	0	0%	--	--	0.0049	0.012	0.034	0	0	--	--	--	--	--		
	1,2,4-Trichlorobenzene	mg/kg	65	1	2%	0.0022	0.0022	0.0049	0.41	62	0	0	0.3	0	6	--	--		
	1,2,4-Trimethylbenzene	mg/kg	46	1	2%	0.00058	0.00058	0.0049	0.012	52	0	0	--	--	--	--	--		
	1,2-Dichlorobenzene	mg/kg	52	2	4%	0.0016	0.006	0.0049	0.012	600	0	0	0.9	0	0	--	--		
	1,2-Dichloroethane	mg/kg	62	0	0%	--	--	0.00046	0.012	0.28	0	0	0.001	0	52	--	--		
	1,2-Dichloroethene	mg/kg	46	0	0%	--	--	0.0049	0.012	--	--	--	--	--	--	--	--		
	1,2-Dichloropropane	mg/kg	62	0	0%	--	--	0.00023	0.012	0.34	0	0	0.001	0	52	--	--		
	1,3,5-Trichlorobenzene	mg/kg	46	0	0%	--	--	0.0049	0.012	--	--	--	--	--	--	--	--		
	1,3,5-Trimethylbenzene	mg/kg	46	0	0%	--	--	0.0049	0.012	21	0	0	--	--	--	--	--		
	1,3-Dichlorobenzene	mg/kg	52	1	2%	0.00089	0.00089	0.0049	0.012	531	0	0	--	--	--	--	--		
	1,3-Dichloropropene (see cis-, trans-)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	1,3-Dichloropropane	mg/kg	46	0	0%	--	--	0.0049	0.012	105	0	0	--	--	--	--	--		

TABLE 4-6
SUMMARY OF SOILS INVESTIGATIONS - MIDDLE ZONE SOILS (15 FT bgs to Qa/TMcf)
BRC CLOSURE PLAN
(Page 8 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd
Volatile Organic Compounds (Continued)	o-Xylene	mg/kg	46	0	0%	--	--	0.0049	0.012	--	--	--	--	--	--	--	--	--
	sec-Butylbenzene	mg/kg	46	0	0%	--	--	0.0049	0.012	220	0	0	--	--	--	--	--	--
	Styrene	mg/kg	62	0	0%	--	--	0.0004	0.012	1,700	0	0	0.2	0	0	--	--	--
	tert-Butylbenzene	mg/kg	46	0	0%	--	--	0.0049	0.012	390	0	0	--	--	--	--	--	--
	Tetrachloroethene	mg/kg	65	17	26%	0.00023	0.0045	0.00039	0.0078	0.48	0	0	0.003	1	37	--	--	--
	Toluene	mg/kg	65	12	18%	0.00063	0.0018	0.00058	0.012	520	0	0	0.6	0	0	--	--	--
	trans-1,2-Dichloroethene	mg/kg	62	0	0%	--	--	0.0004	0.012	69	0	0	0.03	0	0	--	--	--
	trans-1,3-Dichloropropene	mg/kg	62	0	0%	--	--	0.00033	0.012	0.78	0	0	0.0002	0	0	--	--	--
	Trichloroethene	mg/kg	62	16	26%	0.00013	0.0011	0.00033	0.0078	0.053	0	0	0.003	0	36	--	--	--
	Vinyl acetate	mg/kg	62	0	0%	--	--	0.0006	0.012	426	0	0	8.0	0	0	--	--	--
	Vinyl chloride	mg/kg	62	0	0%	--	--	0.00085	0.012	0.079	0	0	0.0007	0	62	--	--	--
	Xylenes (total)	mg/kg	65	0	0%	--	--	0.0011	0.023	271	0	0	10	0	0	--	--	--
	Tentatively Identified Compounds (TICs)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Water Quality Parameters	Conductivity	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Hardness, total	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Total dissolved solids	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Total suspended solids	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Alkalinity, Total (as CaCO ₃)	mg/kg	29	20	69%	32	750	25	25	--	--	--	--	--	--	--	--	--
	Bicarbonate alkalinity	mg/kg	120	111	93%	21	770	--	--	--	--	--	--	--	--	--	--	--
	Carbonate alkalinity	mg/kg	120	28	23%	1	57	25	25	--	--	--	--	--	--	--	--	--
Hydroxide alkalinity	mg/kg	29	0	0%	--	--	--	--	--	--	--	--	--	--	--	--	--	
Flashpoint	Flammables	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons	Diesel	mg/kg	3	0	0%	--	--	26	260	--	--	--	--	--	--	--	--	--
	Gasoline	mg/kg	3	0	0%	--	--	0.1	0.1	--	--	--	--	--	--	--	--	--
	Grease	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Mineral Spirits	mg/kg	3	0	0%	--	--	26	260	--	--	--	--	--	--	--	--	--
White Phosphorus	White phosphorus	mg/kg	--	--	--	--	--	--	--	1.6	--	--	--	--	--	--	--	--
Methyl Mercury	Methyl mercury	mg/kg	--	--	--	--	--	--	--	6.1	--	--	--	--	--	--	--	--

a - Range of detections include estimated values of detect results between the detection limit and reporting limit. As such some minimum detected concentrations may be below the minimum reporting limit. In these cases the respective sample results are flagged in the data set.

b - The quantitation limits shown include samples which had detections. For screening purposes, the detection limit was used for comparison to the screening levels.

c - From USEPA Region 9 preliminary remediation goals (PRG) table, October 2004 (and the 2007 USEPA radionuclide PRG webpage; <http://epa-prgs.ornl.gov/radionuclides>). Values used are residential soil PRGs.

d - From USEPA Region 9 preliminary remediation goals (PRG) table, October 2004 (and the 2007 USEPA radionuclide PRG webpage; <http://epa-prgs.ornl.gov/radionuclides>). Value used is the soil screening level with a dilution attenuation factor of 1.

e - Values used are the maximum from the provisional soils background data set presented in the Background Shallow Soil Summary Report, BMI Complex and Common Area Vicinity (BRC/TIMET 2007, currently in review by the NDEP).

f - Agency for Toxic Substances and Disease Registry (ATSDR) screening value of 50 parts per trillion (ppt).

SSL = soil screening level.

DAF = dilution attenuation factor.

-- = Not applicable or no value has been established.

TABLE 4-7
SUMMARY OF SOILS INVESTIGATIONS - DEEP ZONE SOILS (MUDDY CREEK FORMATION)
BRC CLOSURE PLAN
(Page 1 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd
Ions	Bromide	mg/kg	55	2	4%	1.1	1.4	2.6	5.8	--	--	--	--	--	--	--	--	--
	Bromine	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Chlorate	mg/kg	55	10	18%	2.1	109	2.1	4.7	--	--	--	--	--	--	--	--	--
	Chloride	mg/kg	62	62	100%	16.6	20900	--	--	--	--	--	--	--	--	1110	8	--
	Chlorine (soluble)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Chlorite	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Fluoride	mg/kg	55	44	80%	0.27	16.7	1.2	1.8	3,666	0	0	--	--	--	2.5	31	0
	Nitrate (as N)	mg/kg	55	35	64%	0.16	16	0.21	0.37	--	--	--	--	--	--	102	0	0
	Nitrite (as N)	mg/kg	55	14	25%	0.25	4.8	0.21	1.6	--	--	--	--	--	--	0.21	14	40
	Orthophosphate	mg/kg	55	3	5%	1.4	7.8	5.2	67.1	--	--	--	--	--	--	--	--	--
	Sulfate	mg/kg	62	61	98%	40.8	31300	746	746	--	--	--	--	--	--	4130	19	0
	Sulfite	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perchlorate	mg/kg	138	65	47%	0.0059	5.93	0.00449	0.105	7.8	0	0	--	--	--	--	--	--	
Dissolved Gases	Ethane	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Ethylene	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Methane	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Chlorinated Compounds	Chloral	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Dichloroacetaldehyde	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PCDDs/PCDFs	OCDF	mg/kg	2	1	50%	3.0 E-5	3.0 E-5	3.2 E-7	3.2 E-7	--	--	--	--	--	--	--	--	--
	OCDD	mg/kg	2	1	50%	1.0 E-5	1.0 E-5	2.1 E-6	2.1 E-6	--	--	--	--	--	--	--	--	--
	1,2,3,4,6,7,8-HpCDF	mg/kg	2	1	50%	4.8 E-6	4.8 E-6	2.0 E-7	2.0 E-7	--	--	--	--	--	--	--	--	--
	1,2,3,4,6,7,8-HpCDD	mg/kg	2	1	50%	3.0 E-6	3.0 E-6	2.6 E-7	2.6 E-7	--	--	--	--	--	--	--	--	--
	1,2,3,4,7,8,9-HpCDF	mg/kg	2	0	0%	--	--	2.0 E-7	2.1 E-6	--	--	--	--	--	--	--	--	--
	1,2,3,4,7,8-HxCDF	mg/kg	2	0	0%	--	--	2.3 E-7	2.4 E-6	--	--	--	--	--	--	--	--	--
	1,2,3,4,7,8-HxCDD	mg/kg	2	0	0%	--	--	2.6 E-7	8.5 E-7	--	--	--	--	--	--	--	--	--
	1,2,3,6,7,8-HxCDF	mg/kg	2	0	0%	--	--	9.2 E-8	1.6 E-6	--	--	--	--	--	--	--	--	--
	1,2,3,6,7,8-HxCDD	mg/kg	2	0	0%	--	--	2.1 E-7	1.3 E-6	--	--	--	--	--	--	--	--	--
	1,2,3,7,8,9-HxCDF	mg/kg	2	0	0%	--	--	1.1 E-7	1.3 E-6	--	--	--	--	--	--	--	--	--
	1,2,3,7,8,9-HxCDD	mg/kg	2	0	0%	--	--	2.5 E-7	1.3 E-6	--	--	--	--	--	--	--	--	--
	1,2,3,7,8-PeCDF	mg/kg	2	0	0%	--	--	1.3 E-7	1.0 E-6	--	--	--	--	--	--	--	--	--
	1,2,3,7,8-PeCDD	mg/kg	2	0	0%	--	--	2.3 E-7	1.0 E-6	--	--	--	--	--	--	--	--	--
	2,3,4,6,7,8-HxCDF	mg/kg	2	0	0%	--	--	1.0 E-7	1.5 E-6	--	--	--	--	--	--	--	--	--
	2,3,4,7,8-PeCDF	mg/kg	2	0	0%	--	--	1.3 E-7	1.1 E-6	--	--	--	--	--	--	--	--	--
	2,3,7,8-TCDF	mg/kg	2	0	0%	--	--	1.9 E-7	5.5 E-7	--	--	--	--	--	--	--	--	--
	2,3,7,8-TCDD	mg/kg	2	0	0%	--	--	1.1 E-7	5.7 E-7	3.9 E-6	0	0	--	--	--	--	--	--
	TCDD TEQ	mg/kg	2	1	50%	3.4 E-6	3.4 E-6	5.6 E-7	5.6 E-7	5.0 E-5 ^f	0	0	--	--	--	--	--	--
Asbestos	Asbestos fibers	fibers	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
General Chemistry Parameters	Ammonia (as N)	mg/kg	55	0	0%	--	--	0.52	1.2	--	--	--	--	--	--	--	--	--
	Cyanide (Total)	mg/kg	60	4	7%	1.2	1.9	0.14	1.2	1,222	0	0	--	--	--	--	--	--
	Iodine	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	pH in soil	SU	55	55	100%	7.4	13.9	--	--	--	--	--	--	--	--	--	--	--
	pH in water	SU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Sulfide	mg/kg	55	6	11%	16.9	34.2	10.4	23.3	--	--	--	--	--	--	--	--	--
	Total inorganic carbon	mg/kg	71	69	97%	619	55400	500	646	--	--	--	--	--	--	--	--	--
	Total Kjeldahl nitrogen (TKN)	mg/kg	55	19	35%	56.5	319	3	5.8	--	--	--	--	--	--	--	--	--
	Total organic carbon (TOC)	mg/kg	74	63	85%	690	41500	500	813	--	--	--	--	--	--	--	--	--
Metals	Aluminum	mg/kg	60	60	100%	4070	24200	--	--	76,142	0	--	--	--	--	15300	23	--
	Antimony	mg/kg	61	20	33%	0.24	1.1	0.17	2.3	31	0	0	0.30	15	40	0.5	7	40
	Arsenic	mg/kg	68	67	99%	3.8	175	5	5	0.39	67	1	1.0	67	1	7.2	64	0
	Barium	mg/kg	68	68	100%	13.3	1240	--	--	5,375	0	--	82	49	--	836	1	--
	Beryllium	mg/kg	60	50	83%	0.32	1.6	0.27	1.5	154	0	0	3.0	0	0	0.89	19	1
	Boron	mg/kg	55	55	100%	4.3	119	--	--	16,000	0	--	--	--	--	11.6	52	--
	Cadmium	mg/kg	67	12	18%	0.077	16.2	0.16	3.1	37	0	0	0.40	3	54	0.1291	6	55
	Calcium	mg/kg	62	62	100%	2160	193000	--	--	--	--	--	--	--	--	82800	17	--

TABLE 4-7
SUMMARY OF SOILS INVESTIGATIONS - DEEP ZONE SOILS (MUDDY CREEK FORMATION)
BRC CLOSURE PLAN
(Page 2 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd	
Metals (Continued)	Chromium	mg/kg	68	68	100%	2.8	102	--	--	100,000	0	--	--	--	--	16.7	35	--	
	Cobalt	mg/kg	60	59	98%	2.2	11.5	0.01	0.01	903	0	0	--	--	--	16.3	0	0	
	Copper	mg/kg	60	60	100%	5.5	677	--	--	3,129	0	--	--	--	--	30.5	16	--	
	Iron	mg/kg	67	67	100%	3380	25500	--	--	23,463	4	--	--	--	--	19700	12	--	
	Lead	mg/kg	68	66	97%	1.3	34.3	2.5	3.6	400	0	0	--	--	--	35.1	0	0	
	Lithium	mg/kg	55	55	100%	17	400	--	--	1,564	0	--	--	--	--	26.5	54	--	
	Magnesium	mg/kg	67	67	100%	6000	124000	--	--	--	--	--	--	--	--	17500	59	--	
	Manganese	mg/kg	68	68	100%	61.4	929	--	--	1,762	0	--	--	--	--	1090	0	--	
	Molybdenum	mg/kg	60	57	95%	0.43	512	0.24	5	391	1	0	--	--	--	2	21	1	
	Nickel	mg/kg	60	60	100%	7.7	27.9	--	--	1,564	0	--	7.0	60	--	30	0	--	
	Niobium	mg/kg	55	4	7%	1.8	2.4	1.7	7.9	--	--	--	--	--	--	2.8	0	45	
	Palladium	mg/kg	55	50	91%	0.14	62	0.43	1	--	--	--	--	--	--	1.5	9	0	
	Phosphorus	mg/kg	55	52	95%	154	1330	336	1730	--	--	--	--	--	--	2010	0	0	
	Platinum	mg/kg	55	2	4%	0.093	0.11	0.1	0.23	--	--	--	--	--	--	0.099	1	53	
	Potassium	mg/kg	55	55	100%	1750	12400	--	--	--	--	--	--	--	--	3890	37	--	
	Selenium	mg/kg	67	20	30%	0.08	20.8	0.44	5	391	0	0	0.30	17	47	0.6	10	41	
	Silicon	mg/kg	55	55	100%	110	4280	--	--	--	--	--	--	--	--	4150	1	--	
	Silver	mg/kg	67	29	43%	0.091	0.68	0.09	1.7	391	0	0	2.0	0	0	0.2609	13	13	
	Sodium	mg/kg	62	62	100%	308	4970	--	--	--	--	--	--	--	--	1320	14	--	
	Strontium	mg/kg	55	55	100%	37.6	31600	--	--	46,924	0	--	--	--	--	808	10	--	
	Sulfur	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Thallium	mg/kg	60	3	5%	0.05	4.6	0.47	8.5	5.2	0	4	--	--	--	1.8	1	4	
	Tin	mg/kg	54	35	65%	0.18	1.7	0.29	1.6	46,924	0	0	--	--	--	0.8	8	13	
	Titanium	mg/kg	60	60	100%	110	1190	--	--	100,000	0	--	--	--	--	1010	2	--	
	Tungsten	mg/kg	55	31	56%	0.15	0.95	0.13	0.8	--	--	--	--	--	--	2.5	0	0	
	Uranium	mg/kg	55	55	100%	1.3	105	--	--	16	6	--	--	--	--	2.7	49	--	
	Vanadium	mg/kg	68	68	100%	8	279	--	--	78	2	--	300	0	--	59.1	4	--	
	Zinc	mg/kg	60	60	100%	17	509	--	--	23,463	0	--	620	0	--	121	4	--	
	Zirconium	mg/kg	55	55	100%	4	138	--	--	--	--	--	--	--	--	179	0	--	
	Chromium (VI)	mg/kg	67	2	3%	0.01	0.012	0.005	0.93	30	0	0	2.0	0	0	0.32	0	55	
Mercury	mg/kg	67	7	10%	0.022	0.27	0.0076	0.1	23	0	0	--	--	--	0.11	1	0		
Organo-phosphorous Pesticides	Azinphos-ethyl	mg/kg	59	0	0%	--	--	0.034	0.14534	--	--	--	--	--	--	--	--	--	
	Azinphos-methyl	mg/kg	60	0	0%	--	--	0.014	0.14534	--	--	--	--	--	--	--	--	--	
	Carbophenothion	mg/kg	59	0	0%	--	--	0.034	0.14534	--	--	--	--	--	--	--	--	--	
	Chlorpyrifos	mg/kg	60	1	2%	0.0042	0.0042	0.014	0.14534	183	0	0	--	--	--	--	--	--	
	Coumaphos	mg/kg	60	0	0%	--	--	0.014	0.14534	--	--	--	--	--	--	--	--	--	
	Demeton-O	mg/kg	59	0	0%	--	--	0.014	0.14534	2.4	0	0	--	--	--	--	--	--	
	Demeton-S	mg/kg	59	0	0%	--	--	0.014	0.14534	2.4	0	0	--	--	--	--	--	--	
	Diazinon	mg/kg	60	0	0%	--	--	0.014	0.14534	55	0	0	--	--	--	--	--	--	
	Dichlorvos	mg/kg	60	2	3%	0.0074	0.0074	0.014	0.14534	1.7	0	0	--	--	--	--	--	--	
	Dimethoate	mg/kg	60	1	2%	0.13	0.13	0.014	0.14534	12	0	0	--	--	--	--	--	--	
	Disulfoton	mg/kg	60	1	2%	0.004	0.004	0.014	0.14534	2.4	0	0	--	--	--	--	--	--	
	EPN	mg/kg	59	0	0%	--	--	0.014	0.14534	0.61	0	0	--	--	--	--	--	--	
	Ethoprop	mg/kg	60	2	3%	0.005	0.0057	0.014	0.14534	--	--	--	--	--	--	--	--	--	
	Ethyl parathion	mg/kg	60	0	0%	--	--	0.014	0.14534	367	0	0	--	--	--	--	--	--	
	Famphur	mg/kg	60	0	0%	--	--	0.014	0.14534	--	--	--	--	--	--	--	--	--	
	Fenthion	mg/kg	60	0	0%	--	--	0.014	0.14534	--	--	--	--	--	--	--	--	--	
	Malathion	mg/kg	60	1	2%	0.0053	0.0053	0.014	0.14534	1,222	0	0	--	--	--	--	--	--	
	Methyl carbophenothion	mg/kg	55	0	0%	--	--	0.034	0.12	--	--	--	--	--	--	--	--	--	
	Methyl parathion	mg/kg	60	0	0%	--	--	0.014	0.14534	15	0	0	--	--	--	--	--	--	
	Mevinphos	mg/kg	60	0	0%	--	--	0.014	0.14534	--	--	--	--	--	--	--	--	--	
Naled	mg/kg	60	0	0%	--	--	0.034	0.14534	122	0	0	--	--	--	--	--	--		

TABLE 4-7
SUMMARY OF SOILS INVESTIGATIONS - DEEP ZONE SOILS (MUDDY CREEK FORMATION)
BRC CLOSURE PLAN
(Page 3 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd	
Organo-phosphorous Pesticides (Continued)	O,O,O-Triethyl phosphorothioate (TEPP)	mg/kg	56	0	0%	--	--	0.014	0.048	--	--	--	--	--	--	--	--	--	
	Phorate	mg/kg	60	2	3%	0.0046	0.0049	0.014	0.14534	12	0	0	--	--	--	--	--	--	
	Phosmet	mg/kg	59	0	0%	--	--	0.07	0.25	1,222	0	0	--	--	--	--	--	--	
	Ronnel	mg/kg	60	2	3%	0.0033	0.0037	0.07	0.25	3,055	0	0	--	--	--	--	--	--	
	Stirophos (Tetrachlorovinphos)	mg/kg	60	3	5%	--	--	0.014	0.14534	20	0	0	--	--	--	--	--	--	
	Sulfotep	mg/kg	60	2	3%	0.0041	0.0051	0.014	0.14534	31	0	0	--	--	--	--	--	--	
Chlorinated Herbicides	2,4,5-T	mg/kg	55	0	0%	--	--	0.021	0.047	611	0	0	--	--	--	--	--	--	
	2,4,5-TP (Silvex)	mg/kg	55	0	0%	--	--	0.021	0.047	489	0	0	--	--	--	--	--	--	
	2,4-D	mg/kg	55	0	0%	--	--	0.083	0.19	686	0	0	--	--	--	--	--	--	
	2,4-DB	mg/kg	55	0	0%	--	--	0.083	0.19	489	0	0	--	--	--	--	--	--	
	Dalapon	mg/kg	55	0	0%	--	--	0.042	0.093	1,833	0	0	--	--	--	--	--	--	
	Dicamba	mg/kg	55	0	0%	--	--	0.042	0.093	1,833	0	0	--	--	--	--	--	--	--
	Dichloroprop	mg/kg	55	0	0%	--	--	0.083	0.19	--	--	--	--	--	--	--	--	--	
	Dinoseb	mg/kg	55	0	0%	--	--	0.014	0.058	61	0	0	--	--	--	--	--	--	
	MCPA	mg/kg	55	0	0%	--	--	8.3	19	31	0	0	--	--	--	--	--	--	
	MCPP	mg/kg	--	--	--	--	--	--	--	61	--	--	--	--	--	--	--	--	--
Organic Acids	4-Chlorobenzene sulfonic acid	mg/kg	57	1	2%	6.5	6.5	1	1	--	--	--	--	--	--	--	--	--	
	Benzenesulfonic acid	mg/kg	57	0	0%	--	--	1	1	--	--	--	--	--	--	--	--	--	
	O,O-Diethylphosphorodithioic acid	mg/kg	57	0	0%	--	--	1	1	--	--	--	--	--	--	--	--	--	
	O,O-Dimethylphosphorodithioic acid	mg/kg	57	2	4%	6.5	14	1	1	--	--	--	--	--	--	--	--	--	
Nonhalogenated Organics	Ethylene glycol	mg/kg	55	0	0%	--	--	52	750	100,000	0	0	--	--	--	--	--	--	
	Ethylene glycol monobutyl ether	mg/kg	--	--	--	--	--	--	--	30,552	--	--	--	--	--	--	--	--	
	Methanol	mg/kg	55	2	4%	7.1	530	52	130	30,552	0	0	--	--	--	--	--	--	
	Propylene glycol	mg/kg	55	0	0%	--	--	52	750	30,034	0	0	--	--	--	--	--	--	
Organochlorine Pesticides	2,4-DDD	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
	2,4-DDE	mg/kg	55	0	0%	--	--	0.0018	0.023	--	--	--	--	--	--	--	--	--	
	4,4-DDD	mg/kg	68	2	3%	0.0044	0.0051	0.0007	0.023	2.4	0	0	0.8	0	0	--	--	--	
	4,4-DDE	mg/kg	68	5	7%	0.0053	0.019	0.00096	0.023	1.7	0	0	3.0	0	0	--	--	--	
	4,4-DDT	mg/kg	68	11	16%	0.0037	0.021	0.00076	0.023	1.7	0	0	2.0	0	0	--	--	--	
	Aldrin	mg/kg	68	0	0%	--	--	0.00072	0.023	0.029	0	0	0.02	0	2	--	--	--	
	alpha-BHC	mg/kg	68	13	19%	0.0023	0.03	0.00083	0.023	0.090	0	0	0.00003	13	55	--	--	--	
	alpha-Chlordane	mg/kg	68	0	0%	--	--	0.00049	0.023	1.6	0	0	0.5	0	0	--	--	--	
	beta-BHC	mg/kg	68	5	7%	0.0024	0.0084	0.00078	0.023	0.32	0	0	0.0001	5	63	--	--	--	
	Chlordane	mg/kg	63	0	0%	--	--	0.018	0.23	1.6	0	0	0.5	0	0	--	--	--	
	delta-BHC	mg/kg	68	0	0%	--	--	0.00048	0.023	--	--	--	--	--	--	--	--	--	
	Dieldrin	mg/kg	68	0	0%	--	--	0.00063	0.023	0.030	0	0	0.0002	0	68	--	--	--	
	Endosulfan I	mg/kg	68	0	0%	--	--	0.00055	0.023	367	0	0	0.9	0	0	--	--	--	
	Endosulfan II	mg/kg	68	3	4%	0.01	0.038	0.00069	0.023	367	0	0	0.9	0	0	--	--	--	
	Endosulfan sulfate	mg/kg	68	0	0%	--	--	0.00058	0.023	--	--	--	--	--	--	--	--	--	
	Endrin	mg/kg	68	0	0%	--	--	0.00061	0.023	18	0	0	0.05	0	0	--	--	--	
	Endrin aldehyde	mg/kg	68	0	0%	--	--	0.0012	0.023	--	--	--	--	--	--	--	--	--	
	Endrin ketone	mg/kg	67	0	0%	--	--	0.00058	0.023	--	--	--	--	--	--	--	--	--	
	gamma-BHC (Lindane)	mg/kg	68	12	18%	0.0027	0.014	0.00064	0.023	0.44	0	0	0.0005	12	56	--	--	--	
	gamma-Chlordane	mg/kg	68	1	1%	0.024	0.024	0.001	0.023	1.6	0	0	0.5	0	0	--	--	--	
	Heptachlor	mg/kg	68	0	0%	--	--	0.00066	0.023	0.11	0	0	1.0	0	0	--	--	--	
	Heptachlor epoxide	mg/kg	68	0	0%	--	--	0.00051	0.023	0.053	0	0	0.03	0	0	--	--	--	
	Methoxychlor	mg/kg	68	19	28%	0.0068	0.16	0.0014	0.045	306	0	0	8.0	0	0	--	--	--	
Toxaphene	mg/kg	68	0	0%	--	--	0.046	0.92	0.44	0	2	2.0	0	0	--	--	--		
Polychlorinated Biphenyls	Aroclor 1016	mg/kg	67	0	0%	--	--	0.02	0.077	3.9	0	0	--	--	--	--	--	--	
	Aroclor 1221	mg/kg	67	0	0%	--	--	0.02	0.077	--	--	--	--	--	--	--	--	--	
	Aroclor 1232	mg/kg	67	0	0%	--	--	0.02	0.077	--	--	--	--	--	--	--	--	--	
	Aroclor 1242	mg/kg	67	0	0%	--	--	0.02	0.077	--	--	--	--	--	--	--	--	--	
	Aroclor 1248	mg/kg	67	0	0%	--	--	0.02	0.077	--	--	--	--	--	--	--	--	--	
	Aroclor 1254	mg/kg	67	0	0%	--	--	0.02	0.077	0.22	--	0	0	--	--	--	--	--	

TABLE 4-7
SUMMARY OF SOILS INVESTIGATIONS - DEEP ZONE SOILS (MUDDY CREEK FORMATION)
BRC CLOSURE PLAN
(Page 4 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd
Polychlorinated Biphenyls (Continued)	Aroclor 1260	mg/kg	67	0	0%	--	--	0.02	0.077	--	--	--	--	--	--	--	--	--
	PCB-77	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-81	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-105	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-114	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-118	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-123	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-126	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-156	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-157	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-167	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-169	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	PCB-189	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Polynuclear Aromatic Hydrocarbons	Acenaphthene	mg/kg	60	0	0%	--	--	0.052	0.56	3,682	0	0	29	0	0	--	--	--
	Acenaphthylene	mg/kg	60	0	0%	--	--	0.1	0.56	--	--	--	--	--	--	--	--	--
	Anthracene	mg/kg	60	0	0%	--	--	0.031	0.56	21,896	0	0	590	0	0	--	--	--
	Benzo(a)anthracene	mg/kg	60	0	0%	--	--	0.016	0.56	0.62	0	1	0.08	0	59	--	--	--
	Benzo(a)pyrene	mg/kg	60	1	2%	0.29	0.29	0.016	0.56	0.062	1	58	0.4	0	53	--	--	--
	Benzo(b)fluoranthene	mg/kg	60	0	0%	--	--	0.016	0.56	0.62	0	1	0.2	0	59	--	--	--
	Benzo(g,h,i)perylene	mg/kg	60	0	0%	--	--	0.031	0.56	--	--	--	--	--	--	--	--	--
	Benzo(k)fluoranthene	mg/kg	60	0	0%	--	--	0.016	0.56	6.2	0	0	2.0	0	0	--	--	--
	Chrysene	mg/kg	60	0	0%	--	--	0.016	0.56	62	0	0	8.0	0	0	--	--	--
	Dibenzo(a,h)anthracene	mg/kg	60	0	0%	--	--	0.031	0.56	0.062	0	59	0.08	0	59	--	--	--
	Indeno(1,2,3-cd)pyrene	mg/kg	60	0	0%	--	--	0.016	0.56	0.62	0	1	0.7	0	1	--	--	--
	Phenanthrene	mg/kg	60	0	0%	--	--	0.031	0.56	--	--	--	--	--	--	--	--	--
	Pyrene	mg/kg	60	0	0%	--	--	0.031	0.56	2,316	0	0	210	0	0	--	--	--
Radionuclides	Gross alpha	pCi/g	56	54	96%	10.3	146	20.6	33	--	--	--	--	--	--	--	--	--
	Gross beta	pCi/g	56	47	84%	18.9	103	15.8	41.9	--	--	--	--	--	--	--	--	--
	Actinium-228	pCi/g	56	29	52%	0.56	1.88	0.1	1.99	732	0	0	--	--	--	3.4	0	0
	Bismuth-212	pCi/g	56	3	5%	1.34	1.56	-0.49	2.1	22,600	0	0	--	--	--	1.82	0	1
	Bismuth-214	pCi/g	56	52	93%	0.5	8.6	0.92	4.56	8,190	0	0	--	--	--	1.62	34	1
	Cobalt-57	pCi/g	55	0	0%	--	--	-0.057	0.07	8.7	0	0	8.4	0	0	0.08	0	0
	Cobalt-60	pCi/g	55	0	0%	--	--	-0.1	0.072	0.036	0	11	0.12	0	0	0.164	0	0
	Lead-210	pCi/g	56	17	30%	1.52	11.3	0.2	5.6	0.15	17	39	0.0006	17	39	2.2	15	17
	Lead-211	pCi/g	--	--	--	--	--	--	--	>100,000	--	--	--	--	--	0.4	--	--
	Lead-212	pCi/g	56	50	89%	0.25	1.72	0.19	1.46	3,640	0	0	>100,000	0	0	2.11	0	0
	Lead-214	pCi/g	56	53	95%	0.68	9.6	1.15	1.47	46,300	0	0	>100,000	0	0	1.72	36	0
	Potassium-40	pCi/g	56	50	89%	5.6	33.1	6.5	23.4	0.11	50	6	--	--	--	35	0	0
	Thallium-208	pCi/g	56	39	70%	0.118	0.58	-0.07	0.52	22,600	0	0	--	--	--	0.72	0	0
	Thorium-227	pCi/g	--	--	--	--	--	--	--	113	--	--	3,340	--	--	0.4	--	--
	Thorium-234	pCi/g	56	43	77%	0.79	18.4	0.81	5.4	1,330	0	0	4,130	0	0	2.5	25	3
	Thorium-232	pCi/g	56	56	100%	0.178	18.2	0	0	3.1	1	--	0.30	54	--	2.23	1	--
	Thorium-228	pCi/g	56	54	96%	0.28	2.18	0.17	1.12	0.15	54	2	3.3	0	0	2.28	0	0
	Thorium-230	pCi/g	56	55	98%	1.04	11.9	1.7	1.7	3.5	15	0	0.30	55	1	3.01	21	0
	Uranium-233/234	pCi/g	56	55	98%	0.59	11.9	1.55	1.55	4.0	10	0	112	0	0	2.84	21	0
	Uranium-235/236	pCi/g	56	33	59%	0.053	1.81	0.023	0.15	0.20	9	0	0.039	33	19	0.21	7	0
	Uranium-238	pCi/g	56	56	100%	0.54	20.5	0	0	0.74	55	--	0.006	56	--	2.37	26	--
	Radium-226	pCi/g	57	56	98%	0.008	9.4	1.95	1.95	0.012	55	1	0.016	55	1	2.36	33	0
	Radium-228	pCi/g	57	49	86%	0.61	4.09	0.09	2	0.068	49	8	0.059	49	8	2.94	2	0
	Actinium-227 (from Th-227)	pCi/g	--	--	--	--	--	--	--	0.10	--	--	--	--	--	0.4	--	--
	Bismuth-210 (from Pb-210)	pCi/g	55	17	31%	1.52	11.3	0.2	5.6	4,800	17	38	--	--	--	2.2	15	16
	Bismuth-211 (from Pb-211)	pCi/g	--	--	--	--	--	--	--	>100,000	--	--	--	--	--	0.4	--	--
Polonium-210 (from Pb-210)	pCi/g	55	17	31%	1.52	11.3	0.2	5.6	38	0	0	--	--	--	2.2	15	16	
Polonium-212 (from Bi-212)	pCi/g	55	3	5%	0.86	1	-0.31	1.08	--	--	--	--	--	--	1.17	0	0	

TABLE 4-7
SUMMARY OF SOILS INVESTIGATIONS - DEEP ZONE SOILS (MUDDY CREEK FORMATION)
BRC CLOSURE PLAN
(Page 6 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd
Semivolatiles Organic Compounds (Continued)	Carbazole	mg/kg	60	0	0%	--	--	0.34	0.77	24	0	0	0.0	0	59	--	--	--
	Dibenzofuran	mg/kg	60	0	0%	--	--	0.34	0.77	145	0	0	--	--	--	--	--	--
	Dichloromethyl ether	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Diethyl phthalate	mg/kg	60	0	0%	--	--	0.34	0.77	48,882	0	0	--	--	--	--	--	--
	Dimethyl phthalate	mg/kg	60	0	0%	--	--	0.34	0.77	100,000	0	0	--	--	--	--	--	--
	Di-n-butyl phthalate	mg/kg	60	0	0%	--	--	0.068	0.77	6,110	0	0	270	0	0	--	--	--
	Di-n-octyl phthalate	mg/kg	60	0	0%	--	--	0.34	0.77	2,444	0	0	10,000	0	0	--	--	--
	Diphenyl disulfide	mg/kg	55	0	0%	--	--	0.34	0.77	--	--	--	--	--	--	--	--	--
	Diphenyl sulfide	mg/kg	55	0	0%	--	--	0.34	0.77	--	--	--	--	--	--	--	--	--
	Diphenyl sulfone	mg/kg	55	0	0%	--	--	0.34	0.77	183.3	0	0	--	--	--	--	--	--
	Fluoranthene	mg/kg	60	0	0%	--	--	0.34	0.77	2,294	0	0	210	0	0	--	--	--
	Fluorene	mg/kg	60	0	0%	--	--	0.34	0.77	2,747	0	0	28	0	0	--	--	--
	Hexachlorobenzene	mg/kg	60	0	0%	--	--	0.34	0.77	0.30	0	59	0.1	0	59	--	--	--
	Hexachlorobutadiene	mg/kg	62	0	0%	--	--	0.005	0.77	6.2	0	0	0.1	0	59	--	--	--
	Hexachlorocyclopentadiene	mg/kg	60	0	0%	--	--	1.7	3.7	365	0	0	20	0	0	--	--	--
	Hexachloroethane	mg/kg	60	0	0%	--	--	0.34	0.77	35	0	0	0.02	0	59	--	--	--
	Hydroxymethyl phthalimide	mg/kg	55	0	0%	--	--	0.34	0.77	--	--	--	--	--	--	--	--	--
	Isophorone	mg/kg	60	0	0%	--	--	0.34	0.77	512	0	0	0.03	0	59	--	--	--
	m,p-Cresol	mg/kg	60	0	0%	--	--	0.38	1.5	306	0	0	--	--	--	--	--	--
	Naphthalene	mg/kg	62	0	0%	--	--	0.01	0.77	56	0	0	4.0	0	0	--	--	--
	Nitrobenzene	mg/kg	60	0	0%	--	--	0.34	0.77	20	0	0	0.007	0	59	--	--	--
	N-nitrosodi-n-propylamine	mg/kg	60	0	0%	--	--	0.34	0.77	0.069	0	59	0.000002	0	59	--	--	--
	N-nitrosodiphenylamine	mg/kg	60	0	0%	--	--	0.34	0.77	99	0	0	0.06	0	59	--	--	--
	o-Cresol	mg/kg	60	0	0%	--	--	0.34	0.77	3,055	0	0	0.8	0	0	--	--	--
	Octachlorostyrene	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	p-Chloroaniline (4-Chloroaniline)	mg/kg	60	0	0%	--	--	0.34	0.77	244	0	0	0.03	0	59	--	--	--
	p-Chlorobenzenethiol	mg/kg	55	0	0%	--	--	0.34	0.77	--	--	--	--	--	--	--	--	--
	Pentachlorobenzene	mg/kg	55	0	0%	--	--	0.34	0.77	49	0	0	--	--	--	--	--	--
	Pentachlorophenol	mg/kg	60	0	0%	--	--	1.7	3.7	3.0	0	1	0.001	0	59	--	--	--
	Phenol	mg/kg	60	0	0%	--	--	0.064	0.77	18,331	0	0	5.0	0	0	--	--	--
Phthalic acid	mg/kg	57	0	0%	--	--	0.34	1	61,103	0	0	--	--	--	--	--	--	
Pyridine	mg/kg	55	0	0%	--	--	0.69	1.5	61	0	0	--	--	--	--	--	--	
Thiophenol	mg/kg	55	0	0%	--	--	0.34	0.77	--	--	--	--	--	--	--	--	--	
Tentatively Identified Compounds (TICs)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
Volatile Organic Compounds	1,1,1,2-Tetrachloroethane	mg/kg	56	0	0%	--	--	0.005	0.02	3.2	0	0	--	--	--	--	--	
	1,1,1-Trichloroethane	mg/kg	60	1	2%	0.0002	0.0002	0.005	0.02	1,200	0	0	0.1	0	0	--	--	
	1,1,2,2-Tetrachloroethane	mg/kg	60	0	0%	--	--	0.005	0.02	0.41	0	0	0.0002	0	59	--	--	
	1,1,2-Trichloroethane	mg/kg	60	0	0%	--	--	0.005	0.02	0.73	0	0	0.0009	0	59	--	--	
	1,1-Dichloroethane	mg/kg	60	0	0%	--	--	0.005	0.02	506	0	0	1.0	0	0	--	--	
	1,1-Dichloroethene	mg/kg	59	0	0%	--	--	0.0058	0.02	124	0	0	0.003	0	58	--	--	
	1,1-Dichloropropene	mg/kg	56	0	0%	--	--	0.005	0.02	--	--	--	--	--	--	--	--	
	1,2,3-Trichlorobenzene	mg/kg	56	0	0%	--	--	0.005	0.1	--	--	--	--	--	--	--	--	
	1,2,3-Trichloropropane	mg/kg	56	0	0%	--	--	0.005	0.1	0.034	0	1	--	--	--	--	--	
	1,2,4-Trichlorobenzene	mg/kg	61	2	3%	0.0013	0.0016	0.005	0.56	62	0	0	0.3	0	4	--	--	
	1,2,4-Trimethylbenzene	mg/kg	56	3	5%	0.00074	0.0013	0.005	0.02	52	0	0	--	--	--	--	--	
	1,2-Dichlorobenzene	mg/kg	60	1	2%	0.0027	0.0027	0.005	0.48	600	0	0	0.9	0	0	--	--	
	1,2-Dichloroethane	mg/kg	60	0	0%	--	--	0.005	0.02	0.28	0	0	0.001	0	59	--	--	
	1,2-Dichloroethene	mg/kg	54	0	0%	--	--	0.006	0.016	--	--	--	--	--	--	--	--	
	1,2-Dichloropropane	mg/kg	60	0	0%	--	--	0.005	0.02	0.34	0	0	0.001	0	59	--	--	
	1,3,5-Trichlorobenzene	mg/kg	54	0	0%	--	--	0.0052	0.016	--	--	--	--	--	--	--	--	
	1,3,5-Trimethylbenzene	mg/kg	56	0	0%	--	--	0.005	0.1	21	0	0	--	--	--	--	--	
	1,3-Dichlorobenzene	mg/kg	60	0	0%	--	--	0.005	0.48	531	0	0	--	--	--	--	--	
	1,3-Dichloropropene (see cis-, trans-)	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	1,3-Dichloropropane	mg/kg	56	0	0%	--	--	0.005	0.02	105	0	0	--	--	--	--	--	

TABLE 4-7
SUMMARY OF SOILS INVESTIGATIONS - DEEP ZONE SOILS (MUDDY CREEK FORMATION)
BRC CLOSURE PLAN
(Page 8 of 8)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	Residential PRG ^c	Count of Detects > PRG	Count of Non-Detects > PRG	SSL (DAF 1) ^d	Count of Detects > SSL	Count of Non-Detects > SSL	Background ^e	Count of Detects > Bkgrnd	Count of Non-Detects > Bkgrnd
Volatile Organic Compounds (Continued)	o-Xylene	mg/kg	56	3	5%	0.00042	0.00068	0.005	0.02	--	--	--	--	--	--	--	--	--
	sec-Butylbenzene	mg/kg	56	0	0%	--	--	0.005	0.02	220	0	0	--	--	--	--	--	--
	Styrene	mg/kg	60	0	0%	--	--	0.005	0.02	1,700	0	0	0.2	0	0	--	--	--
	tert-Butylbenzene	mg/kg	56	0	0%	--	--	0.005	0.02	390	0	0	--	--	--	--	--	--
	Tetrachloroethene	mg/kg	60	25	42%	0.00033	0.038	0.00039	0.02	0.48	0	0	0.003	5	34	--	--	--
	Toluene	mg/kg	60	11	18%	0.00093	0.0039	0.00059	0.02	520	0	0	0.6	0	0	--	--	--
	trans-1,2-Dichloroethene	mg/kg	60	0	0%	--	--	0.0029	0.02	69	0	0	0.03	0	0	--	--	--
	trans-1,3-Dichloropropene	mg/kg	60	0	0%	--	--	0.005	0.02	0.78	0	0	0.0002	0	1	--	--	--
	Trichloroethene	mg/kg	60	14	23%	0.00017	0.0016	0.005	0.02	0.053	0	0	0.003	0	45	--	--	--
	Vinyl acetate	mg/kg	59	0	0%	--	--	0.0058	0.2	426	0	0	8.0	0	0	--	--	--
	Vinyl chloride	mg/kg	60	0	0%	--	--	0.00086	0.02	0.079	0	0	0.0007	0	60	--	--	--
	Xylenes (total)	mg/kg	58	4	7%	0.0012	0.0027	0.0012	0.031	271	0	0	10	0	0	--	--	--
	Tentatively Identified Compounds (TICs)		mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Water Quality Parameters	Conductivity	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Hardness, total	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Total dissolved solids	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Total suspended solids	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Alkalinity, Total (as CaCO ₃)	mg/kg	7	4	57%	32	78	25	25	--	--	--	--	--	--	--	--	--
	Bicarbonate alkalinity	mg/kg	7	4	57%	23	74	--	--	--	--	--	--	--	--	--	--	--
	Carbonate alkalinity	mg/kg	7	4	57%	3	23	--	--	--	--	--	--	--	--	--	--	--
Hydroxide alkalinity	mg/kg	7	0	0%	--	--	--	--	--	--	--	--	--	--	--	--	--	
Flashpoint	Flammables	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Petroleum Hydrocarbons	Diesel	mg/kg	1	0	0%	--	--	40	40	--	--	--	--	--	--	--	--	--
	Gasoline	mg/kg	1	0	0%	--	--	40	40	--	--	--	--	--	--	--	--	--
	Grease	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	Mineral Spirits	mg/kg	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
White Phosphorus	White phosphorus	mg/kg	--	--	--	--	--	--	--	1.6	--	--	--	--	--	--	--	--
Methyl Mercury	Methyl mercury	mg/kg	--	--	--	--	--	--	--	6.1	--	--	--	--	--	--	--	--

a - Range of detections include estimated values of detect results between the detection limit and reporting limit. As such some minimum detected concentrations may be below the minimum reporting limit. In these cases the respective sample results are flagged in the data set.

b - The quantitation limits shown include samples which had detections. For screening purposes, the detection limit was used for comparison to the screening levels.

c - From USEPA Region 9 preliminary remediation goals (PRG) table, October 2004 (and the 2007 USEPA radionuclide PRG webpage; <http://epa-prgs.ornl.gov/radionuclides>). Values used are residential soil PRGs.

d - From USEPA Region 9 preliminary remediation goals (PRG) table, October 2004 (and the 2007 USEPA radionuclide PRG webpage; <http://epa-prgs.ornl.gov/radionuclides>). Value used is the soil screening level with a dilution attenuation factor of 1.

e - Values used are the maximum from the provisional soils background data set presented in the Background Shallow Soil Summary Report, BMI Complex and Common Area Vicinity (BRC/TIMET 2007, currently in review by the NDEP).

f - Agency for Toxic Substances and Disease Registry (ATSDR) screening value of 50 parts per trillion (ppt).

SSL = soil screening level.

DAF = dilution attenuation factor.

-- = Not applicable or no value has been established.

TABLE 4-8
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – ALL DATA
BRC CLOSURE PLAN
(Page 1 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Ions	Bromide	mg/L	60	13	22%	0.18	248	0.25	125	--	--	--	--	--	--
	Bromine	mg/L	60	13	22%	0.35	496	0.5	250	--	--	--	--	--	--
	Chlorate	mg/L	60	20	33%	1.5	338	2	20	--	--	--	--	--	--
	Chloride	mg/L	60	57	95%	114	54000	0.2	10000	250	49	1	--	--	--
	Chlorine (soluble)	mg/L	60	57	95%	228	80400	0.4	20000	--	--	--	--	--	--
	Chlorite	mg/L	49	6	12%	0.04	0.098	0.1	100	1000	0	10	--	--	--
	Fluoride	mg/L	60	45	75%	0.45	148	0.1	60.3	4	3	8	2.2	9	8
	Nitrate (as N)	mg/L	53	37	70%	0.066	235	0.02	11.6	10	16	2	10	16	2
	Nitrite (as N)	mg/L	50	3	6%	8.7	532	0.02	100	1	3	41	1	3	41
	Orthophosphate	mg/L	50	16	32%	1.3	429	0.5	318	--	--	--	--	--	--
	Sulfate	mg/L	60	56	93%	187	76800	0.5	5000	250	55	1	--	--	--
Perchlorate	mg/L	60	41	68%	0.0033	30	0.004	2	0.0245 ^e	36	9	0.018 ^f	37	12	
Dissolved Gases	Ethane	mg/L	60	1	2%	0.00058	0.00058	0.005	0.005	--	--	--	--	--	--
	Ethylene	mg/L	60	9	15%	0.00045	0.006	0.005	0.005	--	--	--	--	--	--
	Methane	mg/L	60	33	55%	0.00022	0.19	0.005	0.005	--	--	--	--	--	--
General Chemistry	Ammonia (as N)	mg/L	60	23	38%	0.026	51	0.05	50	--	--	--	--	--	--
	Iodine	mg/L	60	3	5%	0.54	261	1	50	--	--	--	--	--	--
	pH in water	SU	60	60	100%	5.8	8.9	0.1	0.1	6.5-8.5	4	--	6.5-9 ^g	4	--
	Total inorganic carbon	mg/L	50	7	14%	56.8	86.2	50	50	--	--	--	--	--	--
	Total Kjeldahl nitrogen (TKN)	mg/L	58	44	76%	0.099	112	0.1	0.66	--	--	--	--	--	--
Total organic carbon (TOC)	mg/L	60	0	0%	--	--	50	50	--	--	--	--	--	--	
Metals	Aluminum	mg/L	60	11	18%	0.202	13.3	0.15	15	0.05	11	49	36	0	0
	Antimony	mg/L	60	0	0%	--	--	0.025	2.5	0.006	--	60	0.015	--	60
	Arsenic	mg/L	60	30	50%	0.0203	0.142	0.05	5	0.01	30	30	0.000045	30	30
	Barium	mg/L	60	57	95%	0.0097	0.301	0.01	1	2	0	0	2.6	0	0
	Beryllium	mg/L	60	0	0%	--	--	0.0025	0.25	0.004	--	53	0.073	--	4
	Boron	mg/L	60	57	95%	0.696	21	0.25	25	--	--	--	7.3	6	0
	Cadmium	mg/L	60	4	7%	0.00092	0.0534	0.0025	0.25	0.005	1	36	0.018	1	6
	Calcium	mg/L	60	60	100%	22.6	723	0.5	50	--	--	--	--	--	--
	Chromium	mg/L	60	14	23%	0.0145	0.387	0.05	5	0.1	8	27	55	0	0
	Cobalt	mg/L	60	12	20%	0.0018	0.0337	0.01	1	--	--	--	0.73	0	1
	Copper	mg/L	60	46	77%	0.0018	0.462	0.005	0.5	1.3	0	0	1.5	0	0
	Iron	mg/L	31	9	29%	0.239	10.3	0.25	25	0.3	8	18	11	0	1
	Lead	mg/L	60	1	2%	0.007	0.007	0.015	1.5	0.015	0	52	--	--	--
	Lithium	mg/L	60	38	63%	0.102	72.5	0.05	8.69	--	--	--	0.73	12	2
	Magnesium	mg/L	60	60	100%	7.45	16100	0.25	50	--	--	--	--	--	--
	Manganese	mg/L	60	33	55%	0.0018	4.17	0.01	1	0.05	23	1	0.88	10	0
	Molybdenum	mg/L	60	58	97%	0.0102	2.17	0.025	2.5	--	--	--	0.18	13	0
	Nickel	mg/L	60	51	85%	0.0032	0.101	0.025	2.5	--	--	--	0.73	0	4
	Niobium	mg/L	60	1	2%	0.0878	0.0878	0.125	25	--	--	--	--	--	--
	Palladium	mg/L	60	57	95%	0.0013	0.0433	0.0025	0.25	--	--	--	--	--	--
	Phosphorus	mg/L	60	4	7%	0.154	1.44	0.02	10	--	--	--	--	--	--
	Platinum	mg/L	60	0	0%	--	--	0.005	0.5	--	--	--	--	--	--
	Potassium	mg/L	60	60	100%	6.78	16700	0.5	100	--	--	--	--	--	--
	Selenium	mg/L	60	10	17%	0.0054	0.131	0.025	2.5	0.05	2	27	0.18	0	5
	Silicon	mg/L	60	58	97%	0.599	55.8	1.25	125	--	--	--	--	--	--
	Silver	mg/L	60	1	2%	0.0021	0.0021	0.01	1	0.1	0	5	0.18	0	5
	Sodium	mg/L	60	60	100%	141	45000	0.25	50	--	--	--	--	--	--
	Strontium	mg/L	60	60	100%	0.431	15.1	0.025	2.5	--	--	--	22	0	--
	Sulfur	mg/L	60	60	100%	58	19900	2	200	--	--	--	--	--	--
	Thallium	mg/L	60	4	7%	0.0025	0.0122	0.01	1	0.002	4	56	0.0024	4	56
	Tin	mg/L	60	0	0%	--	--	0.01	1	--	--	--	22	--	0
	Titanium	mg/L	60	30	50%	0.0045	0.58	0.01	1	--	--	--	146	0	0
	Tungsten	mg/L	60	8	13%	0.0034	0.0295	0.025	2.5	--	--	--	--	--	--
Uranium	mg/L	60	43	72%	0.0015	0.0838	0.005	0.5	0.03	22	6	0.0073	36	17	

TABLE 4-8
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – ALL DATA
BRC CLOSURE PLAN
(Page 2 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Metals (Continued)	Vanadium	mg/L	60	15	25%	0.009	0.12	0.05	5	--	--	--	0.036	7	45
	Zinc	mg/L	60	38	63%	0.02	1.65	0.05	5	0.5	4	0	11	0	0
	Zirconium	mg/L	60	0	0%	--	--	0.1	25	--	--	--	--	--	--
	Chromium (VI)	mg/L	60	33	55%	0.011	0.3	0.01	0.01	--	--	--	0.11	4	0
	Mercury	mg/L	60	1	2%	0.00025	0.00025	0.0002	0.00033	0.002	0	0	0.011	0	0
Organo-phosphorous Pesticides	Azinphos-ethyl	mg/L	60	0	0%	--	--	0.0006	0.0006	--	--	--	--	--	--
	Azinphos-methyl	mg/L	60	0	0%	--	--	0.0025	0.0025	--	--	--	--	--	--
	Carbophenothion	mg/L	60	0	0%	--	--	0.0006	0.0006	--	--	--	--	--	--
	Chlorpyrifos	mg/L	60	0	0%	--	--	0.0005	0.0005	--	--	--	0.11	--	0
	Coumaphos	mg/L	60	0	0%	--	--	0.0005	0.0005	--	--	--	--	--	--
	Demeton-O	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	0.0015	--	0
	Demeton-S	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	0.0015	--	0
	Diazinon	mg/L	60	0	0%	--	--	0.0005	0.0005	--	--	--	0.033	--	0
	Dichlorvos	mg/L	60	0	0%	--	--	0.0005	0.0005	--	--	--	0.00023	--	60
	Dimethoate	mg/L	60	0	0%	--	--	0.0005	0.0005	--	--	--	0.0073	--	0
	Disulfoton	mg/L	60	0	0%	--	--	0.0005	0.0005	--	--	--	0.0015	--	0
	EPN	mg/L	60	0	0%	--	--	0.0005	0.0005	--	--	--	--	--	--
	Ethoprop	mg/L	60	0	0%	--	--	0.0005	0.0005	--	--	--	0.00036	--	60
	Ethyl parathion	mg/L	60	0	0%	--	--	0.0005	0.0005	--	--	--	0.22	--	0
	Famphur	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	Fenthion	mg/L	60	0	0%	--	--	0.0025	0.0025	--	--	--	--	--	--
	Malathion	mg/L	60	0	0%	--	--	0.0012	0.0012	--	--	--	0.73	--	0
	Methyl carbophenothion	mg/L	60	0	0%	--	--	0.0008	0.0008	--	--	--	--	--	--
	Methyl parathion	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	0.0091	--	0
	Mevinphos	mg/L	60	0	0%	--	--	0.0062	0.0062	--	--	--	--	--	--
	Naled	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.073	--	0
	O,O,O-Triethyl phosphorothioate (TEPP)	mg/L	60	1	2%	0.00016	0.00016	0.0005	0.0005	--	--	--	--	--	--
	Phorate	mg/L	60	0	0%	--	--	0.0012	0.0012	--	--	--	0.0073	--	0
Phosmet	mg/L	60	0	0%	--	--	0.0012	0.0012	--	--	--	0.73	--	0	
Ronnel	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	1.8	--	0	
Stirophos (Tetrachlorovinphos)	mg/L	60	0	0%	--	--	0.0025	0.0025	--	--	--	0.0028	--	0	
Sulfotep	mg/L	60	0	0%	--	--	0.0005	0.0005	--	--	--	0.018	--	0	
Organic Acids	4-Chlorobenzene sulfonic acid	mg/L	60	0	0%	--	--	0.05	0.05	--	--	--	--	--	--
	Benzenesulfonic acid	mg/L	60	1	2%	0.96	0.96	0.05	2	--	--	--	--	--	--
	O,O-Diethylphosphorodithioic acid	mg/L	60	0	0%	--	--	0.05	2	--	--	--	--	--	--
	O,O-Dimethylphosphorodithioic acid	mg/L	60	6	10%	5.1	12	0.25	5	--	--	--	--	--	--
Nonhalogenated	Ethylene glycol	mg/L	60	0	0%	--	--	10	10	--	--	--	73	--	0
	Methanol	mg/L	60	0	0%	--	--	5	5	--	--	--	18	--	0
	Propylene glycol	mg/L	60	0	0%	--	--	10	10	--	--	--	18	--	0
Organochlorine Pesticides	2,4-DDD	mg/L	60	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
	2,4-DDE	mg/L	60	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
	4,4-DDD	mg/L	60	0	0%	--	--	0.00005	0.00005	--	--	--	0.00028	--	0
	4,4-DDE	mg/L	60	2	3%	0.000068	0.00017	0.00005	0.00005	--	--	--	0.0002	0	0
	4,4-DDT	mg/L	60	0	0%	--	--	0.00005	0.00005	--	--	--	0.0002	--	0
	Aldrin	mg/L	60	0	0%	--	--	0.00005	0.00005	--	--	--	0.000004	--	60
	alpha-BHC	mg/L	60	10	17%	0.000067	0.00035	0.00005	0.00005	--	--	--	0.000011	10	50
	alpha-Chlordane	mg/L	60	0	0%	--	--	0.00005	0.00005	--	--	--	0.00019	--	0
	beta-BHC	mg/L	60	12	20%	0.000077	0.00094	0.00005	0.00005	--	--	--	0.000037	12	48
	Chlordane	mg/L	60	0	0%	--	--	0.0005	0.0005	0.002	--	0	0.00019	--	60
	delta-BHC	mg/L	60	8	13%	0.000054	0.00043	0.00005	0.00005	--	--	--	--	--	--
	Dieldrin	mg/L	60	0	0%	--	--	0.00005	0.00005	--	--	--	0.0000042	--	60
	Endosulfan I	mg/L	60	0	0%	--	--	0.00005	0.00005	--	--	--	0.22	--	0
	Endosulfan II	mg/L	60	0	0%	--	--	0.00005	0.00005	--	--	--	0.22	--	0
	Endosulfan sulfate	mg/L	60	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
	Endrin	mg/L	60	0	0%	--	--	0.00005	0.00005	0.002	--	0	0.011	--	0

TABLE 4-8
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – ALL DATA
BRC CLOSURE PLAN
(Page 3 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Organochlorine Pesticides (Continued)	Endrin aldehyde	mg/L	60	1	2%	0.000072	0.000072	0.00005	0.00005	--	--	--	--	--	--
	Endrin ketone	mg/L	60	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
	gamma-BHC (Lindane)	mg/L	60	0	0%	--	--	0.00005	0.00005	0.0002	--	0	0.000052	--	0
	gamma-Chlordane	mg/L	60	9	15%	0.000064	0.00042	0.00005	0.00005	--	--	--	0.00019	1	0
	Heptachlor	mg/L	60	0	0%	--	--	0.00005	0.00005	0.0004	--	0	0.000015	--	60
	Heptachlor epoxide	mg/L	60	0	0%	--	--	0.00005	0.00005	0.0002	--	0	0.0000074	--	60
	Methoxychlor	mg/L	60	0	0%	--	--	0.0001	0.0001	0.04	--	0	0.18	--	0
Toxaphene	mg/L	60	0	0%	--	--	0.002	0.002	0.003	--	0	0.000061	--	60	
Polynuclear Aromatic Hydrocarbons	Acenaphthene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.37	--	0
	Acenaphthylene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Anthracene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	1.8	--	0
	Benzo(a)anthracene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.000092	--	60
	Benzo(a)pyrene	mg/L	60	0	0%	--	--	0.01	0.01	0.0002	--	60	0.0000092	--	60
	Benzo(b)fluoranthene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.000092	--	60
	Benzo(g,h,i)perylene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Benzo(k)fluoranthene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.000092	--	60
	Chrysene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.0092	--	60
	Dibenzo(a,h)anthracene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.0000092	--	60
	Indeno(1,2,3-cd)pyrene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.000092	--	60
Phenanthrene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	--	--	--	
Pyrene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.18	--	0	
Radionuclides	Gross alpha	pCi/L	60	9	15%	24	70.1	3	3	15 ^h	9	0	--	--	--
	Gross beta	pCi/L	60	54	90%	8.3	13400	4	4	-- ⁱ	--	--	--	--	--
	Thorium-232	pCi/L	57	0	0%	--	--	1	1	--	--	--	0.47	--	51
	Thorium-228	pCi/L	57	0	0%	--	--	1	1	--	--	--	0.16	--	51
	Thorium-230	pCi/L	57	2	4%	0.28	0.55	1	1	--	--	--	0.52	1	49
	Uranium-233/234	pCi/L	60	56	93%	0.34	38.4	1	1	--	--	--	0.67	49	4
	Uranium 235/236	pCi/L	60	29	48%	0.16	1.1	0.1	0.1	--	--	--	0.66	3	0
	Uranium-238	pCi/L	60	56	93%	0.14	26.3	1	1	--	--	--	0.55	48	4
	Radium-226	pCi/L	50	33	66%	0.12	7.6	1	1	5.0 ^j	j	j	0.00082	33	17
Radium-228	pCi/L	60	15	25%	0.45	6.3	3	3	5.0 ^j	j	j	0.046	15	45	
Radium-226/228	pCi/L	60	34	57%	0.53	11.7	3	4	5.0 ^j	7	0	--	--	--	
Aldehydes	Acetaldehyde	mg/L	60	7	12%	0.0042	0.0057	0.03	0.03	--	--	--	0.0017	7	53
	Chloroacetaldehyde	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Dichloroacetaldehyde	mg/L	60	0	0%	--	--	0.35	0.35	--	--	--	--	--	--
	Formaldehyde	mg/L	60	0	0%	--	--	0.06	0.06	--	--	--	5.5	--	0
	Trichloroacetaldehyde	mg/L	60	0	0%	--	--	0.15	0.15	--	--	--	--	--	--
Semivolatile Organic Compounds	1,2,4,5-Tetrachlorobenzene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.011	--	0
	1,2-Diphenylhydrazine	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.000084	--	60
	1,4-Dioxane	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.0061	--	60
	2,4,5-Trichlorophenol	mg/L	58	0	0%	--	--	0.01	0.01	--	--	--	3.6	--	0
	2,4,6-Trichlorophenol	mg/L	58	0	0%	--	--	0.01	0.01	--	--	--	0.0036	--	58
	2,4-Dichlorophenol	mg/L	58	0	0%	--	--	0.01	0.01	--	--	--	0.11	--	0
	2,4-Dimethylphenol	mg/L	58	0	0%	--	--	0.01	0.01	--	--	--	0.73	--	0
	2,4-Dinitrophenol	mg/L	58	0	0%	--	--	0.05	0.05	--	--	--	0.073	--	0
	2,4-Dinitrotoluene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.073	--	0
	2,6-Dinitrotoluene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.036	--	0
	2-Chloronaphthalene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.49	--	0
	2-Chlorophenol	mg/L	58	0	0%	--	--	0.01	0.01	--	--	--	0.03	--	0
	2-Methylnaphthalene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	2-Nitroaniline	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.11	--	0
	2-Nitrophenol	mg/L	58	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	3,3-Dichlorobenzidine	mg/L	60	0	0%	--	--	0.05	0.05	--	--	--	0.00015	--	60
	3-Nitroaniline	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.0032	--	60
4,4'-Dichlorobenzil	mg/L	60	0	0%	--	--	0.0094	0.011	--	--	--	--	--	--	

TABLE 4-8
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – ALL DATA
BRC CLOSURE PLAN
(Page 4 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Semivolatile Organic Compounds (Continued)	4-Bromophenyl phenyl ether	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	4-Chloro-3-methylphenol	mg/L	58	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	4-Chlorophenyl phenyl ether	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	4-Chlorothioanisole	mg/L	60	0	0%	--	--	0.05	0.05	--	--	--	--	--	--
	4-Nitroaniline	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.0032	--	60
	4-Nitrophenol	mg/L	58	0	0%	--	--	0.025	0.025	--	--	--	--	--	--
	Acetophenone	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Aniline	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.012	--	0
	Azobenzene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.00061	--	60
	Benzoic acid	mg/L	58	0	0%	--	--	0.05	0.05	--	--	--	150	--	0
	Benzyl alcohol	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	11	--	0
	Benzyl butyl phthalate	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	7.3	--	0
	bis(2-Chloroethoxy)methane	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	bis(2-Chloroethyl) ether	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.00001	--	60
	bis(2-Chloroisopropyl) ether	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.00027	--	60
	bis(2-Ethylhexyl) phthalate	mg/L	60	0	0%	--	--	0.01	0.01	0.006	--	60	0.0048	--	60
	bis(p-Chlorophenyl) sulfone	mg/L	60	2	3%	0.001	0.0011	0.01	0.01	--	--	--	--	--	--
	bis(p-Chlorophenyl)disulfide	mg/L	60	0	0%	--	--	0.05	0.05	--	--	--	--	--	--
	Carbazole	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.0034	--	60
	Dibenzofuran	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.012	--	0
	Diethyl phthalate	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	29	--	0
	Dimethyl phthalate	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	365	--	0
	Di-n-butyl phthalate	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	3.6	--	0
	Di-n-octyl phthalate	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	1.5	--	0
	Diphenyl disulfide	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Diphenyl sulfide	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Diphenyl sulfone	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.11	--	0
	Fluoranthene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	1.5	--	0
	Fluorene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.24	--	0
	Hexachlorobenzene	mg/L	60	0	0%	--	--	0.01	0.01	0.001	--	60	0.000042	--	60
	Hexachlorobutadiene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.00086	--	60
	Hexachlorocyclopentadiene	mg/L	60	0	0%	--	--	0.01	0.01	0.05	--	0	0.22	--	0
	Hexachloroethane	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.0048	--	60
	Hydroxymethyl phthalimide	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Isophorone	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.071	--	0
	m,p-Cresol	mg/L	58	0	0%	--	--	0.01	0.02	--	--	--	1.8	--	0
	Naphthalene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.0062	--	60
	Nitrobenzene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.0034	--	60
	N-nitrosodi-n-propylamine	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.0000096	--	60
	N-nitrosodiphenylamine	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.014	--	0
o-Cresol	mg/L	58	0	0%	--	--	0.01	0.01	--	--	--	1.8	--	0	
Octachlorostyrene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	--	--	--	
p-Chloroaniline (4-Chloroaniline)	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.15	--	0	
p-Chlorobenzenethiol (see 4-Chlorothiophenol)	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	--	--	--	
Pentachlorobenzene	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.029	--	0	
Pentachlorophenol	mg/L	58	0	0%	--	--	0.05	0.05	0.001	--	58	0.00056	--	58	
Phenol	mg/L	58	0	0%	--	--	0.01	0.01	--	--	--	11	--	0	
Phthalic acid	mg/L	60	0	0%	--	--	0.05	0.2	--	--	--	37	--	0	
Pyridine	mg/L	60	0	0%	--	--	0.02	0.02	--	--	--	0.036	--	0	
Thiophenol	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	--	--	--	
Volatile Organic Compounds	1,1,1,2-Tetrachloroethane	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	0.00043	--	60
	1,1,1-Trichloroethane	mg/L	60	0	0%	--	--	0.001	0.001	0.2	--	0	3.2	--	0
	1,1,2,2-Tetrachloroethane	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	0.000055	--	60
	1,1,2-Trichloroethane	mg/L	60	0	0%	--	--	0.001	0.001	0.005	--	0	0.0002	--	60
	1,1-Dichloroethane	mg/L	60	10	17%	0.00021	0.00099	0.001	0.001	--	--	--	0.81	0	0

TABLE 4-8
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BRC CLOSURE PLAN
(Page 5 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Volatile Organic Compounds (Continued)	1,1-Dichloroethene	mg/L	60	8	13%	0.00025	0.0035	0.001	0.001	0.007	0	0	0.34	0	0
	1,1-Dichloropropene	mg/L	60	1	2%	0.00033	0.00033	0.001	0.001	--	--	--	--	--	--
	1,2,3-Trichlorobenzene	mg/L	60	1	2%	0.00033	0.00033	0.001	0.001	--	--	--	--	--	--
	1,2,3-Trichloropropane	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	0.0000056	--	60
	1,2,4-Trichlorobenzene	mg/L	60	5	8%	0.00069	0.0019	0.001	0.001	0.07	0	0	0.0072	0	0
	1,2,4-Trimethylbenzene	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	0.012	--	0
	1,2-Dichlorobenzene	mg/L	60	2	3%	0.00071	0.012	0.001	0.001	0.6	0	0	0.37	0	0
	1,2-Dichloroethane	mg/L	60	1	2%	0.0019	0.0019	0.001	0.001	0.005	0	0	0.00012	1	59
	1,2-Dichloroethene (see cis-, trans-)	mg/L	60	2	3%	0.00054	0.00076	0.002	0.002	--	--	--	--	--	--
	1,2-Dichloropropane	mg/L	60	1	2%	0.0012	0.0012	0.001	0.001	0.005	0	0	0.00016	1	59
	1,3,5-Trichlorobenzene	mg/L	60	5	8%	0.00033	0.00091	0.005	0.005	--	--	--	--	--	--
	1,3,5-Trimethylbenzene	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	0.012	--	0
	1,3-Dichlorobenzene	mg/L	60	4	7%	0.00021	0.0059	0.001	0.001	--	--	--	0.18	0	0
	1,3-Dichloropropane	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	0.12	--	0
	1,4-Dichlorobenzene	mg/L	60	4	7%	0.0011	0.0055	0.001	0.001	0.075	0	0	0.0005	4	56
	2,2-Dichloropropane	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2,2-Dimethylpentane	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2,2,3-Trimethylbutane	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2,3-Dimethylpentane	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2,4-Dimethylpentane	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2-Chlorotoluene	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	0.12	--	0
	2-Hexanone	mg/L	60	0	0%	--	--	0.005	0.005	--	--	--	--	--	--
	2-Methylhexane	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2-Nitropropane	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.0000012	--	60
	3,3-Dimethylpentane	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	3-Ethylpentane	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	3-Methylhexane	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	4-Chlorotoluene	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	4-Methyl-2-pentanone (MIBK)	mg/L	60	1	2%	0.0026	0.0026	0.005	0.005	--	--	--	2	0	0
	Acetone	mg/L	60	5	8%	0.0021	0.12	0.002	0.04	--	--	--	5.5	0	0
	Acetonitrile	mg/L	60	0	0%	--	--	0.01	0.01	--	--	--	0.1	--	0
	Benzene	mg/L	60	8	13%	0.00018	0.0011	0.001	0.001	0.005	0	0	0.00035	5	52
	Bromobenzene	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	0.02	--	0
	Bromodichloromethane	mg/L	60	4	7%	0.00021	0.032	0.001	0.001	0.08 ^k	k	k	0.00018	4	56
	Bromoform	mg/L	60	1	2%	0.0099	0.0099	0.001	0.001	0.08 ^k	k	k	0.0085	1	0
	Bromomethane	mg/L	60	0	0%	--	--	0.002	0.002	--	--	--	0.0087	--	0
	Carbon disulfide	mg/L	60	4	7%	0.00053	0.0025	0.001	0.001	--	--	--	1	0	0
	Carbon tetrachloride	mg/L	60	10	17%	0.00051	0.022	0.001	0.001	0.005	2	0	0.00017	10	50
	Chlorobenzene	mg/L	60	1	2%	0.001	0.001	0.001	0.001	0.1	0	0	0.11	0	0
	Chlorobromomethane	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	Chloroethane	mg/L	60	0	0%	--	--	0.002	0.002	--	--	--	0.0046	--	0
	Chloroform	mg/L	60	34	57%	0.00019	1.4	0.001	0.05	0.08 ^k	k	k	0.00017	34	26
	Chloromethane	mg/L	60	8	13%	0.00035	0.0022	0.002	0.002	--	--	--	0.16	0	0
cis-1,2-Dichloroethene	mg/L	60	1	2%	0.00076	0.00076	0.001	0.001	0.07	0	0	0.061	0	0	
cis-1,3-Dichloropropene	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	--	--	--	
Cymene (Isopropyltoluene)	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	--	--	--	
Dibromochloromethane	mg/L	60	1	2%	0.014	0.014	0.001	0.001	0.08 ^k	k	k	0.00013	1	59	
Dibromochloropropane	mg/L	60	0	0%	--	--	0.001	0.001	0.0002	--	60	0.000048	--	60	
Dibromomethane	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	0.061	--	0	
Dichloromethane (Methylene chloride)	mg/L	60	0	0%	--	--	0.001	0.012	0.005	--	1	0.0043	--	1	
Dimethyldisulfide	mg/L	60	0	0%	--	--	0.005	0.005	--	--	--	--	--	--	
Ethanol	mg/L	60	0	0%	--	--	0.25	0.25	--	--	--	--	--	--	
Ethylbenzene	mg/L	60	0	0%	--	--	0.001	0.001	0.7	--	0	1.3	--	0	
Freon-11 (Trichlorofluoromethane)	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	1.3	--	0	
Freon-113 (1,1,2-Trifluoro-1,2,2-trichloroethane)	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	59	--	0	

TABLE 4-8
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – ALL DATA
BRC CLOSURE PLAN
(Page 6 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Volatile Organic Compounds (Continued)	Freon-12 (Dichlorodifluoromethane)	mg/L	60	0	0%	--	--	0.002	0.002	--	--	--	0.39	--	0
	Heptane	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	Isopropylbenzene	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	0.66	--	0
	m,p-Xylene (see Xylenes (total))	mg/L	60	0	0%	--	--	0.002	0.002	--	--	--	--	--	--
	Methyl ethyl ketone (2-Butanone)	mg/L	60	1	2%	0.022	0.022	0.005	0.005	--	--	--	7	0	0
	Methyl iodide	mg/L	60	0	0%	--	--	0.002	0.002	--	--	--	--	--	--
	MTBE (Methyl tert-butyl ether)	mg/L	60	2	3%	0.0006	0.00061	0.002	0.002	--	--	--	0.0062	0	0
	n-Butylbenzene	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	0.24	--	0
	n-Propylbenzene	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	0.24	--	0
	Nonanal	mg/L	60	0	0%	--	--	0.005	0.005	--	--	--	--	--	--
	o-Xylene (see Xylenes (total))	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	sec-Butylbenzene	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	0.24	--	0
	Styrene	mg/L	60	0	0%	--	--	0.001	0.001	0.1	--	0	1.6	--	0
	tert-Butylbenzene	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	0.24	--	0
	Tetrachloroethene	mg/L	60	23	38%	0.00022	0.042	0.001	0.002	0.005	5	0	0.0001	23	37
	Toluene	mg/L	60	0	0%	--	--	0.001	0.001	1	--	0	0.72	--	0
	trans-1,2-Dichloroethene	mg/L	60	0	0%	--	--	0.001	0.001	0.1	--	0	0.12	--	0
	trans-1,3-Dichloropropene	mg/L	60	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	Trichloroethene	mg/L	60	12	20%	0.00021	0.0043	0.001	0.001	0.005	0	0	0.000028	12	48
	Vinyl acetate	mg/L	60	0	0%	--	--	0.002	0.002	--	--	--	0.41	--	0
Vinyl chloride	mg/L	60	0	0%	--	--	0.002	0.002	0.002	--	0	0.00002	--	60	
Xylenes (total)	mg/L	60	0	0%	--	--	0.003	0.003	10	--	0	0.21	--	0	
Total Trihalomethanes (TTHM)	mg/L	60	34	57%	0.0	1	0.004	0.004	0.08 ^k	10	0	--	--	--	
Water Quality Parameters	Conductivity	umhos/cm	60	60	100%	1090	271000	1	50	--	--	--	--	--	--
	Hardness, total	mg/L	60	60	100%	40	70000	5	500	--	--	--	--	--	--
	Total dissolved solids	mg/L	60	60	100%	492	205000	5	5	500	59	0	1,900 / 2,400 ^l	54 / 47	0
	Total suspended solids	mg/L	60	59	98%	5	916	1	1	--	--	--	--	--	--
	Alkalinity, Total (as CaCO ₃)	mg/L	60	60	100%	33	342	5	5	--	--	--	--	--	--
	Bicarbonate alkalinity	mg/L	60	60	100%	31	342	5	5	--	--	--	--	--	--
	Carbonate alkalinity	mg/L	60	2	3%	8	14	5	5	--	--	--	--	--	--
Hydroxide alkalinity	mg/L	60	2	3%	4	7	5	5	--	--	--	--	--	--	

a - Range of detections include estimated values of detect results between the detection limit and reporting limit. As such some minimum detected concentrations may be below the minimum reporting limit. In these cases the respective sample results are flagged in the data set.

b - The quantitation limits shown include samples which had detections. For screening purposes, the detection limit was used for comparison to the screening levels.

c - USEPA Maximum Contaminant Levels (MCLs).

d - Unless otherwise noted the Alternative Criteria used are from USEPA Region 9 preliminary remediation goals (PRG) table, October 2004 (and the 2007 USEPA radionuclide PRG webpage; <http://epa-prgs.ornl.gov/radionuclides>). Values used are tap water PRGs.

e - An MCL for perchlorate has not been promulgated. The USEPA Drinking Water Equivalent Level of 24.5 µg/L was used.

f - Nevada provisional action level of 18 µg/l.

g - A NDEP water quality standard was used for Class A (municipal or domestic supply) waters for pH and total phosphorus based on Nevada Administrative Code (NAC) 445A.118 through 445A.225.

h - The MCL for Alpha Particles was used as comparison to Gross Alpha results. The MCL excludes the contributions from radon and uranium. The Gross Alpha concentrations were not adjusted due to contributions from radon nor uranium prior to comparison to MCL.

i - The MCL for Beta particles photon emitters is 4 millirems per year and was not used to compare to Gross Beta concentrations.

j - The constituent is regulated under the MCL for the combined concentration of radium-226 and radium-228. For comparison to the MCL, concentrations of both constituents are summed.

k - The constituent is regulated under the MCL for Total Trihalomethanes (TTHM). For comparison to the MCL for TTHM, concentrations of all TTHM constituents need to be considered.

l - Nevada Requirement to Maintain Existing Higher Quality level of 1,900 / 2,400 mg/L for total dissolved solids (Nevada Administrative Code [NAC] 445A.199 / NAC 445A 200/201).

