

22 February 2008

Mr. Brian Rakvica, P.E.  
Supervisor, Special Projects Branch  
Nevada Division of Environmental Protection  
Bureau of Corrective Actions  
2030 E. Flamingo Road, Suite 230  
Las Vegas, NV 89119

**Subject: Geosyntec Response to ASW Comments on Response to Interim CAMU  
Design Review Report #1, #2, and #3  
BMI Industrial Complex Remediation Design Review  
Applied Soil Water Technologies, LLC Proj. No. 039-001  
Geosyntec Project: SC0313**

Dear Mr. Rakvica,

On behalf of Basic Remediation Company (BRC), Geosyntec Consultants (Geosyntec) hereby responds to the 1 and 7 February 2008 letters written by Applied Soil Water Technologies, LLC (ASW) to Nevada Department of Environmental Protection (NDEP) regarding the Interim CAMU Design Review. In addition, this letter responds to the 12 February 2008 email prepared by Mr. Brian Rakvica of NDEP. The ASW review focused on Geosyntec's response to the Interim Design Review Report #1, #2, and #3 dated 8, 23, and 29 January 2008, respectively, and the final cover liner system design review.

For ease of review, ASW's discussion will be repeated in italics with Geosyntec's response following. Review Report #1 comments and responses are as follows:

**Design Standard/Basis of Design – Discussion**  
**GCL Hydraulic Conductivity and Time for Break-Through and**  
**Attenuation**

*ASW is in agreement with the response provided. Both of these design considerations are reliant on the major design premise of minimizing the potential for leachate generation. Therefore, it is critical that moisture within the placed waste material and stormwater during construction activities be managed in strict accordance with the project's Technical Specifications for the duration of the project.*

**Consistency with the Technical Specifications**

*Geosyntec's response states that, "A flux rate of  $1 \times 10^{-8} \text{ m}^3/\text{m}^2\text{-sec}$  and a hydraulic conductivity  $5 \times 10^{-9} \text{ cm/sec}$  are generally equivalent at an effective confining stress of 5 psi."*

*ASW requests that a reference or other justification be provided which presents the calculation used to derive the conversion.*

The attached CETCO Bentomat ST certified properties sheet notes for GCL index flux and GCL hydraulic conductivity indicates the following (Attachment A):  
"ASTM D5887 Index flux and hydraulic conductivity testing with deaired distilled/deionized water at 80 psi (551 kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. Reported value is equivalent to 92 gal/acre/day. This flux value is equivalent to a permeability of  $5 \times 10^{-10} \text{ cm/sec}$  for typical GCL thickness."

*Geosyntec referenced Koerner and Daniel (1993) indicating that "...bentonite layer is typically 7 to 10mm thick..." It is further indicated that "this thickness range, 0.27 to 0.39 inches, is higher than the value of 0.2 inches used in the calculation, which results in a conservative evaluation of the GCL equivalency."*

*ASW is in agreement with the conservative evaluation. However, we recommend that the design engineer specify a minimum thickness in the project's Technical Specifications consistent with the equivalency evaluation. Based on the response it does not appear that it will be a problem for manufacturers to meet the minimum thickness requirement.*

In the 18 February 2008 conference call between ASW, Geosyntec, and BRC, all parties agreed the mass per unit area testing, performed in accordance with ASTM D 5993, specified at a frequency of one per 100,000 square feet is sufficient for demonstrating the equivalency evaluation.

*Geosyntec stated that, "The seaming requirement described in the Specifications states that GCL shall be seamed with Manufacturer's recommended procedures. The Manufacturer's typical seaming recommendations include bentonite-enhanced seams with a bentonite application rate of one quarter pound per lineal foot."*

*ASW recommends that a minimum standard be specified in the project's Technical Specifications rather than relying on a yet-to-be-determined-Manufacturer's procedures.*

The following statement has been added to Section 02772.3.06 of the Technical Specifications (Attachment B):

C. GCL shall be seamed, at a minimum, as follows:

1. CETCO Super Groove and GSE Gundseal products: No bentonite required.
2. All others: bentonite application rate of one quarter pound per linear foot.

**High Density Polyethylene (HDPE) Chemical Compatibility / Waste Placement Phasing**

*Geosyntec's response states that, "In accordance with Section 02205, Part 3.09.M, a minimum of 6 feet (2 feet of operations layer soil and 4 feet of contaminated soils) shall be placed prior to placement of Slit Trench waste material. This requirement, coupled with the dry nature of the waste material placed in the CAMU, will limit the potential for high concentrations of chemicals from contacting the geosynthetic liner system components. Also, the nature of the slit trench waste is typically not at concentrations that are representative of pure chemical and are not representative of typical chemical compatibility testing solutions."*

*Geosyntec also stated that, "The concentrations of chemicals within the East Side Area and Western Ditch Material Soils are not great enough to cause compatibility issues with the HDPE geomembrane. In addition the dry nature of the soil when placed will limit the contact of chemicals with the liner system components..."*

*ASW recommends that, at a minimum, concentration thresholds of chemical constituents anticipated to be encountered during the project that could potentially adversely affect the performance of the HDPE geomembrane be determined. Areas with sample results that exceed these values could be handled accordingly.*

Section 02205.3.10 of the Technical Specifications describes waste handling procedures for all debris, hazardous and non-hazardous, to be disposed in the CAMU. While mixing and blending of materials will occur based on the nature of the excavation and disposal process, additional mixing will be required if a large mass of suspected hazardous material is encountered. Currently, the Specifications define hazardous and suspected hazardous material based on visual observation and they require the Construction Manager to be present if the material is encountered. Therefore, the Construction Manager will ultimately decide if additional blending of the material is necessary.

**Veneer Stability of Geosynthetic-Saturated Soil Lined Sideslopes, Cover Liner System**

*ASW performed a review of the stability analysis as presented by Geosyntec Consultants dated January 8, 2008. The analysis utilized an approach outlined in Koerner, R. K. and Soong, T.Y., (1998), "Analysis and Design of Veneer Cover Soils", Proceedings of the Sixth International Conference on Geosynthetics, Atlanta, Georgia, Vol. I, 1998.*

*In summary of the Geosyntec analysis, "The calculations suggest that a minimum geosynthetic interface friction angle of 20 degrees is required to prevent the development of tension in the geosynthetic components of the side slope liner final cover system. A review of the literature indicates that a friction angle of 20 degrees is obtainable. The critical interface is likely the internal friction angle of the GCL."*

*ASW verified the veneer calculations by performing an analysis as outlined in Koerner, R.M. and Soong, T. Y., (2005), "Analysis and design of veneer cover soils", Geosynthetics*

*International, Special Issue on the Giroud Lectures, 12 No. 1, 28-49, 2005. The primary difference between this method and the method utilized in the Geosyntec analysis is that this method considers porewater pressures due to water accumulating at the toe of the slope and seepage forces due to flow parallel to the slope.*

*In summary, utilizing the same input values used in the Geosyntec analysis it was determined that the factor of safety becomes less than one when toe saturation reaches an approximate height of 17-feet within the cover liner system. Considering adequate toe drainage and the anticipated material properties for the final cover system, this condition is unlikely to occur.*

*ASW recommends that Geosyntec verify the calculations that consider water accumulation at the toe and/or seepage forces for inclusion in the final design.*

*As mentioned in a previous report, verification of interface friction assumptions of the final cover liner system using soils and materials that will be incorporated into the constructed product is critical.*

During the 18 February 2008 conference call between ASW, Geosyntec, and BRC, all parties agreed that the veneer stability evaluation performed is sufficient.