TABLE 4-9
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – UPPER UNCONFINED WATER-BEARING ZONE
BRC CLOSURE PLAN
(Page 1 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria	
Ions	Bromide	mg/L	33	9	27%	0.19	248	0.25	125	--	--	--	--	--	--	
	Bromine	mg/L	33	9	27%	0.38	496	0.5	250	--	--	--	--	--	--	
	Chlorate	mg/L	33	17	52%	1590	338000	2000	20000	--	--	--	--	--	--	
	Chloride	mg/L	33	32	97%	240	2840	0.2	200	250	31	0	--	--	--	
	Chlorine (soluble)	mg/L	33	32	97%	480	5680	0.4	400	--	--	--	--	--	--	
	Chlorite	mg/L	24	3	13%	81	97	100	1000	1000	0	0	--	--	--	
	Fluoride	mg/L	33	26	79%	0.45	23.7	0.1	50	4	1	2	2.2	7	2	
	Nitrate (as N)	mg/L	33	27	82%	0.066	235	0.02	11.6	10	13	2	10	13	2	
	Nitrite (as N)	mg/L	29	1	3%	8.7	8.7	0.2	10	1	1	27	1	1	27	
	Orthophosphate	mg/L	29	10	34%	1.3	429	0.5	318	--	--	--	--	--	--	
	Sulfate	mg/L	33	30	91%	668	3470	0.5	517	250	30	1	--	--	--	
	Perchlorate	mg/L	33	33	100%	3.3	29600	8	2000	0.0245 ^e	29	0	0.018 ^f	30	0	
Dissolved Gases	Ethane	mg/L	33	0	0%	--	--	0.005	0.005	--	--	--	--	--	--	
	Ethylene	mg/L	33	0	0%	--	--	0.005	0.005	--	--	--	--	--	--	
	Methane	mg/L	33	13	39%	0.00022	0.19	0.005	0.005	--	--	--	--	--	--	
General Chemistry	Ammonia (as N)	mg/L	33	6	18%	26.1	2450	50	200	--	--	--	--	--	--	
	Iodine	mg/L	33	2	6%	0.54	0.56	1	50	--	--	--	--	--	--	
	pH in water	none	33	33	100%	6.1	7.7	0.1	0.1	6.5-8.5	2	--	6.5-9 ^g	2	--	
	Total inorganic carbon	mg/L	26	6	23%	56.8	86.2	50	50	--	--	--	--	--	--	
	Total Kjeldahl nitrogen (TKN)	mg/L	33	23	70%	0.099	112	0.1	0.52	--	--	--	--	--	--	
Total organic carbon (TOC)	mg/L	33	0	0%	--	--	50	50	--	--	--	--	--	--		
Metals	Aluminum	mg/L	33	10	30%	0.202	13.3	0.15	0.75	0.05	10	23	36	0	0	
	Antimony	mg/L	33	0	0%	--	--	0.025	0.125	0.006	0	33	0.015	0	33	
	Arsenic	mg/L	33	23	70%	0.0323	0.142	0.05	0.25	0.01	23	10	0.000045	23	10	
	Barium	mg/L	33	33	100%	0.0097	0.301	0.01	0.05	2	0	0	2.6	0	0	
	Beryllium	mg/L	33	0	0%	--	--	0.0025	0.0125	0.004	0	30	0.073	0	0	
	Boron	mg/L	33	32	97%	0.696	4.36	0.25	1.25	--	--	--	7.3	0	0	
	Cadmium	mg/L	33	0	0%	--	--	0.0025	0.0125	0.005	0	24	0.018	0	0	
	Calcium	mg/L	33	33	100%	111	686	0.5	2.5	--	--	--	--	--	--	
	Chromium	mg/L	33	9	27%	0.0145	0.387	0.05	0.25	0.1	6	17	55	0	0	
	Cobalt	mg/L	33	8	24%	0.0065	0.0233	0.01	0.05	--	--	--	0.73	0	0	
	Copper	mg/L	33	27	82%	0.0018	0.0169	0.005	0.025	1.3	0	0	1.5	0	0	
	Iron	mg/L	15	5	33%	0.239	10.3	0.25	1.25	0.3	4	9	11	0	0	
	Lead	mg/L	33	1	3%	0.007	0.007	0.015	0.075	0.015	0	29	--	--	--	
	Lithium	mg/L	33	18	55%	0.102	1.05	0.05	0.25	--	--	--	0.73	1	0	
	Magnesium	mg/L	33	33	100%	55	459	0.25	1.25	--	--	--	--	--	--	
	Manganese	mg/L	33	14	42%	0.009	1.43	0.01	0.05	0.05	9	0	0.88	7	0	
	Molybdenum	mg/L	33	33	100%	0.0126	0.327	0.025	0.125	--	--	--	0.18	4	0	
	Nickel	mg/L	33	33	100%	0.0032	0.0478	0.025	0.125	--	--	--	0.73	0	0	
	Niobium	mg/L	33	0	0%	--	--	0.125	0.625	--	--	--	--	--	--	
	Palladium	mg/L	33	33	100%	0.0052	0.0384	0.0025	0.0125	--	--	--	--	--	--	
	Phosphorus	mg/L	33	2	6%	0.154	1.22	0.1	0.5	--	--	--	--	--	--	
	Platinum	mg/L	33	0	0%	--	--	0.005	0.025	--	--	--	--	--	--	
	Potassium	mg/L	33	33	100%	6.78	188	0.5	2.5	--	--	--	--	--	--	
	Selenium	mg/L	33	9	27%	0.0054	0.131	0.025	0.125	0.05	1	16	0.18	0	0	
	Silicon	mg/L	33	33	100%	18.5	55.8	1.25	6.25	--	--	--	--	--	--	
	Silver	mg/L	33	0	0%	--	--	0.01	0.05	0.1	0	0	0.18	0	0	
	Sodium	mg/L	33	33	100%	141	1560	0.25	2.5	--	--	--	--	--	--	
	Strontium	mg/L	33	33	100%	2.33	15.1	0.025	0.125	--	--	--	--	22	0	0
	Sulfur	mg/L	33	33	100%	151	980	2	10	--	--	--	--	--	--	
	Thallium	mg/L	33	3	9%	0.0025	0.0122	0.01	0.05	0.002	3	30	0.0024	3	30	
	Tin	mg/L	33	0	0%	--	--	0.01	0.05	--	--	--	--	22	0	0
	Titanium	mg/L	33	19	58%	0.0045	0.58	0.01	0.05	--	--	--	146	0	0	
	Tungsten	mg/L	33	6	18%	0.0044	0.0295	0.025	0.125	--	--	--	--	--	--	
Uranium	mg/L	33	33	100%	0.0053	0.0838	0.005	0.025	0.03	21	0	0.0073	31	0		

TABLE 4-9
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – UPPER UNCONFINED WATER-BEARING ZONE
BRC CLOSURE PLAN
(Page 2 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Metals (Continued)	Vanadium	mg/L	33	9	27%	0.0194	0.104	0.05	0.25	--	--	--	0.036	6	24
	Zinc	mg/L	33	17	52%	0.02	0.181	0.05	0.25	0.5	0	0	11	0	0
	Zirconium	mg/L	33	0	0%	--	--	0.1	2.5	--	--	--	--	--	--
	Chromium (VI)	mg/L	33	18	55%	0.014	0.3	0.01	0.01	--	--	--	0.11	3	0
	Mercury	mg/L	33	1	3%	0.00025	0.00025	0.0002	0.00033	0.002	0	0	0.011	0	0
Organo-phosphorous Pesticides	Azinphos-ethyl	mg/L	33	0	0%	--	--	0.0006	0.0006	--	--	--	--	--	--
	Azinphos-methyl	mg/L	33	0	0%	--	--	0.0025	0.0025	--	--	--	--	--	--
	Carbophenothion	mg/L	33	0	0%	--	--	0.0006	0.0006	--	--	--	--	--	--
	Chlorpyrifos	mg/L	33	0	0%	--	--	0.0005	0.0005	--	--	--	0.11	0	0
	Coumaphos	mg/L	33	0	0%	--	--	0.0005	0.0005	--	--	--	--	--	--
	Demeton-O	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	0.0015	--	0
	Demeton-S	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	0.0015	--	0
	Diazinon	mg/L	33	0	0%	--	--	0.0005	0.0005	--	--	--	0.033	0	0
	Dichlorvos	mg/L	33	0	0%	--	--	0.0005	0.0005	--	--	--	0.00023	0	33
	Dimethoate	mg/L	33	0	0%	--	--	0.0005	0.0005	--	--	--	0.0073	0	0
	Disulfoton	mg/L	33	0	0%	--	--	0.0005	0.0005	--	--	--	0.0015	0	0
	EPN	mg/L	33	0	0%	--	--	0.0005	0.0005	--	--	--	--	--	--
	Ethoprop	mg/L	33	0	0%	--	--	0.0005	0.0005	--	--	--	0.00036	0	33
	Ethyl parathion	mg/L	33	0	0%	--	--	0.0005	0.0005	--	--	--	0.22	0	0
	Famphur	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	Fenthion	mg/L	33	0	0%	--	--	0.0025	0.0025	--	--	--	--	--	--
	Malathion	mg/L	33	0	0%	--	--	0.0012	0.0012	--	--	--	0.73	0	0
	Methyl carbophenothion	mg/L	33	0	0%	--	--	0.0008	0.0008	--	--	--	--	--	--
	Methyl parathion	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	0.0091	0	0
	Mevinphos	mg/L	33	0	0%	--	--	0.0062	0.0062	--	--	--	--	--	--
	Naled	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.073	0	0
	O,O,O-Triethyl phosphorothioate (TEPP)	mg/L	33	1	3%	0.00016	0.00016	0.0005	0.0005	--	--	--	--	--	--
	Phorate	mg/L	33	0	0%	--	--	0.0012	0.0012	--	--	--	0.0073	0	0
Phosmet	mg/L	33	0	0%	--	--	0.0012	0.0012	--	--	--	0.73	0	0	
Ronnel	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	1.8	0	0	
Stirophos (Tetrachlorovinphos)	mg/L	33	0	0%	--	--	0.0025	0.0025	--	--	--	0.0028	0	0	
Sulfotep	mg/L	33	0	0%	--	--	0.0005	0.0005	--	--	--	0.018	0	0	
Organic Acids	4-Chlorobenzene sulfonic acid	mg/L	33	0	0%	--	--	0.05	0.05	--	--	--	--	--	--
	Benzenesulfonic acid	mg/L	33	0	0%	--	--	0.05	2	--	--	--	--	--	--
	O,O-Diethylphosphorodithioic acid	mg/L	33	0	0%	--	--	0.05	2	--	--	--	--	--	--
	O,O-Dimethylphosphorodithioic acid	mg/L	33	4	12%	6.3	12	0.25	5	--	--	--	--	--	--
Nonhalogenated	Ethylene glycol	mg/L	33	0	0%	--	--	10	10	--	--	--	73	0	0
	Methanol	mg/L	33	0	0%	--	--	5	5	--	--	--	18	0	0
	Propylene glycol	mg/L	33	0	0%	--	--	10	10	--	--	--	18	0	0
Organochlorine Pesticides	2,4-DDD	mg/L	33	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
	2,4-DDE	mg/L	33	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
	4,4-DDD	mg/L	33	0	0%	--	--	0.00005	0.00005	--	--	--	0.00028	0	0
	4,4-DDE	mg/L	33	2	6%	0.000068	0.00017	0.00005	0.00005	--	--	--	0.0002	0	0
	4,4-DDT	mg/L	33	0	0%	--	--	0.00005	0.00005	--	--	--	0.0002	0	0
	Aldrin	mg/L	33	0	0%	--	--	0.00005	0.00005	--	--	--	0.000004	0	33
	alpha-BHC	mg/L	33	9	27%	0.000067	0.00035	0.00005	0.00005	--	--	--	0.000011	9	24
	alpha-Chlordane	mg/L	33	0	0%	--	--	0.00005	0.00005	--	--	--	0.00019	--	0
	beta-BHC	mg/L	33	11	33%	0.000077	0.00094	0.00005	0.00005	--	--	--	0.000037	11	22
	Chlordane	mg/L	33	0	0%	--	--	0.0005	0.0005	0.002	0	0	0.00019	--	33
	delta-BHC	mg/L	33	8	24%	0.000054	0.00043	0.00005	0.00005	--	--	--	--	--	--
	Dieldrin	mg/L	33	0	0%	--	--	0.00005	0.00005	--	--	--	0.0000042	0	33
	Endosulfan I	mg/L	33	0	0%	--	--	0.00005	0.00005	--	--	--	0.22	--	0
	Endosulfan II	mg/L	33	0	0%	--	--	0.00005	0.00005	--	--	--	0.22	--	0
	Endosulfan sulfate	mg/L	33	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
	Endrin	mg/L	33	0	0%	--	--	0.00005	0.00005	0.002	0	0	0.011	0	0

TABLE 4-9
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – UPPER UNCONFINED WATER-BEARING ZONE
BRC CLOSURE PLAN
(Page 3 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Organochlorine Pesticides (Continued)	Endrin aldehyde	mg/L	33	1	3%	0.000072	0.000072	0.00005	0.00005	--	--	--	--	--	--
	Endrin ketone	mg/L	33	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
	gamma-BHC (Lindane)	mg/L	33	0	0%	--	--	0.00005	0.00005	0.0002	0	0	0.000052	0	0
	gamma-Chlordane	mg/L	33	8	24%	0.000064	0.00016	0.00005	0.00005	--	--	--	0.00019	--	0
	Heptachlor	mg/L	33	0	0%	--	--	0.00005	0.00005	0.0004	0	0	0.000015	0	33
	Heptachlor epoxide	mg/L	33	0	0%	--	--	0.00005	0.00005	0.0002	0	0	0.0000074	0	33
	Methoxychlor	mg/L	33	0	0%	--	--	0.0001	0.0001	0.04	0	0	0.18	0	0
Toxaphene	mg/L	33	0	0%	--	--	0.002	0.002	0.003	0	0	0.000061	0	33	
Polynuclear Aromatic Hydrocarbons	Acenaphthene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.37	0	0
	Acenaphthylene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Anthracene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	1.8	0	0
	Benzo(a)anthracene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.000092	0	33
	Benzo(a)pyrene	mg/L	33	0	0%	--	--	0.01	0.01	0.0002	0	33	0.0000092	0	33
	Benzo(b)fluoranthene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.000092	0	33
	Benzo(g,h,i)perylene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Benzo(k)fluoranthene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.000092	0	33
	Chrysene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.0092	0	33
	Dibenzo(a,h)anthracene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.0000092	0	33
	Indeno(1,2,3-cd)pyrene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.000092	0	33
Phenanthrene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	--	--	--	
Pyrene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.18	0	0	
Radionuclides	Gross alpha	pCi/L	33	8	24%	24	70.1	3	3	15 ^h	8	0	--	--	--
	Gross beta	pCi/L	33	28	85%	12.9	165	4	4	-- ⁱ	--	--	--	--	--
	Thorium-232	pCi/L	27	0	0%	--	--	1	1	--	--	--	0.47	0	27
	Thorium-228	pCi/L	27	0	0%	--	--	1	1	--	--	--	0.16	0	27
	Thorium-230	pCi/L	27	1	4%	0.55	0.55	1	1	--	--	--	0.52	1	26
	Uranium-233/234	pCi/L	33	33	100%	2.2	38.4	1	1	--	--	--	0.67	33	0
	Uranium 235/236	pCi/L	33	24	73%	0.19	1.1	0.1	0.1	--	--	--	0.66	3	0
	Uranium-238	pCi/L	33	33	100%	1.4	26.3	1	1	--	--	--	0.55	33	0
	Radium-226	pCi/L	26	16	62%	0.12	2.1	1	1	5.0 ^j	j	j	0.00082	16	10
Radium-228	pCi/L	33	3	9%	0.65	1.0	3	3	5.0 ^j	j	j	0.046	3	30	
Radium-226/228	pCi/L	33	16	48%	0.53	5.1	3	4	5.0 ^j	1	0	--	--	--	
Aldehydes	Acetaldehyde	mg/L	33	2	6%	0.0046	0.0051	0.03	0.03	--	--	--	0.0017	2	31
	Chloroacetaldehyde	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Dichloroacetaldehyde	mg/L	33	0	0%	--	--	0.35	0.35	--	--	--	--	--	--
	Formaldehyde	mg/L	33	0	0%	--	--	0.06	0.06	--	--	--	5.5	0	0
	Trichloroacetaldehyde	mg/L	33	0	0%	--	--	0.15	0.15	--	--	--	--	--	--
Semivolatile Organic Compounds	1,2,4,5-Tetrachlorobenzene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.011	0	0
	1,2-Diphenylhydrazine	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.000084	0	33
	1,4-Dioxane	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.0061	0	33
	2,4,5-Trichlorophenol	mg/L	31	0	0%	--	--	0.01	0.01	--	--	--	3.6	0	0
	2,4,6-Trichlorophenol	mg/L	31	0	0%	--	--	0.01	0.01	--	--	--	0.0036	0	31
	2,4-Dichlorophenol	mg/L	31	0	0%	--	--	0.01	0.01	--	--	--	0.11	0	0
	2,4-Dimethylphenol	mg/L	31	0	0%	--	--	0.01	0.01	--	--	--	0.73	0	0
	2,4-Dinitrophenol	mg/L	31	0	0%	--	--	0.05	0.05	--	--	--	0.073	0	0
	2,4-Dinitrotoluene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.073	0	0
	2,6-Dinitrotoluene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.036	0	0
	2-Chloronaphthalene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.49	0	0
	2-Chlorophenol	mg/L	31	0	0%	--	--	0.01	0.01	--	--	--	0.03	0	0
	2-Methylnaphthalene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	2-Nitroaniline	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.11	0	0
	2-Nitrophenol	mg/L	31	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	3,3-Dichlorobenzidine	mg/L	33	0	0%	--	--	0.05	0.05	--	--	--	0.00015	0	33
	3-Nitroaniline	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.0032	0	33
4,4'-Dichlorobenzil	mg/L	33	0	0%	--	--	0.0094	0.011	--	--	--	--	--	--	

TABLE 4-9
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – UPPER UNCONFINED WATER-BEARING ZONE
BRC CLOSURE PLAN
(Page 4 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Semivolatile Organic Compounds (Continued)	4-Bromophenyl phenyl ether	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	4-Chloro-3-methylphenol	mg/L	31	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	4-Chlorophenyl phenyl ether	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	4-Chlorothioanisole	mg/L	33	0	0%	--	--	0.05	0.05	--	--	--	--	--	--
	4-Nitroaniline	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.0032	0	33
	4-Nitrophenol	mg/L	31	0	0%	--	--	0.025	0.025	--	--	--	--	--	--
	Acetophenone	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Aniline	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.012	0	0
	Azobenzene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.00061	0	33
	Benzoic acid	mg/L	31	0	0%	--	--	0.05	0.05	--	--	--	150	0	0
	Benzyl alcohol	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	11	0	0
	Benzyl butyl phthalate	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	7.3	0	0
	bis(2-Chloroethoxy)methane	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	bis(2-Chloroethyl) ether	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.00001	0	33
	bis(2-Chloroisopropyl) ether	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.00027	0	33
	bis(2-Ethylhexyl) phthalate	mg/L	33	0	0%	--	--	0.01	0.01	0.006	0	33	0.0048	0	33
	bis(p-Chlorophenyl) sulfone	mg/L	33	2	6%	0.001	0.0011	0.01	0.01	--	--	--	--	--	--
	bis(p-Chlorophenyl)disulfide	mg/L	33	0	0%	--	--	0.05	0.05	--	--	--	--	--	--
	Carbazole	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.0034	0	33
	Dibenzofuran	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.012	0	0
	Diethyl phthalate	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	29	0	0
	Dimethyl phthalate	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	365	0	0
	Di-n-butyl phthalate	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	3.6	0	0
	Di-n-octyl phthalate	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	1.5	0	0
	Diphenyl disulfide	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Diphenyl sulfide	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Diphenyl sulfone	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.11	0	0
	Fluoranthene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	1.5	0	0
	Fluorene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.24	0	0
	Hexachlorobenzene	mg/L	33	0	0%	--	--	0.01	0.01	0.001	0	33	0.000042	0	33
	Hexachlorobutadiene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.00086	0	33
	Hexachlorocyclopentadiene	mg/L	33	0	0%	--	--	0.01	0.01	0.05	0	0	0.22	0	0
	Hexachloroethane	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.0048	0	33
	Hydroxymethyl phthalimide	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Isophorone	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.071	0	0
	m,p-Cresol	mg/L	31	0	0%	--	--	0.01	0.02	--	--	--	1.8	--	0
	Naphthalene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.0062	0	33
	Nitrobenzene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.0034	0	33
	N-nitrosodi-n-propylamine	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.0000096	0	33
	N-nitrosodiphenylamine	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.014	0	0
o-Cresol	mg/L	31	0	0%	--	--	0.01	0.01	--	--	--	1.8	0	0	
Octachlorostyrene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	--	--	--	
p-Chloroaniline (4-Chloroaniline)	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.15	0	0	
p-Chlorobenzenethiol (see 4-Chlorothiophenol)	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	--	--	--	
Pentachlorobenzene	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.029	0	0	
Pentachlorophenol	mg/L	31	0	0%	--	--	0.05	0.05	0.001	0	31	0.00056	0	31	
Phenol	mg/L	31	0	0%	--	--	0.01	0.01	--	--	--	11	0	0	
Phthalic acid	mg/L	33	0	0%	--	--	0.05	0.2	--	--	--	37	--	0	
Pyridine	mg/L	33	0	0%	--	--	0.02	0.02	--	--	--	0.036	0	0	
Thiophenol	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	--	--	--	
Volatile Organic Compounds	1,1,1,2-Tetrachloroethane	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	0.00043	0	33
	1,1,1-Trichloroethane	mg/L	33	0	0%	--	--	0.001	0.001	0.2	0	0	3.2	0	0
	1,1,2,2-Tetrachloroethane	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	0.000055	0	33
	1,1,2-Trichloroethane	mg/L	33	0	0%	--	--	0.001	0.001	0.005	0	0	0.0002	0	33
	1,1-Dichloroethane	mg/L	33	9	27%	0.00021	0.00099	0.001	0.001	--	--	--	0.81	0	0

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BRC CLOSURE PLAN
(Page 5 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Volatile Organic Compounds (Continued)	1,1-Dichloroethene	mg/L	33	6	18%	0.00025	0.0035	0.001	0.001	0.007	0	0	0.34	0	0
	1,1-Dichloropropene	mg/L	33	1	3%	0.00033	0.00033	0.001	0.001	--	--	--	--	--	--
	1,2,3-Trichlorobenzene	mg/L	33	1	3%	0.00033	0.00033	0.001	0.001	--	--	--	--	--	--
	1,2,3-Trichloropropane	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	0.000056	0	33
	1,2,4-Trichlorobenzene	mg/L	33	5	15%	0.00069	0.0019	0.001	0.001	0.07	0	0	0.0072	0	0
	1,2,4-Trimethylbenzene	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	0.012	0	0
	1,2-Dichlorobenzene	mg/L	33	2	6%	0.00071	0.012	0.001	0.001	0.6	0	0	0.37	0	0
	1,2-Dichloroethane	mg/L	33	1	3%	0.0019	0.0019	0.001	0.001	0.005	0	0	0.00012	1	32
	1,2-Dichloroethene (see cis-, trans-)	mg/L	33	1	3%	0.00076	0.00076	0.002	0.002	--	--	--	--	--	--
	1,2-Dichloropropane	mg/L	33	1	3%	0.0012	0.0012	0.001	0.001	0.005	0	0	0.00016	1	32
	1,3,5-Trichlorobenzene	mg/L	33	5	15%	0.00033	0.00091	0.005	0.005	--	--	--	--	--	--
	1,3,5-Trimethylbenzene	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	0.012	0	0
	1,3-Dichlorobenzene	mg/L	33	4	12%	0.00021	0.0059	0.001	0.001	--	--	--	0.18	0	0
	1,3-Dichloropropane	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	0.12	0	0
	1,4-Dichlorobenzene	mg/L	33	4	12%	0.0011	0.0055	0.001	0.001	0.075	0	0	0.0005	4	29
	2,2-Dichloropropane	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2,2-Dimethylpentane	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2,2,3-Trimethylbutane	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2,3-Dimethylpentane	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2,4-Dimethylpentane	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2-Chlorotoluene	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	0.12	0	0
	2-Hexanone	mg/L	33	0	0%	--	--	0.005	0.005	--	--	--	--	--	--
	2-Methylhexane	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2-Nitropropane	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.000012	0	33
	3,3-Dimethylpentane	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	3-Ethylpentane	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	3-Methylhexane	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	4-Chlorotoluene	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	4-Methyl-2-pentanone (MIBK)	mg/L	33	0	0%	--	--	0.005	0.005	--	--	--	2	0	0
	Acetone	mg/L	33	0	0%	--	--	0.002	0.002	--	--	--	5.5	0	0
	Acetonitrile	mg/L	33	0	0%	--	--	0.01	0.01	--	--	--	0.1	0	0
	Benzene	mg/L	33	2	6%	0.00018	0.00032	0.001	0.001	0.005	0	0	0.00035	0	31
	Bromobenzene	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	0.02	0	0
	Bromodichloromethane	mg/L	33	4	12%	0.00021	0.032	0.001	0.001	0.08 ^k	k	k	0.00018	4	29
	Bromoform	mg/L	33	1	3%	0.0099	0.0099	0.001	0.001	0.08 ^k	k	k	0.0085	1	0
	Bromomethane	mg/L	33	0	0%	--	--	0.002	0.002	--	--	--	0.0087	0	0
	Carbon disulfide	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	1	0	0
	Carbon tetrachloride	mg/L	33	8	24%	0.00051	0.022	0.001	0.001	0.005	1	0	0.00017	8	25
	Chlorobenzene	mg/L	33	1	3%	0.001	0.001	0.001	0.001	0.1	0	0	0.11	0	0
	Chlorobromomethane	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	Chloroethane	mg/L	33	0	0%	--	--	0.002	0.002	--	--	--	0.0046	0	0
	Chloroform	mg/L	33	27	82%	0.00019	1.4	0.001	0.05	0.08 ^k	k	k	0.00017	27	6
	Chloromethane	mg/L	33	2	6%	0.00074	0.0019	0.002	0.002	--	--	--	0.16	0	0
cis-1,2-Dichloroethene	mg/L	33	1	3%	0.00076	0.00076	0.001	0.001	0.07	0	0	0.061	0	0	
cis-1,3-Dichloropropene	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	--	--	--	
Cymene (Isopropyltoluene)	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	--	--	--	
Dibromochloromethane	mg/L	33	1	3%	0.014	0.014	0.001	0.001	0.08 ^k	k	k	0.00013	1	32	
Dibromochloropropane	mg/L	33	0	0%	--	--	0.001	0.001	0.0002	0	33	0.000048	0	33	
Dibromomethane	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	0.061	0	0	
Dichloromethane (Methylene chloride)	mg/L	33	0	0%	--	--	0.001	0.012	0.005	0	1	0.0043	0	1	
Dimethyldisulfide	mg/L	33	0	0%	--	--	0.005	0.005	--	--	--	--	--	--	
Ethanol	mg/L	33	0	0%	--	--	0.00025	0.00025	--	--	--	--	--	--	
Ethylbenzene	mg/L	33	0	0%	--	--	0.001	0.001	0.7	0	0	1.3	0	0	
Freon-11 (Trichlorofluoromethane)	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	1.3	0	0	
Freon-113 (1,1,2-Trifluoro-1,2,2-trichloroethane)	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	59	0	0	

TABLE 4-9
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – UPPER UNCONFINED WATER-BEARING ZONE
BRC CLOSURE PLAN
(Page 6 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Volatile Organic Compounds (Continued)	Freon-12 (Dichlorodifluoromethane)	mg/L	33	0	0%	--	--	0.002	0.002	--	--	--	0.39	0	0
	Heptane	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	Isopropylbenzene	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	0.66	0	0
	m,p-Xylene (see Xylenes (total))	mg/L	33	0	0%	--	--	0.002	0.002	--	--	--	--	--	--
	Methyl ethyl ketone (2-Butanone)	mg/L	33	0	0%	--	--	0.005	0.005	--	--	--	7	0	0
	Methyl iodide	mg/L	33	0	0%	--	--	0.002	0.002	--	--	--	--	--	--
	MTBE (Methyl tert-butyl ether)	mg/L	33	2	6%	0.0006	0.00061	0.002	0.002	--	--	--	0.0062	0	0
	n-Butylbenzene	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	0.24	0	0
	n-Propylbenzene	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	0.24	0	0
	Nonanal	mg/L	33	0	0%	--	--	0.005	0.005	--	--	--	--	--	--
	o-Xylene (see Xylenes (total))	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	sec-Butylbenzene	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	0.24	--	0
	Styrene	mg/L	33	0	0%	--	--	0.001	0.001	0.1	0	0	1.6	0	0
	tert-Butylbenzene	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	0.24	0	0
	Tetrachloroethene	mg/L	33	20	61%	0.00022	0.042	0.001	0.002	0.005	4	0	0.0001	20	13
	Toluene	mg/L	33	0	0%	--	--	0.001	0.001	1	0	0	0.72	0	0
	trans-1,2-Dichloroethene	mg/L	33	0	0%	--	--	0.001	0.001	0.1	0	0	0.12	0	0
	trans-1,3-Dichloropropene	mg/L	33	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	Trichloroethene	mg/L	33	9	27%	0.00022	0.0042	0.001	0.001	0.005	0	0	0.000028	9	24
	Vinyl acetate	mg/L	33	0	0%	--	--	0.002	0.002	--	--	--	0.41	0	0
Vinyl chloride	mg/L	33	0	0%	--	--	0.002	0.002	0.002	0	0	0.00002	0	33	
Xylenes (total)	mg/L	33	0	0%	--	--	0.003	0.003	10	0	0	0.21	0	0	
Total Trihalomethanes (TTHM)	mg/L	33	27	82%	0.0017	1.5	0.004	0.004	0.08 ^k	8	0	--	--	--	
Water Quality Parameters	Conductivity	umhos/cm	33	33	100%	1750	8420	1	1	--	--	--	--	--	--
	Hardness, total	mg/L	33	33	100%	402	4750	5	125	--	--	--	--	--	--
	Total dissolved solids	mg/L	33	33	100%	1210	7970	5	5	500	33	0	1,900 / 2,400 ^l	31 / 27	0
	Total suspended solids	mg/L	33	33	100%	7	900	1	1	--	--	--	--	--	--
	Alkalinity, Total (as CaCO ₃)	mg/L	33	33	100%	56	342	5	5	--	--	--	--	--	--
	Bicarbonate alkalinity	mg/L	33	33	100%	56	342	5	5	--	--	--	--	--	--
	Carbonate alkalinity	mg/L	33	0	0%	--	--	5	5	--	--	--	--	--	--
Hydroxide alkalinity	mg/L	33	0	0%	--	--	5	5	--	--	--	--	--	--	

a - Range of detections include estimated values of detect results between the detection limit and reporting limit. As such some minimum detected concentrations may be below the minimum reporting limit. In these cases the respective sample results are flagged in the data set.

b - The quantitation limits shown include samples which had detections. For screening purposes, the detection limit was used for comparison to the screening levels.

c - USEPA Maximum Contaminant Levels (MCLs).

d - Unless otherwise noted the Alternative Criteria used are from USEPA Region 9 preliminary remediation goals (PRG) table, October 2004 (and the 2007 USEPA radionuclide PRG webpage; <http://epa-prgs.ornl.gov/radionuclides>). Values used are tap water PRGs.

e - An MCL for perchlorate has not been promulgated. The USEPA Drinking Water Equivalent Level of 24.5 µg/L was used.

f - Nevada provisional action level of 18 µg/l.

g - A NDEP water quality standard was used for Class A (municipal or domestic supply) waters for pH and total phosphorus based on Nevada Administrative Code (NAC) 445A.118 through 445A.225.

h - The MCL for Alpha Particles was used as comparison to Gross Alpha results. The MCL excludes the contributions from radon and uranium. The Gross Alpha concentrations were not adjusted due to contributions from radon nor uranium prior to comparison to MCL.

i - The MCL for Beta particles photon emitters is 4 millirems per year and was not used to compare to Gross Beta concentrations.

j - The constituent is regulated under the MCL for the combined concentration of radium-226 and radium-228. For comparison to the MCL, concentrations of both constituents are summed.

k - The constituent is regulated under the MCL for Total Trihalomethanes (TTHM). For comparison to the MCL for TTHM, concentrations of all TTHM constituents need to be considered.

l - Nevada Requirement to Maintain Existing Higher Quality level of 1,900 / 2,400 mg/L for total dissolved solids (Nevada Administrative Code [NAC] 445A.199 / NAC 445A 200/201).

TABLE 4-10
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – INTERMEDIATE WATER-BEARING ZONE
BRC CLOSURE PLAN
(Page 1 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Ions	Bromide	mg/L	15	1	7%	0.45	0.45	0.25	125	--	--	--	--	--	--
	Bromine	mg/L	15	1	7%	0.9	0.9	0.5	250	--	--	--	--	--	--
	Chlorate	mg/L	15	3	20%	1470	24900	2000	20000	--	--	--	--	--	--
	Chloride	mg/L	15	14	93%	114	29700	100	2000	250	10	1	--	--	--
	Chlorine (soluble)	mg/L	15	14	93%	228	59400	200	4000	--	--	--	--	--	--
	Chlorite	mg/L	13	2	15%	40	98	100	20000	1000	0	4	--	--	--
	Fluoride	mg/L	15	11	73%	0.47	148	0.1	50	4	1	3	2.2	1	3
	Nitrate (as N)	mg/L	11	7	64%	1.7	45.1	0.2	10	10	3	0	10	3	0
	Nitrite (as N)	mg/L	11	1	9%	76	76	0.02	10	1	1	8	1	1	8
	Orthophosphate	mg/L	12	4	33%	1.3	50.4	0.5	250	--	--	--	--	--	--
	Sulfate	mg/L	15	14	93%	402	76800	0.5	5000	250	14	0	--	--	--
Perchlorate	mg/L	15	7	47%	87	16300	4	2000	0.0245 ^e	7	4	0.018 ^f	7	4	
Dissolved Gases	Ethane	mg/L	15	1	7%	0.00058	0.00058	0.005	0.005	--	--	--	--	--	--
	Ethylene	mg/L	15	3	20%	0.001	0.0024	0.005	0.005	--	--	--	--	--	--
	Methane	mg/L	15	10	67%	0.00025	0.014	0.005	0.005	--	--	--	--	--	--
General Chemistry	Ammonia (as N)	mg/L	15	8	53%	53.5	51300	50	50000	--	--	--	--	--	--
	Iodine	mg/L	15	0	0%	--	--	1	50	--	--	--	--	--	--
	pH in water	none	15	15	100%	5.8	8.7	0.1	0.1	6.5-8.5	2	--	6.5-9 ^g	1	--
	Total inorganic carbon	mg/L	13	1	8%	69.9	69.9	50	50	--	--	--	--	--	--
	Total Kjeldahl nitrogen (TKN)	mg/L	14	10	71%	0.16	8.6	0.1	0.66	--	--	--	--	--	--
Total organic carbon (TOC)	mg/L	15	0	0%	--	--	50	50	--	--	--	--	--	--	
Metals	Aluminum	mg/L	15	0	0%	--	--	0.15	15	0.05	0	15	36	0	0
	Antimony	mg/L	15	0	0%	--	--	0.025	2.5	0.006	0	15	0.015	0	15
	Arsenic	mg/L	15	5	33%	0.0286	0.0917	0.05	5	0.01	5	10	0.000045	5	10
	Barium	mg/L	15	14	93%	0.0129	0.0676	0.01	1	2	0	0	2.6	0	0
	Beryllium	mg/L	15	0	0%	--	--	0.0025	0.25	0.004	0	13	0.073	0	2
	Boron	mg/L	15	15	100%	0.868	14.9	0.5	25	--	--	--	7.3	2	0
	Cadmium	mg/L	15	2	13%	0.0023	0.0534	0.0025	0.25	0.005	1	7	0.018	1	3
	Calcium	mg/L	15	15	100%	22.6	723	0.5	50	--	--	--	--	--	--
	Chromium	mg/L	15	2	13%	0.0295	0.229	0.05	5	0.1	1	6	55	0	0
	Cobalt	mg/L	15	1	7%	0.0337	0.0337	0.01	1	--	--	--	0.73	0	1
	Copper	mg/L	15	10	67%	0.0047	0.462	0.005	0.5	1.3	0	0	1.5	0	0
	Iron	mg/L	10	1	10%	3.41	3.41	0.25	25	0.3	1	7	11	0	1
	Lead	mg/L	15	0	0%	--	--	0.015	1.5	0.015	0	13	--	--	--
	Lithium	mg/L	15	12	80%	0.134	45.4	0.05	7.81	--	--	--	0.73	4	1
	Magnesium	mg/L	15	15	100%	9.79	16100	0.25	50	--	--	--	--	--	--
	Manganese	mg/L	15	9	60%	0.0018	3.62	0.01	1	0.05	5	1	0.88	2	0
	Molybdenum	mg/L	15	13	87%	0.0189	2.17	0.025	2.5	--	--	--	0.18	5	0
	Nickel	mg/L	15	9	60%	0.0059	0.0536	0.025	2.5	--	--	--	0.73	0	2
	Niobium	mg/L	15	0	0%	--	--	0.125	25	--	--	--	--	--	--
	Palladium	mg/L	15	14	93%	0.0014	0.0369	0.0025	0.25	--	--	--	--	--	--
	Phosphorus	mg/L	15	1	7%	1.44	1.44	0.02	10	--	--	--	--	--	--
	Platinum	mg/L	15	0	0%	--	--	0.005	0.5	--	--	--	--	--	--
	Potassium	mg/L	15	15	100%	8.98	15400	0.5	100	--	--	--	--	--	--
	Selenium	mg/L	15	1	7%	0.121	0.121	0.025	2.5	0.05	1	6	0.18	0	2
	Silicon	mg/L	15	13	87%	0.599	39.3	2.5	125	--	--	--	--	--	--
	Silver	mg/L	15	0	0%	--	--	0.01	1	0.1	0	3	0.18	0	3
	Sodium	mg/L	15	15	100%	181	29500	0.25	50	--	--	--	--	--	--
	Strontium	mg/L	15	15	100%	0.636	14.8	0.025	2.5	--	--	--	22	0	0
	Sulfur	mg/L	15	15	100%	80.4	19900	2	200	--	--	--	--	--	--
	Thallium	mg/L	15	0	0%	--	--	0.01	1	0.002	0	15	0.0024	0	15
	Tin	mg/L	15	0	0%	--	--	0.01	1	--	--	--	22	0	0
	Titanium	mg/L	15	8	53%	0.0051	0.116	0.01	1	--	--	--	146	0	0
	Tungsten	mg/L	15	0	0%	--	--	0.025	2.5	--	--	--	--	--	--
Uranium	mg/L	15	7	47%	0.005	0.0426	0.005	0.5	0.03	1	3	0.0073	4	8	

TABLE 4-10
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – INTERMEDIATE WATER-BEARING ZONE
BRC CLOSURE PLAN
(Page 2 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Metals (Continued)	Vanadium	mg/L	15	4	27%	0.0133	0.12	0.05	5	--	--	--	0.036	1	11
	Zinc	mg/L	15	12	80%	0.0235	1.55	0.05	5	0.5	3	0	11	0	0
	Zirconium	mg/L	15	0	0%	--	--	0.1	25	--	--	--	--	--	--
	Chromium (VI)	mg/L	15	11	73%	0.011	0.19	0.01	0.01	--	--	--	0.11	1	0
	Mercury	mg/L	15	0	0%	--	--	0.0002	0.0002	0.002	0	0	0.011	0	0
Organo-phosphorous Pesticides	Azinphos-ethyl	mg/L	15	0	0%	--	--	0.0006	0.0006	--	--	--	--	--	--
	Azinphos-methyl	mg/L	15	0	0%	--	--	0.0025	0.0025	--	--	--	--	--	--
	Carbophenothion	mg/L	15	0	0%	--	--	0.0006	0.0006	--	--	--	--	--	--
	Chlorpyrifos	mg/L	15	0	0%	--	--	0.0005	0.0005	--	--	--	0.11	0	0
	Coumaphos	mg/L	15	0	0%	--	--	0.0005	0.0005	--	--	--	--	--	--
	Demeton-O	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	0.0015	--	0
	Demeton-S	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	0.0015	--	0
	Diazinon	mg/L	15	0	0%	--	--	0.0005	0.0005	--	--	--	0.033	0	0
	Dichlorvos	mg/L	15	0	0%	--	--	0.0005	0.0005	--	--	--	0.00023	0	15
	Dimethoate	mg/L	15	0	0%	--	--	0.0005	0.0005	--	--	--	0.0073	0	0
	Disulfoton	mg/L	15	0	0%	--	--	0.0005	0.0005	--	--	--	0.0015	0	0
	EPN	mg/L	15	0	0%	--	--	0.0005	0.0005	--	--	--	--	--	--
	Ethoprop	mg/L	15	0	0%	--	--	0.0005	0.0005	--	--	--	0.00036	0	15
	Ethyl parathion	mg/L	15	0	0%	--	--	0.0005	0.0005	--	--	--	0.22	0	0
	Famphur	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	Fenthion	mg/L	15	0	0%	--	--	0.0025	0.0025	--	--	--	--	--	--
	Malathion	mg/L	15	0	0%	--	--	0.0012	0.0012	--	--	--	0.73	0	0
	Methyl carbophenothion	mg/L	15	0	0%	--	--	0.0008	0.0008	--	--	--	--	--	--
	Methyl parathion	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	0.0091	0	0
	Mevinphos	mg/L	15	0	0%	--	--	0.0062	0.0062	--	--	--	--	--	--
	Naled	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.073	0	0
	O,O,O-Triethyl phosphorothioate (TEPP)	mg/L	15	0	0%	--	--	0.0005	0.0005	--	--	--	--	--	--
	Phorate	mg/L	15	0	0%	--	--	0.0012	0.0012	--	--	--	0.0073	0	0
Phosmet	mg/L	15	0	0%	--	--	0.0012	0.0012	--	--	--	0.73	0	0	
Ronnel	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	1.8	0	0	
Stirophos (Tetrachlorovinphos)	mg/L	15	0	0%	--	--	0.0025	0.0025	--	--	--	0.0028	0	0	
Sulfotep	mg/L	15	0	0%	--	--	0.0005	0.0005	--	--	--	0.018	0	0	
Organic Acids	4-Chlorobenzene sulfonic acid	mg/L	15	0	0%	--	--	0.05	0.05	--	--	--	--	--	--
	Benzenesulfonic acid	mg/L	15	0	0%	--	--	0.05	1	--	--	--	--	--	--
	O,O-Diethylphosphorodithioic acid	mg/L	15	0	0%	--	--	0.05	0.05	--	--	--	--	--	--
	O,O-Dimethylphosphorodithioic acid	mg/L	15	2	13%	5.1	5.2	0.25	5	--	--	--	--	--	--
Nonhalogenated	Ethylene glycol	mg/L	15	0	0%	--	--	10	10	--	--	--	73	0	0
	Methanol	mg/L	15	0	0%	--	--	5	5	--	--	--	18	0	0
	Propylene glycol	mg/L	15	0	0%	--	--	10	10	--	--	--	18	0	0
Organochlorine Pesticides	2,4-DDD	mg/L	15	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
	2,4-DDE	mg/L	15	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
	4,4-DDD	mg/L	15	0	0%	--	--	0.00005	0.00005	--	--	--	0.00028	0	0
	4,4-DDE	mg/L	15	0	0%	--	--	0.00005	0.00005	--	--	--	0.0002	0	0
	4,4-DDT	mg/L	15	0	0%	--	--	0.00005	0.00005	--	--	--	0.0002	0	0
	Aldrin	mg/L	15	0	0%	--	--	0.00005	0.00005	--	--	--	0.000004	0	15
	alpha-BHC	mg/L	15	1	7%	0.00014	0.00014	0.00005	0.00005	--	--	--	0.000011	1	14
	alpha-Chlordane	mg/L	15	0	0%	--	--	0.00005	0.00005	--	--	--	0.00019	--	0
	beta-BHC	mg/L	15	1	7%	0.000082	0.000082	0.00005	0.00005	--	--	--	0.000037	1	14
	Chlordane	mg/L	15	0	0%	--	--	0.0005	0.0005	0.002	0	0	0.00019	--	15
	delta-BHC	mg/L	15	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
	Dieldrin	mg/L	15	0	0%	--	--	0.00005	0.00005	--	--	--	0.0000042	0	15
	Endosulfan I	mg/L	15	0	0%	--	--	0.00005	0.00005	--	--	--	0.22	--	0
	Endosulfan II	mg/L	15	0	0%	--	--	0.00005	0.00005	--	--	--	0.22	--	0
	Endosulfan sulfate	mg/L	15	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
	Endrin	mg/L	15	0	0%	--	--	0.00005	0.00005	0.002	0	0	0.011	0	0

TABLE 4-10
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – INTERMEDIATE WATER-BEARING ZONE
BRC CLOSURE PLAN
(Page 3 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Organochlorine Pesticides (Continued)	Endrin aldehyde	mg/L	15	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
	Endrin ketone	mg/L	15	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
	gamma-BHC (Lindane)	mg/L	15	0	0%	--	--	0.00005	0.00005	0.0002	0	0	0.000052	0	0
	gamma-Chlordane	mg/L	15	1	7%	0.00042	0.00042	0.00005	0.00005	--	--	--	0.00019	1	0
	Heptachlor	mg/L	15	0	0%	--	--	0.00005	0.00005	0.0004	0	0	0.000015	0	15
	Heptachlor epoxide	mg/L	15	0	0%	--	--	0.00005	0.00005	0.0002	0	0	0.0000074	0	15
	Methoxychlor	mg/L	15	0	0%	--	--	0.0001	0.0001	0.04	0	0	0.18	0	0
Toxaphene	mg/L	15	0	0%	--	--	0.002	0.002	0.003	0	0	0.000061	0	15	
Polynuclear Aromatic Hydrocarbons	Acenaphthene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.37	0	0
	Acenaphthylene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Anthracene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	1.8	0	0
	Benzo(a)anthracene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.000092	0	15
	Benzo(a)pyrene	mg/L	15	0	0%	--	--	0.01	0.01	0.0002	0	15	0.0000092	0	15
	Benzo(b)fluoranthene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.000092	0	15
	Benzo(g,h,i)perylene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Benzo(k)fluoranthene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.000092	0	15
	Chrysene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.0092	0	15
	Dibenzo(a,h)anthracene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.0000092	0	15
	Indeno(1,2,3-cd)pyrene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.000092	0	15
Phenanthrene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--	
Pyrene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.18	0	0	
Radionuclides	Gross alpha	pCi/L	15	1	7%	60	60	3	3	15 ^h	1	0	--	--	--
	Gross beta	pCi/L	15	14	93%	8.33	12200	4	4	-- ⁱ	--	--	--	--	--
	Thorium-232	pCi/L	13	0	0%	--	--	1	1	--	--	--	0.47	0	13
	Thorium-228	pCi/L	13	0	0%	--	--	1	1	--	--	--	0.16	0	13
	Thorium-230	pCi/L	13	0	0%	--	--	1	1	--	--	--	0.52	0	13
	Uranium-233/234	pCi/L	15	13	87%	0.34	19.8	1	1	--	--	--	0.67	11	2
	Uranium 235/236	pCi/L	15	4	27%	0.18	0.57	0.1	0.1	--	--	--	0.66	0	0
	Uranium-238	pCi/L	15	13	87%	0.14	15.2	1	1	--	--	--	0.55	10	2
	Radium-226	pCi/L	13	8	62%	0.44	7.6	1	1	5.0 ^j	j	j	0.00082	8	5
Radium-228	pCi/L	15	5	33%	1.1	4.4	3	3	5.0 ^j	j	j	0.046	5	10	
Radium-226/228	pCi/L	15	8	53%	0.7	10.8	3	4	5.0 ^j	3	0	--	--	--	
Aldehydes	Acetaldehyde	mg/L	15	2	13%	0.0045	0.0057	0.03	0.03	--	--	--	0.0017	2	13
	Chloroacetaldehyde	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Dichloroacetaldehyde	mg/L	15	0	0%	--	--	0.35	0.35	--	--	--	--	--	--
	Formaldehyde	mg/L	15	0	0%	--	--	0.06	0.06	--	--	--	5.5	0	0
	Trichloroacetaldehyde	mg/L	15	0	0%	--	--	0.15	0.15	--	--	--	--	--	--
Semivolatile Organic Compounds	1,2,4,5-Tetrachlorobenzene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.011	0	0
	1,2-Diphenylhydrazine	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.000084	0	15
	1,4-Dioxane	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.0061	0	15
	2,4,5-Trichlorophenol	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	3.6	0	0
	2,4,6-Trichlorophenol	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.0036	0	15
	2,4-Dichlorophenol	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.11	0	0
	2,4-Dimethylphenol	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.73	0	0
	2,4-Dinitrophenol	mg/L	15	0	0%	--	--	0.05	0.05	--	--	--	0.073	0	0
	2,4-Dinitrotoluene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.073	0	0
	2,6-Dinitrotoluene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.036	0	0
	2-Chloronaphthalene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.49	0	0
	2-Chlorophenol	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.03	0	0
	2-Methylnaphthalene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	2-Nitroaniline	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.11	0	0
	2-Nitrophenol	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	3,3-Dichlorobenzidine	mg/L	15	0	0%	--	--	0.05	0.05	--	--	--	0.00015	0	15
	3-Nitroaniline	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.0032	0	15
4,4'-Dichlorobenzil	mg/L	15	0	0%	--	--	0.0094	0.011	--	--	--	--	--	--	

TABLE 4-10
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – INTERMEDIATE WATER-BEARING ZONE
BRC CLOSURE PLAN
(Page 4 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Semivolatile Organic Compounds (Continued)	4-Bromophenyl phenyl ether	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	4-Chloro-3-methylphenol	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	4-Chlorophenyl phenyl ether	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	4-Chlorothioanisole	mg/L	15	0	0%	--	--	0.05	0.05	--	--	--	--	--	--
	4-Nitroaniline	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.0032	0	15
	4-Nitrophenol	mg/L	15	0	0%	--	--	0.025	0.025	--	--	--	--	--	--
	Acetophenone	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Aniline	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.012	0	0
	Azobenzene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.00061	0	15
	Benzoic acid	mg/L	15	0	0%	--	--	0.05	0.05	--	--	--	150	0	0
	Benzyl alcohol	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	11	0	0
	Benzyl butyl phthalate	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	7.3	0	0
	bis(2-Chloroethoxy)methane	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	bis(2-Chloroethyl) ether	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.00001	0	15
	bis(2-Chloroisopropyl) ether	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.00027	0	15
	bis(2-Ethylhexyl) phthalate	mg/L	15	0	0%	--	--	0.01	0.01	0.006	0	15	0.0048	0	15
	bis(p-Chlorophenyl) sulfone	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	bis(p-Chlorophenyl)disulfide	mg/L	15	0	0%	--	--	0.05	0.05	--	--	--	--	--	--
	Carbazole	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.0034	0	15
	Dibenzofuran	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.012	0	0
	Diethyl phthalate	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	29	0	0
	Dimethyl phthalate	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	365	0	0
	Di-n-butyl phthalate	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	3.6	0	0
	Di-n-octyl phthalate	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	1.5	0	0
	Diphenyl disulfide	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Diphenyl sulfide	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Diphenyl sulfone	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.11	0	0
	Fluoranthene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	1.5	0	0
	Fluorene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.24	0	0
	Hexachlorobenzene	mg/L	15	0	0%	--	--	0.01	0.01	0.001	0	15	0.000042	0	15
	Hexachlorobutadiene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.00086	0	15
	Hexachlorocyclopentadiene	mg/L	15	0	0%	--	--	0.01	0.01	0.05	0	0	0.22	0	0
	Hexachloroethane	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.0048	0	15
	Hydroxymethyl phthalimide	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Isophorone	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.071	0	0
	m,p-Cresol	mg/L	15	0	0%	--	--	0.01	0.02	--	--	--	1.8	--	0
	Naphthalene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.0062	0	15
	Nitrobenzene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.0034	0	15
	N-nitrosodi-n-propylamine	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.0000096	0	15
	N-nitrosodiphenylamine	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.014	0	0
o-Cresol	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	1.8	0	0	
Octachlorostyrene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--	
p-Chloroaniline (4-Chloroaniline)	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.15	0	0	
p-Chlorobenzenethiol (see 4-Chlorothiophenol)	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--	
Pentachlorobenzene	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.029	0	0	
Pentachlorophenol	mg/L	15	0	0%	--	--	0.05	0.05	0.001	0	15	0.00056	0	15	
Phenol	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	11	0	0	
Phthalic acid	mg/L	15	0	0%	--	--	0.05	0.05	--	--	--	37	--	0	
Pyridine	mg/L	15	0	0%	--	--	0.02	0.02	--	--	--	0.036	0	0	
Thiophenol	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--	
Volatile Organic Compounds	1,1,1,2-Tetrachloroethane	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	0.00043	0	15
	1,1,1-Trichloroethane	mg/L	15	0	0%	--	--	0.001	0.001	0.2	0	0	3.2	0	0
	1,1,2,2-Tetrachloroethane	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	0.000055	0	15
	1,1,2-Trichloroethane	mg/L	15	0	0%	--	--	0.001	0.001	0.005	0	0	0.0002	0	15
	1,1-Dichloroethane	mg/L	15	1	7%	0.00025	0.00025	0.001	0.001	--	--	--	0.81	0	0

TABLE 4-10
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BRC CLOSURE PLAN
(Page 5 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Volatile Organic Compounds (Continued)	1,1-Dichloroethene	mg/L	15	2	13%	0.00027	0.00081	0.001	0.001	0.007	0	0	0.34	0	0
	1,1-Dichloropropene	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	1,2,3-Trichlorobenzene	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	1,2,3-Trichloropropane	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	0.000056	0	15
	1,2,4-Trichlorobenzene	mg/L	15	0	0%	--	--	0.001	0.001	0.07	0	0	0.0072	0	0
	1,2,4-Trimethylbenzene	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	0.012	0	0
	1,2-Dichlorobenzene	mg/L	15	0	0%	--	--	0.001	0.001	0.6	0	0	0.37	0	0
	1,2-Dichloroethane	mg/L	15	0	0%	--	--	0.001	0.001	0.005	0	0	0.00012	0	15
	1,2-Dichloroethene (see cis-, trans-)	mg/L	15	1	7%	0.00054	0.00054	0.002	0.002	--	--	--	--	--	--
	1,2-Dichloropropane	mg/L	15	0	0%	--	--	0.001	0.001	0.005	0	0	0.00016	0	15
	1,3,5-Trichlorobenzene	mg/L	15	0	0%	--	--	0.005	0.005	--	--	--	--	--	--
	1,3,5-Trimethylbenzene	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	0.012	0	0
	1,3-Dichlorobenzene	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	0.18	0	0
	1,3-Dichloropropane	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	0.12	0	0
	1,4-Dichlorobenzene	mg/L	15	0	0%	--	--	0.001	0.001	0.075	0	0	0.0005	0	15
	2,2-Dichloropropane	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2,2-Dimethylpentane	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2,2,3-Trimethylbutane	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2,3-Dimethylpentane	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2,4-Dimethylpentane	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2-Chlorotoluene	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	0.12	0	0
	2-Hexanone	mg/L	15	0	0%	--	--	0.005	0.005	--	--	--	--	--	--
	2-Methylhexane	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2-Nitropropane	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.0000012	0	15
	3,3-Dimethylpentane	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	3-Ethylpentane	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	3-Methylhexane	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	4-Chlorotoluene	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	4-Methyl-2-pentanone (MIBK)	mg/L	15	0	0%	--	--	0.005	0.005	--	--	--	2	0	0
	Acetone	mg/L	15	2	13%	0.0025	0.013	0.002	0.002	--	--	--	5.5	0	0
	Acetonitrile	mg/L	15	0	0%	--	--	0.01	0.01	--	--	--	0.1	0	0
	Benzene	mg/L	15	2	13%	0.00043	0.0011	0.001	0.001	0.005	0	0	0.00035	2	13
	Bromobenzene	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	0.02	0	0
	Bromodichloromethane	mg/L	15	0	0%	--	--	0.001	0.001	0.08 ^k	k	k	0.00018	0	15
	Bromoform	mg/L	15	0	0%	--	--	0.001	0.001	0.08 ^k	k	k	0.0085	0	0
	Bromomethane	mg/L	15	0	0%	--	--	0.002	0.002	--	--	--	0.0087	0	0
	Carbon disulfide	mg/L	15	3	20%	0.00053	0.0025	0.001	0.001	--	--	--	1	0	0
	Carbon tetrachloride	mg/L	15	2	13%	0.00094	0.0088	0.001	0.001	0.005	1	0	0.00017	2	13
	Chlorobenzene	mg/L	15	0	0%	--	--	0.001	0.001	0.1	0	0	0.11	0	0
	Chlorobromomethane	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	Chloroethane	mg/L	15	0	0%	--	--	0.002	0.002	--	--	--	0.0046	0	0
	Chloroform	mg/L	15	7	47%	0.00026	0.41	0.001	0.01	0.08 ^k	k	k	0.00017	7	8
	Chloromethane	mg/L	15	1	7%	0.0017	0.0017	0.002	0.002	--	--	--	0.16	0	0
cis-1,2-Dichloroethene	mg/L	15	0	0%	--	--	0.001	0.001	0.07	0	0	0.061	0	0	
cis-1,3-Dichloropropene	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	--	--	--	
Cymene (Isopropyltoluene)	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	--	--	--	
Dibromochloromethane	mg/L	15	0	0%	--	--	0.001	0.001	0.08 ^k	k	k	0.00013	0	15	
Dibromochloropropane	mg/L	15	0	0%	--	--	0.001	0.001	0.0002	0	15	0.000048	0	15	
Dibromomethane	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	0.061	0	0	
Dichloromethane (Methylene chloride)	mg/L	15	0	0%	--	--	0.001	0.001	0.005	0	0	0.0043	0	0	
Dimethyldisulfide	mg/L	15	0	0%	--	--	0.005	0.005	--	--	--	--	--	--	
Ethanol	mg/L	15	0	0%	--	--	0.00025	0.00025	--	--	--	--	--	--	
Ethylbenzene	mg/L	15	0	0%	--	--	0.001	0.001	0.7	0	0	1.3	0	0	
Freon-11 (Trichlorofluoromethane)	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	1.3	0	0	
Freon-113 (1,1,2-Trifluoro-1,2,2-trichloroethane)	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	59	0	0	

TABLE 4-10
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – INTERMEDIATE WATER-BEARING ZONE
BRC CLOSURE PLAN
(Page 6 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Volatile Organic Compounds (Continued)	Freon-12 (Dichlorodifluoromethane)	mg/L	15	0	0%	--	--	0.002	0.002	--	--	--	0.39	0	0
	Heptane	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	Isopropylbenzene	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	0.66	0	0
	m,p-Xylene (see Xylenes (total))	mg/L	15	0	0%	--	--	0.002	0.002	--	--	--	--	--	--
	Methyl ethyl ketone (2-Butanone)	mg/L	15	0	0%	--	--	0.005	0.005	--	--	--	7	0	0
	Methyl iodide	mg/L	15	0	0%	--	--	0.002	0.002	--	--	--	--	--	--
	MTBE (Methyl tert-butyl ether)	mg/L	15	0	0%	--	--	0.002	0.002	--	--	--	0.0062	0	0
	n-Butylbenzene	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	0.24	0	0
	n-Propylbenzene	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	0.24	0	0
	Nonanal	mg/L	15	0	0%	--	--	0.005	0.005	--	--	--	--	--	--
	o-Xylene (see Xylenes (total))	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	sec-Butylbenzene	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	0.24	--	0
	Styrene	mg/L	15	0	0%	--	--	0.001	0.001	0.1	0	0	1.6	0	0
	tert-Butylbenzene	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	0.24	0	0
	Tetrachloroethene	mg/L	15	3	20%	0.0004	0.019	0.001	0.001	0.005	1	0	0.0001	3	12
	Toluene	mg/L	15	0	0%	--	--	0.001	0.001	1	0	0	0.72	0	0
	trans-1,2-Dichloroethene	mg/L	15	0	0%	--	--	0.001	0.001	0.1	0	0	0.12	0	0
	trans-1,3-Dichloropropene	mg/L	15	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	Trichloroethene	mg/L	15	3	20%	0.00021	0.0043	0.001	0.001	0.005	0	0	0.000028	3	12
	Vinyl acetate	mg/L	15	0	0%	--	--	0.002	0.002	--	--	--	0.41	0	0
Vinyl chloride	mg/L	15	0	0%	--	--	0.002	0.002	0.002	0	0	0.00002	0	15	
Xylenes (total)	mg/L	15	0	0%	--	--	0.003	0.003	10	0	0	0.21	0	0	
Total Trihalomethanes (TTHM)	mg/L	15	7	47%	0.0018	0.412	0.004	0.004	0.08 ^k	2	0	--	--	--	
Water Quality Parameters	Conductivity	umhos/cm	15	15	100%	1110	199000	1	10	--	--	--	--	--	--
	Hardness, total	mg/L	15	15	100%	118	70000	5	500	--	--	--	--	--	--
	Total dissolved solids	mg/L	15	15	100%	650	182000	5	5	500	15	0	1,900 / 2,400 ^l	14 / 11	0
	Total suspended solids	mg/L	15	14	93%	5	826	1	1	--	--	--	--	--	--
	Alkalinity, Total (as CaCO ₃)	mg/L	15	15	100%	35	153	5	5	--	--	--	--	--	--
	Bicarbonate alkalinity	mg/L	15	15	100%	35	150	5	5	--	--	--	--	--	--
	Carbonate alkalinity	mg/L	15	1	7%	14	14	5	5	--	--	--	--	--	--
Hydroxide alkalinity	mg/L	15	1	7%	7	7	5	5	--	--	--	--	--	--	

a - Range of detections include estimated values of detect results between the detection limit and reporting limit. As such some minimum detected concentrations may be below the minimum reporting limit. In these cases the respective sample results are flagged in the data set.

b - The quantitation limits shown include samples which had detections. For screening purposes, the detection limit was used for comparison to the screening levels.

c - USEPA Maximum Contaminant Levels (MCLs).

d - Unless otherwise noted the Alternative Criteria used are from USEPA Region 9 preliminary remediation goals (PRG) table, October 2004 (and the 2007 USEPA radionuclide PRG webpage; <http://epa-prgs.ornl.gov/radionuclides>). Values used are tap water PRGs.

e - An MCL for perchlorate has not been promulgated. The USEPA Drinking Water Equivalent Level of 24.5 µg/L was used.

f - Nevada provisional action level of 18 µg/l.

g - A NDEP water quality standard was used for Class A (municipal or domestic supply) waters for pH and total phosphorus based on Nevada Administrative Code (NAC) 445A.118 through 445A.225.

h - The MCL for Alpha Particles was used as comparison to Gross Alpha results. The MCL excludes the contributions from radon and uranium. The Gross Alpha concentrations were not adjusted due to contributions from radon nor uranium prior to comparison to MCL.

i - The MCL for Beta particles photon emitters is 4 millirems per year and was not used to compare to Gross Beta concentrations.

j - The constituent is regulated under the MCL for the combined concentration of radium-226 and radium-228. For comparison to the MCL, concentrations of both constituents are summed.

k - The constituent is regulated under the MCL for Total Trihalomethanes (TTHM). For comparison to the MCL for TTHM, concentrations of all TTHM constituents need to be considered.

l - Nevada Requirement to Maintain Existing Higher Quality level of 1,900 / 2,400 mg/L for total dissolved solids (Nevada Administrative Code [NAC] 445A.199 / NAC 445A 200/201).

TABLE 4-11
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – DEEP WATER-BEARING ZONE
BRC CLOSURE PLAN
(Page 1 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Ions	Bromide	mg/L	12	3	25%	0.18	0.62	0.25	125	--	--	--	--	--	--
	Bromine	mg/L	12	3	25%	0.35	1.2	0.5	250	--	--	--	--	--	--
	Chlorate	mg/L	12	0	0%	--	--	2000	20000	--	--	--	--	--	--
	Chloride	mg/L	12	11	92%	136	54000	40	10000	250	8	0	--	--	--
	Chlorine (soluble)	mg/L	12	11	92%	272	80400	80	20000	--	--	--	--	--	--
	Chlorite	mg/L	12	1	8%	87	87	100	100000	1000	0	6	--	--	--
	Fluoride	mg/L	12	8	67%	0.53	125	0.1	60.3	4	1	3	2.2	1	3
	Nitrate (as N)	mg/L	9	3	33%	1.5	2.3	0.2	10	10	0	0	10	0	0
	Nitrite (as N)	mg/L	10	1	10%	532	532	0.02	100	1	1	6	1	1	6
	Orthophosphate	mg/L	9	2	22%	4.5	70.8	0.5	250	--	--	--	--	--	--
	Sulfate	mg/L	12	12	100%	187	43600	5	2500	250	11	0	--	--	--
	Perchlorate	mg/L	12	1	8%	17.3	17.3	4	400	0.0245 ^e	0	5	0.018 ^f	0	8
Dissolved Gases	Ethane	mg/L	12	0	0%	--	--	0.005	0.005	--	--	--	--	--	--
	Ethylene	mg/L	12	6	50%	0.00045	0.006	0.005	0.005	--	--	--	--	--	--
	Methane	mg/L	12	10	83%	0.00029	0.023	0.005	0.005	--	--	--	--	--	--
General Chemistry	Ammonia (as N)	mg/L	12	9	75%	87.2	7640	50	5000	--	--	--	--	--	--
	Iodine	mg/L	12	1	8%	261	261	1	50	--	--	--	--	--	--
	pH in water	none	12	12	100%	6.2	8.9	0.1	0.1	6.5-8.5	2	--	6.5-9 ^g	1	--
	Total inorganic carbon	mg/L	11	0	0%	--	--	50	50	--	--	--	--	--	--
	Total Kjeldahl nitrogen (TKN)	mg/L	11	11	100%	0.28	11	0.1	0.5	--	--	--	--	--	--
Total organic carbon (TOC)	mg/L	12	0	0%	--	--	50	50	--	--	--	--	--	--	
Metals	Aluminum	mg/L	12	1	8%	0.277	0.277	0.15	6	0.05	1	11	36	0	0
	Antimony	mg/L	12	0	0%	--	--	0.025	1	0.006	0	12	0.015	0	12
	Arsenic	mg/L	12	2	17%	0.0203	0.0324	0.05	2	0.01	2	10	0.000045	2	10
	Barium	mg/L	12	10	83%	0.0143	0.0759	0.01	0.4	2	0	0	2.6	0	0
	Beryllium	mg/L	12	0	0%	--	--	0.0025	0.1	0.004	0	10	0.073	0	2
	Boron	mg/L	12	10	83%	0.742	21	1	10	--	--	--	7.3	4	0
	Cadmium	mg/L	12	2	17%	0.00092	0.0043	0.0025	0.1	0.005	0	5	0.018	0	3
	Calcium	mg/L	12	12	100%	23.9	610	0.5	20	--	--	--	--	--	--
	Chromium	mg/L	12	3	25%	0.0349	0.138	0.05	2	0.1	1	4	55	0	0
	Cobalt	mg/L	12	3	25%	0.0018	0.0255	0.01	0.4	--	--	--	0.73	0	0
	Copper	mg/L	12	9	75%	0.0077	0.135	0.005	0.2	1.3	0	0	1.5	0	0
	Iron	mg/L	6	3	50%	0.365	2.74	0.25	10	0.3	3	2	11	0	0
	Lead	mg/L	12	0	0%	--	--	0.015	0.6	0.015	0	10	--	--	--
	Lithium	mg/L	12	8	67%	0.369	72.5	0.0542	8.69	--	--	--	0.73	7	1
	Magnesium	mg/L	12	12	100%	7.45	14300	0.25	25	--	--	--	--	--	--
	Manganese	mg/L	12	10	83%	0.0235	4.17	0.01	0.4	0.05	9	0	0.88	1	0
	Molybdenum	mg/L	12	12	100%	0.0102	2.05	0.025	1	--	--	--	0.18	4	0
	Nickel	mg/L	12	9	75%	0.0095	0.101	0.025	1	--	--	--	0.73	0	2
	Niobium	mg/L	12	1	8%	0.0878	0.0878	0.125	25	--	--	--	--	--	--
	Palladium	mg/L	12	10	83%	0.0013	0.0433	0.0025	0.1	--	--	--	--	--	--
	Phosphorus	mg/L	12	1	8%	0.424	0.424	0.02	4	--	--	--	--	--	--
	Platinum	mg/L	12	0	0%	--	--	0.005	0.2	--	--	--	--	--	--
	Potassium	mg/L	12	12	100%	9.73	16700	0.5	100	--	--	--	--	--	--
	Selenium	mg/L	12	0	0%	--	--	0.025	1	0.05	0	5	0.18	0	3
	Silicon	mg/L	12	12	100%	2.73	9.09	2.5	50	--	--	--	--	--	--
	Silver	mg/L	12	1	8%	0.0021	0.0021	0.01	0.4	0.1	0	2	0.18	0	2
	Sodium	mg/L	12	12	100%	165	45000	0.25	50	--	--	--	--	--	--
	Strontium	mg/L	12	12	100%	0.431	11.4	0.025	1	--	--	--	22	0	0
	Sulfur	mg/L	12	12	100%	57.8	17000	2	200	--	--	--	--	--	--
	Thallium	mg/L	12	1	8%	0.0043	0.0043	0.01	0.4	0.002	1	11	0.0024	1	11
	Tin	mg/L	12	0	0%	--	--	0.01	0.4	--	--	--	22	0	0
	Titanium	mg/L	12	3	25%	0.0089	0.099	0.01	0.4	--	--	--	146	0	0
	Tungsten	mg/L	12	2	17%	0.0034	0.0069	0.025	1	--	--	--	--	--	--
Uranium	mg/L	12	3	25%	0.0015	0.0082	0.005	0.2	0.03	0	3	0.0073	1	9	

TABLE 4-11
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – DEEP WATER-BEARING ZONE
BRC CLOSURE PLAN
(Page 2 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Metals (Continued)	Vanadium	mg/L	12	2	17%	0.009	0.0248	0.05	2	--	--	--	0.036	0	10
	Zinc	mg/L	12	9	75%	0.029	1.65	0.05	2	0.5	1	0	11	0	0
	Zirconium	mg/L	12	0	0%	--	--	0.1	2.5	--	--	--	--	--	--
	Chromium (VI)	mg/L	12	4	33%	0.022	0.052	0.01	0.01	--	--	--	0.11	0	0
	Mercury	mg/L	12	0	0%	--	--	0.0002	0.0002	0.002	0	0	0.011	0	0
Organo-phosphorous Pesticides	Azinphos-ethyl	mg/L	12	0	0%	--	--	0.0006	0.0006	--	--	--	--	--	--
	Azinphos-methyl	mg/L	12	0	0%	--	--	0.0025	0.0025	--	--	--	--	--	--
	Carbophenothion	mg/L	12	0	0%	--	--	0.0006	0.0006	--	--	--	--	--	--
	Chlorpyrifos	mg/L	12	0	0%	--	--	0.0005	0.0005	--	--	--	0.11	0	0
	Coumaphos	mg/L	12	0	0%	--	--	0.0005	0.0005	--	--	--	--	--	--
	Demeton-O	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	0.0015	--	0
	Demeton-S	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	0.0015	--	0
	Diazinon	mg/L	12	0	0%	--	--	0.0005	0.0005	--	--	--	0.033	0	0
	Dichlorvos	mg/L	12	0	0%	--	--	0.0005	0.0005	--	--	--	0.00023	0	12
	Dimethoate	mg/L	12	0	0%	--	--	0.0005	0.0005	--	--	--	0.0073	0	0
	Disulfoton	mg/L	12	0	0%	--	--	0.0005	0.0005	--	--	--	0.0015	0	0
	EPN	mg/L	12	0	0%	--	--	0.0005	0.0005	--	--	--	--	--	--
	Ethoprop	mg/L	12	0	0%	--	--	0.0005	0.0005	--	--	--	0.00036	0	12
	Ethyl parathion	mg/L	12	0	0%	--	--	0.0005	0.0005	--	--	--	0.22	0	0
	Famphur	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	Fenthion	mg/L	12	0	0%	--	--	0.0025	0.0025	--	--	--	--	--	--
	Malathion	mg/L	12	0	0%	--	--	0.0012	0.0012	--	--	--	0.73	0	0
	Methyl carbophenothion	mg/L	12	0	0%	--	--	0.0008	0.0008	--	--	--	--	--	--
	Methyl parathion	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	0.0091	0	0
	Mevinphos	mg/L	12	0	0%	--	--	0.0062	0.0062	--	--	--	--	--	--
	Naled	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.073	0	0
	O,O,O-Triethyl phosphorothioate (TEPP)	mg/L	12	0	0%	--	--	0.0005	0.0005	--	--	--	--	--	--
	Phorate	mg/L	12	0	0%	--	--	0.0012	0.0012	--	--	--	0.0073	0	0
Phosmet	mg/L	12	0	0%	--	--	0.0012	0.0012	--	--	--	0.73	0	0	
Ronnel	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	1.8	0	0	
Stirophos (Tetrachlorovinphos)	mg/L	12	0	0%	--	--	0.0025	0.0025	--	--	--	0.0028	0	0	
Sulfotep	mg/L	12	0	0%	--	--	0.0005	0.0005	--	--	--	0.018	0	0	
Organic Acids	4-Chlorobenzene sulfonic acid	mg/L	12	0	0%	--	--	0.05	0.05	--	--	--	--	--	--
	Benzenesulfonic acid	mg/L	12	1	8%	0.96	0.96	0.05	0.05	--	--	--	--	--	--
	O,O-Diethylphosphorodithioic acid	mg/L	12	0	0%	--	--	0.05	0.05	--	--	--	--	--	--
	O,O-Dimethylphosphorodithioic acid	mg/L	12	0	0%	--	--	0.25	5	--	--	--	--	--	--
	Ethylene glycol	mg/L	12	0	0%	--	--	10	10	--	--	--	73	0	0
Nonhalogenated	Methanol	mg/L	12	0	0%	--	--	5	5	--	--	--	18	0	0
	Propylene glycol	mg/L	12	0	0%	--	--	10	10	--	--	--	18	0	0
	2,4-DDD	mg/L	12	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
Organochlorine Pesticides	2,4-DDE	mg/L	12	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
	4,4-DDD	mg/L	12	0	0%	--	--	0.00005	0.00005	--	--	--	0.00028	0	0
	4,4-DDE	mg/L	12	0	0%	--	--	0.00005	0.00005	--	--	--	0.0002	0	0
	4,4-DDT	mg/L	12	0	0%	--	--	0.00005	0.00005	--	--	--	0.0002	0	0
	Aldrin	mg/L	12	0	0%	--	--	0.00005	0.00005	--	--	--	0.000004	0	12
	alpha-BHC	mg/L	12	0	0%	--	--	0.00005	0.00005	--	--	--	0.000011	0	12
	alpha-Chlordane	mg/L	12	0	0%	--	--	0.00005	0.00005	--	--	--	0.00019	--	0
	beta-BHC	mg/L	12	0	0%	--	--	0.00005	0.00005	--	--	--	0.000037	0	12
	Chlordane	mg/L	12	0	0%	--	--	0.0005	0.0005	0.002	0	0	0.00019	--	12
	delta-BHC	mg/L	12	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
	Dieldrin	mg/L	12	0	0%	--	--	0.00005	0.00005	--	--	--	0.0000042	0	12
	Endosulfan I	mg/L	12	0	0%	--	--	0.00005	0.00005	--	--	--	0.22	--	0
	Endosulfan II	mg/L	12	0	0%	--	--	0.00005	0.00005	--	--	--	0.22	--	0
	Endosulfan sulfate	mg/L	12	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
	Endrin	mg/L	12	0	0%	--	--	0.00005	0.00005	0.002	0	0	0.011	0	0

TABLE 4-11
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – DEEP WATER-BEARING ZONE
BRC CLOSURE PLAN
(Page 3 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Organochlorine Pesticides (Continued)	Endrin aldehyde	mg/L	12	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
	Endrin ketone	mg/L	12	0	0%	--	--	0.00005	0.00005	--	--	--	--	--	--
	gamma-BHC (Lindane)	mg/L	12	0	0%	--	--	0.00005	0.00005	0.0002	0	0	0.000052	0	0
	gamma-Chlordane	mg/L	12	0	0%	--	--	0.00005	0.00005	--	--	--	0.00019	--	0
	Heptachlor	mg/L	12	0	0%	--	--	0.00005	0.00005	0.0004	0	0	0.000015	0	12
	Heptachlor epoxide	mg/L	12	0	0%	--	--	0.00005	0.00005	0.0002	0	0	0.0000074	0	12
	Methoxychlor	mg/L	12	0	0%	--	--	0.0001	0.0001	0.04	0	0	0.18	0	0
Toxaphene	mg/L	12	0	0%	--	--	0.002	0.002	0.003	0	0	0.000061	0	12	
Polynuclear Aromatic Hydrocarbons	Acenaphthene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.37	0	0
	Acenaphthylene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Anthracene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	1.8	0	0
	Benzo(a)anthracene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.000092	0	12
	Benzo(a)pyrene	mg/L	12	0	0%	--	--	0.01	0.01	0.0002	0	12	0.0000092	0	12
	Benzo(b)fluoranthene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.000092	0	12
	Benzo(g,h,i)perylene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Benzo(k)fluoranthene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.00092	0	12
	Chrysene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.0092	0	12
	Dibenzo(a,h)anthracene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.0000092	0	12
	Indeno(1,2,3-cd)pyrene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.000092	0	12
Phenanthrene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--	
Pyrene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.18	0	0	
Radionuclides	Gross alpha	pCi/L	12	0	0%	--	--	3	3	15 ^h	0	0	--	--	--
	Gross beta	pCi/L	12	12	100%	8.3	13400	4	4	-- ⁱ	--	--	--	--	--
	Thorium-232	pCi/L	11	0	0%	--	--	1	1	--	--	--	0.47	0	11
	Thorium-228	pCi/L	11	0	0%	--	--	1	1	--	--	--	0.16	0	11
	Thorium-230	pCi/L	11	1	9%	0.28	0.28	1	1	--	--	--	0.52	0	10
	Uranium-233/234	pCi/L	12	10	83%	0.57	7.2	1	1	--	--	--	0.67	5	2
	Uranium 235/236	pCi/L	12	1	8%	0.16	0.16	0.1	0.1	--	--	--	0.66	0	0
	Uranium-238	pCi/L	12	10	83%	0.21	4.4	1	1	--	--	--	0.55	5	2
	Radium-226	pCi/L	11	9	82%	0.22	5.7	1	1	5.0 ^j	j	j	0.00082	9	2
Radium-228	pCi/L	12	7	58%	0.45	6.3	3	3	5.0 ^j	j	j	0.046	7	5	
Radium-226/228	pCi/L	12	10	83%	0.5	11.7	3	4	5.0 ^j	3	0	--	--	--	
Aldehydes	Acetaldehyde	mg/L	12	3	25%	0.0042	0.0048	0.03	0.03	--	--	--	0.0017	3	9
	Chloroacetaldehyde	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Dichloroacetaldehyde	mg/L	12	0	0%	--	--	0.35	0.35	--	--	--	--	--	--
	Formaldehyde	mg/L	12	0	0%	--	--	0.06	0.06	--	--	--	5.5	0	0
	Trichloroacetaldehyde	mg/L	12	0	0%	--	--	0.15	0.15	--	--	--	--	--	--
Semivolatile Organic Compounds	1,2,4,5-Tetrachlorobenzene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.011	0	0
	1,2-Diphenylhydrazine	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.000084	0	12
	1,4-Dioxane	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.0061	0	12
	2,4,5-Trichlorophenol	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	3.6	0	0
	2,4,6-Trichlorophenol	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.0036	0	12
	2,4-Dichlorophenol	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.11	0	0
	2,4-Dimethylphenol	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.73	0	0
	2,4-Dinitrophenol	mg/L	12	0	0%	--	--	0.05	0.05	--	--	--	0.073	0	0
	2,4-Dinitrotoluene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.073	0	0
	2,6-Dinitrotoluene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.036	0	0
	2-Chloronaphthalene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.49	0	0
	2-Chlorophenol	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.03	0	0
	2-Methylnaphthalene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	2-Nitroaniline	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.11	0	0
	2-Nitrophenol	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	3,3-Dichlorobenzidine	mg/L	12	0	0%	--	--	0.05	0.05	--	--	--	0.00015	0	12
	3-Nitroaniline	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.0032	0	12
4,4'-Dichlorobenzil	mg/L	12	0	0%	--	--	0.0094	0.01	--	--	--	--	--	--	

TABLE 4-11
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – DEEP WATER-BEARING ZONE
BRC CLOSURE PLAN
(Page 4 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Semivolatile Organic Compounds (Continued)	4-Bromophenyl phenyl ether	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	4-Chloro-3-methylphenol	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	4-Chlorophenyl phenyl ether	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	4-Chlorothioanisole	mg/L	12	0	0%	--	--	0.05	0.05	--	--	--	--	--	--
	4-Nitroaniline	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.0032	0	12
	4-Nitrophenol	mg/L	12	0	0%	--	--	0.025	0.025	--	--	--	--	--	--
	Acetophenone	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Aniline	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.012	0	0
	Azobenzene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.00061	0	12
	Benzoic acid	mg/L	12	0	0%	--	--	0.05	0.05	--	--	--	150	0	0
	Benzyl alcohol	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	11	0	0
	Benzyl butyl phthalate	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	7.3	0	0
	bis(2-Chloroethoxy)methane	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	bis(2-Chloroethyl) ether	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.00001	0	12
	bis(2-Chloroisopropyl) ether	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.00027	0	12
	bis(2-Ethylhexyl) phthalate	mg/L	12	0	0%	--	--	0.01	0.01	0.006	0	12	0.0048	0	12
	bis(p-Chlorophenyl) sulfone	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	bis(p-Chlorophenyl)disulfide	mg/L	12	0	0%	--	--	0.05	0.05	--	--	--	--	--	--
	Carbazole	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.0034	0	12
	Dibenzofuran	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.012	0	0
	Diethyl phthalate	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	29	0	0
	Dimethyl phthalate	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	365	0	0
	Di-n-butyl phthalate	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	3.6	0	0
	Di-n-octyl phthalate	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	1.5	0	0
	Diphenyl disulfide	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Diphenyl sulfide	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Diphenyl sulfone	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.11	0	0
	Fluoranthene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	1.5	0	0
	Fluorene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.24	0	0
	Hexachlorobenzene	mg/L	12	0	0%	--	--	0.01	0.01	0.001	0	12	0.000042	0	12
	Hexachlorobutadiene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.00086	0	12
	Hexachlorocyclopentadiene	mg/L	12	0	0%	--	--	0.01	0.01	0.05	0	0	0.22	0	0
	Hexachloroethane	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.0048	0	12
	Hydroxymethyl phthalimide	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	Isophorone	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.071	0	0
	m,p-Cresol	mg/L	12	0	0%	--	--	0.01	0.02	--	--	--	1.8	--	0
	Naphthalene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.0062	0	12
	Nitrobenzene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.0034	0	12
	N-nitrosodi-n-propylamine	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.0000096	0	12
	N-nitrosodiphenylamine	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.014	0	0
	o-Cresol	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	1.8	0	0
	Octachlorostyrene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
p-Chloroaniline (4-Chloroaniline)	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.15	0	0	
p-Chlorobenzenethiol (see 4-Chlorothiophenol)	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--	
Pentachlorobenzene	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.029	0	0	
Pentachlorophenol	mg/L	12	0	0%	--	--	0.05	0.05	0.001	0	12	0.00056	0	12	
Phenol	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	11	0	0	
Phthalic acid	mg/L	12	0	0%	--	--	0.05	0.05	--	--	--	37	--	0	
Pyridine	mg/L	12	0	0%	--	--	0.02	0.02	--	--	--	0.036	0	0	
Thiophenol	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--	
Volatile Organic Compounds	1,1,1,2-Tetrachloroethane	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	0.00043	0	12
	1,1,1-Trichloroethane	mg/L	12	0	0%	--	--	0.001	0.001	0.2	0	0	3.2	0	0
	1,1,2,2-Tetrachloroethane	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	0.000055	0	12
	1,1,2-Trichloroethane	mg/L	12	0	0%	--	--	0.001	0.001	0.005	0	0	0.0002	0	12
	1,1-Dichloroethane	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	0.81	0	0

TABLE 4-11
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BRC CLOSURE PLAN
(Page 5 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Volatile Organic Compounds (Continued)	1,1-Dichloroethene	mg/L	12	0	0%	--	--	0.001	0.001	0.007	0	0	0.34	0	0
	1,1-Dichloropropene	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	1,2,3-Trichlorobenzene	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	1,2,3-Trichloropropane	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	0.000056	0	12
	1,2,4-Trichlorobenzene	mg/L	12	0	0%	--	--	0.001	0.001	0.07	0	0	0.0072	0	0
	1,2,4-Trimethylbenzene	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	0.012	0	0
	1,2-Dichlorobenzene	mg/L	12	0	0%	--	--	0.001	0.001	0.6	0	0	0.37	0	0
	1,2-Dichloroethane	mg/L	12	0	0%	--	--	0.001	0.001	0.005	0	0	0.00012	0	12
	1,2-Dichloroethene (see cis-, trans-)	mg/L	12	0	0%	--	--	0.002	0.002	--	--	--	--	--	--
	1,2-Dichloropropane	mg/L	12	0	0%	--	--	0.001	0.001	0.005	0	0	0.00016	0	12
	1,3,5-Trichlorobenzene	mg/L	12	0	0%	--	--	0.005	0.005	--	--	--	--	--	--
	1,3,5-Trimethylbenzene	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	0.012	0	0
	1,3-Dichlorobenzene	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	0.18	0	0
	1,3-Dichloropropane	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	0.12	0	0
	1,4-Dichlorobenzene	mg/L	12	0	0%	--	--	0.001	0.001	0.075	0	0	0.0005	0	12
	2,2-Dichloropropane	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2,2-Dimethylpentane	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2,2,3-Trimethylbutane	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2,3-Dimethylpentane	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2,4-Dimethylpentane	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2-Chlorotoluene	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	0.12	0	0
	2-Hexanone	mg/L	12	0	0%	--	--	0.005	0.005	--	--	--	--	--	--
	2-Methylhexane	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	2-Nitropropane	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.000012	0	12
	3,3-Dimethylpentane	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	3-Ethylpentane	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	3-Methylhexane	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	--	--	--
	4-Chlorotoluene	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	4-Methyl-2-pentanone (MIBK)	mg/L	12	1	8%	0.0026	0.0026	0.005	0.005	--	--	--	2	0	0
	Acetone	mg/L	12	3	25%	0.0021	0.12	0.002	0.04	--	--	--	5.5	0	0
	Acetonitrile	mg/L	12	0	0%	--	--	0.01	0.01	--	--	--	0.1	0	0
	Benzene	mg/L	12	4	33%	0.0003	0.00097	0.001	0.001	0.005	0	0	0.00035	3	8
	Bromobenzene	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	0.02	0	0
	Bromodichloromethane	mg/L	12	0	0%	--	--	0.001	0.001	0.08 ^k	k	k	0.00018	0	12
	Bromoform	mg/L	12	0	0%	--	--	0.001	0.001	0.08 ^k	k	k	0.0085	0	0
	Bromomethane	mg/L	12	0	0%	--	--	0.002	0.002	--	--	--	0.0087	0	0
	Carbon disulfide	mg/L	12	1	8%	0.00068	0.00068	0.001	0.001	--	--	--	1	0	0
	Carbon tetrachloride	mg/L	12	0	0%	--	--	0.001	0.001	0.005	0	0	0.00017	0	12
	Chlorobenzene	mg/L	12	0	0%	--	--	0.001	0.001	0.1	0	0	0.11	0	0
	Chlorobromomethane	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	Chloroethane	mg/L	12	0	0%	--	--	0.002	0.002	--	--	--	0.0046	0	0
	Chloroform	mg/L	12	0	0%	--	--	0.001	0.001	0.08 ^k	k	k	0.00017	0	12
	Chloromethane	mg/L	12	5	42%	0.00035	0.0022	0.002	0.002	--	--	--	0.16	0	0
cis-1,2-Dichloroethene	mg/L	12	0	0%	--	--	0.001	0.001	0.07	0	0	0.061	0	0	
cis-1,3-Dichloropropene	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	--	--	--	
Cymene (Isopropyltoluene)	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	--	--	--	
Dibromochloromethane	mg/L	12	0	0%	--	--	0.001	0.001	0.08 ^k	k	k	0.00013	0	12	
Dibromochloropropane	mg/L	12	0	0%	--	--	0.001	0.001	0.0002	0	12	0.000048	0	12	
Dibromomethane	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	0.061	0	0	
Dichloromethane (Methylene chloride)	mg/L	12	0	0%	--	--	0.001	0.001	0.005	0	0	0.0043	0	0	
Dimethyldisulfide	mg/L	12	0	0%	--	--	0.005	0.005	--	--	--	--	--	--	
Ethanol	mg/L	12	0	0%	--	--	0.00025	0.00025	--	--	--	--	--	--	
Ethylbenzene	mg/L	12	0	0%	--	--	0.001	0.001	0.7	0	0	1.3	0	0	
Freon-11 (Trichlorofluoromethane)	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	1.3	0	0	
Freon-113 (1,1,2-Trifluoro-1,2,2-trichloroethane)	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	59	0	0	

TABLE 4-11
SUMMARY OF GROUNDWATER RESULTS – THIRD QUARTERLY EVENT 2006 – DEEP WATER-BEARING ZONE
BRC CLOSURE PLAN
(Page 6 of 6)

Parameter of Interest	Compound List	Units	Total Count	Detect Count	Detection Frequency	Min. Detect ^a	Max. Detect ^a	Min. Non-Detect Limit ^b	Max. Non-Detect Limit ^b	MCL ^c	Count of Detects > MCL	Count of Non-Detects > MCL	Alternate Criteria ^d	Count of Detects > Alternate Criteria	Count of Non-Detects > Alternate Criteria
Volatile Organic Compounds (Continued)	Freon-12 (Dichlorodifluoromethane)	mg/L	12	0	0%	--	--	0.002	0.002	--	--	--	0.39	0	0
	Heptane	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	Isopropylbenzene	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	0.66	0	0
	m,p-Xylene (see Xylenes (total))	mg/L	12	0	0%	--	--	0.002	0.002	--	--	--	--	--	--
	Methyl ethyl ketone (2-Butanone)	mg/L	12	1	8%	0.022	0.022	0.005	0.005	--	--	--	7	0	0
	Methyl iodide	mg/L	12	0	0%	--	--	0.002	0.002	--	--	--	--	--	--
	MTBE (Methyl tert-butyl ether)	mg/L	12	0	0%	--	--	0.002	0.002	--	--	--	0.0062	0	0
	n-Butylbenzene	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	0.24	0	0
	n-Propylbenzene	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	0.24	0	0
	Nonanal	mg/L	12	0	0%	--	--	0.005	0.005	--	--	--	--	--	--
	o-Xylene (see Xylenes (total))	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	sec-Butylbenzene	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	0.24	--	0
	Styrene	mg/L	12	0	0%	--	--	0.001	0.001	0.1	0	0	1.6	0	0
	tert-Butylbenzene	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	0.24	0	0
	Tetrachloroethene	mg/L	12	0	0%	--	--	0.001	0.001	0.005	0	0	0.0001	0	12
	Toluene	mg/L	12	0	0%	--	--	0.001	0.001	1	0	0	0.72	0	0
	trans-1,2-Dichloroethene	mg/L	12	0	0%	--	--	0.001	0.001	0.1	0	0	0.12	0	0
	trans-1,3-Dichloropropene	mg/L	12	0	0%	--	--	0.001	0.001	--	--	--	--	--	--
	Trichloroethene	mg/L	12	0	0%	--	--	0.001	0.001	0.005	0	0	0.000028	0	12
	Vinyl acetate	mg/L	12	0	0%	--	--	0.002	0.002	--	--	--	0.41	0	0
Vinyl chloride	mg/L	12	0	0%	--	--	0.002	0.002	0.002	0	0	0.00002	0	12	
Xylenes (total)	mg/L	12	0	0%	--	--	0.003	0.003	10	0	0	0.21	0	0	
Total Trihalomethanes (TTHM)	mg/L	12	0	0%	--	--	0.004	0.004	0.08 ^k	0	0	--	--	--	
Water Quality Parameters	Conductivity	umhos/cm	12	12	100%	1090	271000	1	50	--	--	--	--	--	--
	Hardness, total	mg/L	12	12	100%	40	32000	5	250	--	--	--	--	--	--
	Total dissolved solids	mg/L	12	12	100%	492	205000	5	5	500	11	0	1,900 / 2,400 ^l	9 / 9	0
	Total suspended solids	mg/L	12	12	100%	7	916	1	1	--	--	--	--	--	--
	Alkalinity, Total (as CaCO ₃)	mg/L	12	12	100%	33	136	5	5	--	--	--	--	--	--
	Bicarbonate alkalinity	mg/L	12	12	100%	31	136	5	5	--	--	--	--	--	--
	Carbonate alkalinity	mg/L	12	1	8%	8	8	5	5	--	--	--	--	--	--
Hydroxide alkalinity	mg/L	12	1	8%	4	4	5	5	--	--	--	--	--	--	

a - Range of detections include estimated values of detect results between the detection limit and reporting limit. As such some minimum detected concentrations may be below the minimum reporting limit. In these cases the respective sample results are flagged in the data set.

b - The quantitation limits shown include samples which had detections. For screening purposes, the detection limit was used for comparison to the screening levels.

c - USEPA Maximum Contaminant Levels (MCLs).

d - Unless otherwise noted the Alternative Criteria used are from USEPA Region 9 preliminary remediation goals (PRG) table, October 2004 (and the 2007 USEPA radionuclide PRG webpage; <http://epa-prgs.orml.gov/radionuclides>). Values used are tap water PRGs.

e - An MCL for perchlorate has not been promulgated. The USEPA Drinking Water Equivalent Level of 24.5 µg/L was used.

f - Nevada provisional action level of 18 µg/l.

g - A NDEP water quality standard was used for Class A (municipal or domestic supply) waters for pH and total phosphorus based on Nevada Administrative Code (NAC) 445A.118 through 445A.225.

h - The MCL for Alpha Particles was used as comparison to Gross Alpha results. The MCL excludes the contributions from radon and uranium. The Gross Alpha concentrations were not adjusted due to contributions from radon nor uranium prior to comparison to MCL.

i - The MCL for Beta particles photon emitters is 4 millirems per year and was not used to compare to Gross Beta concentrations.

j - The constituent is regulated under the MCL for the combined concentration of radium-226 and radium-228. For comparison to the MCL, concentrations of both constituents are summed.

k - The constituent is regulated under the MCL for Total Trihalomethanes (TTHM). For comparison to the MCL for TTHM, concentrations of all TTHM constituents need to be considered.

l - Nevada Requirement to Maintain Existing Higher Quality level of 1,900 / 2,400 mg/L for total dissolved solids (Nevada Administrative Code [NAC] 445A.199 / NAC 445A 200/201).

TABLE 4-12
BACKGROUND SHALLOW SOIL DESCRIPTIVE SUMMARY STATISTICS
BRC CLOSURE PLAN
(Page 1 of 2)

Analyte Group	Analyte	Sample Size	Detection Frequency	All Data			Censored (Non-Detect) Data			Detected Data		
				Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Metals and Anions (mg/kg)	Aluminum	120	100.0%	3,740	8,899	15,300	--	--	--	3,740	8,899	15,300
	Antimony	120	40.8%	0.039	0.25	0.50	0.039	0.26	0.33	0.12	0.24	0.50
	Arsenic	120	100.0%	2.1	4.1	7.2	--	--	--	2.1	4.1	7.2
	Barium	120	100.0%	73	223	836	--	--	--	73	223	836
	Beryllium	120	100.0%	0.16	0.56	0.89	--	--	--	0.16	0.6	0.89
	Boron	104	32.7%	3.2	4.9	12	3.2	3.8	5.1	5.2	7.1	12
	Cadmium	120	13.3%	0.052	0.13	0.16	0.13	0.13	0.13	0.052	0.11	0.16
	Calcium	104	100.0%	8,160	28,134	82,800	--	--	--	8,160	28,134	82,800
	Chloride	104	69.2%	0.25	118	1,110	0.25	1.3	6.2	1.2	170	1,110
	Chromium	120	100.0%	2.6	8.9	17	--	--	--	2.6	8.9	17
	Chromium Hexavalent	104	0.0%	0.25	0.25	0.25	0.25	0.25	0.25	--	--	--
	Cobalt	120	100.0%	3.7	8.2	16	--	--	--	3.7	8.2	16
	Copper	120	100.0%	7.8	17	31	--	--	--	7.8	17	31
	Fluoride	104	12.5%	0.051	0.37	2.5	0.051	0.32	2.1	0.16	0.71	2.5
	Iron	120	100.0%	5,410	12,808	19,700	--	--	--	5,410	12,808	19,700
	Lead	120	100.0%	3.0	9.4	35	--	--	--	3.0	9.4	35
	Lithium	104	100.0%	7.5	14	27	--	--	--	7.5	14	27
	Magnesium	120	100.0%	4,580	9,505	17,500	--	--	--	4,580	9,505	17,500
	Manganese	120	100.0%	151	425	1,090	--	--	--	151	425	1,090
	Mercury	120	77.5%	0.0072	0.018	0.11	0.0072	0.0072	0.0072	0.008	0.022	0.11
	Molybdenum	120	100.0%	0.17	0.55	2.0	--	--	--	0.17	0.55	2.0
	Nickel	120	100.0%	7.8	15	30	--	--	--	7.8	15	30
	Niobium	104	0.0%	1.0	1.4	2.8	1.0	1.4	2.8	--	--	--
	Nitrate	104	86.5%	0.10	7.6	102	0.10	0.10	0.10	0.11	8.8	102
	Nitrite	104	4.8%	0.061	0.065	0.21	0.061	0.061	0.061	0.075	0.15	0.21
	Palladium	104	100.0%	0.14	0.46	1.5	--	--	--	0.14	0.46	1.5
	Platinum	104	4.8%	0.044	0.045	0.099	0.044	0.044	0.044	0.045	0.071	0.099
	Potassium	104	100.0%	625	1,730	3,890	--	--	--	625	1,730	3,890
	Selenium	120	43.3%	0.047	0.21	0.60	0.047	0.15	0.16	0.10	0.29	0.60
	Silicon	104	100.0%	335	981	4,150	--	--	--	335	981	4,150
	Silver	120	13.3%	0.019	0.23	0.26	0.26	0.26	0.26	0.019	0.050	0.083
	Sodium	104	100.0%	111	486	1,320	--	--	--	111	486	1,320
	Strontium	104	100.0%	69	223	808	--	--	--	69	223	808
	Sulfate	104	77.9%	0.61	180	4,130	0.61	2.5	4.4	2.1	230	4,130
	Thallium	120	35.0%	0.10	0.69	1.8	0.20	0.57	1.1	0.10	0.92	1.8
	Thorium	16	100.0%	4.6	5.9	7.7	--	--	--	4.6	5.9	7.7
	Tin	103	100.0%	0.19	0.48	0.80	0.19	0.19	0.19	0.20	0.48	0.80
	Titanium	120	100.0%	200	510	1,010	--	--	--	200	510	1,010
	Tungsten	104	0.0%	0.49	1.2	2.5	0.49	1.2	2.5	--	--	--
	Uranium	103	100.0%	0.43	1.0	2.7	--	--	--	0.43	1.0	2.7
Vanadium	120	100.0%	15	35	59	--	--	--	15	35	59	
Zinc	120	100.0%	15	37	121	--	--	--	15	37	121	
Zirconium	104	100.0%	60	126	179	--	--	--	60	126	179	

TABLE 4-12
BACKGROUND SHALLOW SOIL DESCRIPTIVE SUMMARY STATISTICS
BRC CLOSURE PLAN
(Page 2 of 2)

Analyte Group	Analyte	Sample Size	Detection Frequency	All Data			Censored (Non-Detect) Data			Detected Data		
				Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Radionuclides (pCi/g)	Actinium-227	104	0.0%	-0.57	-0.044	0.40	-0.57	-0.044	0.40	--	--	--
	Actinium-228	120	100.0%	1.1	1.8	3.4	--	--	--	1.1	1.8	3.4
	Bismuth-210	104	1.0%	-0.60	0.61	2.2	-0.60	0.59	2.0	2.2	2.2	2.2
	Bismuth-211	104	0.0%	-0.57	-0.044	0.40	-0.57	-0.044	0.40	--	--	--
	Bismuth-212	120	56.7%	0.29	1.0	1.8	0.29	0.78	1.3	0.71	1.2	1.8
	Bismuth-214	120	100.0%	0.52	0.95	1.6	--	--	--	0.52	0.95	1.6
	Cobalt-57	104	0.0%	-0.045	0.000013	0.040	-0.045	0.000013	0.040	--	--	--
	Cobalt-60	104	0.0%	-0.073	0.0015	0.082	-0.073	0.0015	0.082	--	--	--
	Lead-210	120	1.7%	-0.60	0.72	2.2	-0.60	0.70	2.2	1.9	2.1	2.2
	Lead-211	104	0.0%	-0.57	-0.044	0.40	-0.57	-0.044	0.40	--	--	--
	Lead-212	120	100.0%	0.94	1.5	2.1	--	--	--	0.94	1.5	2.1
	Lead-214	120	100.0%	0.61	0.97	1.7	--	--	--	0.61	0.97	1.7
	Polonium-210	104	1.0%	-0.60	0.61	2.2	-0.60	0.59	2.0	2.2	2.2	2.2
	Polonium-212	104	61.5%	0.19	0.65	1.2	0.19	0.48	0.78	0.46	0.75	1.2
	Polonium-214	104	100.0%	0.52	0.96	1.6	--	--	--	0.52	0.96	1.6
	Polonium-215	104	0.0%	-0.57	-0.044	0.40	-0.57	-0.044	0.40	--	--	--
	Polonium-216	104	100.0%	1.1	1.5	2.1	--	--	--	1.1	1.5	2.1
	Polonium-218	104	92.3%	0.49	1.1	2.4	0.59	0.84	1.0	0.49	1.1	2.4
	Potassium-40	120	100.0%	18	25	35	--	--	--	18	25	35
	Protactinium-234	104	0.0%	-0.34	-0.078	0.13	-0.34	-0.078	0.13	--	--	--
	Radium-223	104	0.0%	-0.57	-0.044	0.40	-0.57	-0.044	0.40	--	--	--
	Radium-224	104	100.0%	1.1	1.5	2.1	--	--	--	1.1	1.5	2.1
	Radium-226	104	92.3%	0.49	1.1	2.4	0.59	0.84	1.0	0	1.1	2.4
	Radium-228	84	81.0%	0.95	1.9	2.9	0.95	1.6	2.0	1.2	2.0	2.9
	Thallium-207	104	0.0%	-0.57	-0.044	0.40	-0.57	-0.044	0.40	--	--	--
	Thallium-208	120	100.0%	0.33	0.54	0.72	--	--	--	0.33	0.54	0.72
	Thorium-227	104	0.0%	-0.57	-0.044	0.40	-0.57	-0.044	0.40	--	--	--
	Thorium-228	120	100.0%	1.1	1.7	2.3	--	--	--	1.1	1.7	2.3
	Thorium-230	120	100.0%	0.66	1.2	3.0	--	--	--	0.66	1.2	3.0
	Thorium-231	104	10.6%	0	0.065	0.21	0	0.061	0.17	0.047	0.10	0.21
	Thorium-232	120	100.0%	1.1	1.6	2.2	--	--	--	1.1	1.6	2.2
	Thorium-234	120	54.2%	-0.53	1.2	2.5	-0.53	0.61	1.4	1.1	1.6	2.5
Uranium-233/234	120	50.8%	0.47	1.2	2.8	0.47	0.90	1.2	0.53	1.3	2.8	
Uranium-235	120	45.0%	0	0.066	0.21	0	0.046	0.11	0.037	0.090	0.21	
Uranium-238	120	100.0%	0.45	1.1	2.4	--	--	--	0.45	1.1	2.4	

mg/kg milligrams per kilogram
pCi/g picocuries per gram
Max maximum concentration
Min minimum concentration

TABLE 4-13
SUMMARY OF DATA GAPS
BRC CLOSURE PLAN
(Page 1 of 5)

No.	Data Gap Description	Action Needed to fill Data Gap	Deliverable to Report New Data/Assessment	Current Status
Site-Wide				
1	Background concentrations of chemicals (metals and radionuclides) in Deep Soils are unknown.	Investigation of Deep Background Qa and TMCf soils	Report of Deep Background Soil Investigation	1) Work Plan to conduct deep background soil investigation is in revision by BRC.
2	Methods of reducing reporting limits for laboratory chemical analyses to levels below screening evaluation levels need to be assessed and/or developed.	1) Working with the chemical analytical laboratories to seek methods to reduce reporting limits 2) Evaluate suggestions by the NDEP for reducing detection limits for certain chemicals (e.g.: arsenic).	1) All forthcoming reports that report chemical analytical results.	1) Efforts are ongoing with laboratories to reduce reporting limits
Eastside Area				
3	Aquifer parameters in the Eastside Area are not well defined.	1) Conduct aquifer testing.	1) Report of Aquifer Testing	1) Aquifer Testing Work Plan is in implementation
4	Background and Upgradient distribution of Site Related Chemicals in groundwater	1) Implement Upgradient Qa Work Plan 2) Develop Work Plan for Background Qa Wells	1) Upgradient Qa Report 2) Background Qa Report	1) The Upgradient Qa (and Deep Soils Background) Report is in revision by BRC 2) BRC will develop the Background Qa Work Plan after current investigations are completed.
5	Control of perchlorate groundwater concentrations in the Upper Unconfined Water Bearing Zone in the Eastside Area needs to be improved.	1) Monitor additional wells in the Eastside 2) Install additional wells in the North-East area	1) Report of Four Quarters of Groundwater Monitoring 2) North-East Area Report	1) Reports of 1 st , 2 nd , and 3 rd Quarterly Monitoring Events have been submitted to NDEP; 4th quarterly monitoring event has been completed and the final report is in preparation. 2) Work Plan to conduct north-east area investigation is under review by NDEP
6	The potential for downward leaching of chemicals into Deep Soils and Upper Unconfined Water Bearing Zone at the Eastside Area is currently unknown.	1) Groundwater Modeling, Including Leaching Modeling under present and future land use scenarios 2) Comparison of soil concentrations to Soil Screening Values (DAF-1) for the Soil-to-Groundwater Pathway 3) Collect additional chemical data (soils and groundwater) as well as physical soils data.	1) Groundwater Modeling Report 2) Detailed Eastside CSM 3) Various work plans to complete investigations.	1) The Groundwater Modeling Work Plan is approved by NDEP 2) Preparation of Eastside detailed CSM is planned pending completion of Aquifer Testing, Modeling, North-East Area Investigation, the Deep Soil Background Investigation, and the Upgradient Qa Investigation.

TABLE 4-13
SUMMARY OF DATA GAPS
BRC CLOSURE PLAN
(Page 2 of 5)

No.	Data Gap Description	Action Needed to fill Data Gap	Deliverable to Report New Data/Assessment	Current Status
7	The potential for downward leaching of chemicals in the Qa to leach into and through the TMCf to the Middle and Deep Water Bearing Zones at the Eastside Area is currently unknown.	1) Groundwater Modeling, Including Leaching Modeling under present and future land use scenarios 2) Comparisons of soil concentrations to Soil Screening Values (DAF-1) for the Soil-to-Groundwater Pathway 3) Physical analysis of cores for soil hydrologic parameters during implementation of the aquifer testing work plan. 4) Collect additional chemical data (soils and groundwater)	1) Groundwater Modeling Report 2) Detailed Eastside CSM 3) Aquifer testing 4) Various work plans to complete investigations.	1) The Groundwater Modeling Work Plan is approved by NDEP 2) Preparation of Eastside detailed CSM is planned pending completion of Aquifer Testing, Modeling, North-East Area Investigation, the Deep Soil Background Investigation, and the Upgradient Qa investigation 3) Soil Core Physical analysis for hydrologic parameters will be performed as part of the scope of the Aquifer Testing work plan approved by NDEP
8	The location (other than paleochannels already discovered), extent and influence of potential preferential pathways at the Eastside Area is not precisely known.	1) Evaluation of borings advanced by upgradient property owners 2) BRC to advance additional borings near the Eastside Area southern property boundary 3) BRC to complete northeast area groundwater investigation and advance additional borings in the northern property boundary (in review with NDEP) 4) Review and evaluation of utility corridors as potential pathways	1) BRC soil borings will be reported as a component of the Report of Deep Background Soil Investigation 2) BRC north-east area evaluations will be reported as a separate report	1) Work Plan to conduct deep background soil investigation is under review by NDEP. 2) Work Plan to conduct north-east area investigation is under review by NDEP
9	The temporal distribution of Eastside Groundwater elevations and flow patterns, water quality composition, dispersion, and concentration trends is partially known. This includes the location, extent, and magnitude of historical mounding.	1) Periodic monitoring of Eastside Groundwater 2) Assessment and analysis of spatial and temporal trends 3) Conduct Aquifer Testing 4) Conduct GW Modeling	1) Report of Four Quarters of Groundwater Monitoring, BRC Eastside 2) GW Modeling report	1) Reports of 1 st , 2 nd , and 3 rd Quarterly Monitoring Events have been submitted to NDEP; 4th quarterly monitoring event has been completed and the final report is in preparation. 2) Groundwater modeling will be completed after completion of the Aquifer Testing
10	Upgradient and cross-gradient chemical impacts in the Eastside Area from off-Site is unknown.	1) Address Data Gap #8 2) Evaluate data from CSMs from TIMET, Tronox, Stauffer, Montrose, and Pioneer 3) Implement comparative evaluation of contemporaneous on- and off-Site groundwater monitoring data	1) Detailed Eastside CSM 2) Parcels 4A/4B investigation 3) Upgradient wells installation	1) Preparation of Eastside detailed CSM is planned pending completion of Aquifer Testing, Modeling, North-East Area Investigation, the Deep Soil Background Investigation and the Upgradient Qa Investigation

TABLE 4-13
SUMMARY OF DATA GAPS
BRC CLOSURE PLAN
(Page 3 of 5)

No.	Data Gap Description	Action Needed to fill Data Gap	Deliverable to Report New Data/Assessment	Current Status
11	The connectivity of the Deep Water Bearing Zone, and Middle Zone Sand Lenses, with the Upper Unconfined Water Bearing Zone in the Eastside Area is unknown.	1) Conduct isotope analysis of groundwater collected from the Deep Water Bearing Water to evaluate the source of high TDS 2) Conduct aquifer testing, stressing one water bearing zone while monitoring others 3) Conduct Groundwater Modeling sensitivity analysis for the lower boundary flux to determine the overall impact on mass balance 4) Evaluate Piper diagrams as provided by NDEP and as generated from data 5) Evaluation of investigation data from other sources, such as TIMET and Tronox	1) Aquifer Testing Report 2) Groundwater Modeling Report 3) Eastside CSM	1) Preparation of Eastside detailed CSM is planned pending completion of Aquifer Testing, Modeling, North-East Area Investigation, the Deep Soil Background Investigation and the Upgradient Qa Investigation 2) Aquifer Testing work plan is in implementation 3) Groundwater Modeling work plan has been approved by NDEP; implementation is on hold awaiting results of Aquifer Testing
12	Paleochannel influence on preferential groundwater flow and transport is unknown in the Eastside.	1) Conduct aquifer testing in key locations. 2) Complete north-east area investigation 3) Add data points from off-Site CSMs (in preparation) to Qa/TMCf structural contour map. 4) Add data points from planned boring advancement for upgradient monitoring well installation, aquifer testing extraction well installation, and northeast area groundwater investigation.	1) Aquifer Testing Report 2) North-east area Report/Detailed Eastside CSM 3) Groundwater Modeling Report	1) Aquifer Testing work plan is in implementation 2) Preparation of Eastside detailed CSM is planned pending completion of Aquifer Testing, Modeling, North-East Area Investigation, the Deep Soil Background Investigation and the Upgradient Qa Investigation
13	Mass Flux of Contaminants off of Site	Complete northern "flux boundary" well installation per North-East area Work Plan	1) Complete Work Plan implementation 2) Conduct groundwater monitoring 3) Complete data analysis	1) Work Plan is in revision/review.
CAMU Area				
14	Soil chemical samples are lacking in the vicinity of SV-10 and on the upgradient side of the CAMU Site.	1) Additional soil sampling in the SV-10 vicinity 2) Evaluation of soil sampling data produced by investigations by upgradient locations.	1) Revised CAMU CSM	1) Future work in the vicinity of SV-10 is in the planning phase. 2) Status of offsite property investigations at upgradient locations is being tracked 3) CAMU CSM will be updated in the future

TABLE 4-13
SUMMARY OF DATA GAPS
BRC CLOSURE PLAN
(Page 4 of 5)

No.	Data Gap Description	Action Needed to fill Data Gap	Deliverable to Report New Data/Assessment	Current Status
15	The extent of hydraulic connectivity between groundwater in the Qal and in the TMCf at the CAMU Area is unknown.	1) Evaluate data from CSMs from Tronox, Stauffer, Montrose, and Pioneer as available. 2) Potentially install supplemental wells.	1) Revised CAMU CSM	1) CAMU CSM will be updated in the future
16	Temporal distribution of CAMU Area Groundwater elevations and flow patterns, water quality composition, and concentration trends need to be assessed.	1) Evaluate data from CSMs from Tronox, Stauffer, Montrose, and Pioneer. 2) Initiate periodic monitoring program.	1) Revised CAMU CSM 2) Periodic Groundwater Monitoring Reports	1) CAMU CSM will be updated in the future 2) Periodic monitoring will be implemented in conjunction with CAMU construction
17	Dissolved oxygen and redox data collected at the CAMU Area to assess the presence and potential for anaerobic biodegradation in groundwater need to be assessed.	1) Evaluate groundwater sampling data from BRC, Tronox, Stauffer, Montrose, and Pioneer 2) Collect data from BRC wells. 3) Install new wells as necessary. 4) Initiate periodic monitoring program.	1) Revised CAMU CSM 2) Periodic Groundwater Monitoring Reports	1) CAMU CSM will be updated in the future 2) Periodic monitoring will be implemented in conjunction with CAMU construction
18	Limited data exists with which to characterize the redox condition of groundwater in the CAMU Site and vicinity its effect on chemical fate and transport.	1) Evaluate groundwater sampling data from BRC, Tronox, Stauffer, Montrose, and Pioneer 2) Collect data from BRC wells. 3) Install new wells as necessary. 4) Initiate periodic monitoring program.	1) Revised CAMU CSM 2) Periodic Groundwater Monitoring Reports	1) CAMU CSM will be updated in the future 2) Periodic monitoring will be implemented in conjunction with CAMU construction
19	At the CAMU Site, the performance of the current BMI landfill cap to act as a barrier to precipitation infiltration and subsequent leachate generation is unknown.	1) Cap Surface inspections and permeability field tests will be performed to assess the landfill cap performance. 2) An assessment of the feasibility of advancing angled or directional borings will be performed. 3) If deemed feasible and useful, the work will be conducted.	Cap Inspection Report	Future work is in the planning phase.
20	Temporal groundwater elevation and chemical concentration data is limited for the CAMU Site.	1) Periodic groundwater elevation gauging and water quality sampling of CAMU Site wells 2) Incorporation of data from offsite wells in the vicinity of the CAMU Site.	1) Periodic Groundwater Monitoring Reports	1) Periodic monitoring will be implemented in conjunction with CAMU construction

TABLE 4-13
SUMMARY OF DATA GAPS
BRC CLOSURE PLAN
(Page 5 of 5)

No.	Data Gap Description	Action Needed to fill Data Gap	Deliverable to Report New Data/Assessment	Current Status
21	The range of historic groundwater fluctuation of groundwater has not been evaluated relative to the elevation of wastes in the STA, the Northern Landfill Lobe, and the Southern Landfill Lobe.	1) Periodic groundwater monitoring including elevation gauging	1) Periodic Groundwater Monitoring Reports	1) Periodic monitoring will be implemented in conjunction with CAMU construction
22	Soil and groundwater data on the CAMU Site for deeper zones is limited.	1) Evaluation of soil sampling data produced by investigations by upgradient locations.	1) Refined CAMU CSM	1) Status of offsite property investigations at upgradient locations is being tracked 2) CAMU CSM will be updated in the future
23	Broad suite chemical analytic data for the Western Ditch Area is limited.	1) Since the soils in the Western Ditch Area will be disposed of in the proposed CAMU, this is not a significant data gap.	1) CAMU design documents 2) Report of CAMU completion.	No further work planned
24	Limited information is available regarding the materials deposited in the historic BMI landfills.	No additional actions planned	Current CAMU CSM (February 16, 2007) contains the most current information available on this topic	No further work planned
25	Limited information is available regarding the concentrations of chemicals in the vadose zone beneath the historic BMI Landfills.	No additional actions planned	Current CAMU CSM (February 16, 2007) contains the most current information available on this topic	No further work planned
26	Based on the configuration of the existing monitoring wells limited data are available to determine the specific impacts to groundwater from the historic BMI landfills versus the historic Slit Trench Area.	No additional actions planned. The landfills and Slit Trench Area will be treated as one unit for the purposes of the development of land use and groundwater impact mitigation strategies.	Current CAMU CSM (February 16, 2007) contains the most current information available on this topic	No further work planned
27	The depths of waste placement at the CAMU Site and how these depths relate to groundwater conditions has not been investigated completely.	No additional actions planned. A search for engineering plans and waste placement documentation for the historic Trade Effluent Settling Ponds as well as the slit trenches has been conducted.	Current CAMU CSM (February 16, 2007) contains most current information available on this topic	No future work planned.

TABLE 9-1
FATE AND TRANSPORT SCREENING MODEL VALUES
BRC CLOSURE PLAN
(Page 1 of 2)

Parameter	Abbrev.	Value	Units	Reference
<u>Outdoor Air Parameters</u>				
Particulate emission factor ^a	PEF	1.36 E+9	m ³ /kg	USEPA 2002a
Dispersion factor for volatiles emitted from soil ^b	Q/C _{vol}	83.1	g/m ² -s per kg/m ³	USEPA 2002a
<u>Construction Dust Parameters</u>				
Fraction of vegetative cover	V	0	--	USEPA 2002a
Mean annual wind speed	U	4.0	m/s	(1)
Equivalent threshold value of wind speed	U _t	11.3	m/s	USEPA 2002a
Function dependent on U/U _t	F(x)	0.194	--	USEPA 2002a
Wet soil bulk density	r _{soil}	1.74	Mg/m ³	(2)
Percent moisture in soil	M	--	%	Site-specific
Depth of site excavation	d _{excav}	--	m	Site-specific
Number of times soil is dumped	N _A	2.0	--	USEPA 2002a
Percent weight of silt in soil	s	--	%	Site-specific
Mean vehicle speed	S _{doz}	11.4	km/hr	USEPA 2002a
Areal extent of site tilling	A _{till}	--	acre	(3)
Number of times soil is tilled	N _A	2.0	--	USEPA 2002a
Subchronic dispersion factor for area source-Constant A	A	2.454	--	USEPA 2002a
Subchronic dispersion factor for area source-Constant B	B	17.566	--	USEPA 2002a
Subchronic dispersion factor for area source-Constant C	C	189.043	--	USEPA 2002a
Width of road segment	W _R	6.1	m	USEPA 2002a
Mean vehicle weight	W	8.0	tonnes	USEPA 2002a
Number of days/year ≥ 0.01 inches	p	27.0	days	(1)
Subchronic dispersion factor for road segment-Constant A	A	12.935	--	USEPA 2002a
Subchronic dispersion factor for road segment-Constant B	B	5.738	--	USEPA 2002a
Subchronic dispersion factor for road segment-Constant C	C	71.771	--	USEPA 2002a
Areal extent of site surface contamination	A _{surf}	--	acres	Site-specific
<u>Indoor Air Parameters</u>				
Foundation crack fraction	η	0.01	unitless	ASTM 2000
Enclosed space volume/infiltration area ratio, resid.	L _r	200	cm	ASTM 2000
Enclosed space volume/infiltration area ratio, comm.	L _c	300	cm	ASTM 2000
Enclosed space air exchange rate, residential	ER _r	12	1/day	ASTM 2000
Enclosed space air exchange rate, commercial	ER _c	20	1/day	ASTM 2000
<u>Groundwater Parameters</u>				
Hydraulic conductivity	K	---	m/yr	Site-specific
Hydraulic gradient	i	---	m/m	Site-specific
Aquifer thickness	d _a	---	m	Site-specific
Infiltration rate	I	---	in/yr	(4)
Source length parallel to groundwater flow	L	---	m	Site-specific

TABLE 9-1
FATE AND TRANSPORT SCREENING MODEL VALUES
BRC CLOSURE PLAN
(Page 2 of 2)

Parameter	Abbrev.	Value	Units	Reference
<u>Soil/Water Partition Parameters</u>				
Fraction of organic carbon content in soil	foc	---	mg/mg	Site-specific
Organic carbon-water partition coefficient	Koc	---chemical-specific---		USEPA 2002a
Water-filled soil porosity	q _w	---	L _{water} /L _{soil}	Site-specific
Air-filled soil porosity	q _a	---	L _{air} /L _{soil}	Site-specific
Henry's law constant (dimensionless)	H'	---chemical-specific---		USEPA 2002a
Soil bulk density	r _b	---	kg/L	Site-specific

^aFor non-construction worker exposures only. Construction worker dust exposures calculated from USEPA, 2002a.

^bCalculated using values for Las Vegas, NV in Appendix D of USEPA, 2002a.

- (1) - Based on long-term weather data for the area of interest (WRCC 2006, On-line. <http://www.wrcc.dri.edu/>).
- (2) - Based on data from vicinity investigations (from data collected in the BMI Common Areas in 2004 and Environ [2003]).
- (3) - Assumed value of one fifth of the site based upon USEPA (2002a).
- (4) To be based on the water balance as part of the groundwater model being developed for the site.

TABLE 9-2
DETERMINISTIC EXPOSURE FACTORS – CONSTRUCTION WORKERS
BRC CLOSURE PLAN
(Page 1 of 1)

Parameter	Abbrev.	Value	Units	Reference
Dermal absorption fraction	ABS	---	---chemical-specific---	USEPA 2004c
Dermal permeability coefficient (water)	K _p	---	---chemical-specific---	USEPA 2004c
Dermal adherence factor, soil	AF _s	0.3	mg/cm ²	USEPA 2002a
Averaging time, carcinogenic	AT _c	70	years	USEPA 2002a
Averaging time, non-carcinogenic	AT _{nc}	1	years	Based on ED _{cw}
Adult body weight	BW _a	70	kg	USEPA 2002a
Exposure frequency, soil	EF _{s,cw}	250	days/year	USEPA 2002a
Exposure frequency, water	EF _{w,cw}	50	days/year	(1)
Exposure duration	ED _{cw}	1	years	(2)
Exposure time, water	ET _{cw}	1	hrs/event	(3)
Adult inhalation rate	IR _a	20	m ³ /day	USEPA 2002a
Construction worker exposed surface area, soil	SA _{cw,s}	3,300	cm ² /day	USEPA 2002a
Construction worker exposed surface area, water	SA _{cw,w}	5,300	cm ² /day	USEPA 2004c
Construction worker soil ingestion rate	IR _{s,cw}	330	mg/day	USEPA 2002a
Construction worker water ingestion rate	IR _{w,cw}	0.05	L/event	(4)
<u>Radionuclide-specific factors</u>				
Exposure time fraction, indoors	ET _i	0	unitless	(5)
Exposure time fraction, outdoors	ET _o	0.33	unitless	(5)
Area correction factor	ACF _{cw}	0.9	unitless	USEPA 2000a, 2007a
Gamma shielding factor	GSF	0.4	unitless	USEPA 2000a, 2007a

(1) Assumes exposure one day per week, for the length of exposure duration (one year).

(2) Based on site data. A one-year exposure duration is appropriate for carcinogenic effects, because the methodology averages exposures over a lifetime (see USEPA 2002a).

(3) No data available. Values used are based on USEPA's average exposure frequency for recreational swimming.

(4) No data available. Value used is based incidental ingestion rate while swimming.

(5) Assumes worker spends 100% of time outdoors, 8 hours a day.

TABLE 9-3
DETERMINISTIC EXPOSURE FACTORS –
COMMERCIAL/PARK MAINTENANCE WORKERS^a
BRC CLOSURE PLAN
(Page 1 of 1)

Parameter	Abbrev.	Value	Units	Reference
Dermal absorption fraction	ABS	---	chemical-specific--	USEPA 2004c
Maintenance worker dermal adherence factor	AF _{mw}	0.2	mg/cm ²	USEPA 2002a
Commercial worker dermal adherence factor	AF _{cmw}	NA	mg/cm ²	USEPA 2002a
Averaging time, carcinogenic	AT _c	70	years	USEPA 2002a
Averaging time, non-carcinogenic	AT _{nc}	25	years	Based on ED _{mw}
Adult body weight	BW _a	70	kg	USEPA 2002a
Maintenance worker exposure frequency	EF _{mw}	225	days/year	USEPA 2002a
Commercial worker exposure frequency	EF _{cmw}	250	days/year	USEPA 2002a
Exposure duration	ED	25	years	USEPA 2002a
Adult inhalation rate	IR _a	20	m ³ /day	USEPA 2002a
Maintenance worker exposed surface area	SA _{mw}	3,300	cm ² /day	USEPA 2002a
Commercial worker exposed surface area	SA _{cmw}	NA	cm ² /day	USEPA 2002a
Maintenance worker soil ingestion rate	IR _{s,mw}	100	mg/day	USEPA 2002a
Commercial worker soil ingestion rate	IR _{s,cmw}	50	mg/day	USEPA 2002a
<u>Radionuclide-specific factors</u>				
Commercial worker exposure time fraction, indoors	ET _{cmw,i}	0.33	based on 8 hr/d	
Commercial worker exposure time fraction, outdoors	ET _{cmw,o}	0	indoor worker	
Maintenance worker exposure time fraction, indoors	ET _{mw,i}	0	outdoor worker	
Maintenance worker exposure time fraction, outdoors	ET _{mw,o}	0.33	based on 8 hr/d	
Commercial worker area correction factor	ACF _{cmw}	0.9	unitless	USEPA 2000a, 2007a
Maintenance worker area correction factor	ACF _{mw}	0.9	unitless	USEPA 2000a, 2007a
Commercial worker gamma shielding factor	GSF	0.4	unitless	USEPA 2000a, 2007a
Maintenance worker gamma shielding factor	GSF	0.4	unitless	USEPA 2000a, 2007a

^aExposure parameters for maintenance workers and commercial workers are based on outdoor and indoor commercial/industrial worker exposure factors, respectively, from USEPA, 2002a.

TABLE 9-4
DETERMINISTIC EXPOSURE FACTORS – TRESPASSER/RECREATIONAL USER
BRC CLOSURE PLAN
(Page 1 of 1)

Parameter	Abbrev.	Value	Units	Reference
Dermal absorption fraction	ABS	---	---chemical-specific---	USEPA 2004c
Dermal permeability coefficient (water)	K _p	---	---chemical-specific---	USEPA 2004c
Dermal adherence factor	AF	0.2	mg/cm ²	USEPA 2002a
Averaging time, carcinogenic	AT _c	70	years	USEPA 2002a
Averaging time, non-carcinogenic	AT _{nc}	6	years	Based on ED _{mw}
Body weight	BW _t	31	kg	USEPA 1997
Exposure time	ET	4	hrs/day	Professional judgment
Exposure frequency, soil	EF _t	50	days/year	Professional judgment
Exposure frequency, water	EF _{w,t}	10	days/year	Professional judgment
Exposure duration	ED _t	6	years	USEPA 1997
Exposure time, water	ET _t	1	hrs/event	Professional judgment
Inhalation rate	IR _{a,t}	1.2	m ³ /hr	USEPA 1997
Available skin surface area, soil	SA _t	3,200	cm ² /day	USEPA 2004c
Available skin surface area, water	SA _{w,t}	5,300	cm ² /day	USEPA 2004c
Trespasser/recreational soil ingestion rate	IR _{s,t}	100	mg/day	USEPA 1997
Trespasser/recreational water ingestion rate	IR _{w,t}	0.05	L/event	USEPA 1989
<u>Radionuclide-specific factors</u>				
Trespasser/recreational exposure time fraction, indoors	ET _{t,i}	0	outdoor only	
Trespasser/recreational exposure time fraction, outdoors	ET _{t,o}	0.17	based on 4 hr/d	
Area correction factor	ACF _t	0.9	unitless	USEPA 2000a, 2007a
Gamma shielding factor	GSF	0.4	unitless	USEPA 2000a, 2007a

TABLE 9-5
DETERMINISTIC EXPOSURE FACTORS – RESIDENTIAL
BRC CLOSURE PLAN
(Page 1 of 1)

Parameter	Abbrev.	Value	Units	Reference
Dermal absorption fraction	ABS	---	---chemical-specific---	USEPA 2004c
Soil-plant bioconcentration factors	Br	---	---chemical-specific---	USEPA 1996, 2000a
Dermal adherence factor, adult	AF _a	0.07	mg/cm ²	USEPA 2004c
Dermal adherence factor, child	AF _c	0.2	mg/cm ²	USEPA 2004c
Averaging time, carcinogenic	AT _c	70	years	USEPA 2002a
Averaging time, non-carcinogenic	AT _{nc}	30	years	Based on ED _r
Adult body weight	BW _a	70	kg	USEPA 2002a
Child body weight	BW _c	15	kg	USEPA 2002a
Exposure frequency	EF _r	350	days/year	USEPA 2002a
Exposure duration	ED _r	30	years	USEPA 2002a
Adult inhalation rate	IR _{a,i}	20	m ³ /day	USEPA 2002a
Child inhalation rate	IR _{c,i}	10	m ³ /day	USEPA 1997, 2006
Available skin surface area, adult	SA _a	5,700	cm ² /day	USEPA 2004c
Available skin surface area, child	SA _c	2,800	cm ² /day	USEPA 2004c
Fruit/vegetable ingestion rate, aboveground, child	CR _{ag,c}	0.0179	kg DW/d	USEPA 1997
Fruit/vegetable ingestion rate, belowground, child	CR _{bg,c}	0.0033	kg DW/d	USEPA 1997
Fruit/vegetable ingestion rate, aboveground, adult	CR _{ag,a}	0.0609	kg DW/d	USEPA 1997
Fruit/vegetable ingestion rate, belowground, adult	CR _{bg,a}	0.0098	kg DW/d	USEPA 1997
Soil to plant transfer factor	TF	---	---chemical-specific---	USEPA 1996, 2002a
Contaminated plant fraction from the site	CPF	0.25	--	USEPA 2007a
Adult soil ingestion rate	IR _{s,a}	100	mg/day	USEPA 2002a
Child soil ingestion rate	IR _{s,c}	200	mg/day	USEPA 2002a
<u>Radionuclide-specific factors</u>				
Exposure time fraction, outdoors	ET _o	0.073	unitless	USEPA 2000a, 2007a
Exposure time fraction, indoors	ET _i	0.684	unitless	USEPA 2000a, 2007a
Dilution factor for indoor inhalation	DF _i	0.4	unitless	USEPA 2000a, 2007a
Area correction factor	ACF _{cw}	0.9	unitless	USEPA 2000a, 2007a
Gamma shielding factor	GSF	0.4	unitless	USEPA 2000a, 2007a

APPENDIX A

NDEP COMMENTS ON THE AUGUST 2006 BRC CLOSURE PLAN,
BRC RESPONSE TO COMMENTS,
AND REDLINE/STRIKEOUT VERSION OF THE TEXT

ATTACHMENT A-1

NDEP COMMENTS ON THE AUGUST 2006 BRC CLOSURE PLAN,
BRC RESPONSE TO COMMENTS

Appendix A
Response to NDEP Comments Dated January 18, 2007
on the August 2006 BRC Closure Plan

NDEP Attachment A Comments

1. General comment, please note that it will be necessary to develop a red-line mark up of this document to be included with the resubmitted Closure Plan. This was created for this version of the Closure Plan after the Closure Plan was submitted and in some cases the red-line mark up did not match the final draft of the Closure Plan. It is the expectation of the NDEP that a red-line mark up will not be created for Section 4.0 (Conceptual Site Model) of the revised version of the Closure Plan.

Response: A redline/strikeout version of the report text has been included. As noted, since Sections 4 was substantially re-written, the red-line version does not include the red-line markups for this Section, in order to aid readability.

2. General comment, this section should reflect the agreement previously reached on the intent of the Closure Plan. This agreement was along the lines of presenting a Closure Plan that conceptually described the steps that BRC would undertake to assess risks at the site and, hence, to make risk-based decisions (including decisions to close parcels). These steps might include identifying exposure areas (decision units – areas, sub-areas), possible receptors, potentially contaminated media, how risk assessment source terms will be characterized (data collection, fate and transport modeling), and how risk-based decisions (including background and baseline considerations) might be made (e.g., NFA or potential remediation). It would be more in line with the original intent of this document to describe this closure process in the introduction (and would provide additional transparency). A lot of the introductory material is good, but piecing it all together in this way would be helpful.

Response: A discussion on the intent and steps of the Closure Plan has been added to Section 1.

3. General comment, for numbers ten and less the text switches between spelling out the number and using the Arabic number. This is a stylistic issue that the NDEP suggests BRC address.

Response: This change has been made globally throughout the revised report.

4. Section 1.0, general comment, it would be helpful if the text of Section 1 provided a summary of the process depicted in Figure 1-4. The Sections that follow could then provide some more detail.

Response: BRC has attempted to provide this summary.

5. Section 1.0, general comment, the role of risk assessment and data quality assessment do not appear to be explained properly. “Data sufficiency, representativeness, and adequacy”

include some components of EPA's quality system, however, they are not the only components. Data sufficiency is not defined in EPA documents; representativeness is one of six Data Quality Indicators; and, adequacy is used in connection with Data Adequacy and Data Quality Assessment. However, these quality components should be evaluated with respect to the decision endpoint, which in this case is a risk assessment. The iteration as described suggests that they are evaluated in isolation from the decision process. Consequently, risk assessment is not performed after evaluating these (and other) quality components; it must be performed for these components to be properly evaluated. In addition, it would seem that the "inner loop" on Figure 1-4 involves an iterative cycle of collecting data and performing risk assessment, the endpoint of which will be a risk assessment that either passes specific risk objectives, or does not (in the latter case, it ceases because it is technically impractical (too costly) to perform further remediation). In either case, the decision will then be made, which might include no further action because the risk assessment passes (either directly, or indirectly), or a change in land use options and inclusion of other institutional controls, etc. The "outer loop" on Figure 1-4 is not really a loop. These issues could likely be better explained in the text.

Response: *BRC has attempted to address this comment via discussion in the text.*

6. Section 1.0, pages 1-1 through 1-3, page 1-1 describes the 2,690 acres differently than on page 1-2. They are not necessarily inconsistent (this depends how the word "comprised" is interpreted), but the descriptions are different enough that they can cause some confusion. It would also be more helpful if Figures 1-1 through 1-3 were referenced earlier, so that the reader has somewhere to reference as soon as the areas are being described. It would be helpful if the bullets on Page 1-2 were related to the Figures.

Response: *References to Figures 1-1 through 1-3 have been provided within the first paragraph of the report. In addition, the bulleted lists provide reference to the appropriate figure.*

7. Section 1.0, page 1-2, at the bottom of page 1-2 it is stated that two areas will not be subject to soil remediation. These two areas are included in Figure 1-1, are given an asterisk in the Figure legend, but the asterisk is not defined.

Response: *An asterisk explanation was provided, just to the right of the title block of the figure. This asterisk explanation has been moved to the bottom of the figure legend.*

8. Section 1.0, page 1-2, the introductory discussion on page 1-2 focuses on the Eastside area and the CAMU area. It seems that some discussion is needed on the other areas (Parcel 9, and the rest of Parcel 5/6) for completeness.

Response: *Discussion on these other areas has been provided.*

9. Section 1.0, page 1-3, at the top of page 1-3 is a sentence that indicates that groundwater and the vadose zone will be remediated as necessary. It would be helpful if this were written in

the context of the entire approach, covering surface soil and air as well as subsurface media. As is stands, this sentence seems out of place or incomplete. A quick summary of the areas and the closure process for these areas would be more helpful.

Response: *The text has been revised to address this issue.*

10. Section 1.1, page 1-3, the term post-no-further-action-determination is not easy to understand. It is suggested that the derivation and intent of this term be included here to provide some context.

Response: *This terminology is introduced early in Section 1 and explained in relation to the AOC3.*

11. Section 1.1, page 1-4, it appears there is a missing word identified using square brackets in the following sentence. "...however that there may [be] portions of the Eastside..."

Response: *The 'be' has been added to this sentence.*

12. Section 1.1, page 1-4, BRC states "The CAMU area will be the permanent location of the proposed CAMU." This sentence reads very awkwardly. The NDEP suggests: "The CAMU area will be the permanent location for the remediation waste from the Upper and Lower Ponds".

Response: *This sentence has been revised as suggested.*

13. Section 1.1.1, page 1-4, this section discusses human health risk protection only in the context of surface soils. Does this mean that fate and transport modeling from groundwater, or from the vadose zone, is not a component of the risk assessment?

Response: *Reference to soils only has been removed.*

14. Section 1.1.3, page 1-5, please modify this Section based on the NDEP's comments provided below for Section 10.

Response: *Comment noted.*

15. Section 1.3, page 1-6, it would be helpful if some of the definitions (e.g., no-further-action-determination) that are provided here could be provided earlier in the document.

Response: *The no-further-action-determination term is introduced in Section 1.0.*

16. Section 1.4, pages 1-6 and 1-7, it would be expedient to provide a reference to BRC's approved *Soil and Groundwater Clean-Up Team Professional Profiles* and delete much of the extraneous language in this section.

Response: *The text has been modified to reflect this comment.*

17. Section 2, because much of this section is based on historical documents, the completeness and accuracy of which NDEP cannot verify, NDEP cannot review or concur with the majority of this Section. NDEP suggests that Section 2.3 "Disposal Practices on to BMI Common Areas" be addressed via Section 4.0 under a new "Source Characterization" subsection and be revised to provide the information on an individual effluent conveyance or disposal unit basis. This would provide a more complete description of sources for the Site Conceptual Model.

Response: *Reference to Section 4.2, Source Characterization, has been provided in this section.*

18. Section 3.0, reference to Table 3-1, please specify if this is the site-related chemical (SRC) list or if this includes the proposed broad suite analytical. This differentiation is important and is not clear in the text.

Response: *The table presents the broad suite analytical list for the project. The text has been revised to reflect this.*

19. Section 3.0, page 3-1, last paragraph, please note that BRC should clarify that COPC selection is a function of the risk assessment process and that COPC selection should not be conducted prior to initiating a sub-area-specific HRA.

Response: *Text has been added to the report to reflect this comment.*

20. Section 4.0, general comment, statements within the CSM that offer unsubstantiated conclusions will be rejected unless supported by data collected and presented within the CSM.

Response: *Comment noted. Comments 20 through 88 refer to Section 4 as drafted in October 2006. The new Section 4 has been completely re-written after these comments were received and after BRC met with the NDEP to review these comments. The intent was to substantially reduce the amount of text and figures provided in this Section. The organization suggested in Attachment B of these comments for Section 4 was followed. Based on these discussions with the NDEP, it is BRC's understanding that many of the comments below on Section 4 will be addressed when a complete and detailed stand-alone CSM is prepared for the Eastside; therefore, individual responses to Comments 21 through 88 are not being provided at this time. BRC has reviewed the comments, however, and has addressed them, as applicable, in the revised Section 4. Furthermore, BRC provided the NDEP a draft version of the revised Section 4 text for informal review and obtained NDEP red-line comments – these have been incorporated into the revised Section 4.*

21. Section 4.0, general comments,
 - a. Scattered throughout Section 4.0 are references to work that is *ongoing*. The CSM should be a description of what is known about the system; as such, references to *ongoing* work should be included only in Section 4.7 *Further Considerations for Refining the CSM*. For examples please refer to additional comments below.
 - b. This section frequently digresses from a discussion on the Site CSM to bring in extraneous thoughts not related to the CSM. For examples please refer to additional comments below.
 - c. Consistent terminology and definition should be used for the subareas. For example, terminology used in the Closure Plan includes “subareas”, “management units”, “exposure areas”, and “homogenous areas”.
 - d. BRC should discuss the extent that the deposition of wastes is specifically understood. For example, it is the understanding of the NDEP that a document exists which describes the number of pounds of each waste stream that was sent to the Upper and Lower Ponds by each of the major tenants of the BMI Complex. It is the understanding of the NDEP that this document describes this information on a waste stream and temporal basis. If BRC’s understanding is more limited, BRC should clarify if it is reasonable to expect all site-related chemicals to have come to be located anywhere on the Site.
22. Section 4.1, page 4-1, this Section lists many aspects of a CSM. Receptors are included in this Section, but it would also be helpful to include land use scenarios so that the receptors are better defined in the context of potential future land use. Also, please note that it would be helpful if the CSM descriptions in the following sub-sections followed the listed items. At least, some items seem to be missing such as: land use scenarios and receptors; migration pathways, background or baseline, do not appear to have been discussed completely.
23. Section 4.1.1, page 4-2, first paragraph, fourth line. it seems there may be two numbers transposed. Please verify that the acreage is 2,231 acres and not 2,321 acres.
24. Section 4.1.1, pages 4-2 through 4-4, some discussion of the geological source of the soils might be helpful given the complications of characterizing soil background conditions (because the alluvial fan has soil from two different mountain ranges).
25. Section 4.1.1, page 4-3, BRC states that the effluent included “Chlorinated organics formed by the reaction of chlorine with carbon at elevated temperatures”. It appears that BRC may be referring to the class of compounds known as dioxins and furans (and related dioxin-like compounds). If this is the case, please refer to these compounds plainly. If not, please explain what is intended by the above statement.
26. Section 4.1.2, This section needs to be expanded to include historical, current and potential future information and figures with the following information:
 - a. Channel, seepage, disposal pond, wetland locations and capacities
 - b. Site-wide drainage patterns
 - c. Flow rates
 - d. Surface water chemical composition
 - e. Conceptual and analytical modeling of pond water infiltration and mounding, overflow and seepage

- f. In addition, the NDEP also recommends a separate section on groundwater/surface water interaction be added that provides more detail and supporting data on the historical and current relationships Site-wide between groundwater and surface water.
27. Section 4.1.3, Pg. 4-5, 1st paragraph, BRC has indicated here that 500 borings were reviewed. The rationale used to pick contacts between layers should be described. The source of all 500 boring logs should be referenced and organized on a sub-area basis in a database or hard copy file for NDEP review.
28. Section 4.1.3, pages 4-5 and 4-6, BRC states that three paleochannels exist. As the NDEP has noted on numerous occasions, the NDEP does not concur with BRC's interpretations.
29. Section 4.1.3, pages 4-5 and 4-6, BRC omits discussion of the Middle Zone located in the Muddy Creek Formation (MCF). Please clarify this issue in the revised report.
30. Section 4.1.3, page 4-6, 1st paragraph, the last portion of this paragraph that discusses the productiveness of monitoring wells should be a separate paragraph and provide:
- An explanation of how monitoring well production rates are correlated, or not, to saturated screen thickness, lithology, and head measurements
 - Reference to a map depicting monitoring well locations discussed
 - A discussion of the tested locations relative to other locations of interest, including, distribution of chemicals in soil and groundwater and paleochannel locations
31. Section 4.1.3, page 4-6, 2nd paragraph and Section 4.1.3.3, last paragraph on page 4-9 and first paragraph on page 4-10, these sections indicate that "the shallower groundwater presents evidence of contact with the Las Vegas Wash gravels, although not directly with surface waters flowing in the Wash" and "well and boring log data infer, that, for the most part, groundwater in the Aa does not surface at the Las Vegas Wash but does mix with Las Vegas Wash water in the subsurface along the boundary of the Las Vegas Wash fluvial gravels..." A more detailed discussion or reference to a more specific review of appropriately referenced head and lithologic data that supports specific locations, instances and evidence of this contact and mixing is needed. NDEP recommends adding a section on surface water-groundwater interaction.
32. Section 4.1.3.1, page 4-6, last paragraph and Section 4.1.3.2, page 4-8, 2nd paragraph, a more detailed description of alluvium removal and backfill composition in areas such as the Weston Hills and effects on groundwater flow in these areas is needed to understand potential future impacts from the site on to areas to the north of the site and the Las Vegas Wash. This should include estimates of hydraulic parameter data and cross sections depicting hydrologic features including the sub-drain systems.
33. Section 4.1.3.1, page 4-7, 1st full paragraph, a review of BRC's referenced *Aquifer Testing Workplan* indicates that the proposed testing locations were selected primarily based on recovery rates during well development and purging and not based on their location in relation to paleochannels or subsurface soil and groundwater chemical distribution. Therefore, the proposed aquifer testing will not likely provide information needed to

determine to what extent known paleochannels provide a preferential path for groundwater flow and contaminant migration.

34. Section 4.1.3.1, page 4-7, Figure 4-3 Topographic Surface of the Muddy Creek Formation compared to Figure 8-1 Paleochannels from BRC's *2004 Hydrogeologic Characterization Summary BMI Upper and Lower Ponds and Ditches, Henderson, Nevada* shows significantly less detail. Please provide an explanation of this decreasing level of detail.
35. Section 4.1.3.2, page 4-8, this is the first mention of the Middle Zone, BRC notes that the lenses were sporadic and unpredictable. Please discuss the location of the "lenses" site wide and which depth intervals these lenses occurred over. This discussion should be correlated on a depth to water basis. Please note that in some portions of the Site it appears that these lenses are sub-parallel to the Aa. Also, please discuss what analyses have been conducted by BRC to determine that these "lenses" are "sporadic".
36. Section 4.1.3.2, page 4-8, BRC discusses a data gap on the southwestern portion of the site regarding a paleochannel that may originate on TIMET and travel on to the Site. BRC then discusses several alternatives for resolution of this data gap. This data gap is important because it represents a possible off-site loading of contaminants on to the Site. An alternative that is noticeably absent is: further investigation of the Site to resolve this data gap. This alternative should be considered and implemented, as necessary. In addition, no supporting evidence has been provided by BRC, please explain the basis for this statement. This discussion should be moved to Section 4.7.
37. Section 4.1.3.2, pages 4-7 and 4-8, in the first paragraph it is described that the depth to the Muddy Creek formation is somewhere between 25 feet and 65 feet. In the last paragraph it seems that the depth is described as relatively constant at 50 feet. Please clarify this.
38. Section 4.1.3.3, general comment, it is recommend that a table that includes the following information be provided to summarize known quantitative hydrogeologic information within and between the Aa and TMCf Deep Zone. Please note that if this information is not known these items should be discussed as a data gap.
 - a. Horizontal K range
 - b. Vertical K range
 - c. Horizontal gradient magnitude range and direction (trends over time if available)
 - d. Vertical gradient magnitude range and direction
 - e. Groundwater Seepage Velocity range estimates (calculate if not available in reference material)
 - f. Well recovery rates
 - g. References for information provided
39. Section 4.1.3.3, page 4-9, BRC states "Water quality is poor." Please use a commonly accepted groundwater quality classification methodology such as referenced by Fetter (2001) on page 386; in which case groundwater at the site would be classified as brackish. An explanation of the term brackish as it relates to site contamination would be helpful as well.

40. Section 4.1.3.3, page 4-8, the *Occurrence of Groundwater* section contains information on groundwater quality. Please revise the title or the text accordingly.
41. Section 4.1.3.3, page 4-11, the NDEP has the following comments:
- Review of laboratory analytical data in *Table 3-24 General Chemistry Analytical Results for Groundwater* from the 2004 Hydrogeologic Characterization Summary, October 2004 indicates significant concern for the accuracy of the laboratory inorganic analysis results. Many of the cation-anion balances do not meet Standard Methods procedures for checking correctness of analysis; many of the measured TDS values versus calculated TDS ratios do not fall within the Standard Methods acceptable range of 1.0 to 1.2; the NDEP is uncertain why the majority of TDS analyses are “J” flagged. The NDEP recommends that BRC require analytical laboratory to perform Standard Methods check on correctness of analysis before reporting same. In addition, it is not clear to the NDEP how any of the conclusions in this section can be derived with data that does not meet standard quality checks. Additional comments are provided below for BRC’s consideration in the future.
 - BRC states “By plotting the Stiff diagrams for the Aa and Deep Zone on a single figure, *one can conclude, for the most part, that these waters have the same ions and cations at similar concentrations and ratios, indicating a similar original source water. The Stiff diagrams for wells MCF-16a, -06a, -07, and -08 are of different composition, however, with much greater ionic concentrations and suggest that an impact has occurred.*” (Italic emphasis added).
 - The NDEP does not agree with the very general conclusion in the first sentence, in part because it is immediately contradicted in the sentence that follows. At least four of the Stiff diagram patterns are so small that they can not readily be discerned, *e.g.*, MCF-02A, MCF-03A, MCF-27, and AA-18. The Stiff diagrams for groundwater in the Aa wells appear similar. However, the Stiff diagrams for monitor wells in the Deep Zone MCF-06A, -07, -08A, and -16A (blue plots on Figure 4-10) are decidedly different from the Stiff diagrams for the Aa monitor wells because of the concentration of the cations and anions and likely not because of the composition.
 - A Piper diagram of the water quality in the Aa Zone would show that the cation composition is predominantly calcium/magnesium (>50%) type. Groundwater in the Deep Zone appears to be predominantly calcium/magnesium (>50%) type. The anion composition for groundwater in both the Aa and MCF Zone wells is similar, both are predominated by chloride and sulfate (>90%).
 - Inorganic chemical composition of groundwater is a function of lithology, mineral solution kinetics, and flow patterns in the aquifer (Fetter, 2001). What characteristic of the Stiff diagrams suggest “similar source water”? How can a conclusion about source water be drawn from these data points without direct comparison to source water? Also, what characteristic of the Stiff diagrams for monitor wells MCF-06A, -07, -08A, and -16A suggest impact other than concentration?
42. Section 4.1.3.3, page 4-11, BRC states “Despite the lack of data indicating connectivity between water in the sporadic sand lenses of the TMCf and the Aa above, the Upper TMCf will be conservatively modeled in the numerical modeling in progress, as an upward flux boundary that allows limited water flow upward to the Aa. This conservative approach is also

denoted in Figure 4-8 by the arrowed term ‘Upward Gradient.’” Until proven otherwise the occurrence of Site related chemicals in the Deep Zone (e.g. perchlorate) appears indicative that connectivity existed at sometime in the past. This is not a conservative assumption, it is known that: 1) there is an upward hydraulic gradient at the site, 2) the hydraulic conductivity of this layer is very low (*i.e.*, it is not impermeable), and 3) groundwater moves in response to hydraulic head. Thus it seems reasonable to model this boundary as discussed in Section 6.6 *Bottom Boundary Condition* of the *Groundwater Modeling Work Plan*. This issue should be covered in greater detail in the CSM.

43. Section 4.1.3.3, page 4-11, BRC states “An analysis of water quality data from the eight monitoring wells completed in the TMCf revealed that TDS concentrations ranged from 1,150 to 159,000 mg/L, and chloride concentrations ranged from 113 to 49,700 mg/L.” These topics are mixed; water quality information is mixed with the occurrence of groundwater. Refer to comment above.
44. Section 4.1.3.3, page 4-11, 1st full paragraph, last sentence, please strike out this sentence. The CSM should be a description of what is known about the system; as such, references to ongoing work should be included only in existing Section 4.7 titled *Further Considerations for Refining the CSM*.
45. Section 4.2.3, page 4-15, BRC states “While details of the Willowstick geophysical survey methodology and results will be presented in the *Draft Eastside Conceptual Site Model*, the Willowstick survey was used in this report as a contributing basis for developing and enhancing the definition of isoconcentration contours for TDS, perchlorate, nitrate, and to a lesser extent other Site chemical constituents.” The NDEP requires additional explanation as to how a surface geophysical technique can differentiate between specific ions as appears to be suggested in this sentence.
46. Section 4.2.4, page 4-16, please specify what the “screening limits” are that were used for organic acids.
47. Section 4.3, general comment, this section and the accompanying figures need further assessment and presentation of sampling and analysis (which locations were analyzed for which analyte) distribution (samples per acre within each sub-area and distribution within each sub-area [clustering]), representativeness of chemical distribution in soils within each sub-area, statistical analyses in comparison to background concentrations and in relation to effluent or waste conveyance or disposal units.
48. Section 4.3, page 4-17, second paragraph, BRC discusses chemical distributions at the Site. BRC groups these distributions into broad categories. BRC should revise this section to include discussion of metals that have been detected at concentrations (e.g., arsenic) significantly above background concentrations and applicable screening levels. The only discussion of metals contained in this paragraph is to generally state that metals have been detected but are “consistent with natural background conditions”. Also, BRC must discuss radionuclides.

49. Section 4.3, page 4-17, fourth paragraph, BRC continues to diminish the occurrence of metals at the Site in this paragraph. BRC states “metal and radionuclide exceedances were more likely concentrations that cannot be readily differentiated from background.” BRC has not provided or referenced specific statistical analysis to substantiate this claim. Figures 4-16 and 4-17 (amongst others) appear to illustrate that arsenic exceedances may be readily differentiated from background.
50. Section 4.3, page 4-17, 4th paragraph, this discussion of background concentrations should provide references to background data used and recommended procedures followed in determining background concentrations (e.g., EPA Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites).
51. Section 4.3, pages 4-17 last paragraph and 4-18 1st paragraph, several additions and clarifications are recommended as follows:
 - a. Add a table with the SRC list providing values of screening levels used and references.
 - b. Explain clearly that PRGs in soils do not address the leaching to groundwater pathway, should also include soil screening levels (SSLs) as screening levels (also, please note that Section 4.6, page 4-52, 3rd paragraph, it is not appropriate to discuss PRGs in the context of a discussion of leaching).
 - c. Please include provisional background concentrations in a table and reference the source and methodology used for derivation of these levels.
52. Section 4.3, page 4-17, the last paragraph starts with reference to surface soils and non-volatiles. Over the page, it then continues with subsurface soils and volatiles. Perhaps some discussion of non-volatiles in the subsurface should also be included in this paragraph, especially since metals seem to be present as well (e.g., arsenic). The various sections describing the sub-areas are replete with these types of inconsistencies.
53. Section 4.3, page 4-18, the level of data validation, data quality assessment, and data usability evaluation conducted on the data used for purposes of the screening exercises and procedures used to perform these tasks should be described in the document.
 - a. For example, explain whether or not the most recent data (from the 2004 hydro-geological investigation) have been validated, and provide an analysis, by chemical class and area, of whether they are generally consistent with previous data. If the most recent data have been validated and are consistent with previous data then there is some confidence that screens performed using previous data are meaningful.
 - b. For example, there is much less confidence that there are no exceedances of screening levels when there are data gaps for a particular area or analyte. Figures, if used, should be revised to indicate which sample locations have no data for specific analytes or contaminant classes.
54. Section 4.3, pages 4-18 and 4-19, please note that it is inappropriate to make conclusions regarding potential risk without adequate characterization data and/or data evaluation, however, it is appropriate to use the screens to justify the first phase of remedial action.
55. Section 4.3, pages 4-18 and 4-19, the document should be revised to include discussion of the expected geochemical differences between shallower and deeper soils at the site and how

these expected differences affect interpretation of the figures that are presented. The NDEP could not locate this discussion except for a cursory discussion in footnote 323 on page 4-19. Please clarify this issue.

56. Section 4.3, page 4-19, please provide a table or a reference to the documentation of the comparison of reporting limits with the screening levels and do not include unusable data when making statements regarding chemical distribution.
57. Section 4.3, sub-area-specific discussions, BRC should revise the discussion of the chemical data to be consistent. Examples of inconsistencies are:
 - a. Radium-226.
 - i. Section 4.3.1.6, BRC discusses Ra-226 relative to the “screening levels”. Based on later discussions it is not clear what the “screening levels” are referring to.
 - ii. Section 4.3.2.6, BRC discusses Ra-226 versus “10 times the PRG” and versus “provisional background values”.
 - iii. Section 4.3.3.6, BRC discusses all Ra-226 data versus provisional background only. No discussion of PRGs or screening levels was contained in this section.
 - iv. Section 4.3.7.6, BRC discusses Ra-226 “detections” versus provisional background and developed percentages of detections that exceed provisional background.
 - v. Section 4.3.8.7, BRC discusses Ra-226 in terms of frequency of detection (FOD) and versus provisional background. FOD is not consistently discussed.
58. Sections 4.3.1 through 4.3.10, due to data gaps and/or incomplete data assessment information such as the number or percent of samples exceeding a screening level are not meaningful. Accordingly, it is suggested that this information be removed and more general observations regarding the data be made for purposes of the CSM and remedial action planning. NDEP suggests that the document merely identify chemicals that have exceeded the screening criteria.
59. Section 4.3.1.1, page 4-19, in this section BRC explains that 31% of the surface soil samples and 60% of the subsurface soil samples in the Western Hook sub-area appear to exceed the provisional background range for arsenic. This statement supports the NDEP’s comments above and appears contrary to BRC’s conclusions contained in the previous section regarding the prevalence of metals. The remainder of the sections addressing the other sub-areas appear to have similar statements. This comment should be applied globally and will not necessarily be repeated for every case within the document. BRC must insure that the various sections of the Closure Plan are accurate and not contradictory.
60. Section 4.3.1.3, pages 4-19 and 4-20, BRC states that 15 surface soil samples were analyzed for dioxins and furans with 247 individual analyses reported. As the NDEP has repeatedly stated, including in the July 11, 2005 letters to BRC on the previous version of the Closure Plan, this is not a useful discussion for dioxin/furans. NDEP has repeatedly requested that dioxin/furan results be discussed in terms of Dioxin/Furan TEQs. This comment is global and must be applied to the remainder of the report.
61. Section 4.3.1.8, page 4-21, BRC states “In general, chemical impacts in soils that pose a risk within the Western Hook sub-area appear limited to arsenic in soils.” As stated above, it is

not appropriate to make statements regarding potential risk. NDEP suggests removing this statement. Additionally, BRC stated in Section 4.3.1.6, page 4-20 “Radium-226 was detected in 18 of 20 surface soil samples, with activities exceeding screening levels in all of the samples (100 percent).” Similar results are reported for deeper soil data. This is contrary to BRC’s statement in section 4.3.1.8.

62. Section 4.3.5.8, please delete sections where “summary of exceedances” is presented for each subarea. Given the incomplete status of soil data assessment, information regarding chemical distribution should be used in a more general sense to support the CSM and remedial action decisions (e.g., depth of excavation).
63. Section 4.3.8.2, page 4-31, this is the first instance where “other metals” are discussed. It is suggested that all classes of compounds be discussed for all sub-areas. This discussion will allow the reader to make meaningful comparisons between sub-areas and understand the data gaps that exist at the Site.
64. Section 4.3.8.9, page 4-33, this is the first instance where SVOCs are discussed. See similar comment above.
65. Section 4.3.8.10, page 4-33, in reference to organochlorine pesticides, BRC states “Analytical results for the TMCf suggest that these chemicals have not migrated substantially below the Qa”. Because of the variability in both the expected historical deposition of varying concentration and volumes in the original effluent and the concentrations observed in Qa soil samples, NDEP does not believe 4 samples collected over a 208.2 acre area in the TMCf is a sufficiently representative sample size. Therefore, no conclusions can be drawn regarding the migration of these chemicals below the Qa. This discussion should be revised to indicate how many sample *locations* are represented by these 59 samples and 4 samples, respectively.
66. Section 4.4, general comment, this section should be expanded to provide an assessment of the representativeness of groundwater sample distribution based on chemical distribution of chemical impacts in soils and aquifer permeability distribution. Also note in Section 4.4.1 page 4-40, 1st full paragraph, the document states “these channels do not appear to control the distribution of contaminants in the Aa.” NDEP notes that the depicted distribution of contaminants in the Aa is also related to source chemical mass distribution, sample distribution, and permeability distribution. Therefore, it is incorrect to conclude based on available information whether these channels do or do not appear to control distribution of contaminants in the Aa. NDEP recommends this sentence be removed.
67. Section 4.4, pages 4-37 and 4-38, BRC states “As noted previously, further investigation to quantify aquifer production, chemical quality, and temporal variability is ongoing, and the results outlined below should be taken as a snapshot in time. Use of groundwater at the Site is not anticipated and will be prohibited by deed restriction.” NDEP requests that this discussion be integrated into Section 4.7.
68. Section 4.4.1, page 4-38, Title. Although this section is titled "*Distribution of Chemical Impacts to the Alluvial Aquifer (Aa)*" it includes discussion of chemical impacts in the TMCf.

Please clarify this issue in the text and discuss the limits of the Aa (which may include the saturated portion of the Muddy Creek Formation or provide appropriate cross-referencing to the section of the report that explains this issue.

69. Section 4.4.1, page 4-39, BRC states “The most common non-detects were for analytes in the following chemical classes: PAHs, PCBs, radionuclides, VOCs, and SVOCs. Further review of these non-detects revealed that 53 of the analytes had reporting limits that were greater than the tap water PRG at least 90 percent of the time. This is primarily due to the very low reporting limits required for comparison to the tap water PRGs. A total of five of these 53 compounds also had reporting limits above their respective MCLs: Aroclor 1016, benzo(a)pyrene, 1,2-dibromo-3-chloropropane (DBCP), hexachlorobenzene, and pentachlorophenol. Additional groundwater monitoring is being conducted to improve the reporting limits on these chemicals.” NDEP notes that these elevated detection limits prevent comparison of certain site related chemicals to available screening levels.
70. Section 4.4.1, page 4-39, BRC provides a discussion for the basis of the presentation of the groundwater data. The first bullet states “Many of the analytes detected are in the same class of chemicals, with their occurrence related”. While the NDEP does not necessarily disagree with presentation of a limited number of analytes, the discussion contained in this bullet is lacking. This discussion should be expanded to include the chemical properties and fate and transport characteristics of the BHC compounds. BRC goes on to state that “if an area has been impacted by one of these isomers, then the other isomers are expected to be present.” NDEP recommends that the statement be amended to state “if an area has been impacted by one of these isomers, then the other isomers may be present.”
71. Section 4.4.1, pages 4-39 and 4-40, BRC states that “Any remedy to be implemented at the Site will be focused on an entire class of chemicals.” This statement should be amended to state “Remedies selected at the site will be focused on chemicals with similar treatability characteristics.” For example, a simple coagulation and flocculation treatment for metals as a class of chemicals would not provide sufficient treatment for arsenic.
72. Section 4.4.1.4, page 4-41, BRC states “Though a variety of Site and offsite data sources were consulted in interpreting Site groundwater data, data presented in this and other groundwater figures were collected at the same time using one, uniform methodology.” This is a very vague explanation without references; please add additional references to the appropriate, approved methodologies.
73. Section 4.4.1.1, BRC discusses individual dioxin and furan congeners without placing the data in the appropriate context. The NDEP has repeatedly requested that BRC discuss this class of compounds in terms of dioxin/furan TEQs. In addition, an MCL exists for 2,3,7,8-TCDD. Please review 40 CFR 141 for additional information on the MCL for dioxins and furans and revise this section accordingly.
74. Section 4.4.2, page 4-43, BRC states “Given the large number of analyses reported in all chemical classes collected from groundwater samples collected in 2004 BRC believes the data set is useful for discussions regarding the presence and extent of chemicals in TMCf

groundwater at the Site.” This explanation is repeated several times; it is suggested that this text be removed from this and other sections and included in the introduction to this section.

75. Section 4.4.2, page 4-44, BRC states “The precise source of these elevated concentrations is unknown, although an off-Site source is suggested by the lack of extensive and corresponding chemical impact to soils by these elements in the TMCf soils (the deep soil zone) beneath the Aa on Site.” Please discuss if a sufficient number of soil samples were collected from the TMCf and at appropriate depths and locations to draw this conclusion. Based on the size of the Site and the limited number of samples collected from the sub-surface, it is the belief of the NDEP that BRC cannot support these statements.
76. Section 4.4.2 and last paragraph on pg. 4-52, although BRC has not provided information to substantiate the historical or current presence of off-site sources of contamination, NDEP does not believe that the potential for off-site impacts to the Deep Zone and deeper migration from the Site are mutually exclusive.
77. Section 4.4.2, page 4-44, BRC states “This interpretation is further supported by elevated concentrations of perchlorate, as discussed below, and total chromium in the southern property boundary (upgradient) wells in the Deep Zone, indicating a potential off-Site contribution to these constituent concentrations in the Deep Zone.” Please explain where the hypothesized off-site source for these elevated perchlorate concentrations is located.
78. Section 4.4.2, page 4-44, BRC states “This hypothesis as well as others will be evaluated as part of the ongoing fieldwork. For example, one hypothesis also under study through the use of groundwater modeling is the possibility that historic disposal of effluent to the First Eight Rows sub-area resulted in mounding of Aa groundwater. If plausible, this mounding could have provided the gradient to drive significant groundwater movement to the south where the coarse-grained facies of the TMCf was encountered and provided the pathway for migration to the Deep Zone.” This section should be revised to indicate that groundwater mounding beneath the Upper Ponds is likely or probable, as opposed to “plausible.” The City of Henderson’s operation and monitoring of the Southern RIBs demonstrated mounding beneath those ponds; furthermore, BRC has previously presented this data to the NDEP in the form of analytical mounding calculations and hydrographs (e.g.: Figure 3-19 of the October 2004 version of the Closure Plan).
79. Section 4.4.2.4, page 4-45, BRC states “There were nine organophosphorous pesticides detected in the groundwater samples collected from the Deep Zone; none were detected at concentrations above PRGs or MCLs.” This observation indicates that the Deep Zone was impacted at sometime in the past and hydraulic connection existed at that time.
80. Section 4.4.2.5, page 4-45, BRC states “None of the Deep Zone samples from wells downgradient or beneath the Lower and Upper Ponds contained perchlorate. This suggests that perchlorate impacts to the Deep Zone are not related to Site soils or alluvial groundwater.” The NDEP does not concur with this statement, please refer to other comments provided by the NDEP regarding impacts to the Deep Zone.

81. Section 4.5, general comments, the NDEP has the following comments:
- The objective of presenting pre-excavation data for areas already excavated should be made clear. For example, the pre-excavation data may support the identification of chemicals that may require remediation in other areas. This comment is also applicable to the last paragraph of Section 4.6 (p. 4-53).
 - This section should clarify whether and how soil sample confirmation data was included in the information presented in this section and in the associated tables and figures.
82. Section 4.5, BRC states “by far the greatest frequency of asbestos detection occurs in the First Eight Rows sub-area.” It is not clear to the NDEP that the asbestos characterization data are adequate to make this statement as BRC has not presented any analysis to support this statement.
83. Section 4.6, general comment, given the incomplete site characterization and/or incomplete data quality assessment, conclusions based on the number of screening level exceedances should be avoided. Accordingly, the discussions in this section should be replaced with more general observations regarding data distributions for purposes of supporting the CSM and remedial action planning.
84. Section 4.6, pages 4-50 to-53, please remove sections from the summary that do not directly pertain to what is known about the Site.
85. Section 4.6, pages 4-50 through 4-51 and Figures 4-42 through 4-46
BRC should review available information and summarize the following in a table. If specific information on rates is not available provide capacities, fluid heights, dimensions, etc.:
- Ditch dates of operation
 - Pond dates receiving effluent
 - Pond capacities and standing fluid heights
 - Ditch flow rates and changes over time
 - Ditch effluent composition and changes over time (if presumed to possibly contain all SRCs, please state so)
 - Pond liquid composition and changes over time
86. Section 4.6, page 4-52, BRC states “The limited impact to the TMCf soils by Site chemicals is indicative of limited leaching into the fine-grained TMCf soils from the overlying perched Aa. This limited impact to the TMCf soils, the currently observed upward groundwater gradient from the Deep Zone, and the Site upgradient chemical impacts (*e.g.*, perchlorate) in the Deep Zone groundwater suggests that the Deep Zone confined aquifer found at a depth of more than 380 feet bgs has not been impacted by direct downward leaching of chemicals beneath the Site effluent disposal ponds.” Please discuss the use of the term “perched” to describe this aquifer. It is not clear to the NDEP that this aquifer is perched. Please clarify if a sufficient number of TMCf soil samples been collected to make this determination and if a sufficient number of TMCf soil samples been collect to demonstrate that there were no preferential flow pathways. As the NDEP as stated above it is the belief of the NDEP that BRC has not collected sufficient data to support these conclusions. As NDEP has requested previously, this discussion on vertical gradient direction should be revised to provide a

comparison of the elevation of the pond overflow point to the elevation of the groundwater level in the Deep Zone.

87. Section 4.6, pages 4-52 and 4-53, the NDEP has the following comments:

- a. BRC states “Further detailed consideration of this interpretation, and others, will be pursued based on data derived from upcoming additional groundwater monitoring, aquifer testing, and groundwater modeling. These activities, particularly the groundwater modeling, will consider the potential that, at some point in the past when the BMI ponds were filled and in use, a downward gradient existed between the pond liquid surfaces and the Deep Zone.” NDEP requests that this discussion integrated into Section 4.7.
- b. BRC states “Additional impacts to the Site may have occurred as a result of migration from off-site sources. This will be clarified though the review of upgradient water quality data as planned off-site groundwater monitoring is performed.” NDEP recommends that this section and any reference to off-site sources be removed until evidence is provided of the location and source of off-site contamination.
- c. BRC states “BRC performed IRMs, consisting of excavation and removal, transport, and subsequent stockpiling of shallow impacted soils in a secured holding area, within the First Eight Rows sub-area. The IRM excavations were performed as shown in Figure 4-41. The stockpiled soils were placed in secure holding areas and treated with an application of a binding agent to resist the erosive potential of heat, wind, and water. BRC plans to transport and dispose stockpiled soil at the CAMU planned at the former BMI Landfill Site west of Highway 95. Permit applications are now in process for the planned CAMU.” Please be advised that, as written, this statement has nothing to do with the explanation of the CSM. BRC must provide a discussion of the chemical make up of these IRM materials and how this relates to source materials.

88. Section 4.7, pages 4-53 through 4-55, the NDEP has the following comments:

- a. This section should be renamed “Data Needs”.
- b. On page 4-54, BRC states the following: “Identified data gaps prompt the following work by BRC, presently being undertaken or to be undertaken in the near future:” It is not clear to the NDEP where the “data gaps” have been listed. These data gaps should be described and their significance should be explained in a transparent fashion in the CSM.
- c. Examples of “work by BRC, presently being undertaken or to be undertaken in the near future” that appears to not be listed herein are as follows:
 - i. “Characterization of Site soils and groundwater”. This is a very obvious portion of the work that was omitted and it is not clear to the NDEP why or how this could be excluded.
 - ii. “Background/upgradient investigations to assess groundwater quality in various water bearing zones.”
 - iii. It appears that BRC has not listed any work to address the connectivity of the water bearing zones or the connectivity of the water bearing zones with the Las Vegas Wash. Furthermore, all of the data gaps to be addressed via groundwater modeling appear to be omitted from this section.
- d. Please explain the difference between “characterization” and “quantification” of “aquifer production, chemical quality and temporal variability”.

- e. Please explain the significance of the bullet “Additional control on Aa perchlorate concentrations beneath the Spray Wheel sub-area.”
- f. Additional discussion on data gaps is included as part of Attachment B.

Response: *BRC has attempted to re-organize Section 4 per suggestions included in Attachment B. Please see responses to Attachment B comments below.*

89. Section 6.0, general comment, the content of this section somewhat overlaps that contained in Section 9, although some of the content in this section is not contained in Section 9, and some of the content of Section 9 is not contained in this section. It would be best to combine the information regarding data usability methodology into one section (Section 6) so the reader is provided all relevant information regarding the evaluation of data usability in one place.

Response: *Redundant discussions on data usability have been removed from Section 9.*

90. Section 6.0, general comment, please cite the USEPA Guidance for Data Usability in Risk Assessment (USEPA, 1992a, 1992b) in the introduction of this section.

Response: *References to these guidance documents have been added to the text.*

91. Section 6.6, page 6-5, Precision, please include a discussion of laboratory precision as well.

Response: *A sentence discussing laboratory precision has been added to the text.*

92. Section 7.0, page 7-1, the focus seems to be Eastside soils only. Yet, much of the rest of this Closure Plan addresses groundwater issues as well. Closure can be attained only when all media are dealt with. Some elaboration is needed

Response: *The last sentence of this section does discuss the fact that DQOs for other media such as groundwater will be developed in Sampling and Analysis Plans for those media, as applicable.*

93. Section 7.1, pages 7-1 through 7-9, the DQO steps are described very well in general. One aspect that seems to be missing (probably from Step 1) is gathering all available relevant information so that a CSM can be developed and the needs of the site actions can be better defined. Early development of a CSM helps streamline environmental characterization and cleanup projects.

Response: *The following sentence has been added to Step 1: “This includes gathering all available relevant information so that a CSM can be developed and the needs of the site actions can be better defined.”*

94. Section 7.1, page 7-3, fifth bullet, last sentence states “The PSQs identified...” This should be changed to “The PSQs are identified...”

Response: *The sentence as written is grammatically correct. No change has been made.*

95. Section 7.1, page 7-4, Step 3, the intent of the DQO process is really new data collection. The historical data should be folded into the CSM, and the need for any new data should be determined (iteratively potentially).

Response: *Appropriate text has been added.*

96. Section 7.1, page 7-4, Step 3, please note that inputs go beyond concentration data if fate and transport modeling are to be performed. Parameters that support the entire risk assessment are inputs. They all need to be “collected”.

Response: *Comment noted.*

97. Section 7.1, page 7-4, Step 3, 3rd bullet – action level should probably be plural, since there are usually several (or many) action levels that are considered.

Response: *The text has been changed to reflect this comment.*

98. Section 7.1, page 7-6, Step 6, please note that Step 6 is often very difficult to successfully accomplish for complex sites. The new DQO guidance from EPA provides some flexibility in the rigor that needs to be applied. One of the problems is that the classical statistical approach often is not very supportive of decision analysis, Type I and Type II errors do not adequately match the needs of the problem, and the simple statistical models implied by DQO guidance do not often fit the problem. In addition, it is not unusual for sample size to be driven more by budget than the latter steps of the DQO process. To some extent the issue of data adequacy for decision making can be handled instead in the DQA process, where a probability distribution can be developed for the output(s) of interest, and comparison can be made of that distribution to the corresponding action level(s). As it stands, the NDEP doubts that Step 6 will ever be able to be practically implemented at this site, and the NDEP would prefer a discussion of methods that will be implemented.

Response: *BRC has added some text to reflect the comment above.*

99. Section 7.1, page 7-7, number 1) under the first bullet. It seems the text [“true state of nature”?] is a leftover fragment from a previous comment and should be removed.

Response: *This fragment has been removed from the sentence.*

100. Section 7.1, page 7-8, Step 7, Items 1 and 2, the method for testing the statistical method and the statistical model must be established in Step 5 (if the rigor of this approach is going

to be used). The statistical model must come first. Optimization in Step 7 is not really true optimization, but simply evaluates the cost of collecting the requisite data in different ways. Perhaps only one way will be considered (e.g., surface soil sampling by a standard SOP followed by fixed laboratory analysis), in which case, no comparisons will be performed. This is the most likely case. Often, other alternatives consist of schemes such as field screening, composite sampling, etc., but it does not seem that other options will be evaluated for this project. Please clarify.

Response: *Comment noted. BRC has added some text in response to this comment*

101. Section 8.1, pages 8-1 and 8-2, please provide specific references to the existing soils RAS and ROD documents that are discussed in this Section.

Response: *References to the soils RAS and ROD that have been completed for Eastside Soils, have been added.*

102. Sections 8.2 through 8.6, pages 8-2 through 8-3, please note that all future RAS documents should be evaluated versus all of the criteria consistent with the USEPA guidance for conducting a Feasibility Study. These criteria are as follows:

- a. Overall protection of human health and the environment;
- b. Compliance with ARARs;
- c. Long-term effectiveness and permanence;
- d. Reduction of toxicity, mobility or volume;
- e. Short-term effectiveness;
- f. Implementability;
- g. Cost;
- h. State acceptance; and
- i. Community acceptance.

Response: *Comment noted. BRC has added this text to this Section in the beginning in order to minimize repeating the criteria under each RAS discussion.*

103. Section 9.0, a red-line mark up of this section is included as an attachment to this letter. In addition, select comments are provided below. The redline mark-ups represent NDEP's primary comments regarding Section 9.

Response: *Comment noted. BRC accepts the redline mark-ups as is.*

104. Section 9.0, general comment, The USEPA Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors". OSWER Directive 9285.6-03 (USEPA, 1991) is cited more than once in this section. NDEP has no objection to this citation, however we recognize that the majority of the content of this 1991 guidance has been updated (USEPA, 1995, 1997, 2001, 2002, 2004) and request that the most recent USEPA land use and exposure parameter guidance be used.

Response: BRC is well aware that there are several more recent exposure parameter guidance documents, as referenced in both the text and tables for Section 9.

105. Section 9.0, general comment, data quality assessment is not discussed in this Section or any other Section of the Closure Plan. Please advise how this will be addressed.

Response: Data quality assessment is addressed as part of both the data usability and data adequacy evaluations, as noted in Sections 5.7, 9.3.2.1, 9.3.2.7, and 9.3.2.8.

106. Section 9.0, general comment, please note that the use of default values for risk assessment is not paramount. If site-specific information is available that justifies different values or distributions, then the site-specific information should be used.

Response: As noted several times in Section 9, site-specific values will be used where available.

107. Section 9.0 and elsewhere, general comment, reference is sometimes made to being conservative in the risk assessment or the fate and transport modeling. The NDEP notes that if probabilistic risk assessment (PRA) is performed then conservatism should be removed from the model. Although the PRA methodology is not developed in this document, it might be worth noting that conservatism will not be a factor in a PRA if performed. A probabilistic model should be based on expectation and not conservatism. We also note that reference has been made to background risk in Section 9.11. If background risk is to be calculated deterministically then some care needs to be given to conservatism. It probably would not be ideal to overstate background risks. See comment 136 below, and consider adding some language related to the role of background risk earlier in the document, possibly including some brief note about the role of conservatism when calculating background risk deterministically. The NDEP requests that BRC clarify these issues in the revised Closure Plan. Note conservatism is referred to in many Sections including (but not limited to): Sections 4.1.3.3, 9.5.3, 9.6.1, 9.6.3, 9.7.2.1, and 9.8.

Response: Issues regarding probabilistic risk assessment will be addressed in a separate probabilistic risk assessment methodology submittal to the NDEP, as appropriate.

108. Section 9.1.1, it would be helpful if the aggregation of exposure areas was discussed this early in this section. That is, that 1/8 acre might be the target for exposure, but sampling will not occur on many of these exposure units, instead assumptions of similar populations across the site (or areas larger than 1/8 acre, as supported by the data) will allow estimates to be applied to 1/8 acre units. This is an important concept to get across early. The decision can hence be made simultaneously for many 1/8 acre exposure units based on the data and the documentation that the exposure areas can be aggregated.

Response: A paragraph addressing this has been added to Section 9.1.1.

109. Section 9.1.1, pages 9-2 and 9-3, it is already known that risk goals 1 and 2 are likely not achievable because of background levels (arsenic, radium, etc.), in which case item 3 is the only one that applies, and cleanup to background is being sought. In addition, item 3 needs a better explanation or a different path needs to be offered. For example, BRC is not intending to cleanup to background for certain contaminants (e.g.: lead and dioxins/furans).

Response: *Language for item 3 has been revised to clarify this issue.*

110. Section 9.3.1.1, pages 9-4 and 9-5, this section states that “current exposures exist at the Site” but that “only potential future land-use conditions will be quantitatively evaluated” (bottom of p. 9-5). The NDEP suggests that some discussion be added in this section regarding how risks to current receptors are being managed and/or that the scope of the human health risk assessments be limited to future scenarios only.

Response: *This section has been modified to state that: “Risks to current receptors are being managed through site access control. In addition, although current exposures exist at the Site, the risk assessments will be performed after soils remediation is performed, therefore only potential future land-use conditions will be quantitatively evaluated.”*

111. Section 9.3.1.1, pages 9-4 and 9-5, please provide clarification for the use of the term “future”. Please discuss if “future” refers to post-remediation or post-development or both.

Response: *As identified in the Section 9.3.1.2 header, future refers to both redevelopment and post-development exposure pathways.*

112. Section 9.3.1.2, 2nd sentence of the 2nd paragraph, this sentence is awkward. Both references in this section pertain to redevelopment. Perhaps the second sub-area is being remediated at the same time that the first referenced sub-area is being developed? Also, please note that the remainder of the paragraph should probably be separated from the 1st two sentences as they do not seem to connect.

Response: *Redline changes by NDEP to this section have been accepted by BRC.*

113. Section 9.3.2, general comments, the content of this section somewhat overlaps that contained in Section 6, although some of the content in this section is not contained in Section 6, and some of the content of Section 6 is not contained in this section. It would be best to combine the information regarding data usability methodology into one section (e.g., Section 6) so the reader is provided all relevant information regarding the evaluation of data usability in one place. In addition, please note that Part B of the USEPA Data Usability in Risk Assessment guidance should be used for assessment of usability of radionuclide data.

Response: *Most of the content of this section have been removed, and reference to Section 6 added.*

114. Section 9.4.1, page 9-13, second full paragraph, the second sentence should be changed to “This is equivalent to asking if a set of the largest values of the site distribution are significantly larger (in a statistical sense) than the maximum value of the background distribution.”

Response: *This paragraph was revised in the provided redline version of the text (Attachment C). This sentence has been added to the sixth paragraph of Section 9.4.1.*

115. Section 9.4.2, page 9-14, please note that the ATSDR Interim Policy Guideline for dioxins is as follows: “If one or more soil sampling values exceed the screening value of 50 parts per trillion (ppt) of toxicity equivalents (TEQs), further site-specific evaluations are needed ...” (ATSDR, 1997, p.2). Accordingly, it is appropriate to identify dioxins/furans as COPCs if one or more soil sample concentration exceeds 50 ppt TEQ. While this criterion will generally be applied for the health risk assessments, NDEP will approve elimination of dioxins and furans on a case-by-case basis, particularly given the ongoing reassessment of 2,4,7,8-TCDD. If dioxin/furans are detected at the site at concentrations associated with $> 1 \times 10^{-6}$ risk, but are not included as COPCs (based on the 50 ppt TEQ criterion), a related discussion should be included in the uncertainty analysis. In regard to the 50 ppt screening level, further updates in dioxin guidance should be considered at the time the HRA(s) are conducted.

Response: *Redline edits to this section by NDEP are acceptable to BRC.*

116. Section 9.5.1, page 9-16, last full paragraph, please clarify here that both of the statistical methods listed will result in use of a 95% UCL of the mean concentration, its just a matter of how the 95% UCL is estimated (assuming randomness (no spatial correlation) or assuming a spatial correlation structure). BRC should also note that the correlation referred to here is spatial correlation.

Response: *Text has been added to this paragraph to clarify this issue.*

117. Section 9.5.1, page 9-17, for clarification, GiSdT stands for Guided Interactive Statistical Decision Tools.

Response: *This definition has been added.*

118. Section 9.5.1, page 9-17, sixth sentence states, “Under a deterministic risk assessment framework, UCLs of representative cells, including those with the mean, 95 percentile and/or maximum UCLs, will be considered.” The intended meaning of this statement is not clear. It seems that the representativeness of cells will be determined by ordering the UCLs for all of the cells. If this is the case, it needs to be stated more clearly.

Response: *Consistent with the Statistical Methodology report, the sentence has be revised to read: “Under a deterministic risk assessment framework, the maximum UCL across all cells, or*

block kriging will be applied to the entire sub-area to estimate an overall mean, standard error, and UCL for the sub-area.”

119. Section 9.5.2 and 9.5.3, reference is made to volatile SVOCs in these sections. While specific analytical methods are not identified in these sections, volatile SVOCs, such as certain PAHs other than naphthalene, are not included in the TO-14 or TO-15 analyte list. Following COPC identification for each health risk assessment, please ensure that all COPCs meeting USEPA criteria for VOCs are either included in flux chamber analysis (e.g., TO-13) or rationale is provided for the air pathway being insignificant for those chemicals (e.g., based on soil data). This section also does not identify the analytical method to be used for radon.

Response: *Because the risk assessments will be conducted post-remediation, this exposure pathway for SVOCs is not expected to be significant. VOCs and SVOCs will be first analyzed in soil. Therefore, the appropriate TO method will be selected depending on the VOCs/SVOCs detected in soil and data collected from shallow groundwater beneath the site.*

120. Section 9.5.3, page 9-19, second paragraph, third sentence states “The dispersion factor for the construction worker will not be adjusted to account for soil intrusion activities.” It is not clear that this is appropriate, please explain.

Response: *Redline edits to this section by NDEP are acceptable to BRC.*

121. Section 9.6, general comment, in addition to adding current groundwater concentrations to the groundwater concentrations predicted from modeling leaching from site soil, each health risk assessment should show the latter separately (i.e., the model-predicted groundwater concentration without the addition of current groundwater concentration).

Response: *Text has been added to address this issue.*

122. Section 9.6.1.1, page 9-22. All references to the term “da” must be corrected to be thickness of the aquifer.

Response: *The text has been corrected.*

123. Section 9.6.1.1, page 9-22, BRC states “The aquifer thickness (da) value will be based on stratigraphic data noted in the lithologic map of the Site (prepared as part of the CSM process described in Section 4.0).” Please reference the specific map in Section 4 that this refers to.

Response: *These maps will be developed as part of a more comprehensive CSM to be developed for the site.*

124. Section 9.6.1.1, pages 9-22 and 9-23, last paragraph on page 9-22. “The site-specific term representing source length parallel to groundwater flow (L) will be selected based on the known areal (sp?) extent of a given COPC within a particular exposure area. Each COPC will be modeled separately. The source length parallel to groundwater flow (L) will be dependent on the particular COPC being modeled.” If the aerial extent of a COPC is known, then please explain what is being modeled in this context. In this example the term “L” would be the measured length of the aerial extent parallel to groundwater flow.

Response: *Agreed. The L term in the model will be the length of ‘contamination’ for a particular COPC.*

125. Section 9.6.1.2, page 9-23. “The equation used for estimating groundwater concentrations is (from USEPA 1996b [shown reversed from this document, below])...” Please correct this to read “The equation used for estimating groundwater concentrations is (from USEPA 1996b [shown as solved in terms of C_{gw}, below])...”

Response: *The text has been corrected.*

126. Section 9.6.1.2, page 9-23, last paragraph, BRC states “For the purposes of screening analysis, the resultant predicted groundwater concentrations of COPCs from post-remediation soils will be compared to applicable environmental- and health-based standards (e.g., MCLs and ambient water quality criteria for the protection of freshwater organisms).” This assumption does not account for the potential impact of vadose zone soil if contaminated and not remediated. For example, a contaminated soil column that was re-wetted post-development.

Response: *Comment acknowledged. Vadose zone modeling will account for all soil impacts following remediation.*

127. Section 9.6.3, page 9-25, 1st paragraph in section, BRC states “The analysis will initially apply the conservative assumption that predicted groundwater concentrations at the point of infiltration will proceed undiluted and unattenuated up to the point of entry into the Las Vegas Wash. If more refined analyses are warranted, approval from NDEP will be sought prior to conducting those analyses.” Please explain how this relates to the groundwater model that is being developed.

Response: *BRC considers what is proposed for the MODFLOW modeling to be the refined analysis.*

128. Section 9.7.1, general comment, text in this section indicates that the identification of exposure pathways and receptors is supported by the CSM presented in Section 4, however exposure pathways and receptors are not included in Section 4. The association should be made between Section 4 and critical health risk assessment components of the CSM, such as exposure pathways and receptors.

Response: *After discussions with NDEP, the intent was to keep Section 4 abbreviated and focused. Therefore, the identification of exposure pathways and receptors were discussed in Section 9.*

129. Section 9.7.1, page 9-26, please note that the CSM in Section 4.0 is not meant to be comprehensive, it is meant to be a summary.

Response: *The text has been corrected.*

130. Section 9.7.2.2, page 9-29, as previously requested, please do not age-adjust chemical LADDs for the resident. Please show child-specific LADDs and adult-specific LADDs separately, and do not use age-adjusted exposure parameters except for radionuclides.

Response: *Redline edits to this section by NDEP are acceptable to BRC.*

131. Section 9.7.2.3, page 9-30, the NDEP suggests that BRC add a sentence that if PRA is performed then a global numerical sensitivity analysis should be performed, which will be described in more detail in the PRA planning documents.

Response: *Text has been added to address this issue.*

132. Section 9.7.4, page 9-31, reference is made to results of the radon indoor air measurements. It is not clear how indoor air measurements will be made prior to construction of buildings. Please clarify. It is NDEP's understanding that future indoor radon exposure assessment will be based on the results of the surface flux chamber program and typical indoor air dispersion factors.

Response: *Indoor air measurements will not be made. This sentence has been revised to read "...results of the estimated radon indoor air concentrations will be compared to USEPA's recommended action level of 4 pCi/L."*

133. Section 9.7.5, page 9-32, second full paragraph, second to last sentence states, "In addition, it will be assumed that asbestos only occurs at the soil surface (zero to two inches), unless it is plausible that it exists at deeper depths based on available sample data or information for a particular exposure scenario." Justification of this assumption is needed, given the amount of grading that has occurred on the site over time.

Response: *As noted in the next sentence "This will be determined on a case-by-case basis with NDEP."*

134. Section 9.10, page 9-38, some discussion should be provided about uncertainty analysis if a probabilistic risk assessment is performed, since aspects of a probabilistic risk assessment have been described in this section. BRC could add a sentence along the lines of "If a

PRA is performed the uncertainty analysis will be performed quantitatively. Details will be provided in the PRA planning documents”.

Response: *Text has been added to address this issue.*

135. Section 9.11, page 9-39, first paragraph this appears to be the first time that background risk has been mentioned in this document. This is very important for the decision making process at this Site, and should be discussed earlier in the Closure Plan. It should probably be discussed in Section 4. We also note that the role that background risk plays, or might play, in the decision making process should be described earlier in the document (also Section 4?). The role that it plays might depend on the data, but if background risk is under consideration then it needs to be described earlier in the document. Note also that a potential issue here is that Section 9.11 in particular is not well integrated with the rest of the document.

Response: *Comment acknowledged.*

136. Section 9.11, page 9-39, last paragraph, first sentence states, “Having the mean and standard deviation of concentrations of the risk-driver chemicals within each cell, chemical concentrations of targeted contaminants will be statistically generated from a normal distribution, where the total cancer risks and non-cancer hazards are calculated for each set of concentrations.” It is not clear exactly how this will work or why boot strapping is needed if normality is assumed. What will be the sample size for the parametric bootstrap? The geospatial algorithm should be able to produce means, standard errors, and hence UCLs directly for each cell in the block. It is requested that BRC clarify what is intended here. Also note that this has not been described sufficiently earlier in the document, so it seems strange to see this description in the final section of the Closure Plan. Perhaps some further integration with earlier sections would help.

Response: *The text has been corrected to clarify this issue.*

137. Section 10, general comment, the NDEP did not develop comments for this section or the ecological scoping checklist provided under separate cover. The development plans for the area known as the “No-Build Area” have evolved over time and it is no longer necessary to complete an ecological risk assessment for this area. Additional discussion on this matter is provided below.

- a. BRC should include a brief discussion in the revised Section 10 to note that an ecological risk assessment work plan will be developed if and when impacts and receptors are identified. For example, if it is discovered that off-Site impacts are adversely affecting ecological receptors it may be necessary to develop and ecological risk assessment work plan.