Review Report #2 comments and responses are as follows:

#### **Geotextile Separation/Filtration Review**

*Geosyntec's response states that, "The retention portion of the filtration calculation was conservatively based on non-dispersive clay soil, which is not indicative of soils found on site, while the permittivity portion of the calculation was conservatively based on higher hydraulic conductivity soil." ... "the assumptions in the calculation are sufficiently conservative to allow for finer grained materials to be used as operations layer."*

*ASW agrees that if a more conservative soil was considered for the analysis then the anticipated site soils should meet the design intent for this design component. However, ASW recommends that consideration be made regarding the hydraulic conductivity of the operations layer in the general vicinity of the sumps. This item is discussed in further detail in subsequent sections.*

*Geosyntec's response states that regarding the operations layer, "...we do not believe that hydraulic conductivity testing during construction is warranted."*

*As presented herein, ASW recommends that the design engineer consider the material properties of the operations layer soils in the general vicinity of the facility sumps. If the design engineer determines that further consideration be made to these soil material properties, ASW would suggest at a minimum performing hydraulic conductivity testing for these soils.*



Hydraulic conductivity is unnecessary because water will either report to the sumps or, more likely, pond above the operations layer. Stormwater collected in the sump or ponded on the operations layer will be removed and used for dust control or disposed as outlined in the Technical Specifications (Attachment B).

### ***Degree of Survivability***

*We agree with the using “moderate survivability” for the geotextile overlying the geocomposite in the base liner system. However, the placement specification for the operations layer was changed from a minimum compaction specification to a performance specification utilizing a D6 dozer. The specification should be more specific as to the model of D6 that is acceptable (e.g. D6N LGP) due to the fact that the pressures applied by some models of D6 exceed the maximum ground pressure criteria for moderate survivability presented in Koerner.*

The attached puncture calculation demonstrates the 6 oz/yd<sup>2</sup> geotextile can withstand ground pressure of greater than 10 psi, which is a higher ground pressure than a standard Caterpillar D6 dozer (Attachment C).

### **Geocomposite Equivalency Review**

*Geosyntec’s response states, “...The factor of safety for chemical clogging was selected to be 1.0 based on the waste material characterized in the RAP. The waste material will be blended and dried so they are placed at below optimum moisture content, minimizing the generation of leachate and therefore limit the mobilization of soluble materials that could precipitate out of solution in the geocomposite.”*

*According to the design specifications regarding material placement in the CAMU, the waste material is to be moisture conditioned to at or less than optimum moisture content. In the event that one or more significant storm events occur during construction activities, following the placement of the operations layer and prior to the placement of the overlying compacted waste, it is likely that the operations layer will remain at the soils field capacity. Considering that the operations layer soils are contaminated soils and that potential stormwater introduced to the operations layer during construction activities will have likely contacted waste, and also be contaminated, it is ASW’s opinion that the factor of safety for chemical clogging should be greater than 1.0.*

The calculation package has been revised to account for chemical clogging by increasing the factor of safety for chemical clogging from 1.0 to 1.5. With the increased chemical clogging factor of safety, the required transmissivity has been increased from  $6.1 \times 10^{-5}$  cm/sec to  $9.2 \times 10^{-5}$  cm/sec (Attachment D). The technical specifications have been updated accordingly (Attachment B).

### **HELP Model Results**

*Geosyntec's report states that, "...runoff will occur over the operations layer to the sump where it will permeate through the operations layer into the sump and therefore never travel in the piping. ...Evaporation in the model is set to 18 inches, which is considered conservative for the project area."*

*It is ASW's opinion that there is the potential that storm water runoff that reports to the sump areas will not be able to permeate through operations layer fast enough to prevent excessive pooling in the event of a major storm event.*

*Geosyntec's response also states, "...it is highly unlikely that the cell will be fully exposed to a rain event of this magnitude without having waste placement well underway."*

*It is ASW's understanding that the design premise is based on the fact that the waste material will be moisture conditioned and compacted in order to minimize the potential for meteoric water to infiltrate into the waste thereby minimizing the potential for long-term leachate generation. Therefore, it should be expected that a very large percentage of storm water introduced to the facility during construction activities will eventually report to the sumps or other low lying areas and will need to be managed by the contractor.*

Hydraulic conductivity is unnecessary because water will either report to the sumps or, more likely, pond above the operations layer. Stormwater collected in the sump or ponded on the operations layer will be removed and used for dust control or disposed as outlined in the Technical Specifications (Attachment B).

### **Sump Capacity**

*Geosyntec's response states that sump capacities were designed based on average annual total HELP model results that were used to calculate average daily values. Therefore, peak daily events were not considered when sizing the sumps. The HELP reported a peak daily rain event of 1.83-inches.*

*The totals for Sumps 1,2 and 3 based on average annual data are as follows:*

*Sump 1 = 169 ft<sup>3</sup>*

*Sump 2 = 231 ft<sup>3</sup>*

*Sump 3 = 65 ft<sup>3</sup>*

*According to the Geosyntec response regarding the HELP model results, runoff will occur over the operations layer to the sump where it will permeate through the operations layer into the sump. Therefore consideration should be given to peak daily events. As mentioned above there is the potential for a large percentage of a storm event to report to the sumps during construction. ASW recommends that the design engineer consider the potential for managing these volumes of water to avoid a release from containment.*

*We give caution in using the peak daily values reported by the HELP model directly for this evaluation. For some reason the model allocated approximately 40-percent of the total peak*

*precipitation to Snow Water. This should not have an impact on the sizing of the collection pipes due to the fact they had much more capacity than needed; however, the design engineer may want to review the results.*

Please see above response for stormwater management. In addition, the Contractor is required to submit a storm water management plan to be approved by the Construction Manager. The storm water management plan will outline what measures the Contractor will take to minimize leachate generation and respond to storm events.

### **Vadose Zone Monitoring System**

*Geosyntec's response states that, "The vadose zone monitoring sump is to be lined with 60 mil HDPE geomembrane."*

*ASW recommends that details associated with vadose zone monitoring system's liner should be included in the Construction Drawings (e.g. type, termination, anchorage etc).*

Detail 12 of the Construction Drawings will be modified to show the vadose zone monitoring sump material types, limits, and dimensions.

### **Grading Plan**

*According to Geosyntec's response, the technical specifications require the Contractor to prepare a Water Management plan. Specifically it was stated in the discussion regarding maximum head on the liner system, that the specifications requires the contractor to not allow the liquid level in the sump to exceed 3 feet.*

*Considering that the major design premise is to manage water during construction such that there will be minimal potential to generation leachate. It is ASW's opinion that there should be more upfront engineering to manage water during construction and less reliance on the contractor.*

The current Technical Specifications require the Contractor to submit a storm water management plan to be approved by the Construction Manager. This plan will detail steps the Contractor will implement prior to, during, and after a storm event to handle water.

### **Operation Layer General Comment**

*When the specification was changed the moisture content at placement specification was deleted. The moisture content at placement needs to be specified.*

Section 02205.3.08.D of the Technical Specifications has been updated to include the following statement: "Moisture content shall be less than or equal to optimum."

Review report responses #3

*Slit Trench Backfill*

*According to the technical specifications Section 02200.3.08.B, Soil used for the Slit Trench Backfill shall be on-site materials meeting the requirements of Subpart 2.01, Slit Trench Backfill shall consist of "...earthen materials excavated from the slit trenches that are separated and earthen materials adjacent to the slit trenches." Section 02205.2.01.B states that the Slit Trench Cover Soil is to be composed of clean soil materials. ASW suggests that clarification be made in Section 02200 that the Slit Trench Backfill be clean or non-contaminated materials for consistency.*

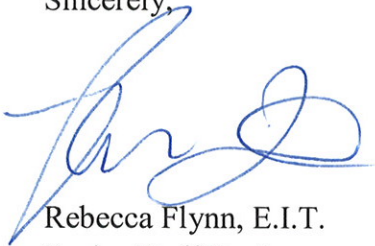
*All impacted slit trench materials are to be excavated, to the maximum extent possible. Given that, NDEP agreed that the adjacent soils can be used as backfill within the slit trench excavation since the area was being capped by both the base liner and final cover systems of the CAMU.*

Based on the 18 February 2008 conference call, a clarification of adjacent materials is requested for slit trench backfill materials.