Response: *The text has been revised to reflect this comment.*

- b. BRC provided the NDEP with substantial documentation during a January 3, 2007 meeting to explain the development plans for the No-Build Area. These plans indicate that the No-Build area will receive a substantial amount of fill material and development after remediation is complete. It is the belief of the NDEP that these developments do not constitute suitable habitat and hence an ecological risk assessment is not necessary.

Response: *Comment noted.*

- c. BRC should modify the remainder of the Closure Plan to note that the end use of the No Build Area is recreational. In addition, it is advised that the No Build Area be renamed the “Recreational Sub-Area” or something similar.

Response: *All reference to the No-Build area now refer to the “Trails & Recreation” sub-area.*

138. Table 4-3a, the NDEP has the following comments:
 - a. It appears that a comparison to background was only completed for arsenic, radium-226 and radium-228. It is not clear why this is the case. The discussions in the CSM portion of the text are therefore limited by this lack of analysis. BRC should either provide the rationale for the selection of these compounds or conduct a more thorough analysis.

Response: *The revised soil summary table provides background comparisons for all metals and radionuclides with background data.*

- b. It may be useful to add another column to indicate the number of samples with elevated detection limits. The term “elevated” could be defined via a foot note. Alternately, BRC could format the soils tables to be consistent with the format and content of the groundwatertables (e.g.: Table 4-13).

Response: *The revised summary tables provide information on elevated detection limits.*

- c. These comments apply to all similar tables.

Response: *Comment noted.*

139. Table 9-1, page 1 of 2, bottom of page, “Depth of Aquifer” should be changed to “Aquifer Thickness”. This reference must be checked and revised throughout the remainder of the document.

Response: *This change has been made to the table.*

140. Figure 1-4, the NDEP has the following comments:
 - a. In the bottom right hand corner of the figure, the box to the left of “does assessment pass” that is labeled “No” is missing the arrow to the next box.

Response: *The arrow has been added to this figure.*

141. Figure 4-3, the NDEP has the following comments:

Response: *Comments 141 through 157 refer to figures provided in the October 2006 version of Section 4. As noted in the response to Comment 20 earlier, the revised Section 4 is substantially re-organized based on discussions with NDEP and per NDEP comments in Attachment B. Therefore, many of the old figures have been eliminated. Thus, BRC is not providing individual responses to the NDEP comments on specific figures for Section 4 below. However, for those figures that have been retained, BRC has revised the figures per NDEP comments. These include comments 152-157.*

- a. Revise this figure to include the level of detail in Plate 3 generated by Kerr-McGee dated July 15, 1998. For example, this figure should be revised to include the paleochannel present on both the former Kerr-McGee property and the Site.
 - b. Submit a revised version of this figure at a smaller scale that includes boring labels and contact elevation picks for each location posted.
 - c. Provide clarification and reference to the data used to generate this figure. For example, it is not clear that all of the Ampac data has been used.
 - d. It is not possible for the NDEP to verify the interpretations presented on this figure, however, it is expected that a similar figure will be submitted as part of the site-wide CSM.
 - e. NDEP does not concur with the interpretations presented on this figure.
142. Figure 4-4, please explain the difference between the “upper and lower coarse grained facies” and the “coarse interbeds”.
143. Figure 4-5, this figure lacks the detail that is necessary. It is not clear why BRC has not included a vast majority of the available wells that would provide meaningful detail (and control) to this figure.
144. Figure 4-8, the NDEP has the following comments:
- a. The Deep Zone should be shown as a continuous water bearing zone.
 - b. The sporadic water bearing sand lenses should be shown with an upward gradient.
145. Figure 4-9, the NDEP has the following comments:
- a. Please note that the AMPAC report titled “Supplemental Hydrogeologic Investigation” dated January 24, 2000 provides reference to “Deep Zone” wells that could be added to this figure for additional control points for potentiometric surface contours.
 - b. The Tronox TR series of wells as well as a deep well installed by Montrose could be utilized in the development of this Figure.
 - c. In addition, the lack of detail and control demonstrated on this figure suggests a data gap that requires consideration.
 - d. A similar figure should be developed for the alluvial aquifer.
146. Figure 4-10, the NDEP has the following comments:

- a. The legend states that blue symbols represent the Deep Zone and red symbols represent the Aa. However, the following wells appear misrepresented: MCF-06C – red, MCF-12B – red, and MCF-16C – red. Please clarify.
 - b. At least four of the Stiff diagram patterns are so small that they can not readily be discerned: MCF-02A, MCF-03A, MCF-27, and AA-18.
 - c. Also, Figure 4-10 should contain a key for the description of the various MCF designations such as “A”, “B”, and “C”.
147. Figures 4-16 through 4-40, the NDEP provides general comments as follows:
- a. It should be noted that BRC has elected to compare Site data to the maximum background concentration. It would be helpful to explain to the reader that this is the least conservative comparison that could be made. It is suggested that this issue be addressed in the text.
 - b. Any figure that includes chemical data should include a statement regarding the provisional status of the data plotted.
 - c. Provide the rationale for the selection of which chemicals were presented in figures. NDEP also recommends that the same chemicals be plotted for soil and groundwater. This would be analogous to the process that the NDEP discussed in detail with BRC regarding the CAMU-area CSM.
148. Figure 4-17, this figure has a symbol in the legend which appears to apply only to soil data in Parcels 4A and 4B. This note states “A background dataset has not been established for deeper Qa and TMCf soils.” It is not clear to the NDEP why this note only applies to samples in Parcels 4A and 4B. This note appears to be inconsistently applied on other figures as well (i.e.: Figure 4-18).
149. Figures 4-22 through 4-24: Provide an explanation of what PRG was used for purposes of plotting “OC pesticide concentrations” and the rationale for selection of this PRG. Since different pesticides may have different PRGs, it is inappropriate to present data as “OC pesticide concentrations” for purposes of PRG comparisons and in general this figure requires further refinement and/or explanation.
150. Figure 4-36, label the contours on this figure.
151. Figure 4-37, this is a good example of a figure that was developed without inclusion of all available data. Perchlorate data is collected regularly by Tronox and Ampac and this data has not been included on this figure. NDEP has issued similar comments on this issue in the past. A similar comment is applicable for Figure 4-34 (total chromium). This figure and all others that are similar should be revised to address this comment.
152. Figures 4-42 through 4-46, the NDEP has detailed examples of a number of issues with these figures below. The NDEP’s comments should not be considered comprehensive. BRC should review these figures for completeness, accuracy and transparency prior to resubmittal.
- a. BRC should consider depicting these Figures as a time range instead of a snapshot in time.

- b. Due to the complexity of these figures it is requested that BRC include a series of notes as an attachment to each figure. It may be necessary to present these figures on a larger sheet of paper in the revised Closure Plan.
 - c. The mountain ranges should be shown as the McCullough and River Mountains.
 - d. These figures should indicate lands owned by BMI or the BMI Complex over time.
 - e. The discharge from the plants to the air should be defined in the legend as it is depicted as a gray arrow.
 - f. The gradient should be shown as downward for the alluvial aquifer.
 - g. The gradient for the “sporadic water-bearing sandy lenses” should be shown as upward.
 - h. It is the belief of the NDEP that the Deep Zone Aquifer should be shown as continuous.
153. Figure 4-42, the NDEP has the following comments:
- a. The Western and Northwest Ditches are not shown as connected to the Lower Ponds, please clarify as this contradicts information depicted in aerial photographs.
 - b. It is the understanding of the NDEP that housing developments existed in 1943 (per a review of aerial photographs), please depict these as is appropriate. In addition, the Pitman community does not appear until 1976 (aerial photographs show housing in this area by 1943), please explain.
 - c. It appears that BRC does not depict any evaporation from the Upper Ponds on this figure. Please explain.
 - d. The blue shading shown in the Upper Ponds is not explained in the legend. Similar issues exist on Figures 4-43 through 4-46. Please address this in the legend. In addition, it is not clear to the NDEP why the shading is only shown in a limited portion of the upper eight rows of ponds. In addition, the figure depicts “water movement” to the Upper Ponds but “water and chemical infiltration” from the ponds.
 - e. Between Figure 4-42 and 4-43 the shading of the Las Vegas Wash changes from blue (water movement) to pink (water and chemical movement). This shading then becomes blue again by 1992. Please explain the significance of this inconsistency.
 - f. Please note that Lake *Mead* Drive is mis-spelled on this figure and others.
 - g. These comments apply to the remainder of the figures that are similar.
154. Figure 4-43, the NDEP has the following comments:
- a. BRC shows the arrow labeled “direction of upper zone groundwater flow” as being water and chemical waste movement. This is not the case on Figures 4-42 or 4-44, please explain why this is not consistent. Also, please clarify as to the potential sources for the chemical waste; NDEP will not accept unsupported statements in the CSM.
 - b. Water appears to be flowing backwards in the Western and Northwestern ditches. Please explain.
155. Figure 4-44, the NDEP has the following comments:
- a. Please explain the exact date of the figure and how that correlates to the start up date of the lined TIMET ponds.
 - b. “Groundwater Mounding” is shown adjacent the Las Vegas Wash and an undefined source of chemical and water movement is shown in this vicinity. This phenomena is shown on Figures 4-43 and 4-44 but is not shown on any other figure. It is the understanding of the NDEP that groundwater mounding has occurred and still occurs in a

number of places on and around the BMI Complex. Please explain these issues and depict groundwater mounding as appropriate.

156. Figure 4-45, the NDEP has the following comments:
- BRC shows the Alpha Ditch as “inactive”, however, it is the understanding of the NDEP that the Alpha Ditch was merely replaced by the Alpha pipeline. It is the understanding of the NDEP that this pipeline is and has been active.
 - The feature known as the “Kerr-McGee Seep” appears to be omitted from this figure. All applicable seeps should be shown and identified on this figure and all others.
157. Figure 4-46, the NDEP has the following comments:
- BRC has a label that states “no discharge” in the vicinity of the Las Vegas Wash. Actually, Tronox (Kerr-McGee) has a discharge from their remedial system and the discharge from the Alpha Pipeline exists in these areas. Please clarify.
 - Please be more specific regarding the date of this figure. The TIMET ponds went out of service in May 2005 and should be labeled as “inactive” if this figure depicts the Site after May 12, 2005. If not, perhaps a footnote should explain this issue.
 - The sub-drain systems in the Tuscany and Weston Hills developments should be depicted on these figures. In addition the C-1 Channel should be depicted on these and other figures.
 - The road labeled as “to Golf Course” should be labeled with its proper street name. In addition, this road leads to *residential housing* as well as a golf course. It is not clear why BRC has chosen to make this distinction. In addition, the development is “Tuscany” not “Tuscany Hills”.
158. Figure 9-1, the NDEP has the following comments:
- Upper right-hand corner: change “Potential Human Receptors” to “Potential Future Human Receptors”.
 - Please delete the note at the bottom regarding current receptors.
 - Regarding surface water, please clarify the location(s) of the surface water that the trespasser is exposed to and why workers and residents would not come into contact with those waters.

Response: *The figure has been modified accordingly. For comment 158.c. surface waters are those waters previously associated with the ‘No-Build’ sub-area. Since this area has been replaced with the ‘Trails & Recreation’ sub-area, and no surface waters are anticipated following development, exposures to surface waters for workers and residents will not occur. Construction worker exposures to surface waters may occur during excavation operations.*

NDEP Attachment B Comments

1. The purpose of Section 4.0, Conceptual Site Model (CSM) was to provide a broad overview of the current understanding of Site conditions. The existing CSM provides too much detail and overstates the level of understanding at the Site. Included in this Attachment are examples and explanations for the recommended, revised content of CSM Section of the Closure Plan. BRC should discuss any issues that require clarification prior to resubmittal.

Response: *Comment noted. The section has been extensively revised to reflect this comment. Additionally, several discussions have been held with NDEP. Finally, NDEP was provided a draft text of the revised Section 4 and received helpful red-line comments on an informal basis. These have been included in the revised Section 4.*

2. The NDEP suggests that BRC review ASTM Standard E 1689-95 – Standard Guide for Developing Conceptual Site Models for Contaminated Sites. Based on this the CSM should contain the following elements:
 - Brief Site Summary
 - Site Description, including a discussion of the limits of the study area or system boundaries
 - Source Characterization
 - Discussion of background levels for each media of interest
 - Migration Pathway Descriptions
 - Environmental Receptor Identification and Discussion
 - Discussion of Data Needs (Gaps)
 - Maps, Tables and Figures

Response: *The revised Section 4 follows the suggested organization.*

3. Discussion of data needs (gaps), the NDEP suggests that BRC develop a table that includes information as presented in the example below. This table could be aided through the addition of another column labeled “CSM Pathway”. Please note that this example is not intended to be comprehensive.

CSM Receptor	Data Need	Deliverable(s) to Address Data Need
Human, ecological, groundwater	Distribution of Site Related Chemicals in on-site and off-site soils	CAP, Statistical Methodology document, Closure Plan, etc.
	Distribution of Site Related Chemicals in groundwater (all water bearing zones)	

CSM Receptor	Data Need	Deliverable(s) to Address Data Need
	Distribution of Site Related Chemicals in groundwater relative to subsurface permeability distribution (all water bearing zones) and preferential pathways (alluvial aquifer)	
	Mass flux of contaminants in groundwater off of Site	
	Validated data set	Various data validation reports
	Background range of inorganic constituent concentrations in surface and near-surface soils	
	Background and upgradient (including contribution of contaminant loading from off-Site sources [e.g. potentially TIMET property]) distribution of Site Related Chemicals in groundwater	
	Location, extent, and magnitude of historical and future groundwater recharge and mounding, and impact on contaminant migration in alluvial aquifer	Groundwater Modeling
	Location, extent and influence of paleochannels or other preferential migration pathways (e.g. subsurface drain systems) on groundwater contaminant migration	
Groundwater	Occurrence and continuity of groundwater in Middle Zone	
	Background range of inorganic constituents for: <ul style="list-style-type: none"> • deeper quaternary alluvium soils • Upper Muddy Creek Formation soils 	Existing background studies underway and in development
	Background conditions for Upper Muddy Creek Formation soils	

CSM Receptor	Data Need	Deliverable(s) to Address Data Need
	Background and upgradient conditions for deeper water bearing zones	
Ecological	Identification of ecological receptors	Ecological Scoping Checklist, Screening Level Ecological Risk Assessment
	Hydraulic properties (e.g.: K_H , K_V and S) of water bearing zones.	Aquifer Testing Workplan and Report
	Connectivity (or absence of connectivity) of water bearing zones.	
	Connection of Alluvial Aquifer with LV Wash Gravels	
	Location, occurrence, and flows of groundwater seeps	
	Seasonal fluctuations of groundwater levels and horizontal and vertical hydraulic gradients	Quarterly monitoring of groundwater
	Geologic and physical properties of Site soils that affect leaching of contaminants to groundwater	
	Groundwater seepage velocities	
	Occurrence and areal extent of contaminant migration via fugitive dust suspension and deposition	
	Occurrence and areal extent of contaminant migration via erosion and surface water sheet flow	

Response: The data gap table provided in the revised Section 4 is organized per the comment above.

4. Screening levels, the NDEP has the following comments:
 - a. NDEP suggests that BRC use a screening level of 2,400 mg/L for Total Dissolved Solids. The reference for this value is NAC 445A.200 – NAC 445A.201.

- b. All remaining screening levels should be adequately defined and referenced. It would be expeditious to create a table that listed all screening levels and the respective source for the screening level.

Response: *Screening levels are provided in a new table as suggested.*

5. Tables, please remove all of the remaining Tables except as listed below.

Response: *As part of the reorganization, various tables have been removed as suggested.*

6. Tables, the following existing tables are suitable for retention in the CSM (once the comments in Attachment A are addressed, as applicable):
 - a. Tables 1-1, 3-1, 9-1, 9-2, 9-3, 9-4, 9-5, 10-1 and 10-2.

Response: *These tables have been retained and modified as needed.*

7. Tables, the following tables are suggested to be developed and included in the revised CSM:
 - a. For soil data, one table that presents data in the following columns:
 - i. Analyte name
 - ii. Range of detections
 - iii. Number of detections exceeding the “screening level”
 - iv. Range of non-detections
 - v. Number of non-detections exceeding the “screening level”

Response: *These tables have been developed and incorporated into the revised Section 4.*

- b. For groundwater data, one table that presents data in the following columns:
 - i. Analyte name
 - ii. Range of detections
 - iii. Number of detections exceeding the “screening level”
 - iv. Range of non-detections
 - v. Number of non-detections exceeding the “screening level”

Response: *These tables have been developed and incorporated into the revised Section 4.*

8. Figures, please remove the following Figures:
 - a. Figure 4-1 and 4-2, these Figures are duplicative of Figures provided for Section 1.0.
 - b. Figures 4-11 and 4-12, these Figures do not add value to the report.
 - c. Figures 4-14 through 4-40, these Figures will be replaced with new Figures as described below.

Response: *These figures have been removed from the previous version of Section 4 as suggested.*

9. Figures, the following existing figures are suitable for retention in the CSM (once the comments in Attachment A are addressed, as applicable):
- a. Figures 4-3 through 4-10.
 - b. Figures 4-13 and 4-41.
 - c. Block diagrams, Figures 4-42 through 4-46 are appropriate for this type of CSM. There are a number of comments in Attachment A that must be addressed.
 - d. Figures 9-1 and 10-1.

Response: These figures have been retained and modified as necessary.

10. Figures, the following figures are suggested to be developed and included in the revised CSM:
- a. One figure shall be developed for each of the following horizons:
 - i. Surface soils (0-1' bgs)
 - ii. Near-surface soils (1-15' bgs, this interval can be refined based on BRC's review of the project database)
 - iii. Middle Zone Soils (BRC to define this interval based on a review of the project database)
 - iv. Deep Zone Soils (BRC to define this interval based on a review of the project database)
 - v. Alluvial Aquifer (including the upper, saturated portion of the Muddy Creek Formation, as applicable)
 - vi. Middle Zone (sometimes referred to as the sporadic, water bearing lenses)
 - vii. Deep Zone (this is the water bearing zone below 300' bgs)

Response: These figures have been developed and incorporated into the revised Section 4.

- b. Each figure shall evaluate the project database for each analyte versus the applicable screening level. The symbols to be used on the figures shall fall into the following categories:
 - i. Any analyte exceeds a screening level (non-detects to be evaluated at ½ the detection limit)
 - ii. No analytes exceed a screening level (non-detects to be evaluated at ½ the detection limit)
 - iii. Each of these symbols should differentiate (by shape, color or asterisk) if the location has been analyzed for either: the full analyte list or an abbreviated analyte list.

Response: This information has been included in the revised figures for the revised Section 4.

ATTACHMENT A-2
REDLINE/STRIKEOUT

SECTION 1

1 INTRODUCTION

In February 2006, Basic Remediation Company (BRC) and others executed the *Settlement Agreement and Administrative Order on Consent: BMI Common Areas, Phase 3 (AOC3)*¹ with the Nevada Division of Environmental Protection (“NDEP” or “Division”) for certain property located in Clark County, Nevada. This property (the “Site”) covers approximately 2,690 acres (~~2287~~; 2,287 acres east of Boulder Highway, 34 acres west of Boulder Highway (“Parcel 9”); and 369 acres Parcel 5/6)contiguous to Parcel 9 (“Parcel 5/6”). Together, these three parcels compose the “Basic Management, Inc. (BMI) Common Areas”, and they lie within the southeastern quadrant of the Las Vegas Valley– (Figure 1-1). Figure 1-2 depicts the 2,287 acre tract east of Boulder Highway, and Figure 1-3 depicts the two tracts to the west of Boulder Highway. The Site is shown in context with nearby features such as the BMI industrial complex, neighboring land uses, historic conveyance ditches and the like on Figure 1-1.

The AOC3 defines the overall framework within which the Site is to be characterized and chemical pollutants remediated, as necessary. Among other matters, the AOC3 specifically “governs the performance and/or completion of Environmental Contaminant characterization, the screening and selection of Remedial Actions, and the implementation and long-term Operation and Maintenance of Division-approved Remedial Actions, each and all as necessary to implement the existing Record of Decision (ROD) and future ROD(s) concerning Soil Pollution Conditions and Water Pollution Conditions at the Site.”² The steps and sequence by which these characterization and remedial actions are to be performed are stated in the *Scope of Work*, which is a part of the AOC3. This Closure Plan has been prepared pursuant to the AOC3, and particularly in furtherance of the *Scope of Work*. This Closure Plan is also responsive to the existing ROD referenced in the AOC3 text quoted above, which is NDEP’s *Record of Decision, Remediation of Soils and Sediments in the Upper and Lower Ponds at the BMI Complex* (November, 2001). BRC has endeavored to limit the extent of technical detail in this Closure Plan – in an effort to improve its readability, accessibility, and to keep the document to a

¹ Periodically, this document will reference other project documents that have been or are being prepared to achieve the goals of this closure effort. While some of these documents have been approved and are, thus, final, others are in development. These latter documents will always be referred to as “Draft” in this Plan. The inclusion of such Draft documents in this Plan does not in any way imply NDEP concurrence or approval of such documents – rather, these references are simply in order to create a manageable narrative.

² AOC3, §1.9

manageable length. Technical details are to be found in the various documents referenced in this Plan.

This revision of the Closure Plan (Revision 1) incorporates NDEP comments dated January 18, 2007 on the August 2006 BRC Closure Plan, as well as a completely re-written Section 4, based on a meeting between BRC and NDEP to review these comments. All NDEP comments and BRC's response-to-comments on the August 2006 version of the Closure Plan are provided in Appendix A. As discussed with and requested by the NDEP, detailed responses to each of the Section 4 comments are not provided at this time. However, included in Appendix A is a redline/strikeout version of the text showing the revisions from the August 2006 version of the Closure Plan. Because of the substantial revisions to Section 4, redline/strikeout for this section is based on the revised draft version commented on by NDEP on March 21, 2007.

The Closure Plan contains the history of the Site, its future uses, BRC's characterization and remediation plans with respect to soils and to waters, the objectives and methods of such remediation plans, and various maps, tables, figures and other references as might be useful to the regulator and ~~lay reader.~~ The other stakeholders. This Closure Plan conceptually describes the steps that BRC will undertake to assess risks at the Site and, hence, to make risk-based decisions (including decisions to seek no further action determinations ("NFADs") for discrete parcels within the Site). The term NFAD is defined in the AOC3 in Section XVII. These steps include dividing the Site into discrete exposure areas ("sub-areas"), the identification of possible receptors and pathways, the identification of actual and potentially contaminated media, the definition of risk assessment source terms (such as data collection, and fate and transport modeling), and how risk-based decisions will be made (including the consideration of background data) for the purposes of prompting remediation, determining appropriate uses, seeking NFADs for sub-areas, and Site Closure. In brief, the Closure Plan states why BRC is choosing to progress down certain paths and how BRC is going to proceed through characterization, remediation, and assessment activities to ~~affeteffect~~ Site ~~closure~~ Closure— the ultimate aim of the AOC3.

The Site is near the ~~Basic Management, Inc. (BMI)~~ Industrial Complex, in Clark County, Nevada, approximately 13 miles southeast of Las Vegas and two miles northeast of the City of Henderson's downtown. The property represents what is known as the BMI Common Areas; as noted above, the total extent of the Site is approximately 2,690 acres and is ~~comprised of the "Eastside Area" of approximately 2,321 acres located~~ composed of the properties east of Boulder Highway ~~and the (2,287 acres), the Parcel 9 area west of Boulder Highway (34 acres), and the~~

Parcel 5/6 and CAMU Area west of Boulder Highway (369 acres). For ease of use, the term “Eastside” area will be used to denote the areas east of Boulder Highway as well as the Parcel 9 area, which is located immediately adjacent to and west of Boulder Highway. The proposed Corrective Action Management Unit (CAMU)³ area of approximately 114 acres ~~lies~~ within the 369 acre ~~Parcel 5/6) to the portion~~ west of Boulder Highway.⁴

The Site consists of:

- land on which unlined wastewater effluent ponds (and associated conveyance ditches) were built and into which various industrial plant wastewaters were discharged from 1942 through 1976 (see Figure 1-2);
- land on which lined wastewater effluent ponds were constructed and into which effluent from the Titanium Metals Company Corporation (TIMET) plant was discharged from 1976 to 2005 (see Figure 1-2);
- land on which the City of Henderson constructed municipal wastewater rapid infiltration basins (“RIBs”— see Figure 1-2);
- land which BMI conveyed to the City of Henderson and upon which the City of Henderson is presently building a wastewater treatment plant (the Water Reclamation Facility [WRF])— see Figure 1-2);
- land on which unlined wastewater effluent ponds were constructed but which were either never used or rarely used (see Figure 1-2);
- ~~land which was used for landfills; and,~~
- land which appears never to have had ~~no~~ historical use (see Figure 1-2); and
- land which was used for private, industrial landfills (see Figure 1-3).

The Eastside portionArea of the Site is shown in Figure 1-~~12~~ and the CAMU portionArea of the Site is shown in Figure 1-~~2,3~~. Figure 1-~~12~~ shows the various sub-areas into which the Eastside

³ The proposed CAMU is a lined and capped landfill into which the contaminated ~~solids, soils and sediments, sediment, sludge, etc.~~ from the Eastside Area will be placed and interred.

⁴ ~~The Eastside area also includes, for ease of reference the portion of land called “Parcel 9 South” which is actually located immediately adjacent to and west of Boulder Highway.~~

Area has been sub-divided for purposes of focusing the processes of exposure identification, remediation, and, later, development purposes. The rationale for this subdivision is discussed in Section 4. Note that two sub-areas in the Eastside Area are not subject to soils remediation under the AOC3: these are the WRF sub-area, which is owned by the City of Henderson, and the “No Further Action (NFA) Areas” sub-area, which is owned by the Landwell Company. ~~Groundwater and vadose zone contamination, as might exist under these sub-areas are still subject to the AOC3 and will be remediated, as necessary by BRC. The CAMU area is not slated for further development.~~As noted above, Figures 1-1 and 1-2 also depict the geographic relationship of the Site to the cities of Henderson and Las Vegas. Figure 1-~~3-1~~1 shows both the Eastside and CAMU areas as well as other significant features such as the BMI industrial plants, neighboring land uses, historic conveyance ditches, and the like. The Eastside Area is within the City of Henderson’s boundary; the CAMU Area is within Clark County. Further detail and maps of the Site are found in Section 4 of this Closure Plan and in the ~~Draft~~NDEP-approved *Corrective Action Plan* (~~submitted to NDEP and presently under review by the NDEP~~BRC 2006a).

The CAMU Area has also been sub-divided for ease of discussion into various sub-areas more fully described in the Draft CAMU Area Conceptual Site Model (Daniel B. Stephens & Associates, Inc. [DBS&A] and BRC 2007) and in the Remedial Action Plan (BRC 2006b), under review by the NDEP. The CAMU sub-area will not be developed (except to contain the CAMU); however, adjoining parts (known as Parcel 5/6) may be redeveloped.

All media—soils, air, and groundwater—are covered by the AOC3. Groundwater and vadose zone contamination, as might exist under the two sub-areas that have been granted NFAs with respect to soils are still subject to the AOC3 and will be remediated, as and if necessary by BRC, to achieve the purpose of the AOC3, which is overall Site Closure.

Over the past 15 years, a multi-phased investigation has been conducted by BRC and others under the oversight of the NDEP to identify the hydrogeology of the Site and the nature and extent of chemical occurrences⁵⁴ in the Site soils and groundwater. This investigation is continuing. Results of the studies conducted to date have been used to construct two Conceptual Site Models (CSM) - one for the Eastside Area and one for the CAMU ~~area~~Area. Section 4 of this Plan contains a summary of ~~the Eastside CSM. BRC is also preparing both CSMs. After completion of several investigations in the planning stages or underway, BRC will also prepare a~~

⁵⁴ The term chemical (as in chemical occurrence and chemical concentrations), as used in this sentence and throughout the remainder of this Closure Plan, refers to various organic and inorganic compounds. A complete list of all Site Related Chemicals (SRC) is provided in Section 3 of this Closure Plan.

more detailed *Draft Eastside Conceptual Site Model* which will contain additional technical detail beyond what has been presented in summary fashion in Section 4 of this Plan. ~~This Plan does not contain a similar summary of the CAMU area CSM since the CAMU area is not slated for further development. However, BRC is in the process of preparing for the Eastside Area. BRC has prepared~~ a separate *Draft CAMU-Area Conceptual Site Model document*, which ~~will be~~ has been provided to NDEP for review. NDEP has provided comments, and this document will be revised as needed in the future.

1.1 CLOSURE PLAN GOAL

The goal of the Closure Plan is to execute the provisions of the AOC3 such that remediation of the Site results in ~~post Determination (that is, post No Further Action Determination (NFAD))~~ chemical concentrations in Site media which:

1. Do not pose an unacceptable risk to human health and the environment under anticipated future uses, including residential use in the Eastside Area; or
2. Are representative of background conditions at the Site.

Because the owner of the Site plans to redevelop the Eastside Area according to a master-plan which includes residential, commercial, and civic uses, BRC has chosen to use the U.S. Environmental Protection Agency (USEPA) residential standard as the human health risk standard for the Eastside ~~of the Site~~Area, recognizing however that there may be portions of the Eastside Area in which this standard cannot be achieved. Should this occur, BRC will discuss alternative USEPA risk standards with the NDEP for those portions of the Eastside Area so affected.

The CAMU sub-area will be the permanent location ~~of~~ for the remediation wastes from the Upper and Lower Ponds and associated conveyance ditches. These wastes will be interred in the proposed CAMU. After construction of the CAMU, this sub-area will essentially include the CAMU and the older Slit Trenches and the closed BMI Landfill. Appropriate long term monitoring will be conducted in this area as required by the NDEP. Details concerning the CAMU are found in the ~~*Draft Remedial Action Plan, presently under revision by BRC and to be re-submitted to NDEP in September 2006. Any NFAD requested by BRC for this area will be to appropriate industrial or commercial standards*~~ Remedial Action Plan (BRC 2006b).

1.1.1 Human Health Protection

For human health protection, BRC's goal is to remediate the Eastside ~~area Site soils~~Area sub-areas such that they are suitable for residential uses, assuring health protective conditions at unit 1/8th-acre exposure areas. The 1/8th-acre area corresponds to the size of a typical residential lot size, as presented in USEPA's 1989 *Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual (Part A)* (RAGS). There are only two exceptions to this general goal of residential end use in the Eastside Area, specifically, the "~~No-Build~~Trails & Recreation" sub-area (see Figure 1-12), and, ~~as previously discussed~~, the WRF sub-area.

Risk level and cleanup goals consistent with USEPA precedents and guidelines for residential uses have been established and ~~will be~~are discussed in Section 9 of this Plan.

1.1.2 Protection of Groundwater Quality

Characterization and, if necessary, subsequent remediation of groundwater is specified by the AOC3 for the entire Site. Certain groundwater characterization work has been completed by BRC in 2004 (Eastside Area) and 2005 (CAMU Area)⁶⁵; certain work is on-going (*e.g.*, quarterly groundwater monitoring in the Eastside Area; analyses and the construction of a Eastside Area-wide hydrological model); and certain work is planned in the near-term (*e.g.*, determination of upgradient groundwater conditions; aquifer testing, etc.). While the 2004 and 2005 investigations (along with investigations of groundwater conditions by other neighboring property owners) have provided a foundational understanding of groundwater under the Site, data gaps remain. Major data gaps are discussed in Section 4. As further data are collected to close these data gaps, these data will be added to the characterization of groundwater in the respective CSMs, which are intended, like all CSMs, to be "living" documents. Once the groundwater is characterized sufficiently under the Eastside Area and under the CAMU ~~area~~Area, in accordance with the AOC3 BRC will prepare appropriate Remedial Alternatives Study (RAS) documents and submit these to the NDEP for its review. If remediation is necessary of the groundwater(s), such will be performed by BRC, all in accordance with the provisions of the AOC3.

⁶⁵ The details of these investigations will be contained in the respective Draft CSMs being prepared for the Eastside and CAMU areas.

1.1.3 Ecological Receptors

~~Field assessments of ecological resources at the Site have identified the No-Build sub-area of the Eastside (Figure 1-1) as containing potentially sensitive ecological resources. However, no endangered species (flora or fauna) have been found. Policy and guidance regarding ecological assessment are being formulated by the NDEP, and definitive plans for applying such assessment to the No-Build sub-area are pending this guidance. With this caveat, Section 10 of this Closure Plan provides additional discussion regarding ecological assessment of the No-Build sub-area.~~

BRC has assessed ecological resources for the Site as a whole and arrived at the conclusion that there are no significant ecological resources present that will be adversely affected by the proposed development. In particular, BRC has evaluated such resources for the sub-area known as the Trails & Recreation sub-area whose development plans have evolved over time. BRC provided the NDEP with substantial documentation during a January 3, 2007 meeting to explain the development plans for this sub-area. These plans indicate that the Trails & Recreation sub-area will receive a substantial amount of fill material and development after remediation is complete. The NDEP believes that these developments do not constitute suitable habitat and hence an ecological risk assessment is not necessary. As noted in Section 10 of this Plan, an ecological risk assessment work plan will be developed if and when impacts and receptors are identified. For example, if it is discovered that off-Site impacts are adversely affecting ecological receptors it may be necessary to develop an ecological risk assessment work plan.

1.2 DOCUMENT ORGANIZATION

Based on suggestions provided by the NDEP to BRC,⁷⁶ this Closure Plan contains the following sections:

1. Introduction
2. Site History
3. Site Related Chemicals List
4. Eastside ~~Conceptual Site Model~~Area CSM: Overview
5. Data Verification and Validation Reports

⁷⁶ See Part I Comments from the NDEP to BRC (NDEP, July 11, 2005).

6. Data Usability Evaluations
7. Data Quality Objectives, including Principal Study Questions
8. Remedial Alternative Studies
9. Risk Assessment Methods – Human Health
10. Risk Assessment Methods – Ecological

As noted earlier, per the Scope of Work in the AOC3, there are a number of other, free-standing plans pertinent to the characterization and remediation of the Site. A list of these documents and their current status is provided in Table 1-1.

1.3 ITERATIVE APPROACH TOWARD CLOSURE

The characterization, remediation, and assessment processes stipulated in the AOC3 are designed to lead to determinations, by sub-area in the Eastside Area, of no-further action with respect to Eastside Area soils, determinations(s) of no-further action with respect to Site groundwater(s), and ultimately to Site Closure. These determinations will be risk-based. In other words, the decision endpoint in each case is a risk assessment. The processes are specified and depicted in the Scope of Work of the AOC3 and are purposefully iterative in order to achieve a robust and defensible risk assessment result. For example, it can be stated here that the processes leading to determinations of no-further action in the Eastside Area soils contain ~~two~~ an iterative ~~loops~~ loop (Figure 1-4). In the ~~inner~~ loop, at a given stage of remediation, risk assessment will not be initiated unless proper data sufficiency, representativeness, and adequacy analysis is first achieved. If necessary, additional data will be gathered or analyzed to meet the goals of data quality required for risk assessment. ~~In the outer loop, once~~ The risk assessment will, in turn, help to assure that these data characteristics are properly evaluated. Once risk assessment is completed, the assessment will be made as to whether the remediation conducted meets cleanup goals. If cleanup goals are not achieved, additional remediation, ~~characterization~~ associated confirmation sampling, and assessment cycles will be conducted until a decision end point is reached – namely that the cleanup goals are either met ~~or proven infeasible~~ (and the NFAD is issued or Site Closure is achieved, as the case may be) or proven infeasible because it is technically impractical or too costly, in which case changes in land use or institutional controls may be considered.

Thus, Figure 1-4 shows the overall sequence of steps that will be taken in order to effect Site closure. This sequence will generally be followed by BRC, and any changes to this sequence that may become necessary will only be made with NDEP concurrence.

1.4 PROJECT ROLES AND RESPONSIBILITIES

~~Specific roles and responsibilities have been defined for key project personnel to ensure that project goals are achieved. Each defined role will be performed by a responsible, qualified individual. Roles and responsibilities defined for this phase of the project are as follows:~~

- ~~• The Project Program Manager (Specific roles and responsibilities have been defined for key project personnel to ensure that project goals are achieved. Each defined role will be performed by a responsible, qualified individual. These roles include the Project Program Manager, the Risk Assessment Task Manager, the Hydrogeology Characterization Task Manager, the Project Statistician, and the Construction Manager. The Project Program Manager is Dr. Ranajit (Ron) Sahu, C.E.M., BRC) who is responsible for the successful and timely completion of the specified activities. The Program Manager is responsible for assuring that all policies and procedures set forth in the project plans are followed by the project team. Details of team functions and curricula vitae are found in BRC's most current *Soil and Groundwater Clean-Up Team Professional Profiles*, which is submitted to the NDEP on a periodic basis.~~
- ~~• The Data Acquisition Task Manager (DATM) (Dr. Ranajit (Ron) Sahu, BRC) is responsible for implementation of the various sampling activities, to ensure technical adequacy and defensibility of data collected for closure, and for interpretation of results associated with sampling events.~~
- ~~• The Risk Assessment Task Manager (Mr. Mark Jones, MWH) is responsible for implementation of risk assessment activities described in the Closure Plan, including assessment of data usability for risk assessment purposes. The Risk Assessment Task Manager will be supported by an Ecological Risk Assessment Task Manager (Mr. Mark Shibata, MWH) for ecological risk assessment (ERA).~~
- ~~• The Hydrogeology Characterization Task Manager (Dr. Stephen Cullen, Daniel B. Stephens & Associates, Inc. [DBS&A]) is responsible for directing the technical approach and interpretation of results associated with hydrogeologic investigations at the Site (DBS&A) and BRC. 2007. Draft CAMU Area Conceptual Site Model.~~

- ~~The Data Manager (Mr. Ken Kiefer, MWH) is responsible for establishing and maintaining an accurate and representative, comprehensive Site-wide database (using MS Access), suitable for risk assessments and data query and depiction.~~
- ~~The Project Chemists (Ms. Jackie Luta, ERM and Ms. Kursti Runkle, MWH) are responsible for coordination with project laboratories for implementation of sampling activities, and ensuring that data review and validation for analytical results obtained during Site characterization are properly performed and integrated into the data pool. They will be supported in the data review/validation effort by various other chemists as well as the specialist chemists at Laboratory Data Consultants (LDC). LDC offers particular expertise in validation of laboratory data.~~
- ~~The Project Statistician (Dr. Shahrokh Rouhani, NewFields) is responsible for constructing and conducting the statistical analyses that will be used to determine the adequacy of data for risk assessment purposes. He will be assisted, as necessary, by Dr. A.K. Singh of the University of Nevada, Las Vegas (UNLV).~~

~~A roster of the BRC project team along with qualifications is filed with the NDEP each year.~~

SECTION 1 REFERENCES

Basic Remediation Company (BRC). 2006a. Corrective Action Plan (CAP) for the Basic Remediation Company (BRC) Common Areas Remediation Project.

BRC. 2006b. Remedial Action Plan (RAP).

Nevada Division of Environmental Protection (NDEP). 2001. Record of Decision, Remediation of Soils and Sediments in the Upper and Lower Ponds at the BMI Complex. Henderson, Nevada. November 2.

U.S. Environmental Protection Agency (USEPA). 1989. Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual (Part A). Interim Final. Office of Emergency and Remedial Response, Washington, D.C. USEPA/540/1-89/002. December.

SECTION 2

2 SITE HISTORY

In 1941, approximately 5,000 acres of empty desert in the southeastern quadrant of the Las Vegas Valley was deeded by the United States for use as the site of what was to become the world's largest magnesium plant, a plant that would play a critical role in World War II. Since that time, parts of the original site have remained industrialized, parts of the site have been used for the disposal of a variety of industrial wastes, parts of the site have been abandoned, parts of the site have been converted to other uses, and some parts have remained virgin desert. Over the past 63 years, more than 80 private and public entities have owned or leased or operated facilities on the original site, engaging in a wide range of commercial enterprises from heavy manufacturing of chemicals and metals to warehousing and distribution. The land's uses and ownership are, in a word, complex. But they are, in large part, known.

The land encompassed by the Closure Plan is owned by only one of the many entities that have been involved at the site since 1941, and although the present owner has never been engaged in manufacturing at the site, it is important to establish the historical context for the site as a whole since this context is crucial to understanding the smaller site that is the subject of the Closure Plan. Accordingly, this section provides an overview of the ownership, manufacturing, disposal, and regulatory histories of the original site.

2.1 SITE OWNERSHIP

2.1.1 United States Government – 1941 to 1949

The United States military, in response to the outbreak of war in Europe in 1939, established a substantial aircraft-purchasing program. Magnesium was a crucial component in aircraft production and, by 1940, the demand for magnesium exceeded the supply.⁸⁷ The government took action to make certain that the available magnesium was being used appropriately. On February 12, 1941, the Priorities Division of the Office of Production Management (OPM) requested magnesium producers to allocate stocks to defense industries. The next day, the OPM gave complete preferential status to defense needs for magnesium over non-defense orders. In May, the OPM added magnesium to the list of critical materials and placed the material under

⁸⁷ Report on Magnesium, p. 8, July 24, 1943. NARA I, RG 46, Box 469, Folder: (General) Magnesium Correspondence. [BR030913-925]

industry-wide control. The OPM issued an “M Order,” making mandatory the curtailment of magnesium for all non-defense uses.⁹⁸

When in late 1940 President Franklin Roosevelt called for the development of a vast “arsenal of democracy,”⁺⁹⁹ Howard Eells, President of Basic Refractories, Inc. (BRI), was one of many industrialists that responded. Mr. Eells formed an alliance with a British company, Magnesium Electron, Ltd. (MEL), which operated a magnesium plant in England and was willing to provide technical support for the construction and operation of similar facilities in the United States.⁺¹⁰

On April 23, 1941, accompanied by Lt. Colonel P. Scheeburger, the Air Corps Chief of the Industrial Planning Section (IPS), Mr. Eells and others affiliated with BRI met with Air Corps personnel and Edgar Lewis, the Special Assistant to the Assistant Secretary of War, and proposed that the company operate a magnesium project.⁺¹¹ BRI personnel prepared a compelling proposal, pointing out that there were three necessary requirements to produce magnesium: (1) magnesium oxide (MgO), (2) chlorine (as a gas), and (3) electric power. Mr. Eells felt that the company’s 30 million tons of magnesite deposits in Nye County and hydroelectric power obtained from Boulder Dam could readily fill the need.⁺¹² He indicated that one of the major problems that existed was a lack of capital.⁺¹³ He proposed construction of a 60,000-ton capacity plant at BRI’s magnesite property in Gabbs as well as a 20,000-ton magnesium plant and a chlorine production facility at a location to be determined. He reiterated that while government funding would be required and assurances regarding patent issues were needed, BRI’s relationship and agreement with MEL eliminated the need for experimentation to develop plant design and production methods.⁺¹⁴ The Air Corps’ Colonel Hopkins and Mr. Lewis referred Mr. Eells to the Reconstruction Finance Corporation (RFC) for funding to be

⁹⁸ Chronological List of OPM Press Releases on Magnesium. NARA I, RG 46, Box 474, Folder: WPB Magnesium. [BR032030-031]

⁺⁹⁹ FDR Speech, December 29, 1940.

⁺¹⁰ “Magnesium,” circa 1943. NARA I, RG 46, Box 478, Folder: Las Vegas Basic Magnesium. [BR032509-561, @ BR032536]

⁺¹¹ War Department Memo # 231, April 23, 1941. UNLV Special Collections, T-6. [BR000607]

⁺¹² Magnesium Project, BRI, April 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009407-430]

⁺¹³ Magnesium Project, BRI, April 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009420]

⁺¹⁴ Magnesium Project, BRI, April 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009421-422]

obtained through its subsidiary, the Defense Plant Corporation (DPC), and told him what needed to be done before approaching the Air Corps engineers.⁺⁶¹⁵

BRI was invited to meet with additional Air Corps and War Department personnel on May 21, 1941, at which time the government requested that BRI study the costs associated with its plan and prepare three proposals—one for a 5,600-ton unit, another for two 5,600-ton units, and a third proposal for three 5,600-ton units. The decision as to whether to proceed on a one-, two-, or three-unit facility was to be referred to the Secretary of War with a recommendation by the Air Corps after consideration of capital and production costs, housing, labor, and power. Other action items were identified and the IPS recommended that the plant location should be referred to Washington for approval by a higher authority.⁺⁷¹⁶

BRI submitted a formal request to the Army Air Service to authorize the project the next day.⁺⁸¹⁷ The Air Corps forwarded the request to the Patent Liaison Branch asking for direction as to making the patents available to BRI. The Air Corps pointed out that “the Under Secretary of War has directed that the setting up of all magnesium production projects be given the highest priority.”⁺⁹¹⁸

Negotiations continued and technicians from England came to the United States to assist.²⁰¹⁹ In the meantime, William Knudsen, Director General of the OPM, wrote to the Under Secretary of War advising that annual magnesium metal capacity required for national defense needed to be increased from 30 million to 400 million pounds. Knudsen stated that companies building facilities “will be requested to immediately change their plans to provide the capacities indicated.”²⁺²⁰

⁺⁶¹⁵ War Department Memo # 231, April 23, 1941. UNLV Special Collections, T-6. [BR000607]

⁺⁷¹⁶ War Department Memo # 255, May 17, 1941. UNLV Special Collections, T-6. [BR000945] PS, Notes on Basic Refractories, May 21, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010507-512]

⁺⁸¹⁷ Eells to Assistant Chief, Materials Division, May 22, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010497-498]

⁺⁹¹⁸ P. Schneeberger to Chief, Patent Liaison Branch, May 28, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010484-485]

²⁰¹⁹ P. Schneeberger to Basic Refractories, June 9, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010462]

²⁺²⁰ Frederick Hopkins to Chief, Industrial Planning Section, June 10, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010452] See also Chronological List of OPM Press Releases on Magnesium. NARA I, RG 46, Box 474, Folder: WPB Magnesium. [BR032030-031]

By June 12, BRI submitted a detailed plan for three proposals in which BRI also recommended construction of a magnesium refining plant. At the meeting, the IPS told BRI that it needed to apply for priority assistance with the OPM so that the company would be able to obtain steel and machine tools. BRI again reiterated its need for working capital. The government requested that BRI furnish a statement regarding assurance that MEL would provide advice and assistance in the plant construction and operation. BMI told IPS that it would form a subsidiary with ownership shared by BRI and MEL. The subsidiary was to be the lessee for the DPC lease that would be negotiated.²²²¹

That same day, Colonel Schneeberger sent a telegram to the Air Corps Facilities Section that the IPS was “definitely assured” that BMI would receive necessary assistance from the British technicians, as well as all designs, plans, drawings, specifications, and process information needed to construct and operate the facility. The Air Corps Experimental Engineering Section was convinced that the plans were sound and approved the proposed installations. Colonel Schneeberger commented on the swiftness that BRI was able to produce plans to increase the size of the project, which had grown from a maximum capacity of 33.6 million to 112 million pounds.²³²²

On June 23, 1941, MEL documented its commitment to provide the drawings and information needed to construct the plants, and that it would send trained personnel and staff needed to operate the facility. The only caveats were that BRI had to obtain a “complete indemnity” from the United States government against any patent infringement action and the British Air Ministry had to agree to allow the technical staff to leave England.²⁴²³ The proposed Basic Magnesium plant was intended to be a duplicate of the British plant²⁵²⁴ and was subject to patents assigned to Magnesium Development Company.²⁶²⁵

²²²¹ PS, Notes of Basic Refractories, June 12, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010315-317]

²³²² Telegram, Industrial Planning Section, June 12, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010352-359]

²⁴²³ C.J.P. Ball, to H.P. Eells, June 23, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010350]

²⁵²⁴ Metallurgical Operations at Basic Magnesium Inc. April 23, 1942, p. 1. NARA II, RG 234, Entry 1065, Box 102, Metals Reserve Company Contract File 1940-1955. [BR004804]

²⁶²⁵ See for instance, Inter-office Memorandum to Chief Patent Liaison Office, June 16, 1941 and attached list of patents. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010421-424] Basic Magnesium and Magnesium Development entered into a license agreement in or about December 1941. Reuben T. Carlson, DPC to Marvin Braverman, April 24, 1942. NARA II, RG 234, Entry 1065, Box 102, Metals Reserve Company Contract File 1940-1955. [BR004811]

Final negotiations continued with a conference held on July 22 to work out details of agreement and compensation terms,²⁷²⁶ a request by the Air Corps for additional information regarding land improvements on July 23,^{2823,27} and a meeting with the RFC regarding mining claims on July 24. RFC wanted assurance that there were at least 12 million tons of ore in the claims to be leased to the government.²⁹²⁸

On August 1, 1941, after nearly five months of talks, negotiations with the DPC culminated. Basic Magnesium Inc., (which was formed by BRI and MEL) and the DPC entered into an agreement for the construction and operation of the magnesium facilities, which were designated Plancor ~~201.~~³⁰201.²⁹

Finally authorized, the project gained momentum. On August 4, the War Department informed the DPC that it would reimburse the DPC for the acquisition and installation of the plant facilities³¹³⁰ and several days later the DPC approved Basic Magnesium's request to purchase \$9.5 million of electrical equipment.³²³¹ By August 18, the DPC, Bureau of Reclamation, and Basic Magnesium conferred and agreed that DPC would buy water and power services at Lake Mead and Boulder Dam and would construct water lines, power lines, and transformer stations from Lake Mead and Boulder Dam to the plant site, which was to be located southeast of Las Vegas, then a small railroad watering station. The DPC agreed to negotiate power and water contracts, and that power to Gabbs would be provided by constructing a transmission line some 60 miles to connect the plant site to the California Electric Company power system at Millers, Nevada.³³³²

The DPC assigned an engineer to the project, whose general duties included authorization to approve plans, designs, specifications, and construction schedules for the construction of the plant. The DPC engineer was also responsible for approving vendor bills and to oversee the acquisition and installation of machinery and equipment. He was authorized to approve

²⁷²⁶ Memorandum of conference, July 22, 1941. UNLV Special Collections, T-6. [BR000907]

²⁸²⁷ P. Scheeberger to D.W. Stewart, BRI, July 23, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009274]

²⁹²⁸ Memorandum of conference, July 24, 1941. UNLV Special Collections, T-6. [BR000904-906]

³⁰²⁹ Agreement, August 1, 1941. NARA II, RG 72, Entry 147, Box 13, Folder: Basic Magnesium. [BR004860-870]

³¹³⁰ Robert Patterson to DPC, August 4, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010246-248]

³²³¹ P. Schneeberger to Chief, Facilities Section, Materiel Division, August 13, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009938-939]

³³³² D.W. Stewart to Assistant to Chief, Materiel Division, August 18, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009933-935]

contractors employed by Basic Magnesium, as well as the contracts entered into in conjunction with the construction program.³⁴³³

By September 11, the Reclamation Service of Department of Interior made arrangements to buy the power needed for the magnesium plant from the Metropolitan Water Company. After survey and consultation by the engineers of the Reclamation Service, a preliminary "Appendix A" for the magnesium plant was drafted, indicating that a new site had been selected for the magnesium plant.³⁵³⁴

Mr. Ells stated that Basic Magnesium was short of technical personnel and preparation of a complete Appendix A "would necessitate a long delay in beginning the project." Perhaps given the urgency of the wartime situation in Europe and the American military's pressing need to rearm and modernize, Colonel Schneeberger advised he would authorize the project anyway.³⁶³⁵

Colonel Schneeberger followed up with a memo to the Air Corps Facilities Section explaining why the project should not follow usual procedure.³⁷³⁶ The Chief of the Facilities Section forwarded the request to the War Department. The War Department concurred that complying with procedure would probably result in a delay, but felt that the decision was up to the Air Corps.³⁸³⁷ The Facilities Section was willing to grant Colonel Schneeberger and the IPS authority to proceed with the final approval of the project if the DPC concurred.³⁹³⁸ The DPC sent IPS a telegram, stating that it would accept the Air Corps' commitment without preparation of a

³⁴³³ W.L. Drager to Basic Magnesium, October 31, 1941. UNLV Special Collections, T-6. [BR001027] Lewis E. Ashbaugh was appointed on September 4, 1941 and was replaced by Ralph Adams on October 31, 1941. By October 12, 1942, there were twenty-two DPC employees working at the Basic Magnesium plants. In addition, ten Basic Magnesium employees were assigned specifically to assist the DPC staff. See: Personnel, Salaried Employees, Defense Plant Corporation, as of October 12, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming. [BR006429]

³⁵³⁴ D.A. Graham, Notes on Basic Magnesium, September 11, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009911-912]

³⁶³⁵ D.A. Graham, Notes on Basic Magnesium, September 11, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009911-912]

³⁷³⁶ P. Schneeberger to Chief, Facilities Section, Materiel Division, September 13, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009902-903]

³⁸³⁷ Edgar Lewis to W.F. Volandt, September 20, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009890]

³⁹³⁸ Letter to W.L. Drager, DPC, September 23, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009878]

detailed Appendix A, but that one would be required when the construction was close to completion.⁴⁰³⁹

The sheer magnitude of the project called for extraordinary planning and organization skills.

- Land acquisition arrangements had to be made.
- The plant site was barren desert.
- There was no water at the site. A large water supply line had to be installed from Lake Mead over mountains and some 20 miles to the plant site.
- There was no power at the site. Dual power lines were required from Boulder Dam to the facility.
- There were no local services. Houses, schools, hospital, stores, markets, post office, fire department, churches, sewage facilities, and the like all had to be built.
- The facilities to extract and process ores so that the magnesium plant would have the raw material needed had to be constructed.
- A means to transport the ores from Gabbs to the magnesium plant had to be decided.
- The magnesium production facilities themselves had to be built. These would encompass a massive complex approximately two miles in length, and which would include a chlorine plant, preparation plant, chlorination plant, metals recovery plant, and an electrolysis plant, as well as the support facilities for each.

As it turned out, Colonel Schneeberger's decision to approve the project without a completed Appendix A had far-reaching implications. The DPC typically used the Appendix A to ascertain the soundness of the project plan, check for items overlooked in the planning phase, see if costs were over- or underestimated, and ultimately as a tool to watch over the government's investment. Under normal circumstances, after the project was authorized, the contractor would provide a fully completed Appendix A with its costs substantiated. The Appendix A would be updated as necessary as expenditures were made, and the DPC could readily track the progress of the project and identify any potential problems. Without an Appendix A and a competent

⁴⁰³⁹ John W. Synder, Executive Vice President, DPC, to Major J.L. Bowling, December 2. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009557]

operator, mistakes, such as those which were to occur with the magnesium plant's waste effluent system, occurred.

For example, a summary of anticipated costs provided to the IPS on August 1, 1941, included \$204,000 for a waste or "trade" effluent drainage system.⁴⁴⁴⁰ However, in March 1942, it was "suddenly" discovered that no design work had been done to provide adequate facilities for trade effluent disposal. Basic Magnesium's engineers decided to ask the MEL consultants to investigate the problem.⁴²⁴¹ A neutralization plant was designed that was supposed to provide an adequate area to allow for the evaporation of a volume of 5,000 gallons of effluent per minute. However, an error was made in the calculations and the neutralization plant was only one-tenth of the size actually required. Additional waste disposal ponds had to be constructed. To compound the problem, H.C. Mann, the Project Manager, ordered the immediate construction of the ponds—which ultimately encompassed approximately 1,670 acres—and another miscalculation was made. The person making the calculations made "one very bold assumption...which was decidedly in error as later experience has proved. He assumed that there would be no underground percolation."⁴³⁴²

Acquisitions

The site selected for the magnesium plant was situated in the barren desert approximately 13 miles southeast of Las Vegas, Nevada. (See Figures 2-1 and 2-2). The federal government already owned a substantial amount of land in proximity to the selected site. That federal land was withdrawn from entry and made available for use to the DPC for the plant site and for future use if needed. Basic Magnesium deeded the state and private land that it had previously acquired to the DPC on November 27, 1941.⁴⁴ 1941.⁴³ The land holdings acquired by the government are depicted in Figure 2-3.

Construction on the project began on September 15, 1941, before all of the land had been officially deeded. Within 3 weeks, the first cost increase request was submitted to the

⁴⁴⁴⁰ D.W. Stewart to Assistant Chief of Material Division, August 1, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009272]

⁴²⁴¹ S.J. Fletcher, Neutralization of Effluent Liquor, March 13, 1942. UNLV Special Collections, T-6. [BR033898]

⁴³⁴² E.H. Clary, "Trade Effluent," in History of Civil Engineering, October 21, 1944. UNLV Special Collections, T-22. [BR033889-910]

⁴⁴⁴³ Map, Basic Magnesium Site and Vicinity, U-41, Issue No. 6, August 24, 1944. [NARA, San Bruno, RG 121, WAA Property Disposal Records, Box 13] See also F. McComthe to Cliff Young, June 15, 1956. [BR001532-533] Ray Pavey to GSA, August 31, 1954. [BR001516-517]

IPS.⁴⁵⁴⁴ Further problems developed and by November Colonel Schneeberger was informed of “material differences” developing between the American and British personnel and that these differences were delaying the project. In addition, Col. Schneeberger confirmed concern about the purity of the ore deposits at Gabbs and indicated a further survey might be necessary.⁴⁶⁴⁵

Basic Magnesium’s Director of Plant Protection and Chief Investigator informed Air Corps District Planning Office of “irregularities” in the management of the facility, including: lack of organization and responsibility, misuse of company equipment, extravagant use of Government funds, unqualified people hired to fill key positions at high salaries, and abuse of overtime payment.⁴⁷⁴⁶

On the morning of December 7, 1941, Japan attacked the United States naval base at Pearl Harbor, Hawaii. The Congress immediately approved the President’s declaration of war against Japan, and before month’s end, Germany and Italy had declared war on the United States. The Plancor 201 project—already a matter of great urgency—had become critical to the war effort of the United States itself.

By early 1942, the DPC had become dissatisfied with the project’s progress, and an investigation was initiated. One of the individuals who looked into the matter reported back, describing chaos: “The site was cleared before one final drawing had been made. I have seen construction men leaning over [draftsmen’s] shoulders to see the last line drawn; then they’d rush out into the field and put up that much more of it...”⁴⁸⁴⁷ The DPC Supervising Engineer, Ralph Adams, was reportedly not up to the task either, as the investigator noted: “If I ever saw a stupid old fuddy-duddy, it’s Adams. I’d guess that he’s an old-school civil engineer bewildered by a million angles of the most complex scientific project in the world.”⁴⁹⁴⁸

The DPC decided to retain an outside consultant, Coverdale & Colpitts (C&C), to direct, supervise, and coordinate the engineering and construction of the Basic Magnesium facility.

⁴⁵⁴⁴ P. Schneeberger to Chief, Facilities Section, October 7, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009838-841]

⁴⁶⁴⁵ P. Schneeberger, Notes on Basic Magnesium, November 10, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009775]

⁴⁷⁴⁶ E.K. Merritt to Industrial Planning Officer, February 6, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009623-624]

⁴⁸⁴⁷ Paul Harrison to Donn Sutton, February 12, 1942. NARA I, RG 46, Box 477, Folder: Basic Magnesium Notes. [BR032409-417, @ 32411]

⁴⁹⁴⁸ Paul Harrison to Donn Sutton, February 12, 1942. NARA I, RG 46, Box 477, Folder: Basic Magnesium Notes. [BR032409-417, @ 32414]

C&C entered into an agreement with Basic Magnesium on April 9, 1942, and immediately set about trying to get the project back on track.⁵⁰⁴⁹ By May 23, the DPC engineer and auditor had determined that the project was over-committed⁵¹⁵⁰ and, on June 30, when C&C completed its cost estimate for Plancor 201, they informed the IPS that the cost overrun was more than \$20 million. Outraged, the IPS ordered that a conference be arranged with people “competent to discuss the situation at the earliest possible moment to enable this office to take necessary action to protect the government’s financial interest and at the same time avoid delay in completion of the project.”⁵²⁵¹ The conference was held July 3 at which IPS claimed to be shocked to find out that Basic Magnesium appeared “suddenly to be bankrupt.” The company had no funds with which to meet payroll for the week, and it was IPS’ position was that the problem was the DPC’s. IPS personnel, Lt. Colonels Doolan and Shawhan, stated that the “Government might well be forced to install an interim or temporary receiver until the matter was worked out.”⁵³⁵²

Searching for solutions, the Air Corps explored the possibility of forcing Basic Magnesium to abandon the English technology for the chemical processing. The IPS ascertained that the agreement contained no provision concerning the process to be used and told the Air Corps that refusal to authorize or approve the purchase of certain types of equipment was a method that they could use to exert control over processes used at the site. The IPS referred the Air Corps to the DPC for a more definitive answer.⁵⁴⁵³

While the government explored its options on how and where it could find additional funding for the project, relations between C&C and Basic Magnesium deteriorated. In part, Mr. Eells used the imposition of C&C as construction engineers as the catalyst for his position that the “DPC has taken the completion of the construction of this plant out of the hands of Basic Magnesium, Inc., and is proceeding to construct it itself...”⁵⁵⁵⁴ Mr. Eells claimed that C&C’s role was forced

⁵⁰⁴⁹ Letter agreement, April 9, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR008928-932]

⁵¹⁵⁰ Telegraph, Weber to H.P. Eells, May 23, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR008896]

⁵²⁵¹ Teletype Message P. Schneeberger to Col. F.M. Hopkins, July 2, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR008948-949]

⁵³⁵² G.D. Carrington, July 3, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010264-265]

⁵⁴⁵³ A.E. Jones to Acting Chief, Industrial Planning Section, June 30, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR008972]

⁵⁵⁵⁴ G.D. Carrington, July 6, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR010263]

on Basic Magnesium.⁵⁶⁵⁵ he stated, “To show you how sweeping [the DPC’s] responsibility was in the mind of those who directed [C&C’s] appointment, it was stated in one of the meetings in Mr. Husband’s office that I might as well take a holiday.”⁵⁷⁵⁶ On August 15, Mr. Eells pointed out to the War Department that Basic Magnesium lacked the authority and responsibility to fulfill its obligation because C&C did not function as a part of Basic Magnesium’s organization.⁵⁸⁵⁷

Allegations of blame for the cost overruns were in no shortage. The Truman Committee⁵⁹⁵⁸ found that there was “entirely too much dependence placed on the overly optimistic estimates of quality and quantity of the magnesite ore deposits...”⁶⁰⁵⁹ The Committee also commented that BRI’s objective was to commercialize its magnesite deposits and that the company was not acting on patriotic motives to assist in relieving the shortage of magnesium metal.⁶¹⁶⁰

Apparently it was clear to the government that further intervention was required to keep the magnesium project going. The WPB and the DPC approached the Anaconda Copper Mining Company (Anaconda) on August 5, 1942, and implored Anaconda to take over the operations of Basic Magnesium. At this initial meeting, P.G. Spilsbury represented Anaconda. The WPB briefed him on the “background of the proposition ... that Anaconda consider purchasing the controlling interest ... and take over the operation and management” of Basic Magnesium. The WPB then requested that Mr. Spilsbury talk with Sam Husbands, President of the DPC. Mr. Spilsbury spent an hour with Mr. Husbands who spent the time “reviewing the whole situation and begging [Anaconda] to consider taking over management because of the record which we demonstrated and the faith he had in our ability.”⁶²⁶¹ Mr. Spilsbury related the information

⁵⁶⁵⁵ S.P. Brown, Notes on Basic Magnesium, July 8, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR008934]

⁵⁷⁵⁶ H.P. Eells to P. Schneeberger, August 1, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR008810-812]

⁵⁸⁵⁷ H.P. Eells to P. Schneeberger, August 15, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR008763] See also H.P. Eells to P. Schneeberger, September 3, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR008715]

⁵⁹⁵⁸ On March 1, 1941, the U.S. Senate authorized formation of the Committee to Investigate the National Defense Program for the purpose of conducting an inquiry into potential waste and corruption in defense contracts. The committee was commonly known as the Truman Committee.

⁶⁰⁵⁹ Truman Committee findings. NARA I, RG 46, Box 478, Folder: Las Vegas Basic Magnesium. [BR032557]

⁶¹⁶⁰ Truman Committee findings. NARA I, RG 46, Box 478, Folder: Las Vegas Basic Magnesium. [BR032559]

⁶²⁶¹ P.G. Spilsbury to J.R. Hobbins, August 5, 1942. [BML008466] Imperial Chemical Industries owned 48 percent of the MEL stock.

regarding the corporate relationship between BRI and MEL, indicating that Basic Magnesium was a “dummy company set up in response to the suggestion of the RFC.”⁶³⁶²

By mid August 1942, Anaconda had swiftly investigated the development of the Basic Magnesium ore reserves at Gabbs⁶⁴⁶³ and had visited the magnesium plant. Clyde E. Weed, Anaconda’s Vice President in Charge of Mining Operations, summarized his observations to J.R. Hobbins, Anaconda’s President, “I do not believe that the organization, as now constituted, can ever operate a plant successfully, and one of the first jobs would be revamping this organization to make it workable.”⁶⁵⁶⁴ He continued, indicating that if Anaconda were to take over the management of the plant, the company would need to obtain several assurances from the DPC. These assurances included that the DPC would have to agree to provide the money to complete the construction and to make any changes the company considered necessary. Likewise, Anaconda wanted to “be given a free hand in making decisions, as far as engineering goes, without consulting Defense Plant engineers.... We should be given a free hand in the management in order to develop a proper organization.”⁶⁶⁶⁵ Mr. Weed reported that he and Frederick Laist, Anaconda’s Vice President in Charge of Metallurgical Operations, agreed:

1. That magnesium has a future as a metal.
2. That the process as developed will be successful in making magnesium.
3. That the process is subject to improvement in both metallurgy and costs.
4. That this will give us the opportunity to study the magnesium business, and that at the end of the emergency, the Anaconda would be in position to decide definitely whether they wish to remain in the magnesium business.⁶⁷⁶⁶

Mr. Laist summarized his conclusions to Mr. Hobbins, “Acquisition of the controlling interest in Basic Magnesium seems to be an excellent way of obtaining a position in the magnesium business and learning all about it with a minimum of risk.”⁶⁸⁶⁷

⁶³⁶² P.G. Spilsbury to J.R. Hobbins, August 5, 1942. [BML008467]

⁶⁴⁶³ Reno Sales Memorandum to C.E. Weed, August 17, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming. [BR005870]

⁶⁵⁶⁴ C.E. Weed to J.R. Hobbins, August 17, 1942. [YBD13486]

⁶⁶⁶⁵ C.E. Weed to J.R. Hobbins, August 17, 1942. [YBD13487]

⁶⁷⁶⁶ C.E. Weed to J.R. Hobbins, August 17, 1942. [YBD13488]

⁶⁸⁶⁷ Frederick Laist to J.R. Hobbins, August 16, 1942. [BML10204]

Correspondence suggests that the take-over request was a closely held secret while negotiations were underway. On September 1 and 2, Mr. Weed and R.B. Caples, Anaconda's Manager of its Great Falls (Montana) Reduction Plant, met with Mr. Eells in Cleveland regarding the organization and development of Basic Magnesium. Mr. Eells told them that after the DPC installed C&C, the British interests insisted that Major C.P. Ball and H.C. Mann be in charge of running the Basic Magnesium plant. Major Ball brought a staff of six British engineers to Nevada, and forty-five engineers from the plant were sent to England for six months to study the MEL plant operations. Mr. Eells informed the two Anaconda representatives that Basic Magnesium contracted with the DPC to supply all requirements of magnesite from the Gabbs properties at a royalty of \$0.0025 per pound of magnesium produced. He indicated that if another entity operated the plant, the royalty doubled.⁶⁹⁶⁸

Negotiations between Anaconda and the DPC continued to progress, and Anaconda evaluated various options for taking over the operations of the plant.⁷⁰⁶⁹ Reno Sales, Anaconda's Chief Geologist, provided Mr. Weed with mining district maps for the Gabbs area. On September 19, Mr. Weed reported back to Mr. Sales that the maps "came in very handy in our discussion of the Basic Magnesium problems with the DPC. When I have finished with the maps I will return them to you at Butte. We are meeting with the Defense Plant officials again on Monday, and I imagine at that time something very definite will be decided."⁷⁴⁷⁰

On September 28, Mr. Weed wrote to Mr. Sales, "You might be interested to know that the Basic Magnesium set-up is about cleaned up and undoubtedly we are elected to operate the property for the balance of the emergency. Also confidentially, as Mr. Hobbins has not as yet announced it, Frank Case will go there as manager, and Mr. Satterthwaite, Superintendent of the zinc plant at Great Falls, will go there as his assistant."⁷²⁷¹

⁶⁹⁶⁸ R.B. Caples, Memorandum of Visit with Mr. Howard P. Eells, Jr. at Cleveland, Ohio, September 1st and 2nd, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming. [BR006306-310] Regarding royalty, see also "Legal Summary," in Engineer's Final Report, n.d. NARA II, RG 234, Entry 146, Box 114, Folder: DPC Engineers Reports and Appendices, Plancor 201. [BR004114-115]

⁷⁰⁶⁹ Memorandum Summarizing Various ideas respecting the Basic Magnesium setup, September 1, 1942. [YBD15148-154] Letter to C.F. Kelley, September 5, 1942. [YBD15131-135]

⁷⁴⁷⁰ C.E. Weed to Reno Sales, September 19, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming. [BR005879]

⁷²⁷¹ C.E. Weed to Reno Sales, September 28, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming. [BR005878]

Basic Magnesium, BRI, MEL, and Anaconda came to an agreement on September 30, 1942.⁷³ 1942.⁷² The DPC agreed to purchase the mining claims in Nye County for \$450,000 and Anaconda agreed to pay \$75,000 for 52,500 shares of Basic Magnesium stock.⁷⁴ 73 The take-over was not made public knowledge until the end of October, when the Secretary of Commerce issued a press release.⁷⁵ 74 The next day Cornelius F. Kelly, chairman of Anaconda's board and chief executive officer of the company, issued a statement that Anaconda's participation in the enterprise "has been undertaken at the invitation of the government and of the English and American interests in Basic Magnesium. Our function is that of management...without responsibility [for what] has occurred prior to our taking over and is undertaken for the purpose of doing what we can at the request of all the interested parties to aid in the war effort."⁷⁶ 75 On November 30, 1942, the Air Corps Facilities Section was informed that it was "officially confirmed that Anaconda own[ed] controlling interest in BMI."⁷⁷ 76 Filings with the Nevada Secretary of State's office reveal that Anaconda representatives, including J.E. Hobbins, Frederick Laist, C.F. Kelly, C.E. Moran, W.K. Daly, J.H. Quayle, Jr., and F.M. Brynes, had become officers and/or directors of Basic Magnesium.⁷⁸ 77

The effects of Anaconda's involvement and expertise were readily apparent. For instance, personnel set about determining changes to the organization and processes used that would save money and/or materials at the magnesium plant in Henderson. One of the first steps taken was to remove the English engineers from supervisory positions and thereafter they functioned solely as consultants.⁷⁹ 78 Major process improvements were made after Anaconda assumed control of Basic Magnesium, including the elimination of peat from the flow sheet,⁸⁰ 79 reducing the chlorine consumption, and reclaiming some of the by-products—particularly cell melt and

⁷³ 72 Agreed upon procedures, September 30, 1942. [YBD15102-106]

⁷⁴ 73 Excerpt from Minutes of Meeting of Board of Directors of Basic Refractories, October 20, 1942. [YBD15642-646]

⁷⁵ 74 Press Release, RFC 1679, October 26, 1942. NARA I, RG 46, Box 473, Folder: Basic Magnesium D.P.S. Files Rev. [BR031838] See also W.H. Hoover, General Counsel to Richard Inglis, Hauxhurst, Inglis, Sharp & Cull, October 19, 1942. [YBD15737-044]

⁷⁶ 75 "ACM Acquires Interest in Basic Magnesium Inc." *Great Falls Tribune*, October 27, 1942. [BR006300]

⁷⁷ 76 Jesse Bowling to G.H. Moriarty, December 3, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR008663-664]

⁷⁸ 77 Officers, Directors, and Designation of Resident Agent, June 14, 1943. Nevada Secretary of State. [BR039135]

⁷⁹ 78 Roy E. Thomas, Chief Engineer, April 30, 1945. UNLV Special Collections, T-6. [BR008015]

⁸⁰ 79 Satterthwaite to R.B. Caples, Manager, ACMC, Great Falls, MT, April 17, 1943. Anaconda Document Collection, American Heritage Center, University of Wyoming. [BR006273-274]

chlorinator cleanings.⁸¹⁸⁰ In testimony presented to Congress, Basic Magnesium personnel claimed that over \$1.1 million had been saved through “improvements that have been made or suggested since Anaconda took over the management....”⁸²⁸¹

Anaconda worked diligently with the Air Corps to eliminate items not essential to the operation of the Basic Magnesium facility and to keep construction costs as low as possible. As a part of its on-going assessment of funds expended and anticipated to be spent, Wilbur Jurden, Anaconda’s Chief Engineer, wrote to Major J.L. Bowling of the Army Air Corps, requesting additional funding for emergency construction items essential to bring the plant to its full capacity and to ensure its continued operation.

Additional waste disposal ponds were among these emergency facilities:

The tailings water from the plant contains considerable impurities and injurious chemicals and we are not allowed to let any of this water drain into the Las Vegas Gulch from whence it would go into Lake Mead. Results of operations to date have shown conclusively that the effluent ponds already constructed are inadequate and unless these additional ponds are constructed and quickly, we may find ourselves faced with a curtailment of production due to the inability to dispose of the effluent water and as production of magnesium is rapidly increasing this situation is becoming worse.⁸³⁸²

Construction of the effluent ponds began between December 7 and 29, 1942. By April 19, 1943, the ponds had been completed and were in use.

The first metallic magnesium production at the Basic Magnesium plant occurred on August 31, 1942. The plant was in full production by July 12, 1943, and by the end of July 1943, the plant was producing at 110 percent of capacity.⁸⁴⁸³ On April 8, 1944, the War Production Board

⁸¹⁸⁰ Investigation of Industrial Centralization (Basic Magnesium Plant), Hearings before a Special Committee, 78th Congress, Second Session, Part 5, November 27 and 28, 1944, pp. 457-458, containing text of letter from H.G. Satterthwaite to F.O. Case, November 23, 1944. [BR038409-410]

⁸²⁸¹ Investigation of Industrial Centralization (Basic Magnesium Plant), Hearings before a Special Committee, 78th Congress, Second Session, Part 5, November 27 and 28, 1944, pp. 457-458, containing text of letter from H.G. Satterthwaite to F.O. Case, November 23, 1944. [BR038409-410] An extensive list of cost saving efforts and improvements after Anaconda took over are detailed on pages 457-476 of the hearing transcript. [RB038409-422]

⁸³⁸² Wilbur Jurden, Chief Engineer, Anaconda, to Major J.L. Bowling, Production Division, DPC, April 21, 1943. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B. [BR009535-545, see BR009540-541 for evaporation pond line item.] Construction of the ponds was completed prior to the submission of the funding request.

⁸⁴⁸³ Final Engineer’s Report, Part “C” – Historical. NARA II, RG 234, Entry 146, Box 114, Folder: DPC Engineers Reports and Appendices. [BR004127]

(WPB) ordered Basic Magnesium to curtail production. Between April 20 and May 13, 1944, four units were shut down. On July 26, the WPB ordered a further curtailment with two more units to be shut down. Operations ceased at two more units in October, and by November 15, the remainder of the plant shutdown. The magnesium operations at Henderson ceased “after 807 days of continuous operation” and after having produced 166,322,685 pounds of marketable refined or alloyed magnesium ingots, billets, or slabs.⁸⁵⁸⁴ Production of by-products from August 1942 to November 1944 was:⁸⁶⁸⁵

Liquid chlorine	15,843 tons
Caustic soda	45,314 tons
Flux	1,287 tons
Magnesium chloride	735 tons

Basic Magnesium’s efforts under Anaconda’s control were an extraordinary accomplishment. Frank Case, who had been appointed by Anaconda to serve as General Manager for Basic Magnesium, explained that they strove to make it a viable concern: “We [the management staff] as a group are very optimistic now about our chances of making [Basic Magnesium] a commercial success; a company that can compete with the Dow Company – we might just as well be outspoken about it...”⁸⁷⁸⁶

However, with the demand for magnesium declining, Anaconda decided that it did not want to acquire the Basic Magnesium site,⁸⁸⁸⁷ and the DPC therefore engaged J.M. Montgomery & Co., Inc. to supervise the overall management of the facilities.⁸⁹⁸⁸ The Operating Agreement between

⁸⁵⁸⁴ A Chronological History of Basic Magnesium, November 16, 1944. Anaconda Document Collection, American Heritage Center, University of Wyoming. [BR033096-098]

⁸⁶⁸⁵ Investigation of Industrial Centralization (Basic Magnesium Plant), Hearings before a Special Committee, 78th Congress, Second Session, Part 5, November 27 and 28, 1944, pp. 518-519. [BR038446] Production was given in terms of sales and shipments.

⁸⁷⁸⁶ Hearing of the Sub-Committee on Light Metals and Aviation of the Special Committee Investigating the War Program, May 11, 1943. NARA I, RG 46, Box 478. [BR032165-166]

⁸⁸⁸⁷ Imperial Chemical Industries to J.R. Hobbins, July 12, 1945. [BML1172-173] The letter refers to Anaconda’s loss of interest in magnesium. Anaconda purchased MEL’s shares in Basic Magnesium and the company continued to exist until Anaconda dissolved it in November 1974. Consent to Dissolution, November 14, 1974. Nevada Secretary of State. [BR039210]

⁸⁹⁸⁸ Agreement, May 14, 1945. NARA II, RG 72, Entry 147, Box 13, Folder: Basic Magnesium Plancor 201. [BR004907-913]

DPC and Basic Magnesium was terminated on May 16, 1945, together with all of the company's purchase rights under the Agreement.⁹⁰⁸⁹

The world-scale magnesium plant and its associated facilities had been constructed from scratch in a period of less than 20 months under very difficult conditions at a cost of over \$130 million. The plant operated from August 1942 until November 1944, when the government ascertained that it had a sufficient magnesium supply and so shut down the magnesium operations. The government's agreement with Basic Magnesium for the operation of the plant was terminated and, in May 1945, the United States engaged J.M. Montgomery & Co., Inc. to supervise the overall management of the facilities.⁹⁴⁹⁰ Guy F. Atkinson Company replaced J.M. Montgomery & Co. under a Property Protection and Maintenance contract in November 1946.⁹² 1946.⁹¹

Lessees

In an effort to recoup some of its investment for building the facility, as well as to ensure production of things still needed for the war effort, the government proceeded to lease portions of site to various companies. The table below depicts these leases:

Company	Lease Area
Allied Productions	Undefined buildings and space
Amecco Chemicals, Inc.	Electrolysis Building No. 2 and adjacent chlorination building
Basic Boat Builders	Lease 480 square feet in Canteen Building S-12
Bureau of Reclamation	A portion of the site on which transformers were located
Carter Printing & Engraving	Print Shop, rooms 14 and 17 in Building K- 33 ⁹³ <u>33</u> ⁹²
City Mercantile Company	Unknown

⁹⁰⁸⁹ L.A. Kelly, Counsel, Office of Defense Plants, Memorandum Accompanying SPB-5. Army Corps of Engineers, Sacramento. [BR001551-553]

⁹⁴⁹⁰ Agreement between DPC and J.M. Montgomery, May 14, 1945. [BR004907-913]

⁹²⁹¹ Cost-Plus-A-Fixed-Fee Property Protection and Maintenance Contract, November 29, 1946. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 12]

⁹³ ~~Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]~~

⁹² Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

Company	Lease Area
Coulter, Harden & Company	Purchase of cell melt, rental of equipment and office space in Central Laboratory Building K- 33 ⁹⁴ <u>33</u> ⁹³
Desert Furniture & Carpet Company	Warehouse space ⁹⁵ <u>94</u>
Gelatines, Inc.	Peat Building B-5, Peat Building B-6, Peat Slab B-30, Secondary Peat Building B-8, and Canteen S-14
Hardesty Chemical Company	Electrolysis Building No. 2 and adjacent chlorination building
Hodsdon Brothers, Inc.	North portion of the Magnesite Garage T-30, and some equipment ⁹⁶ <u>95</u>
Industrial & Metallurgical Engineering Company	Space and equipment in Permanent Laboratory Building K-33
Mineral Materials Company	Manganese Ore Company Spur Track
Myers-Thornton Gas Company	Propane storage area ⁹⁷ <u>96</u>
Nevada Clay Products Company	Buildings B-12, B-22 and certain portions of B-2
Nevada Wholesale Meat Company	Lease 11,000 square feet in Cafeteria Building S- 11 ⁹⁸ <u>11</u> ⁹⁷

⁹⁴93 Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

~~⁹⁵ Sales Brochure, Plancor 201, n.d.~~

⁹⁴ Sales Brochure, Plancor 201, n.d.

~~⁹⁶ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]~~

⁹⁵ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

~~⁹⁷ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]~~

⁹⁶ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

Company	Lease Area
Nevada, New York & Ohio Chemical Company	East end of Preparation Plant Building ⁹⁹⁹⁸ and the east side of Building B- 2 ¹⁰⁰ <u>2</u> ⁹⁹
O.J. Scherer Company	First leased south half of Change House S-8 and Building K-5. Transferred work to Building T- 3 ¹⁰¹ <u>3</u> ¹⁰⁰
Sears Robuck & Company	Warehouse space ¹⁰² <u>101</u>
State of Nevada, Employment Service Department	Office space in McNeil Administration Building K- 2 ¹⁰³ <u>2</u> ¹⁰²
Stauffer Chemical Company (<u>Stauffer</u>)	Three parcels, space in the permanent laboratory building, parking area, and tank cars
True Gems	Change House Building S- 9 ¹⁰⁴ <u>9</u> ¹⁰³
Underwriters Salvage Company of New York	Leased 9,960 square feet in Building T-4

⁹⁸ ~~Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]~~

⁹⁷ ~~Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]~~

⁹⁹⁹⁸ See item 1 in John R. Reilly to Irving Gumbo, December 10, 1947. [BR002336]

¹⁰⁰ ~~Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]~~

⁹⁹ ~~Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]~~

¹⁰¹ ~~Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]~~

¹⁰⁰ ~~Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]~~

¹⁰² ~~Sales Brochure, Plancor 201. n.d.~~

¹⁰¹ ~~Sales Brochure, Plancor 201. n.d.~~

¹⁰³ ~~Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]~~

¹⁰² ~~Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]~~

¹⁰⁴ ~~Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]~~

¹⁰³ ~~Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]~~

Company	Lease Area
United States Vanadium Corporation	Refinery Buildings J-1 and J-5, a portion of Flux Plant and equipment, laboratory space, the west half of Change House S-7, shop and maintenance equipment, and three settling ponds. ⁴⁰⁵ <u>104</u>
Vadelite Corporation	Portions of Administration Building
Western Electro Chemical Company (WECCO)	Salt Storage Building, Acid Tank Neutralization area, Railroad Unloading Platform, Unit 4, Office building in K-36 area, Change House S-2, and Storage Yard (between Tr. 11 and 12 and 8 th and 9 th streets)
Western Mineral & Development Corporation	Laboratory room in Building K- 33 ⁴⁰⁶ <u>33</u> ¹⁰⁵
Mendelsohn, William	Portion of McNeil Administration Building K- 2 ⁴⁰⁷ <u>2</u> ¹⁰⁶

In addition, the government leased machinery and/or equipment to Litalloys Corporation and Bakelite Corporation. It is unknown if the machinery and/or equipment was used on site or moved to another location.

In November 1946, the RFC, as successor to the DPC, transferred the site to the War Assets Administration (WAA). ⁴⁰⁸107 Charged with selling off the government-owned wartime facilities, the WAA arranged for a utilization study and appraisal of the plant.

⁴⁰⁵ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

¹⁰⁴ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

⁴⁰⁶ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

¹⁰⁵ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

⁴⁰⁷ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

¹⁰⁶ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

⁴⁰⁸107 Memorandum of Understanding, November 8, 1946. Army Corps of Engineers, Sacramento. [BR001539-546]

The Government appraiser believed that the best use for the property was as facilities for a diversified chemical industry.⁺⁰⁹¹⁰⁸ Within 1 week after the report was published, the WAA offered the Colorado River Commission (CRC) the opportunity to purchase, lease, or take over the Basic Magnesium plant.⁺⁰¹⁰⁹ Negotiations were formally initiated and, in a Letter of Intent dated March 17, 1948, the WAA agreed to transfer all the rights and assets (personal and real property) that were associated with the Basic Magnesium project, Plancor 201, to CRC.⁺¹¹⁰

Conveyances

Date	From	To	Area
6/3/1949	WAA	CRC	See 2- 4
Unknown	WAA	Department of Interior, Bureau of Reclamation	Six parcel located within Section 13, T 22S, R 62E, with electrical transmission facilities. Parcel sizes were 2.726, 8.035, 3.871, 2.42, 12.186, and 19.119 acres. ⁺²¹¹¹ See Figure 2-4.

2.1.2 Colorado River Commission – 1949 to 1953

Acquisitions

Negotiations between the CRC and the federal government were concluded and the property was transferred to the CRC in a deed dated June 3, 1949.^{+31949.112} Figure 2-5 depicts the land transferred to the CRC.

Lessees

The CRC’s goals were to obtain the property in order to prevent its cannibalization and to then sell it in such a way to ensure the continued operation of the facilities and encourage industrial

⁺⁰⁹¹⁰⁸ Industrial Utilization Study and Facilities Appraisal Report, Volume 1, October 1, 1947 [BR003398]

⁺⁰¹⁰⁹ Letter to Colorado River Commission, October 7, 1947. NARA, San Bruno, RG 269, Box 21, Basic Magnesium Case Files, Folder: Board Memoranda Plancor 201, (1 of 3). [BR002334-335]

⁺¹¹⁰ Letter of Intent, March 17, 1948. BMI [BR001408-413]

⁺²¹¹¹ See Quitclaim Deed, June 3, 1949, Item 4, pp. 3-5. [BR001605-607]

⁺³¹¹² Quitclaim Deed, June 3, 1949. Army Corps of Engineers, Sacramento. [BR001603-615]

development of the area.⁺⁺⁴¹¹³ In the meantime, while it negotiated sales of the property, the CRC continued leasing portions of the facility, as shown in the table below:

Company	Area
Combined Metals Reduction Company	Metal Unit 10, Refinery Building J-2, East half of Change House S-7, ^{++57, 114} Loading Platform J-12 and approximately 88.09 acres of land. As of May 23, 1952, the company was in the process of amending the lease to include Buildings P-1, T-1, T-11, T-18 and additional land. ⁺⁺⁶¹¹⁵
Daniel Furse and Dante Bagni	Cafeteria
Henderson Riding Club	Land near sewage plant
J.W. Conroy	Buildings T-38 and T-39
Mainor, William	Land near sewage plant
Miller, Haynes & Smith, Inc.	Building K-38
National Lead Company	Metal Units 7, 8, and 9, Change House S-1, Cafeteria Building S-11, Peat Building B-5, S-14, Refinery J-1, Refinery J-5, and approximately 62.12 acres of land.
National Lead Company	Metal Unit 10, Refinery Building J-2, East half of Change House S-7, Canteen S-12, and Loading Platform J-12. (Assigned from Combined Metals Reduction/ Pioche Manganese)
Paraffine Companies, Inc.	Manganese Ore spur and land
Post Transportation	One half of Change House S-3 and Land for garage

⁺⁺⁴¹¹³ Assignment of Lease. NARA San Bruno, RG 291, Real Property Files, Box 1, Folder: Nev-5, Inspection of Leases. [BR002880]

⁺⁺⁵¹¹⁴ Combined Metals to have the right to occupy the west half of Change House S-y when lease with United States Vanadium Corporation expired or was terminated.

⁺⁺⁶¹¹⁵ Agreement of Sale, CRC to BMI, May 23, 1952. [See BR001362]

Company	Area
Company	
Stauffer Chemical Company	Chlorine and Caustic plant and land. ⁺⁷¹¹⁶ Approximately 237.476 acres.
Union Pacific Railroad Company	Office space in laboratory Building K-33
US Lime Products Corporation	Portion of preparation plant building B-1 and Building B-21.
US Treasury Department, Bureau of Federal Supply	Approximately three acres located north and east of Gate 4 for storage space for magnesium ingots. ⁺⁸¹¹⁷

Conveyances

The CRC subdivided the plant complex into parcels and proceeded to sell them, as follows:

Date	From	To	Area
4/28/1951	CRC	Stauffer Chemical Co.	259.196 acres
6/28/1951	CRC	WECCO	Preparation Area ⁺⁹¹¹⁸
8/21/1951	CRC	Arrowhead Lime and Chemical Company (US Lime)	Preparation Area ⁺²⁰¹¹⁹
11/6/1951	CRC	Hercules Powder Company	Land ⁺²⁴¹²⁰ approximately 36.65 acres
1/24/1952	CRC	OJ Scherer and Associates	Building T-3

⁺⁷¹¹⁶ Agreement of Sale, CRC to BMI, May 23, 1952. [BR001627-644]

⁺⁸ ~~Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]~~

¹¹⁷ ~~Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]~~

⁺¹⁹ Agreement of Sale, CRC to BMI, May 23, 1952. [BR001627-644]

¹¹⁸ Agreement of Sale, CRC to BMI, May 23, 1952. [BR001627-644]

⁺²⁰¹¹⁹ Agreement of Sale, CRC to BMI, May 23, 1952. [BR001627-644] See also BR002977.

⁺²⁴¹²⁰ Agreement of Sale, CRC to BMI, May 23, 1952. [BR001627-644]

Date	From	To	Area
1/31/1952	CRC	Stauffer	11.59 acres
3/31/1952	CRC	Stauffer	36.65 acres
8/1/1952	CRC	WECCO	Area subsequently purchased by Navy ⁺²²¹²¹
9/8/1952	CRC	BMI	Common Areas
9/8/1953	CRC	Stauffer	16.517 acres

In addition, the CRC indicated that several sales were in process as of May 23, 1952. However, the areas involved are unclear and it is unknown if the transactions were in fact completed.⁺²³¹²²

These transactions were identified as:

- W.O. Haynes, Inc., Agreement of Sale dated December 17, 1951.
- Molybdenum Corporation of America, Agreement of Sale dated December 31, 1951.
- Manganese Inc., the necessary legal documents relative to sale were in the process of being compiled on May 23, 1952.