Adjacent materials specified for slit trench backfill include excavated surface material from CAMU Cells IV and V and non-contaminated materials from grading of slit trench sides (dictated by OSHA slope set-back requirements).

If you have any additional questions please feel free to contact us at (858) 674-6559

Sincerely,

A handwritten signature in blue ink, appearing to read 'Rebecca Flynn', with a stylized flourish at the end.

Rebecca Flynn, E.I.T.  
Senior Staff Engineer

Gregory T. Corcoran, P.E.  
Principal

Attachment A: CETCO Bentomat ST Certified Properties Sheet  
Attachment B: Revised Technical Specifications  
Attachment C: 6 oz/yd<sup>2</sup> Puncture Protection Calculation  
Attachment D: Revised Geocomposite Equivalency Calculation

Copies to: Ranajit Sahu, C.E.M., Ph.D., Basic Remediation Company  
Robert B. Valceschini, P.E., ASW

**ATTACHMENT A**  
**CETCO Bentomat ST Certified Properties Sheet**



## BENTOMAT® ST CERTIFIED PROPERTIES

MATERIAL PROPERTY	TEST METHOD	TEST FREQUENCY ft <sup>2</sup> (m <sup>2</sup> )	REQUIRED VALUES
Bentonite Swell Index <sup>1</sup>	ASTM D 5890	1 per 50 tonnes	24 ml/2g min.
Bentonite Fluid Loss <sup>1</sup>	ASTM D 5891	1 per 50 tonnes	18 ml max.
Bentonite Mass/Area <sup>2</sup>	ASTM D 5993	40,000 ft <sup>2</sup> (4,000 m <sup>2</sup> )	0.75 lb/ft <sup>2</sup> (3.6 kg/m <sup>2</sup> ) min
GCL Grab Strength <sup>3</sup>	ASTM D 4632 ASTM D 6768	200,000 ft <sup>2</sup> (20,000 m <sup>2</sup> )	90 lbs (400 N) MARV 22.5 lbs/in (40 N/cm) MARV
GCL Peel Strength <sup>3</sup>	ASTM D 4632 ASTM D 6496	40,000 ft <sup>2</sup> (4,000 m <sup>2</sup> )	15 lbs (65 N) min 2.5 lbs/in (4.4 N/cm) min
GCL Index Flux <sup>4</sup>	ASTM D 5887	Weekly	1 x 10 <sup>-8</sup> m <sup>3</sup> /m <sup>2</sup> /sec max
GCL Hydraulic Conductivity <sup>4</sup>	ASTM D 5887	Weekly	5 x 10 <sup>-9</sup> cm/sec max
GCL Hydrated Internal Shear Strength <sup>5</sup>	ASTM D 5321 ASTM D 6243	Periodic	500 psf (24 kPa) typ @ 200 psf 6,500 psf (311 kPa) typ @ 10,800 psf

***Bentomat ST is a reinforced GCL consisting of a layer of sodium bentonite between a woven and a nonwoven geotextiles, which are needlepunched together.***

### Notes

<sup>1</sup> Bentonite property tests performed at a bentonite processing facility before shipment to CETCO's GCL production facilities.

<sup>2</sup> Bentonite mass/area reported at 0 percent moisture content.

<sup>3</sup> All tensile strength and peel strength testing is performed in the machine direction using 4 inch grips per modified ASTM D 4632. Results are reported as minimum average roll values unless otherwise indicated. Upon request, tensile strength can be reported per ASTM D 6768 and peel strength can be reported per ASTM D 6496.

<sup>4</sup> Index flux and permeability testing with deaired distilled/deionized water at 80 psi (551 kPa) cell pressure, 77 psi (531 kPa) headwater pressure and 75 psi (517 kPa) tailwater pressure. Reported value is equivalent to 925 gal/acre/day. This flux value is equivalent to a permeability of 5x10<sup>-9</sup> cm/sec for typical GCL thickness. Actual flux values vary with field condition pressures. The last 20 weekly values prior the end of the production date of the supplied GCL may be provided.

<sup>5</sup> Peak values measured at 200 psf (10 kPa) and 10,800 psf (517 kPa) normal stress for a specimen hydrated for 48 hours. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design.

*CETCO has developed an edge enhancement system that eliminates the need to use additional granular sodium bentonite within the overlap area of the seams. We call this edge enhancement, SuperGroove™, and it comes standard on both longitudinal edges of Bentomat® ST. It should be noted that SuperGroove™ does not appear on the end-of-roll overlaps and recommend the continued use of supplemental bentonite for all end-of-roll seams.*



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For the most up-to-date information please visit our website, [www.cetco.com](http://www.cetco.com)

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The information and data contained herein are believed to be accurate and reliable. CETCO makes no warranty of any kind and accepts no responsibility for the results obtained through application of this information.

Revised 09/04  
TR 401-BMST

**ATTACHMENT B**  
**Revised Technical Specifications**

**TECHNICAL SPECIFICATIONS  
FOR THE  
BRC EASTSIDE COMMON AREAS SOILS  
REMEDIATION  
HENDERSON, NEVADA**

Prepared for:



**Basic Remediation Company**  
875 West Warm Springs Road  
Henderson, Nevada 89015  
(702) 567-0400

Prepared by:



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February 2008



**CERTIFICATION PAGE**

**TECHNICAL SPECIFICATIONS  
CORRECTIVE ACTION MANAGEMENT UNIT  
BASIC REMEDIATION COMPANY  
HENDERSON, NEVADA**

The Engineering material and data contained in these Technical Specifications were prepared under the supervision and direction of the undersigned, whose seal as a registered Professional Engineer is affixed below.

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Ronald S. Johnson, P.E.  
Engineer of Record

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DRAFT

**SECTION 01010  
SUMMARY OF WORK**

**PART 1 – GENERAL**

**1.01 SUMMARY**

- A. The subject site is near the BMI Industrial Complex, in Clark County, Nevada, approximately 13 miles south of Las Vegas, within the City of Henderson. The property represents a portion of what is known as the BMI Common Areas. The BMI Common Areas is comprised of two areas: the Eastside Area where remedial excavation shall occur and the Corrective Action Management Unit (CAMU) where the containment structure for the remedial wastes shall be constructed. The total extent of the Site including the Eastside Area and the CAMU, as shown on the Construction Drawings, is approximately 2,330 acres. The Eastside Area covers approximately 2,200 contiguous acres, of which approximately 240 acres will be soil and sludge remediation and 93 acres of haul roads, and the CAMU area covers the balance of 130 acres.
- B. The Eastside Area consists of:
1. land on which unlined wastewater effluent evaporation ponds (and associated conveyance ditches) were built and into which various plant wastewaters were discharged from 1942 through 1976;
  2. land on which lined wastewater effluent ponds were constructed and into which effluent from the Titanium Metals Company plant was discharged from 1976 to 2005;
  3. land on which the City of Henderson constructed municipal wastewater infiltration basins (i.e., the Southern Rapid Infiltration Basins (RIBs);
  4. land on which unlined wastewater effluent ponds were constructed but which were never used; and
  5. land which has remained virgin desert.
- C. The CAMU area consists primarily of land which contains:
1. the closed North and South BMI Landfills;
  2. a series of trenches (the "Slit Trenches") into which various wastes were deposited;
  3. the western ditch; and
  4. vacant land.

**1.02 DESCRIPTION OF WORK**

- A. The Work generally involves the construction of six (6) phases of cell development for the CAMU, placement of waste material in the CAMU, and construction of final cover systems over the CAMU and North and South BMI Landfills. Construction of the final CAMU cover system and associated storm water management features overlying the CAMU will be held as Option Scope that may be added to the contract via Contract Modification at the Owner's sole discretion. If the Owner decides to exercise its option to add the Option Scope, the Construction Manager will notify the Contractor no later than 30 days after receipt of the final Eastside Area confirmation sampling results. Excavation, stockpiling, hauling to the CAMU, and placement in the CAMU of an estimated 1.9 million cubic yards of contaminated soil and sludge from the Eastside Area shall generally occur concurrently with CAMU construction. In addition to contaminated Eastside Area

CAMU Construction

Scope of Work  
Basic Remediation Company

soil and sludge, the western ditch contaminated soil and slit trench wastes, located on the CAMU site and as shown on the Construction Drawings, shall be placed in the CAMU.

- B. There will be nine (9) parts to the BRC Eastside Common Areas Soils Remediation project: six (6) phases of CAMU cell construction, final waste placement, and Capping of the CAMU, BMI North, and BMI South Landfills. The following construction activities will occur during the 9 parts of the project:

1. 6 Phased CAMU Construction and Waste Placement:

- a. Mobilization.
  - b. Clearing and Grubbing.
  - c. Demolition.
  - d. Initial topographic survey.
  - e. Mass excavation.
  - f. Engineered fill.
  - g. Storm water control installation: detention basins, storm drain pipe, manholes, channels
  - h. Subgrade preparation.
  - i. Post-excavation grade survey.
  - j. Sump construction.
  - k. Vadose zone monitoring system installation, including side slope riser pipe installation, geomembrane installation, cushion geotextile placement, drainage aggregate placement.
  - l. Liner installation, including: GCL, geomembrane, geocomposite, and operations layer.
  - m. Leachate collection system installation, including: side slope riser, concrete wall, leachate collection pipes, drainage aggregate, and filter geotextile.
  - n. Excavation, scraping, hauling, mixing, solidifying, and placement of CAMU Area soils and wastes and Eastside Areas contaminated soils and sludges.
  - o. Confirmation sampling, by Construction Manager, of completed Eastside Areas excavations.
  - p. Slit trench backfilling with engineered fill.
  - q. Slit trench waste excavation and placement
  - r. Slit trench PCB impacted material excavation, hauling, and off-site disposal in accordance with all state and federal regulations.
  - s. Placement of Interim cover
  - t. As-built preparation and submittal
2. Final Cover System– CAMU (Option Scope)
- a. Placement of interim cover.

- b. Prepared Subgrade.
  - c. Post-fill grade survey.
  - d. Liner installation, including: GCL, geomembrane, geocomposite, and final cover soil layer.
  - e. Drainage system installation, including: drainage pipes, drainage aggregate, and filter geotextile.
  - f. Aggregate base road
  - g. Storm water management features.
  - h. As-built preparation and submittal.
3. Final Cover –BMI Landfills
- a. Waste excavation.
  - b. Engineered fill.
  - c. Prepared subgrade,
  - d. Final cover installation, including: GCL, geomembrane, geocomposite, and cover soil.
  - e. As-built preparation and submittal.

### **1.03 MANDATORY SEQUENCE OF WORK**

A. Contractor shall follow the following mandatory sequences of work.

- 1. Contractor shall secure the CAMU perimeter and Eastside and CAMU staging areas with fencing and install security measures at the CAMU and Eastside Areas prior to starting any other physical work.
- 2. Contractor shall submit to the Construction Manager, for approval all required pre-Notice to Proceed submittals. Construction Manager approval is required prior to starting the work.
- 3. Erosion control best management practices, in accordance with Contractor's approved Surface Water Pollution Prevention Plan (SWPPP), shall be installed before any other soil surfaces are disturbed.
- 4. The Northwest Retention Basin shall be installed first, followed by the Northeast Retention Basin and associated storm drain piping and manholes before any clearing and grubbing commences on the CAMU site.
- 5. The western perimeter stormwater channels shall be excavated to the grades shown before any clearing and grubbing commences on the CAMU site.
- 6. Phase I shall be the first phase constructed and shall be 100% constructed and approved prior to placement of waste within the lined area and prior to commencing excavation of Phase II.
- 7. All decontamination areas and the vacuum station shall be established and constructed prior to any waste excavation or transport.

8. Western Ditch waste shall be excavated to provide operations layer material for Phase I before placement of any other waste within Phase I. Western Ditch excavation shall continue during Phase II excavation. Western Ditch soils shall be screen, if necessary for operations layer, and placed in Phase I.
9. Phase II shall be constructed immediately after Phase I and shall be 100% constructed and approved prior to placement of waste within the lined area.
10. Phases IIIA, IIIB, IV, and, V may be constructed concurrently with Phase II however, they must be completed in numerical order with each respective phase being 100% constructed and approved prior to placement of waste within the respective phased area.
11. Slit trench waste shall be excavated during Phase II cell construction and filling, with waste material placed in Phase I and Phase II of the CAMU. Slit trenches shall be backfilled and compacted as soon as Construction Manager approves of individual slit trench waste removal completion and Owner has conducted the post-excavation survey.
12. Concurrent with Slit Trench waste excavation, commence East Side Area waste excavation and transport to the CAMU
13. East Side Area waste excavation shall proceed in the following order with each preceeding area being 100% completed before proceeding to the next successive area.
  - a. Sewer line alignment within the Beta ditch
  - b. Parcel 7A.
  - c. Remainder of Beta Ditch.
  - d. Remainder of Eastside area with remediation proceeding from east to west. Hot spot areas identified through confirmation sampling that require excavation shall receive priority attention and shall be excavated and removed before excavating other wastes.

#### **1.04 DEFINITIONS**

- A. OWNER - The term Owner means Basic Remediation Company (BRC) for whom the Work is to be provided.
- B. CONSTRUCTION MANAGER – The term Construction Manager means the firm responsible for project administration and project documentation control (Weston Solutions, Inc). All formal documents shall be submitted to the Construction Manager for proper distribution and/or review. During the period of Work the Construction Manager shall act as an authorized representative of the Owner.
- C. DESIGN ENGINEER - The term Design Engineer(s) means the firm(s) responsible for the design and preparation of the Construction Documents and is the Engineer-of-Record for the project. The Engineer is responsible for approving all design changes, modifications, or clarifications encountered during construction. The Design Engineer reports directly to the Owner.
- D. CQA ENGINEER – The term CQA Engineer refers to the firm responsible for CQA related monitoring and testing activities. The CQA Engineer's authorized personnel shall include CQA Engineer-of-Record and Lead CQA Monitor. The CQA Engineer may also perform CQC work as appropriate. The CQA Engineer reports directly to the Owner.
- E. CONTRACTOR - The term Contractor means the firm that is responsible for the Work. The Contractor's responsibilities include the Work of any and all subcontractors and suppliers. The Contractor reports directly to the Construction Manager. All subcontractors report directly to the Contractor.