With the sale of the parcels to individual companies and the sale of what became known as the Common Areas to a syndicate of tenants that had formed under the name BMI, the CRC had essentially achieved its objective. On January 21, 1953, as a part of its payment to the Federal Government, the CRC re-assigned six leases to the General Services Administration. The transaction thereby made the United States the owner of those facilities again.⁺²⁴¹²³

Ownership of the facility after the completion of the CRC conveyances is depicted in Figure 2-6.

⁺²² Referred to in letter to GSA Regional Director, January 18, 1954. [BR002436-437]

⁺²¹ Referred to in letter to GSA Regional Director, January 18, 1954. [BR002436-437]

⁺²³¹²² Agreement of Sale, CRC to BMI, May 23, 1952. [BR001627-644]

⁺²⁴¹²³ Assignment of Lease. [BR002880] "Leases" in Office Memorandum, Liquidation of the Colorado River Commission Activities at the Basic Magnesium Project, January 26, 1953. [BR002986-990] See also: Office Memorandum, Robert B. Bradford to Deputy Regional Director, Public Building Service, April 25, 1956. [BR002865] Lease and Option Agreements attached to Richard H. Greenburg, Regional Comptroller, GSA, to Robert J. Moore, BMI, January 30, 1953. [BR002975-983] Transmittal of Notes, Deeds and Leases Assigned to GSA, January 28, 1953. [BR002984-985] Richard H. Greenburg, Regional Comptroller, GSA, to Robert J. Moore, BMI, January 30, 1953. [BR002974] Elmo L. Buttle, Chief, Surplus Real Property Division, October 5, 1953. [BR002971]

Various transactions have occurred since the property was sold by the CRC. The following section is arranged by entity to show these land acquisitions, lessees, and conveyances.

2.1.3 United States Government

Acquisitions

As noted above, the CRC re-assigned six leases to the General Services Administration in January 1953, as a part of its payment to the Federal Government. The transaction made the United States the owner of those facilities again.⁺²⁵¹²⁴ The land acquisitions and conveyances involving the government are depicted in Figure 2-7.

Date	From	To	Area
1/23/1953	CRC	GSA	Assignment of Leases for Refineries J-1, J-2 and J-5, Metal Units 7-10, Peat Building B-5, Loading Platform J-12, Building S-14, Cafeteria Building S-11, Canteen S-12, Change House S-1 and the east half of S-7.
12/31/1953	WECCO	USA/US Navy	Two parcels 151.3689 and 138.9621 acres ⁺²⁶¹²⁵

Lessees

Company	Lease Area	Term
Pioche Manganese Company	Refinery Building J-2	1953 to 1967 This building was originally leased to predecessor Combined Metals Reduction Company. Pioche

⁺²⁵¹²⁴ Assignment of Lease. [BR002880] "Leases" in Office Memorandum, Liquidation of the Colorado River Commission Activities at the Basic Magnesium Project, January 26, 1953. [BR002986-990] See also: Office Memorandum, Robert B. Bradford to Deputy Regional Director, Public Building Service, April 25, 1956. [BR002865] Lease and Option Agreements attached to Richard H. Greenburg, Regional Comptroller, GSA, to Robert J. Moore, BMI, January 30, 1953. [BR002975-983] Transmittal of Notes, Deeds and Leases Assigned to GSA, January 28, 1953. [BR002984-985] Richard H. Greenburg, Regional Comptroller, GSA, to Robert J. Moore, BMI, January 30, 1953. [BR002974] Elmo L. Buttle, Chief, Surplus Real Property Division, October 5, 1953. [BR002971]

⁺²⁶ Agreement of Sale, CRC to BMI, May 23, 1952. [BR001627-644]

¹²⁵ Agreement of Sale, CRC to BMI, May 23, 1952. [BR001627-644]

Company	Lease Area	Term
		Manganese assigned and transferred Refinery Building J-2 to National Lead on July 5, 1956. ¹²⁷ <u>1956.</u> ¹²⁶
National Lead	Refineries J-1 and J-5	1953 to 1962
National Lead	Metal Units 7 through 9, Peat Building B-5 and S-14, Change House S-1, Cafeteria Building S-11 and approximately 62.12 acres of land.	1953 to 1967
National Lead	Metal Unit 10, Refinery Building J-2, East half of Change House S-7, Canteen S-12, and Loading Platform J-12.	1953 to 1967 Canteen S-12 and Loading Platform J-12 were originally leased to predecessor Combined Metals Reduction Company. Pioche Manganese assigned and transferred Canteen S-12 and Loading Platform J-12 to National Lead on July 5, 1956. ¹²⁸ <u>1956.</u> ¹²⁷

Conveyances

Date	From	To	Area
3/15/1962	USA	American Potash and Chemical Corporation	Two Parcels, 151.3689 and 138.9621 acres ¹²⁹ <u>128</u>
3/2/1962	GSA	National Lead Company	Refineries J-1 and J- 5. ¹³⁰ <u>5.</u> ¹²⁹

¹²⁷¹²⁶ See Letter from Richard Greenburg, GSA, to Robert Moore, BMI, January 30, 1953. [BR002974]

¹²⁸¹²⁷ See Letter from Richard Greenburg, GSA, to Robert Moore, BMI, January 30, 1953. [BR002974]

¹²⁹ Deed of Trust, March 15, 1962. [BR002931-940]

¹²⁸ Deed of Trust, March 15, 1962. [BR002931-940]

Date	From	To	Area
4/27/1967	GSA	National Lead Company	Assignment of Leases for Refinery J-1, Metal Units 7-10, Peat Building B-5, Loading Platform J-12, Building S-14, Cafeteria Building S-11, Canteen S-12, Change House S-1 and the east half of S-7.

2.1.4 Stauffer Chemical Company of Nevada / Pioneer Chlor-Alkali Company, Inc.

Land acquisitions and conveyances involving Stauffer ~~Chemical Company~~ are depicted in Figure 2-8.

Acquisitions

Date	From	To	Area
11/28/1952	Hercules Powder Co.	Stauffer	114.65 acres
9/1953	BMI	Stauffer	19.70 acres
4/1972	BMI	Stauffer	15.314 acres
8/1984	BMI	Stauffer	7.386 acres
10/19/1988	Stauffer	Pioneer Chlor-Alkali Company (<u>Pioneer</u>)	All properties

Lessees ¹³⁴¹³⁰

Company	Lease Area	Term
Chemada Corporation	Unspecified parcel for the purpose of installing a gas	September 1968

¹³⁰ ~~Referred to in Memorandum by Fred Johnston to Chief, Real Property Division, November 25, 1966. [BR002993-994]~~

¹²⁹ ~~Referred to in Memorandum by Fred Johnston to Chief, Real Property Division, November 25, 1966. [BR002993-994]~~

¹³⁴¹³⁰ Leasing information from the Pioneer Chlor Alkali Company, Stauffer Management Company, ECA, March 22, 1993. Page numbers are referenced.

Company	Lease Area	Term
	turbine power plant. ⁺³²¹³¹	
Chemical Properties, Inc.	Office and truck repair space	November 24, 1984, and for a short period thereafter. ⁺³³¹³²
Montrose Chemical	A series of sub-parcels	1947 until 1983. ⁺³⁴ <u>1983.</u> ¹³³
Post Transportation, Bulk Transportation, and Nu-Bulk Transportation	A small portion of the site ⁺³⁵¹³⁴	Unclear
Saguaro Power Corporation	6 acres for a 90-megawatt natural gas-fired cogeneration facility.	This lease was initiated in 1990 by Pioneer. ⁺³⁶¹³⁵

Conveyances

Date	From	To	Area
3/18/1981	Stauffer	State of Nevada	41.47 acres for Interstate 515
10/1988	Stauffer	Pioneer	All properties [sale agreement executed 8/88; transaction closed 10/26/88]

In 2003, Bayer CropSciences, Inc. succeeded to certain assets and liabilities of the Stauffer Management Company, an affiliate of the Stauffer Chemical Company.

¹³² See p. 3-9.

¹³¹ See p. 3-9.

¹³³ See p. 3-9.

¹³² See p. 3-9.

¹³⁴ See p.3-5. See Figure 3-4 in the ECA for a depiction of the leased area. See also Montrose ECA, p. 21. [B002332]

¹³³ See p.3-5. See Figure 3-4 in the ECA for a depiction of the leased area. See also Montrose ECA, p. 21. [B002332]

¹³⁵ See p. 3-5. See Figure 3-4 in the ECA for a depiction of the leased area.

¹³⁴ See p. 3-5. See Figure 3-4 in the ECA for a depiction of the leased area.

¹³⁶ See p. 3-9.

¹³⁵ See p. 3-9.

2.1.5 Western Electro Chemical Company

Land acquisitions and conveyances involving WECCO/American Potash and Chemical Corporation/Kerr-McGee Chemical Corporation (Kerr-McGee) are depicted in Figure 2-9.

Acquisitions

Date	From	To	Area
3/15/1962	USA	American Potash and Chemical Corporation	Two Parcels, 151.3689 and 138.9621 acres ⁺³⁷¹³⁶

Lessees

Company	Lease Area	Term
Buckles Construction Company	Portion of Unit 1	August 1973 to June 1989 ⁺³⁸ <u>1989</u> ¹³⁷
Burris Oil and Chemical Company (also doing business as Basic Resources Company [not affiliated with BMI])	Unclear	May 1979 to May 1983 ⁺³⁹ <u>1983</u> ¹³⁸
Delbert Madsen and Estate of Delbert Madsen	Triangular shaped <u>two</u> acre parcel at the northeastern corner of the Kerr-McGee property	June 1976 to at least 1993 ⁺⁴⁰ <u>1993</u> ¹³⁹
Dillon Potter	2 acres southeast of the Southern Nevada Auto Parts	Unknown

¹³⁷ ~~Deed of Trust, March 15, 1962. [BR002931-940]~~

¹³⁶ ~~Deed of Trust, March 15, 1962. [BR002931-940]~~

¹³⁸ ~~KMCC ECA, p. 7-24. [B002133]~~

¹³⁷ ~~KMCC ECA, p. 7-24. [B002133]~~

¹³⁹ ~~KMCC ECA, p. 7-21. [B002130]~~

¹³⁸ ~~KMCC ECA, p. 7-21. [B002130]~~

¹⁴⁰ ~~KMCC ECA, p. 7-26. [B002135]~~

¹³⁹ ~~KMCC ECA, p. 7-26. [B002135]~~

Company	Lease Area	Term
	lease area ⁺⁴⁴ <u>140</u>	
Ebony Construction Company	Portion of Unit 1	1977 and 1978. ⁺⁴² <u>1978.</u> ¹⁴¹
Green Ventures International	Office space	August 1980 to September 1981. ⁺⁴³ <u>1981.</u> ¹⁴²
J.B. Kelley	The area south of the Koch lease	Period of lease unknown. ⁺⁴⁴ <u>143</u>
Koch Asphalt Company (aka Koch Materials Company)	The area surrounding Building B-3	May 1983 to at least 1993. ⁺⁴⁵ <u>1993.</u> ¹⁴⁴
Nevada Precast Concrete Products	Office space	January 1973 to May 1978. ⁺⁴⁶ <u>1978.</u> ¹⁴⁵
Southern Nevada Auto Parts and related companies ⁺⁴⁷ <u>146</u>	10 acres	1972 to at least 1993. ⁺⁴⁸ <u>1993.</u> ¹⁴⁷

¹⁴¹ KMCC ECA, p. 7-28. [B002137]

¹⁴⁰ KMCC ECA, p. 7-28. [B002137]

¹⁴² KMCC ECA, p. 7-24. [B002133]

¹⁴¹ KMCC ECA, p. 7-24. [B002133]

¹⁴³ KMCC ECA, p. 7-23. [B002132]

¹⁴² KMCC ECA, p. 7-23. [B002132]

¹⁴⁴ KMCC ECA, p. 7-21. [B002130] See Plate 7.3 for the location of the operations.

¹⁴³ KMCC ECA, p. 7-21. [B002130] See Plate 7.3 for the location of the operations.

¹⁴⁵¹⁴⁴ KMCC ECA, p. 7-21. [B002130]

¹⁴⁶ KMCC ECA, p. 7-23. [B002132]

¹⁴⁵ KMCC ECA, p. 7-23. [B002132]

¹⁴⁷ Robert and William Ellis leased this area beginning in October 1972 doing business as SNAP-TOW, Southern Nevada Auto Parts, and Pick-A-Part. Ed Smith and Vern Christensen leaseholders since January 1990, doing business as Nevada Recycling (auto salvage yard) on the northern portion of this area.

¹⁴⁶ Robert and William Ellis leased this area beginning in October 1972 doing business as SNAP-TOW, Southern Nevada Auto Parts, and Pick-A-Part. Ed Smith and Vern Christensen leaseholders since January 1990, doing business as Nevada Recycling (auto salvage yard) on the northern portion of this area.

¹⁴⁸ KMCC ECA, pp. 7-26 to 7-28. [B002135-137]

¹⁴⁷ KMCC ECA, pp. 7-26 to 7-28. [B002135-137]

Company	Lease Area	Term
State Industries	Unit 1, Buildings T-4, T-5, and T-8	1969 to 1988 ¹⁴⁹ <u>1988</u> ¹⁴⁸

Conveyances

Date	From	To	Area
12/31/1953	WECCO	USA/US Navy	Two parcels 151.3689 and 138.9621 acres ⁺⁵⁰ <u>149</u>
1971	Kerr-McGee	Chemstar	Small parcel ⁺⁵⁺ <u>150</u> See Figure 2-10
1988	Kerr-McGee	Chemstar	Small parcel ⁺⁵² <u>151</u> See Figure 2-10

In 2006, Kerr-McGee became Tronox LLC.

2.1.6 National Lead Company/Titanium Metals Corporation

TIMET was formed by a joint venture agreement between Allegheny Ludlum Steel Corporation and National Lead Company in ~~1950~~⁺⁵³ 1950¹⁵². Land acquisitions and conveyances involving the companies are depicted in Figure 2-11.

Acquisitions

Date	From	To	Area
8/20/1957	BMI	TIMET	Portion of NW ¼ of Section 13 and

¹⁴⁹ Henderson Steering Committee ECA, p. 16. [B002484]

¹⁴⁸ Henderson Steering Committee ECA, p. 16. [B002484]

¹⁵⁰ Agreement of Sale, CRC to BMI, May 23, 1952. [BR001627-644]

¹⁴⁹ Agreement of Sale, CRC to BMI, May 23, 1952. [BR001627-644]

⁺⁵⁺¹⁵⁰ Chemstar Lime Company, ECA, April 15, 1993, p. 8. Site facility boundaries are shown on maps at B002640-2641.

⁺⁵²151 Chemstar Lime Company, ECA, April 15, 1993, p. 8. Site facility boundaries are shown on maps at B002640-2641.

⁺⁵³152 Timet, ECA, April 15, 1993., p. 3-1

Date	From	To	Area
			Roadways around Building T-3
9/4/1957	A.T. and Mildred Newell	TIMET	Portion of NW ¼ of Section 13
3/2/1962	GSA	National Lead Company	Refineries J-1 and J- 5 ¹⁵⁴ <u>5</u> ¹⁵³
4/28/1967	GSA	National Lead Company	Metal Units 7, 8, 9, and 10. Refinery Building J-1, J-2 and J-5. Peat Building B-5 and S-14. Change House S-1 and the East half of Change House S-7. Cafeteria Building S-11 Canteen S-12, and Loading Platform J-12.
12/29/1967 and 1/20/1972	National Lead Company	TIMET	Fourteen parcels, Refinery Building J-2, Canteen S-12 and S-14, Loading Platform J-12, Peat Building B-5, Ingot Refinery J-1, Billet Foundry J-5 and additional land
4/17/1985 8/13/1980 4/13/1972	BMI	TIMET	Parcel 1, 62.8 acres Parcel 2, 204.02 acres Parcel 3, 197.6 acres

Lessees

Company	Lease Area	Term
1400 Corporation	T-52, storage vault. KBMI Radio Tower	1963
BMI	Fire Station Building S-10	July 1961

¹⁵⁴ ~~Referred to in Memorandum by Fred Johnston to Chief, Real Property Division, November 25, 1966. [BR002993-994]~~

¹⁵³ Referred to in Memorandum by Fred Johnston to Chief, Real Property Division, November 25, 1966. [BR002993-994]

Company	Lease Area	Term
	and Building T-1	
Burriss Oil & Chemical Company	Canteen S-14 and 1.6 acres of vacant land (contiguous)	December 1978
Chemtec Corporation	Building K-55	1975 to 1978. Operations unknown. ⁺⁵⁵ <u>154</u>
City of Henderson	TIMET ball park	April 1959
Coyote Construction (Wirthlin Trenching)	Building S-17 and one acre of land.	1978-1979 operations unknown. ⁺⁵⁶ <u>155</u>
Frank Briscoe Company	B-5, including rail track #5	60 to 90 days in 1980. ⁺⁵⁷ <u>1980.</u> ¹⁵⁶
John Wiley Jones Company, Inc.	Building T-18 and Unit No. J-2	April 1960
Jones Chemicals, Inc.	Building T-11	January 1963 to at least January 1991
Jones Chemicals, Inc.	Building T-18	April 1964 to at least January 1991
Jones Chemicals, Inc.	Building T-16	Unknown to January 1966
Jones Chemicals, Inc.	Locomotive House Building P-1	January 1966 to at least January 1991
Magnesite Truck Company	Building T-30	Ca. 1951 to possibly late 1956. operations unknown. ⁺⁵⁸ <u>157</u>
Musical Arrangements,	Building K-3	April 1972

¹⁵⁵ TIMET ECA, p. 4-56. [B002860]

¹⁵⁴ TIMET ECA, p. 4-56. [B002860]

¹⁵⁶ TIMET ECA, p. 4-57. [B002861]

¹⁵⁵ TIMET ECA, p. 4-57. [B002861]

¹⁵⁷ TIMET ECA, p. 4-57. [B002861]

¹⁵⁶ TIMET ECA, p. 4-57. [B002861]

¹⁵⁸ TIMET ECA, p. 4-58. [B002862]

¹⁵⁷ TIMET ECA, p. 4-58. [B002862]

Company	Lease Area	Term
Inc.		
National Sound Corporation	Building K-55	1972, for a period of two months. ⁺⁵⁹ <u>158</u>
Per Boy Associates	Southwest quarter Section 7	June 1965
Rosecrest Cabinets	Half of Building K-32	October 1973 to 1989
Skaggs Company, Inc.	Portion of T-2 warehouse	August 1972
State Industries	Outside, east end of Building T-3	1980 for storing non-polychlorinated biphenyls (PCBs)-containing transformers. ⁺⁶⁰ <u>159</u>
State Stove and Manufacturing Company	Building T-2	1972-1980 for warehousing purposes. ⁺⁶⁴ <u>160</u>
TIMET Employees Federal Credit Union	Building K-32	March 1968
Espy Construction	Areas within the Pabco Road Ponds	Since October 1980. ⁺⁶² <u>1980.</u> ¹⁶¹
Henderson Telephone Company	Building K-32	Until 1954. ⁺⁶³ <u>1954.</u> ¹⁶²
M. Zenoft (lease assigned to Television Company of America)	Portion of Building K-32	September 1953. ⁺⁶⁴ <u>1953.</u> ¹⁶³

⁺⁵⁹ ~~TIMET ECA, p. 4-56. [B002860]~~
¹⁵⁸ TIMET ECA, p. 4-56. [B002860]
⁺⁶⁰¹⁵⁹ TIMET ECA, p. 4-57. [B002861]
⁺⁶¹ ~~TIMET ECA, p. 4-57. [B002861]~~
¹⁶⁰ TIMET ECA, p. 4-57. [B002861]
⁺⁶² ~~TIMET ECA, p. 4-55. [B002859]~~
¹⁶¹ TIMET ECA, p. 4-55. [B002859]
⁺⁶³ ~~TIMET ECA, p. 4-55. [B002859]~~
¹⁶² TIMET ECA, p. 4-55. [B002859]
⁺⁶⁴¹⁶³ ~~TIMET ECA, p. 4-55. [B002859]~~

2.1.7 Chemstar, Inc.

United States Lime Corporation leased property at the Basic Magnesium site and began operations in November 1948. In 1950, Arrowhead Lime and Chemical Company purchased the land and improvements on which US Lime was operating. The connection between Arrowhead Lime and US Lime is unclear. However, Chemstar, the current successor to US Lime, indicated that it acquired the rotary kiln building (B-1), the pellet storage bins (B-21) and the adjacent open yard in ~~1950.~~⁺⁶⁵ 1950.¹⁶⁴ In 1971 and 1988, two additional parcels were acquired from Kerr-McGee. The three continuous parcels comprise 10.45 acres.⁺⁶⁶165 The Chemstar facility is depicted in Figure 2-10.

2.2 MANUFACTURING PROCESSES USED AT THE SITE

Information regarding the owners' and/or lessees' manufacturing processes is provided below. It is arranged alphabetically by company name.

1400 Corporation

The company leased facilities from TIMET and operated a radio station. No relevant manufacturing processes appear to have occurred.

Allied Productions, Inc.

Allied Productions leased facilities at the site from the US government. The company produced motion pictures. No relevant manufacturing processes appear to have occurred.

Amecco Chemicals, Inc.

Amecco Chemicals acquired the Hardesty Chemical lease of the electrolysis building #2 and the adjacent chlorination building on September 1, 1947, and began operations at the site on October

⁺⁶⁵164 Chemstar Lime Company, ECA, April 15, 1993, p. 11.

⁺⁶⁶165 Chemstar Lime Company, ECA, April 15, 1993, p. 8. Site facility boundaries are shown on maps at B002640-2641.

1 of that year.⁺⁶⁷¹⁶⁶ In a monthly report on the status of lessees at the Basic Magnesium site, the WAA noted that Amecco had 70 employees at the site.⁺⁶⁸¹⁶⁷

Amecco purchased chlorine piped in from Stauffer ~~Chemical Company~~ and produced four chemical products:

- Monochlorobenzene
- Paradichlorobenzene
- Orthodichlorobenzene
- Arsenite

In conjunction with its assessment of how to collect on the delinquent rental and utility charges incurred by Hardesty Chemical, the government reported that Amecco was closely associated with Hardesty Chemical. The companies shared the same president; Amecco was a minority owner of Hardesty Chemical preferred stock; and, at least between October 1947 and March 1948, Hardesty Chemical financed Amecco operations. In addition, Raymond T. Heilpern, Vice President and counsel for Amecco, was also an officer, director, and counsel for Hardesty Chemical.⁺⁶⁹¹⁶⁸

The government ascertained that Amecco was “practically bankrupt,” that Hardesty Chemical was financially able to pay rent and utility charges, legally liable for the rent, “and also for the utility charges on the theory that Amecco was acting in effect as [Hardesty Chemical’s] agent when it incurred the utility charges.”⁺⁷⁰¹⁶⁹

The WAA also indicated that Raymond Heilpern (counsel for both Amecco and Hardesty Chemical) informed the WAA that Stauffer ~~Chemical~~ “was going to finance Amecco’s operations, supplying chlorine on memorandum invoice, even purchasing benzene with Stauffer funds, all in order to keep Amecco going as a consumer of Stauffer’s by-product chlorine.”⁺⁷¹¹⁷⁰ Stauffer, in a carefully worded letter to the WAA, noted that the company was not going to

⁺⁶⁷¹⁶⁶ Information from WAA, Washington Credit Division Report, April 30, 1948. [BR002381-391]

⁺⁶⁸¹⁶⁷ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

⁺⁶⁹¹⁶⁸ WAA, Washington Credit Division Report, April 30, 1948, [BR002381-391]

⁺⁷⁰¹⁶⁹ WAA, Washington Credit Division Report, April 30, 1948, p. 6. [BR002386]

⁺⁷¹¹⁷⁰ WAA, Washington Credit Division Report, April 30, 1948, p. 5. [BR002385]

initiate action in order to obtain repayment of approximately \$22,000 that Amecco owed Stauffer. Moreover, Stauffer informed the WAA that it was working out arrangements for liquidation of the amount over an extended period of time. “We are making this arrangement in part because of our interest in seeing that Amecco Chemicals, Inc., maintains and if possible, increases the scope of its operation at Henderson.”¹⁷²¹⁷¹

Basic Boat Builders

Basic Boat Builders leased facilities at the site from the US government in which it constructed boats.

Basic Magnesium Inc.

The original development of the site was the construction of a magnesium plant and associated facilities. There were two major raw materials used to produce magnesium—magnesite and chlorine—and two primary components to the operations—a chlorine/caustic plant and a magnesium production plant. A flow chart of the operations can be found as Figure 2-12. The following provides a brief overview of the processes used to manufacture magnesium:

Chlorine/Caustic Plant

Sodium ~~Chloride~~chloride (salt) was processed dissolved) in the chlorine/caustic plant to form a saturated brine. The saturated brine was then purified by settling out the mud and solid material, and then treated with sodium carbonate. After the sodium carbonate reacted with the calcium and magnesium, those materials were then settled from the brine. The brine was cleaned up and put into a chlorine electrolytic cell where a direct electric current passed through the cell and formed chlorine gas, sodium hydroxide (caustic soda), and by-product hydrogen.

Magnesium Plant

The magnesium plant consisted of ten large buildings, Units 1 through 10, each of which were divided into two rooms—a chlorinator room and an electrolytic cell room.

The chlorinators produced the feed for the electrolytic cells by converting magnesium into magnesium chloride. In this process MgO was mixed together with coat, recycled magnesium chloride, and peat moss to form a pellet. The pellets were dried and fed to the chlorinator. The

¹⁷²¹⁷¹ WAA, Washington Credit Division Report, April 30, 1948, Exhibit 2-A. [BR002388]

material was heated to the appropriate temperature, the reaction occurred, and then the molten magnesium chloride was drawn off and transported to the electrolytic cells.

Electrolytic cells contained a molten salt bath consisting of the chloride salts of sodium, potassium, calcium, and magnesium. The cells consisted of steel cathodes and graphite anodes contained in a refractory lined steel box. When a direct current passed through the cell, chlorine gas was drawn to the positively charged anode, and magnesium was drawn to the negatively charged cathode of the cell. The magnesium eventually broke off of the cathode and floated to the top of the cell. Periodically the magnesium was removed from the cell and then cast into ingots or mixed with other metals to make magnesium alloys.

Buckles Construction Company

Buckles Construction Company leased a portion of Unit 1 from Kerr-McGee. The company used the facility for steel fabrication and equipment storage. ⁺⁷³¹⁷²

Bulk Transportation

Bulk Transportation leased facilities from Stauffer-~~Chemical~~. Bulk Transportation transported chlor alkali products from Stauffer, along with similar materials for other companies at the site. Other transportation companies, including Nu-Bulk Transportation and Post Transportation, have also leased the same area from Stauffer and have presumably conducted similar operations, which may have also included truck washing. ⁺⁷⁴¹⁷³

Bureau of Reclamation

The Bureau of Reclamation leased a portion of the site on which transformers were located and presumably used them for power generation. No manufacturing processes appear to have occurred. However, it is possible that the transformers owned by the Bureau of Reclamation may have leaked PCB's over time.

Burriss Oil and Chemical Company (also doing business as Basic Resources Company)

⁺⁷³¹⁷² KMCC ECA, p. 7-24. [B002133]

⁺⁷⁴¹⁷³ Stauffer/Pioneer ECA, p. 3-5. [B001671]

Burriss Oil/Basic Resources operated an asphalt emulsion batch plant for blending and packaging a variety of asphalt emulsions. The production process involves milling asphalt cement with soap emulsifiers.⁺⁷⁵¹⁷⁴ The companies were Kerr-McGee Lessees.

Carter Printing & Engraving

Carter Printing & Engraving leased facilities from the US government and used them as a print shop.

Chemada Corporation

Chemada Corporation leased an unspecified parcel from Stauffer for the purpose of installing a gas turbine power plant. Details regarding the company's operations are unknown.⁺⁷⁶¹⁷⁵ The gas turbine was removed prior to 1988.

Chemical Properties, Inc.

Chemical Properties leased office and truck repair space from Stauffer ~~Chemical~~. Details regarding the company's operations are unknown.⁺⁷⁷¹⁷⁶

Chemstar Lime Company

Chemstar Lime Company's predecessors (United States Lime Corporation, United States Lime Division of the Flinkote Company, Genstar Corporation, Genstar Cement & Lime Company, Genstar Lime Company, and Chemstar Inc.) acquired a portion of the site from CRC and expanded operations with property acquired from Kerr-McGee. Production processes used by Chemstar are described in Section 4 of the Phase I Environmental Conditions Assessment (ECA), prepared in 1993. To briefly summarize, lime production encompasses three production stages:

- Mining and rock preparation
- Calcining to convert carbonate rock to calcium and/or magnesium oxides (quicklime)
- Hydrating the quicklime to hydroxides

⁺⁷⁵¹⁷⁴ KMCC ECA, p. 7-21. [B002130]

⁺⁷⁶¹⁷⁵ See p. 3-9.

⁺⁷⁷¹⁷⁶ See p. 3-9.

Chemtec Corporation

Chemtec Corporation leased facilities from TIMET. Details regarding its operations are unknown.

City Mercantile Company

City Mercantile Company leased facilities from the US government. Its operations are unknown.

City of Henderson

The City of Henderson leases an area used as a municipal park from TIMET. No manufacturing processes appear to have occurred.

On September 28, 1992, through condemnation, the City of Henderson acquired from BMI 35.34 acres immediately to the south of the Upper Ponds as the site for a municipal wastewater injection facility (the ~~Rapid Infiltration Basins~~ [RIBs]), which was in operation from 1992 to at least 2002. On October 6, 2003, as a part of a land exchange, the City acquired approximately 101.638 acres generally located adjacent and west of the Lower Ponds from BMI. In turn, the City conveyed 73.157 acres (including the acreage associated with the RIBs) to LandWell. The City used the land it acquired for a municipal wastewater treatment facility (the City of Henderson WRF), which is presently under construction.

Combined Metals Reduction Company

Combined Metals Reduction Company leased facilities at the site from the CRC. The CRC conveyed the ownership of the property to GSA after the CRC had sold the bulk of its holdings. The Combined Metals Reduction Company assigned the lease to Pioche Manganese Company, which in turn assigned the leased facilities to National Lead Company. Details regarding operations conducted by Combined Metals Reduction Company are unclear, although there is some indication that the company produced ferro-manganese alloys and that its operations may have been similar to those of the Pioche Manganese Company. ⁴⁷⁸¹⁷⁷

⁴⁷⁸¹⁷⁷ Henderson Steering Committee ECA, p. 14. [B002482]

Coulter, Harden & Company

Coulter, Harden & Company leased facilities at the site from the US government. The company processed cell melt refuse.⁺⁷⁹¹⁷⁸

Coyote Construction (Wirthlin Trenching)

Coyote Construction leased facilities from TIMET. Details regarding its operations are unknown.⁺⁸⁰¹⁷⁹

Daniel Furse and Dante Bagni

Daniel Furse and Dante Bagni leased cafeteria space from the CRC. No manufacturing processes appear to have occurred.

Delbert Madsen and Estate of Delbert Madsen

Delbert Madsen and subsequently the Estate of Delbert Madsen leased a triangular shaped 2-acre parcel at the northern most, eastern corner of the Kerr-McGee property.⁺⁸¹¹⁸⁰ The area was used as a storage and salvage yard for 1940s-vintage transportable government housing, used mobile homes, old vehicles and wrecked vehicles.⁺⁸²¹⁸¹

Desert Furniture & Carpet Company

Desert Furniture & Carpet Company leased warehouse facilities from the US government and used them for furniture storage. No manufacturing processes appear to have occurred.

Dillon Potter

Dillon Potter leased a 2-acre portion of the Kerr-McGee property southeast of the SNAP-TOW lease area. The area was used to maintain a limited number of livestock including horses, pigs, cattle, chickens, and peacocks.⁺⁸³¹⁸²

⁺⁷⁹¹⁷⁸ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11] See also, WAA Sales Brochure, Plancor 201. n.d.

⁺⁸⁰¹⁷⁹ TIMET ECA, p. 4-57. [B002861]

⁺⁸¹¹⁸⁰ See KMCC ECA, Plate 7-4.

⁺⁸²¹⁸¹ KMCC ECA, p. 7-26. [B002135]

⁺⁸³¹⁸² KMCC ECA, p. 7-28. [B002137]

Ebony Construction Company

Ebony Construction Company leased a portion of property center of the north side of Unit 1 in 1977 and 1978 from Kerr-McGee. It provided construction management and staging activities. ⁺⁸⁴¹⁸³ No relevant manufacturing processes appear to have occurred.

Espy Construction

Espy Construction has occupied areas within the Pabco Road Ponds area since October 1980. Espy was used by various plants within the industrial complex to demolish outdated process equipment, build berms for effluent control, and construct evaporation ponds. It is a TIMET lessee.

Frank Briscoe Company

Frank Briscoe Company leased facilities from TIMET and used them for unloading filter media materials. ⁺⁸⁵¹⁸⁴

Gelatines, Inc.

Gelatines, Inc. leased facilities from the US government. The company's operations are unknown.

Green Ventures International

Green Ventures International leased facilities from Kerr-McGee and operated an alfalfa sprouts marketing office. ⁺⁸⁶¹⁸⁵ No manufacturing processes appear to have occurred.

Hardesty Chemical Company

Hardesty Chemical Company leased electrolysis building #2 and the adjacent chlorination building for operation of a chemical plant from the US government beginning in September 1946. The company produced synthetic detergents, muriatic acid, monochlorobenzene, paradichlorobenzene, and orthodichlorobenzene. ⁺⁸⁷¹⁸⁶

⁺⁸⁴¹⁸³ KMCC ECA, p. 7-24. [B002133]

⁺⁸⁵¹⁸⁴ TIMET ECA, p. 4-57. [B002861]

⁺⁸⁶¹⁸⁵ KMCC ECA, p. 7-23. [B002132]

⁺⁸⁷¹⁸⁶ Sales Brochure, Plancor 201. n.d.

Hardesty Chemical sold or assigned its interest in the lease to Amecco Chemicals, Inc. on September 1, 1947, but apparently did not inform or consult the WAA. Amecco wrote to the WAA advising the government that it had “purchased the entire interest of the Hardesty Chemical Co., Inc. in it’s (sic) Basic Magnesium Plant operation, including plant, machinery, and chemical stocks and will continue the operation here, commencing October 1st.”⁺⁸⁸¹⁸⁷ The WAA did not recognize the assignment or purchase of the lease, and as of March 31, 1948, Hardesty Chemical was delinquent on its lease and utility charges and owed the government almost \$50,000. The WAA noted that since the government had agreed to dispose of the entire Basic Magnesium site to the CRC, they felt that the decision regarding Amecco’s continuation of operations should reside with the CRC.⁺⁸⁹¹⁸⁸ See the discussion under Amecco Chemicals, Inc. for additional information.

In its assessment of the delinquent rental and utility payments, the government ascertained that Amecco was “practically bankrupt,” that Hardesty Chemical was financially able to pay rent and utility charges, legally liable for the rent, “and also for the utility charges on the theory that Amecco was acting in effect as [Hardesty Chemical’s] agent when it incurred the utility charges.”⁺⁹⁰¹⁸⁹ The government also noted that Hardesty Chemical was a subsidiary of W.C. Hardesty Company, Inc., which in turn was a subsidiary of Binney & Smith Company. W.C. Hardesty owned 75 percent of Hardesty Chemical’s preferred stock and Amecco owned the remaining 25 percent. W.C. Hardesty owned 51 percent and Bormar Corporation owned 49 percent of Hardesty Chemical’s common stock.⁺⁹¹¹⁹⁰

Henderson Riding Club

The Henderson Riding Club leased facilities from the CRC. No manufacturing processes appear to have occurred.

Henderson Telephone Company

The Henderson Telephone Company leased facilities from TIMET. No manufacturing processes appear to have occurred.

⁺⁸⁸¹⁸⁷ Information from WAA, Washington Credit Division Report, April 30, 1948. [BR002381-391]

⁺⁸⁹¹⁸⁸ According to a WAA summary pertaining to Hardesty Chemical operations, Hardesty accepted the RFC’s Letter of Intent in December 1945. The property was delivered to the company in operating condition on September 1, 1946. Information from WAA, Washington Credit Division Report, April 30, 1948. [BR002381-391]

⁺⁹⁰¹⁸⁹ WAA, Washington Credit Division Report, April 30, 1948, p. 6. [BR002386]

⁺⁹¹¹⁹⁰ WAA, Washington Credit Division Report, April 30, 1948. [BR002381-391]

Hodsdon Brothers, Inc.

Hodsdon Brothers, Inc. leased facilities from the US government. Details about the company's operations are unknown.

Industrial & Metallurgical Engineering Company

Industrial & Metallurgical Engineering Company leased facilities from the US government. Details about the company's operations are unknown.

J.B. Kelley

J.B. Kelley leased facilities from Kerr-McGee. Details regarding operations are unknown.

J.W. Conroy

J.W. Conroy leased facilities from the CRC. Details regarding operations are unknown.

John Wiley Jones Company, Inc.

John Wiley Jones Company leased facilities from TIMET. The company repackaged chlorinated chemicals for swimming pool maintenance and also manufactured sodium hypochlorite (bleach).

Jones Chemicals, Inc.

Jones Chemical is the successor to John Wiley Jones Company. It leases facilities from TIMET. The company repackages chlorinated chemicals for swimming pool maintenance.

Koch Materials Company (aka Koch Asphalt Company)

Koch Materials Company and/or Koch Asphalt Company leased facilities from Kerr-McGee and operated an asphalt emulsion batch plant for blending and packaging a variety of asphalt emulsions. The production process involved milling asphalt cement with soap emulsifiers.⁺⁹²¹⁹¹

Magnesite Truck Company

Magnesite Truck Company leased facilities from TIMET. Details regarding the company's operations are unknown.⁺⁹³¹⁹²

⁺⁹²¹⁹¹ KMCC ECA, p. 7-21. [B002130]

Mainor, William

William Mainor leased facilities from the CRC. Details regarding operations are unknown.

Mendelsohn, William

William Mendelsohn leased warehouse space from the US government and used it to store furniture. No manufacturing processes appear to have occurred.

Miller, Haynes & Smith, Inc.

Miller, Haynes & Smith, Inc. leased facilities from the CRC. Details regarding the company's operations are unknown.

Montrose Chemical Corporation of California

In 1947, Stauffer ~~Chemical Company~~ sub-leased approximately 10 acres of land to Montrose Chemical Corporation (Montrose), on which Montrose built an organic chemical manufacturing plant. The company expanded its operations in 1954, when it built a hydrochloric acid (HCl) manufacturing plant to produce industrial grade HCl. Montrose expanded its facilities again in 1977, but ultimately dismantled its entire organic chemical manufacturing plant in ~~1983.~~¹⁹⁴ 1983.¹⁹³ The area that Montrose leased from Stauffer between 1947 and 1983 changed, and ultimately involved twelve parcels totaling, at a maximum, approximately 20 acres.

Information regarding industrial processes and waste generation is presented in detail in Section 4 of the Montrose ECA, prepared in 1993. To briefly summarize, the company manufactured:

- Chloral, 1947-1983
- Chlorobenzene or MCB, 1947-1983
- Polychlorinated Benzenes, 1947-1983
- Dichlorobenzil, 1967-1983
- Muriatic acid, 1947-1983

¹⁹³¹⁹² TIMET ECA, p. 4-58. [B002862]

¹⁹⁴¹⁹³ Montrose ECA, p. 21. [B002332]

- Ethyl chloride, 1958-1961

Musical Arrangements, Inc.

Musical Arrangements, Inc. leased facilities from TIMET. The company's operations consisted of making music tapes. ⁺⁹⁵¹⁹⁴ No relevant manufacturing processes appear to have occurred.

Myers-Thornton Gas Company

Myers-Thornton Gas Company leased facilities from the US Government. The company distributed propane. No relevant manufacturing processes appear to have occurred.

National Sound Corporation

National Sound Corporation leased facilities from TIMET. It is believed that no production activities occurred. ⁺⁹⁶¹⁹⁵

Nevada Clay Products Company

Nevada Clay Products Company leased facilities from the US government. Details regarding the company's operations are unknown.

Nevada Precast Concrete Products

Nevada Precast Concrete Products leased office space from Kerr-McGee. ⁺⁹⁷¹⁹⁶ No manufacturing processes appear to have occurred.

Nevada Wholesale Meat Company

Nevada Wholesale Meat Company leased cafeteria facilities from the US government. No manufacturing processes appear to have occurred.

Nevada, New York & Ohio Chemical Company

Nevada, New York & Ohio Chemical Company leased facilities at the site under a sub-lease obtained from Stauffer ~~Chemical~~ during the time that Stauffer was leasing its site from the US

⁺⁹⁵¹⁹⁴ TIMET ECA, p. 4-55. [B002859]

⁺⁹⁶¹⁹⁵ TIMET ECA, p. 4-56. [B002860]

⁺⁹⁷¹⁹⁶ KMCC ECA, p. 7-23. [B002132]

government. It appears that the Nevada, New York & Ohio Chemical lease began in January 1946 and the plant closed in July 1947 for renovation. As of October 1947 the plant was inactive due to market conditions.⁺⁹⁸¹⁹⁷ It is unknown if the Nevada, New York & Ohio Chemical operations resumed. Nevada, New York & Ohio Chemical produced aluminum chloride.⁺⁹⁹¹⁹⁸

Nu-Bulk Transportation

Nu-Bulk Transportation leased facilities from Stauffer-~~Chemical~~. Nu-Bulk Transportation transported chlor-alkali products from Stauffer, along with similar materials for other companies at the site. Other transportation companies, including Bulk Transportation and Post Transportation, have also leased the same area from Stauffer and have presumably conducted similar operations.²⁰⁰¹⁹⁹

O.J. Scherer Company

O.J. Scherer Company initially leased Building T-3 until 1951, when it purchased it from CRC. The company subsequently sold it to TIMET. Scherer operated a machine shop, fabricated machinery, and conducted machinery and equipment repair activities.²⁰¹²⁰⁰

Paraffine Companies, Inc.

Paraffine Companies, Inc. leased facilities from the CRC. Details regarding the company's operations are unknown.

Per Boy Associates

Per Boy Associates leased facilities from TIMET. Details regarding the company's operations are unknown.

Pioche Manganese Company

Combined Metals Reduction Company assigned its lease for facilities at the site to Pioche Manganese Company. Pioche Manganese used a portion of the leased area for manganese slag

⁺⁹⁸¹⁹⁷ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

⁺⁹⁹¹⁹⁸ Sales Brochure, Plancor 201. n.d.

²⁰⁰¹⁹⁹ Stauffer/Pioneer ECA, p. 3-5. [B001671]

²⁰¹²⁰⁰ Information from Memorandum John R. Reilly to Irving Gumbel, July 15, 1947. [BR002371-373]

storage. Pioche processed ore supplied by the nearby Three Kids' Mine. The company operated an arc (carbon electrode) furnace for ore processing. The operations produced manganese and process slag, which was stockpiled in areas north and east of Building J-~~2~~.²⁰²2.²⁰¹

Post Transportation Company

Post Transportation Company leased facilities from the CRC and thereafter from Stauffer Chemical. Post Transportation transported chlor alkali products from Stauffer, along with similar materials for other companies at the site. Other transportation companies, including Bulk Transportation and Nu-Bulk Transportation, have also leased the same area from Stauffer and have presumably conducted similar operations.²⁰³202

Rosecrest Cabinets

Rosecrest Cabinets leased facilities from TIMET. Details regarding the company's operations are unknown.

Saguaro Power Corporation

Saguaro Power Corporation leased six acres from Pioneer ~~Chlor-Alkali Company~~ for the construction and operation of a 90-megawatt natural gas-fired electrical cogeneration facility.²⁰⁴203 The plant was commissioned in 1991 and has been in operation since then. Pioneer receives the steam and Nevada Power Company purchases the electricity.

Sears Robuck & Company

Sears Robuck & Company leased warehouse space from the US government and used it for furniture storage. No manufacturing processes appear to have occurred.

Skaggs Company, Inc.

Skaggs Company, Inc. leased warehouse facilities from TIMET. Details regarding the company's operations are unknown.

²⁰²201 TIMET ECA, p. 3-3. [B002784]

²⁰³202 Stauffer/Pioneer ECA, p. 3-5. [B001671]

²⁰⁴203 See p. 3-9.

Southern Nevada Auto Parts and related companies

Robert and William Ellis leased a 10-acre portion of the Kerr-McGee site doing business as SNAP-TOW, Southern Nevada Auto Parts, and Pick-A-Part. Ed Smith and Vern Christensen have been leaseholders since January 1990, doing business as Nevada Recycling (an auto salvage yard) on the northern portion of this area. Operations at the auto impound yard (SNAP-TOW) consist of storage of wrecked, police impounded, and repossessed vehicles. Activities at the auto salvage yard at the northern and western portions of the lease area include buyer dismantling and retrieval of parts. ²⁰⁵204.

State Industries, Inc.

State Industries leased space from Kerr-McGee for the production of commercial and domestic water heaters. ²⁰⁶205 The company also leased a portion of the site from TIMET and used it to store non-PCB-containing transformers. ²⁰⁷206

State of Nevada, Employment Service Department

The Employment Service Department leased office space from the US government. No manufacturing processes appear to have occurred.

State Stove and Manufacturing Company

State Stove and Manufacturing Company leased warehouse space from TIMET. No manufacturing processes appear to have occurred.

Stauffer Chemical Company of Nevada

Stauffer Chemical Company of Nevada initially leased a portion of the site from the US government. The company subsequently purchased that portion of property as well as additional parcels. Pioneer ~~Chlor-Alkali Company, Inc.~~ acquired Stauffer's manufacturing facilities in October ~~1988.~~ ²⁰⁸1988. ²⁰⁷ Production processes used by Stauffer and Pioneer are described in depth in Section 4 of the Phase I ECA, prepared in 1993. To briefly summarize, the Stauffer used five industrial processes for the production of:

²⁰⁵204 KMCC ECA, pp. 7-26 to 7-28. [B002135-137]

²⁰⁶205 Henderson Steering Committee ECA, p. 16 [B002484]

²⁰⁷206 TIMET ECA, p. 4-57. [B002861]

²⁰⁸207 Henderson Steering Committee ECA, p. 13. [B002481]

- Parachlorothiophenol/Thiophenol
 - Parachlorothiophenol, 1960-1984
 - Thiophenol, 1967-1982
- Trithion/Imidan process, 1958-1984
 - Trithion, 1958-1984 (intermittent)
 - Methyl Trithion, 1960-1963
 - O,O-diethylphosphorodithoioic acid (DTA), 1972-1975, 1977-1984
 - Imidan, 1964-1976 (intermittently)
- Benzene Hexachloride process (Lindane), 1946-1958
- Chlor Alkali process, 1945 to present (since October 1988 under Pioneer)
- HCl process, 1945 to present^{209,208} (since October 1988 under Pioneer. The HCl unit was owned by Montrose ~~Chemical Company~~ until at least 1997 and leased to Pioneer.)

Operations subsequent to 1988 have been limited to the production of chlorine, sodium hydroxide (caustic soda), sodium hypochlorite (bleach), and muriatic (hydrochloric) acid.

TIMET

TIMET was formed by a joint venture agreement between Allegheny Ludlum Steel Corporation and National Lead Company in 1950.²⁴⁹ 1950.²⁰⁹ National Lead initially leased facilities at the site from the CRC, which assigned the leases to the GSA after the CRC has sold most of the Basic Magnesium property. TIMET ultimately obtained title to the leased property. Industrial processes and wastes generated are discussed in detail in Section 4 of the TIMET ECA. To summarize, the principal products manufactured by the company are:

- Titanium ingots
- Titanium tetrachloride
- Titanium sponge
- Titanium fines

^{209,208} Stauffer/Pioneer ECA, p. 1-2. [B001661]

²⁴⁹ Timet, ECA, April 15, 1993., p. 3-1

- Neutralized leach liquor (magnesium chloride sold as a roadway dust suppressant)

The process used to produce titanium starts with the chlorination of rutile (titanium dioxide ore) to produce titanium tetrachloride. The titanium tetrachloride is then purified and reduced to titanium metal with elemental magnesium.

TIMET Employees Federal Credit Union

TIMET Employees Federal Credit Union leased office space from TIMET. No relevant manufacturing processes appear to have occurred.

True Gems

True Gems leased facilities from the US government. The company manufactured costume jewelry. No relevant manufacturing processes appear to have occurred.

Underwriters Salvage Company of New York

Underwriters Salvage Company of New York leased space from the US government. The company used the space for warehousing and processing salvaged groceries. No relevant manufacturing processes appear to have occurred.

Union Pacific Railroad Company

Union Pacific Railroad Company leased office space from the CRC. No manufacturing processes appear to have occurred.

United States Vanadium Corporation

United States Vanadium Corporation leased facilities at the site from the US government. The company's operations included chemical beneficiation of tungsten concentrates produced by itself and others in Nevada and California.²¹²¹⁰ Work as of October 1947 consisted of reclaiming concentrates from the settling ponds and re-running them for scheelite.²¹²¹¹ The company produced synthetic scheelite, tungstic acid, molybdenum trisulphate, ammonia parathustate.

²¹²¹⁰ Information from WAA, Proposal of USVC lease, February 28, 1946. [BR002359-363]

²¹²¹¹ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

U.S. Lime Products Corporation

U.S. Lime Products Corporation appears to have initially leased facilities at the site from the CRC. The company's successors acquired the site. See the discussion under Chemstar Lime Company.

U.S. Navy

In 1950, WECCO entered into an agreement with the Navy Department to set up and operate a sodium perchlorate plant in a part of the Basic Magnesium facility. In addition, WECCO agreed to operate a 50-ton per day ammonium perchlorate plant on 290 acres that the Navy acquired from WECCO.²¹³²¹²

In 1954, WECCO was absorbed by American Potash & Chemical Corporation and took over all contract rights from WECCO in connection with the Navy facility. WECCO and American Potash & Chemical Corporation had no lease with the Navy; instead the company operated the plant, furnishing ammonium perchlorate on a supply contract for the Navy Department. The supply contract provided that sufficient money be included in the per pound charge of ammonium perchlorate to cover overhead, maintenance, profit, and production costs.²¹⁴²¹³

Through most of its operation, the plant was the sole producer of ammonium perchlorate for defense purposes.²¹⁵²¹⁴ According to a 1958 appraisal of the Naval Industrial Reserve Plant, the Government, "either directly or indirectly through defense contractors, was the sole purchaser of ammonium perchlorate in volume."²¹⁶²¹⁵

²¹³²¹² Deed of Conveyance, October 26, 1953. NARA San Bruno, RG 121, Box 23, Folder: N-Nev-5-415 US Naval Industrial Reserve Plant (DOD 473 and DOD 217). [BR002789-793] The Navy vested title to the property to the United States of America on December 31, 1953. Letter to Regional Director, GSA, January 18, 1954. NARA San Bruno, RG 121, Box 4, Folder: R-Nev-5, Basic Magnesium, Western Electrochemical Co. General through Final Disposition. [BR002436-437]

²¹⁴²¹³ Appraisal of US Naval Industrial Reserve Plant (DOD 473 and DOD 217), October 31, 1958. NARA San Bruno, RG 121, Box 22, Folder: N-Nev-5-415 US Naval Industrial Reserve Plant (DOD 473 and DOD 217). [BR002535-537]

²¹⁵²¹⁴ Appraisal of US Naval Industrial Reserve Plant (DOD 473 and DOD 217), October 31, 1958. NARA San Bruno, RG 121, Box 22, Folder: N-Nev-5-415 US Naval Industrial Reserve Plant (DOD 473 and DOD 217). [BR002583]

²¹⁶²¹⁵ Appraisal of US Naval Industrial Reserve Plant (DOD 473 and DOD 217), October 31, 1958. NARA San Bruno, RG 121, Box 22, Folder: N-Nev-5-415 US Naval Industrial Reserve Plant (DOD 473 and DOD 217). [BR002584]

The industrial facilities associated with the government-owned WECCO/American Potash & Chemical Corporation facilities consisted of two parts:

- Production equipment situated in buildings owned by the company, which was covered under a Naval Bureau of Ordnance contract, NOrd (F) 1741 (DOD-217).
- Approximately 290 acres of land, plus buildings, equipment, and improvements, which were owned by the Navy Department and built adjacent to WECCO's property. This portion of the facilities was covered under a Naval Bureau of Ordnance contract, NOrd (F) 1740 (DOD-473).

US Treasury Department, Bureau of Federal Supply

The US Treasury Department leased storage space for magnesium ingots.²¹⁷²¹⁶ No manufacturing processes appear to have occurred.

Vadelite Corporation

Vadelite Corporation leased office space from the US government. The company designed prefabricated houses. No relevant manufacturing processes appear to have occurred.

Western Electro Chemical Company/Kerr-McGee Chemical Corporation

WECCO initially leased facilities from the US government. It subsequently purchased the property.

Industrial processes and wastes generated are discussed in the Kerr-McGee ECA, Section 4. To briefly summarize, the facility has three production areas:

- Chlorate/perchlorate-based compounds
 - Sodium chlorate, 1945 to at least 1990
 - Potassium chlorate, 1945-1975
 - Potassium perchlorate, 1945-1983
 - Sodium perchlorate production, 1945 to at least 1990
 - Ammonium perchlorate, 1951 to at least 1990
 - Magnesium perchlorate, 1969-1976

²¹⁷²¹⁶ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

- o Tumbleaf Defoliant®, 1975-1985
- Electrolytic manganese dioxide, 1951 to at least 1990
- Boron and halogenated boron products,
 - o Elemental boron, 1972 to the present
 - o Boron Trichloride, 1972 to the present
 - o Boron Tribromide, 1973 to the present

Western Mineral & Development Corporation

Western Mineral & Development Corporation leased facilities at the site from the US government. The company reportedly processed gypsum and conducted truck repair activities.²¹⁸²¹⁷ The company was unable to secure financing, and the extent of its operations is unclear.²¹⁹²¹⁸

Zenoft, M.

M. Zenoft leased facilities from TIMET for a radio station. The lease was assigned to Television Company of America. No relevant manufacturing processes appear to have occurred.

2.3 DISPOSAL PRACTICES ON TO BMI COMMON AREAS

Information regarding the owners' and/or lessees' disposal practices on to the BMI Common areas is provided below. It is arranged alphabetically by company name. [An overview of the source characterization for the Eastside and CAMU areas, based on data collected from investigations conducted since 1996, is presented in Section 4.2.](#)

Amecco Chemicals Inc.

Amecco Chemicals reportedly disposed of wastes in the BMI Landfill. Types and volume of wastes are unknown.²²⁰²¹⁹

²¹⁸²¹⁷ Monthly Report of Status of Lessees for October 1947. [NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11]

²¹⁹²¹⁸ Sales Brochure, Plancor 201. n.d.

²²⁰²¹⁹ Henderson Steering Committee ECA, p. 40. [B002508]

Basic Magnesium Inc. ²²¹²²⁰

All of the wastes deposited in or discharged to the BMI Common Areas from the Basic Magnesium operation can be classified as either: (1) solid material which would go to a landfill, (2) total suspended solids (TSS) and total dissolved solids (TDS) which would go to evaporation ponds, or (3) trace impurities which would be discharged with the dissolved and suspended solids. These wastes can be characterized as salts from the production process (chloride salts of magnesium, sodium, calcium, etc.) and organic and inorganic solids of various types. The solids would have consisted of impurities in the magnesite, compounds formed from the impurities in the acid neutralization process, sodium carbonate formed by the reaction of excess caustic with carbon dioxide, and chlorinated organics formed by the reaction of chlorine with carbon at elevated temperatures. These materials would have left behind a residual evaporite in the soils of the evaporation ponds on the Common Areas. This following briefly examines the types of wastes likely produced by each of the major process steps.

Chlorine/Caustic Plant

In the Chlorine/Caustic plant there were several ways in which wastes occurred:

- The salt arrived in the plant in solid form. To use the material it was necessary to dissolve the salt in water to form a saturated brine solution. Solid impurities in the salt needed to be removed. As a result, mud and other insoluble material were settled out of the brine and were eventually washed, presumably to the Basic Magnesium settling ponds.
- Before the salt brine could be used in the chlorine cells, it had to be purified. Sodium carbonate was introduced into the brine and precipitated calcium as calcium carbonate and magnesium as magnesium carbonate. The material (sludge) was settled out of the brine and discharged to the settling ponds. In addition to the carbonates, the sludge material carried a significant amount of salt with it.
- A certain amount of asbestos waste was generated from this operation. The Hooker electrolytic chlorine cell used an asbestos membrane. Every time the cell was rebuilt, the old membrane was discarded. The total quantity of this was small (100 to 200 tons).

²²¹²²⁰ In addition to cited sources, see Expert Report of Clifford B. Wilson on Wastes Produced by Basic Magnesium, Inc., March 18, 2004, and Supplemental and Rebuttal Expert Report, Clifford B. Wilson on Wastes Produced by Basic Magnesium, Inc., April 19, 2004.

- There is indication that, at least in the early days of the plant, all of the caustic from the chlorine/caustic plant was wasted.²²²²²¹ The caustic, when combined with the discharge from the magnesium portion of the operation, precipitated magnesium hydroxide, which resulted in a solution leaving the plant with a pH in the range of 11 and would have resulted in white solids being deposited in the ponds. It appears that through May or June of 1943 all of the caustic was used as cell effluent from the chlorine cells. The caustic that was used for neutralization up through May 1943 was wasted as sodium carbonate. Because this material was cell effluent it also contained a significant amount of salt (15 percent). Beyond that point (*i.e.*, May 1943), the caustic was wasted as a 50 percent caustic solution in water and went to the evaporation ponds.²²³²²² It is probable that the wasted caustic was either carbonated by the addition of CO₂ or by the reaction with CO₂ from the atmosphere and was ultimately deposited as sodium carbonate in the pond.
- The caustic evaporator plant began operations in the summer of 1943 and sales of caustic soda from the plant first occurred in August 1943. There would have been losses from this plant, mainly in the form of a “sulfate purge” stream. The sulfate purge stream was generated when sulfate was removed from the caustic that was being evaporated. This stream was purged from the plant and most probably went to the Basic Magnesium ponds. The sulfate purge stream contained sodium sulfate, caustic and salt. The estimate of losses assumes that the caustic soda that was not sold and utilized as a commercial product was wasted. According to hearings conducted after the plant shut down, 45,314 tons of caustic was shipped from the plant at a value of \$775,920.
- The chlorine liquefaction process produced at least two waste streams:
 - A small chlorinated organic stream was generated by the chlorine drying step. Indications are that this was discharged to a small impoundment near the plant.
 - Cleaning up the tail gas from the liquefaction process generated a sodium hypochlorite stream. It was estimated that the loss of chlorine with the tail gas was two percent,²²⁴²²³

²²²²²¹ Phase I Environmental Conditions Assessment Report, Pioneer Chlor Alkali Company, Inc. Stauffer Chemical Company Site, Weston Managers Designers/Consultants, March 22, 1993, p. 5-4. [B001722]

²²³²²² Phase I Environmental Conditions Assessment for The Basic Management, Inc. Industrial Complex Clark County, Nevada, Geraghty & Miller, Inc., April 14, 1993, p. 33. [B002501]

²²⁴²²³ Chlorine & Caustic Plants and Henderson Plant Services, Description of Process and Equipment, Chlorine Plant – Liquefaction quantity flow sheet. [BR002266].

but considering the low pressure (30 pounds per square inch [psi])²²⁵²²⁴ used in the liquefaction process, it is likely that the losses were much higher.

The Chlorinators

The chlorinator furnaces were a major source of losses from the magnesium process. Some of these sources include the following:

- The chlorination reaction does not proceed with 100 percent efficiency. As a result, there was a loss of chlorine from the chlorinators.
- HCl was generated in the chlorinator. This was a result of the reaction of chlorine and water at the high temperature to form HCl.
- Because of the high temperature in the chlorinator, some of the magnesium chloride evaporated and was carried out of the chlorinator as a vapor.²²⁶²²⁵
- The temperatures in the chlorinator along with the presence of chlorine with large amounts of carbon led to the formation of relatively low levels of chlorinated organics.²²⁷²²⁶ These organics were carried as a vapor out of the chlorinator and most would condense in the chlorinator scrubbers. They were eventually discharged with the cooling water from the scrubbers. In general, these devices are known to produce hexachlorobenzene and chlorinated dibenzofurans as byproducts.
- Impurities coming in with the magnesite (iron oxides, silica, etc.) and the coal tended to build up in the chlorinators. It was necessary to remove the chlorinator from service approximately every three weeks in order to remove this material.²²⁸²²⁷

²²⁵²²⁴ Chlorine & Caustic Plants and Henderson Plant Services, Description of Process and Equipment, p. 4. [BR002220]

²²⁶²²⁵ Kh. L. Strelets, Electrolytic Production of Magnesium, TT76-50003, U.S. Dept. of Commerce, Technical Information Service, Springfield, Va., translated by J. Schmorak, Keter Publishing House Jerusalem Ltd., 1977, p. 193.

²²⁷²²⁶ Reference document submitted by the Experts of the European Community and Member States of the European Union on Best available techniques (BAT) and best environmental practices (BEP) for reducing and/or eliminating emissions of by-products POPs to the First Session of the UNEP Expert Group on BAT and BEP, 10-14 March 2003, USA, p. 39.

²²⁸²²⁷ Engineering and Mining Journal, October 1943, p. 66.

- Flow sheets indicate that magnesium chloride was recycled from the chlorinators to the pellet production operation. However, because these pellets were dried at high temperature²²⁹²²⁸ (about 1,800 degrees F), this material can be considered to be a total loss. This is because at that temperature the magnesium chloride break downs and forms HCl.²³⁰²²⁹ The acid was discharged through the scrubbers in the pellet production plant.

The Magnesium Cells

The magnesium cells were the heart of the process. This was the point where everything came together to produce the product of the plant. Only minor amounts of waste would have been generated from the cells themselves. Most of the waste materials were in solid form, although there were probably minor amounts of liquid wastes. These wastes included:

- Cell Mud (sludge) was the material that settled to the bottom of the cell and had to be removed before it caused a deterioration of cell performance. The cell mud generally contained MgO, some magnesium metal, acidic insoluble material and the remainder being cell bath.²³⁴²³⁰ The material came out as a solid (even though much of it was soluble) and, in all probability, it ended up in the Basic Magnesium landfill.
- Cell Melt had to be periodically removed from the cell. This was typically done to control the composition of the cell melt in the cell. The material also came out as a solid. Most of this material went to make flux. The flux, in turn, went to the casting operation and then eventually ended up as a waste from the casting operation.
- Some waste associated with the gas handling system was probably generated. The chlorine gas coming from the cell was sent to the chlorinator. A certain amount of cell melt salts were present in the cell gas (due to evaporation of the salts from the cell). These would be lost either as a solid in the gas handling system or eventually as an aqueous discharge to the evaporation ponds. There is also indication that gas from the cathode compartment of the cells was scrubbed in a water scrubber. This gas would have contained HCl.

²²⁹²²⁸ Metallurgical Operation at Basic Magnesium, Inc. Las Vegas, Nevada, April 23, 1942, p. 4. [R004807]

²³⁰²²⁹ K. K. Kelly, *Energy requirements and Equilibria in the Dehydration, Hydrolysis, and Decomposition of Magnesium Chloride*, technical paper 676, U.S. Dept. of Interior, Bureau of Mines, Washington, D. C., 1945.

²³⁴²³⁰ Kh. L. Strelets, *Electrolytic Production of Magnesium*, TT76-50003, U.S. Dept. of Commerce, Technical Information Service, Springfield, Va., translated by J. Schmorak, Keter Publishing House Jerusalem Ltd., 1977, p. 302-303.

- In addition to the wastes listed above, Magnesium cells are known to produce trace quantities of chlorinated organics. The conditions in the electrolytic cell (*i.e.*, strong chlorine, graphite and a temperature of 700 °C) provide conditions that are capable of producing highly chlorinated organics such as hexachlorobenzene.²³²²³¹

Magnesium Casting

Essentially all the wastes generated from the casting operations were in solid form. When magnesium is handled in the molten form, a certain amount of burning takes place. Fluxes were used to minimize this burning by protecting the surface of the melt. Fluxes were also utilized to settle impurities out of the metal. The MgO from burning and the fluxes were all heavier than the metal and eventually settled to the bottom of the holding crucible. The sludge from the casting operation was removed from the casting crucibles and most probably went to the landfill. Typically the losses from the casting of magnesium run in the order of six percent or more of the magnesium metal handled.²³³²³²

Flux Plant

The wastes from the flux plant would have been minimal. There are, in general, two types of fluxes. The first of these are blended fluxes, which were made by mixing solid materials (chloride salts) together and then packaging them. The second type of flux is a fused flux, which was made by melting the salts and then grinding (after solidification) or flaking the materials to provide the flux in a form that can be used in the casting operation. Neither of these types of operations produce a significant amount of waste either in solid or liquid form. There were dust collectors associated with the operation that would have captured dusts and discharged them with the liquid effluent from the plant.

TSS and TDS Discharges

There were extensive discharges of suspended solids. A Basic Magnesium internal report generated before the plant started up predicted discharge of an estimated 300 tons per day.²³⁴²³³

²³²²³¹ Zero Toxics, Sources of by-product POPs and their Elimination, Darryl Luscombe and Pat Costner, Greenpeace International Toxics Campaign, May 2001, p. 14-15.

²³³²³² Hearing of the Sub-committee on Light Metals and Aviation of the Special Committee Investigating the War Program, Held in the Office of Mr. F. O. Case, General Manager Basic Magnesium on May 11, 1943 at 2:30 P.M., p. 41. [BR032205]

²³⁴²³³ Basic Magnesium Incorporated Engineering Department, History of Civil Engineering, by E. H. Clary, BMI Internal Report No. 18, Date: April 1, 1942, p. 18. [BR33900]

Since the plant management's only concern with waste was where they could put it, this number was used to estimate the TSS discharge. Although parts of the operation probably operated and discharged waste more than just during the time of the production magnesium, the estimate of the discharge has been made only on the basis of a stabilized full production capacity. Some portion of these TSS discharges would have been due to impurities contained in the magnesite feed to the plant.

The composition of the TSS and TDS from the Basic Magnesium process would have been a varied mix of materials that included, but were not limited to, the following:

- Arsenic
- Asbestos
- Calcium carbonate
- Chlorinated hydrocarbons containing hexachlorobenzene, chlorinated dibenzofurans, octachlorostyrene, PCBs, and others
- Magnesium chloride
- Magnesium hydroxide
- Muds
- Other chlorides such as calcium chloride and potassium chloride
- Sodium carbonate
- Sodium chloride
- Sodium hydroxide
- Sodium hypochlorite
- Sodium sulfate
- Sulfuric acid (H₂SO₄)
- Wastes from the magnesite

There were numerous places where these materials entered the waste streams leaving the Basic Magnesium process. The following is a partial list of the places where these wastes entered the streams that eventually ended up in the Basic Magnesium evaporation ponds:

- Cooling water from numerous sources
- Cooling tower blow down
- Dust collector at the Flux Plant
- Dust from chlorine filters and chlorine mains
- Filters and surge tanks at the Brine Preparation plant
- Slurry from the Recovery and Neutralization plant
- Wash Tower at the Preparation Plant
- Wash Tower for cathode exhaust
- Water from the Henderson Sewer treatment plant

Cell Demolition

After the plant operations ceased, the magnesium cells would have eventually been demolished and put into the landfill. The debris from this would have consisted of the bath in the cells, the refractory used in the cell, the anodes and the cathodes used in the cell. The steel shell might have been recovered as recycled steel.

Calculated Waste Totals

Basic Magnesium, Inc

Portion of the Process	Total Tons of Wastes
Liquid Losses	
Material lost to Trade Effluent Ponds	90,429
Magnesium plant losses to Upper Ponds	230,127

Chlorine/caustic plant losses to Upper Ponds	104,803
Chlorine/caustic plant losses to Lower Ponds	10,982
Losses going to Landfill	
Cell Mud	14,824
Solids lost in the chlorinator	24,545
Losses of casting sludge	26,520
Magnesium Cells going to landfill	20,730
Landfill Total	86,619

City of Henderson ²³⁵²³⁴

Sewage treatment facilities (HSTP1) operated by the City of Henderson were constructed in 1958. HSTP1 continued operations until 1985, when it was closed.

HSTP1 received and treated domestic and light industry sewage from the Henderson/Pittman area. It did not receive or treat BMI sewage effluent.

A sewage treatment plant constructed in 1942 received and treated sewage effluent from the BMI industries and the City of Henderson until it closed in or about 1985. BMI operated the plant until 1974, at which time the City of Henderson assumed ownership and control. Sewage at HSTP2 underwent minor treatment and was discharged as raw sewage into the upper ponds. Unlined infiltration basins located near HSTP2 continue to receive treated effluent from the City of Henderson.

Sewage from the Henderson/Pittman area is currently treated through HSTP3, which began operations in November 1983. Sewage is treated and passes through microscreens at HSTP3 before discharge into the infiltration basins. Treated effluent is periodically pumped into the lower ponds whenever the discharge from HSTP3 exceeds its capacity. ²³⁶²³⁵

²³⁵²³⁴ In addition to the cited sources, see Expert Report of Paul D. Fahrenthold, Ph. D., March 18, 2004, and Fahrenthold Supplemental and Rebuttal Expert Report, April 19, 2004.

²³⁶²³⁵ See Henderson Steering Committee ECA, p. 58-60. [B002526-528]

As noted earlier, the City of Henderson also operated RIBs as injection points for municipal waste water on a portion of the site from 1992 to at least 2002.

Hardesty Chemical Company

Hardesty Chemical Company reportedly disposed of wastes in the BMI Landfill. Types and volume of wastes are unknown. ²³⁷236

Jones Chemical Company

Jones Chemical Company disposed of wastes to the:

- BMI Landfill
 - Wastes included general trash and floor sweeping, sodium carbonate, sodium bicarbonate, diatomaceous earth, tri-sodium phosphate, Borax, Vermiculite clays, sodium chloride, and sodium sulfate. ²³⁸237
- BMI Upper Ponds
 - Rinse and wash water containing small amounts of chlorides. ²³⁹238

Montrose Chemical Corporation of California ²⁴⁰239

Process waste streams generated from the manufacture of all the products produced by Montrose can be classified as H₂SO₄ waste, HCl waste, sodium hypochlorite waste, and sulfonated organics waste. Specific information describing the wastes discharged to the BMI Ponds as of 1971 is provided in the Montrose ECA. ²⁴¹240

²³⁷236 Henderson Steering Committee ECA, p. 40. [B002508]

²³⁸237 Henderson Steering Committee ECA, p. 45. [B002513]

²³⁹238 Henderson Steering Committee ECA, p. 58. [B002526]

²⁴⁰239 In addition to the cited sources, see Expert Report of Paul D. Fahrenthold, Ph. D., March 18, 2004, and Fahrenthold Supplemental and Rebuttal Expert Report, April 19, 2004.

²⁴¹240 See Montrose ECA, pp. 78-79. [B002389 and B002390] The information is further summarized on individual pages BR 013616 and labeled H-01. Page H-01 also provides information on a non-process stream, demineralizer wastes, also discharged to the BMI Ponds. The Montrose process flow diagrams included in the ECA [B0001623, B0001629, and B0001630] and the data from BR013616 provide the basis for a material balance calculation of the wastewater quantities discharged to the BMI Ponds.

Wastes discharged from the Montrose operations were commingled with wastes from Stauffer's operations in plant sewers.²⁴²²⁴¹ Stauffer reports that historically, stormwater and wastewaters from the Stauffer and Montrose operations areas were conveyed to off-site impoundments via a system of ditches.²⁴³²⁴² In 1970-1971, the combined effluents were diverted from the Lower to the Upper Ponds through the Beta Ditch Extension.²⁴⁴²⁴³

The Montrose ECA indicates that the company disposed of wastes to the:

- Basic Magnesium Landfill
 - Wastes included still bottom residues, empty DDT paper bags, and miscellaneous equipment and scrap²⁴⁵²⁴⁴
- Basic Magnesium Ponds via process sewers
 - Wastes included chloride wastes, H₂SO₄ wastes, and process washwaters containing sulfonated metabolites of DDT.²⁴⁶²⁴⁵

Historical records provide additional information about waste disposal practices:

- In September 1957, Stauffer identified sources of contaminants in its and Montrose's effluent. Those items specifically identified as belonging to Montrose are:
 - Dilute HCl from Montrose included all HCl that could not be sold.
 - Spent H₂SO₄ from Montrose Chloral stills – 860 tons per month. The H₂SO₄ content was about 70 percent by weight and thus was equivalent to about 600 tons per month of 100 percent H₂SO₄.
- A November 1970 Stauffer Chemical Company Industrial Waste Survey identified six separate discharge lines from the Stauffer and Montrose facilities.²⁴⁷²⁴⁶ Those items specifically identified as belonging to Montrose are:

²⁴²²⁴¹ See Montrose ECA, p. 77. [B002388]

²⁴³²⁴² The ditches can be found in the Montrose ECA, Figure 5-1 [B001720] and 5-3 [B0001726]

²⁴⁴²⁴³ Pioneer/Stauffer ECA, p. 5-7. [B001725]

²⁴⁵²⁴⁴ See Montrose ECA, Section 5.10, p. 76. [B002387]

²⁴⁶²⁴⁵ See Montrose ECA, Section 5.11 and 5.12, pp. 77-83. [B002388-394]

- o Montrose discharge to the American Potash ponds: consisted principally of a Montrose chemical waste stream and a smaller stream from a H₂SO₄ tank overflow. The total stream was estimated to be 600,000 gallons per day.
- o Main Sewer discharge was a blend of eight streams going to the storm sewer at an estimated 2.4 million gallons per day. The streams included:
 - o Once-through cooling water from the Montrose building
 - o Caustic waste and Montrose Water: once-through cooling water from Montrose Building 5A. The water was contaminated with the effluent from the caustic sump, which handled waste from the filter and floor washings. The estimated discharge rate was 1.7 million gallons per day.

Additional information regarding the combined Stauffer and Montrose waste stream can be found in the Stauffer Chemical section.

²⁴⁷²⁴⁶ Montgomery Research, Inc., Stauffer Chemical Company Industrial Waste Survey, November 1970. [ST013797-830]

Calculated Waste Totals

Montrose Chemical Corporation of California

Process Operation	Dates Operation Occurred (Years)	Volume of Waste (Tons)	TDS Concentration in Waste (Percent)	Volume of TDS Waste (Tons)	Distribution of Wastes	
					Upper Ponds (Jan. 1971- Dec. 1975)	Lower Ponds (May 1945- Dec. 1970)
Oliver Filtrate	1/67-12/75	55,232	0.10%	55	31	25
HCl Wastes	1/47-12/75					
Final vent scrubber		1,271,216	0.50%	6,356	1,096	5,260
Acid plant main sewer		317,804	0.50%	1,589	274	1,315
HCl Gas demister		88	35.00%	31	5	26
Benzene wash water		11,035	2.18%	241	41	199
Sulfonated Organics	1/67-12/75					
Sulfonated organics		236,709	2.00%	4,734	2,630	2,104
H ₂ SO ₄ waste		236,709	6.00%	14,203	7,890	6,312
Demineralizer Wash Water	1/47-12/75	235,174	1.50%	3,528	608	2,919
Chloral drying vent scrubber	1/47-12/75	127,122	0.60%	763	132	631
P-1 condensate	1/47-12/75	50,849	0.04%	20	4	17
Poly column &	1/47-12/75	1,271,21	0.10%	1,271	219	1,052

Process Operation	Dates Operation Occurred (Years)	Volume of Waste (Tons)	TDS Concentration in Waste (Percent)	Volume of TDS Waste (Tons)	Distribution of Wastes	
					Upper Ponds (Jan. 1971- Dec. 1975)	Lower Ponds (May 1945- Dec. 1970)
P-10 evactor		6				
MCB column evactor	1/47-12/75	1,271,216	0.10%	1,271	219	1,052
Totals				34,062	13,149	20,912

Pioche Manganese Company

Pioche Manganese Company reportedly disposed of wastes in the Basic Magnesium Landfill. Types and volume of wastes are unknown. ²⁴⁸₂₄₇

State Industries, Inc. ²⁴⁹₂₄₈

State Industries discharged wastes to the:

- Basic Magnesium Ponds, 1970 to 1974
 - The composition of the waste was steel cleaning and preservation wash liquids. Individual components of the waste included borax, soda ash, phosphate chemicals, and H₂SO₄. ²⁵⁰₂₄₉ Wastewater discharge to ponds at a rate of 35,000 gallons per month. ²⁵¹₂₅₀
 - Liquid wastes periodically discharged to the Beta Ditch through the acid drain system included neutralized and unneutralized waste cyanide solutions, pickling process wastes, spent H₂SO₄, borax, soda ash, and phosphate chemicals. In addition, State Industries

²⁴⁸₂₄₇ Henderson Steering Committee ECA, p. 40. [B002508]

²⁴⁹₂₄₈ In addition to the cited sources, see Expert Report of Paul D. Fahrenthold, Ph. D., March 18, 2004, and Fahrenthold Supplemental and Rebuttal Expert Report, April 19, 2004.

²⁵⁰₂₄₉ State Industries to W.M. Tebeau, March 23, 1982. [BR014200-203]

²⁵¹₂₅₀ State Industries to H. LaVerne Rosse, May 18, 1982. [BR014285] J.A. Westphal and W.E. Nork, "Reconnaissance Analysis of Effects of Waste Water Discharge on the Shallow Groundwater Flow System Lower Las Vegas Valley Nevada," April 1972. [BR023990]

discharged surface impoundment contents to the acid drain system on three occasions to facilitate liner repairs.²⁵²²⁵¹

- Basic Magnesium landfill: approximately 50 pounds of asbestos pipe wrapping.²⁵³²⁵²

Stauffer Chemical Company of Nevada/Pioneer Chlor-Alkali Company, Inc.²⁵⁴²⁵³

Stauffer/Pioneer provided information regarding waste disposal to the BMI Common Areas in Section 5.3 of the Stauffer/Pioneer ECA. To briefly summarize, Stauffer/Pioneer disposed of wastes to the:

- Basic Magnesium Landfill, 1945-1979
 - Wastes included concrete cell parts, asbestos shavings, asbestos sludge, graphite anodes, chlorine liquefaction sludge, carbon tetrachloride, and high paraffin fuel oil.
- Basic Magnesium Upper and Lower Ponds and associated conveyance ditches, 1946-1976
 - Wastes included asbestos, industrial effluent, and stormwater. Stormwater (but not industrial effluent) disposal to the Basic Magnesium Ponds continued at least until 1981.

Historical records provide additional information about waste disposal practices:

- In March 1952, Stauffer wrote to the CRC asking permission to “use the one large Northwest evaporation pond inside the BMP fenced area....” The company needed to use the additional pond because the caustic evaporation ponds that it leased from the CRC were “full almost to the point of overflow into the main storm sewer drain ditch.”²⁵⁵²⁵⁴
- In September 1957, Stauffer identified sources of contaminants in its and Montrose’s effluent:
 - Sludge from brine area – an average of 380,000 pounds per month.
 - Dilute HCl from Montrose included all HCl that could not be sold.

²⁵²²⁵¹ KMCC ECA, p. 7-3 [B002112]

²⁵³²⁵² Henderson Steering Committee ECA, p. 45. [B002513]

²⁵⁴²⁵³ In addition to the cited sources, see Expert Report of Paul D. Fahrenthold, Ph. D., March 18, 2004, and Fahrenthold Supplemental and Rebuttal Expert Report, April 19, 2004.

²⁵⁵²⁵⁴ A.T Newell to R.J. Moore, March 7, 1952. [ST011629]

- o Spent H₂SO₄ from Montrose Chloral stills – 860 tons per month. The H₂SO₄ content was about 70 percent by weight and thus was equivalent to about 600 tons per month of 100 percent H₂SO₄.
- o Caustic plant sewers – 100 tons of 100 percent sodium hydroxide per month, 50 tons sodium chloride per month, 10,000 pounds of Filter-Aid (based on 400 filter runs), and 7,500 pounds per month MgO (based on 1,500 tons of 100 percent low iron sodium hydroxide at 5 pounds of MgO per ton).
- o Chlorine Area – 1,000 pounds per month of asbestos from cell renewal and 100 percent H₂SO₄ equivalent in H₂SO₄ (dilute), which was on average 52,000 pounds per month for ~~1957.~~²⁵⁶ 1957.²⁵⁵
- A November 1970 Stauffer Chemical Company Industrial Waste Survey identified six separate discharge lines from the Stauffer and Montrose facilities.²⁵⁷256
 - o Montrose discharge to the American Potash ponds: consisted principally of a Montrose chemical waste stream and a smaller stream from a H₂SO₄ tank overflow. The total stream was estimated to be 600,000 gallons per day.
 - o Chlorine water stream to the East Pond: consisted of three streams from the liquefaction plant. The pH varied on these combined waste stream. The total volume discharged was 80,000 gallons per day.
- Main Sewer discharge was a blend of eight streams going to the storm sewer at an estimated 2.4 million gallons per day. The streams included:
 - o Once-through cooling water from the Montrose building
 - o Effluent from the Cell-Renewal Building, containing asbestos fibers from the cell diaphragms
 - o Effluent from the Brine Plant
 - o Effluent from the Caustic Plant

²⁵⁶255 Inter-Office Correspondence, from George R. Stewart to J.F. Orr, September 24, 1957. [ST031129]

²⁵⁷256 Montgomery Research, Inc., Stauffer Chemical Company Industrial Waste Survey, November 1970. [ST013797-830]

- o East & West Cooling Tower blowdown
- o Effluent from the Sludge Tank, consisting of contaminated saturated brine solution
- o Effluent from the Boiler Plant
- o Effluent from the Power Plant
- o Effluent from floor drains
 - Power Plant Blowdown: condensate water and blowdown from the #3 cooling tower, which was discharged at a rate of 65,000 gallons per day.
 - Caustic waste and Montrose Water: once-through cooling water from Montrose Building 5A. The water was contaminated with the effluent from the caustic sump, which handled waste from the filter and floor washings. The estimated discharge rate was 1.7 million gallons per day.
 - Agricultural Plant: was excluded from the study, but the report indicated that the waste stream from the agricultural plant flowed into the West Pond.
- Analyses of the wastes streams in this 1970 survey indicated the following:
 - o All samples showed a small concentration of mercury
 - o All samples showed traces of arsenic
 - o All samples showed cadmium
 - o All samples showed chromium 6
 - o Cell renewal samples showed 587 milligrams per liter (mg/L) lead
 - o A combined sample from the Main Sewer, Power Plant Blowdown, and Montrose Water showed <0.05 mg/L lead

Additional information regarding laboratory analyses can be found in Table IV-1 and V-1 of the 1970 report.

- Sometime between 1969 and 1975, Stauffer constructed a series of trenches in an area approximately 2,000 feet west of the BMI landfill. There is ~~little~~ documentation concerning disposal to these “slit trenches,” although anecdotal information (confirmed by field observation) indicates that the features were dug with a backhoe to depths of 15 to 20 feet. Wastes were deposited to approximately 10 feet below ground surface (~~ft~~-bgs) and the trenches were then backfilled. Aerial photographs indicate that the trenches were closed in or about 1980.

Wastes generated by Stauffer have been categorized as follows:

Thiophenol/p-Chlorothiophenol Waste

The initial process wastes evaluated were generated by the thiophenol/p-chlorothiophenol process. That process generated phosphoric acid waste, caustic waste and process aqueous waste. The Stauffer Process Flow Diagram, Figure 4-2 of the ECA (B001717) indicates the origin of the waste streams. Their volume is defined on pages B001689-B001691. Phosphoric acid waste stream data were provided for the time period of 1960 to 1970. Those data were used to derive an average waste volume value for each year of production. Those data were used to make the calculations presented below. A further calculation was made that the total mass of the waste stream, including the organic phase, should be counted as non-volatile solids entering the BMI Ponds.

The quantity and composition of aqueous waste from thiophenol/p-chlorothiophenol production was reported in the ECA at B001691. The composition was reported as ~~3~~three percent “other,” interpreted as solids, and 97 percent water.

There are no data on the quantity of or dissolved solid content of the caustic stream generated by the process.

Trithio/Imidan Waste

The Trithio/Imidan waste streams are identified on B001697 as an organic waste, an aqueous waste and a dithio acid, identified previously as DTA. The quantity of aqueous waste was presented on B001698 as 24,700 Tons from the time period 1961-1974. These data were used to calculate the waste generated from the 1958-1975 production time frame.

The organic wastes were buried on-site in the Basic Magnesium Landfill.

The DTA wastes were produced from 1958 through 1975. Data exist which indicate that the waste stream volume was 2,259,000 pounds (B001699) from December 1977 through June 1978. These data were extrapolated to the entire production period.

Chlorine and Caustic Soda Waste

Chlorine and caustic soda were produced at the Magnesium Plant Site from 1942 through the present. While there are a number of waste streams from the process operations, only three were sent to the Basic Magnesium Ponds. In 1976, the chlor-alkali plant became a “zero-discharge” facility, meaning that all wastes were thereafter handled and stored on-site.

The first stream is brine sludge. This stream, shown on Figure 4-6 of the ECA (B001704) is generated from the purification of the brine fed to the electrolysis cells. The volume of the stream is presented in the ECA at B001741 as 113,000 Tons from the period 1946-1980. This value was adjusted for the 1946-1975 time frame.

The second waste from the process discharged to the BMI Ponds was the hypochlorite waste stream. According to Stauffer’s ECA (B001711), hypochlorite waste totaled 8,300 Tons during the 1963-1974 time frame. Extrapolating this value to the 1946-1975 time frame, combined with the concentration of solids in the stream as presented on B001742 produced a value for the waste stream to the BMI Ponds.

The third waste stream is sulfate slurry. This stream is generated by the removal of solids from the ~50 percent caustic soda solution produced in the caustic evaporation process. The destination of this stream in the post 1976 time frame was to CAPD Pond 6 (B001711). The volume of this stream is given at B001745 for the years 1983 and 1987. The sulfate concentration of 7seven percent is at B001711. The quantity of waste for 1983 and 1987 was used to calculate the production quantity for the entire production time frame at the concentration provided at B001711.

Calculated Waste Totals

Stauffer Chemical Company of Nevada/Pioneer Chlor Alkali Company, Inc.

Process Operation	Dates Operation Occurred (Years)	Volume of Waste (Tons)	TDS Concentration in Waste (Percent)	Volume of TDS Waste (Tons)	Distribution of Wastes	
					Upper Ponds (Jan. 1971- Dec. 1975)	Lower Ponds (May 1945- Dec. 1970)
thiophenol/ p-chlorothiophenol	1/60-12/75					
Phosphoric acid waste		19,636	~100%	0*	-	-
Aqueous process waste		1,206,400	3%	36,192	11,310	24,882
Caustic wastewater		No data			-	-
Trithion/Imidan	1/58-12/75					
Aqueous waste	1/58--12/74	29,992	10%	0**	-	-
Organic waste	Buried on site				-	-
Dithio acid salt	1/58-12/75 (18)	2,259,000 pounds produced from 12/77 to 6/78	27.35%	9,532	2,648	6,884
Chlor-alkali	1/46-12/75 (30)					
Brine sludge				519,842	86,640	433,202
Hypochlorite waste					-	-

Process Operation	Dates Operation Occurred (Years)	Volume of Waste (Tons)	TDS Concentration in Waste (Percent)	Volume of TDS Waste (Tons)	Distribution of Wastes	
					Upper Ponds (Jan. 1971- Dec. 1975)	Lower Ponds (May 1945- Dec. 1970)
Sulfate slurry					-	-
Fume scrubber					-	-
Total				565,566	100,598	464,968

“-” Signifies that this waste stream was not distributed to the Upper or Lower Ponds, or that data were not available.

* According to the Fahrenthold Supplemental and Rebuttal Expert Report, 19 April 2004, these wastes were sent to on-site trenches and pond, and were not distributed to the Upper or Lower Ponds.

** According to the Fahrenthold Supplemental and Rebuttal Expert Report, 19 April 2004, these wastes were sent to on-site leach beds, and were not distributed to the Upper or Lower ponds.

TIMET²⁵⁸²⁵⁷

TIMET provided detailed information regarding waste disposal to the BMI Common Areas in Section 5 of the TIMET ECA. To briefly summarize, the company discharged wastes to the:

- BMI Landfill
 - Wastes included combustible and non-combustible trash, sludge dryer residue, scrap titanium fines, magnesium cell smut, dust collectors residues, and chlorinator bed dump materials.²⁵⁹²⁵⁸
- BMI Ponds, 1951 to 1977
 - Wastes included leach liquor, caustic waste, and other process wastes. All discharges from the TIMET plant were commingled with other BMI facilities waste effluents and conveyed in unlined and lined channels to the BMI ponds.²⁶⁰²⁵⁹

²⁵⁸²⁵⁷ In addition to the cited sources, see Expert Report of Paul D. Fahrenthold, Ph. D., March 18, 2004, and Fahrenthold Supplemental and Rebuttal Expert Report, April 19, 2004.

²⁵⁹²⁵⁸ Henderson Steering Committee ECA, pp. 45-46. [B002513-514]

²⁶⁰²⁵⁹ TIMET ECA, p. 5-1. [B002895]

- o TIMET disposed of large quantities of its CSD solids in the “OPW” ponds located south of the Spray Wheel and capped this with soils scraped from the southern portions of the Spray Wheel.
- o TIMET Active Ponds, 1976 to 2005 – BMI conveyed to TIMET, property within the BMI Common Areas occupied by several rows of the Upper Ponds. TIMET regraded this property and constructed thereupon lined-evaporation ponds, into which it flowed effluent from its titanium manufacturing process from 1983 to 2005. In 2005, a wastewater treatment plant was constructed by TIMET and BRC within the TIMET plant, which allowed TIMET to terminate effluent discharge to the TIMET Active Ponds. These Ponds were formally taken out of service in June 2005, and the land reconveyed back to an affiliate of BMI.
- o TIMET Spray Wheel, 1983 to 1991 – BMI conveyed property within the BMI Common Areas occupied by a number of Upper and Lower Ponds, transected by the Beta Ditch. TIMET regraded this property and installed an evaporative agricultural-type “Spray Wheel” for the evaporative disposal of aqueous salt waste. The Spray Wheel was in operation from 1983 to 1991, after which it was permanently taken out of service, dismantled, and removed. The property was reconveyed by TIMET to an affiliate of BMI in 2005.