- F. SURVEYOR – The term Surveyor means the firm that shall perform field surveys and provide as-built Record Drawings for the Work. A Surveyor shall be employed by the Contractor to provide construction layout, as-built Record Drawings, base-line surveys, and quantity estimates. A third party Surveyor, employed and paid for by the Owner, will perform quality assurance checks of control points, as-builts, and quantities, as directed by the Construction Manager. The Surveyor shall be a Registered Land Surveyor, licensed to practice in the State of Nevada.
- G. SITE - The term Site refers to all approved staging areas, and all areas where the Work is to be performed, both public and privately owned.
- H. WORK - The term Work means the entire completed construction, or various separately identifiable parts thereof, required to be furnished under the Contract Documents. Work includes any and all labor, services, materials, equipment, tools, supplies, and facilities required by the Contract Documents and necessary for the completion of the project. Work is the result of performing services, furnishing labor, and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.
- I. DAY - A calendar day.
- J. CONTRACT DOCUMENTS - Contract Documents consist of all documents identified in the Agreement executed between the Owner and the Contractor.

## 1.05 REFERENCES

- A. ~~The Contractor is encouraged to familiarize itself with the following documents in preparing its bid. Unless otherwise noted, the documents are available on BRC's website at [www.landwelleo.com](http://www.landwelleo.com). Proceed to "Data Repository" under "Current".~~
- ~~1. Basic Remediation Company (BRC), 2006, "Community Involvement Plan (CIP)," November.~~
  - ~~2. BRC, 2006, "Corrective Action Plan (CAP) For The Basic Remediation Company (BRC) Common Areas Remediation Project," September.~~
    - ~~a. Appendix C: Dust Control and Mitigation Plan~~
  - ~~3. BRC, 2005, "Perimeter Air Monitoring Plan For Soil Remediation Activities BMI Upper and Lower Ponds and Ditches, Clark County, Nevada," April~~
  - ~~4. BRC, Environmental Resources Management (ERM), and Daniel B. Stevens & Associates (DBS&A), 2007, "BRC Closure Plan: BMI Common Areas, Clark County, Nevada," May.~~
  - ~~5. BRC, Geosyntec, ERM, 2007, "Draft: Remedial Alternative Study for the Slit Trench Area," July.~~
  - ~~6. BRC and MWH, 2005, "BRC CAMU area, 2005 soil, soil vapor, groundwater, and slit trench investigation report," October.~~
  - ~~7. Clark County Department of Comprehensive Planning, Land Use Planning, Land Use Permit No. UC 0389 06 dated May 10, 2006. (Provided in Bid Package)~~
  - ~~8. Daniel B Stephens & Associates, Inc (DBS&A), 2006, "Conceptual Site Model, Proposed CAMU Site, Henderson, Nevada," October.~~
  - ~~9. Geosyntec, 2007 "Construction Quality Assurance Plan for the Construction of the Corrective Action Management Unit, Basic Remediation Company, Henderson, Nevada," August.~~



- ~~10. Geosyntec, 2007. "Revised Remedial Action Plan (RAP) Permit Application for Corrective Action Management Unit (CAMU), Henderson, Nevada," Prepared for Basic Remediation Company, Submitted to Nevada Department of Environmental Protection, March.~~
- ~~11. Geotechnical & Environmental Services, Inc (GES), 2007, "Eastside Geotech Sampling, Henderson, Nevada," Prepared for Basic Remediation Company, October."Nevada Department of Environmental Protection, 2001, "Record of Decision: Remediation of Soils and Sediments in the Upper and Lower Ponds at the BMI Complex, Henderson, Nevada," November.~~
- ~~12. Nevada Department of Environmental Protection (NDEP), Permit for Hazardous Remediation Waste Management Activity, issued 24 September 2007. (Provided in Bid Package)~~
- ~~13. NDEP, 2007, "Record of Decision: Remediation of Soil in the Slit Trench Area of the BMI Common Areas, Henderson, Nevada," September.~~
- ~~14. NDEP, 2001, "Record of Decision: Remediation of Soils and Sediments in the Upper and Lower Ponds at the BMI Complex, Henderson, Nevada."~~
- ~~15. Nevada Department of Transportation (NDOT) Traffic Permit No. 91464 2006 dated 13 April 2006.~~
- ~~16. PBS&J, 2006, "Landwell Haul Route: Traffic Control Plan, Boulder Highway and Warm Springs Road intersection," Prepared for The Landwell Company, April.~~
- ~~17. PBS&J, 2006, "Technical Drainage Study for the Eastside Landfill," prepared for Basic Remediation Company, October.~~
- ~~18. Conceptual Drainage Study~~
- ~~19. Pond and Sludge Dewatering Studies:~~
  - ~~a. Hart Crowser, 2004, "Draft: Assessment of Geotextile Tube Dewatering Technology for Timet Ponds, Henderson, Nevada," Prepared for Basic Remediation Company, November.~~
  - ~~b. Pincock Allen & Holt, 2004 "Assessment of Geotextile Tube Dewatering Technology for Timet Ponds, Henderson, Nevada," Prepared for Basic Remediation Company, July.~~
  - ~~c. Ocean and Coastal Consultants, Inc, 2005, "Timet Ponds Drying Recommendations," April.~~

A. The Contractor is required to familiarize itself with the following documents in preparing its bid. These documents have been provided with the Contract Documents.

1. BRC, 2006. "Appendix C: Dust Control and Mitigation Plan, Corrective Action Plan (CAP) For The Basic Remediation Company (BRC) Common Areas Remediation Project," September.
2. BRC, 2005. "Perimeter Air Monitoring Plan For Soil Remediation Activities BMI Upper and Lower Ponds and Ditches, Clark County, Nevada," April
3. BRC, Geosyntec, ERM, 2007, "Draft: Remedial Alternative Study for the Slit Trench Area," July.
4. BRC and MWH, 2005, "BRC CAMU area, 2005 soil, soil vapor, groundwater, and slit trench investigation report," October.

5. Clark County Department of Comprehensive Planning, Land Use Planning, Land Use Permit No. UC-0389-06 dated May 10, 2006. (Provided in Bid Package)
  6. Geosyntec, 2007 "Construction Quality Assurance Plan for the Construction of the Corrective Action Management Unit, Basic Remediation Company, Henderson, Nevada," August.
  7. Geotechnical & Environmental Services, Inc (GES), 2007, "Eastside Geotech Sampling, Henderson, Nevada," Prepared for Basic Remediation Company, October."Nevada Department of Environmental Protection, 2001, "Record of Decision: Remediation of Soils and Sediments in the Upper and Lower Ponds at the BMI Complex, Henderson, Nevada," November.
  8. Nevada Department of Environmental Protection (NDEP), Permit for Hazardous Remediation Waste Management Activity, issued 24 September 2007. (Provided in Bid Package)
  9. Nevada Department of Transportation (NDOT) Traffic Permit No. 91464-2006 dated 13 April 2006.
  10. PBS&J, 2006, "Landwell Haul Route: Traffic Control Plan, Boulder Highway and Warm Springs Road intersection," Prepared for The Landwell Company, April.
- B. The Contractor is encouraged to familiarize itself with the following documents in preparing its bid. These documents have been provided with the Supplemental Documents
1. Basic Remediation Company (BRC), 2006, "Community Involvement Plan (CIP)," November.
  2. BRC, 2006. "Corrective Action Plan (CAP) For The Basic Remediation Company (BRC) Common Areas Remediation Project," September.
  3. BRC, Environmental Resources Management (ERM), and Daniel B. Stevens & Associates (DBS&A), 2007, "BRC Closure Plan: BMI Common Areas, Clark County, Nevada," May.
  4. Daniel B Stephens & Associates, Inc (DBS&A), 2006, "Conceptual Site Model, Proposed CAMU Site, Henderson, Nevada," October.
  5. Geosyntec, 2007. "Revised Remedial Action Plan (RAP) Permit Application for Corrective Action Management Unit (CAMU), Henderson, Nevada," Prepared for Basic Remediation Company, Submitted to Nevada Department of Environmental Protection, March.
  6. NDEP, 2007, "Record of Decision: Remediation of Soil in the Slit Trench Area of the BMI Common Areas, Henderson, Nevada," September.
  7. NDEP, 2001, "Record of Decision: Remediation of Soils and Sediments in the Upper and Lower Ponds at the BMI Complex, Henderson, Nevada."
  8. PBS&J, 2006, "Technical Drainage Study for the Eastside Landfill," prepared for Basic Remediation Company, October.
  9. Conceptual Drainage Study
  10. Pond and Sludge Dewatering Studies:
    - a. Hart Crowser, 2004, "Draft: Assessment of Geotextile Tube Dewatering Technology for Timet Ponds, Henderson, Nevada," Prepared for Basic Remediation Company, November.