**United States Lime Corporation/ United States Lime Division of the Flinkote Company/
Genstar Corporation/Genstar Cement & Lime Company/Genstar Lime
Company/Chemstar Inc./Chemstar Lime Company²⁶¹²⁶⁰**

Chemstar identified three waste streams that have been discharged to the BMI Ponds:

- Hydrator start-up waste
- Hydration process waste
- Hydrator dust collector waste²⁶²²⁶¹

United States Vanadium Company

²⁶¹²⁶⁰ In addition to the cited sources, see Expert Report of Paul D. Fahrenthold, Ph. D., March 18, 2004, and Fahrenthold Supplemental and Rebuttal Expert Report, April 19, 2004.

²⁶²²⁶¹ See Chemstar ECA, Sections 4-5, pp. 18-66. [B002647-97]

United States Vanadium Company reportedly disposed of wastes in the BMI Landfill. Types and volume of wastes are unknown.²⁶³²⁶²

Western Electro Chemical/American Potash and Chemical/Kerr-McGee²⁶⁴²⁶³

Kerr-McGee provided detailed information regarding waste disposal to the BMI Common Areas in Section 5 of the Kerr-McGee ECA. To briefly summarize, WECCO/AP&CC/Kerr-McGee disposed of wastes to the:

- BMI Landfill
 - Wastes included sodium chlorate filter cake, asbestos, elemental carbon powder, dried residues from cleaning of the Kerr-McGee surface impoundments, as well as materials such as paper, cartons, bags, pallets, drums, and plastics²⁶⁵²⁶⁴
- Upper and Lower Ponds via the Beta Ditch
 - Chlorate (including sodium chlorate filter cake), perchlorate, and boron process wastes and related waste streams from cooling tower blowdown, boiler blowdown, and housekeeping washings (by Kerr-McGee, predecessors, and tenants) between 1945 and ~~1976~~²⁶⁶1976²⁶⁵

In addition to Kerr-McGee's production facilities at the BMI complex, the U.S. Navy owned land and equipment required for the production of ammonium perchlorate. The Navy's ownership began in January 1954 and lasted until February 1962. The ECA for Kerr-McGee reports that during the Navy's period production of ammonium perchlorate, ammonium perchlorate wastes were discharged to the Basic Magnesium Ponds.²⁶⁷²⁶⁶

2.4 CORPORATE SUCCESSION

The following section presents an overview of corporate succession from the founding of Basic Magnesium, Inc. to the present:

²⁶³²⁶² Henderson Steering Committee ECA, p. 40. [B002508]

²⁶⁴²⁶³ In addition to the cited sources, see Expert Report of Paul D. Fahrenthold, Ph. D., March 18, 2004, and Fahrenthold Supplemental and Rebuttal Expert Report, April 19, 2004.

²⁶⁵²⁶⁴ KMCC ECA, pp. 7-8 and 7-9 [B002117-118]

²⁶⁶²⁶⁵ KMCC ECA, pp. 5-66 [B002038] and 5-68 to 5-69. [B002040-2041] See also Section 7.

²⁶⁷²⁶⁶ KMCC ECA, p. 7-6. [B002215]

Basic Magnesium Incorporated

BRI was formed on May 29, 1931, as Basic Dolomite, Inc. an Ohio corporation. The company acquired the raw and clinkered dolomite business of Dolomite Inc. and of Basic Products Company.²⁶⁸²⁶⁷ On October 15, 1936, Basic Dolomite formed a subsidiary called Basic Ores, Inc., whose operations included mining brucite ore in Nye County, Nevada.²⁶⁹²⁶⁸ Basic Dolomite changed its name to BRI in March ~~1941.~~²⁷⁰ 1941.²⁶⁹

BRI changed its subsidiary's name from Basic Ores, Inc. to Basic Magnesium Inc. on November 14, ~~1941,~~²⁷¹ 1941,²⁷⁰ and the parent company took over the former mining operations.

The authorized capital for Basic Magnesium was \$100,000, of which BRI owned 55 percent and MEL 45 percent.²⁷²²⁷¹ BRI transferred its magnesite holdings in Nye County in exchange for its 55 percent interest in Basic Magnesium. In exchange for its 45 percent interest in Basic Magnesium, MEL donated its technical skill and expertise and agreed to supply the "know how" for the construction and operation of the magnesium plant project.²⁷³²⁷² Subsequently, 2.5 percent of the interest held by BRI was transferred to George Thatcher.²⁷⁴²⁷³

When it became apparent to the U.S. government in mid-1942 that the operations of the magnesium plant could not succeed under the management of the existing Basic Magnesium Inc., the government approached the Anaconda Copper Company and implored them to take over the operations of Basic Magnesium. Anaconda evaluated the situation and on September 30, 1942, Basic Magnesium, BRI, MEL, and Anaconda reached an agreement.²⁷⁵²⁷⁴ The DPC agreed

²⁶⁸²⁶⁷ Basic Refractories, Inc., Corporate Background, n.d. NARA I, RG 46, Box 476, Folder: Basic Magnesium Corporate History. [BR032651-657]

²⁶⁹²⁶⁸ Articles of Incorporation of Basic Ores, Inc., October 15, 1936. Nevada Secretary of State. [BR039109]

²⁷⁰²⁶⁹ Basic Refractories, Inc., Corporate Background, n.d. NARA I, RG 46, Box 476, Folder: Basic Magnesium Corporate History. [BR032651-657]

²⁷¹²⁷⁰ Certificate of Amendment to Articles of Incorporation, November 14, 1941. Nevada Secretary of State. [BR039125]

²⁷²²⁷¹ Dun & Bradstreet report, April 25, 1942. NARA I, RG 46, Box 476, Folder: Basic Magnesium Corporate History. [BR032668-675] Certificate of Amendment to Articles of Incorporation, November 14, 1941. Nevada Secretary of State. [BR039125] Officers, Directors, and Designation of Resident Agent, December 6, 1941. Nevada Secretary of State. [BR039131]

²⁷³²⁷² "Magnesium," circa 1943. NARA I, RG 46, Box 478, Folder: Las Vegas Basic Magnesium. [BR032509-561, @ BR032536]

²⁷⁴²⁷³ Investigation of Industrial Centralization (Basic Magnesium Plant), Hearings before a Special Committee, 78th Congress, Second Session, Part 5, November 27 and 28, 1944, p. 522. [BR038448]

²⁷⁵²⁷⁴ Agreed upon procedures, September 30, 1942. [YBD15102-106]

to purchase the mining claims in Nye County for \$450,000 and Anaconda agreed to pay \$75,000 for 52,500 shares of Basic Magnesium stock. ²⁷⁶²⁷⁵

Anaconda purchased the MEL share holdings in Basic Magnesium in 1951. Anaconda dissolved Basic Magnesium Inc. in November 1974. The Anaconda Company was merged into a wholly-owned subsidiary of the Atlantic Richfield Company on January 12, 1977. Atlantic Richfield Company was purchased by the British Petroleum Company (BPC) in 1999.

Basic Management, Inc.

BMI was formed in 1952 for the purpose of providing utility and other services to companies in the BMI Complex. Basic Environmental Company LLC (BEC) is a limited liability company organized and existing under the laws of the State of Nevada. BEC was formed in March 1999. BEC owns property at issue within or near the BMI Complex. BMI's original shareholders were Stauffer-~~Chemical Company~~, National Lead, Combined Metals Reduction Company, WECCO and U.S. Lime. BMI is the sole member of BEC.

BMI is a corporation organized and existing under the laws of the State of Nevada. BMI was previously known as Basic Investment Inc. (BII) and was formed in 1993 as a holding company for separate operations of several subsidiaries and/or affiliates (*i.e.*, BEC, The LandWell Company LP, BRC, Basic Land Company, Basic Water Company, and Basic Power Company). BII's original shareholders were Kerr-McGee, TIMET, Pioneer-~~Chlor Alkali Company, Inc.~~, and Chemical Lime Company of Arizona. In March 1999, BII's name was changed to BMI. In 2000, Pioneer Partners 2000, LLC succeeded to the shares owned by Pioneer-~~Chlor Alkali Company, Inc.~~ Treco, Inc. succeeded to TIMET's interest in BMI.

Chemstar Lime Company

United States Lime Products Corporation was formed in 1926. The company was purchased by Flintkote Company on June 30, 1958, and became the United States Lime Division of the Flintkote Company. The Genstar Corporation purchased Flintkote in December 1979. Genstar incorporated the Henderson lime plant into the Genstar Cement & Lime Company on July 22, 1981, and into Genstar Lime Company in October 1983. Imasco purchased the parent company, Genstar Corporation, in 1983. Imasco proceeded to sell off the production subsidiaries, and

²⁷⁶²⁷⁵ Excerpt from Minutes of Meeting of Board of Directors of Basic Refractories, October 20, 1942. [YBD15642-646]

Chemical Lime Company of Forth Worth, Texas and Lime Holding Company purchased Genstar Lime Company on December 6, 1986. Genstar Lime Company changed its name to Chemstar, Inc. in 1986, and to Chemstar Lime Company in ~~1991.~~²⁷⁷ 1991.²⁷⁶

Kerr-McGee Chemical Corporation/Tronox LLC

WECCO was formed in 1941. American Potash and Chemical Company merged with WECCO in 1955. Kerr-McGee purchased American Potash and Chemical Company in 1967. In 2005, Kerr-McGee ~~Chemical Company~~ became Tronox LLC.

Montrose Chemical Corporation of California

Montrose ~~Chemical Corporation of California~~ was formed in 1946. The company still exists. Stauffer Management Company and Chris-Craft Industries, Inc. each own a 50 percent share in Montrose.²⁷⁸277

Stauffer Chemical Company of Nevada/Pioneer Chlor-Alkali Company, Inc.

Stauffer Chemical Company of Nevada (a Nevada corporation) was formed sometime prior to 1944, and was owned by Stauffer Chemical Company (a California corporation). Pioneer ~~Chlor-Alkali Company, Inc.~~ acquired Stauffer's chlor-alkali manufacturing facilities in October 1988.

TIMET

Titanium Metals Corporation, also known as TIMET was formed from a joint venture agreement between Allegheny Ludlum Steel Corporation and National Lead Company in 1950. TIMET still exists.

2.5 REGULATORY ACTIVITIES

2.5.1 Introduction

As described in Section 2.0, the BMI Complex has been the site of many industrial activities including production of magnesium, pesticides, other organic chemicals, titanium, acids,

²⁷⁷276 Chemstar Lime Company ECA, p. 13. [B002644]

²⁷⁸277 SEC Filing, Annual Report to Stockholders, March 23, 1990.

caustics, chlorine and rocket propellants.²⁷⁹²⁷⁸ From the 1940's until the 1970's, operating companies in the complex made extensive use of unlined evaporation ponds located adjacent to the plants in the BMI Common Areas.²⁸⁰²⁷⁹ A landfill, reportedly on the site of the war-time Trade Effluent Ponds, accepted organic and inorganic wastes from the operating companies until it ceased operation in 1980.²⁸¹ 1980.²⁸⁰ Much of this activity went unregulated until the advent of federal and state environmental laws in the 1970's.

In the early 1970's, under the federal National Pollutant Discharge Elimination System (NPDES) program, the industries at the Basic Magnesium Complex curtailed waste discharges to the Basic Magnesium ponds, and lined ponds were constructed by individual companies.²⁸²²⁸¹ Later in 1976, the operating companies discontinued the use of the original Lower and Upper ponds in compliance with zero discharge waste requirements.²⁸³²⁸² Beginning around this time, the USEPA and the NDEP began requiring regular environmental sampling at the Basic Magnesium Complex.²⁸⁴²⁸³ This sampling resulted in various regulatory actions involving the operating companies and a three phase environmental investigatory process that continues today.

Both the USEPA and the NDEP have been active in environmental regulation of the Basic Magnesium Complex. The principal regulator has been the NDEP. The Bureaus of Water Pollution Control and Solid and Hazardous Waste Management, the Chemical Accident Prevention Program and the Bureau of Corrective Action in the NDEP provide the day-to-day regulation and permitting of environmental activities at the Basic Magnesium Complex. This has included overseeing of closure of liquid waste disposal ponds, addressing spills and releases and insuring that contaminated groundwater and soils are cleaned up.²⁸⁵²⁸⁴

Beginning in 1990, NDEP initiated a three phase environmental investigation and corrective action program for each operating company and for the BMI Common Areas. NDEP entered into consent agreements with each operating company in 1991 covering the plant sites in the

²⁷⁹²⁷⁸ NDEP Memorandum "Environmental Studies at the BMI Complex, Henderson, Nevada, December 1998." [BR034398-34401]

²⁸⁰²⁷⁹ Id.

²⁸¹²⁸⁰ Id.

²⁸²²⁸¹ Id.

²⁸³²⁸² Id.

²⁸⁴²⁸³ Aerial Reconnaissance of Hazardous Waste and Pollution Sources – BMI Industrial Complex – Henderson, Nevada, 1943 – 1979. [B000001-50]

²⁸⁵²⁸⁴ NDEP Memorandum "Environmental Studies at the BMI Complex, Henderson, Nevada, December 1998." [B018551-18554]

complex, and with all the operating companies covering the BMI Common Areas. Phase I, completed in 1993, was a data gathering activity that focused on historical information and liquid and solid waste management practices. The results of these investigations identified data gaps and areas requiring more intensive study during Phase II. Phase II, reflected in a second round of consent agreements, was intended to provide additional information and data and evaluation of remediation alternatives.²⁸⁶²⁸⁵ Phase III (*i.e.*, the AOC3) will involve the remediation of the contaminated areas.

2.5.2 BMI Common Areas

The Phase I consent agreement for the BMI Common Areas originally included a definition of the “site” which included areas previously used for waste disposal plus other BMI properties beyond the commonly understood Basic Magnesium complex. BMI, which was not a party to this consent agreement, soon realized that the “site” definition was overly broad, and sought to exclude areas unaffected by waste disposal activities. In April 1992 the NDEP began excluding certain parcels from the 1991 Consent Agreement because they had not been used for waste disposal. These excluded properties include Victory Village, the Henderson Water Treatment Plant with associated easements, a section of Major Avenue, Opportunity Village,²⁸⁷²⁸⁶ the BMI properties west of Interstate 95,²⁸⁸ 95,²⁸⁷ “the Storm Channel Easement” and portions of parcel 1A.²⁸⁹²⁸⁸ In addition, during the 1990s BMI performed corrective action on particular parcels, leading to NDEP issuance of NFA letters for areas 4A, 4B, 5, 6, 9 North, Warm Springs and Pabco Roads Right-of-Ways and the Pioneer Detention Basin, excluding them from the Consent Agreement and further remedial action.²⁹⁰²⁸⁹

In 1993, the Henderson Industrial Site Steering Committee (HISSC), a coalition of Basic Magnesium Complex companies, conducted a Phase I investigation that included a review of

²⁸⁶²⁸⁵ Environmental Conditions Investigation Report, BMI Common Areas, Henderson, Nevada (ERM-West, Inc., August 1996). [B011708-11952]

²⁸⁷²⁸⁶ Letter from Robert Ritchey to Verne Ross, November 1, 1991, acknowledged by NDEP on January 23, 1992.

²⁸⁸²⁸⁷ Letter from Jeffrey Denison of NDEP to Mark Paris of BMI, June 19, 1992. [A000640]

²⁸⁹²⁸⁸ Letter from Robert Kelso to Gregory Schlink, November 2, 1993.

²⁹⁰²⁸⁹ September 30, 1997, Letter from Allen Biaggi to Dan Stewart re: No Further Action for Exclusion Area 6 [A000694-98]; August 18, 1998, Letter from Allen Biaggi of NDEP to Dan Stewart of BMI re: No Further Action for Exclusion Area 5 [A000699]; October 6, 1998, Letter from Allen Biaggi of NDEP to Dan Stewart of BMI re: No Further Action on Pabco/Warm Springs Parcel 4c [A000519-520]; August 19, 1999, Letter from Allen Biaggi of NDEP to Crowley of BMI re: No Further Action for 12.692 acre parcel and 4.99 acre parcel [G006619-6620]

existing documents and past practices. The results of this investigation were presented in its Phase I ECA, which was submitted to the NDEP in April ~~1993.~~²⁹¹1993.²⁹⁰ Based upon its review of the Phase I ECA, the NDEP determined that a Phase II Environmental Conditions Investigation (ECI) was necessary. In an August 1994 Letter of Understanding (LOU), the NDEP identified several study items that, in its opinion, required additional study and investigation during the second phase.²⁹²291 In February 1996, HISSC entered into a Phase II Consent Agreement, in which a work plan was submitted and approved by the NDEP.²⁹³292

In 1996, HISSC completed a field investigation. These results were presented in August 1996 in a Draft ECI for the BMI Common Areas.²⁹⁴293 Based on the draft ECI, the NDEP requested that HISSC conduct a RAS for the BMI Common Areas. NDEP approved the RAS work plan in July, 1999.

In December 1999, BMI and NDEP entered into a Liability Transfer and Assumption Agreement with the other HISSC parties.²⁹⁵294 This agreement gave a BMI subsidiary – BRC – primary responsibility for the cleanup and remediation for soils in the BMI Common Areas. The agreement also gave BRC the power to be the primary negotiator with the NDEP with regard to the clean up of contaminated soil in the BMI Common Areas. In December 2002, a similar agreement was reached between BMI, Montrose ~~Chemical Corporation of California,~~ and NDEP with respect to groundwater contamination.

In 2000 and 2001, BMI submitted a draft RAS, a proposed Corrective Action Plan (CAP) and a Draft Closure Plan for the BMI Common Areas. NDEP issued a ROD for Soils in the BMI Common Areas in November ~~2001.~~²⁹⁶2001.²⁹⁵ In February 2003, NDEP, BRC and other parties executed the AOC3. All current submittals, including this Closure Plan, are being provided in response to the AOC3.

²⁹¹290 Phase I Environmental Conditions Assessment for the Basic Management, Inc. Industrial Complex (Geraghty & Miller, April, 1993). [B002294-2628]

²⁹²291 NDEP Memorandum “Environmental Studies at the BMI Complex, Henderson, Nevada, December 1998.” [B018551-18554]

²⁹³292 Consent Agreement between NDEP and BMI, et. al., dated February 23, 1996. [A000285-394]

²⁹⁴293 Environmental Conditions Investigation Report, BMI Common Areas, Henderson, Nevada (ERM-West, Inc., August 1996). [B011708-11952]

²⁹⁵294 The BMI et. al. Liability Transfer and Assumption Agreement, December 30, 1999. [BR049347-49363]

²⁹⁶295 Record of Decision, Remediation of Soils and Sediments in the Upper and Lower Ponds at the BMI Complex, Henderson, Nevada, November 2, 2001. [BR005787]

2.5.3 Pioneer Chlor Alkali Company and Stauffer Management Company

Soon after the USEPA and the NDEP began the requirement for environmental sampling at the BMI Complex, the NDEP issued an August 1979 Violation and Order against Stauffer for groundwater contamination.²⁹⁷²⁹⁶ In February 1982 both the NDEP and the Clark County Health District requested data and information regarding environmental conditions at the Stauffer site. In 1983, Stauffer entered into a Consent Agreement with NDEP. In July 1984, the USEPA issued their findings of a Toxic Substances Control Act dioxin investigation.²⁹⁸²⁹⁷

Pioneer and Stauffer are parties to a 1991 Consent Agreement with the NDEP. Pioneer and Stauffer submitted their Phase I ECA in April 1993. Based upon the ECA, a LOU was executed with the NDEP in August 1994 that identified study areas at the Pioneer facility for further investigation. In a subsequent Consent Agreement, Pioneer and Stauffer agreed to conduct a Phase II ECI of the study areas.²⁹⁹²⁹⁸ Pioneer and Stauffer submitted its Phase II ECI in June 1996.³⁰⁰^{1996.}²⁹⁹ In addition, Pioneer and Stauffer have submitted a number of documents to the NDEP regarding various supplemental Phase II environmental studies at the site.

2.5.4 Titanium Metals Corporation

The NDEP began requesting groundwater information from TIMET in 1982.³⁰¹^{1982.}³⁰⁰ The NDEP issued a Finding of Alleged Violation and Order against TIMET in December 1990.³⁰²^{1990.}³⁰¹ This was followed by the NDEP revoking TIMET's authority to discharge from their Spray Wheel in September 1991.³⁰³^{1991.}³⁰² TIMET also received a Notification of Penalties for Water Pollution Violation in December 1997.³⁰⁴^{1997.}³⁰³

²⁹⁷²⁹⁶ Letter from Marvin Tabeau of NDEP to James Wiseman of Stauffer, August 28, 1979. [ST090880]

²⁹⁸²⁹⁷ USEPA Preliminary TSCA Dioxin Investigation at BMI Complex, Henderson, Nevada, July 10, 1984. [C000784-846]

²⁹⁹²⁹⁸ Draft Phase I Environmental Conditions Assessment.

³⁰⁰²⁹⁹ NDEP Memorandum "Environmental Studies at the BMI Complex, Henderson, Nevada, December 1998." [B018441-18554]

³⁰¹³⁰⁰ Id.

³⁰²³⁰¹ Letter from Joseph Livak of NDEP to Tom Buck of Timet, December 31 1990. [B021736-21749]

³⁰³³⁰² Letter from John Nelson of NDEP to R.J. Allinger of Timet, September 5, 1991. [B021662]

³⁰⁴³⁰³ Letter from Joseph Livak of NDEP to John Sanderson of Timet, December 29, 1997. [G002748]

TIMET signed a Consent Agreement with the NDEP in 1991. TIMET submitted its Phase I ECA in April ~~1993.~~³⁰⁵ 1993.³⁰⁴ The NDEP issued a LOU in August 1994 that identified 54 study items at the TIMET facility. The Draft Phase II ECI Work Plan was submitted to the NDEP in June 1996, and the Final Phase II Consent Agreement was signed in June ~~1996.~~³⁰⁶ 1996.³⁰⁵ After review and comment, TIMET submitted its final ECI in February ~~1998.~~³⁰⁷ 1998.³⁰⁶ This was later approved with conditions in June ~~1998.~~³⁰⁸ 1998.³⁰⁷ Phase II environmental studies continue at the site.

2.5.5 ~~Kerr-McGee Chemical Company~~Corporation (Tronox)

Kerr-McGee signed a 1991 Consent Agreement with the NDEP. Based upon the information found in its Phase I ECA, which was submitted in April 1993, a LOU between Kerr-McGee and the NDEP was established in August ~~1994.~~³⁰⁹ 1994.³⁰⁸

Kerr-McGee signed Consent Agreement in August 1996 that defined the process required for additional study.³¹⁰³⁰⁹ Kerr-McGee's Work Plan, which included both field activities and file searches, was approved by the NDEP in August ~~1997.~~³¹¹ 1997.³¹⁰ The NDEP later approved their Phase II ECI in June 1998 with conditions for further study. Kerr-McGee entered into another Consent Agreement with the NDEP in July 1999 that involved additional sampling toward the development of a RAS.³¹²³¹¹ Kerr-McGee (now Tronox) has also worked with the NDEP on perchlorate issues, including a 1999 temporary permit to discharge perchlorate "seep."³¹³³¹² Phase III remedial and Phase II environmental studies continue at the site.

³⁰⁵³⁰⁴ Titanium Metals Corporation Phase I Environmental Conditions Assessment, April 1993. [B002758-2984]

³⁰⁶³⁰⁵ NDEP Memorandum "Environmental Studies at the BMI Complex, Henderson, Nevada, December 1998." [B018551-18554]

³⁰⁷³⁰⁶ Draft Environmental Conditions Investigation Report, Titanium Metals Corporation Facility, Henderson, Nevada (Tetra Tech EM, Inc. February 20, 1998). [B013059-14214]

³⁰⁸³⁰⁷ NDEP Memorandum "Environmental Studies at the BMI Complex, Henderson, Nevada, December 1998." [B018551-18554]

³⁰⁹³⁰⁸ Letter of Understanding between NDEP and Kerr-McGee dated August 14, 1994.

³¹⁰³⁰⁹ Consent Agreement between Kerr McGee and NDEP dated June 28, 1996. [G013903-13915]

³¹¹³¹⁰ NDEP Memorandum "Environmental Studies at the BMI Complex, Henderson, Nevada, December 1998." [B018551-18554]

³¹²³¹¹ Consent Agreement between Kerr McGee and NDEP, July 26, 1999. [B021792-21884]

³¹³³¹² Letter from Catherine Pool of NDEP to Patrick Corbett of Kerr McGee, November 10, 1999. [G014288-14306]

2.5.6 Montrose Chemical Corporation

Montrose signed a 1991 Consent Agreement with the NDEP. Montrose submitted its Phase I ECA in April ~~1993.~~³¹⁴ 1993.³¹³ Montrose completed its Phase II ECI in August 1997, which covered issues regarding soil contamination at their property.³¹⁵³¹⁴ Montrose, Pioneer and Stauffer are working jointly with regard to groundwater contamination. A joint report regarding groundwater was submitted to the NDEP in ~~1998.~~³¹⁶ 1998.³¹⁵ Phase II environmental studies continue at the site.

2.5.7 City of Henderson

The City of Henderson has been involved in many environmental issues regarding the Basic Magnesium Complex. In December 1990, Henderson entered into a LOU with the NDEP regarding contamination of the BMI Complex.³¹⁷³¹⁶ In March 1992, the NDEP issued a violation against Henderson’s wastewater discharge permit.³¹⁸³¹⁷ Later that year Henderson entered into an environmental monitoring agreement with BMI.³¹⁹³¹⁸ In June 2001, Henderson was involved in selecting alternative 4B of the RAS for the BMI Common Areas.³²⁰³¹⁹

BMI Complex Regulatory Timeline

Date	Action
1972-1973	Under the NPDES program, the industries at BMI curtailed waste discharges to the BMI ponds; lined ponds were constructed by individual companies.
1976	Industries at BMI discontinued the use of the original lower and upper ponds in compliance with zero discharge waste requirements.
May 1979 – September	USEPA conducts sampling at complex.

³¹⁴³¹³ Montrose Chemical Company Phase II Environmental Conditions Assessment, August 11, 1997. [B011953-13058]

³¹⁵³¹⁴ NDEP Memorandum “Environmental Studies at the BMI Complex, Henderson, Nevada, December 1998.” [B018551-18554]

³¹⁶³¹⁵ Id.

³¹⁷³¹⁶ Id.

³¹⁸³¹⁷ Letter from Joseph Livak of NDEP to Philip Speight of the City of Henderson, March 20, 1992. [A000773-778]

³¹⁹³¹⁸ Monitoring Agreement between the City of Henderson and BMI, December 15, 1992. [B015287-15302]

³²⁰³¹⁹ Letter from Monica Simmons of City of Henderson to Alan Biaggi of NDEP, June 14, 2001. [BR005661]

Date	Action
1989	
August 1979	NDEP issues Violation and Order against Stauffer for organic pollutants found in the groundwater [C000458-460].
March 1980	USEPA requests hazardous waste records for BMI complex [C000482-499].
July 1980	USEPA issues report of hazardous waste and pollution sources at BMI complex [BR001884-1939].
August 1980	USEPA conducts a site inspection of the BMI complex [C000622-631].
June 1981	USEPA issues findings of its “Henderson Industrial Complex Hazardous Waste Investigation” [C001645-1774].
February 1982	NDEP issues order requesting data and information from BMI complex [C000667-670]. Clark County Health District requests asbestos information from Stauffer [A000963-964].
May 1982	NDEP issues order requesting TIMET produce data regarding groundwater.
June 1982	NDEP begins sampling at BMI complex [ST032143-32161].
June 1983	Stauffer enters Consent Agreement with NDEP.
July 1984	USEPA issues findings of TSCA Dioxin Investigation of Stauffer and Montrose [C000784-846].
September 1987	Montrose submits Closure/Post Closure Plan for RCRA ponds [C002068-2095].
December 1990	LOU between NDEP and the City of Henderson regarding BMI contamination [A000942-950]. NDEP issues Finding of Alleged Violation and Order to TIMET for “unlawful discharge of a pollutant without a permit” [B021736-21749].
January 1991	NDEP stays previous order against TIMET.
April 1991	Consent Agreement with NDEP and HISSC companies [A000039-79].
September 1991	NDEP revokes TIMET’s authority to discharge from Spray Wheel [B021662].

Date	Action
March 1992	Phase I ECA submitted for BMI Common Areas. NDEP issues a violation to The City of Henderson's wastewater discharge permit [A000773-778].
June 1992	NDEP agrees to exclude BMI properties west of Interstate 95 from the 1991 Consent Agreement [A000640].
January 1992	NDEP agrees to exclude Victory Village, the Henderson Water Treatment Plant and associated easements, a section of Major Avenue and Opportunity Village from the 1991 Consent Agreement.
December 1992	Monitoring Agreement entered into between the City of Henderson and BMI [B015287-15292].
April 1993	Phase I ECA's submitted for Stauffer [B001646-1841], Chemstar Lime [B002629-2713], Kerr-McGee [B001842-2293], Montrose [B002301-2459] and TIMET [B002758-3191].
May 1993	LOU between NDEP and Chemstar regarding environmental assessment activities [A001013-1015].
June 1993	LOU between NDEP and TIMET regarding assessment/remediation activities [A000191-203].
November 1993	NDEP holds a public hearing regarding the ECA for BMI Common Areas [NDEP0003281-3282]. NDEP agrees to exclude the Storm Channel Easement and parts of parcel 1A.
August 1994	NDEP identifies items requiring additional study during the Phase II investigation in LOU with Pioneer and Stauffer. NDEP identifies items requiring additional study during the Phase II investigation in the LOU with TIMET. NDEP identifies items requiring additional study during the Phase II investigation in the LOU with Kerr-McGee [ST039340-39351].
February 1996	Phase II Consent Agreement with HISSC companies [A000284-394].
March 1996	NDEP holds public hearing regarding Phase II Consent Agreement [A000105-142].
June 1996	Phase II ECI submitted for Stauffer [ST047243-47865]. Final Phase II Consent Agreement between NDEP and TIMET [B021792-21884].

Date	Action
July 1996	Phase II Consent Agreement between Kerr-McGee and NDEP [G003514-3515].
August 1996	Phase II ECI for BMI Common Areas submitted to NDEP [B020361-20605] Phase II Consent Agreement between NDEP and Kerr-McGee [G003380-3483].
March 1997	NDEP determines soil characterization in ECI for BMI Common Areas is complete [A001218-1219].
April 1997	NDEP approves Kerr-McGee Work Plan [G003559-3562]
December 1997	NDEP approves RAS work plan for BMI Common Areas [B019962-19963]. NDEP issues Notification of Penalties for Water Pollution Violation against TIMET [G002748].
August 1997	Montrose submits Phase II ECI to NDEP [B011953-13058]. Kerr-McGee submits Phase II ECI to NDEP [B008447-9113].
September 1997	NDEP issues NFAD for Exclusion Area 6 [A000894-900]
February 1998	TIMET submits Phase II ECI to NDEP [B013226-14214]
May 1998	Consent Decree entered in Clark County, Nevada, District Court between NDEP and TIMET [G002697-2699].
June 1998	NDEP approves final Phase II ECI Report with TIMET [NDEP0003084-3090]. NDEP approves final Phase II ECI Report with Kerr-McGee.
August 1998	NDEP issues NFAD for Exclusion Area 5 [A000487-488].
October 1998	NDEP issues NFAD for Warm Springs and Pabco Roads Right-of-Ways [A000519-520].
December 1998	NDEP holds public hearing regarding Phase II ECI investigation for BMI Common Areas [B019551-19554].
July 1999	NDEP issues NFAD to Pioneer for the Pioneer Detention Basin [G006608-6609]. Consent Agreement entered into between NDEP and Kerr-McGee [G013903-13915].

Date	Action
August 1999	NDEP issues NFAD to Kerr-McGee for a 12.692 acre portion of Section 13 and a 4.99 acre portion of Section 12 [G006619-6620].
November 1999	NDEP issues temporary permit for the discharge of perchlorate treated “seep” to Kerr-McGee [G014288-14306].
December 1999	Liability Transfer and Assumption Agreement between BMI <i>et al.</i> (Soils) [BR049347-49363]
January 2000	RAP, Permit for CAMU for BMI Common Areas is submitted to NDEP [G003048-3283].
March 2000	RAS for Soils for BMI Common Areas submitted to NDEP [S003093-3275]. NDEP issues NFAD for Nevada Power Substation Property [BR055966-55976].
April 2000	NDEP holds a public hearing regarding the RAS for BMI Common Areas [BR035143].
June 2000	Presentation of CAP for BMI Common Areas [BR005615-5641].
June 2001	City of Henderson approves Alternative 4B of the RAS [BR005661].
February 2001	BMI submits Site Closure Plan to NDEP (revised July 2001 [S000540-711].
November 2001	NDEP issues ROD for Soils at BMI Common Areas [BR005787-5853].
February 2002	NDEP issues Draft Closure Plan for BMI Common Areas [S0045535620].
December 2002	Liability Transfer and Assumption Agreement between BMI <i>et al.</i> (Groundwater) [BR049507-49515].
August 2003	NDEP proposes Phase III Administrative Order on Consent [BR052900-52791].
February 2006	NDEP, BRC, and others execute the AOC3.
<u>September 2006</u>	<u>NDEP approves BRC's Corrective Action Plan</u>

SECTION 2 REFERENCES

Primary Sources:

Archival, Corporate, and Agency Records

- “Leases” in Office Memorandum, Liquidation of the Colorado River Commission Activities at the Basic Magnesium Project, January 26, 1953.
- “Magnesium,” circa 1943. NARA I, RG 46, Box 478, Folder: Las Vegas Basic Magnesium.
- A Chronological History of Basic Magnesium, November 16, 1944. Anaconda Document Collection, American Heritage Center, University of Wyoming.
- A.E. Jones to Acting Chief, Industrial Planning Section, June 30, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- A.T Newell to R.J. Moore, March 7, 1952.
- Agreed upon procedures, September 30, 1942.
- Agreement between DPC and J.M. Montgomery, May 14, 1945.
- Agreement of Sale, CRC to BMI, May 23, 1952.
- Agreement, August 1, 1941. NARA II, RG 72, Entry 147, Box 13, Folder: Basic Magnesium.
- Agreement, May 14, 1945. NARA II, RG 72, Entry 147, Box 13, Folder: Basic Magnesium Plancor 201.
- Appraisal of US Naval Industrial Reserve Plant (DOD 473 and DOD 217), October 31, 1958. NARA San Bruno, RG 121, Box 22, Folder: N-Nev-5-415 US Naval Industrial Reserve Plant (DOD 473 and DOD 217).
- Articles of Incorporation of Basic Ores, Inc., October 15, 1936 and subsequent amendments. Nevada Secretary of State.
- Assignment of Lease. NARA San Bruno, RG 291, Real Property Files, Box 1, Folder: Nev-5, Inspection of Leases.
- Basic Refractories, Inc., Corporate Background, n.d. NARA I, RG 46, Box 476, Folder: Basic Magnesium Corporate History.

- C.E. Weed to J.R. Hobbins, August 17, 1942.
- C.E. Weed to Reno Sales, September 19, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming.
- C.E. Weed to Reno Sales, September 28, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming.
- C.J.P. Ball, to H.P. Eells, June 23, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Chronological List of OPM Press Releases on Magnesium. NARA I, RG 46, Box 474, Folder: WPB Magnesium.
- Cost-Plus-A-Fixed-Fee Property Protection and Maintenance Contract, November 29, 1946. NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 12.
- D.A. Graham, Notes on Basic Magnesium, September 11, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- D.W. Stewart to Assistant Chief of Material Division, August 1, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Deed of Conveyance, October 26, 1953. NARA San Bruno, RG 121, Box 23, Folder: N-Nev-5-415 US Naval Industrial Reserve Plant (DOD 473 and DOD 217).
- Deed of Trust, March 15, 1962.
- Dun & Bradstreet report, April 25, 1942. NARA I, RG 46, Box 476, Folder: Basic Magnesium Corporate History.
- E.H. Clary, History of Civil Engineering, October 21, 1944. UNLV Special Collections, T-22.
- E.K. Merritt to Industrial Planning Officer, February 6, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Edgar Lewis to W.F. Vollandt, September 20, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.

- Eells to Assistant Chief, Materials Division, May 22, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Elmo L. Buttle, Chief, Surplus Real Property Division, October 5, 1953.
- Engineer's Final Report, n.d. NARA II, RG 234, Entry 146, Box 114, Folder: DPC Engineers Reports and Appendices, Plancor 201.
- FDR Speech, December 29, 1940.
- Final Engineer's Report, Part "C" – Historical. NARA II, RG 234, Entry 146, Box 114, Folder: DPC Engineers Reports and Appendices.
- Fred Johnston to Chief, Real Property Division, November 25, 1966.
- Frederick Hopkins to Chief, Industrial Planning Section, June 10, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Frederick Laist to J.R. Hobbins, August 16, 1942.
- G.D. Carrington, July 3, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- G.D. Carrington, July 6, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- H.P. Eells to P. Schneeberger, August 1, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- H.P. Eells to P. Schneeberger, August 15, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- H.P. Eells to P. Schneebergr, September 3, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Hearing of the Sub-committee on Light Metals and Aviation of the Special Committee Investigating the War Program, Held in the Office of Mr. F. O. Case, General Manager Basic Magnesium on May 11, 1943 at 2:30 P.M.
- Imperial Chemical Industries to J.R. Hobbins, July 12, 1945.
- Industrial Utilization Study and Facilities Appraisal Report, Volume 1, October 1, 1947

- Information from Memorandum John R. Reilly to Irving Gumbel, July 15, 1947.
- Information from WAA, Proposal of USVC lease, February 28, 1946.
- Information from WAA, Washington Credit Division Report, April 30, 1948.
- Inter-Office Correspondence, from George R. Stewart to J.F. Orr, September 24, 1957.
- Inter-Office Memorandum to Chief Patent Liaison Office, June 16, 1941 and attached list of patents. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Investigation of Industrial Centralization (Basic Magnesium Plant), Hearings before a Special Committee, 78th Congress, Second Session, Part 5, November 27 and 28, 1944, pp. 457-458, containing text of letter from H.G. Satterthwaite to F.O. Case, November 23, 1944.
- J.A. Westphal and W.E. Nork, "Reconnaissance Analysis of Effects of Waste Water Discharge on the Shallow Groundwater Flow System Lower Las Vegas Valley Nevada," April 1972.
- Jesse Bowling to G.H. Moriarty, December 3, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- John R. Reilly to Irving Gumbo, December 10, 1947.
- John W. Synder, Executive Vice President, DPC, to Major J.L. Bowling, December 2. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- L.A. Kelly, Counsel, Office of Defense Plants, Memorandum Accompanying SPB-5. Army Corps of Engineers, Sacramento.
- Lease and Option Agreements attached to Richard H. Greenburg, Regional Comptroller, GSA, to Robert J. Moore, BMI, January 30, 1953.
- Letter agreement, April 9, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Letter of Intent, March 17, 1948.
- Letter to C.F. Kelley, September 5, 1942.
- Letter to Colorado River Commission, October 7, 1947. NARA, San Bruno, RG 269, Box 21, Basic Magnesium Case Files, Folder: Board Memoranda Plancor 201, (1 of 3).

- Letter to Regional Director, GSA, January 18, 1954. NARA San Bruno, RG 121, Box 4, Folder: R-Nev-5, Basic Magnesium, WECCO General through Final Disposition.
- Letter to W.L. Drager, DPC, September 23, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Magnesium Project, BRI, April 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Map, Basic Magnesium Site and Vicinity, U-41, Issue No. 6, August 24, 1944. [NARA, San Bruno, RG 121, WAA Property Disposal Records, Box 13] See also F. McComthe to Cliff Young, June 15, 1956.
- Memorandum of Conference, July 24, 1941. UNLV Special Collections, T-6.
- Memorandum of Understanding, November 8, 1946. Army Corps of Engineers, Sacramento.
- Memorandum Summarizing Various ideas respecting the Basic Magnesium setup, September 1, 1942.
- Metallurgical Operations at Basic Magnesium Inc. April 23, 1942, p. 1. NARA II, RG 234, Entry 1065, Box 102, Metals Reserve Company Contract File 1940-1955.
- Minutes of Meeting of Board of Directors of Basic Rrefractories, October 20, 1942.
- Montgomery Research, Inc., Stauffer Chemical Company Industrial Waste Survey, November 1970.
- Monthly Report of Status of Lessees for October 1947. NARA, San Bruno, RG 121, WAA Property Disposal Files, Box 11.
- P. Scheeberger to D.W. Stewart, BRI, July 23, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- P. Schneeberger to Basic Refractories, June 9, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- P. Schneeberger to Chief, Facilities Section, Materiel Division, August 13, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.

- P. Schneeberger to Chief, Facilities Section, Materiel Division, September 13, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- P. Schneeberger to Chief, Facilities Section, October 7, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- P. Schneeberger to Chief, Patent Liaison Branch, May 28, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- P. Schneeberger, Notes on Basic Magnesium, November 10, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- P.G. Spilsbury to J.R. Hobbins, August 5, 1942.
- Paul Harrison to Donn Sutton, February 12, 1942. NARA I, RG 46, Box 477, Folder: Basic Magnesium Notes.
- Personnel, Salaried Employees, Defense Plant Corporation, as of October 12, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming.
- Press Release, RFC 1679, October 26, 1942. NARA I, RG 46, Box 473, Folder: Basic Magnesium D.P.S. Files Rev.
- PS, Notes of Basic Refractories, June 12, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- PS, Notes on Basic Refractories, May 21, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Quitclaim Deed, June 3, 1949. Army Corps of Engineers, Sacramento.
- R.B. Caples, Memorandum of Visit with Mr. Howard P. Eells, Jr. at Cleveland, Ohio, September 1st and 2nd, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming.
- Ray Pavey to GSA, August 31, 1954.
- Reno Sales Memorandum to C.E. Weed, August 17, 1942. Anaconda Document Collection, American Heritage Center, University of Wyoming.

- Report on Magnesium, p. 8, July 24, 1943. NARA I, RG 46, Box 469, Folder: (General) Magnesium Correspondence.
- Reuben T. Carlson, DPC to Marvin Braverman, April 24, 1942. NARA II, RG 234, Entry 1065, Box 102, Metals Reserve Company Contract File 1940-1955.
- Richard Greenburg, GSA, to Robert Moore, BMI, January 30, 1953.
- Robert B. Bradford to Deputy Regional Director, Public Building Service, April 25, 1956.
- Robert Patterson to DPC, August 4, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Roy E. Thomas, Chief Engineer, April 30, 1945. UNLV Special Collections, T-6.
- S.J. Fletcher, Neutralization of Effluent Liquor, March 13, 1942. UNLV Special Collections, T-6.
- S.P. Brown, Notes on Basic Magnesium, July 8, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Sales Brochure, Plancor 201. n.d.
- Satterthwaite to R.B. Caples, Manager, ACMC, Great Falls, MT, April 17, 1943. Anaconda Document Collection, American Heritage Center, University of Wyoming.
- SEC Filing, Annual Report to Stockholders, March 23, 1990.
- State Industries to H. LaVerne Rosse, May 18, 1982.
- State Industries to W.M. Tebeau, March 23, 1982.
- Telegram, Industrial Planning Section, June 12, 1941. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Telegraph, Weber to H.P. Eells, May 23, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Teletype Message P. Schneeberger to Col. F.M. Hopkins, July 2, 1942. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.
- Transmittal of Notes, Deeds and Leases Assigned to GSA, January 28, 1953.

- Truman Committee findings. NARA I, RG 46, Box 478, Folder: Las Vegas Basic Magnesium.
- W.H. Hoover, General Counsel to Richard Inglis, Hauxhurst, Inglis, Sharp & Cull, October 19, 1942.
- W.L. Drager to Basic Magnesium, October 31, 1941. UNLV Special Collections, T-6.
- WAA, Washington Credit Division Report, April 30, 1948,
- War Department Memo # 231, April 23, 1941. UNLV Special Collections, T-6.
- War Department Memo # 255, May 17, 1941. UNLV Special Collections, T-6.
- Wilbur Jurden, Chief Engineer, Anaconda, to Major J.L Bowling, Production Division, DPC, April 21, 1943. NPRC-MPR, Accession 342-54-4046, Box 15, Folder: Correspondence 88A, 88B.

Phase I Environmental Conditions Reports

- Chemstar Lime Company
- Henderson Steering Committee
- Kerr-McGee Chemical Corporation
- Pioneer Chlor Alkali Company, Stauffer Management Company
- Titanium Metals Corporation

Expert Reports

- Expert Report of Clifford B. Wilson on Wastes Produced by Basic Magnesium, Inc., March 18, 2004.
- Supplemental and Rebuttal Expert Report, Clifford B. Wilson on Wastes Produced by Basic Magnesium, Inc., April 19, 2004.
- Expert Report of Paul D. Fahrenthold, Ph. D., March 18, 2004.
- Supplemental and Rebuttal Expert Report, Paul D. Fahrenthold, Ph. D., April 19, 2004.

- Expert Report of Julie A. Corley on United States Government and the Anaconda Copper Mining Company Involvement with the Basic Magnesium Complex, March 19, 2004.
- Supplemental Expert Report of Julie A. Corley on United States Government and the Anaconda Copper Mining Company Involvement with the Basic Magnesium Complex, April 19, 2004.

Secondary Sources:

Journal and Newspaper Articles

- “ACM Acquires Interest in Basic Magnesium Inc.” *Great Falls Tribune*, October 27, 1942.
- Engineering and Mining Journal, October 1943, p. 66.
- K. K. Kelly, *Energy requirements and Equilibria in the Dehydration, Hydrolysis, and Decomposition of Magnesium Chloride*, technical paper 676, U.S. Dept. of Interior, Bureau of Mines, Washington, D. C., 1945.
- Kh. L. Strelets, *Electrolytic Production of Magnesium*, TT76-50003, U.S. Dept. of Commerce, Technical Information Service, Springfield, Va., translated by J. Schmorak, Keter Publishing House Jerusalem Ltd., 1977
- Reference document submitted by the Experts of the European Community and Member States of the European Union on best available techniques (BAT) and best environmental practices (BEP) for reducing and/or eliminating emissions of by-products Persistent Organic Pollutants (POPs) to the First Session of the UNEP Expert Group on BAT and BEP, 10-14 March 2003.
- Zero Toxics, Sources of by-product POPs and their Elimination, Darryl Luscombe and Pat Costner, Greenpeace International Toxics Campaign, May 2001, p. 14-15.

SECTION 3

3 SITE RELATED CHEMICALS LIST

Based on a thorough review of the various chemicals (including likely by-products and degradation products) produced, used, handled, generated, or disposed by the manufacturing companies and BMI, BRC has, with the NDEP's oversight, created a comprehensive Site Related Chemicals (SRC) List for the BMI Common Areas. In creating this list, BRC considered:

- All historical uses at the Site;
- The multiplicity of plant source processes and chemicals that have or may have been discharged into the ponds via the conveyance ditches;
- The lack of certainty and specificity of these discharges into known ditches and ponds; and
- Anticipated future uses.

The SRC submittal (BRC Common Areas Site Related Chemicals Tables, 2006) documents the information used in the development of the SRC list, including the lists themselves. Table 3-1 contains ~~a copy of the~~ broad suite analytical list for ~~reference purposes~~ the project, based on the SRC list. This analytical program (or appropriate subsets, based on the NDEP's approval) will be applied to all characterization and confirmation sampling conducted as part of Closure of this Site.

It should be noted that on-going investigations are currently being performed by various companies associated with historical operations at the BMI Complex under the NDEP's supervision. If those investigations identify additional SRCs that might have been discharged to the Upper and Lower Ponds and Ditches, the analytical program and the SRC list itself will be updated as needed to include additional chemicals. Conversely, if investigations show that some chemicals do not occur at the Site, they may be removed, with the NDEP's permission. Or, if subsequent sampling and analysis demonstrates to the NDEP's satisfaction that certain analytical suites can be eliminated without adversely affecting risk assessment reliability, those suites may be eliminated from the analytical program.

As later discussed in Section 9.0.9, it is permissible following USEPA's current guidance to eliminate various chemicals from the SRC list, leaving a smaller number of chemicals of potential concern (COPCs) that are analyzed and used in risk assessments. BRC expects that some number of the analytes in the SRC list will be eliminated for risk assessment purposes (*i.e.*,

not be carried over as COPCs) in accordance with this guidance as the project progresses. The selection of COPCs is a function of the risk assessment process. COPC selection will not be conducted prior to initiating a sub-area-specific risk assessment.

SECTION 4

NOTE: The redline edits for this section are compared to the revised Section 4 provided to NDEP in March 2007 and received back from NDEP by BRC on March 21, 2007

4 SITE-WIDE CONCEPTUAL SITE MODEL OVERVIEW

This section of the Closure Plan presents an overview of the CSM for the “Eastside Area” (Figure [x]) and the CSM for the “~~Corrective Action Management Unit (CAMU) Area~~” (Figure ~~⇒~~) of the Site. The Site boundaries were set and are described by the AOC3. A history of the Site and adjacent industrial plants situated to the southwest is provided in Section 2 of this plan.

Pursuant to the Scope of Work set forth in the AOC3, two comprehensive and detailed CSMs for the Site ~~will~~are to be prepared as separate stand-alone reports. These stand-alone CSMs are for the Eastside Area and for the CAMU Area (as further defined, below). The CAMU Area CSM was submitted to the NDEP in February 2007 and ~~is currently under review by~~BRC has received requests for certain additional data in this regard from the NDEP. The Eastside Area CSM is under development and will be submitted to the NDEP ~~in the first half of 2007~~after various current investigations are implemented and the data thereby collected and incorporated. Both CSMs will be “living documents” and will be updated periodically as new data are collected and analyzed.

The American Society for Testing and Materials (ASTM) guidance E 1689-95, *Standard Guide for Developing Conceptual Site Models for Contaminated Sites* (2003) states the basic activities associated with the development of a CSM, and these include:

- Brief Site Summary
- Site Description, including a description of the limits of the study area
- Source Characterization
- Background Levels for each media of interest
- Migration Pathway Descriptions
- Environmental Receptor Identification
- Discussion of Data Gaps

- Maps, Tables, and Figures

The activities called for in the ASTM guidance are summarized in this section of the Closure Plan.

4.1 SITE SUMMARY

~~NOTE FROM NDEP: it would be helpful if this Section referenced a figure that showed the areas described below.~~ The area known as the “BMI Common Areas” is delineated in Appendix A of the AOC3. The subject Site is near the BMI Industrial Complex, in Clark County, Nevada, approximately 13 miles south of the city of Las Vegas and approximately two miles northeast of the ~~city~~City of Henderson (Figure 2-1). The total extent of the Site, including the Eastside Area (Figure 1-2) and the CAMU Area (Figure 1-3), as delineated in Appendix A of the AOC3, is ~~approximately 2,401 acres~~discussed in Section 1 of this Closure Plan. The Eastside Area (including relevant portions of Parcel 9) covers approximately ~~2,287~~2,321 contiguous acres, and the CAMU ~~area~~Area covers ~~the balance of~~ approximately 114 acres. The Eastside Area lies to the east of Boulder Highway (except for Parcel 9, which is adjoining and to the west of Boulder Highway) and to the north of Lake Mead Parkway and consists of:

- Land on which unlined wastewater effluent evaporation/infiltration ponds (and associated conveyance ditches) were built and into which various plant wastewaters were discharged from 1942 through 1976;
- Land on which effluent from the TIMET plant was disposed through the ~~used~~use of a spray irrigation wheel;
- Land on which lined wastewater effluent ponds were constructed and into which effluent from the ~~Titanium Metals Company~~TIMET plant was discharged from 1976 to 2005;
- Land on which the City of Henderson constructed municipal wastewater infiltration basins (e.g., the Southern ~~Rapid Infiltration Basins~~ (RIBs));
- Land on which unlined wastewater effluent ponds were constructed but which were never used; and,
- Land that has remained desert.

The CAMU ~~area~~Area consists primarily of land which contains:

- The closed BMI Landfill;₂
- Land on and under which Stauffer-~~Chemical Company~~ constructed a line of groundwater extraction wells and their associated piping, treatment, and reinjection apparatus;
- Land across which traversed the former Western Ditch that carried effluent from the Plants to the Western Ditch Extension and from there towards the Las Vegas Wash;
- A series of trenches (the "Slit Trenches") into which various wastes and trash were deposited; and,
- Land that appears to have had no historical use.

~~It is anticipated that the~~The CAMU Area will continue to be used as a waste disposal facility ~~and that the.~~ The Eastside Area will be redeveloped to a mixed use, including residential use, in accordance with a master plan.

4.1.1 Site Description

~~NOTE FROM NDEP: it would be helpful if this Section referenced a figure that showed the areas described below.~~ The Site represents a portion of the property known as the BMI Common Areas. The total extent of the property is approximately ~~2,401~~2,435 acres and is comprised of: 1) the "Eastside Area" of approximately ~~2,287~~2,321 contiguous acres located east of Boulder Highway and including Parcel 9 (Figure 1-2) and, 2) the CAMU ~~area~~Area of approximately 114 acres (within the 369 acre Parcel 5/6) to the west of Boulder Highway (Figure 1-3). The Site contained a network of ditches, canals, flumes, and unlined ponds that were used for the disposal of aqueous waste from the original magnesium plant and, later, other industrial plants and the municipality adjacent to it. The ponds are sometimes referred to as the "BMI Ponds" or the "evaporation ponds of the BMI Common Areas" or the "Upper Ponds" and "Lower Ponds." The Lower Ponds are topographically lower and located to the north; the Upper Ponds are topographically higher and located to the south. This disposal network comprised less than half of the Site.

This overview of the CSMs describes:

- The entire 2,2872,321 acres of the Eastside Area, bounded on the south by Lake Mead Parkway, on the west by Boulder Highway (except for Parcel 9) and the community of Pittman, and on the north by the Tuscany and Weston Hills communities ~~(and including Parcel 9)~~; and
- The 114 acres which comprises the CAMU Area within the footprint of the property located east of Eastgate Road, west of 4th Street, approximately 1400 feet south of West Warm Springs Road, and north of the properties operated by Pioneer ~~Chlor Alkali~~, Stauffer ~~Chemical~~, and Montrose ~~Chemical~~.

Effluent wastes discharged to the ponds of the BMI Common Areas from the war-time Basic Magnesium operations can be characterized as salts from the production process (chloride salts of a variety of metals and radionuclides); organic solids; and inorganic solids and dissolved components of various types. Chlorinated organic chemicals were included in the effluent. ~~NOTE FROM NDEP: what about dissolved components?~~ Notable processes that contributed to the waste stream from the plants that succeeded Basic Magnesium included effluents from the manufacture of the following types of products: chlorine and sodium hydroxide (caustic soda); a variety of chlorate ~~and~~, perchlorate compounds; ~~a variety of, and~~ halogenated boron compounds ~~(this may be better phrased?)~~; manganese dioxide; titanium and related compounds; and a variety of pesticides. Among these wastes were salts; organic and inorganic chemicals; and metals. A more detailed description of these processes and their effluents is found in Section 2. An overview of the contaminants now found on Site ~~willis~~ also ~~be~~ found below in Section 4.3,4.2, “Source Characterization.”

Due to the size of the Site and its various historical, present, and prospective uses, BRC has subdivided the 2,2872,321 acre Eastside Area into sub-areas. The rationale for this subdivision is to divide the Site into sub-areas in which acreages of reasonably similar geography, geology, past use, and future use are grouped together. By dividing the Site into various sub-areas, the Site restoration and reclamation can be more focused, and thus achieved in a more precise, cost effective and timely manner. Figure 41-2 depicts the sub-areas that are the focus of this CSM summary for the Eastside Area. These Eastside Area sub-areas are:

- Western Hook (227 acres);
- Trails & Recreation ~~and Parks Area~~ sub-area (151.4 acres);
- City of Henderson WRF Expansion (101.3 acres);

- Galleria North (135.6 acres);
- Sunset North Commercial (57.9 acres);
- Upper Ponds (284.5 acres);
- Spray Wheel (128.7 acres);
- TIMET Ponds (209.9 acres);
- First Eight Rows (208.2 acres);
- Mohawk (49.2 acres);
- Southern ~~RIBS~~RIBS (~~210.9~~245.1 acres); and
- No-Further-Action (NFA) Areas (522.2 acres).

With two exceptions (the City of Henderson WRF sub-area and the sub-area named NFA Areas), the sub-areas listed above are included in the Closure Plan as it addresses impacts to soils. The City of Henderson has received a NFA determination from the NDEP for its City of Henderson WRF Expansion sub-area relative to soil impacts, and the owner of the NFA Areas sub-area has received a ~~NFA determination~~determinations for this sub-area relative to soil impacts.

As noted, all of the Eastside Area sub-areas are planned for redevelopment according to a mixed-use master plan, which will include above- and below-ground utilities (potable water, sewerage, power, gas), roadways, trails, parks, homes, schools, shops, and municipal buildings. Some of the Eastside Area sub-areas will be primarily residential (*e.g.*, Mohawk), some will be primarily commercial (*e.g.*, Sunset North Commercial), one will be exclusively dedicated to trails and parks (*i.e.*, Trails & Recreation~~& Parks~~ sub-area), and some will be a mixture (*e.g.*, Southern RIBs).

Figure ~~41~~3 depicts the sub-areas that are the focus of this CSM summary for the CAMU Area. These CAMU Area sub-areas are:

- Eastern W. Ditch (6.1 acres);
- Northern Landfill Lobe (51.7 acres);
- Northern Lobe of the Borrow Area (9.3 acres);

- Slit Trench Area (27.7 acres);
- Southern Landfill Lobe (8.2 acres);
- Southern Lobe of the Borrow Area (8.5 acres); and
- Western W. Ditch (2.3 acres).

As mentioned above, it is anticipated that the CAMU Area will ~~be used~~continue use as a waste disposal area.

All of the sub-areas listed above, including the two in the Eastside Area excluded from the Closure Plan relative to soil impacts, are covered by the AOC3 and are included in the Closure Plan for groundwater impacts.

4.1.2 Geology ~~(please add references to this Section)~~

4.1.2.1 Regional Geology

Southern Nevada regional geology is typical of the Basin and Range Province morphology of the Western Cordillera of North America. In this region, Cenozoic tectonic extension has resulted in one of the world's most extensive systems of fault-bounded mountains separated by sediment-filled valleys, extending across Idaho, Oregon, Nevada, Utah, Arizona, New Mexico, California, and northern Mexico.

The Basin and Range Province is typified by elongated north-south-trending arid valleys bounded by mountain ranges that also bound adjacent valleys. Basins consist of down-dropped blocks of crust, and the ranges are upthrust slabs with a regional tilt to the east. The normal arrangement in the Basin and Range system is that each valley is bounded on each side by a normal fault that runs parallel to the range. Upthrown sides of Basin and Range normal faults form mountains that rise abruptly and steeply, and the down-dropped sides create low valleys. The fault plane, along which the two sides of the fault move, extends deep in the crust, usually at a nominal angle of 60 degrees. In places, the relief or vertical difference between the two sides is as much as 10,000 feet.

The mountain range rock types in this region consist primarily of consolidated sedimentary and volcanic rocks of Proterozoic and Mesozoic age, with some Precambrian Era rocks. A lesser percentage of the mountain rock types are metamorphic and intrusive igneous rocks. Following

uplift, sediments originating from the mountain sources began filling the valleys, with sedimentary rocks of the Cenozoic Era forming the basin stratigraphy. Cenozoic volcanic rocks also comprise portions of selected mountain ranges in the Basin and Range Province.

4.1.2.2 Local Geology

The geology of the Las Vegas Valley has been mapped and described by several researchers, most recently by Page *et al.* ~~in 2005~~ (2005). As is common throughout the Las Vegas Valley, Site soils are primarily sand and gravel, with occasional cobbles. This is consistent with the depositional environment of an alluvial fan. The Site is located on alluvial fan sediments, with a surface that slopes to the north-northeast at a gradient of approximately 0.02 foot per foot (ft/ft) towards the Las Vegas Wash. These uppermost alluvial sediments were deposited within the last two million years and are of Quaternary age. The alluvial soils on the Site were deposited from the McCullough and the River Mountain ranges, located to the southwest and southeast of the Site, respectively. Regional drainage is generally to the east.

The uppermost strata beneath the Site, at the CAMU Area and the Eastside Area, consist primarily of alluvial sands and gravels derived from the River Mountains and from the volcanic source rocks in the McCullough Range. These deposits are of Quaternary age, and are thus mapped and referred to as Qa the Quaternary alluvium (Qal; Carlsen et al. 1991). The QaQal is typically on the order of 50 feet thick at the Site with variations due, in part, to the non-uniform contact between the QaQal and the underlying Tertiary Muddy Creek Formation (TMCf).

The TMCf underlies the QaQal. The Muddy Creek formation, of which the TMCf is the uppermost part, is a lacustrine deposition from the Tertiary Age, and it underlies much of the Las Vegas Valley. It is more than 2,000 feet thick in places. The lithology of the TMCf underlying the Site is typically fine-grained (sandy silt and clayey silt), although layers with increased sand content are sporadically encountered. These TMCf materials have typically low permeability, with hydraulic conductivities on the order of 10^{-6} to 10^{-8} centimeters per second, ~~or approximately 7.5 feet per year. (REFERENCE) (Weston 1993).~~

The contact between the QaQal and the underlying TMCf is not a planar surface (Figure 4-1). The unconformity between these two geologic units is a result of uplift and erosion of the TMCf prior to the deposition of the alluvial sediments that comprise the QaQal. As the TMCf was eroded, shallow channels were incised into its surface and filled with the relatively coarse-grained alluvium, resulting in the development of southwest-to-northeast trending paleochannels. ~~Figure 4-6 presents the Topographic Surface of the Muddy Creek Formation. Figure 4-7,~~

~~—————*Geologic Block Diagram with View from the Southwest, is a block diagram that*2 depicts the relationships between the QaQal and the TMCf at the Site. For reference, the Site property boundary overlies the block diagram.~~

4.1.3 Surface Water

Surface water flow occurs for brief periods of time during periodic precipitation events and drains to the Las Vegas Wash, which is to the north of the Site's northern border. Four jurisdictional wetlands are present in the northern portion of the Site that contain water during portions of the year. These four wetlands are near larger wetlands associated with the Las Vegas Wash and occupy approximately 13 acres ~~see (Figure XXX4-3)~~. Groundwater seeps have been observed at various locations in the northern portions of the Site closer to the Las Vegas Wash and at nearby off-Site locations ~~see Figure XXX~~. In recent years, the observed seeps have been restricted to the wetland areas. An evaluation of historical aerial photos indicates that seeps have appeared in association with past effluent infiltration at the Eastside Area ponds and with infiltration of municipal wastewater at municipal RIBs on the Eastside Area.

4.1.4 Groundwater

The logs of more than 500 borings installed at the Site were reviewed to evaluate the primary Site geologic units, including their lithology, geometry, and stratigraphy. More than 15 miles of geophysical transects have been shot across the 3.6 square mile Site (Figure 4-4), and these transects have also been evaluated. This evaluation has yielded a good understanding of the depositional environments of the various strata, which control the flow of groundwater and the distribution of chemicals that are found in both soils and groundwater at the Site.

Groundwater is primarily encountered in two distinct layers (shallow and deep) at both the CAMU Area and at the Eastside Area. The shallower layer of groundwater is unconfined and typically encountered in the QaQal and the upper portion of the TMCf. The deeper groundwater occurs in the TMCf. The potentiometric surface in the Upper Unconfined Water Bearing Zone generally follows topography, sloping towards the Las Vegas Wash. The depth to groundwater at the Site ranged from approximately eight feet bgs at the northern perimeter of the Eastside Area to 65 feet bgs at the southern border when water level data were collected in 2004 (Eastside Area) and 2005 (CAMU Area). More recent groundwater data from quarterly monitoring in 2006-2007 is under analysis at the present time; however some of these data are also discussed later.

On the eastern side of the Eastside Area, groundwater is not found in the ~~QaQal~~. The shallowest groundwater in this portion of the Eastside Area is encountered within the uppermost fine-grained sediments of the ~~Upper Muddy Creek formation (upper TMCf)~~, just below the contact between the ~~QaQal~~ and the TMCf. ~~Figure 4-8, Groundwater Surface Elevation, Alluvial Aquifer (Aa), depicts this first groundwater (Figure 4-5).~~

Wells completed in both the ~~QaQal~~ and the TMCf water-bearing zones, at both the CAMU Area and the Eastside Area, are generally low producing, as indicated by recovery rates of less than ~~five~~ gallons per minute (gpm) observed after purging monitoring wells installed in 2004 and 2005. (A notable exception is an Eastside ~~Aa Area Upper Unconfined Water Bearing Zone, also referred to as the alluvial aquifer [Aa], groundwater~~ well on the west side of the first eight rows of Upper Ponds, AA-09, just downgradient of the closed ~~TimeT~~~~TIMET~~ Ponds, that recovered at a rate of 52 gpm during 2004.)

Deep groundwater occurs within the TMCf and is encountered between 335 and 395 feet bgs, as encountered while drilling at the Site during Summer ~~2004~~~~2004~~ (Figure 4-6). There is no indication that deep groundwater, which is confined and under pressure, is in contact with the Las Vegas Wash to the north of the Site. To the east of the Site, faulting has been identified that may provide a pathway of hydraulic connectivity between Deep Zone groundwater and the Las Vegas Wash. The shallower groundwater presents evidence of contact with the Las Vegas Wash gravels. With the exception of the wetlands discussed previously, the potentiometric surface does not emerge as surface water prior to flowing into the Las Vegas Wash. ~~Stiff diagrams for the Aa and the Deep Zone (Figure 4-7) graphically depict cation/anion constituent data. The similarity or dissimilarity of the Aa and the Deep Zone groundwater is a data gap that will be addressed through future investigations.~~

Between shallow and deep groundwater occur several hundred feet of dry to moist, fine-textured, silts to silty clays ~~comprised~~~~comprising~~ the TMCf. This unit, between the Upper Unconfined Water Bearing Zone and the Deep Zone, has been designated as the Middle Zone. Thin sand lenses were sporadically and unpredictably encountered ~~in~~ this upper portion of the TMCf during drilling. Many ~~encountered~~~~of the~~ sand lenses were saturated; others were unsaturated. These lenses are typically less than ~~one~~ foot in thickness and the borings studied (~~please insert a brief description of how these were studied~~~~through the construction of project cross-section and fence diagrams~~) do not appear to establish lateral interconnection ~~between Middle Zone lenses observed in individual borings~~. The lenses were encountered at depths ranging from 55 feet bgs to more than 300 feet bgs. ~~Figure 4-9, Hydrogeologic Cross Section Z-Z' Location Map, and~~

~~Figure 4-10, Hydrogeologic Cross Section Z-Z', depict the hydrogeological relationships of the units described above. (Figure 4-8 and Figure 4-9).~~

Shallow groundwater quality is classified as brackish, with ~~total dissolved solids (TDS)~~ concentrations averaging approximately 4,090 mg/L. A number of contaminant chemicals are also present.

Figures 4-~~4210~~ through 4-~~4614~~ are block diagrams that summarize the features of the Eastside Area depicted between circa 1943 and circa 2005. Figure 4-15 depicts the future scenario following redevelopment of the Site. Figures 4-~~16~~ through 4-~~18~~ are block diagrams that summarize the features of the CAMU Area circa 1943, 1976, and 2005. Figure 4-19 depicts the future scenario with the CAMU in place.

Water level measurements in monitoring wells in the vicinity of the Site ~~have indicated~~indicate that groundwater in the deep TMCf is under pressure; ~~this general trend of a rising potentiometric surface serves to maintain the,~~ which causes an upward groundwater gradient ~~(thus likely inhibiting the downward flow from the Qal of water with dissolved chemicals) in the vicinity of the Site. (NOTE FROM NDEP: Please note that the latter is only true if the,~~ Where the potentiometric head in the shallow zone is lower than the head in the deeper ~~zones)~~zone, the upward gradient can inhibit downward groundwater flow and contaminant transport from the Qal. However, where the potentiometric head in the shallow zone is greater than the head in the deeper zone, downward groundwater flow and contaminant transport can still occur from the Qal.

In the vicinity of the CAMU Area, groundwater is typically encountered first in the Qal under unconfined conditions. The Qal is unsaturated toward the east, with saturation first noted in the uppermost TMCf, ~~very near~~close to the contact between the Qal and the TMCf. It is thought that the Qal has been dewatered in this area as a result of operation of the Tronox remediation system, located on the property east and adjacent to the CAMU Area. ~~(REFERENCE)~~ Groundwater extraction has been conducted immediately east of the CAMU Area, at the Tronox facility, since ~~1987-1987~~ (Tronox 2006).

As a part of this system, groundwater is extracted and treated for chromium, nitrate, chlorate, perchlorate, and other chemicals present in the influent water. The majority of this treatment occurs on the Tronox plant site at the BMI Complex, east of and adjacent to the CAMU Area. Ferrous sulfate is also added approximately 8,700 feet downgradient at the location known as the Athens Road Lift Station. Approximately 5,500 feet farther downgradient toward the Las Vegas

Wash, a line of nine extraction wells, oriented orthogonal to flow of groundwater, captures groundwater that is subsequently treated to remove perchlorate. Water from the perchlorate treatment system is treated to remove solids, disinfected with an ultraviolet (UV) system, and then discharged via pipeline to the Las Vegas Wash. Based on the most recent reporting from Tronox (2006), the maximum groundwater level fluctuation induced by groundwater pumping and downgradient injection of water has been approximately 10 feet.

Another line of remediation extraction wells, known as the Pioneer/Stauffer/Montrose Groundwater Treatment System (GWTS), ~~are~~is installed north and downgradient of the CAMU Area ~~(see Section 4.5). NOTE FROM NDEP: it is not clear why such a detailed description of the TRX system is included and the PSSM GWTS description is so brief. Please make these consistent...either make the PSSM one longer or the TRX one shorter. The GWTS is an 1,800-foot long line of 13 remediation extraction wells installed north and downgradient of the CAMU Area, oriented orthogonal to the flow of groundwater. The GWTS was originally designed to only remove volatile organic compound (VOCs) from groundwater. In correspondence dated January 2005, NDEP noted that the GWTS was to be modified to remove pesticides and semi-volatile organic compounds (SVOCs). NDEP stated that there might be chemicals not treated by the GWTS and that the GWTS might not be capturing all of the impacted groundwater moving through the Pioneer/Stauffer/Montrose facilities area. In this scenario, it is likely that groundwater and contaminants continue to flow north towards the Las Vegas Wash. Subsequent to this January 2005 letter, there has been a substantial and continuing dialogue between the NDEP and Pioneer/Stauffer/Montrose concerning the efficacy of the current GWTS, various operational and design inadequacies, and proposed upgrades to remedy these inadequacies. It is anticipated that this dialogue will lead within the next 36 months to a modification of the GWTS.~~

The CAMU CSM report presents a full summary of additional features relating to the historical and current groundwater recharge in the Site area.

4.2 SOURCE CHARACTERIZATION

Historical operations and chemical disposal at both the CAMU Area and Eastside Area have resulted in chemical impacts to soil and groundwater. Site investigations to collect and summarize historical operational information (Section 2), and to collect and analyze soil and groundwater quality data, have been conducted 30 times since 1996. All data collected from investigations conducted since 1996 have been subjected to a data validation process to insure that the data are of sufficient quality for use in interpreting Site conditions.

A detailed discussion of the analytical data and impacts to the CAMU Area is presented in the CAMU CSM. The Eastside Area CSM, in preparation, will present a similar detailed discussion of the Eastside Area analytical data and impacts. An overview of the source characterization for each of the two Site Areas is presented below.

A ~~Site-Related Chemicals (SRC)~~ list of laboratory analytes was developed to include every chemical known (including potential chemical byproducts and degradation products) to have been manufactured or used by any of the entities at the BMI industrial site from inception to present. This is discussed in Section 3.

~~Some (NDEP NOTE: can we quantify this a little?)~~ A subset of these analytes have been detected at the Site. Detected analytes were grouped into chemical classes and compared to regulatory-established screening levels in order to put relative concentrations at the Site into a context that has been established by regulatory precedence. In order to provide a manageable, useful, and accurate discussion of the chemical impacts to the Site, the chemicals were grouped into the following classes ~~of like chemicals~~:

- Aldehydes, asbestos, dioxins and furans, herbicides, metals, organic acids, organochlorine pesticides, organophosphate pesticides, perchlorate, PCBs, radionuclides, SVOCs, and VOCs.

Because asbestos only occurs as a solid, and owing to the fact that there is not a mechanism to transport this compound to greater depths, only surface soils were analyzed for its presence.

Detected pre-remedial ~~site~~Site chemical concentrations³²⁴ are screened against USEPA Region 9 Residential ~~PRGs~~preliminary remediation (PRGs), and soil screening levels (SSLs) using a dilution attenuation factor (DAF) of 1. Except in the Mohawk sub-area, where contaminated soils have been excavated, the data represent pre-remedial conditions. Dioxins/furans toxic equivalency (TEQ) concentrations were compared to the Agency for Toxic Substances and Disease Registry (ATSDR) screening value of 50 parts per trillion (ppt). The analytical results for naturally occurring constituents, including arsenic, radium-226, and radium-~~228~~228, were compared to shallow soil background concentrations. Finally, the reporting limits for all reported

³²⁴ ~~It is important to recognize that the site specific media concentrations observed in the field data are pre-remediation concentrations (except in the Mohawk subarea, where contaminated soils were excavated). NOTE FROM NDEP: please do not bury important discussions in foot notes.~~

non-detects in soils were compared with the ~~PRGs or with the~~ screening levels noted above in order to evaluate the usefulness of the “non-detect” data.

4.2.1 Summary of Eastside Area Source Characterization

Historical waste disposal practices at the Eastside Area ditches, canals, flumes, and unlined ponds have impacted soil and groundwater in this Area. Table ~~4.xxx,4-1~~ presents BRC’s estimate of volumes deposited into the Upper and Lower Ponds from 1942 until 1976, based on ~~an~~ extensive review of historical operating reports, memoranda, and other data.

4.2.1.1 Eastside Area Soil

The analytical data collected during the Site investigations conducted in this Area since 1996 were organized into a relational database that forms the basis of the Eastside Area source characterization. The data were sorted, screened, and statistically analyzed. Table ~~{4.x}4-2~~ presents the screening levels that were used in the data summary tables and figures. Table 4-3 presents the following for each soil analyte on the SRC list:

- Screening levels;
- Maximum background levels;
- Range of detections;
- Number of detections exceeding the screening level;
- Range of non-detections; and
- Number of non-detections exceeding the screening level.

Tables ~~{4.x}, {4.x}, and {4.x}4-4 through 4-7~~ present these data categorized by the following soil horizon. These three tables encompass, respectively: horizons.

- Surficial soil (1-foot bgs or less) (Table 4-4);
- Shallow soil/Near-surface soils (between 1-foot bgs and first groundwater); and 15 feet bgs) (Table 4-5)
- Middle zone soils (between 15 feet bgs and the Qal/TMcf interface) (Table 4-6); and

- Deep soil (below Aa groundwater)-Deep zone soils (within the TMCf) (Table 4-7).

Figures 4-20 through 4-23 present the soil data showing locations where chemicals exceed screening levels.

Shallow soil chemical data indicate that asbestos was deposited in the subareassub-areas of Sunset North Commercial, Spray Wheel, First Eight Rows, Mohawk, and the Southern RibsRIBs. For the samples collected and analyzed, the greatest frequency of asbestos detection occurred in the First Eight Rows subareassub-area.

Soil chemical impacts on the EasternEastside Area were compared to EPAUSEPA Region 9 Residential PRGs, USEPA SSLs (using a DAF of 1), ATSDR TEQs for dioxins/furans, and the provisional background dataset for metals and radiochemicals. The chemical groups and significant individual chemicals detected most often and most frequently at concentrations above screening levels (“exceedances”) were arsenic, dioxins and furans, organochlorine pesticides, perchlorate, and radium-226 and radium-228.

Arsenic concentrations exceeded PRGs in almost all samples at all intervals, as do the activities of radium-226 and radium-228. Comparison of arsenic and the radium-226 and radium-228 isotopes sample concentrations to the background dataset indicates that these chemicals generally occur at concentrations not substantially different from background concentrations in the Site vicinity. However, the existing data indicate that some areas appear to be relatively elevated in concentration compared to background. BRC will continue to evaluate and address these areas, as appropriate, and update the CSM as needed.

~~NOTE FROM NDEP: perhaps some verbiage could be included that discusses that there ARE areas of the Site that are significantly elevated and there are hotspots. This is critical.~~

Chemical groups that demonstrated a relatively low (and in some cases, no) frequency of exceedance of the soil screening levels included VOCs, SVOCs, PCBs, aldehydes, asbestos, herbicides, organophosphate pesticides, radionuclides (other than radium isotopes), organic acids, and polycyclic aromatic hydrocarbons (PAHs).

As measured by the quantity and type of soil sample chemical analytic results that exceeded the soil screening values, the greatest soil impact on the EasternEastside Area occurred in the First Eight Rows subareassub-area, with lesser impacts observed in the remaining subareassub-areas.

As indicated by frequency of chemical analyte exceedances above the PRG screening level, soil chemical impact is greatest in surface soil samples and decreases with depth into the QaQal soils above the Upper Unconfined Water Bearing Zone. Preliminary evaluation of the Eastside Area soil data has not addressed the potential for leaching of soil chemical constituents to the Upper Unconfined Water Bearing Zone. That evaluation will be reported in the detailed CSM for the Eastside Area. The ~~rapid~~ decline in concentration of detected chemicals with increasing depth in the TMCf soil suggests that the extent of contamination in the unsaturated sediments below the Upper Unconfined Water Bearing Zone is minimal.

4.2.1.2 Eastside Area Groundwater

Evaluation of Eastside Area groundwater is based on data derived from ~~a~~ groundwater monitoring and sampling ~~event conducted in July 2004. NOTE FROM NDEP: it is not clear why the 2004 data set is the only data set used. BRC has spent a great deal of time and resources to collect quarterly data and this should have also been considered. events conducted in July 2004; as well as more recently in April-June 2006, July-August 2006, and October-November 2006.~~

Groundwater chemical results were statistically analyzed and compared to (1) maximum contaminant limits (MCLs) where they have been established, (2) secondary water treatment standards, and (3) the USEPA Region 9 PRGs for tap water for a residential water use scenario. ~~{Table 4-z}4-2 lists all the screening levels and the citation for each. Groundwater data are also statistically analyzed. Table [4.y], and Table 4-8~~ presents the following for each groundwater analyte on the SRC list, using the most recent 2006 data:

- Screening levels;

- Range of detections;
- Number of detections exceeding the screening level;
- Range of non-detections; and
- Number of analyses with reported detection levels exceeding the screening level.

Tables 4-9 through 4-11 present these data categorized by the following groundwater zones.

- Upper unconfined water-bearing zone (Table 4-9);
- Intermediate water-bearing zone (Table 4-10); and

- Deep water-bearing zone (Table 4-11).

Figures 4-24 through 4-26 present the most recent 2006 groundwater data showing locations where chemicals exceed screening levels.

Generally, water in the Upper Unconfined Water Bearing Zone is classified as brackish, with average TDS concentration of 4,090 mg/L. The Aa water can be further classified as being of calcium-chloride to calcium-sulfate in chemical character. Groundwater within the Upper Unconfined Water Bearing Zone has been impacted by the chemicals historically used in the Plants Area to the west as a result of wastewater disposal to the effluent ditches and ponds. In addition, off-Site sources have been identified for impacted groundwater flowing west of Pabco Road and beneath the Lower Ponds. In addition to perchlorate, groundwater in the Upper Unconfined Water Bearing Zone has been impacted with elevated levels of certain dioxins and furans, certain metals (total chromium, selenium, and copper), certain organochlorine pesticides, certain radionuclides as well as certain SVOCs, and VOCs. Groundwater samples collected from Upper Unconfined Water Bearing Zone groundwater do not exhibit detectable concentrations of PCBs, PAHs, herbicides, organophosphorus pesticides, or organic acids.

4.2.2 Summary of CAMU Area Source Characterization

The revised CAMU CSM document was submitted to the NDEP February 16, 2007. Recently BRC has received comments on this CSM. The following summary is based on this report revised draft report, taking into consideration considering NDEP's comments.

4.2.2.1 CAMU Area Soil

Impacts to soil on the CAMU Area have been documented to exist in the North Landfill Lobe, beneath the Western Drainage Ditch (beneath pieces of Western W. Ditch Area and the Eastern W. Ditch Area), and in the STASlit Trench Area. These impacts include VOCs, SVOCs, pesticides, metals, Aroclors, PCBs, radiochemicals, and dioxins/furans. Though specific information does not exist on historical waste disposal activities or subsurface investigations at the South Landfill Lobe, it is logical to assume that similar impacts exist here that exist beneath the North Landfill Lobe. Investigations and studies have indicated that limited soil impacts have occurred in the North Borrow Pit Lobe and the South Borrow Pit Lobe. A formal risk assessment has been performed on the soils in these two Borrow Pit Lobes (ERM 2007) and has been approved by the NDEP. The risk assessment indicates that the soils in these two lobes present minimal hazard to human health. An NFAD (with conditions) for these soils has been obtained

by BRC. These soils are to be excavated to make room for the below-grade portion of the CAMU. The excavated soils will be used as underlayment with an overlying, approved cap.

Excluding the portion of land through which the Western Drainage Ditch traversed and based on the absence of historical waste disposal activities, no impacts to soil are known at the Eastern W. Ditch Area.

4.2.2.2 CAMU Area Off-Site Soil

A variety of chemical manufacturing, storage, handling, distribution, and waste disposal facilities historically operated at facilities south and upgradient of the CAMU Area. Environmental investigation reports document that activities at these facilities have resulted in soil impacts beneath the facilities. These impacts include VOCs, SVOCs, pesticides, and metals; and additional impacts may exist. However, a complete interpretation comparable to the one given the CAMU Area is not possible because of the limited analyte list used for analyzing samples collected from the upgradient locations. It is BRC's understanding that a CSM is in preparation by others covering both upgradient and downgradient areas of the CAMU. BRC will provide the CAMU CSM for this effort.

4.2.2.3 CAMU Area Groundwater

The current data for groundwater within the CAMU Site boundary include:

- Historical one-time groundwater grab samples collected from borings (HLA 1998), performed for Montrose;
- Data collected from groundwater monitoring wells installed in the past (ERM 1999);
- Data collected from groundwater monitoring wells installed during the 2005 CAMU investigation performed for BRC.

Impacts to groundwater have occurred in the Aa beneath and upgradient of the CAMU Area. Chemicals detected in this groundwater in the CAMU Area perimeter wells ~~(BRC and MWH, during the 2005)~~ CAMU investigation include VOCs, SVOCs, pesticides, metals, PCBs, dioxins/furans, TDS, and radionuclides. Chemicals that exceed MCLs in the Aa in both the CAMU Area upgradient and downgradient wells are significantly fewer in both number and type, ~~and~~. These exceedances include VOCs, SVOCs, pesticides, dioxins (only in the upgradient wells), and metals. Fewer chemicals were found in the CAMU Area downgradient wells than in the upgradient wells. Notable chemicals detected at concentrations above MCLs in the

upgradient wells that were not detected above MCLs in the downgradient wells include vinyl chloride, uranium-238, and ~~dioxins~~PCBs.

Trichloroethylene (TCE) was detected above the MCL in a downgradient well but not in the upgradient wells. ~~While further~~Further investigation of upgradient groundwater ~~conditions~~ is needed (and is being conducted) by offsite property owners) to characterize upgradient groundwater quality and evaluate the source of the detected TCE. Because it is well-documented that PCE can degrade to TCE in anaerobic groundwater, it is suspected that TCE may be the presence of this compound is the result of biodegradation daughter product of PCE moving in groundwater originating from upgradient ~~locations or from compounds that have entered groundwater from~~ sources such as or originating from the BMI Landfill or the STA in the CAMU Area and were subsequently degraded. NOTE FROM NDEP: it is not known what is being referenced herein? Evidence regarding biodegradation has not been presented....perhaps a brief note regarding what is being referred to can be included?CAMU Slit Trench Area.

Based on comparison of soil sample results from the Qal depth interval greater than 10 ~~ft~~feet bgs to the DAF-1 soil screening criteria for representative chemicals, impacts to groundwater beneath the CAMU may have resulted from historical disposal of wastes in the CAMU Area in the North Landfill Lobe, the South Landfill Lobe, the ~~STA~~Slit Trench Area, the Eastern W. Ditch Area, and the Western W. Ditch Area. These impacts include metals, organochlorine pesticides, PCBs, perchlorate, radiochemicals, SVOCs, and VOCs. ~~The data indicate that detections of~~

BRC has conducted work to evaluate background levels of metals and radiochemicals in shallow soil. The work is under review, as noted further below. Based on a statistical comparison of the data collected to date with the provisional shallow background soils dataset, the detected metals and radiochemicals may be attributable, in whole or in part, to natural sources and ~~that the concentrations~~ may be representative of background levels. ~~(NOTE FROM NDEP: the preceding sentence is somewhat of a non-sequitur given the next sentence) BRC has conducted some work to evaluate shallow soil background levels and~~BRC is developing a study to evaluate background concentrations of deeper (greater than 10 feet bgs) Qal and TMCf soils. Additional evaluation of the data will be conducted when this study is completed.

Historically, all of the chemicals found in any of the wells downgradient or cross-gradient from the CAMU Area were also found in the upgradient wells. For chemicals found at the highest concentrations, such as benzene, chlorobenzene, polychlorinated benzenes, and chloroform,

historical CAMU Area well concentrations upgradient of the CAMU were typically high. Historical isoconcentration plots indicate that significant groundwater sources exist for these chemicals at off-site, upgradient locations. Isoconcentration plots of the boundary wells based on contemporaneous data collected in 2005 show a repeated pattern that likewise indicates that significant upgradient sources exist for these chemicals.

Impacts to groundwater occurring in the TMCf sand lenses have also occurred. In samples collected from wells located upgradient of the CAMU Area, 21 chemicals were detected at concentrations above the MCLs in TMCf groundwater lenses. These chemicals included VOCs, SVOCs, a pesticide, metals, and a radionuclide (uranium-238). All of the chemicals detected above MCLs in the TMCf groundwater samples were also detected above MCLs in samples collected from CAMU Area upgradient perimeter wells. Many were also detected above MCLs in CAMU Area downgradient perimeter wells.

4.3 SOIL BACKGROUND LEVELS

4.3.1 Surficial Soil

~~NOTE FROM NDEP: it would be desirable to have the spacing and formatting of the document be uniform when it is submitted in its final form.~~

~~NOTE FROM NDEP: for completeness, perhaps include a discussion of a supplementary shallow soils background study for pesticides and dioxin/furans?~~

A background soil summary report (for metals, radionuclides, and other inorganics) was completed for the Site by BRC and the adjacent TIMET property in 2006, in 2007 (BRC and TIMET 2007). The report is currently in review with NDEP, and the data are thus currently considered “provisional” until the report is approved. BRC is also currently considering the applicability and value of a shallow background soils evaluation of pesticides and other compounds that have been detected in Site soils but may be due to offsite sources. BRC will address these issues with NDEP.

The general scope of work included the collection of soil samples from background areas upgradient of at higher topographic elevations than the Site industrial areas and analysis of these samples for site-related metals, radionuclides, general chemistry ions, and soil characteristics. The definition of “background” for this report is based upon the U.S. Environmental Protection Agency’s (EPA) Integrated Risk Information System (IRIS) that of the USEPA (2002), which states:

~~“Two types of background levels may exist for chemical substances: (a) Substances or locations that are not influenced by the releases from a site and are usually described as naturally occurring or anthropogenic: (1) Naturally occurring levels: Ambient concentrations of substances present in the environment, without human influence; (b) in forms that have not been influenced by human activity. (2) Anthropogenic levels: Concentrations of substances are natural and human-made substances present in the environment due to human-made, non-site sources (e.g., automobiles, industries).” as a result of human activities...~~”

The main objective of this study was the development of a representative background soil data set that could be used to evaluate whether concentrations of site-related chemicals detected in Site soil samples statistically exceed concentrations of these chemicals in background soil.

Soil samples were collected from 11 sampling locations located on undeveloped properties close to ~~and upgradient from the Site. (NOTE FROM NDEP: please clarify upgradient versus upslope, upwind, etc)~~ the Site. A total of 33 borings were installed at the 11 locations, and 104 independent soil samples were collected for analysis. Soil samples were collected from three depth intervals at each sampling location:

- Surface soil (0 to 0.5 feet ~~below ground surface~~ [bgs]); and
- Two subsurface depths (four to six feet and nine to 11 feet bgs).

In addition to data collected for Site-related metals, radionuclides, and anions, data for soil characteristics (soil texture, pH, conductivity, cation exchange capacity [CEC], salinity, total organic carbon [TOC], and percent moisture) were also collected to evaluate whether the background soil locations are representative of characteristics of Site soils.

Specific goals and comparisons proposed for the background soils study included the collection of data such that:

- The data from the sampled soil units are representative of Site soils;
- The data form a sufficient sample population that can be used to support statistical comparison of on-Site and background data sets;
- The data are sufficient to form more than one background data set, if required based on statistical comparisons of data from different geologic settings;

- The data could be used to evaluate the comparability of background data collected during this study to data collected by Environ for the City of Henderson (Environ 2003); and
- The data could be used to evaluate the comparability of soil originating from geologic units in the northern McCullough Range and the River Mountains.

The background study concluded that the 11 sampling locations represent the range of soils found within the vicinity of the Site. It was also considered reasonable to conclude that the background samples collected reflect background conditions for soils at the Site based on sample location characteristics obtained from published documentation, site inspection, and sample collection. Key results include:

- Metals and Anions - A total of 43 metals and anions were analyzed in each sample. Although there were some statistically significant differences, the results of statistical tests comparing groupings of the BRC/TIMET metals data by depth suggest that data for two intervals of subsurface soil (4 to ~~6.6 feet bgs~~, and 9 to 11 feet bgs) can be combined for all metals. Significant differences were found for 24 metals and anions when comparing BRC/TIMET ~~surface~~ sample results from the surface to the subsurface sample results. This difference is, These differences are likely the result of ~~anthropogenic background and because of this, surface soil may be retained as a separate data set for statistical comparisons of metals.~~ background differences associated with the difference in soil type with depth. Because of this difference, surface soil sample results may constitute a different background dataset from deeper subsurface soil sample results. This possibility is being investigated by BRC. A work plan, as discussed below, to investigate background for the deep Qal and TMCf soils is in review and will be submitted to NDEP for review and acceptance.
- Radionuclides - Results of statistical tests comparing radionuclide activities for the different sampling depths indicate that the data for radionuclides from all depths can be pooled and treated as a single data set.
- Other Parameters - Parameters such as pH, conductivity, TOC, and soil texture provide additional insights into the comparability of soil samples collected from site and background areas or different areas within a site. Because the concentrations of metals in solid media (e.g., soils and sediments) may be correlated with grain size or TOC, and because pH can radically affect the mobility of metals, ~~collecting and evaluating~~ data for these supporting parameters ~~may will~~ be collected and used to assist in data evaluation.

- Comparability of ~~Mecullough~~McCullough Range and River Mountains Data - The source rocks and soil types for the McCullough Range and River Mountains are similar, and the main factors for soil formation are the same for the alluvial fans derived from both ranges. The heterogeneity of the samples collected on alluvial fan materials from the northern McCullough Range generally encompass the range of concentrations found in the mixed alluvial fan locations, and the River Range alluvial fan locations. Based on a comparison of the BRC/TIMET data set ~~and the Environ data set~~ in areas downgradient from the McCullough Range and the River Mountains, with a few exceptions, the concentrations of metals and radionuclides in soil samples are comparable.
- The BRC/TIMET data set will be used for background comparisons in future investigations after approval by NDEP.
- These background locations were not impacted by Site operations.

Table 4-~~12~~ presents the range of concentrations of metals, radionuclides, and other parameters that resulted from the background study.

4.3.2 Deep Soil

~~In January~~At present, insufficient background data exist to evaluate whether concentrations of certain Site-related chemicals detected in deeper Site samples statistically exceed concentrations of these chemicals in deeper (as compared to shallow) background soil. In order to address this data gap, in April 2007, a work plan (~~NOTE FROM NDEP: this should be a global change~~) for the evaluation of deeper background soil chemistry (~~and upgradient groundwater quality~~) was submitted to the NDEP for review and approval (DBS&A, 2007). NDEP has provided comments and the plan is in revision by BRC as of this writing. The soil portion of the work plan was written to evaluate deep soil background ranges for metals, radionuclides, general chemistry anions, and certain soil characteristics. The purpose of the soil component of the work plan is to collect data for metals and radionuclides in deep background soils that are comparable to deep Site soils. These data will be used in Site-to-background statistical comparisons. ~~At present, insufficient background data exist to evaluate whether concentrations of certain Site-related chemicals detected in deeper Site samples statistically exceed concentrations of these chemicals in deeper (as compared to shallow) background soil.~~

This soil portion of the work plan scope will provide the following information needed for soil Site-to-background comparisons:

- Soil chemical data for various depth intervals (*e.g.*, starting at 20 feet bgs and proceeding down at 10-foot intervals for the alluvial soils and for two depth intervals into the shallow Muddy Creek formation). Actual depths will depend on particular locations.
- Soil chemical data for a representative range of soil map units applicable to the Site (*e.g.*, Natural Resources Conservation Service [NRCS] mapped Soil Units 117, 182, and 184).
- Soil chemical data to form an adequate sample population to support future statistical comparison of Site and background sample data sets.
- Soil chemical data to form more than one background data set, if required, based on statistical comparisons of data from different soil mapping units.

~~The~~ As noted, the deeper soil background work plan is currently in ~~review with NDEP~~ revision by BRC.

~~NOTE FOM NDEP: Additional Sections should be added to address shallow and deeper groundwater, especially since the existing work plan considers the shallow zone.~~

4.4 UPGRADIENT AND DEEPER GROUNDWATER

The April 2007 work plan for the evaluation of deeper background soil chemistry (Section 4.3.2) also includes well installation for the evaluation of shallow upgradient groundwater conditions along the perimeter of the Eastside Area (DBS&A 2007). Six monitoring wells are proposed to be installed in first-encountered groundwater.

As discussed with NDEP, an evaluation of deeper groundwater conditions will be completed once the evaluation of shallow groundwater, and other related and supporting tasks in progress such as the aquifer testing and numerical modeling, are complete.

4.5 ~~4.4~~ **MIGRATION PATHWAYS**

4.5.1 ~~4.4.1~~ **Eastside Area**

Figures 4-~~42~~10 through 4-~~46~~14 were prepared to summarize changes in site operations that occurred over time. By the spring of 1943, the Upper and Lower Ponds were constructed to aid in the disposal of wastewater as Basic Magnesium's Trade Effluent Ponds, west of present-day Boulder Highway, reached capacity. Wastewater was conveyed to the unlined Upper and Lower Ponds Areas via a series of four unlined ditches. The Western Ditch and Northwest Ditch ~~were~~

~~located to the north (the western ditch is actually located in the CAMU Area and once extended it crossed some of the Plant Sites...clarify) of the Basic Magnesium complex and both conveyed effluent waters to the Lower Ponds.....NOTE FROM NDEP: need to clarify this, because if the ditches were off Site how did the wastewater get to them???. During 1942 until 1976, wastewater was conveyed to the Upper and Lower ponds via the Alpha and Beta Ditches. Once wastewater entered the Alpha or Beta Ditches, it was transferred to the east for management in the Upper Ponds via the Beta Ditch or to the north for management in the Lower Ponds via the Alpha Ditch. Effluent liquids containing chemicals deposited sediment in the pond and ditch bottoms. The Upper Ponds were constructed first, followed by the Lower Ponds to the north shortly thereafter. The ponds were designed in a cascade fashion such that as the nearer (southerly) ponds were filled, the next row (to the north) would fill. Evaporation left evaporative sediments and non-volatile chemicals in the pond cells. NOTE FROM NDEP: VOCs are also water soluble and just as likely could have infiltrated as effluent seeped downward in the soil. Because they are soluble they just as likely could have reached the water table and may not be expected to be in soils. This is an important clarification)~~

Chemicals not evaporated likely leached from pond and ditch sediments and bottoms through the Eastside Area soils to the underlying ~~alluvial~~ groundwater. ~~NOTE FROM NDEP: and deeper zones based on the chemical data.~~ Rainwater is presumed to have also created a leaching mechanism for dried evaporite sediment. In 1976, the Upper and Lower Ponds were permanently removed from service.

Although more than 100 ponds were built in 1942-43 and have been identified on plans and aerial photographs, there is no documentary, photographic, or visual indication that more than the first ~~10~~eight rows of the Upper Ponds were ever directly in service (*i.e.*, filled with effluent). It appears from the documentary evidence that the large number of ponds constructed resulted from an erroneous assumption made in 1941 or early 1942 when trying to rectify an earlier miscalculation of the evaporative area needed for the magnesium plant's effluent (Clary 1944). The assumption neglected to account for percolation (thus assuming that only evaporation would occur) when considering the fate of effluent discharged to the ponds. As a result, a lesser number of ponds were directly used and filled with effluent than was originally envisioned when the ponds were designed and constructed. The Lower Ponds were in service between 1943 and 1970. The Upper Ponds were in service between 1943 and 1976, when both Upper and Lower Ponds were permanently taken out of service. TIMET operated its lined ponds on-site between 1976 and 2005.

Soluble chemicals leached with percolating waters into the Upper Unconfined Water Bearing Zone where chemical impacts are currently detected in groundwater. Impacts to the ~~Eastern~~Eastside Area groundwater also occurred as the result of the dispersion of chemicals (e.g., perchlorate) in the Tronox groundwater plume to the west and from chemicals (e.g., tetrachloroethylene) from sources to the southwest of the ~~Eastern~~Eastside Area ~~(where is this defined?)~~. Chemicals moved in groundwater in the Upper Unconfined Water Bearing Zone northward toward the Las Vegas Wash with the prevailing groundwater gradient and flow. Site geologic and hydrologic data indicate that the Upper Unconfined Water Bearing Zone is in communication with sediments beneath the Las Vegas Wash and that the Site is contributing chemicals to groundwater in the sediments immediately beneath the Las Vegas Wash.

The ~~more soluble~~less retarded chemicals, such as perchlorate, traveled in groundwater farther, faster, and in greater mass than ~~less soluble chemicals~~. ~~(NOTE FROM NDEP: please note that solubility is not linked to velocity; the parameter that would have contributed to the rate of movement is the retardation factor.)~~ ~~Less soluble, more sorptive~~more retarded chemicals. ~~More sorptive and more retarded chemicals (for example, organochlorine pesticides) migrated ~~and dispersed less in groundwater~~ and are currently less widespread in groundwater. ~~(NOTE FROM NDEP: please note that dispersion is also not related to solubility)~~ Non-soluble chemicals, such as asbestos, moved very little and did not leach.~~

The distribution of chemicals in groundwater beneath the ~~Eastern~~Eastside Area is consistent with percolation through the unlined ponds and subsequent travel in the groundwater within the Upper Unconfined Water Bearing Zone. However, it is suspected that the observed decline in ~~chemicals~~chemical concentrations with depth in the TMCf ~~soils suggests that~~is due to minimal leaching of chemicals from the Upper Unconfined Water Bearing Zone to the underlying TMCf ~~soils has occurred~~. ~~(NOTE from NDEP: it is not clear to the NDEP that sufficient data has been collected to make this statement and this should be included as a data gap.)~~ Soil. Existing soil data collected from the unsaturated fine-grained sediments of the TMCf beneath the Upper Unconfined Water Bearing Zone reveal limited chemical impact to soil. ~~The BRC posits that the existing Site data indicate that the~~ limited impact to the TMCf soils by Site chemicals is indicative of limited leaching into the fine-grained Deep (i.e., TMCf) soils from the overlying perched Aa. ~~This~~As posited by BRC, the limited impact to the Deep soils, the currently observed upward groundwater gradient from the Deep Zone groundwater, and the off-Site, upgradient chemical impacts (e.g., perchlorate) in the Deep Zone groundwater ~~suggests~~suggest that the Deep Zone confined aquifer ~~(found at a depth of more than 380 feet bgs has) may not have~~ been significantly impacted by direct downward leaching of chemicals beneath the Site effluent

disposal ponds. ~~NOTE FROM NDEP: BRC does not have the data to prove this statement. Additionally, BRC has data for groundwater in the deep TMCf to indicate that groundwater is impacted by site related chemicals, e.g., perchlorate, hexavalent chromium, TDS, etc. Furthermore, the NDEP has previously indicated via written comment that these statements would not be accepted until adequately proven. Initial analytic~~ However, some downward leaching of chemicals from Site effluent ponds cannot be ruled out. It is possible that some percolation from the Site ponds, along with pathways from upgradient sources, as well as natural sources can, singly or in combination, explain the observed concentrations of contaminants (including very high levels of TDS) in the deep groundwater.

Initial analytical modeling of infiltration into the Upper Unconfined Water Bearing Zone (using historical measurement of pond disposal as calibration), indicate that a mound of significant areal extent and head builds up quickly under a percolation scenario. This suggests the possibility that groundwater flow direction could have been other than southerly northerly when the ponds were in use, and that significant downward gradients could also have existed, during the time effluent was being disposed to the Eastside Area ponds.

BRC performed interim remedial measures (IRMs), consisting of excavation and removal, transport, and subsequent stockpiling of shallow impacted soils in a secured holding area, within the First Eight Rows sub-area. The IRM excavations were performed as shown in Figure 4-~~41-27~~. The stockpiled soils were placed in secure holding areas and treated with an application of a binding agent to resist the erosive potential of heat, wind, and water. BRC plans to transport and dispose stockpiled soil at the CAMU planned at the former BMI Landfill Site west of Highway 95. Permit applications have been made to the NDEP and other regulatory agencies with jurisdiction for the planned CAMU and are under review and refinement.

4.5.2 ~~4.4.2~~ CAMU Area

At the CAMU ~~area~~Area, the BMI Landfill received wastes from 1942 until 1980, at which time it was closed and capped (Weston, 1993). The North and South Landfill Lobes were covered and capped in order to reduce the potential for chemicals to leach to groundwater. Aerial photographs and historical data reveal that the routing of process effluents from the Pioneer/Stauffer/Montrose site occurred through the Western Drainage Ditch, an unlined surface channel that drained west to the Western Ditch Extension. This practice lasted from 1946 to 1970. The Western Ditch, which is now closed and all liquids removed, eventually flowed north to the Lower Ponds. Periodically, between 1970 and 1980, a variety of process and office wastes were

reportedly disposed of in the Slit Trench Area, located immediately south of the BMI Landfill. There appear to be ten slit trenches that were excavated along east-west trends. Aerial photographs show the slit trenches to range in length from approximately 450 to 900 feet. Based on direct field observations during drilling and sampling operations, the trenches vary in depth between approximately 25 and 32 feet. Trench width is estimated to be eight to 10 feet. Anecdotal evidence and soil sampling results that reveal the presence of dioxins and furans suggest that burning of waste occurred in the Landfill Lobes and the Slit Trench Area.

Directly upgradient of the CAMU Area, four companies have operated industrial chemical production facilities since 1942: Basic Magnesium, Stauffer, Montrose, and Pioneer. Basic Magnesium operated a chlor-alkali plant incident to the manufacture of magnesium. Stauffer operated chlor-alkali facilities and an agricultural chemical plant. Montrose operated a hydrochloric acid and an agricultural chemical plant. Pioneer operated (and still operates) chlor-alkali and hydrochloric acid facilities. These operations have been documented to have resulted in soil and groundwater impacts with TDS, VOCs, SVOCs, pesticides, and metals. Additional upgradient soil impacts may exist.

Chemicals were disposed of in soils and mixed soils/waste in the Northern and Southern Landfill Lobes and in the Slit Trench Area and resulted in direct impacts to soil. Soluble chemicals leached with percolating waters into the Upper Unconfined Water Bearing Zone where chemical impacts are currently detected in groundwater. Volatile chemicals (*e.g.*, tetrachloroethylene) have migrated in ~~vaporous~~ ~~(SPELLING?)~~ the vapor phase to larger volumes of soil, though impacts to groundwater are not widespread. Step-out soil borings in the Slit Trench Area suggest that chemicals have preferentially migrated along the line of trench excavations (nominally east-west) when compared to migration in a direction transverse to the trench lines (nominally north-south). ~~Chemical effluents disposed of via the Western Ditch.~~

Soil ~~Impacts~~ impacts on the CAMU Area have been documented to exist in the North Landfill Lobe, beneath the Western Drainage Ditch (beneath pieces segments of the Western W. Ditch Area and the Eastern W. Ditch Area), within the Slit Trench Area, and inferred to exist in the South Landfill Lobe because of its similar history to the Northern Landfill Lobe. These impacts include VOCs, SVOCs, PCBs, pesticides, metals, and dioxins/furans. PCBs were detected in four samples in two borings in the Slit Trench Area. Investigations and studies have indicated that only limited soil impacts have occurred in the North Borrow Pit Lobe and the South Borrow Pit Lobe. ~~Excluding the portion of land through which the Western Drainage Ditch traversed and based on the absence of historical, and as noted above reports of investigations for these areas~~

~~were submitted by BRC for NFAD issuance by the NDEP, which reviewed the reports and has now issued the NFAD. Because~~ waste disposal activities, ~~no impacts to soil are known at~~ ~~were not conducted at other locations within~~ the Eastern W. Ditch Area. ~~(PLEASE clarify this last sentence),~~ known soil impacts are limited to the Western Drainage Ditch in this area.

Impacts to the CAMU Area groundwater also occurred as the result of ~~the dispersion of chemicals~~contaminant transport (e.g., perchlorate) ~~in~~from the Tronox groundwater plume to the east and from the American Pacific Corporation (AMPAC) plume (i.e., perchlorate) ~~migrating in groundwater from~~to the southwest. ~~(please provide a Figure to support this statement) Groundwater~~Figure 4-28). CAMU Area groundwater is also impacted by chemicals ~~(all chemicals detected in groundwater at the CAMU area) from detected in groundwater and resulting~~ from sources to the south ~~of the CAMU Area. (please re-work this sentence because it does not make sense as written)~~ Chemicals moved in. Chemicals transported with the prevailing groundwater gradient in the Upper Unconfined Water Bearing Zone northward from the upgradient sources at the plants site, beneath the CAMU Area, and towards the Las Vegas Wash ~~with the prevailing groundwater gradient and flow.~~

Operations at the upgradient plants site have impacted soil and groundwater with VOCs, SVOCs, pesticides, and metals. Soil sources that may continue to impact groundwater may still exist ~~(please complete this sentence)~~at the upgradient plants. Upon entering the groundwater, the chemicals from these off-site locations ~~migrated~~migrate north beneath the CAMU Area. Data ~~indicates~~indicate that CAMU Area sources likely contributed to groundwater impacts. Because detected chemical concentrations are elevated in both upgradient and downgradient CAMU Area monitoring wells, with concentrations being typically higher in the upgradient wells, it is difficult to discern with certainty whether groundwater has been impacted, and to what degree, by releases from the CAMU Area. For chemicals found at the highest concentrations in groundwater, such as benzene, chlorobenzene, polychlorinated benzenes, and chloroform, CAMU Area upgradient wells typically had high concentrations as well. Historical groundwater ~~isoeonecentration~~iso-concentration plots indicate that significant groundwater sources exist for these chemicals at off-site upgradient locations. ~~Isoeonecentration~~Iso-concentration plots of the 2005 contemporaneously collected data from the CAMU Area boundary wells show a repeated pattern that likewise indicates that significant upgradient sources exist for these chemicals.

After exiting beneath the CAMU Area, groundwater flows northward from the CAMU Area towards the Pioneer/Stauffer/Montrose ~~Groundwater Treatment System (GWTS). The GWTS is an 1800-foot long line of 13 remediation extraction wells installed north and downgradient of the~~

~~CAMU Area, oriented orthogonal to the flow of groundwater. The GWTS was originally designed to only remove VOCs from groundwater. In a January 2005 correspondence, NDEP noted that the GWTS was being modified to additionally remove pesticides and SVOCs. NDEP stated that there might be chemicals not treated by the GWTS and that the GWTS might not be capturing all of the impacted groundwater moving through the area that originates from the Pioneer/Stauffer/Montrose facilities. Under that described scenario, it is likely that groundwater and contaminants continue to flow north towards the Las Vegas Wash. GWTS described in Section 4.1.4.~~

~~4.6~~ **4.5-ENVIRONMENTAL RECEPTOR IDENTIFICATION AND DISCUSSION**

~~The topic of environmental receptors is taken up in Section 10 of this Closure Plan.~~

~~Exposures to current receptors are being managed through site access control. Under the prospective redevelopment plan, the Eastside Area of the Site will be used for a variety of purposes, including residential housing, parks, schools, places of worship, commercial and/or light industrial development, and streets. The entire Site will be enhanced by restoration and redevelopment once remediation is complete. Therefore, exposures to ecological receptors will be mitigated or removed. Future receptors identified as “on-site receptors” are defined as receptors located within the current Site boundaries (Figure 1-2), while future “off-site receptors” are those located outside the current Site boundaries. Many potential human receptors are possible at the Site in the period during and after redevelopment. The potentially exposed populations and their potential routes of exposure are discussed in Section 9 of this Closure Plan.~~

~~4.7~~ **4.6-DISCUSSION OF SITE DATA NEEDS (GAPS)**

The CSM represents a functional working description of historical Site operations, potential chemical release sources, chemical impacts to Site soils, the occurrence of groundwater beneath the Site, groundwater flow, chemical impacts to Site groundwater, and the connectivity of Site groundwater to the Las Vegas Wash. This summary of the CSM presents an overview of the ~~extensive~~ Site data that have been gathered over the years by BRC and others. The CSM Summary outlines, ~~in summary form~~, the present understanding of the Site and the physical processes that have resulted in the observed Site chemical impacts.

It is recognized that data gaps remain, including, for example, those pertaining to off-site sources as potential release mechanisms of chemicals to Site groundwater, and to the quantification of soil and aquifer parameters that control Site groundwater flow and chemical transport. ~~The~~

~~following table [4.xx], Data Gaps, Table 4-13 presents in a concise format the data that need to be collected and analyzed to further elucidate support and update the CSM. NOTE FROM NDEP: almost everything listed below is not in the form of an actual Data Gap, some comments are provided below, however, this Table needs some work. In addition, it appears that this Table does not consider any additional investigative work (e.g.: NE Area or Deep GW; future soil sampling (confirmatory), etc).~~

All work will be used to continually update and refine the CSM. As stated at the beginning of this section, two separate, more-detailed CSM documents are in preparation that ~~elaborates~~elaborate upon this CSM summary for each of the Eastside and CAMU areas. The CAMU CSM has been submitted for review to NDEP, comments have been received from NDEP by BRC, and this CSM is being updated. The Eastside Area CSM will be updated upon conclusion of the several field investigations (e.g., aquifer testing, numerical modeling, north-east area investigation, deep soil background investigation, upgradient Qal investigation) presently being formulated/conducted.

~~In~~As discussed in Section 1, in the future, remediation utilizing ~~an~~soil excavation is planned to remove chemically-impacted soils ~~at the Site~~from the Eastside Area which will then be placed in the CAMU. Subsequent to the excavation, confirmation sampling will be conducted that will compare the resulting spatial distribution of soil impacts to remediation clean-up goals. Based on the results of the confirmatory sampling, the Eastside Area CSM will be ~~modified and the excavation either continued or discontinued as appropriate~~updated in the future.

SECTION 4 REFERENCES

- American Society of Testing and Materials (ASTM). 2003. Standard Guide for Developing Site Models for Contaminated Sites. Standard E 1689-95 (Re-approved 2003).
- Basic Remediation Company (BRC) and Titanium Metals Corporation (TIMET). 2007. Background Shallow Soil Summary Report, BMI Complex and Common Areas Vicinity. March 16.
- Carlsen, C.L., R.C. Lunnis, and D.E. Prudie. 1991. Changes in water levels and water quality in shallow groundwater, Pittman-Henderson Area, Clark County, Nevada, Resulting from diversion of industrial cooling water from ditch to pipeline in 1985. U.S. Geological Survey Water-Resources Investigation Report 89-4093. Carson City, Nevada.
- Clary, E.H. 1944. "Trade Effluent," in History of Civil Engineering, October 21, 1944, UNLV Special Collections, T-22 [BR033889-910].
- Daniel B. Stephens & Associates, Inc. (DBS&A). 2007. Revised Work Plan for Determination of Deep Quaternary Alluvium and Upper Muddy Creek Formation Background Soil Chemistry and Upgradient Alluvial Aquifer Conditions, BMI Common Areas and Complex Vicinity. ~~Prepared for Basic Remediation Company (BRC). Submitted to Nevada Division of Environmental Protection.~~ April 9.
- Environ. 2003. Risk Assessment for the Water Reclamation Facility Expansion Site, Henderson, Nevada. Prepared for the City of Henderson, Nevada. October.
- Environmental Resource Management (ERM). 1999. Groundwater Sampling Results, Former BMI Landfill. October.
- ERM. 2007. BRC Human Health Risk Assessment Report, Borrow Area, Clark County, Nevada. March.
- Harding Lawson Associates (HLA). 1998. Groundwater treatment system evaluation, Stauffer Chemical Company/Pioneer Chlor Alkali Company, Inc. Site, Henderson, Nevada. August 3.
- Page, W.R., Lundstrom, S.C., Harris, A.G., Langenheim, V.E., Workman, J.B., Mahan, S.A., Paces, J.B., Dixon, G.L., Rowley, P.D., Burchfiel, B.C., Bell, J.W., and E.I. Smith. 2005.

Geologic and Geophysical maps of the Las Vegas 30' x 60' quadrangle, Clark and Nye Counties, Nevada, and Inyo County, California, USGS, report 2814.

Tronox. 2006. Semi-annual Performance Report, Chromium Mitigation Program, Tronox, Henderson, Nevada, July 25.

U.S. Environmental Protection Agency (USEPA). 2002. Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites. Office of Emergency and Remedial Response, Washington, DC. EPA 540-R-01-003. September.

Weston. 1993. Site Conceptual Model, Stauffer/Pioneer/Montrose Site, Henderson, Nevada, September.

SECTION 5

5 DATA VERIFICATION AND VALIDATION

Data verification and validation are key steps in the assessment phase for any environmental data collection project. As defined in USEPA (2002), data verification is the process of evaluating the completeness, correctness and conformance/compliance of a data set against requirements set forth. Data validation is an analyte- and sample-specific process that extends the evaluation of data beyond method, procedural, or contractual compliance (data verification) to determine the analytical quality of a specific data set. Both verification and validation are necessary and are best performed in the order described here. The descriptions are brief, providing guidance on the basic intent of data verification and validation, and forming the basis for more detailed descriptions that will be presented in each sub-area or decision specific closure plans. Data verification will be performed against the analytical methods and operating procedures, at the laboratories that perform the analyses. Individuals designated by the Project DATM Program Manager will perform data validation. Section 1 discusses the project staffing in this regard. Data validation will evaluate the data against the measurement quality objectives described in this Closure Plan and the Quality Assurance Project Plan (QAPP; BRC and MWH, 2006). Data reporting from the field and laboratory operations will follow the requirements specified in the QAPP.

5.1 FIELD DATA VERIFICATION

All field personnel will be responsible for following the sampling and documentation procedures described in the work plan so that defensible data are obtained. Project Team Personnel will verify field notes and records against field procedures and data sets to identify any inconsistencies, non-conformance or anomalous data. The quality control (QC) steps required during field operation will also be checked against the applicable procedure. Chain-of-Custody, field logbooks, instrument calibration, and sampling records will be reviewed. The field team will be interviewed to reconcile any inconsistencies as soon as possible after the fieldwork is completed. A systematic effort to identify inconsistencies will be performed before field data are reported. Inconsistencies may result from improper sampling or measurement methodology, data transcription and calculation errors, and loss of data due to natural causes. Anomalies that are identified as a result of sampling, measurement or transcription errors will be identified and corrected; anomalies that cannot be attributed to these causes will be identified in the sample reports but not excluded from the sample sets.

5.2 LABORATORY DATA VERIFICATION

Laboratory personnel will verify analytical data at the time of analysis and reporting and through subsequent reviews of the raw data for any non-conformance to the requirements of the analytical method and laboratory QA/QC procedures. Verification will include reviewing positive and negative control results including method blanks, laboratory control samples, matrix spikes, duplicate, surrogate, tracer, carrier and internal standards. Results will be verified against the Method Detection Limits (MDLs), Minimum Detectable Activity, and Practical Quantitation Limits as well as the method or laboratory established recovery and variability requirements. Analysts may be required to evaluate the selectivity of the results for identification purposes. Laboratory personnel will make a systematic effort to identify any errors before they report the data. Outliers that result from errors found during data verification will be identified and corrected; outliers that cannot be attributed to errors in analysis, transcription, or calculation will be clearly identified in the case narrative section of the analytical data package, but will not be excluded from the data set. Laboratory reports will include certification and signature by lab director along with all additional USEPA Level IV requirements, or, alternatively, the laboratory reports must have sufficient detail to allow the level of review/validation that is required as specified in a sub-area or decision specific QAPP.

5.3 LABORATORY DATA VALIDATION

One or more experienced chemists, who have sufficient background in inorganic and radiochemistry methods and are independent from the activities of this project, will validate all laboratory data. The chemist(s) will be selected by the Project [DATM Program Manager](#). Section 1 discusses the project staffing in this regard. The organic and inorganic data will be validated in accordance with current USEPA National Functional Guidelines (USEPA 1999 and 2004). National Functional Guidelines do not include the radiochemistry anion analysis but this data will undergo a similar review. Radiochemistry data validation will use the U.S. Department of Energy (USDOE) reference document, *Evaluation of Radiochemistry Data Usability* (USDOE 1997). The laboratory will provide data reports at USEPA Level IV so that the raw data is available for full validation. In accordance with the QAPP for this project, 100 percent of the data will undergo Level III data validation, and 10 to 20 percent will undergo Level IV data validation. Full data validation includes all review requirements, thus 100 percent of the data will undergo at least a review. Requirements for cursory (review) and full validation are listed below.

5.4 DATA REVIEW

Data review will be completed on 100 percent of the summary data packages for SRC analyses. No data will be eliminated from this review unless it is selected for full validation. All data will be qualified as necessary in accordance with established criteria. Data review will entail evaluation of USEPA Level III documentation including:

- Narrative, cross-reference, chain-of-custody, and method references;
- Analytical results;
- Surrogate recoveries (as applicable);
- Blank results;
- Laboratory control sample recoveries;
- Duplicate sample results and/or duplicate spike recoveries; and
- Sample spike recoveries.

In cases where the data review indicates uncertainties that require investigation, a full data validation will be performed. The data review process is described in the QAPP and requires verifying the completeness, correctness, and conformance/compliance of the data against acceptance criteria.

5.5 FULL DATA VALIDATION

Full validation will be completed on 10 to 20 percent of the data packages. To perform full data validation, data summary packages of Level IV are required. Level IV data packages consist of the Level III requirements provided above, plus summary of internal standards, initial and continuing calibration recoveries and raw data, initial and calibration blank concentrations and raw data, analytical run logs, sample and standard preparation logs, and all instrument raw data. The data will be validated against the laboratory method requirements and project or work plan specific quality objectives. At a minimum the USEPA National Functional Guidelines steps will be followed.

5.6 DATA VALIDATION REPORT

Based on the outcome of the data verification and data validation procedures, individual sample records may be qualified. Qualifiers (flags) indicate if results are inconsistent, anomalous, outside of tolerance limits, estimated, or rejected. Only rejected data will be considered unusable for decision-making. Flags will follow the National Functional Guidelines, or where none are available (*e.g.*, radiochemistry) will be clearly defined. Data validation reports will include a complete list of applicable Sample Delivery Group (SDG) designations and the number of samples within each SDG along with reconciliation between each sample and SDG. All sensitivity indicators (*e.g.*, Practical Quantitation Limit) will be clearly defined.

5.7 RECONCILIATION WITH USER REQUIREMENTS

After environmental data have been reviewed, verified, and validated in accordance with the procedures described above and in the QAPP, the data must and will be further evaluated to determine whether the Data Quality Objectives (DQOs) have been met. Data will be evaluated according to USEPA's data quality assessment (DQA) process to verify that the type, quality, and quantity of data collected are appropriate for their intended use. DQA methods and procedures are outlined in USEPA *Guidance for Data Quality Assessment, Practical Methods for Data Analysis* (USEPA 2000). The DQA process includes five steps: (1) review the DQOs and sampling design; (2) conduct a preliminary data review; (3) select a statistical test; (4) verify the assumptions of the statistical test; and (5) draw conclusions from the data.

SECTION 5 REFERENCES

Basic Remediation Company (BRC) and MWH. 2006. BRC Quality Assurance Project Plan. April.

U.S. Department of Energy (USDOE). 1997. Evaluation of Radiochemical Data Usability. ES/ER/MS-5.

U.S. Environmental Protection Agency (USEPA). 2000. Guidance for Data Quality Assessment, Practical Methods for Data Analysis. EPA QA/G-9. EPA/600/R-96/084. Office of Environmental Information, Washington, DC. July.

~~U.S. Environmental Protection Agency (USEPA)~~. 2002. Guidance on Environmental Data Verification and Validation. EPA QA/G-8. EPA/240/R-02/004. Office of Environmental Information, Washington, DC. November.

~~U.S. Environmental Protection Agency (USEPA)~~. 2004. National Functional Guidelines for Inorganic Data Review. USEPA 540-R-04-004. OSWER 9240.1-45. October.

SECTION 6

6 DATA USABILITY EVALUATION

This section describes the procedures used to evaluate the acceptability of data for use in the risk assessment. Overall quality of sample results is a function of proper sample management. Management of samples begins at the time of collection and continues throughout the analysis process. The collection of environmental data will follow the quality assurance/quality control (QA/QC) procedures identified in the QAPP (BRC and MWH 2006a) prepared for the Site. Standard Operating Procedures (SOPs) that are wholly consistent with the risk assessment will be followed to ensure that samples are collected and managed properly and consistently and to optimize the likelihood that the resultant data are valid and representative. Field methods are discussed in the Field Sampling and Standard Operating Procedures (FSSOP) document (BRC and MWH 2006b) and adhere to practices consistent with the policies of the NDEP. All relevant site characterization data will be reviewed for applicability and usability following procedures in USEPA's (1992a,b) *Guidance for Data Usability in Risk Assessment (Parts A and B)* and USEPA's (1989) *Risk Assessment Guidance for Superfund*.

6.1 CRITERION I: REPORTS TO RISK ASSESSOR

Data will be reported in a format that provides adequate data summaries and data documentation for the risk assessment. This criterion is limited to identification of the specific site characterization reports that comprise the site database, and the documentation of the report contents. The report components include:

- a. Site description with detailed map indicating site location (including site boundaries), surrounding structures, terrain features, population or receptors, air and water flow, and information regarding operative industrial processes (*i.e.*, source locations).
- b. Site map with sample locations identified.
- c. Description of sampling design and procedures including rationale.
- d. Description of analytical methods used and detection limits including sample quantitation limits (SQL) and detection limits for non-detect data.
- e. Results given on a per-sample basis, qualified for analytical limitations and error, and accompanied by SQLs. Estimated quantities of compounds/tentatively identified compounds.

- f. Field conditions and physical parameter data as appropriate for the environmental media of interest.
- g. Narrative explanation of qualified data on an analyte and sample basis, indicating direction of bias.
- h. QC data results for audits, blanks, replicates, and spikes from the field and laboratory.
- i. Definitions and descriptions of flagged data.
- j. Hardcopy of diskette results.
- k. Raw data (instrument output, chromatograms, spectra) (laboratory report sheets are usually adequate).

6.2 CRITERION II: DOCUMENTATION

The objective of the documentation review is to ensure that each analytical result can be traced to a sample location and that the procedure(s) used to collect the environmental samples were appropriate. The three acceptable types of documentation used to trace samples and analytical methods are chain-of-custody forms, SOPs, and field and analytical records. All three types will be employed by BRC in this Closure Plan.

The minimum requirement of Criterion II is that sample results must be related to a specific geographic location and documentation of the sample location versus sample result (*i.e.*, chain-of-custody records, SOPs, field and analytical records) must be provided. BRC will comply with this requirement, at a minimum.

6.3 CRITERION III: DATA SOURCES

The objective of the data source review is to ensure that the analytical techniques used for the investigation are appropriate to identify COPCs for each exposure area and environmental medium of interest. Comparability of data from different sources (*e.g.*, different investigations, different analytical methods, etc.) will be evaluated.

The minimum requirements for this criterion are:

- a. Analytical sample data results are produced for each medium within an exposure area,

- b. A broad spectrum analysis is available for at least one sample per medium per exposure area,
- c. [where relevant] Field measurement data for physical characteristics of the Site, medium, or contamination source where deemed critical to the quantitative evaluation of risk (*i.e.*, needed for fate/transport modeling). Examples include particle size, pH, soil porosity, soil moisture content, soil organic carbon content, wind direction/speed, topography, percent vegetative cover.

BRC will comply with these requirements.

6.4 CRITERION IV: ANALYTICAL METHODS AND DETECTION LIMITS

For a chemical result to be usable for assessing risks, the analytical method must appropriately identify the chemical form or species, and the sample detection limit must be at or below a concentration that is associated with risk benchmark levels. When a COPC is reported as not detected, the result can only be used with confidence if the quantitation limits reported are lower than the corresponding concentration of concern. (Note: USEPA provides a minimum recommended requirement that the MDL be no more than 20 percent of the concentration of concern). The minimum requirement for this evaluation step is that documentation that routine (*e.g.*, USEPA or ASTM) methods were used to analyze COPCs in critical samples. BRC will comply with this requirement.

6.5 CRITERION V: DATA REVIEW

This step consists of the assessment of the quality of analytical results, performed by a professional knowledgeable in the necessary analytical procedure(s). The requirement for risk assessment is that only data that have been reviewed according to a specified level or plan (usually specified in DQOs) will be used. Any analytical errors, potential data gaps, and/or limitations in the data to be used must and will be addressed; an explanation for data qualifiers must be included.

All site data must have a sufficient level of review. The appropriate level of review, for each data source, must and will be identified, applied, and documented. The minimum requirement for this data usability evaluation criterion is that there be a “defined level of data review for all data” (USEPA 1992). The level and depth of the data review must and will include and examination of laboratory and method performance for the samples and analytes involved. This examination will include:

- Evaluation of data completeness,
- Verification of instrument calibration,
- Measurement of laboratory precision using duplicates; measurement of laboratory accuracy using spikes,
- Examination of blanks for contamination,
- Assessment of adherence to method specifications and QC limits, and
- Evaluation of method performance in the sample matrix.

6.6 CRITERION VI: DATA QUALITY INDICATORS

The data quality indicators (DQI) address field and analytical data quality aspects as they relate to uncertainties in selection of COPCs, exposure point concentrations, and risk characterization. The DQIs are briefly discussed below.

Completeness is measured, for risk assessment purposes, by the total number of data points available and acceptable for each COPC for each medium of interest. For risk assessment purposes, the adequacy of the number of samples is evaluated in terms of: (1) acceptable uncertainty regarding the identification of COPCs in each environmental medium of interest and within each exposure area; and (2) acceptable uncertainty regarding the estimation of exposure point concentration of each COPC within each exposure area.

Comparability is a critical parameter when considering the combination of data sets from different analyses for the same COPCs. Only comparable data sets can readily be combined for the purpose of generating a single risk assessment decision/calculation. The use of standard sampling and analytical methods simplifies the determination of comparability. All non-routine methods will be specifically evaluated for comparability in the data usability evaluation.

Representativeness of data used in risk assessment will be documented. The results of the risk assessment will be biased to the degree that the data do or do not reflect the chemicals and concentrations present in the exposure area of interest. In cases where sampling was not specifically designed to characterize representative COPCs and exposure concentrations for all potential ~~exposure sub~~-areas of the Site, it is critical to evaluate what the impact on the risk assessment results may be. In addition to sampling strategy issues, analytical data quality will be

assessed in regard to representativeness. Holding time, sample preservation, extraction procedures, and results from analyses of blanks affect the representativeness of analytical data.

Precision is determined by evaluating: (1) the sampling variability; and (2) the measurement error. Assessment of sampling variability is critical to identifying the appropriate statistical measures and the number of required samples (USEPA 1992). Assessment of measurement error is accomplished by using the results of field duplicate samples. Field duplicates determine total within-batch measurement error (including analytical error if the samples are also analyzed (as laboratory duplicates)). The laboratory limits for precision, as measured by the relative percent difference between laboratory control sample analyses, are the laboratory control limits, based on historical data calculated, as specified in the analytical methods.

Accuracy is a measure of overestimation or underestimation of reported concentrations and is evaluated from the results of spiked samples. Accuracy is controlled primarily by the analytical process and is reported as bias. Bias is estimated for the measurement process by calculating the percent recovery (%R) for the spiked or reference compound.

The minimum requirements for the assessment of DQIs are:

- Sampling variability must be quantitated for each analyte,
- QC samples must be evaluated to identify and quantitate precision and accuracy,
- Sampling and analytical precision and accuracy must be quantitated.

BRC will comply with these requirements.

SECTION 6 REFERENCES

Basic Remediation Company (BRC) and MWH. 2006a. BRC Quality Assurance Project Plan, BMI Common Areas, Clark County, Nevada. April.

~~Basic Remediation Company (BRC)~~ and MWH. 2006b. BRC Field Sampling and Standard Operating Procedures, BMI Common Areas, Clark County, Nevada. May.

U.S. Environmental Protection Agency (USEPA). ~~1992-1989. Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual (Part A). Interim Final. Office of Emergency and Remedial Response, Washington, D.C. USEPA/540/1-89/002. December.~~

USEPA. 1992a. Guidance for Data Usability in Risk Assessment. Part A. Office of Emergency and Remedial Response, Washington D.C. Publication 9285.7-09A. PB92-963356. April.

USEPA. 1992b. Guidance for Data Usability in Risk Assessment. Part B. Office of Emergency and Remedial Response, Washington D.C. Publication 9285.7-09B. PB92-963362. May.

SECTION 7

7 DATA QUALITY OBJECTIVES

This section first provides a general overview of USEPA and NDEP's 7-step DQO process. After that it discusses one of the key decision inputs to the DQO process, namely the Step 2 Principal Study Questions (PSQs) that this closure process will address before Closure is complete for the Eastside Area. The PSQs are the central Eastside Area-wide questions that provide a basis for the overall closure effort. Per discussions with the NDEP, the other steps of the DQO process will be addressed, on aan Eastside Area sub-area by sub-area basis (for Eastside-soils), in the respective sub-area Sampling and Analysis Plans that BRC plans on developing for each sub-area (Figure 1-4) relating to the soils cleanup. It is also possible that there may be other sub-area specific PSQs that may be developed. These too will be addressed in the respective sub-area Sampling and Analysis Plans. Similarly, the other steps of the DQO process for groundwater or other media will be discussed in subsequent Sampling and Analysis plans for those media as they are developed.

7.1 OVERVIEW OF THE DQO PROCESS

The DQO process is a strategic, systematic process for planning scientific data collection efforts. The DQO process helps investigators and decision makers answer the following basic questions:

- Why do we need data?
- What must the data represent?
- How will we use the data?
- How much uncertainty is tolerable?

By using the DQO process, BRC will ensure that the data collected for decision making are of the right type, quantity, and quality. In addition, the DQO process:

- Ensures that limited resources are spent on collecting only those data that will support defensible decisions;
- Allows flexibility in planning because of its iterative nature (sometimes new information or conclusions cause the planning team to cycle back to earlier steps in the process); and

- Promotes multidisciplinary group consensus-building methodology that ensures buy-in from key participants and critical stakeholders.

The DQO process has been widely applied to environmental problems, such as investigating contamination in soil or water, and is set forth in USEPA guidance.

The DQO process, as defined by USEPA's *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4*, consists of 7seven steps:

Step 1 - State the problem

Step 2 - Identify the decision

Step 3 - Identify the inputs to the decision

Step 4 - Define the study boundaries

Step 5 - Develop decision rules

Step 6 - Specify limits on decision errors

Step 7 - Optimize the process for obtaining data.

Each of these steps, along with sub-activities that comprise each step, are outlined below:

Step 1. State the Problem

The first step in the DQO process is to define the problem that initiated the study. Often, problems can be very complex, requiring investigators to examine a variety of political, economic, scientific, technical, legal, and social factors. This step allows the decision-making team to recognize multiple facets of the problem and consider the perspectives of key stakeholders to ensure all issues are addressed properly and adequately. This includes gathering all available relevant information so that a CSM can be developed and the needs of the site actions can be better defined.

There are 4four basic activities in this step:

- Identify members of the planning team. The planning team is the group of people who will develop the DQOs for the study. Generally, the team consists of representatives from key groups with a role in data collection or use, and often those with a critical interest or stake in

the problem; the size of the team depends on the scope and complexity of the problem. An example of a team for a Superfund site might be the Remedial Project Manager, a soil scientist, a hydrogeologist, a chemist, a risk assessor, representatives from the site's potentially responsible party, a QA specialist, and a statistician.

- Identify the primary decision maker of the planning team and define each member's role and responsibility during the DQO process. The planning team should have a leader (often the person with the most authority over the study) who is responsible for making final decisions based on the recommendations of the planning team. In the example provided above, the Remedial Project Manager would be the logical choice for the primary decision maker for the study.
- Develop a concise description of the problem. This description provides background information about the problem and allows the team to focus on the fundamental issue to be addressed by the study. Some elements to include for the description might be study objectives, regulatory context, groups who are involved or who have an interest in the study, political issues, funding, previous study results, land usage, and any obvious existing sampling design constraints.
- Specify the available resources and relevant deadlines for the study. The planning team needs to determine the budget, personnel, and resources available for the study, as well as list intermediate and final deadlines that may need to be met.

Step 2. Identify the Decision

The second step in the process is to define the decision statement that the study will attempt to resolve. There are 4four basic activities in this step:

- Identify the PSQ(s). The PSQ(s) helps the planning team narrow the often complex issues of a problem so that the team may focus their study. The question(s) identifies the unknown conditions or unresolved issues to the problem being investigated. The PSQs identified for this project in order to affect ultimate closure of the Site are discussed later in this section.
- Define the alternative actions that could result from resolution of the PSQ. The planning team identifies what possible actions may be taken to solve the problem. The types of actions also include the alternative that no action will be taken. For example, if the PSQ is "Is the

soil in a particular site contaminated?,” the alternative actions might be to take corrective action or to take no action.

- Combine the PSQ and the alternative actions into a decision statement. The planning team combines the actions and PSQ developed earlier in this step. A standard format for drafting decision statements is: “Determine whether or not [unknown environmental conditions/issues/criteria from the PSQ] require (or support) [taking alternative actions].” For the example used above, the decision statement would be “Determine whether or not the soil is contaminated and requires corrective action.”
- Organize multiple decisions. If several separate decision statements are to be addressed, the planning team must identify the relationships among the decisions, such as the order in which they should be resolved.

Step 3. Identify Inputs to the Decision

In this step, the planning team identifies the different types of information needed to resolve the decision statement. ~~There are 4~~One of the purposes of the DQO process is to assist in new data collection. Historic data are considered in the CSM and new data needs are identified (potentially iteratively) via the CSM data gaps and DQO process. There are four activities in this step:

- Identify the information that will be required to resolve the decision statement. The team determines what environmental variables and other information are needed to resolve the decision statement. They may consider whether they should use modeling or monitoring approaches or a combination of the two. For example, the information may be variables such as levels of arsenic or radium 226 or even pH.
- Determine the sources for each item of information identified. The team identifies the sources of information they need to collect. The team may be able to use data from previous studies or investigations, or they may need to collect new data, or some combination of both.
- Identify the information that is needed to establish ~~the action level~~levels. The team defines the basis for the action level, which defines a threshold value for determining which alternative action will be taken. Action levels may be based on regulatory standards, or they may be derived from site- and contaminant-specific criteria such as risk analyses. (This step identifies the basis of the action level; the actual numerical value of the action level is set in Step 5.)

- Confirm that appropriate analytical methods exist to provide the necessary data. The team ensures that there are methods available to provide them with acceptable environmental measurements. The team should list each method with its appropriate MDL and limit of quantitation (LOQ), as well as method performance data. If acceptable methods do not exist, the planning team may need to reconsider the approach for providing inputs, or perhaps reformulate the decision statement in Step 2.

Step 4. Define the Boundaries of the Study

In this step, the planning team defines the spatial and temporal boundaries of the problem. There are ~~5~~five activities in this step:

- Specify the characteristics that define the population of interest. The team defines the attributes of the population so that the focus of the study is unambiguous. Some examples of key attributes of interest in the target population are “concentrations of perchlorate in groundwater” or “arsenic concentrations in soil.”
- Define the spatial boundary of the decision statement. There are ~~2~~two steps to this activity. First, the team defines the geographic area to which the decision applies, such as “a property or site boundary.” Second, by using previously existing information, the team divides the population into strata that have relatively homogeneous characteristics (such as contaminant concentrations). By dividing the population, the team reduces the variability within subsets of data and makes the problem more manageable.
- Define the temporal boundary of the problem. There are ~~2~~two steps to this activity. First, the team determines the time frame to which the decision applies. This means that the team decides the time frame for which they wish to make a decision about using the data to be collected. For example, the data might be used to make a decision about possible contaminant exposures to local residents over a 30-year period. Second, the team needs to decide when they can collect data. The team must consider factors such as seasonal or daily variations in the population to be sampled, as well as weather and temperature conditions that may affect the data collected.
- Define the scale of decision making. The team determines the smallest, most appropriate subsets of the population for which they will make a decision. For example, a population might be the concentrations of arsenic in soil at a 100-acre sub-area of the Site, but the scale

of decision-making might be the top 10 feet of soil in a 1/8th acre area (*e.g.*, the area based on the size of a future residential lot).

- Identify practical constraints on data collection. The team identifies obstacles to data collection, such as the availability of sampling equipment or personnel or gaining permission to investigate private property.

Step 5. Develop a Decision Rule

In this step, the planning team summarizes the attributes of the problem and how the information collected will guide the team to choose a course of action that will solve the problem. There are ~~four~~ main elements to the decision rule: the parameter of interest, the scale of decision making, the action level, and the alternative actions.

The ~~three~~ activities involved in this step are as follows:

- Specify the statistical parameter that characterizes the population (the parameter of interest). The planning team determines the parameter of interest (such as a mean, median, or percentile) whose true value the team would like to know and that the data will estimate. For example, at many Superfund sites, investigators often choose the mean as the parameter of interest when the action level is based on long-term, average health effects.
- Specify the action level for the study. The decision maker chooses the numerical value that would cause one to choose between alternative actions. In some cases, the action value is determined by regulatory standards.
- Develop a decision rule. The decision rule is an “if ... then ...” statement that incorporates the parameter of interest, the scale of decision making, the action level, and the actions that would result from the decision. For example, at a site undergoing remediation, the decision rule might be as follows: “If the mean concentration of lead in a 1/8th -acre plot of soil is less than 400 milligrams per kilogram (mg/kg), then remediation is complete; otherwise, continue remediation.”

Step 6. Specify Tolerable Limits on Decision Errors

In this step, the decision maker chooses tolerable limits on decision errors. These limits are used to establish performance goals for the data collection design. ~~There are 4~~BRC recognizes that this Step may be difficult to implement on a complex site such as BRC. BRC will minimize

decision errors by considering data adequacy in the DQA process. However, in the event that BRC may attempt to minimize decision errors using a typical Step 6 analysis, there are four activities in this step:

- Determine the possible range of the parameter of interest. The team establishes the likely upper and lower bounds of the parameter. To determine the range, the team may examine historical and documented analytical data. For example, previous studies may indicate that the range of PAH concentrations in soil undergoing remediation might be from 50 to 1,000 mg/kg.
- Identify the decision errors and choose the null hypothesis. There are 4four steps in this activity:
 1. The team determines the 2two types of decision errors and establishes the true state of nature for each decision error [~~“true state of nature”?~~]. A decision error occurs when the data erroneously lead the decision maker to conclude that the parameter of interest is on one side of the action level, when in fact the true value of the parameter is on the other side of the action level— in other words, a false positive or a false negative.
 2. The team specifies and evaluates the potential consequences of each decision error.
 3. The team then establishes which decision error has more severe consequences near the action level.
 4. The team defines the null hypothesis (baseline condition) and the alternative hypothesis and assigns the terms “false positive” and “false negative” to the appropriate decision error. Sometimes the choice of a baseline condition is determined by regulations. Other times, there may be a preponderance of evidence or logical reasons why one condition should be chosen as the baseline. If none of these circumstances hold, then the baseline is chosen to be the “worst case” so that the data must show convincing evidence to the contrary, leading to a “better safe than sorry” stance.
- Specify a range of possible parameter values where the consequences of decision errors are relatively minor, a gray region. The gray region is a range of possible parameter values where the consequences of a false negative decision error are relatively minor. The gray region is bounded on one side by the action level and on the other side by that parameter value where the consequences of making a false negative decision error begin to be

significant. The decision maker establishes this boundary by examining the consequences of not rejecting the null hypothesis when it is false. Then, the decision maker places this edge of the gray region where these consequences are severe enough to set a limit on the magnitude of this false negative decision error. Specifying a gray region is necessary because variability in the population and unavoidable imprecision in the measurement system combine to produce variability in the data such that a decision may be “too close to call” when the true parameter value is very near the action level. Therefore, the gray region (or “area of uncertainty”) establishes the minimum distance from the action level where the decision maker would like to begin to control false negative decision errors.

- Assign probability limits to points above and below the gray region that reflect the tolerable probability for the occurrence of decision errors. These limits reflect the decision maker’s tolerable limits to making an incorrect decision. The decision maker selects a possible value of the parameter and then chooses a probability limit based on the evaluation of the seriousness of the potential consequences of making the decision error if the true parameter value is located at that point. At a minimum, the decision maker should specify a false positive decision error limit at the action level and a false negative decision error limit at the other end of the gray region.

The outputs of Step 6 may be shown graphically on a Decision Performance Goal Diagram (which is essentially a statistician’s power curve).

Step 7. Optimize the Design

In this final step, the planning team selects a resource-effective data collection design for collecting data that will satisfy the DQOs. There are ~~6~~six activities in this step:

- Review the DQO outputs and existing environmental data. The team reviews the outputs of the ~~6~~six previous steps and ensures that they are consistent.
- Develop general data collection design alternatives. The team decides what kinds of data collection designs are feasible and appropriate for the Site. In this activity, the team also determines what each design will cost and what types of information will be provided by using the design.

Formulate the mathematical expressions needed to solve the design problems for each data collection design alternative. Three mathematical expressions are needed to optimize the design:

1. A method for testing the statistical hypothesis and for defining the sample size formula (*e.g.*, Student's *t*-test)
 2. A statistical model that describes the relationship of the measured value to the "true" value
 3. A cost function that relates the number of samples to the total cost of sampling and analysis.
- Select the optimal sample size that satisfies the DQOs for each data collection design alternative. Using the equations developed in the previous activity and limits placed on decision errors, the team determines the optimal sample size. If no design fits the specified criteria, the team may have to relax the constraints (such as false negative or false positive error rates or the size of the gray region in Step 6) placed upon the design.
 - Select the most resource-effective data collection design that satisfies all of the DQOs. The team evaluates the design options based on cost and the ability to meet the specified DQOs.
 - Document the operational details and theoretical assumptions of the selected design in the sampling and analysis plan. These details are needed to allow for efficient and valid statistical interpretation of the data which is conducted as part of the DQA, before the data are used in subsequent analyses such as risk assessments.

It is unlikely that BRC will attempt a rigorous, quantitative Step 7 analysis for this project in all instances. If suitable alternatives are available, BRC will evaluate the cost of collecting the requisite data in different ways. For example, typically, soil data will be collected via sampling per the approved SOP followed by fixed laboratory analysis; however, it is possible that for some compounds or in certain situations, alternatives such as field screening may also provide valid data. In such cases, the Step 7 analysis will be based on cost considerations without compromising data objectives.

7.2 PRINCIPAL STUDY QUESTIONS FOR THE PROJECT

This subsection discusses the PSQs that are fundamental to the DQO process. These PSQs are identified below at in 7.2.1. Note that it is possible that additional PSQs could be developed in the future or some of the current PSQs could be combined, as needed. For the purposes of these

PSQs, the word “current” is defined as pre-development. This can be any point in time from the present time through the remediation phase, but prior to development. Similarly, “future” is defined as post-remediation. The word “incremental” can mean two different things. In one context, “incremental” means over background or over upgradient conditions. For example, if risks due to the background level for a particular pollutant in soil is X, then incremental in this context would mean that “risk value over X.” In a second context, “incremental” may mean over some prevailing ambient value. For example, if the US average cancer risk is Y due to all causes, then incremental in this case is “cancer risk over Y.” It will be clear, by context, which meaning of incremental is intended.

In general, each study question concerns the existence of contamination in various media, the remediation that has occurred, the confirmation sampling that has followed, and the desire to clean up the Site to background levels so that incremental risk is small. The decision that will be made could be stated with the following question:

Example PSQ 1 – Are the current incremental risks to human health in sub-area X sufficiently low that they are acceptable? If the incremental risks are not sufficiently low then reasonable further action will be taken, otherwise, no further action will be taken.

It should be noted that this approach to PSQs makes it clear that the final decisions are based on incremental risks, as discussed earlier in the first context. Background comparisons are the essential context to the main and final decisions that are based on incremental human health risk over background. The term “reasonably” used in the example PSQ above recognizes that there is uncertainty, that there are consequences to making an incorrect decision and that there are costs involved in mitigation (soil removal in this case). That is, there is a trade-off between reducing uncertainty (via more data collection requiring more time and money and also prolonging present unremediated conditions) and reduction in decision risk, or between mitigation (which also requires more time and money) and putative reduction in human health risk. BRC may refine this example PSQ, if needed, to handle specific risk endpoints such as 10^{-6} excess cancers risk, a Hazard Index (HI) of 1.1.0, or a lead threshold of 400 mg/kg, etc., or make the PSQ relate to a specific medium (*e.g.*, surface soil, groundwater, etc.). While this example PSQ could be aimed at the whole Eastside ~~area~~Area rather than a sub-area, it is BRC’s intention to focus the PSQs on each discrete sub-area of the Site.

7.2.1 Site Principal Study Questions

There are six (6) PSQs. These are:

PSQ 1 – Are the current incremental risks to human health in the sub-area under investigation sufficiently low that they are acceptable? If the incremental risks are not sufficiently low, then reasonable further action will be taken; otherwise, no further action will be taken.

PSQ 2 – Are the current concentrations of contaminants associated with groundwater under the Site (*e.g.*, under the Eastside Area), after consideration of groundwater quality upgradient of the Site, sufficiently low that they are acceptable? If the concentrations are not sufficiently low, then reasonable further action will be taken; otherwise, no further action will be taken.

PSQ 3 – Are the current concentrations of contaminants associated with offsite groundwater downgradient of the Site, after consideration of groundwater quality upgradient of the Site, sufficiently low that they are acceptable? If the concentrations are not sufficiently low, then reasonable further action will be taken; otherwise, no further action will be taken.

PSQ 4 – Are the incremental human health risks associated with groundwater at the Site after development is completed (*i.e.*, post-development and under steady state conditions) sufficiently low that they are acceptable? If the incremental risks are not sufficiently low, then reasonable further action will be taken otherwise; no further action will be taken.

PSQ 5 – Are the current incremental ecological risks in the ~~No-Build~~ Trails & Recreation sub-area sufficiently low that they are acceptable? If the incremental risks are not sufficiently low, then reasonable further action will be taken; otherwise, no further action will be taken.

PSQ 6 – Are there current incremental ecological risks offsite that are attributable to migration of contaminants from the Site? If so, are these incremental risks sufficiently low that they are acceptable? If the incremental risks are not sufficiently low, then reasonable further action will be taken; otherwise, no further action will be taken.

It should be noted that a PSQ for off-site soils locations has not been developed at this time. BRC is in the process of determining via surface soil sampling in suitable offsite locations, whether any offsite migration of site contaminants may have occurred via the air entrainment and dust deposition pathway. BRC has previously conducted sampling and demonstrated that contaminated sediments have not impacted offsite locations via surface water and attendant sediment flows via the ditches. BRC does not believe that surface water sheet flow can transport site soils and sediments offsite since such water is typically contained in the various ponds and cannot flow downgradient.

Finally, it should be noted, for PSQ6, that this evaluation of incremental offsite ecological risks cannot be conducted by BRC alone since offsite migration of contaminants may have occurred due to the actions of numerous parties. Therefore, PSQ6 will likely be addressed via multi-party investigations, as needed.

SECTION 8

8 REMEDIAL ALTERNATIVE STUDIES

Once site characterization investigations are complete (generally pursuant to NDEP-approved work plans), it is customary, based on the findings of such investigative efforts, to develop a RAS in order to address remedial strategies that may be necessary in order to reduce or eliminate contamination in the study area for the particular media (soils, groundwater, vadose zone, etc.) under evaluation. The RAS, once approved, is documented via issuance of a ROD by the NDEP. The ROD, therefore, chooses among the various alternatives evaluated in the RAS. Alternatives can range from the “No Action” alternative to progressively more involved *in-situ* or *ex-situ* remedial actions, depending on the specifics of the study area and the media in question as well as intended future uses of the study area.

Each RAS alternative is evaluated against all of the criteria consistent with the USEPA guidance (USEPA 1988) for conducting a Feasibility Study. These criteria are as follows:

Overall protection of human health and the environment;

Compliance with ARARs;

Long-term effectiveness and permanence;

Reduction of toxicity, mobility or volume;

Short-term effectiveness;

Implementability;

Cost;

State acceptance; and

Community acceptance.

BRC has followed and intends to follow the same approach for this project.

8.1 EASTSIDE AREA SOILS

As part of the ~~RAS~~Eastside Area Soils RAS (ERM 2000), various remedial options were identified to achieve the remedial action objectives and site-specific soil cleanup goals. Those remedial options that best addressed the soil conditions and mitigation of future exposures were combined to form remedial alternatives. The remedial alternatives considered in the RAS were as follows:

Alternative 1 - No action

Alternative 2 - Institutional controls / limited action

Alternative 3 - On-Site capping of soils

Alternative 4 - Excavation and disposal of soils at an on-site landfill (located within the Site [Alternative 4A] or at the BMI Complex [Alternative 4B])

Alternative 5 - Excavation and disposal of soils at an off-site landfill

These alternatives were evaluated to assess the relative performance of each alternative with respect to the ~~following~~ criteria:

- ~~1) Overall Protection of Human Health;~~
- ~~2) Effectiveness and Permanence;~~
- ~~3) Implementability;~~
- ~~4) Cost; and 5) NDEP and Community Acceptance discussed earlier.~~

Based on the evaluation of alternatives, Alternative 4B (~~i.e., disposal at an on-site landfill—the CAMU~~) was identified as the preferred remedial alternative to eliminate the potential health risks posed by the presence of chemical constituents in Eastside ~~soils. This alternative consists of the excavation and removal of impacted soils containing chemical concentrations in excess of the cleanup goals (as discussed in Section 9). The excavated soils will then be transported to, and placed in, the CAMU to be constructed on BEC property. The CAMU will be constructed to be protective~~Area soils. Because of the rapidly expanding residential development surrounding the Eastside Area, and with the input from community stakeholders and the state, Alternative 4B was proposed by BRC as best fitting the USEPA criteria of overall protection of human health and

the environment, ~~and will be designed with sufficient capacity to serve as the disposal site for all soils and sediments derived from soils remediation activities in the Eastside~~compliance with ARARs, long-term effectiveness and permanence, reduction of toxicity, mobility or volume, short-term effectiveness, implementability, cost, state acceptance, and community acceptance. The NDEP approved this proposed remedial alternative in its ROD (NDEP 2001), and the Henderson City Council unanimously affirmed it.

8.2 CAMU AREA SLIT-TRENCH WASTES

BRC is currently preparing a RAS for the wastes located in the slit-trench sub-area in the CAMU portion of the Site. Since the CAMU is proposed to be located on this sub-area, BRC is evaluating, with guidance from the NDEP, whether some or a portion of the wastes located in this sub-area should be excavated prior to the construction of the CAMU in this sub-area.

8.3 EASTSIDE AREA SHALLOW GROUNDWATER AND VADOSE ZONE

BRC is currently conducting characterization of shallow (*i.e.*, Aa) groundwater in the Eastside Area as discussed previously in Section 4. Upon completion of these characterization efforts as well as related groundwater modeling studies and studies relating to evaluation of groundwater conditions upgradient of the Eastside Area, BRC will prepare a RAS for shallow groundwater and associated vadose zone for the Eastside Area.

8.4 EASTSIDE AREA DEEPER GROUNDWATER

BRC is currently conducting characterization of deeper groundwater (*i.e.*, TMCf) in the Eastside Area as discussed previously in Section 4. Upon completion of these characterization efforts, BRC will discuss the need to prepare a RAS for deeper groundwater with the NDEP.

8.5 CAMU AREA GROUNDWATER

BRC has conducted an evaluation of groundwater in the CAMU ~~area~~Area in 2005. This ~~will be~~is discussed in the *Draft CAMU Area Conceptual Site Model*. Groundwater in this area is contaminated upgradient of the CAMU ~~area~~Area and is presently being remediated (for certain contaminants) by others, downgradient of the CAMU ~~area~~Area. BRC will conduct additional evaluations of impacts to groundwater from the CAMU ~~area~~Area and then discuss RAS options with the NDEP and others presently conducting groundwater remediation in this area.

8.6 OTHER STUDY AREAS OR MEDIA

As noted in Section 4, BRC is in the process of conducting additional evaluations in order to better understand site conditions and to close data gaps. As BRC continues these evaluations, it may become necessary for BRC to address remediation of particular study areas or particular media. If needed, BRC will follow the same basic procedure discussed above. BRC will first complete appropriate characterization pursuant to NDEP-approved work plans, followed by discussions with the NDEP relating to the findings. Finally, if needed, the necessary RAS will be developed.

SECTION 8 REFERENCES

Environmental Resources Management (ERM). 2000. Remedial Alternatives Study for Soils and Sediments in the Upper and Lower Ponds at the BMI Complex. Henderson, Nevada. March 1.

Nevada Division of Environmental Protection (NDEP). 2001. Record of Decision, Remediation of Soils and Sediments in the Upper and Lower Ponds at the BMI Complex. Henderson, Nevada. November 2.

U.S. Environmental Protection Agency (USEPA). 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final. Office of Emergency and Remedial Response, Washington, DC. EPA/540/G-89/004. October.

SECTION 9

9 RISK ASSESSMENT METHODOLOGY – HUMAN HEALTH

As presented in Section 1.1, BRC proposes that risk assessments at the Site be performed after remediation is completed, with the status of completion to be based upon confirmatory field observations and laboratory analyses. By performing risk assessments after remediation, environmental conditions will form a baseline for post-remediation exposures and risks, then and into the future.

9.1 PURPOSE

The purpose of the human health risk assessment is to evaluate the potential for adverse human health impacts that may occur as a result of potential exposures to residual concentrations of chemicals in soil, groundwater, surface water, and air following remediation. Findings of the human health risk assessment are intended to support the site closure process.

This section describes the technical approach, guiding principals, and tasks that will be employed to complete the post-remediation human health risk assessment. BRC's proposed baseline risk assessment approach for the Site follows basic procedures outlined in the USEPA's *Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual* (USEPA 1989) and *Draft Risk Assessment Guidance for Superfund: Volume 3—Part A, Process for Conducting Probabilistic Risk Assessment* (USEPA 2001a). Other guidance documents consulted by BRC in formulating its risk assessment methodology include:

- ~~• *Guidelines for Exposure Assessment*. USEPA. 1992a.~~

*Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual. Supplemental Guidance: Standard Default Exposure Factors*²². USEPA. 1991a.

Guidelines for Exposure Assessment. USEPA. 1992A.

Exposure Factors Handbook. USEPA. 1997.

Soil Screening Guidance for Radionuclides. USEPA. 2000a.

Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. USEPA. 2002a.

Technical Support Document for a Protocol to Assess Asbestos-Related Risk. Final Draft. USEPA. 2003a.

Nevada Administrative Code Chapter NAC 445A. Adopted Permanent Regulation of the Nevada State Environmental Commission. LCB File No. R119-96. NDEP. 1996.

A full list of guidance documents consulted is provided in the Reference section at the end of this document. It is anticipated that this human health risk assessment methodology will be the primary tool used to guide discussions with the NDEP with regard to the content and level of detail of the human health risk assessment that is needed to support decision-making for the Site.

9.1.1 Human Health Protection

For human health protection, BRC's goal is to remediate the Site soils such that they are suitable for unrestricted residential uses, assuring health protective conditions at 1/8th-acre exposure areas. The 1/8th-acre area corresponds to the size of a typical residential lot size, as presented in USEPA (1989) and is applicable to future Site conditions. There are only two exceptions to this general goal of residential end use, specifically, the areas within the Site that are designated as wetlands, and the adjoining areas where no development is planned (see delineation of "~~No-Build Area~~" Trails & Recreation sub-area on Figure 1-2).

It should be noted that although 1/8th-acre areas are the target for exposure, sampling will not occur on many of these 1/8th-acre exposure areas, instead assumptions of similar populations across the site (or areas larger than 1/8th-acre, as supported by the data) will allow estimates to be applied to 1/8th-acre exposure areas. The decision can hence be made simultaneously for many 1/8th-acre exposure areas based on the data and documentation that the exposure areas can be aggregated.

Project-specific risk level and remediation goals consistent with USEPA precedents and guidelines for residential uses have been established, as summarized later in this section. It should be noted that: 1) all comparisons to risk or chemical-specific goals will be made on an exposure area basis consistent with likely exposure assumptions, and 2) these comparisons shall be demonstrated through the use of statistical modeling to apply to each 1/8th-acre exposure area. The project-specific risk levels and remediation goals are presented below.

9.1.1.1 Risk Level Goals

The following target risk goals have been established for the Site in conjunction with additional chemical-specific goals discussed in Section 9.1.1.2:

5. Post-NFAD chemical and radionuclide concentrations in Site soils are targeted to have an associated residual, cumulative theoretical upper-bound incremental carcinogenic risk level point of departure of 10^{-6} . This is the target risk goal for the project. For cases where NDEP identifies this goal to be unfeasible, it is BRC's understanding that the NDEP will re-evaluate the goal in accordance with USEPA guidance (~~USEPA 1991b~~). In no case will the residual, cumulative theoretical upper bound carcinogenic risk levels exceed those allowed per USEPA guidance.
6. Post-NFAD chemical concentrations in Site soils are targeted to have an associated cumulative, non-carcinogenic HI of ~~+1.0~~ or less. If the screening HI is determined to be greater than ~~+1.0~~, target organ-specific HIs will be calculated for primary and secondary organs (see discussion in Section 9.9). The final risk goal will be to achieve target organ-specific non-carcinogenic HIs of less than ~~+1.0~~.
7. ~~Metals~~Where background levels exceed risk level goals or chemical-specific remediation goals, metals and radionuclides in Site soils are targeted to have risks no greater ~~or lesser~~ than those associated with background conditions.

~~9.1.1.2~~ 9.1.1.2 Chemical-Specific Remediation Goals

In addition to the risk goals discussed above, a chemical-specific remediation goal has been established for lead. The target goal for lead is 400 ~~milligrams per kilogram (mg/kg)~~ for residential land use, which is a residential soil concentration identified by USEPA (based on the Integrated Exposure Uptake Biokinetic Model [IEUBK] model) as protective of a residential scenario (USEPA, 2004~~ea~~).

9.2 OVERVIEW OF THE HUMAN HEALTH RISK ASSESSMENT PROCESS

Pursuant to NAC 445A and consistent with USEPA (2001a), and the National Academy of Science (1994) guidance, BRC proposes to follow a "tiered," or iterative, approach. The tiered approach focuses risk assessments on specific objectives, such as identifying potential areas of concern that need further investigation and/or remediation, and eliminating from further consideration areas that do not pose a risk to human health or the environment. BRC proposes to employ this tiered process

for the post-remediation risk assessments, including specifically all pathways identified in Section 9.7.1. Therefore, references in this Closure Plan to “the risk assessment” pertain to each of these iterative risk assessments as they may be conducted at the Site.

The risk assessment process described herein consists of two tiers based on USEPA (2001a) recommendations. The first tier of the risk assessment process is a deterministic risk assessment approach, while the second tier is a probabilistic risk assessment approach. The deterministic risk assessment methodology is described comprehensively in this section. Specific details regarding proposed probabilistic risk assessment methodology will be described in a separate submittal to NDEP following the determination that a probabilistic risk assessment is warranted for a particular site. ~~This tiered human health risk assessment approach is consistent with the tiered approach to be used in the ecological risk assessment (ERA) (in preparation).~~ In preparing the human health risk assessment methodology, every effort has been made to take full advantage of available information to clarify the proposed technical approach. This human health risk assessment methodology is a “living” document—some portions of this document (*e.g.*, probabilistic distributions) will be submitted for insertion into a supplemental human health risk assessment methodology (as needed) as input from the NDEP is incorporated into the document prior to ~~the~~ conducting the risk assessment for each sub-area.

9.3 SUMMARY OF CONCEPTUAL SITE MODEL AND DATA USABILITY EVALUATION

9.3.1 Summary of Conceptual Site Model

The CSM is a tool used in risk assessment to describe relationships between chemicals and potentially exposed human receptor populations, thereby delineating the relationships between the suspected sources of chemicals identified at the Site, the mechanisms by which the chemicals might be released and transported in the environment, and the means by which the receptors could come in contact with the chemicals. The CSM provides a basis for defining DQOs, guiding site characterization, and developing exposure scenarios. The site history, land uses, climate, physical attributes, including geology and hydrogeology, and various field investigations are fully described in Section ~~4.0.4~~, and in the Site-Wide CSM (in preparation).

9.3.1.1 Potential Current Exposure Pathways and Receptors

The Site is currently vacant except for the area of the City of Henderson southern RIBs. The potential on-site and off-site ~~exposure pathways and~~ receptors are currently ~~as follows:~~ trespassers, occasional on-site workers, and off-site residents.

- ~~Trespassers/recreational users~~

- ~~Incidental soil ingestion~~

- ~~Dermal contact with soil~~

- ~~Inhalation of dust~~

- ~~Inhalation of soil and groundwater vapors (outdoors)~~

- ~~Dermal contact with water within the TIMET Active Ponds, groundwater seeps in wetlands and vicinity, and Las Vegas Wash water~~

- ~~Incidental ingestion of water within the TIMET Active Ponds, groundwater seeps in wetlands and vicinity, and Las Vegas Wash water~~

- ~~Onsite worker (e.g., the decommissioning and removal of the TIMET ponds)~~

- ~~Incidental soil ingestion~~

- ~~Dermal contact with soil~~

- ~~Inhalation of dust (outdoors)~~

- ~~Inhalation of soil and groundwater vapors (outdoors)~~

- ~~Dermal contact with water within the TIMET Active Ponds, groundwater seeps in wetlands and vicinity, and Las Vegas Wash water~~

- ~~Incidental ingestion of water within the TIMET Active Ponds, groundwater seeps in wetlands and vicinity, and Las Vegas Wash water~~

- ~~Offsite adult and child residents~~

- ~~Incidental soil ingestion following dust deposition (downwind)~~

- ~~Dermal contact with soil following dust deposition (downwind)~~

- ~~Consumption of homegrown produce following dust deposition (downwind)~~

- ~~Inhalation of dust (outdoors) (downwind)~~

- ~~Inhalation of groundwater vapors (indoors and outdoors)~~

- ~~Dermal contact (via drinking water source) with Las Vegas Wash water~~

- ~~Ingestion (via drinking water source) of Las Vegas Wash water~~

- ~~Offsite commercial workers~~

- ~~Incidental soil ingestion following dust deposition (downwind)~~

- ~~Dermal contact with soil following dust deposition (downwind)~~

- ~~Inhalation of dust (outdoors) (downwind)~~

- ~~Inhalation of groundwater vapors (indoors and outdoors)~~

- ~~Offsite construction workers~~

~~Incidental soil ingestion following dust deposition (downwind)~~
~~Dermal contact with soil following dust deposition (downwind)~~
~~Inhalation of dust (outdoors) (downwind)~~
~~Inhalation of groundwater vapors (outdoors)~~
~~Dermal contact with groundwater~~
~~Incidental ingestion of groundwater~~

~~Although~~ Risks to current receptors are being managed through site access control. In addition, although current exposures exist at the Site, the risk assessments will be performed after soils remediation is performed, therefore only potential future land-use conditions will be quantitatively evaluated.

9.3.1.2 Potential Future (Redevelopment and Post-Redevelopment) Exposure Pathways and Receptors

Under the current, prospective redevelopment plan, the Site will be used for a variety of purposes, including residential housing, parks, schools, places of worship, commercial and/or light industrial development, ~~wildlife corridors,~~ and streets. The entire Site (~~with the exception of the No-Build Area~~) will be enhanced by restoration and redevelopment once remediation is complete. To construct parks, civic structures and residences, the land will be cut and/or filled, paved with roads or foundations, and nurtured with imported top soils³²²³²⁰ as needed.

The Site will be redeveloped in several phases. Throughout the redevelopment process, one sub-area of the Site will be redeveloped while another sub-area is redeveloped sequentially. ~~Receptors~~ Future receptors identified as “on-site receptors” are defined as receptors located within the current Site boundaries (Figure 1-2), while future “off-site receptors” are those located outside the current Site boundaries. “On-site receptors” are those future receptors that will be located within the ~~subare~~sub-area under evaluation. “Off-site receptors” are those future receptors that will be located outside of the ~~subare~~sub-area under evaluation that may have complete exposure pathways associated with sources within the ~~subare~~sub-area.

Many potential human receptors are possible at the Site in the period during and after redevelopment. The potentially exposed populations and their potential routes of exposure are presented in Figure 9-1 and summarized in Section 9.7.1. Because the background general water quality (*i.e.*, high salt concentrations) of the groundwater beneath the Site and in the surrounding

³²²³²⁰ Note: Imported soil data will not be included in risk assessment calculations.

area is poor and because BRC will place institutional controls in the form of a deed restriction to prevent future users from utilizing groundwater beneath the Site, the use of private water wells by residents, businesses, or parks for drinking water, irrigation water, or other non-potable uses (e.g., washing cars, filling swimming pools) will not occur in the post-redevelopment phase. Therefore, exposure pathways relating to this type of use are incomplete.

9.3.2 Summary of Data Usability Evaluation

~~This section~~Section 6 describes the procedures to be used to evaluate the acceptability of data for use in the risk assessment. ~~Overall quality of sample results is a function of proper sample management. Management of samples begins at the time of collection and continues throughout the analysis process. The collection of environmental data will follow the QA/QC procedures identified in the QAPP (BRC and MWH 2006a) prepared for the Site. SOPs that are wholly consistent with the risk assessment will be followed to ensure that samples are collected and managed properly and consistently and to optimize the likelihood that the resultant data are valid and representative. Field methods are discussed in the FSSOP document (BRC and MWH 2006b) and adhere to practices consistent with the policies of the NDEP.~~

In addition to data validation, a QA/QC review of the analytical results will be conducted during the post-remediation field sampling effort. The analytical data will be reviewed for applicability and usability following procedures in the *Guidance for Data Usability in Risk Assessment (PartParts A and B)* (USEPA 1992b,c) and USEPA (1989).

9.3.2.1 Overview of the Data Evaluation Process

The primary objective of the data usability evaluation is to identify appropriate data for use in the risk assessment. All relevant site characterization data will be reviewed for applicability and usability following procedures in USEPA's (1992b,c) *Guidance for Data Usability in Risk Assessment (PartParts A and B)* and USEPA's (1989) *Risk Assessment Guidance for Superfund (RAGS)*. The USEPA data usability evaluation framework provides the basis for identifying and evaluating uncertainties in the ~~HRA~~human health risk assessment in regard to the site characterization data. Data usability is the process of assuring or determining that the quality of data generated meets the intended use. USEPA has established a specific guidance framework to provide risk assessors a consistent basis for making decisions about the minimum quality and quantity of environmental analytical data that are sufficient to support ~~HRA~~risk assessment decisions (USEPA, 1992b,c). The USEPA data usability guidance provides an explicit set of data

quality criteria that are used to determine the usability of site characterization data in the HRARisk assessment process.

The six USEPA evaluation criteria by which data are judged for usability in risk assessment are:

- Availability of information ~~contained in~~associated with Site ~~reports~~data;
- Documentation;
- Data sources;
- Analytical methods and detection limits;
- Data review; and
- DQIs, including precision, accuracy, representativeness, comparability, and completeness (PARCC).

A summary of these six criteria for determining data usability in the present risk assessment is described in this section. In addition, further details related to ~~how the data usability~~ evaluation ~~will be conducted for the HRAs~~ are described in Section 6.0.6.

9.3.2.2—Criterion I—Availability of Information Associated with Site Data

~~The usability analysis of the site characterization data requires the availability of sufficient data for review. The required information is available from documentation associated with the Site data and data collection efforts.~~

9.3.2.3—Criterion II—Documentation Review

~~The objective of the documentation review is to confirm that the analytical results provided are associated with a specific sample location and collection procedure, using available documentation. For the purposes of the data usability analysis, the chain-of-custody forms prepared in the field will be reviewed and compared to the analytical data results provided by the laboratory to ensure completeness of the data set. Based on the documentation review, all samples analyzed by the laboratory will be correlated to the correct geographic location at the Site. Field procedures included documentation of sample times, dates and locations, other sample specific information such as depth (ft bgs) will also be recorded. Information from field forms generated during sample collection activities will be imported into the project database.~~

~~The analytical data will be reported in a format that provides adequate information for evaluation, including appropriate QC measures and acceptance criteria. Each laboratory report will describe the analytical method used, provide results on a sample by sample basis along with sample specific detection limits, and provide the results of appropriate QC samples such as laboratory control spike samples, sample surrogates and internal standards (organic analyses only), and matrix spike samples. All laboratory reports, except for asbestos, will provide the documentation required by USEPA's Contract Laboratory Program (USEPA 2000a, 2005a,b,c). This documentation includes chain of custody records, calibration data, QC results for blanks, duplicates, and spike samples from the field and laboratory, and all supporting raw data generated during sample analysis. Reported sample analysis results will be imported into the project database.~~

~~9.3.2.4 Criterion III—Data Sources~~

~~The review of data sources is performed to determine whether the analytical techniques used in the site characterization process are appropriate to identify the COPCs in the risk assessment. The site data collection activities will be developed to characterize a broad spectrum of chemicals potentially present on the Site. Laboratory analyses for these analytes for each sample are identified in the SRC list developed for the project (Section 3.0).~~

~~The State of Nevada is in the process of certifying the laboratories used to generate the analytical data. As such, standards of practice in these laboratories follow the quality program developed by the Nevada Revised Statutes (NRS) and are within the guidelines of the analytical methodologies established by the USEPA.~~

~~9.3.2.5 Criterion IV—Analytical Methods and Detection Limits~~

~~In addition to the appropriateness of the analytical techniques evaluated as part of Criterion III, it is necessary to evaluate whether the analytical methods appropriately identify COPCs and whether the detection limits are low enough to allow adequate characterization of risks. At a minimum, this data usability criterion can typically be met by using standard USEPA and USDOE analytical methods to analyze samples collected at the Site. USEPA and USDOE methods will be used in conducting the laboratory analysis of post-remediation samples and are considered the most appropriate method for the respective constituent class and each is in the process of approval by NDEP as part of the SRC list (Section 3.0).~~

~~For the analytical data, the associated reference method is provided in the following guidelines:~~

- ~~USEPA (2000a) Contract Laboratory Program Statement of Work for Organic Analysis;~~
- ~~USEPA (2005a) Contract Laboratory Program Statement of Work for Organic Analysis;~~
- ~~USEPA (2005b) Contract Laboratory Program Statement of Work for Inorganic Analysis;~~
- ~~USEPA (2005e) Contract Laboratory Program Statement of Work for Chlorinated Dioxins and Furans Analysis;~~
- ~~USEPA (1996a) Test Methods for Evaluation Solid Wastes, SW-846 Third Edition;~~
- ~~USDOE (1997) Procedures Manual of the Environmental Measurements Laboratory, HASL-300; and~~
- ~~Berman and Kolk (2000) Modified Elutriator Method for the Determination of Asbestos in Soils and Bulk Material.~~

~~Laboratory reporting limits are based on those outlined in the reference method and the sampling and analysis plan. In accordance with respective laboratory SOPs, the analytical processes include performing instrument calibration, laboratory method blanks, and other verification standards used to ensure QC during the analyses of collected samples. The range of detection limits achieved for field samples will be compared to risk benchmark levels presented in the QAPP (BRC and MWH 2006a).~~

9.3.2.6 Criterion V – Data Review

~~The data review portion of the data usability process will be conducted by a qualified professional and will focus primarily on the quality of the analytical data that will be received from the laboratory. Data Validation Summary Reports will be prepared for all data collection efforts. Any analytical errors and/or limitations in the data will be addressed and an explanation for data qualification will be provided in respective data tables.~~

9.3.2.7 Criterion VI – Data Quality Indicators

~~DQIs are used to verify that sampling and analytical systems used in support of project activities are in control and the quality of the data generated for this project is appropriate for making decisions affecting future activities. The DQIs address the field and analytical data quality aspects as they affect uncertainties in the data collected for site characterization and the risk assessment. The DQIs include PARCC. The QAPP (BRC and MWH 2006a) provides the~~

~~definitions and specific criteria for assessing DQIs using field and laboratory QC samples and is the basis for determining the overall quality of the data set. Data validation activities include the evaluation of PARCC parameters, and all data not meeting the established PARCC criteria will be qualified during the validation process using the guidelines presented in the National Functional Guidelines for Laboratory Data Review, Organics and Inorganics and Dioxin/Furans (USEPA 1999, 2001b, 2004a, 2005d). Accordingly, these components of the data validation process will be carried into the data usability evaluation.~~

~~For some analytical results, quality criteria will not be met and various data qualifiers will be added to indicate limitations and/or bias in the data. The definitions for the data qualifiers, or data validation flags, used during validation are those defined in USEPA guidelines (USEPA 1999, 2001b, 2004a, 2005d). Data validation flags indicate when results are considered non-detect (U), estimated (J), or rejected (R). Sample results may be rejected based on findings of serious deficiencies in the ability to properly collect or analyze the sample and meet QC criteria.~~

~~Only rejected data will be considered unusable for decision-making purposes, and rejected analytical results will not be used in the risk assessment. Sample results qualified as estimated may be affected by special circumstances and are likely to be quantitatively biased to some degree; estimated analytical results will be used in the risk assessment. Datum qualified as non-detect represents an analyte or compound that is not detected above the SQL, and such data will be used in the risk assessment. These data usability decisions follow the guidelines provided in USEPA's (1992b) *Guidance for Data Usability in Risk Assessment—Parts A and B*.~~

9.3.2.2 Data Adequacy

The concept of data adequacy incorporates: (i) an analytical program that seeks to quantify all relevant Site chemicals that have the potential to affect risk calculations, and (ii) a spatial density of sampling points that provides confidence that the Site has been sufficiently characterized and that areas requiring remediation have not been missed. The risk assessment analytical program for the Site represents a broad suite of analyses that cover all chemicals that might be conceivably expected to be present at elevated levels at the Site as a result of historical operations on the Site or adjacent to the Site.

An evaluation of the adequacy of the sampling for use in risk assessment will be presented in the risk assessment report. The evaluation may incorporate the results from three analyses. The first qualitatively evaluates whether the sample collection appears to be adequately representative in

relation to the CSM. The second analysis addresses data quality using traditional classical statistics-based process. The third analysis presents a probabilistic analysis of the data.

9.4 SELECTION OF COPCS FOR HUMAN HEALTH RISK ASSESSMENT

COPCs will be selected for each exposure area evaluated. The broad suite of analytes presented in the SRC list (Section [3.03](#)) is considered to be the current list of potential COPCs at the Site, based on site characterization conducted to date. However, in order to ensure that each risk assessment focuses on those substances that contribute the greatest to the overall risk (USEPA 1989); two procedures will be used to identify the COPCs for quantitative evaluation in the risk assessment:

- Identification of chemicals with detected levels which are greater than background concentrations (where applicable), and
- Identification of chemicals that are frequently detected at the Site.

As to the latter, chemicals that are infrequently detected within an area will be discussed on a case-by-case basis with NDEP. The procedure for evaluating COPCs relative to background conditions is presented below.

9.4.1 Evaluation of Site Concentrations Relative to Background Conditions

USEPA (1989, 2002[a,b,c](#)) guidance allows for the elimination of chemicals from further quantitative evaluation if detected levels are not elevated above naturally occurring levels. Typically for purposes of selecting COPCs for risk assessment, COPCs are chemicals that are shown to be elevated above naturally occurring levels based on statistical analyses. For the purpose of selecting COPCs for each sub-area [HRA risk assessment](#), appropriate statistical methods will be applied for the background analyses. When the results of the statistical analyses indicate that a particular chemical is within background levels, then the chemical will not be identified as a COPC and will not be quantitatively evaluated in the risk assessment. That is, a chemical is selected as a COPC based on background conditions if it is determined to be above background levels based on a weight-of-evidence evaluation of the results of the individual background comparison tests. A chemical will be excluded as a COPC if it is determined to be at or below background levels based on a collective weight of evidence approach. The chemical will, however, be addressed qualitatively in the uncertainty analysis section of the risk assessment report (USEPA 2002[ab](#)). Also consistent with USEPA guidance (2002[ab](#)), for

chemicals that exceed their respective background levels, risks will be calculated considering both background and site-related risks. In addition, risks associated with background levels will also be presented for comparison purposes.

The comparison of site-related soil concentrations to background levels will be conducted using the existing, provisional soils background data set presented in ~~Environ (2003) and BRC/TIMET (2006). The BRC/TIMET background data report is pending approval by the NDEP, the Background Shallow Soil Summary Report, BMI Complex and Common Area Vicinity (BRC and TIMET 2007, currently in review by the NDEP), which includes both the Environ (2003) dataset and the BRC/TIMET dataset collected in 2005.~~

Background comparisons will be performed using the Quantile test, Slippage test, the *t*-test, and the Wilcoxon Rank Sum test with Gehan modification. The Quantile test, Slippage test, and Wilcoxon Rank Sum test are ~~non-parametri~~nonparametric. That is, the tests are distribution free; thus an assumption of whether the data are normally or lognormally distributed is not necessary. The computer statistical software program, Guided Interactive Statistical Decision Tools (GISdT[®]); (Neptune and Company ~~2006~~2007), will be used to perform all statistical comparisons, with a decision error of $\alpha = 0.025$. ~~An alpha = 0.025 is adequate to identify differences between the two datasets.~~

The Wilcoxon Rank Sum test performs a test for a difference between the sum of the ranks for two populations. This is a nonparametric method for assessing differences in the centers of the distributions that relies on the relative rankings of data values. Knowledge of the precise form of the population distributions is not necessary. The Wilcoxon Rank Sum test has less power than the two-sample *t*-test when the data are normally distributed, but the assumptions are not as restrictive. The GISdT[®] version of the Wilcoxon Rank Sum test uses the Mantel approach which is equivalent to using the Gehan ranking system.

The Quantile test addresses tail effects which are not addressed in the Wilcoxon rank-sum test. The Quantile test looks for differences in the right tails (upper-end of the data set) rather than central tendency like the Wilcoxon rank-sum test. The Quantile test will be performed using a defined quantile = 0.80.

The Slippage test looks for a shift to the right in the extreme right-tail of the background data set versus the extreme right-tail of the site data set. This is equivalent to asking if a set of the largest values of the site distribution are significantly larger (in a statistical sense) than the maximum value of the background distribution.