- b. Pincock Allen & Holt, 2004 "Assessment of Geotextile Tube Dewatering Technology for Timet Ponds, Henderson, Nevada," Prepared for Basic Remediation Company, July.
- c. Ocean and Coastal Consultants, Inc, 2005, "Timet Ponds Drying Recommendations," April. "

#### **1.06 SUBMITTALS**

- A. The following shall be submitted prior to issuance of Notice to Proceed:
  - 1. Performance and Payment Bond
  - 2. Insurance Certificates
  - 3. Approved City of Henderson and Clark County Land-use permits
- B. The Contractor shall submit to the Construction Manager the CAMU Grading Permit and Eastside Area Grading Permit in accordance with Subpart 1.12 of this Section.

#### **1.07 CONTRACTOR QUALIFICATIONS**

- A. The Contractor, and all subcontractors, shall be licensed at the time of bidding, and throughout the period of the Contract, by the State of Nevada to do the type of work required under terms of these Contract Documents. By submitting a bid, the Contractor certifies that he is skilled, competent, and knowledgeable on the nature, extent and inherent conditions of the Work to be performed and has been regularly engaged in the general class and type of work called for in these Contract Documents and meets the qualifications required in these Specifications.
- B. By submission of a bid for this Project, the Contractor acknowledges that he is thoroughly familiar with the Site conditions.

#### **1.08 CONTRACTOR'S RESPONSIBILITIES**

- A. Start, layout, construct, and complete the Project in accordance with the Contract Documents.
- B. Provide a competent Site superintendent, capable of reading and understanding the Construction Documents, who shall receive instructions from the Construction Manager.
- C. Provide labor, construction supplies, equipment, tools, machinery, and other services and facilities necessary to properly execute and complete the work, and pay the cost thereof.
- D. Establish means, techniques, and procedures for constructing and otherwise executing the Work.
- E. Establish and maintain proper Health and Safety practices for the duration of the Project. The Contractor shall be responsible for health and safety of the personnel on site including: Contractor's personnel, Owner, Construction Manager and personnel, consultants, subcontractors, suppliers, and visitors. In particular, the Contractor shall account for site specific Health and Safety issues (hazards), including but not limited to waste excavation, heat, construction activities, etc.
- F. Pay cost of legally required sales, consumer, and use taxes and governmental fees.
- G. Perform Work in accordance with codes, ordinances, rules, regulations, orders, and other legal requirements of governmental bodies and public agencies bearing on performance of Work.
- H. Forward submittals and communications to the Construction Manager. Where applicable, the Construction Manager shall coordinate submittals and communications with the representatives who shall give approvals and directions through the Construction Manager.

CAMU Construction

Scope of Work  
Basic Remediation Company

- I. Maintain order, safe practices, and proper conduct at all times among Contractor's employees. The Construction Manager, and its authorized representative, may require that disciplinary action be taken against an employee of the Contractor for disorderly, improper, or unsafe conduct. Should an employee of the Contractor be dismissed from his duties for misconduct, incompetence, or unsafe practice, or combination thereof, that employee shall not be rehired for the duration of the Work.
- J. Coordinate the Work with the utilities, private utilities, and/or other parties performing work on or adjacent to the Site. Other parties include those responsible for construction management, construction quality assurance monitoring, air and dust monitoring, and conformance sampling. Other parties also includes Owner, utility representatives, regulatory agencies, and/or inspectors. Eliminate or minimize delays in the Work and conflicts with those utilities or contractors. Coordinate activities with the Construction Manager. Schedule private utility and public utility Work relying on survey points, lines, and grades established by the Contractor to occur immediately after those points, lines and grades have been established.
- K. Coordinate activities of the several trades, suppliers, and subcontractors, if any, performing the Work.
- L. The Contractor shall cooperate with all other parties engaged in project-related activities to the greatest extent possible. Disputes or problems shall be referred to the Construction Manager for resolution.
- M. The Contractor is responsible for becoming familiar with all aspects of the Work prior to performing the Work.
- N. The Contractor shall provide documentation for the following training for site personnel:
  - 1. All on-site personnel (except administrative staff):
    - a. 40 hour OSHA HAZWOPER training meeting 29 CFR 1910
    - b. 8 hour OSHA Refresher training meeting 29 CFR 1910
    - c. Respirator Fit Test
  - 2. All on-site supervisors:
    - a. 8 hour OSHA Supervisor training meeting 29 CFR 1910
    - b. Red Cross First Aid and CPR training
  - 3. Geosynthetic Material Installation Technicians
    - a. Qualifications and experience installing similar materials
  - 4. Landfill Manager
    - a. SWANA Manager of Landfill Operations Training

## **1.09 CONFORMANCE**

- A. Work shall conform to the Technical Specifications, CQA Plan, and Drawings that form a part of these Contract Documents.
- B. Omissions from the Technical Specifications, CQA Plan, and Drawings or the misdescription of details of Work which are necessary to carry out the intent of the Contract Documents are customarily performed, shall not relieve the Contractor from performing such omitted or

misdescribed details of the Work, but they shall be performed as if fully and correctly set forth and described in the Technical Specifications, CQA Plan, and Drawings.

#### **1.10 CONTRACTOR USE OF WORK SITE**

- A. Confine Site operations to areas permitted by law, ordinances, permits, and the Contract Documents. The Contractor shall ensure that all persons under his control (including Subcontractors and their workers and agents) are kept within the boundaries of the Site and shall be responsible for any acts of trespass or damage to property by persons who are under his control. Consider the safety of the Work, and that of people and property on and adjacent to work Site, when determining amount, location, movement, and use of materials and equipment on work Site.
- B. The Contractor shall be responsible for protecting private and public property including pavements, drainage culverts, electricity, highway, telephone, and similar property and shall make good of, or pay for, all damage caused thereto. Control of erosion throughout the project is of prime importance and is the responsibility of the Contractor. The Contractor shall provide and maintain all necessary measures to control erosion during progress of the Work to the satisfaction of the Construction Manager and all applicable laws and regulations, and shall remove such measures and collected debris upon completion of the project. All provisions for erosion and sedimentation control apply equally to all areas of the Work.
- C. Contractor shall promptly notify the Construction Manager in writing of any subsurface or latent physical conditions at the Site that differ materially from those indicated or referred to in the Contract Documents. Construction Manager shall promptly review those conditions and advise Owner in writing if further investigations or tests are necessary. If the Construction Manager finds that the results of such investigations or tests indicate that there are subsurface and latent physical conditions which differ materially from those intended in the Contract Documents, and which could not reasonably have been anticipated by Contractor, a Change Order shall be issued incorporating the necessary revisions.
- D. At no time shall Contractor interfere with operations of businesses on or in the vicinity of the Site. Should the Contractor need to work outside the regular working hours, the Contractor is required to submit a written request and obtain approval by the Construction Manager.

#### **1.11 EXISTING UTILITIES**

- A. The Contractor shall be responsible for locating, uncovering, protecting, flagging, and identifying all existing utilities encountered while performing the Work. The Contractor shall request that Underground Service Alert (USA) locate and identify the existing utilities. The request shall be made 48 hours in advance.
- B. The Contractor shall locate all overhead utilities that enter the construction boundary and locate these lines until they terminate or exit the site to ensure that no underground utilities originate from these overhead utilities. If underground utilities do originate from these overhead lines, the Contractor shall locate the underground utility until it terminates or exits the construction boundary.
- C. All located live underground utilities shall be put on the as-built drawings and staked 50 feet on center or marked with other equal physical markings, and shall be protected until all intrusive work is completed in the area. Markings shall indicate both the horizontal and vertical position of the utilities.
- D. The Contractor shall not proceed with any intrusive work at the East Side Area, the CAMU, any integrated peripheral property, the haul roads, including Boulder Highway and West Warm Springs Road, or any other discrete work area until the utility locates have been completed, the Contractor has requested authorization to proceed, and written approval is obtained from the Construction Manager.

- E. Where the work may encounter existing utilities:
  - 1. The Contractor shall de-energize the utilities. When this affects other utility users the Contractor shall make arrangements for alternate service if required.
  - 2. The Contractor shall determine and comply with the requirements of the utility owner for protection of that utility. The Contractor shall provide adequate advance notice to the utility owner, of work near an existing utility.
- F. When the Work requires the Contractor to be near or to cross locations of known utilities, the Contractor shall carefully uncover, support and protect these utilities and shall not cut, damage, or otherwise disturb them without prior authorization from the Construction Manager.
- G. Costs resulting from damage to utilities shall be borne by the Contractor. Costs of damage shall include repair and compensation for incidental costs resulting from the unscheduled loss of utility service to affected parties.
- H. The Contractor shall immediately stop work and notify the Construction Manager of all utilities encountered and/or damaged. The Contractor shall also Survey the exact location of any utilities encountered during construction.

#### **1.12 PRESERVATION OF SCIENTIFIC INFORMATION**

- A. Federal and State legislation provides for the protection, preservation, and collection of data having scientific, prehistoric, historical, or archaeological value (including relics and specimens) that might otherwise be lost due to alteration of the terrain as a result of any construction work. If evidence of such information is discovered during the course of the Work, the Contractor shall notify the Construction Manager immediately, giving the location and nature of the findings. Written confirmation shall be forwarded within two (2) working days.
- B. The Contractor shall exercise care so as not to damage artifacts uncovered during excavation operations, and shall provide such cooperation and assistance as may be necessary to preserve the findings for removal or other disposition by the Construction Manager or Government agency.
- C. Where appropriate, by reason of a discovery, the Construction Manager may order delays in the time of performance, or changes in the Work, or both. If such delays, or changes, or both, are ordered, the time of performance and contract price shall be adjusted in accordance with the applicable clauses of the Contract.

#### **1.13 ADDITIONAL REQUIREMENTS**

- A. **SURVEYING** - The Surveyor shall be employed by the Contractor to provide construction layout, as-built Record Drawings, base-line surveys, and quantity estimates. A third party Surveyor, employed and paid for by the Owner, will perform quality assurance checks of control points, as-builts, and quantities, as directed by the Construction Manager. Surveying shall be conducted such that all applicable standards required by the State of Nevada are in accordance with Section 01050 of these Specifications. The Surveyor shall be a Registered Land Surveyor, licensed to practice in the State of Nevada.
- B. **PERMITS** – The following permits shall be obtained by the Owner and Contractor for the Work.
  - 1. The Owner will provide the following permits:
    - a. Remedial Action Plan (RAP) Permit, Nevada Department of Environmental Protection; and

- b. Traffic – District Permit No. 91464-2006, obtained from NDOT for allowing material haulage across Boulder Highway with up to 120 ton haul trucks permitted. Permits for use of Warm Springs Road and Boulder Highway crossing shall be supported with the provided Traffic Control Plan as necessary. The Traffic Control Plan describes changes to the signaling procedures at the Boulder Highway/Warm Springs interchange, as well as the presence of flagmen and other temporary traffic control procedures as necessary. Additional requirements for public haul roads are in specified in Section 01500.
  - c. CAMU Land Use Permit, Clark County, Department of Comprehensive Planning, Land Use Planning Permit No. UC-0389-06.
2. The Contractor shall be required to obtain permits in accordance with construction of the facility. Permits include:
- a. Dust Control Permit – Obtained from the Air Pollution Control Division of the Clark County Health District. Owner shall provide Contractor with Dust Control Mitigation Plan and Perimeter Air Monitoring Plan outlining procedures for Dust Control Permit compliance.
  - b. Zero-Discharge Permit - If deemed appropriate by the Bureau of Water pollution, “Zero Discharge” permits shall be obtained to address temporary ponds associated with remediation (i.e., decontamination rinse water, TIMET pond dewatering).
  - c. Traffic – The Contractor shall obtain a Traffic Permit for use of West Warm Springs Road. The Permit shall be supported with the provided Traffic Control Plan as necessary. The Traffic Control Plan describes changes to the signaling procedures at the Boulder Highway/Warm Springs interchange, as well as the presence of flagmen and other temporary traffic control procedures as necessary. Additional requirements for public haul roads are in specified in Section 01500.
  - d. Eastside Grading – Contractor shall file and receive a grading permit for the Eastside areas with the COH based on the approved Conceptual Drainage Study (CDS) provided by the Owner.
    - i. Contractor shall ensure the 100-year storm flows shall not increase or be redirected from the current condition established in the approved CDS.
    - ii. Contractor shall ensure interim site conditions shall not increase or redirect flows from current conditions.
  - e. CAMU Grading – The Contractor shall apply for the CAMU grading permit from Clark County. The Owner shall provide to the Contractor the following:
    - i. Technical Drainage Study (TDS)
    - ii. Improvement Plans
    - iii. Comments and Approval from the building department
  - f. Land-use Permit - Within 10 business days of project award, the Contractor shall submit, to the Construction Manager, a completed project specific City of Henderson/Clark County Land Use Permit that covers all work required for this project. The Land Use Permit will subsequently be submitted by the Construction Manager to the Landwell Design Review Committee for review and approval. Once approved by the Design Review Committee, the Owner will submit the Land Use Permit to the City of Henderson for review and approval. The Contractor shall expect that the review and approval process, from the time the Contractor submits the Land Use Permit to final

approval by the City of Henderson, will take approximately 4 weeks. A Notice to Proceed will not be issued before final approval of the Land Use Permit.