Typically an alpha = 0.05 ~~are is~~ used to evaluate a statistically significant result. Since several ~~correlated~~ tests will be conducted, a lower alpha is selected. As more tests are performed, it is more likely that a statistically significant result will be obtained purely by chance. Given the use of multiple statistical tests, an alpha = 0.025 is selected as a reasonable significance level for the COPC selection. ~~Any~~Generally, any chemical that resulted in a p value less than 0.025 in one of four tests will be retained as a COPC. Additionally, these tests are set up with one-sided hypotheses. Consequently, not only are differences between the two samples able to be detected, a directional determination can be made as well (*e.g.*, Site is greater than background).

Cumulative probability plots and side-by-side box-and-whisker plots will also be prepared to evaluate whether the Site data and background data are representative of a single population. These plots ~~will not necessarily be~~ are qualitatively used in the selection of COPCs, ~~but will be presented for qualitative purposes~~. These plots give a visual indication of the similarities between the Site and background data sets. A determination to eliminate a chemical as a COPC on the basis of these visual indications will be made on a case-by-case basis with the NDEP.

9.4.2 Further Selection of COPCs

The COPC selection criteria described in this section will be applied to metals and radionuclide COPCs that are present above background levels, and all other detected chemicals. Initially, as discussed above, the broad-suite analytes will be considered to be potential COPCs at the Site. From this list, a preliminary list of COPCs will be derived for purposes of risk assessment that includes chemicals that are:

- Positively identified in at least one sample in a given medium, including: (1) chemicals with no qualifiers attached (excluding non-detect results with unusually high detection limits, if warranted), and (2) chemicals with qualifiers attached that indicate known identities but estimated concentrations (*e.g.*, J-qualified data);
- Detected at levels significantly elevated above levels of the same chemicals detected in associated blank samples (this protocol includes an analyte if it is known to be site-related and its concentration is greater than five times the maximum amount detected in any blank; if the chemical is a common laboratory contaminant [as defined by USEPA 1989], it is included only if its concentration is greater than 10 times the maximum amount detected in any blank);

- Tentatively identified but presumed to be present because of association with the Site based on historical information; and
- Transformation (*e.g.*, degradation) products of chemicals demonstrated to be present.

In deriving the preliminary list of COPCs, the following criteria established by USEPA (1989) will also be considered:

Historical Information – Chemicals likely to be associated with site activities, based on historical information, will not be eliminated, even if the results of other “COPC reduction” steps indicate that such elimination is warranted.

Concentration and Toxicity - Aspects of concentration and toxicity will be considered prior to eliminating a chemical as a COPC. For example, weight-of-evidence for human toxicity will be considered in conjunction with site exposure concentrations. Thus, Class A carcinogens will be retained as COPCs.

Consistent with ATSDR guidance (De Rosa *et al.* 1997), if the dioxins/furans ~~toxic equivalency~~ (TEQ) concentration does not exceed the ATSDR screening value of 50 ppt for any sample within a ~~subarea~~ sub-area, dioxins/furans will generally not be retained as COPCs for the ~~subarea~~ sub-area. Elimination of dioxins/furans as COPCs based on the ATSDR screening criterion will be subject to NDEP approval on a case-by-case basis. Although the ATSDR screening value was published in 1997 as an interim policy guideline, the value is consistent with a current range of residential cleanup levels identified in a recent review of the scientific evidence for the risks posed by dioxins (Paustenbach *et al.* 2006).

Availability of Toxicity Criteria – Some chemicals have not been assigned toxicity criteria (*i.e.*, cancer slope factor [CSF] or reference dose [RfD]). Prior to eliminating such chemicals, structure-activity relationship (SAR) analysis and applicability of surrogate toxicity values will be considered.

Mobility, Persistence and Bioaccumulation – Chemicals that are highly mobile, are persistent or tend to bioaccumulate will generally be retained as COPCs.

Special Exposure Routes – For some chemicals under special site-specific scenarios, certain exposure routes need to be considered carefully before eliminating COPCs.

Treatability – Chemicals that are difficult to treat should remain as COPCs because of their importance during the selection of remedial alternatives if needed.

Documentation of Rationale – Rationale for the exclusion of any chemicals from the risk assessment will be documented in the risk assessment report.

Need for Further Reduction of COPCs – The need for further reduction of COPCs will be considered prior to applying reduction criteria. It may be appropriate to narrow the number of COPCs included in fate and transport modeling by grouping COPCs with similar fate and transport properties. That is, the modeled behavior of a given COPC will likely reflect that of other COPCs with similar properties. The selection of appropriate COPCs to be included in fate and transport modeling will be discussed with, and approval sought from, NDEP prior to modeling. A discussion of the COPCs that are not included in fate and transport modeling will be presented in the uncertainty section of the risk assessment report.

Approval by the NDEP – NDEP approval will be sought prior to the elimination of any potential COPCs from the risk assessment.

Frequency of detection (FOD) is another criterion that may warrant COPC reduction. Chemicals exhibiting a low FOD within a specific exposure area generally will not contribute significantly to risk and hazard estimates when hot spots are not present. USEPA (1989) suggests that chemicals with a FOD less than or equal to five percent, with the exception of metals and known human carcinogens, may be considered for elimination. Prior to eliminating a COPC based on the FOD criteria, (1) any elevated detection limits will be addressed, and (2) data distributions within ~~exposure-sub~~-areas will be considered (*e.g.*, potential hot spots will be assessed). Additionally, the detection of the COPC in all sampled media will be considered. For example, USEPA recommends that a chemical infrequently detected in soil should not be eliminated if it is frequently detected in groundwater and exhibits mobility in soil. As stated above, chemicals that are infrequently detected within an exposure area will be addressed on an exposure area-specific basis and will be discussed on a case-by-case basis with NDEP.

9.4.3 Summary and Presentation of COPCs

For each exposure area, a summary of the site COPC data (*i.e.*, chemical, range of concentration, background levels, ~~frequency of detection~~FOD, retained/eliminated as COPC, and rationale for elimination) will be presented in table form.

9.5 DETERMINATION OF REPRESENTATIVE EXPOSURE CONCENTRATIONS

A representative exposure concentration is a COPC-specific and media-specific concentration value used in the dose equation for each receptor and each exposure pathway. As described below, the methods, rationale, and assumptions employed in deriving the representative exposure concentrations will be consistent with USEPA guidance and will reflect site-specific conditions.

9.5.1 Soil

The risk assessment will incorporate representative exposure concentration estimates (*e.g.*, 95 percent upper confidence limit of the mean [UCL] [USEPA 2002~~ed~~, Singh *et al.* 1997] as presented below) that specifically relate to potential site-specific human exposure conditions. Representative exposure concentrations may vary across the Site, consistent with the statistical approach presented in the *Statistical Methodology* document (BRC and NewFields 2006; ~~currently under NDEP review~~).

Under a deterministic risk assessment framework, two approaches for developing representative exposure concentrations for soil in a particular exposure area may be used: 1) 95 percent UCL concentration approach; and 2) geostatistical (block kriging) approach. Both of these methods result in use of a 95 percent UCL of the mean concentration, by either 1) assuming randomness (no spatial correlation) or 2) assuming a spatial correlation structure. Each of these approaches is discussed below. The use of each of these approaches for a particular COPC within an exposure area will be dependent on whether the data are spatially correlated or not, as determined through COPC-specific correlation analyses. Results of correlation analyses will be provided to NDEP for review and comment prior to calculation of representative exposure concentrations.

If the data are spatially uncorrelated for a particular COPC, the 95 percent UCL will be computed to represent the sub-area-wide exposure point concentration. Based on USEPA (1989) guidance and NDEP's recommendation, ~~non-detects for COPCs~~ will be assigned a value of one-half random number between zero and the detection limit. ~~Other methods for addressing non-detects may be considered.~~ For radionuclide censored data, the actual reported value will be used. Data identified in the data usability evaluation as unusable due to elevated reporting limits will not be used in the calculation of representative exposure concentrations. The formulas for calculating the 95 percent UCL COPC concentration (as the representative exposure

concentration) are presented in USEPA (2002^{ed}, Singh *et al.* 1997).³²³³²¹ The 95 percent UCL statistical calculations will be performed using the computer statistical software program GISdT[®] (Neptune and Company ~~2006~~2007).

For normally distributed data, the normal 95 percent UCL will be used. For non-normal data, the maximum of the three bootstrap 95 percent UCLs will be selected. If the selected 95 percent UCL does not exceed the maximum value (including detects and detection limits) it will be selected as the exposure point concentration, otherwise the maximum value will be used as the exposure point concentration.

If the data are spatially correlated³²² for a particular COPC, representative exposure concentrations will be determined on the basis of ~~exposure sub-~~areas. The size of the exposure area is dependent on the receptor (that is, 1/8th-acre will be used for residential receptors, while 1/2-acre will be used for worker receptors). For this purpose, the sub-area will be covered by a 1/8th-acre or 1/2-acre cell grid network, *i.e.*, each 1/8th-acre or 1/2-acre exposure area is defined as a cell, respectively. The geostatistical block estimation process (known as the ~~Block Kriging~~block kriging) will be used to estimate the average COPC concentration over each cell along with its standard error. These statistics can be used to calculate the cell-specific UCLs. Under a deterministic risk assessment framework, ~~UCLs of representative cells, including those with the mean, 95 percentile and/or maximum UCLs, will be considered.~~³²⁴ the maximum UCL across all cells, or block kriging will be applied to the entire sub-area to estimate an overall mean, standard error, and UCL for the sub-area.³²³ One of the advantages of the block kriging is the fact that cells in sparsely sampled locations will have higher standard deviations, even when their estimated average values are low. The UCL at these cells will be elevated. This kriging property provides a further safety factor against not discovering previously unknown hotspots. Subsequent samplings around such cells will confirm the actual status of their contamination.

Representative exposure concentrations for soil will be based on the potential exposure depth interval for each of the receptors. For commercial workers, maintenance workers, and trespassers or recreational users, who are exposed to surface soils, data from the top two feet of soil will be

³²³³²¹ Under a probabilistic risk assessment framework, the computed mean concentration and standard error will be used to define the distribution of representative exposure concentration.

³²² Upon a thorough inspection of computed omni-directional and directional variograms, the status of spatial correlation of a chemical in a given soil layer will be determined (BRC and NewFields 2006).

³²⁴³²³ Under a probabilistic risk assessment framework, the mean concentration and standard error from representative cells will be considered for defining the distribution of representative exposure concentration.

used (USEPA 2002~~da~~). For construction workers and residents exposed to on-site surface and sub-surface soils, data from the surface to ten ~~ft~~-bgs will be used, unless representative exposure concentrations are greater for the top two foot depth interval. For external radiation exposures, data from the surface to ten feet bgs will be used for all receptors.

9.5.2 Indoor Air

Concentrations of volatile constituents (VOCs, certain SVOCs, and radon) in soil and groundwater that may infiltrate buildings to be constructed at the Site through cracks in the foundations will be estimated using USEPA surface emission isolation flux chamber (flux chamber) measurements collected at the Site in accordance with USEPA guidance (USEPA 1986) and the Flux Chamber SOP (BRC and MWH 2006~~b~~). The flux chamber is used to measure the emission rates from surfaces emitting gas species. Use of the flux chamber reduces the need for modeling surface flux rates which reduces the uncertainty in the air representative exposure concentrations and the risk characterization. Because the flux chamber measurements will be conducted outdoors on open soil, an “infiltration factor” will be applied to the outdoor flux data to generate data supporting the inhalation of indoor air exposure pathway. The infiltration factor is based on the *ASTM Standard Guide for Risk Based Corrective Action* (2000). The indoor air concentrations will be determined from the following:

$$C_a = \frac{J \times \eta}{L \times ER}$$

where:

- Ca = indoor air concentration (milligram per cubic meter [mg/m³])
- J = measured flux of chemical (mg/m²-min)
- η = foundation crack fraction (unitless)
- L = enclosed space volume/infiltration area ratio (meter [m])
- ER = enclosed space air exchange rate (1/min)

Default parameter values from ASTM (2000) for residential and commercial buildings, where appropriate, will be used where site-specific data are unavailable. These default parameters are presented in Table 9-1. Radon testing will be conducted using static outdoor chambers in addition to the USEPA surface flux chamber following the procedures presented in the Flux Chamber SOP (BRC and MWH 2006~~b~~). Maximum flux rates for samples collected from a particular exposure area (*i.e.*, flux chamber sample resulting in the highest risk for the exposure

area) will be used in the above equation. The number of surface flux samples and their locations will be proposed in a site-specific work plan for each sub-area.

9.5.3 Outdoor Air

Long-term exposure to COPCs bound to dust particles will be evaluated using the USEPA's Particulate Emission Factor (PEF) approach (USEPA 2002~~da~~). The PEF relates concentrations of a chemical in soil to the concentration of dust particles in the air. The Q/C (Site-Specific Dispersion Factor [USEPA 2002~~da~~]) values in this equation will be for Las Vegas, Nevada (Appendix D of USEPA 2002~~da~~; see Table 9-1). The USEPA guidance for dust generated by construction activities (USEPA 2002~~da~~) will be used for short-term construction worker exposures. Input soil concentrations for the model will be the 95 percent UCL exposure point concentrations as described above.

For exposures to VOCs, volatile SVOCs, and radon in outdoor air, the flux chamber measurements as described above will be used. Outdoor flux data will be divided by the dispersion factor for volatiles (Q/Cvol for Las Vegas; from USEPA 2002~~da~~; see Table 9-1) for use in the outdoor air exposure pathway. The same dispersion factor will be used for all scenarios. The dispersion factor for the construction worker will not be adjusted to account for soil intrusion activities. Uncertainties associated with using the default dispersion factor for the construction scenario will be discussed in the uncertainty analysis.

9.5.4 Groundwater

For direct contact with groundwater exposures, the representative exposure concentration will be the lower of the maximum detected concentration or the 95 percent UCL concentration for each detected chemical. Data available from all wells within or immediately adjacent to a particular sub-area will be used in the determination of representative exposure concentrations in groundwater. As noted above at Section 9.5.1, non-detects for COPCs are assigned a random value of one-half between zero and the detection limit (except for radionuclide censored data, where the actual reported value will be used).

9.5.5 Plant Uptake

As indicated in Section 9.7.1, and consistent with USEPA guidance (USEPA ~~1996b, 1996,~~ 2000~~ba~~), the consumption of homegrown produce is applicable and will be evaluated for metals, dioxins/furans, PCBs, relevant SVOC, and radionuclide COPCs. In their *Soil Screening*

Guidance document (USEPA 1996b), USEPA presents generic plant ~~soil screening levels (SSLs)~~ for six metals (arsenic, cadmium, mercury, nickel, selenium, and zinc), based on plant uptake-response slopes from the *Technical Support Document for the Land Application of Sewage Sludge* (USEPA 1992ed). USEPA has not developed plant SSLs for other metals or for organic chemicals. For the six metals assigned a plant uptake SSL, USEPA has concluded that the other soil exposure pathways (e.g., soil ingestion, dermal contact, inhalation) are likely to be adequately protective of the soil-plant-human exposure pathway (USEPA 1996b) for mercury, nickel, selenium, and zinc, but not for arsenic and cadmium. Therefore, risks associated with plant uptake will be addressed using USEPA plant SSLs (USEPA ~~(1996b)~~) for arsenic and cadmium and mercury, nickel, selenium and zinc will not require quantitative evaluation for the plant uptake pathway. For other metals and organic COPCs, USEPA (2005e) guidance will be used, and for radionuclides, USEPA (2000ba) guidance will be used. On a site-by-site basis, BRC and the NDEP will mutually agree on which of the soil COPCs will warrant quantitative evaluation for the plant uptake pathway.

9.6 METHODOLOGY FOR EVALUATING POTENTIAL IMPACTS TO GROUNDWATER AND SURFACE WATER

Several vadose zone fate and transport models are available to evaluate the potential for chemicals to migrate from the unsaturated zone (or vadose zone) to groundwater beneath a site. BRC will not use groundwater in its subsequent redevelopment of the Site and will accept a restriction on groundwater use at the Site. As discussed in Section 9.6.3, as a first level screen, surface water concentrations will be considered equal to groundwater concentrations. The following approach and assumptions will be employed for appropriate fate and transport modeling at the Site.

9.6.1 Soil/Water Partition Equation for Migration to Groundwater

In order to determine the potential impacts of residual levels of COPCs in soil on groundwater quality, a simple, yet conservative, approach is used. The modeling consists of a simple soil/water partitioning and groundwater dilution model provided in the USEPA's *Soil Screening Guidance* (1996b). The model consists of a series of calculations used to determine COPC concentrations in groundwater that result from their presence in the unsaturated zone. The model simulates non-dispersive mass transport in soil from an infinite source. It assumes steady-state flow conditions, that all sources will infiltrate and desorb contaminants from the soil, and that the

infiltrate will mix completely within the mixing zone (see equation below) beneath the Site resulting in an equilibrium groundwater concentration.

The model used is conservatively simplistic in that it does not account for numerous physical and chemical processes in the calculation of chemical transport that in general tend to retard and reduce chemical concentrations as they move down the soil column. The model and equations presented in this section can be used either to (1) predict groundwater concentrations from measured soil concentrations, or (2) establish target soil concentrations protective of groundwater quality (*e.g.*, values below which leachate hypothetically generated from the soils can not cause groundwater concentrations to become elevated above applicable criteria [*e.g.*, MCLs]). The equations as presented below are designed to predict groundwater concentrations from measured soil concentrations. The equations merely need to be solved in terms of C_p to establish target soil concentrations protective of groundwater quality. Calculated groundwater concentrations will then be added to existing groundwater concentrations to determine compliance with allowable groundwater concentrations.

As part of predicting groundwater concentrations from measured soil concentrations, one first calculates a soil leachate concentration using site-specific input parameters (Sections 9.6.1.1 and 9.6.1.2). The partitioning (or distribution) equation from the USEPA's *Soil Screening Guidance* (Equation 10 from USEPA 1996b [rearranging the guidance document equation]) for migration to groundwater will be used:

$$C_p = \frac{C_t}{\left(K_d + \frac{\theta_w + \theta_a H'}{\rho_b} \right)}$$

where:

- C_p = soil leachate concentration (mg/L)
- C_t = soil concentration (mg/kg)
- K_d = soil-water partition coefficient (L/kg)
- θ_w = water-filled soil porosity ($L_{\text{water}}/L_{\text{soil}}$)
- θ_a = air-filled soil porosity ($L_{\text{air}}/L_{\text{soil}}$)
- H' = Henry's Law Constant (dimensionless)
- ρ_b = dry soil bulk density (kilogram per liter [kg/L])

For organic chemicals, soil organic matter is the primary sorbing component of the soil matrix. For organic compounds, the K_d is estimated using the following equation:

$$K_d = f_{oc} \times K_{oc}$$

where:

- f_{oc} = fraction of organic carbon in soil (mg/mg)
- K_{oc} = organic carbon-water partition coefficient (L/kg)

Chemical property values will be obtained from the USEPA literature ([1996b](#), [1996](#), [2000ba](#), [2002da](#)), as well as the National Library of Medicine's on-line Hazardous Substances Database. Where available, soil properties (e.g., fraction of organic carbon, porosity, and dry soil bulk density) will be based on laboratory results associated with soil samples collected from the Site. Model default values (USEPA [1996b](#), [1996](#), [2000ba](#)) will be used where site-specific data are unavailable. These default parameters are presented in Table 9-1. For inorganics, K_d values will be selected to represent a range of soil pH (pH = 8 and 6.5), where available. While current soil pH conditions are in the range of 5.9 to 9.3, the lower pH will be evaluated anticipating some decrease in pH after redevelopment.

9.6.1.1 Groundwater Parameters

The groundwater input parameters used in this evaluation will be based on site-specific data. These data will be collected as part of the overall groundwater characterization program for the Site (see Section [4.04](#)). The hydraulic gradient, or any other parameter, used in any specific area will be based on the most current data set for that area. The input parameter values will be provided to NDEP for review and comment prior to conducting modeling.

The depth of the groundwater mixing zone will be calculated for each exposure area using the following equation provided in the USEPA's *Soil Screening Guidance* (Equation 12 from USEPA [1996b](#)):

$$d = (0.0112L^2)^{0.5} + d_a \{1 - \exp[(-L \times I)/K \times i \times d_a]\}$$

where:

- d = depth of mixing zone (m)
- K = hydraulic conductivity (meter per year [m/yr])

- i = hydraulic gradient (meter per meter [m/m])
- d_a = ~~depth~~thickness of the aquifer (m)
- I = infiltration rate (m/yr)
- L = source length parallel to groundwater flow (m)

The ~~depth~~thickness of the aquifer (d_a) value will be based on stratigraphic data noted in the lithologic map of the Site (prepared as part of the CSM process described in Section 4.04). The site-specific term representing source length parallel to groundwater flow (L) will be selected based on the known areal extent of a given COPC within a particular exposure area. Each COPC will be modeled separately. The source length parallel to groundwater flow (L) will be dependent on the particular COPC being modeled. The infiltration rate will be based on the water balance that is being developed as part of the groundwater model for the Site.

9.6.1.2 Predicted Groundwater Concentrations

The equation used for estimating groundwater concentrations is (from USEPA 1996b [shown ~~reversed from this document~~as solved in terms of C_{gw}, below]):

$$C_{gw} = \frac{C_p}{1 + (Kid / IL)}$$

where:

- C_p = chemical concentration in the soil leachate (mg/L)
- C_{gw} = chemical concentration in groundwater (mg/L)
- K = hydraulic conductivity (meters per year [m/yr])
- i = hydraulic gradient (m/m)
- d = depth of mixing zone (m)
- I = infiltration rate (m/yr)
- L = source length parallel to groundwater flow (m)

Where available, site-specific conditions will be incorporated in the model. The input parameters associated with the model are discussed above.

For the purposes of screening analysis, the resultant predicted groundwater concentrations of COPCs from post-remediation soils will be compared to applicable environmental- and health-based standards (e.g., MCLs and ambient water quality criteria for the protection of freshwater organisms). Results of this modeling will be evaluated separately as well as combined with

existing groundwater concentrations to evaluate whether post-remediation COPC concentrations in soil (if any) could potentially impact groundwater to a cumulative extent greater than applicable standards, or--if existing groundwater concentrations are already above these standards--to determine the incremental increase in concentrations.

9.6.1.3 Determination Whether to Proceed to a More Refined Vadose Zone Modeling Effort

The decision of whether the screening level vadose zone modeling results indicate that final Site conditions are protective of groundwater protection will be made based on the predicted groundwater COPC concentrations:

- If predicted COPC concentrations from the modeling and in combination with existing groundwater concentrations are determined to be below applicable environmental- and health-based standards, it will be concluded that additional modeling will generally not be warranted.
- If predicted COPC concentrations from the modeling and/or in combination with existing groundwater concentrations are determined to be above their respective applicable environmental- and health-based standards, a decision will be made to: (1) proceed with additional vadose zone modeling utilizing more refined modeling tools (e.g., VLEACH vertical migration model), (2) re-evaluate the risk goal in accordance with USEPA guidance, or (3) perform additional soil removal and sampling.

The final determination of whether to conduct more refined vadose zone modeling will be made by the NDEP.

9.6.2 Surface Runoff Modeling

Migration of COPCs to surface water bodies by overland flow is quantified by the estimation of surface runoff. Surface runoff is the potential mass of surface soil that is eroded by precipitation and carried via runoff water to a site of deposition. Factors that can affect the amount of soil erosion taking place include type of soil, intensity of rainfall, steepness of the ground slope, amount of vegetative cover, size of the site subjected to erosion, erosion control practices, and distance to the surface water body or wetland where deposition is expected to occur. For the purposes of this assessment, the revised Universal Soil Loss Equation (USLE) will be used to estimate the mass of COPCs in surface soils eroded and transported to the Las Vegas Wash (USEPA 1988; USDA 2004 as referenced by USEPA 2004b). The revised USLE calculates annual soil loss using the following equation:

$$Y(S)_A = R \times K \times ls \times C \times P \times A \times S_d$$

where:

- $Y(S)_A$ = annual soil loss in runoff tonnes/year [1 tonne = 1,000 kilograms]
R = rainfall and runoff factor (in 10^2 m-ton-cm/ha-hour; USDA 1991)
K = the soil erodibility factor (tonnes/hectare per unit R)
ls = topographic factor (unitless)
C = dimensionless cover/management factor (1.0 for no appreciable plant cover)
P = dimensionless erosion control practice factor (1.0 for uncontrolled sites)
A = area of site (ha)
 S_d = dimensionless sediment delivery ratio

For each parameter, site specific information will be incorporated where available. Where data for parameters are not available, default assumptions based upon available information and databases (USDA 2004) will be incorporated. The annual mass of a particular chemical eroded from an area can be calculated based on the soil concentration and the resultant amount of eroded soil.

$$C_m = C_o \times Y(S)_A$$

where:

- C_o = soil concentration (mg/kg)
 C_m = the mass of chemical eroded from a site (mg/yr)

Surface water concentrations for each chemical from surface runoff can then be estimated using the following equation:

$$C_{sw} = \frac{C_m}{V_{sw}}$$

where:

- V_{sw} = annual surface water volume (L/yr)
 C_{sw} = surface water concentration (mg/L)

For each parameter, site specific information will be incorporated where available. Where data for parameters are not available, default assumptions based upon available information and

databases (USDA 2004) will be incorporated. The annual mass of a particular chemical eroded from an area can be calculated based on the soil concentration and the resultant amount of eroded soil.

9.6.3 Impacts on Las Vegas Wash

Potential impacts on the Las Vegas Wash will be evaluated by predicting the impact of groundwater migration and surface runoff, using the equations above. Applicable or Relevant and Appropriate Requirements (ARARs), protective of human health and ecological risk will be identified by BRC and the NDEP and employed by the NDEP as the basis for managing potential risk to Las Vegas Wash. The analysis will initially apply the conservative assumption that predicted groundwater concentrations at the point of infiltration will proceed undiluted and unattenuated up to the point of entry into the Las Vegas Wash. If more refined analyses are warranted, approval from NDEP will be sought prior to conducting those analyses.

Example models that may be considered for refined analyses include MODFLOW, a three dimensional, saturated flow model developed by the U.S. Geological Survey (USGS) with a comprehensive graphical interface, VLEACH, a one-dimensional, finite difference unsaturated (vadose) zone model developed by USEPA, and SESOIL, a one-dimensional vertical transport model for the vadose zone originally developed for USEPA, which can simulate seasonal climatic variations and varying soil properties with depth.

BRC fully recognizes the importance of this pathway, and the need to protect surface water quality from potential Site-related impacts, including those associated with redevelopment of the Site. Therefore, BRC will work closely with the NDEP to ensure the adequate evaluation and mitigation of these potential impacts. Potential impacts on the Las Vegas Wash are being further evaluated by the pending groundwater characterization and modeling program at the Site. The risk assessment will incorporate information obtained by this program when it becomes available.

9.7 TIERED HUMAN HEALTH RISK ASSESSMENT APPROACH

A tiered approach is proposed for the post-remediation risk ~~assessment~~assessments. The tiered, or iterative, approach for the risk ~~assessment~~assessments follows the USEPA recommendations (USEPA 2001a). The tiered risk assessment approach is applicable for all COPCs, with the exception of lead and asbestos. As discussed in Section 9.1.1.2, Sitesite-specific remediation goals have been established for lead. Because USEPA guidance for probabilistic risk assessment

methods for asbestos is not well established, and because it is not clear how to apply the current asbestos risk assessment approach into a probabilistic assessment, the use of a probabilistic approach for asbestos is too uncertain to use at this time. Therefore, asbestos risks will be evaluated through a deterministic risk assessment only.

9.7.1 Identification of Potentially Exposed Populations and Pathways

The identification of potentially exposed populations and exposure pathways is supported by the CSM. A [comprehensive summary](#) CSM is presented in Section [4.0.4](#). For a complete exposure pathway to exist, each of the following elements must be present (USEPA 1989):

- A source and mechanism for chemical release;
- An environmental transport medium (*i.e.*, air, water, soil);
- A point of potential human contact with the medium; and
- A route of exposure (*e.g.*, inhalation, ingestion, dermal contact).

Figure 9-1 and the following present the primary exposure pathways for each of the potential receptors following remediation at the Site. These populations and complete/potentially complete exposure pathways for each of the receptors will be evaluated in the post-remediation risk [assessment assessments](#), as summarized below.

- Adult and child residents (except at the [No-Build Area Trails & Recreation sub-area](#) [as shown on Figure 9-1])
 - incidental soil ingestion*
 - external exposure from soil[†]
 - dermal contact with soil
 - consumption of homegrown produce*
 - outdoor inhalation of dust*[‡]
 - indoor inhalation of dust*[‡]
 - outdoor and indoor inhalation of VOCs and radon from soil and groundwater
- Indoor commercial workers (except at the [No-Build Area Trails & Recreation sub-area](#))
 - incidental soil ingestion*
 - external exposure from soil[†]
 - indoor inhalation of VOCs and radon from soil and groundwater

- Park and landscape maintenance workers (equivalent to outdoor commercial/industrial workers)
 - incidental soil ingestion*
 - external exposure from soil[†]
 - dermal contact with soil
 - outdoor inhalation of dust*[‡]
 - outdoor inhalation of VOCs and radon from soil and groundwater
- Construction workers
 - incidental soil ingestion*
 - external exposure from soil[†]
 - dermal contact with soil
 - outdoor inhalation of dust*[‡]
 - outdoor inhalation of VOCs and radon from soil and groundwater
 - incidental ingestion of groundwater during construction activities*
 - dermal contact with groundwater during construction activities
- Trespassers and recreational users (for potential exposures at the ~~No-Build Area~~Trails & Recreation sub-area)
 - incidental soil ingestion*
 - external exposure from soil[†]
 - dermal contact with soil
 - outdoor inhalation of dust*[‡]
 - outdoor inhalation of VOCs and radon from soil and groundwater
 - incidental ingestion of surface water*
 - dermal contact with surface water

*Includes radionuclide exposures.

[†]Only radionuclide exposures.

[‡]Includes asbestos exposures.

9.7.2 Deterministic Human Health Risk Assessment Methodology

The deterministic risk assessment will follow procedures outlined in the USEPA's *Risk Assessment Guidance for Superfund: Volume I -- Human Health Evaluation Manual* (USEPA 1989). Other guidance documents that will be relied on include:

- *Guidelines for Exposure Assessment*. USEPA, 1992a.
- ~~*Exposure Factors Handbook, Volumes I-III*. USEPA 1997.~~
- ~~*Child-Specific Exposure Factors Handbook*. USEPA 2002e.~~
- *Soil Screening Guidance: Technical Background Document*. USEPA ~~1996b~~.1996.

~~*Exposure Factors Handbook, Volumes I-III*. USEPA 1997.~~

~~*Soil Screening Guidance for Radionuclides*. USEPA. 2000a.~~
- *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*. USEPA 2002d~~a~~.

~~*Technical Support Document for a Protocol to Assess Asbestos-Related Risk. Final Draft*.
USEPA. 2003a.~~
- ~~*Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual. Supplemental Guidance*. USEPA 1991.~~~~*Child-Specific Exposure Factors Handbook*. USEPA 2006.~~
- Nevada Administrative Code Chapter NAC 445A. Adopted Permanent Regulation of the Nevada State Environmental Commission. LCB File No. R119-96. NDEP 1996.

9.7.2.1 Deterministic Exposure Parameters

The exposure parameters proposed to be used in the deterministic risk assessment are presented in Tables 9-2 through 9-5. These generally conservative default values are based on standard USEPA guidance values. Exposure parameters that have significant impact on the results will be discussed in the uncertainty section of the risk assessment.

9.7.2.2 Deterministic Exposure Assessment

Reasonable maximum exposure levels to chemicals will be calculated for each receptor of concern, using the exposure parameters identified in Tables 9-2 through 9-5. Because the risk assessment may also be conducted probabilistically, a deterministic central tendency exposure (~~CTE~~) will not be evaluated. The methodology used to estimate the average daily dose (ADD) of the chemicals via each of the complete exposure pathways will be based on USEPA (1989, 1992a) guidance. For carcinogens, lifetime ADD (LADD) estimates are based on chronic

lifetime exposure extrapolated over the estimated average 70-year lifetime (USEPA 1989). This is performed in order to be consistent with cancer slope factors, which are based on chronic lifetime exposures. For non-carcinogens, ADD estimates will be averaged over the estimated exposure period. The generic equation for calculating the ADDs and LADDs is:

$$Dose = \frac{C \times IR \times ED \times EF \times BIO}{BW \times AT \times 365 \text{ d/yr}}$$

where:

- Dose = ADD for non-carcinogens and LADD for carcinogens (in mg/kg-day)
- C = chemical concentration in the contact medium (*e.g.*, mg/kg soil)
- IR = intake rate (*e.g.*, mg/day soil ingestion and dermal contact; m³/day for inhalation)
- ED = exposure duration (years of exposure)
- EF = exposure frequency (number of days per year)
- BW = average body weight over the exposure period (kilograms)
- BIO = relative bioavailability (unitless)
- AT = averaging time; same as the ED for non-carcinogens and 70 years (average lifetime) for carcinogens

With the exception of arsenic, the relative oral bioavailability (BIO) of all COPCs will be 100 percent. For arsenic, consistent with scientific literature recommendations on arsenic bioavailability (Roberts *et al.* 2001; Ruby *et al.* 1999; USEPA 2001^{eb}), an arsenic oral bioavailability of 30 percent will be used. The actual oral bioavailability of arsenic (as well as other metals at the Site, for which an oral bioavailability of 100 percent will be used) is likely to be lower than this value. Chemical-specific dermal absorption values from USEPA guidance (USEPA 2004c [Part E RAGS]) will be used in the risk assessments.

Exposure levels of potentially-carcinogenic and non-carcinogenic chemicals will be calculated separately because different exposure assumptions apply (*i.e.*, ADD for non-carcinogens and LADD for carcinogens). Exposure levels will be estimated for each relevant exposure ~~path-~~way (*i.e.*, soil, air, and water), and for each exposure route (*i.e.*, oral, inhalation, and dermal). For non-carcinogens, ADDs will be derived for both child (zero to six years of age) and adult (seven to 30 years of age) receptors. For chemical carcinogens, LADDs will be derived for both child (zero to six years of age) and adult (seven to 30 years of age) receptors. These age classes are consistent with USEPA (1991a) guidance. Daily doses for the same route of exposure will be summed. The total dose of each chemical is the sum of doses across all applicable

exposure routes.

The results of the exposure assessment will be used with information on the toxicity of the COPCs in the risk characterization step of the risk assessment to estimate the potential risks to human health posed by exposure to the COPCs. This process is discussed in Section 9.9.

9.7.2.3 Determination Whether to Proceed to a Probabilistic Risk Assessment

The decision of whether the deterministic risk assessment results indicate that final Site conditions are protective of human health and the environment will be made based on the non-cancer HI and total cancer risk.

- If both the non-cancer HI and the total cancer risk are below their respective acceptable levels (*i.e.*, a target organ HI of 1.0 and a cancer risk point of departure of 10^{-6}), and no hot spots are determined to exist, it will be concluded that PRA-probabilistic risk assessment will generally not be warranted.
- If either the non-cancer HI or the total cancer risk is above their respective acceptable levels, a decision will be made to: (1) proceed to a probabilistic risk assessment, (2) re-evaluate the risk goal in accordance with USEPA guidance, or (3) perform additional soil removal and sampling.

In order to assist in the decision to proceed to a probabilistic risk assessment, a quantitative sensitivity analysis will be performed if BRC considers performance of a probabilistic risk assessment warranted. If a probabilistic risk assessment is performed then a global numerical sensitivity analysis will be performed, which will be described in more detail in a separate probabilistic risk assessment methodology submittal to the NDEP. The final determination of whether a probabilistic risk assessment is warranted will be made by the NDEP. If a probabilistic risk assessment is conducted for a particular exposure area, all chemicals will be included (*i.e.*, no further reduction of COPCs will be conducted).

9.7.3 Probabilistic Human Health Risk Assessment Methodology

The probabilistic risk assessment will follow the procedures outlined in USEPA guidance (1989 and 2001a). It should be noted that the use of probabilistic risk assessment methodology is intended to more explicitly identify and quantify the uncertainty and variability that can be expected in the exposure assessment, and consequently, the risks associated with these

exposures. As discussed above, specific details regarding proposed probabilistic risk assessment methodology will be described in a separate submittal to the NDEP.

9.7.4 Radionuclide Risk Assessment Methodology

Risks associated with radionuclides will be evaluated separately from chemical contaminants. Recently available USEPA risk assessment methodologies for radionuclides will be used (USEPA 2000**ba**). There are several important differences between evaluating risks pertinent to radionuclides and those pertinent to chemical contaminants. These differences include:

- Exposure estimates are based on units of activity (*e.g.*, pCi) instead of units of mass (*e.g.*, mg) in soil;
- Only the carcinogenic effects of radionuclides due to ionizing radiation are considered. A radionuclide may also have a chemical toxicity (*e.g.*, uranium or lead). These risks are addressed separately by using the concentration of mass of chemical in soil, rather than activity; and
- CSFs are based on the total theoretical age-averaged incremental lifetime cancer risk per intake of the radionuclide, or per unit external radiation exposure to gamma-emitting radionuclides. A soil ingestion CSF for adults will be used for all receptors except the resident and trespasser. For residents and trespassers the age-averaged soil ingestion CSF will be used as presented in the radionuclide PRG table (USEPA ~~2006~~2007a). Except for external CSFs, which are presented as risk/year per pCi/g_{soil}, CSFs for radionuclides are not expressed as a function of body weight or time, as are CSFs for chemical contaminants.

Exposure equations and parameter values to be used are the standard deterministic risk assessment exposure parameters based on typical USEPA (2000**ba**, ~~2006~~2007a) default values. The exposure equations will be modified to include radionuclide decay as used in USEPA's radionuclide PRG equations (USEPA ~~2006~~2007a). For exposures not included in this guidance document (*e.g.*, construction worker and trespasser or recreational user exposures to groundwater and surface water, respectively), standard USEPA equations for these pathways will also be used for radionuclide exposures. Default parameter values are presented in Tables 9-2 through 9-5. These factors will also be used in the calculation of a site-specific background radionuclide risk level. The potential risks associated with exposure to radon will be evaluated using the approach for inhalation exposures to radon described in Section 9.5.2 (the equation presented in Section 9.5.2 for VOCs will also be applied for radon). In addition to inclusion in the radionuclide risk

estimates, results of the estimated radon indoor air measurements concentrations will be compared to USEPA's recommended action level of 4 picocuries per liter (pCi/L).

9.7.5 Asbestos Risk Assessment Methodology

Although final guidance is unavailable at this time, USEPA recommends that site-specific risk assessments be performed for asbestos (USEPA 2004d). Risks associated with asbestos in soil will be evaluated using the most recent draft methodology proposed by USEPA (2003a). This methodology is an update of the method described in *Methodology for Conducting Risk Assessments at Asbestos Superfund Sites-Part 1: Protocol* and *Part 2: Technical Background Document* (Berman and Crump 1999a,b). Because the risk assessment methodology for asbestos is unlike that for other COPCs, and the preliminary guidance documents do not include probabilistic methods, asbestos risks will be evaluated using deterministic methods only. Exposure pathways, equations, and parameters to be used will be those presented in USEPA (2003a). Adjustments for exposure duration and exposure intensity, consistent with the methodology, will be made for each of the receptor populations, based on the respective exposure parameters presented in Tables 9-2 through 9-5.

The exposure point concentration for asbestos are based on the pooled analytical sensitivity of the dataset. The pooled analytical sensitivity is calculated as follows:

$$\text{Pooled Analytical Sensitivity} = 1 / \left[\sum_i (1 / \text{analytical sensitivity for trial } i) \right]$$

Two estimates of the asbestos concentration will be evaluated. ~~The estimate of the mean, best estimate and upper bound as defined in the draft methodology (USEPA 2003a). The best estimate concentration is similar to a central tendency estimate, while the upper bound concentration is comparable to a reasonable maximum exposure estimate. The best estimate~~ asbestos concentration is the number of asbestos fibers detected multiplied by the pooled analytical sensitivity:

$$\text{Estimated Bulk Conc. } (10^6 \text{ s/gPM10}) = \text{Long fiber count} \times \text{Pooled analytical sensitivity}$$

The upper bound estimate is the 95 percent upper confidence bound of the mean of the assumed underlying Poisson distribution used to model the number of structures found, multiplied by the pooled analytical sensitivity. In Microsoft® Excel, the 95 percent upper confidence bound of the mean may be calculated utilizing the following equation:

$$95\% \text{ UCL of Poisson Distribution } (10^6 \text{ s/gPM10}) = \text{CHIINV}(1 - \alpha, 2 \times (\text{Long fiber count} + 1)/2)$$

The intent of the risk assessment methodology is to predict the amount of airborne asbestos which can be inhaled by a receptor. In order to quantify the airborne asbestos concentration, the estimated dust levels or PEFs are used:

$$Est. Airborne Conc. (s/cm^3) = Est. Bulk Conc. (10^6 s/gPM10) \times Est. Dust Level (\mu g/cm^3)$$

In addition, it will be assumed that asbestos only occurs at the soil surface (zero to two inches), unless it is plausible that it exists at deeper depths based on available sample data or information for a particular exposure scenario. This will be determined on a case-by-case basis with NDEP.

For assessing asbestos risks, Table 8-2 (Based on Optimum Risk Coefficients) of USEPA (2003a) will be used. Population Table 8-2 presents best estimate risks optimized based upon separation of fiber type, size and endpoint (mesothelioma/lung cancer), thereby reducing apparent variation between the studies utilized. The values in Table 8-2 will be used because they are the authors "best" estimates of potency based upon all the available data (whereas the "conservative values" presented in Table 8-3 present only the most conservative, and best "behaved" data). As described in USEPA (2003a), because the asbestos risks to male and female smokers/non-smokers are different, population averaged risks will be evaluated based on Eqn. 8-1 of USEPA (2003a)-:

$$URF = 0.5 \times ((0.786 \times (NSM + NSF)) + ((0.214 \times (SM + SF))) \times CF$$

where:

URF = Population Averaged Unit Risk Factor [s/cm³]⁻¹; g., mg/kg, milligrams per cubic meter [mg/m³]

NSM = risk for male non-smokers

NSF = risk for female non-smokers

SM = risk for male smokers

SF = risk for female smokers

NSM = risk for male non-smokers

CF = factor to convert risk from risk per 100,000 to risk per 1,000,000

This equation considers male smokers, male non-smokers, female smokers, and female non-smokers. In addition, because both chrysotile and amphibole have been detected in the general area (for example, from the City of Henderson WRF sampling), both could be expected to occur at the Site. Therefore, both amphibole and chrysotile fibers will be evaluated in the risk

assessments, regardless as to whether either is detected within an exposure area (as calculated using the 95 percent UCL of the mean of the assumed underlying Poisson distribution).

To interpret measurements of asbestos in soils, it is necessary to establish the relationship between the asbestos concentrations observed in soils and concentrations that will occur in air when such soil is disturbed by natural or anthropogenic forces. This is because asbestos is a hazard when inhaled (see, for example, Berman and Crump 2001). In fact, the Modified Elutriator Method (Berman and Kolk 2000), which will be the method employed to perform the risk assessments, was designed specifically to facilitate prediction of airborne asbestos exposures based on bulk measurements (see, for example, Berman and Chatfield 1990).

9.8 TOXICITY ASSESSMENT

This section identifies how toxicity values to be used for the risk assessment will be obtained. Toxicity values are published by the USEPA in the on-line Integrated Risk Information System [IRIS]; USEPA ~~2006~~2007b). CSFs are chemical-specific and experimentally derived potency values that are used to calculate the risk of cancer resulting from exposure to potentially carcinogenic chemicals. A higher value implies a more potent carcinogenic potential. RfDs are experimentally derived “no-effect” levels used to quantify the extent of toxic effects other than cancer due to exposure to chemicals. With RfDs, a lower value implies a more potent toxicant. These criteria are generally developed by USEPA risk assessment work groups and listed in the USEPA risk assessment guidance documents and databases. Toxicity criteria will not be developed *de novo* by BRC for elements or compounds that do not have criteria published in the above sources. Should COPCs be found which do not have established toxicity criteria; these will be discussed on a case-by-case basis with NDEP and qualitatively addressed in the uncertainty analysis of the risk assessment report. Where appropriate, and only as approved by NDEP, non-carcinogenic surrogate RfDs may be applied.

Like any biological reaction, the toxicity of a chemical on humans can be described as a range of possible outcomes (severities and levels that cause an endpoint of concern). The uncertainty in the toxicity outcomes or values is an important source of uncertainty in most risk assessments and would be an appropriate parameter to be modeled probabilistically. However, for the purposes of both the deterministic and probabilistic assessments, the toxicity values used will be point estimates (deterministic). Available toxicity values for all Site COPCs to be used in the risk assessment will be obtained from the USEPA. The following hierarchy for selecting toxicity criteria will be used (based on USEPA 2003b):

- IRIS
- USEPA's Provisional Peer Reviewed Toxicity Values (PPRTVs)
- National Center for Environmental Assessment (NCEA, or other current USEPA sources)
- Health Effects Assessment Summary Tables (HEAST)
- USEPA Criteria Documents (*e.g.*, drinking water criteria documents, drinking water Health Advisory summaries, ambient water quality criteria documents, and air quality criteria documents)
- ATSDR toxicological profiles
- USEPA's Environmental Criteria and Assessment Office (ECAO)
- Peer-reviewed scientific literature

For carcinogens, the USEPA weight-of-evidence classification will be identified for each carcinogenic COPC. Available RfDs will be obtained for all COPCs, including carcinogens. A list of COPC-specific non-carcinogenic and carcinogenic toxicity criteria, current at the time of the post-remediation risk assessment, will be submitted to NDEP for approval prior to initiation of each risk assessment. Radionuclides toxicity criteria will be obtained from the USEPA's *Preliminary Remediation Goals for Radionuclides* (USEPA ~~2006~~2007a). For some radionuclides, two different toxicity criteria are available: for that radionuclide only, and for the radionuclide and associated short-lived radioactive decay products (*i.e.*, those decay products with radioactive half-lives less than or equal to six months). To be conservative, the toxicity criteria that include radioactive decay products will be used, even though toxicity criteria are available for some of their respective radioactive decay products, which are also assessed separately.

Although route-to-route extrapolation is generally inappropriate without adequate toxicological information, in this case route-to-route extrapolation will be applied based on USEPA's approach (USEPA 2004e). The uncertainties associated with this approach will be addressed in the risk assessment report. CSFs that account for risks from associated short-lived radioactive decay products (*i.e.*, radon) will be used in the risk assessment.

Although USEPA has developed toxicity criteria for the oral and inhalation routes of exposure, it has not developed toxicity criteria for the dermal route of exposure. Typically, a simple route-to-route (oral-to-dermal) extrapolation is assumed such that the available oral toxicity criteria are used to quantify potential systemic effects associated with dermal exposure. However, as noted in USEPA's *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)* (USEPA 2004c), there is uncertainty associated with this approach because the oral toxicity criteria are based on an administered dose and not an absorbed dose. In general, USEPA (2004c) recommends an adjustment to the oral toxicity criteria to convert an administered dose into an absorbed dose. The adjustment accounts for the absorption efficiency of the chemical in the "critical study" that is the basis of the oral toxicity criterion. If the oral absorption in the critical study is 100 percent, then the absorbed dose is equivalent to the administered dose and no adjustment is necessary. If the oral absorption of a chemical in the critical study is poor (less than 50 percent), then the absorbed dose is much smaller than the administered dose. In this situation, an adjustment to the oral toxicity criteria is recommended.

For the dioxins/furans (~~CDD/CDFs~~), the USEPA toxicity equivalency procedure, developed to describe the cumulative toxicity of these compounds, will be applied. This procedure involves assigning individual toxicity equivalency factors (TEFs) to the 2,3,7,8 substituted ~~CDD/CDF~~ dioxin/furan congeners. TEFs are estimates of the toxicity of dioxin-like compounds relative to the toxicity of 2,3,7,8-TCDD, which is assigned a TEF of 1.0. Calculating the TEQ of a mixture involves multiplying the concentration of individual congeners by their respective TEF. One-half the detection limit will be used for calculating the TEQ for individual congeners that are non-detect in a particular sample. The sum of the TEQ concentrations for the individual congeners is the TEQ concentration for the mixture. TEFs from USEPA (2000~~eb~~) will be used in the risk assessment.

For carcinogenic PAHs, provisional USEPA guidance for estimating cancer risks will be used (USEPA 1993). The procedure uses information from the scientific literature to estimate the carcinogenic potency of several PAHs relative to benzo(a)pyrene. These relative potencies may be used to modify the CSF developed for benzo(a)pyrene for each PAH, or to calculate benzo(a)pyrene equivalent concentrations for each of the PAH's (which would then be used with the benzo(a)pyrene CSF). The former approach will be used in the risk assessment. If one carcinogenic PAH is considered a COPC then all seven carcinogenic PAHs will be considered COPCs, regardless of whether or not they are detected at the Site. Although route-to-route

extrapolation is inappropriate without adequate toxicological information, route-to-route extrapolation will be applied based on USEPA's approach.

The USEPA has not derived toxicity criteria to evaluate the potential non-cancer health hazards associated with exposure to the carcinogenic PAH COPCs. For the ~~HHRA~~human health risk assessment, a toxicological surrogate (*i.e.*, pyrene) will be used to quantify the potential non-carcinogenic effects of the carcinogenic PAHs. This surrogate was selected from a list of six PAHs for which non-cancer oral toxicity criteria have been assigned by the USEPA based on a careful consideration of their relevant toxicity data, target organ(s), dose-response information, and structure-activity relationships. From the available oral non-cancer toxicity data reported by the USEPA, the most sensitive target organs are the liver, kidney, and blood (hematological effects) (IRIS, USEPA ~~2006~~2007b; ATSDR 1990, 1995; ORNL 1993). For the carcinogenic PAHs, the non-cancer target organs were found to be the same and the reported toxicological thresholds for these effects are generally in the range for those reported for the non-cancer PAHs (ATSDR 1995). Although naphthalene (2-ring structure) has the most stringent oral non-cancer toxicity criterion (0.02 mg/kg day), pyrene (4-ring structure; oral RfD of 0.03 mg/kg-day) was selected to be the best surrogate due to (1) non-cancer toxicity endpoints are more consistent with those for carcinogenic PAHs and (2) the greater number of rings in the pyrene chemical structure.

The National Research Council of the National Academies published its technical review of the *Health Implications of Perchlorate Ingestion* in January 2005. From this review USEPA has established a final RfD of 0.0007 mg/kg-day, which is currently contained in the IRIS database (USEPA ~~2006~~2007b). This value will be employed in the risk assessment.

9.9 RISK CHARACTERIZATION

In the last step of a risk assessment, the estimated rate at which a person intakes a COPC is compared with information about the toxicity of that COPC to estimate the potential risks to human health posed by exposure to the COPC. This step is known as risk characterization. In the risk characterization, cancer risks will be evaluated separately from non-cancer adverse health effects. The methods used for assessing cancer risks and non-cancer adverse health effects are discussed below.

9.9.1 Methods for Assessing Cancer Risks

In the risk characterization, carcinogenic risk will be estimated as the incremental probability of an individual developing cancer over a lifetime as a result of a chemical exposure. Carcinogenic risks will be evaluated by multiplying the estimated average exposure rate (*i.e.*, LADD calculated in the exposure assessment) by the chemical's CSF. The CSF converts estimated daily doses averaged over a lifetime to incremental risk of an individual developing cancer. According to USEPA (1989), this approach is appropriate for theoretical upper-bound incremental lifetime cancer risks of less than 1×10^{-2} . The following equations will be used to calculate chemical-specific risks and total risks:

$$Risk = LADD \times CSF$$

where:

LADD = lifetime average daily dose (mg/kg-d)
CSF = cancer slope factor (mg/kg-d)⁻¹

and

$$Total\ Carcinogenic\ Risk = \Sigma\ Individual\ Risk$$

It will be assumed that cancer risks from various exposure routes are additive. Thus, the result of the assessment is necessarily a high-end estimate of the total carcinogenic risk. High-end carcinogenic risk estimates will be evaluated by NDEP in light of site-specific risk management decision criteria.

The equation used to calculate asbestos risks, which will be evaluated separately, is:

$$Risk = Estimated\ Airborne\ Concentration\ (s/cm^3) \times Adjusted\ URF\ (s/cm^3)^{-1}$$

9.9.2 Methods for Assessing Non-Cancer Health Effects

Non-cancer adverse health effects are estimated by comparing the estimated average exposure rate (*i.e.*, ADDs estimated in the exposure assessment) with an exposure level at which no adverse health effects are expected to occur for a long period of exposure (*i.e.*, the RfDs).

ADDs and RfDs are compared by dividing the ADD by the RfD to obtain the ADD:RfD ratio, as follows:

$$\text{Hazard Quotient} = \frac{\text{ADD}}{\text{RfD}}$$

where:

- ADD = average daily dose (mg/kg-d)
- RfD = reference dose (mg/kg-d)

The ADD-to-RfD ratio is known as a hazard quotient. If a person's average exposure is less than the RfD (*i.e.*, if the hazard quotient is less than 1), the chemical is considered unlikely to pose a significant non-carcinogenic health hazard to individuals under the given exposure conditions. Unlike carcinogenic risk estimates, a hazard quotient is not expressed as a probability. Therefore, while both cancer and non-cancer risk characterizations indicate a relative potential for adverse effects to occur from exposure to a chemical, a non-cancer adverse health effect estimate is not directly comparable with a cancer risk estimate.

If more than one pathway is evaluated, the hazard quotients for each pathway, for all COPCs, will be summed to determine whether exposure to a combination of pathways poses a health concern. This sum of the hazard quotients is known as an HI.

$$\text{Hazard Index} = \Sigma \text{Hazard Quotients}$$

A total HI that includes all COPCs and all exposure pathways will be presented in the risk assessment. The NDEP non-cancer risk management target is an HI value of less than or equal to ~~1~~1.0.

For any HI that exceeds ~~1~~1.0, the potential for adverse health effects will be further evaluated by considering the target organs upon which each chemical could have an adverse effect. Target organ-specific HIs will be assessed only after approval by NDEP. The target organ specific HIs will be summed for all relevant COPCs. The segregation of HI by target organ is consistent with USEPA guidance for non-carcinogens, including metals (USEPA 1989, 2001~~d~~e, 2005~~e~~e).

9.10 UNCERTAINTY ANALYSIS

Consistent with USEPA (1989) guidance, for the deterministic risk assessment, a qualitative discussion of the uncertainties associated with the estimation of risks for the Site will be

presented in the risk assessment report. The uncertainty analysis will discuss uncertainties associated with each step of the risk assessment, including site characterization data, data usability, selection of COPCs, representative exposure concentrations, fate and transport modeling, exposure assessment, toxicity assessment, and risk characterization. For both non-carcinogens and carcinogens, the relative contribution of specific COPCs and pathways to total risk and HI will be identified. If a probabilistic risk assessment is performed the uncertainty analysis will be performed quantitatively. Details will be provided in a separate probabilistic risk assessment methodology submittal to the NDEP.

9.11 INTERPRETATION OF FINDINGS

The risk characterization results will be presented in tabular format in the risk assessment report. Key exposure (*e.g.*, estimated intakes, important modeling assumptions, summary of exposure pathways for each receptor) and toxicity information (*e.g.*, CSFs, RfDs, target organs) will be provided. In addition, the risk characterization results will be placed into proper perspective, including a discussion of the concept of *de minimis* risk. The cancer risk assessment results will be presented for both total cancer risk and background cancer risk estimates, as well as presentation of the percent contribution of the background cancer risk to the total cancer risk. In addition, those COPCs and exposure pathways having the greatest influence on the risk assessment results will be identified. As appropriate, graphical presentation of the results will also be included in the risk assessment report. In addition, the format and content of risk assessment reports will follow the guidelines presented in USEPA's *Risk Assessment Guidance for Superfund: Volume I Human Health Evaluation Manual—Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments* (USEPA 2001~~dc~~) and USEPA's Reviewers Checklist (USEPA 1989) to ensure that essential issues are adequately addressed in each risk assessment.

In addition to the above, upon completion of the final cycles of cleanup and sampling, the updated site GISgeographic information system (GIS) database will be used to generate area-wide, layer-specific 1/8th-acre cell average concentrations and their corresponding estimation standard deviations. This process will be performed for the risk-driver chemicals that represent 90 percent of the total cancer risk and non-cancer HI based on the methodology provided in Section 9.9 above.

Having the mean and standard deviation of concentrations of the risk-driver chemicals within each cell, large number of sets of chemical concentrations of targeted contaminants will be

~~statistically generated~~ randomly selected. For this purpose, each concentration will be selected from a normal distribution, ~~where the total~~ associated with the given risk driver. Having a complete set of selected chemical concentrations of risk drivers, the cumulative cancer risks and non-cancer hazards are calculated for each set ~~of concentrations~~. After an appropriately large number of these parametric ~~bootstrap simulations~~ Monte Carlo simulated sets (e.g., 1,000 simulated sets), the upper 95-percentile of the total cancer risks and non-cancer hazards will be determined for each cell. The results of these computations will be provided as area-wide, layer-specific mosaic-colored maps of the upper 95-percentile total cancer risks and non-cancer hazards. These maps will provide a comprehensive depiction of extent of risks over various depths of the entire area.

SECTION 9 REFERENCES

- Agency for Toxic Substances and Disease Registry (ATSDR). 1990. Toxicological Profile for Polycyclic Aromatic Hydrocarbons. U.S. Department of Health and Human Services, Public Health Service.
- Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological Profile for Polycyclic Aromatic Hydrocarbons. U.S. Department of Health and Human Services, Public Health Service. August.
- American Society for Testing and Materials (ASTM). 2000. Standard Guide for Risk-Based Corrective Action. E2081-00.
- Berman, D.W. and Chatfield, E.J. 1990. Interim Superfund Method for the Determination of Asbestos in Ambient Air. Part 2: Technical Background Document, Office of Solid Waste and Remedial Response, U.S. EPA, Washington, D.C., EPA/540/2-90/005b, May.
- Berman, D.W. and K. Crump. 1999a. Methodology for Conducting Risk Assessments at Asbestos Superfund Sites—Part 1: Protocol. Interim Version. Prepared for USEPA Region 9, February 15.
- Berman, D.W. and K. Crump. 1999b. Methodology for Conducting Risk Assessments at Asbestos Superfund Sites—Part 2: Technical Background Document. Interim Version. Prepared for USEPA Region 9, February 15.
- [Berman, D.W. and Crump, K.S. 2001. Technical Support Document for a Protocol to Assess Asbestos-Related Risk. Prepared for Mark Raney, Volpe Center, U.S. Department of Transportation, 55 Broadway, Kendall Square, Cambridge, MA 02142. Under EPA Review.](#)
- Berman, D.W. and Kolk, A. 2000. Modified Elutriator Method for the Determination of Asbestos in Soils and Bulk Material. May (Revision 1).
- Basic Remediation Company (BRC) [and MWH. 2006. BRC Field Sampling and Standard Operating Procedures, BMI Common Areas, Clark County, Nevada. May.](#)

BRC and NewFields Companies, LLC. 2006. Statistical Methodology Report, BMI Common Areas (Eastside), Henderson, Nevada. [currently under NDEP review]

~~Basic Remediation Company (BRC) and MWH. 2006a. BRC Quality Assurance Project Plan, BMI Common Areas, Clark County, Nevada. April. BRC and Titanium Metals Corporation (TIMET). 2007. Background Shallow Soil Summary Report, BMI Complex and Common Areas Vicinity. March 16.~~

~~Basic Remediation Company (BRC) and MWH. 2006b. BRC Field Sampling and Standard Operating Procedures, BMI Common Areas, Clark County, Nevada. May.~~

De Rosa, C.T., Brown, D., Dhara, R. *et al.* 1997. Dioxin and Dioxin-Like Compounds in Soil, Part 1: ATSDR Interim Policy Guidance. Toxicology and Industrial Health 13 759-768.

Environ. 2003. Risk Assessment for the Water Reclamation Facility Expansion Site, Henderson, Nevada. Prepared for the City of Henderson, Nevada. October.

~~Magee, B., Anderson, P., and Burmaster, D. 1996. Absorption Adjustment Factor (AAF) Distributions for Polycyclic Aromatic Hydrocarbons (PAHs). Human and Ecol. Risk Assessment, 2(4):841-873.~~

National Academy of Science (NAS). 1994. Science and Judgment in Risk Assessment. National Research Council. National Academy Press, Washington, D.C.

Neptune and Company. ~~2006-2007~~. Guided Interactive Statistical Decision Tools (GISdT). www.gisdt.org.

Nevada Division of Environmental Protection (NDEP). 1996. Nevada Administrative Code Chapter NAC 445A. Adopted Permanent Regulation of the Nevada State Environmental Commission. LCB File No. R119-96.

Oak Ridge National Laboratory (ORNL). 1993. Toxicity Summary for Pyrene. Chemical Hazard Evaluation Group, Biomedical and Environmental Information Analysis section, Health Sciences Research Division, Oak Ridge, TN, August.

- Paustenbach, D.J., Fehling, K, Scott, P., Harris, M., and B.D Kerger. 2006. Identifying soil cleanup criteria for dioxins in urban residential soils: how have 20 years of research and risk assessment experience affected the analysis? *Journal of Toxicology and Environmental Health, Part B*, 9:87–145.
- Roberts *et al.* 2001. Measurement of Arsenic Bioavailability in Soil Using a Primate Model. *Toxicological Sciences*, 67, 2: 303-310.
- Ruby, M.V., R. Schoof, W. Brattin, M. Goldale, G. Post, M. Harnios, D. E. Mosby, S. W. Casteel, W. Berti, M. Carpenter, D. Edwards, D. Cragin, and W. Chappell. 1999. Advances in evaluating the oral bioavailability of inorganics in soil for use in human health risk assessment. *Environ. Sci. Technol.* 33(21):3697-3705.
- Singh, A.K., Singh, A, and Engelhardt, M. 1997. The Lognormal Distribution in Environmental Applications. EPA Technology Support Center Issue. Office of Research and Development and Office of Solid Waste and Emergency Response, December.
- U.S. Department of Agriculture (USDA). 1991. Guides for Erosion and Sediment Control. Soil Conservation Service.
- USDA. 2004. Revised Universal Soil Loss Equation. <http://msa.ars.usda.gov/ms/oxford/nsl/rusle/>.
- ~~U.S. Department of Energy (USDOE). 1997. Procedures Manual of the Environmental Measurements Laboratory, HASL-300. New York, New York. February.~~
- U.S. Environmental Protection Agency (USEPA). 1986. Measurement of Gaseous Emission Rates From Land Surfaces Using an Emission Isolation Flux Chamber, Users Guide. EPA Environmental Monitoring Systems Laboratory, Las Vegas, Nevada, EPA Contract No. 68-02-3889, Radian Corporation, February.
- USEPA. 1988. Superfund Exposure Assessment Manual. Office of Remedial Response, Washington, DC. OSWER Directive 9285.51. EPA/540/1 88/001. April.

USEPA. 1989. Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual (Part A). Interim Final. Office of Emergency and Remedial Response, Washington, D.C. USEPA/540/1-89/002. December.

USEPA. ~~1991~~. 1991a. Risk Assessment Guidance for Superfund: Volume I—Human Health Evaluation Manual. Supplemental Guidance ‘Standard Default Exposure Factors’. Office of Emergency and Remedial Response, Washington, D.C. OSWER Directive 9285.3-03. March.

USEPA. 1991b. Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions. Memorandum from D.R. Clay, Assistant Administrator, USEPA. OSWER Directive 9355.0-30, April.

USEPA. 1992a. Guidelines for Exposure Assessment. Federal Register, 57(104):22888-22938. May 29.

USEPA. 1992b. Guidance for Data Usability in Risk Assessment. Part A. Office of Emergency and Remedial Response, Washington D.C. Publication 9285.7-09A. PB92-963356. April.

USEPA. 1992c. Guidance for Data Usability in Risk Assessment. Part B. Office of Emergency and Remedial Response, Washington D.C. Publication 9285.7-09B. PB92-963362. May.

USEPA. 1992d. Technical Support Document for Land Application of Sewage Sludge, Volume I and II. EPA 822/R-93-001a. Office of Water.

USEPA. 1993. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. Office of Research and Development, Washington, DC. EPA/600/R-93/089. July.

USEPA. ~~1996a. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. SW-846. Third Edition.~~ USEPA. 1996b. 1996. Soil Screening Guidance: Technical Background Document. Office of Emergency and Remedial Response, Washington, DC. USEPA/540/R-96/018. April.

USEPA. 1997. Exposure Factors Handbook. Office of Research and Development, Washington DC. USEPA/600/P-95/002Fa-c. August.

~~USEPA. 1999. National Functional Guidelines for Organic Data Review. EPA 540/R-99-008. OSWER 9240.1-05A-P. October.~~

USEPA. 2000a. ~~Contract Laboratory Program Statement of Work for Organic Analysis: Multi-media, Multi-concentration. OLM04.3. Office of Emergency and Remedial Response. March.~~ USEPA. 2000b. Soil Screening Guidance for Radionuclides. Office of Radiation and Indoor Air, Washington, DC. USEPA/540-R-00-007 and USEPA/540-R-00-006.

USEPA. 2000~~e~~b. Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds. Part II: Health Assessment for 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) and Related Compounds. National Center for Environmental Assessment, Washington, DC. EPA/600/P-00/001Ae. May.

USEPA. 2001a. Risk Assessment Guidance for Superfund: Volume 3—Part A, Process for Conducting Probabilistic Risk Assessment. Draft. Office of Solid Waste and Emergency Response, Washington, DC.

USEPA. 2001b. ~~National Functional Guidelines for Low Concentration Organic Data Review. EPA 540-R-00-006. OSWER 9240.1-34. June.~~ USEPA. 2001~~e~~. Inorganic Arsenic – Report of the Hazard Identification Assessment Review Committee. Memorandum, From: J. Chen, S. Malish, T. McMathon, Risk Assessment and Science Support Branch; to: N. Cook, Chief, Risk Assessment and Science Support Branch. August 21.

USEPA. 2001~~e~~c. Risk Assessment Guidance for Superfund: Volume I Human Health Evaluation Manual—Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessments. Office of Emergency and Remedial Response, Washington, DC. Publication 9285.7-47. December.

USEPA. 2002a. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Office of Solid Waste and Emergency Response, Washington, DC. OSWER 9355.4-24. December.

USEPA. 2002b. Memorandum on Role of Background in the CERCLA Cleanup Program, from USEPA Office of Emergency and Remedial Response Director Michael B. Cook to Superfund National Policy Managers and all Regions, dated 1 May. OSWER 9285.6-07P.

USEPA. 2002~~b~~c. Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites. Office of Emergency and Remedial Response, Washington, DC. EPA 540-R-01-003. September.

USEPA. 2002~~e~~d. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. Office of Emergency and Remedial Response, Washington, DC. OSWER 9285.6-10. December.

~~USEPA. 2002d. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. Office of Solid Waste and Emergency Response, Washington, DC. OSWER 9355.4-24. December.~~

~~USEPA. 2002e. Child Specific Exposure Factors Handbook. Interim Report. National Center for Environmental Assessment, Office of Research and Development, Washington, DC. EPA-600-P-00-002B. September.~~

USEPA. 2003a. Proposed Methodology for Conducting Risk Assessments at Asbestos Superfund Sites. Office of Emergency and Remedial Response, Washington, DC. January.

USEPA. 2003b. Memorandum on Human Health Toxicity Values in Superfund Risk Assessments, from Michael B. Cook, Director, Office of Superfund Remediation and Technology Innovation to Superfund Remediation Policy Managers, Regions 1 - 10, dated 5 December. OSWER Directive 9285.7-53.

~~USEPA. 2004a. National Functional Guidelines for Inorganic Data Review. EPA 540-R-04-004. OSWER 9240.1-45. October.~~

USEPA. 2004a. Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK). Office of Solid Waste and Emergency Response.

USEPA. 2004b. National Pollutant Discharge Elimination System (NPDES). http://cfpub1.epa.gov/npdes/linkresult.cfm?program_id=0&link_category=4&view=link.

USEPA. 2004c. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. Office of Emergency and Remedial Response, Washington, DC. EPA/540/R/99/005. July.

USEPA. 2004d. Memorandum on Clarifying Cleanup Goals and Identification of New Assessment Tools for Evaluating Asbestos at Superfund Cleanups, from Michael B. Cook, Director, Office of Superfund Remediation and Technology Innovation to Superfund Remediation Policy Managers, Regions 1 - 10, dated 10 August. OSWER Directive 9345.4-05.

USEPA. 2004e. Preliminary Remediation Goals (PRGs), Region 9. Website: www.epa.gov/region09/waste/sfund/prg/index/.

~~USEPA. 2005a. Contract Laboratory Program Statement of Work for Organics Analysis Multi-Media, Multi-Concentration. SOM01.1 May.~~

~~USEPA. 2005b. USEPA Contract Laboratory Program Statement Of Work For Inorganic Analysis Multi-Media, Multi-Concentration ILM06.X Draft November.~~

~~USEPA. 2005c. USEPA Analytical Services Branch Statement of Work for Analysis of Chlorinated Dibenzo-p-Dioxins (CDDs) and Chlorinated Dibenzofurans (CDFs) Multi-Media, Multi-Concentration DLM02.0 May.~~

~~USEPA. 2005d. USEPA Analytical Services Branch (ASB) National Functional Guidelines for Chlorinated Dibenzo-p-Dioxins (CDDs) and Chlorinated Dibenzo-p-Furans (CDFs) Data Review. Office of Superfund Remediation and Technology Innovation (OSRTI), Washington, DC. OSWER 9240.1-51. EPA 540-R-05-001. September.~~ USEPA. 2005e. 2005. Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities. Office of Solid Waste and Emergency Response, Washington DC. EPA530-R-05-006. September.

USEPA. ~~2006~~2006. Child-Specific Exposure Factors Handbook. Interim Report. National Center for Environmental Assessment, Office of Research and Development, Washington, DC. EPA/600/R/06/096A. September.

USEPA. 2007a. Preliminary Remediation Goals for Radionuclides. USEPA on-line database:
<http://epa-prgs.ornl.gov/radionuclides/>.

USEPA. ~~2006~~2007b. Integrated Risk Information System. USEPA on-line database:
<http://www.epa.gov/iris/index.html>.

SECTION 10

10 RISK ASSESSMENT METHODOLOGY – ECOLOGICAL

The purpose of ~~the Ecological Risk Assessment~~ an ecological risk assessment (ERA) is to evaluate the potential for adverse ecological impacts that may occur as a result of potential exposures to residual concentrations of chemicals following remediation. ~~Findings of the ERA are intended to support the site closure process.~~ Setting The biotic setting is important for determining if an ERA is necessary, placing the findings of the ERA in perspective, and, given the number of species and the complexity of biological communities, scoping the ERA effort. A current habitat map is provided in Figure 10-1.

The Las Vegas Wash is located ~~just~~ north of the Site and has been identified as a key regional conservation priority (Audubon International ~~2000's~~ 2000 Ecological Design for Village East, North of Sunset Road, Henderson, Nevada. Prepared for the Landwell Company). The primary source of the perennial surface water for the Las Vegas Wash is treated wastewater. The Wash supports both desert riparian and perennial freshwater aquatic/emergent habitats that provide refuge and foraging habitat for a variety of wildlife species (Figure 10-1). In addition, the Las Vegas Wash serves as the major wildlife movement corridor in the area because of its dependable water source, visual shielding from surrounding development, and vegetation structure.

In addition to the Las Vegas Wash, the City of Henderson's Birding Preserve is the only other permanent surface water in the vicinity of the Site. As with the Las Vegas Wash, the primary source of the perennial surface water for the Henderson Birding Preserve is treated wastewater. The City of Henderson's Birding Preserve supports freshwater aquatic/emergent wetland habitat and will likely continue to support minimally disturbed wetland communities. This birding preserve supports abundant and diverse bird populations.

Much of the area surrounding the Site currently supports or is planned to support residential, commercial, or industrial uses. These areas are not intended to and do not support habitat attractive to support native plant and wildlife populations. These areas are landscaped with a variety of native and non-native ornamental plants. Wildlife that may be observed in these areas are likely to be transient, introduced species that are tolerant of human activity and typical of highly disturbed areas (e.g., European starling, rock dove).

The entire Site is to be developed to support residential and mixed commercial and civic land use. The current development plans for the Site indicate that the Trails & Recreation sub-area

will receive a substantial amount of fill material and be developed for non-residential uses after remediation is complete. Based on discussions between BRC and NDEP, it is currently the belief that these developments do not constitute suitable habitat in this sub-area or in any of the other sub-areas and hence an ERA is not necessary. An ERA work plan will be developed if and when impacts and receptors are identified. For example, if it is discovered that off-Site impacts are adversely affecting ecological receptors it may be necessary to develop an ERA work plan. This work plan will incorporate appropriate USEPA ecological risk guidance documents, as well as those that the NDEP may develop.

~~The entire Site does not have similar ecological resources. This section later provides a discussion of the biotic setting for the Site (in this section Site refers to the Eastside, since the CAMU area does not have any relevant ecological resources based on field evaluation) based on prior evaluations by BRC. These evaluations have noted that the No Build Area sub-area (Figure 1-1), as opposed to the rest of the Site referred to as the "Build Area" in later discussion, of the Site would be the focus for the ERA. There are no significant ecological resources outside of this sub-area. The majority of the Site is to be developed to support residential and mixed commercial and civic land use. To ensure the protection of human health, portions of the Site will undergo remediation. Thus, potential risks to biota due to the direct or indirect loss of habitat as a result of the remediation and redevelopment of the Site will not be addressed by ERA.~~

~~Currently, the NDEP is developing appropriate ecological risk guidance documents. NDEP guidance will rely on appropriate EPA guidance as well. These include the General Assessment Endpoints (GAE) document and Screening Level Ecological Risk Assessment (SLERA) methodology document. Concurrently, the NDEP is also reviewing the *Draft BRC Ecological Risk Work Plan* (BRC 2006). The methodology by which BRC proposes to assess ecological risk is set forth in this draft work plan.~~

10.1 **BIOTIC**

~~Pertinent information from the following reports will be used to describe the biotic setting of the Site and nearby surrounding areas:~~

- ~~• Audubon International (2000), *Audubon International's Ecological Design for Village East, North of Sunset Road, Henderson, Nevada*;~~
- ~~• EDAW, Inc. (2002). *Draft Biological Constraints Report and Wildlife Corridor Suitability Analysis for Provenance, A Green Community in Henderson, Nevada*;~~

- ~~Las Vegas Wash Coordination Committee (LVWCC) (1999), Las Vegas Wash Comprehensive Adaptive Management Plan (CAMP);~~
- ~~LVWCC (2003), Las Vegas Wash Coordination Committee 2002 Year-End Report;~~
- ~~Clark County (2000), Final Clark County Multiple Species Habitat Conservation Plan and Environmental Impact Statement; and~~
- ~~The ecological scoping check list from a recent site visit (25 October 2005) by qualified ecological risk assessors (Table 10-1).~~

~~In addition, the ecology of salteedar (*Tamarix* sp.) is also provided to place the findings of the ERA into perspective.~~

~~10.1.1 Sources of Biological Information~~Plants and wildlife observed during on-site biological surveys are listed in Tables 2-1 and 2-2 from Audubon International (2000) and EDAW (2002), respectively. Species lists for the Site and nearby areas can be found in Table 10-2. A

~~Mammals, birds, reptiles, and fish were observed during 1999 surveys, with the greatest diversity of species occurring in wetland areas. No rare or sensitive communities and no threatened or endangered wildlife species were identified during the 1999 and 2002 field surveys (Audubon International 2000; EDAW 2002).~~

~~10.1.1.1 Build Area~~

~~Desert scrub is the dominant on-site plant community and is found throughout the Build Areas (Figure 10-1). Desert scrub is characterized by open, bare ground with scattered assemblages of broad-leaved evergreen or deciduous microphyll shrubs. The two desert scrub assemblages observed at the Site include (Audubon International 2000):~~

- ~~Creosote bush (*Larrea tridentata*) with no co-dominants found sporadically throughout the Site.~~
- ~~Creosote bush with desert saltbush (*Atriplex polycarpa*) found in the northwestern portion of the Site.~~

It was previously reported that because of the land use over the past 60 years, the Site supports few intact natural communities (Audubon International 2000; EDAW 2002). However, even under natural conditions, desert scrub is considered to support a limited diversity of species.

Resident wildlife species observed or expected in the Build Area include the common kingsnake (*Lampropeltis getulus*), western whiptail (*Cnemidophorus tigris*), side-blotched lizard (*Uta stansburiana*), Gambel's quail (*Callipepla gambelii*), desert wood rat (*Neotoma lepida*), black-tailed jackrabbit (*Lepus californicus*), desert cottontail (*Sylvilagus audubonii*), and coyote (*Canis latrans*) (Audubon International 2000; EDAW 2002; Mayer and Laudenslayer 1988).

10.1.1.2 No-Build Area

The No-Build Area and drainage ditches are dominated by monocultural stands of salteedar (Figure 10-1). Salteedar is an introduced exotic that has spread throughout much of the southwestern United States. As suggested by its common name, salteedar has the ability to take up salts, concentrate these salts in their leaves, and then void these salts aboveground when dropping their leaves. As stereotypic of salteedar stands, few understory plants were observed in the No-Build Area.

During the 2005 site visit, few wildlife or wildlife signs (e.g., burrows, scat, paw prints) were observed in the No-Build Area. Based on the few observed signs, it appears that the No-Build Area may be used as a wildlife corridor between the Las Vegas Wash and the Henderson Bird Preserve.

Wildlife species observed or expected in the No-Build Area include the western whiptail, side-blotched lizard, desert wood rat, desert cottontail, and coyote (see Table 10-2).

10.1.1.3 Las Vegas Wash

Desert Riparian Habitat

Plants comprising desert wash habitats are taller and denser than in surrounding desert scrub habitats. Characteristic of most desert riparian habitat, the riparian habitat at the Las Vegas Wash is characterized by dense groves of low, shrublike trees or tall shrubs (Mayer and Laudenslayer 1988). There is an abrupt transition occurring between desert riparian and more open desert habitats. Overstory species include salteedar, cottonwood, and willows. Subcanopy plants include quailbush, desert lavender, and arrowweed. Groundcover consists of a variety of grasses and forbs. The vertical structure and dense shrubbery are likely to provide refuge and food that

may support a variety of birds and other wildlife at higher densities and diversity relative to surrounding desert habitats (Mayer and Laudenslayer 1988).

Over 120 species of birds have been identified at the Las Vegas Wash and have been added to the Red Rock Audubon Society's Bird List of the Las Vegas Wash (see Table 10-2 for a list of bird species). Thirteen reptile species (nine lizards and four snakes) have been observed at the Wash. Eight small mammal species have been trapped as part of biological surveys at the Wash.

Resident riparian wildlife species observed or expected at the Las Vegas Wash in the vicinity of the Site include the common kingsnake, side-blotched lizard, desert horned lizard (*Phrynosoma platyrhinos*), desert spiny lizard (*Sceloporus magister*), desert iguana (*Dipsosaurus dorsalis*), Great Basin gopher snake (*Pituophis catenifer deserticola*), sidewinder (*Crotalus cerastes*), red-shouldered hawk, broad-tailed hummingbird, pinyon jay, hermit thrush, Lucy's warbler, spotted towhee, desert pocket mouse (*Chaetodipus penicillatus*), cactus mouse (*Peromyscus eremicus*), Merriam's kangaroo rat (*Dipodomys merriami*), desert woodrat (*Neotoma lepida*), eastern cottontail, coyote. A comprehensive list of wildlife observed at the Wash is maintained by the LVWCC.

Freshwater Aquatic/Emergent Habitat

Freshwater aquatic/emergent habitat provides habitat for aquatic insects and a potential source of drinking water for wildlife. Freshwater aquatic/emergent habitat is relatively stable, but may transition to upland habitat types depending on the amount and timing of erosion and changes in hydrology. At the Las Vegas Wash, dense stands of emergent vegetation (e.g., cattails, bullrush) were observed. A small seep, located between the Site boundary and the Las Vegas Wash, was observed to be fringed by herbaceous grasses and forbs. Migratory waterfowl and shorebirds were observed and are expected to forage in freshwater aquatic/emergent habitat at the Las Vegas Wash in the vicinity of the Site.

Resident freshwater aquatic/emergent wildlife species observed or expected at the Las Vegas Wash in the vicinity of the Site include red swamp crayfish (*Procambarus clarkii*), green sunfish (*Lepomis cyanellus*), mosquitofish (*Gambusia affinis*), common carp (*Cyprinus carpio*), black bullhead (*Ameiurus melas*), red shiner (*Cyprinella lutrensis*), spiny softshell turtle (*Apalone spinifera*), and unidentified tadpoles.

10.1.1.4 Other Nearby Surrounding Areas

~~In addition to the Las Vegas Wash, the City of Henderson's Birding Preserve is the only other permanent surface water in the vicinity of the Site. As with the Las Vegas Wash, the primary source of the perennial surface water for the Henderson Birding Preserve is treated wastewater. The City of Henderson's Birding Preserve supports freshwater aquatic/emergent wetland habitat and will likely continue to support minimally disturbed wetland communities. This birding preserve supports abundant and diverse bird populations (Audubon International 2000).~~

10.1.2 Overview of Saltecedar Biology and Ecology

~~Saltecedar is an introduced deciduous exotic that has spread throughout much of the southwestern United States, to the detriment of the natural plant assemblages. Saltecedar grows at elevations no greater than 2,100 meters and prefers saline soils. Seedlings mature rapidly and produce small white or pinkish flowers³²⁵. The typical life span of an individual tree has been reported to be 75 to 100 years (DiTomaso 1998).~~

~~Saltecedar have the ability to produce an almost continual supply of seeds during the growing season—although there appears to be one minor and one major peak of seed production during the growing season. A single saltecedar tree can produce half a million seeds per year. This ability to produce seeds provides an advantage over other woody riparian species because saltecedar can exploit suitable germinating conditions over a longer time when the seeds of other species are not present.~~

~~Saltecedar seeds are quite small, are dispersed by wind or water, and remain viable for only five weeks or so (DiTomaso 1998; DeLoach *et al.* 2000). Once wetted, seeds usually germinate within 24 hours. New seedlings require wet soils for several weeks and can grow up to four meters in a single growing season (DiTomaso 1998). The root system of saltecedar is extensive and is largely responsible for its competitive advantage and survival under stress. The primary root grows downward until it reaches groundwater. Once groundwater is reached, secondary root branching becomes profuse.~~

~~Once mature, saltecedar is tolerant to a variety of environmental stressors including burning, grazing, heat, cold, drought, water inundation, and high concentrations of TDS. In dense mature~~

³²⁵ _____ The fruit is a small three- to five-valved capsule.

~~stands of salteedar with little bare ground exposed beneath the canopy, there is little opportunity for regeneration of any species.~~

~~10.1.2.1 Water Use~~

~~Salteedar is a facultative phreatophyte, a deep-rooted plant that often depends on groundwater for its water supply. Evapotranspiration rates are among the highest of any phreatophyte evaluated in the southwestern United States.~~

~~Salteedar may draw moisture from the saturated zone below the groundwater table and is also capable of extracting soil moisture from less saturated soils in areas with deeper groundwater. The consumption of water can be so extensive that in heavily infested areas salteedar can desiccate springs, drain pools, and dry perennial streams (DiTomaso 1998). Accordingly, the longer a community has been invaded by salteedar, the greater will be the capacity to lower the groundwater table. Dropping the groundwater table is thought to allow salteedar to outcompete other co-existing plant species (DiTomaso 1998).~~

~~Being a facultative (rather than an obligate) phreatophyte, salteedar can survive on soil water alone (DeLoach *et al.* 2000). Under severe drought, salteedar is capable of surviving by dropping its leaves and reducing its evapotranspiration rates.~~

~~10.1.2.2 Salinity~~

~~Salteedar is a facultative halophyte that is capable of tolerating soluble salt concentrations in the soils ranging from 650 to 36,000 parts per million (ppm) and averaging between 6,000 to 8,000 ppm (DiTomaso 1998; Jackson *et al.* 1990) whereas native cottonwood and willow growth is inhibited by soil salinities greater than 1,500 ppm. Accordingly, salteedar has a distinct advantage over other native woody riparian species in environments with high salt concentrations.~~

~~Rather than excluding salts from the roots as do most plants, salteedar, as suggested by its name, has the ability to take up salts, concentrate these salts in salt glands located in their leaves³²⁶, and then void these salts aboveground when dropping their leaves. The composition of the secreted salts has been shown to be non-selective and dependent on the salt composition of the root environment. As mentioned, these salts are eventually deposited on the soil surface under the~~

³²⁶ Salt gland exudate containing 41,000 ppm total solids has been measured on plants rooted in groundwater containing 2,000 ppm total solids (Gatewood *et al.* 1950).

~~plant, sometimes forming a hard crust. Excessive surface deposits of salt are characteristic of salteedar-dominated areas and can inhibit the germination of other plants, thus restricting competition with other under- and overstory plants for space and water.~~

10.1.2.3 Impacts

~~Infestations of salteedar have caused changes in fire frequency and plant and animal diversity.~~

~~Fire. Salteedar is a fire-adapted plant with more efficient fire recovery mechanisms than nearly all other native riparian species. Salteedar is thought to utilize volatilized nutrients, increased soil concentrations of minerals, increased soil pH, and reduced soil moisture better than native woody riparian plants.~~

~~Intervals between wildfires are considerably shorter in salteedar stands as compared to native riparian plant communities. It has been hypothesized that salteedar may enhance the flammability in areas where they grow, leading to replacement of less- or nonfire-adapted plant communities. The increased incidence of fire in salteedar stands has been attributed to the rapid accumulation of leaf litter and senesced woody material (DiTomaso 1998).~~

~~Plant Diversity. Salteedar stands can be considerably more dense than native cottonwood-willow riparian habitat. Infestations of salteedar have led to dramatic reductions in native woody and herbaceous plant composition and abundance (DiTomaso 1998; DeLoach *et al.* 2000).~~

~~Heavy infestations of salteedar can alter the hydrology of an area by reducing soil moisture content and lowering the water table, effectively outcompeting and, in some cases, eliminating other native plants. High salt concentrations in soils produced by salteedar stands can further reduce or eliminate other native plants. Along with these factors, the “weedy” nature/biology of salteedar appears to make it difficult for other native species to re-establish and replace stands of salteedar.~~

~~Animal Diversity. Salteedar rarely provides food and shelter necessary for the survival of wildlife (DiTomaso 1998). As compared to native cottonwood and willow riparian communities, reduced biodiversity has been observed in salteedar-dominated areas.~~

~~Insects. Willow and cottonwood support a greater abundance of insects than does salteedar (DiTomaso 1998). Aside from bees and cicadas, few insects are known to use salteedar as cover or forage. A decreased (four fold) overall abundance of insects was observed in salteedar-dominated areas.~~

~~**Birds.** Although some obligate riparian birds can successfully utilize salteedar, most of these birds continue to demonstrate a preference for more diverse, native plant communities.~~

~~Waterfowl, granivorous (feeding on seeds) frugivorous (feeding on fruit), and insectivorous birds almost completely avoid salteedar. While some granivorous birds may roost in salteedar stands, these birds do not forage in salteedar stands because the seeds of salteedar are too small to be eaten by most animals (DiTomaso 1998).~~

~~Although some riparian birds breed in salteedar that have replaced native vegetation, breeding densities of these birds have declined. When comparing total bird density and species diversity, salteedar stands had consistently lower values than communities dominated by native cottonwood, willow, and mesquite (DiTomaso 1998). In some areas, a decreased (40 fold) density of birds was observed in salteedar-dominated areas (DiTomaso 1998). The sticky substance exuded by salteedar leaves can also damage the plumage of birds (DiTomaso 1998).~~

~~**Mammals.** With the exception of woodrats (*Neotoma* spp.) and the desert cottontail (*Sylvilagus audubonii*), no native mammals are known to feed on mature salteedar. Decreased diversity of small mammals was reported for salteedar-dominated areas (DiTomaso 1998).~~

SECTION 10 REFERENCES

- ~~Audubon International (AI). 2000. Audubon International's Ecological Design for Village East, North of Sunset Road, Henderson, Nevada. Prepared for the Landwell Company.~~
- ~~Basic Remediation Company (BRC) and MWH. 2006. BRC Ecological Risk Assessment Work Plan, BMI Common Areas (Eastside), Clark County, Nevada. January.~~
- ~~Clark County. 2000. Final Clark County Multiple Species Habitat Conservation Plan and Environmental Impact Statement for Issuance of a Permit to Allow Incidental Take of 79 Species in Clark County, NV. September.~~
- ~~DeLoach, C.J., R. I. Carruthers, J. Lovich, T. Dudley and S. Smith. 2000. Ecological interactions in the biological control of salteedar in the US: towards a new understanding. Proc. XI Int. Symp. Biol. Control of Weeds. Bozeman, MT.~~
- ~~DiTomaso, J.M. 1998. Salteedar: Biology, Ecology and Identification. Cooperative Extension University of California, Davis.~~
- ~~EDAW, Inc. 2002. Draft Biological Constraints Report and Wildlife Corridor Suitability Analysis for Provenance, A Green Community in Henderson, Nevada. Prepared for the Landwell Company.~~
- ~~Jackson, J., Ball, J.T. and M.R. Rose. 1990. Assessment of the Salinity Tolerance of Eight Sonoran Desert Riparian Trees and Shrubs. Final Report for Bureau of Reclamation, Yuma Projects Office, Yuma, Arizona, 102 pp.~~
- ~~Las Vegas Wash Coordination Committee (LVWCC). 1999. Las Vegas Wash Comprehensive Adaptive Management Plan (CAMP).~~
- ~~Las Vegas Wash Coordination Committee (LVWCC). 2003. Las Vegas Wash Coordination Committee 2002 Year-End Report. April.~~
- ~~Mayer, K.E. and W.F. Laudenslayer. 1988. A Guide to Wildlife Habitats of California. Resources Agency, Department of Fish and Game. Sacramento, CA.~~