- C. **SEDIMENTATION, EROSION CONTROL, AND DEWATERING** - Contractor shall comply with all laws, ordinances, and permits for controlling erosion, water pollution, and dust emissions resulting from construction activities; the Contractor shall be responsible for any fines imposed due to noncompliance. The Contractor shall prepare and perform work in accordance with the Storm Water Pollution Prevention Plan (SWPPP) in accordance with Section 01100 Subpart 3.08 of these Specifications. Stormwater shall be handled in accordance with SWPPP. SWPPP shall address disposal of contaminated stormwater by off site disposal or as dust control over waste placed in lined areas of the CAMU. Contaminated stormwater is defined as water that contacts waste materials, water collected from sumps, and stormwater removed from waste excavations. Contaminated stormwater shall not be used for dust control on clean, interim or final cover.
- D. **PROTECTION OF EXISTING WELLS** - The Contractor shall exercise care to avoid disturbing or damaging the existing monitor wells that are to remain in place. All wells damaged by the Contractor shall be immediately repaired by the Contractor to the satisfaction of the Construction Manager at no additional cost.
- E. **WORKING HOURS** - Contractor shall establish normal working hours and notify Construction Manager when work is scheduled outside of those hours. Available working hours are 24 hours a day, 7 days a week, with restricted work hours for the following:
  - 1. 7 pm to 6 am: use of non-highway approved trucks up to 120 tons gross weight are allowed for use to haul waste materials from the Eastside Area to the CAMU, crossing Boulder Highway, in accordance with Nevada Department of Transportation (NDOT) permit 91464-2006 obtained by the Owner.
  - 2. Work which creates noise in excess of limits specified in Section 01560 shall be restricted during hours specified in that Section.
- F. **BURNING** - The use of open fires for any reason is prohibited.
- G. **TEMPORARY ROADS** - The Contractor shall be responsible for constructing and maintaining all temporary roads and lay down areas that the Contractor may require in the execution of the Work in accordance with Section 01500.
- H. **CONSTRUCTION WATER** - The Contractor shall obtain and pay for water from the City of Henderson Utilities Division for construction and dust control..
- I. **SAFEGUARDS** - The Contractor shall provide and use all personnel safety equipment, barricades, guardrails, signs, lights, flares, and flagmen as required by OSHA, state, or local codes and ordinances.
- J. **SECURITY** - The Contractor is responsible for 24-hour site security and the safety and condition of all of his tools and equipment. The Contractor shall maintain security in accordance with Section 01100, Part 3.07.
- K. **ACCEPTANCE OF WORK** - The Contractor shall retain ownership and responsibility for all Work until Substantial Completion has been issued by Construction Manager.

## **PART 2 – PRODUCTS**

[NOT USED]



## **PART 3 – EXECUTION**

### **3.01 CONSTRUCTION DRAWINGS**

- A. Three sets of construction drawings comprise the Construction Drawings:
  - 1. Construction Drawings, Basic Remediation Company, Corrective Action Management Unit, Henderson, Nevada, August 2007 – prepared by Geosyntec Consultants, dated August 2007.
  - 2. Improvement Plans for Eastside Landfill – prepared by PBS&J, dated October 2006.
  - 3. Improvement Plans for Eastside Common Area Remediation- prepared by PBS&J, dated August 2007.
- B. Dimensions shown on the drawings take precedence over scaled dimensions. Large-scale details have precedence over smaller scale.

## **PART 4 – MEASUREMENT AND PAYMENT**

[NOT USED]

[END OF SECTION]

**SECTION 01025**  
**MEASUREMENT AND PAYMENT**

**PART 1 – GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. This section covers measurement and payment criteria applicable to the Work performed under lump sum and unit price payment methods, and non-payment for rejected work.

**1.02 RELATED SECTIONS**

- A. This section relates to all other sections of the contract.

**1.03 SUBMITTALS**

- A. Comply with pertinent provisions of Section 01300, "Submittals."
- B. With each request for payment, the Contractor shall submit supporting information as necessary to justify the payment request as specified elsewhere throughout these specifications.
- C. Weight tickets when measurement for payment is by weight.

**1.04 AUTHORITY**

- A. Measurement methods delineated in the individual specification sections are intended to complement the criteria of this section. In the event of conflict, the requirements of the individual specification section shall govern.
- B. A surveyor, licensed in the State of Nevada, hired by the Contractor shall take all measurements. All measurements, cross-sections and quantities shall be stamped and certified by the licensed surveyor and submitted to the Construction Manager. The Construction Manager maintains the right to provide additional measurements and calculation of quantities to verify measurements and quantities submitted by the Contractor.

**1.05 GENERAL**

- A. Undefined items shall be included in the closed related item on the Bid Schedule.

**1.06 LUMP SUM ITEMS**

- A. Lump-sum measurement will be for the entire item or unit of work, or combination thereof, as specified and as indicated in the Bid Schedule of the Bid Form.
  - 1. If the Contractor requests progress payments for lump-sum items or amounts in the Bid Schedule, such progress payments will be made in accordance with a well-balanced, detailed program of payment-apportioning, prepared by the Contractor and submitted to the Construction Manager for approval.
  - 2. Such program for each applicable lump-sum item shall show fixed definable and measurable quantities where possible and unit prices therefore as developed and assigned by the Contractor to the different features of the work and major subdivisions thereof. The summation of extensions of quantities and unit prices and related costs shall equal the amount of the lump-sum bid item indicated on the Bid Schedule.
  - 3. Following the Construction Manager's approval, progress payments will be made in accordance with the Contractor's payment-apportioning program and from the approved

progress schedule, reflecting the progress which occurred during the payment period as approved by the Construction Manager.

## **1.07 UNIT PRICE ITEMS**

### **A. Values of Unit Prices:**

1. The number of units and quantities in the Bid Schedule as estimated quantities are approximate only, and final payment will be made for the actual number of units and quantities which are incorporated in the Work and required by the Contract.

### **B. Measurement Standards:**

1. All work to be paid for at Contract price per unit measurement, as indicated in the Bid Schedule, will be measured by the Surveyor and verified by the Owner in accordance with United States Standard Measures.

### **C. Measurement by Volume:**

1. Measurement by volume will be by the cubic dimension indicated in the Bid Schedule. Method of volume measurement will be by the unit volume in place or removed as specified.
2. Measurement shall be by the cubic dimension using mean lengths, widths and heights or thickness, or by average end area method as measured by Contractor's surveyor and as verified by Owner's surveyor as appropriate. All measurement shall be the difference between the original ground surface and the design ("neat-line") dimensions and grades.
3. Quantities and measurements indicated in the Bid Schedule are for bidding and contract purposes only. Quantities and measurements supplied or placed in the Work and verified by the Construction Manager shall determine payment. If the actual work requires more or fewer quantities than those quantities indicated, the Contractor shall provide the required quantities at the lump sum and unit prices contracted unless modified elsewhere in these Contract Documents.

### **D. Measurement by Area: measurement by area will be by the square dimension shown as specified. Measurement shall be by the square dimension using mean lengths and widths and/or radius as measured by Contractor's surveyor and as verified by Owner's surveyor as appropriate. All measurement shall be the difference between the original ground surface and the design ("neat-line") dimensions and grades.**

### **E. Linear Measurement: linear measurement will be by the linear dimension listed in the Bid Schedule. Unless otherwise indicated, items, components, or work to be measured on a linear basis will be measured at the centerline of the item in place.**

## **1.08 PAYMENT**

- A. Payment includes full compensation for all required labor, products, tools, equipment, transportation, services and incidentals; erection, application or installation of an item of the Work; and all overhead and profit. Final payment for Work governed by unit prices shall be made on the basis of the actual measurements and quantities accepted by the Construction Manager multiplied by the unit price for Work which is incorporated in or made necessary by the Work.
- B. A monthly progress payment schedule shall be used to compensate the Contractor for the Work. The monthly amount to be paid to the Contractor is calculated as the percent of completed work for each bid item multiplied by the total anticipated work for that bid item.

## **1.09 NON-PAYMENT FOR REJECTED PRODUCTS**

A. Payment shall not be made for any of the following:

1. Products wasted or disposed of in a manner that is not acceptable.
2. Products determined as unacceptable before or after placement.
3. Products not completely unloaded from the transporting vehicle.
4. Products placed beyond the design lines, dimensions, grades and levels of the required Work.
5. Products remaining on hand after completion of the Work.
6. Loading, hauling, and disposing of rejected Products.
7. Products rejected because of contamination (i.e. soil residues, fuel spills, solvents, etc.).

## **1.10 BID ITEMS**

A. The bid items provided in the Bid Schedule shall be used by the Construction Manager and Contractor to bid the Work described in these bid documents.

B. The bid schedule is broken into four categories for the measurement and payment of the Work:

1. Base Items: Bid items comprising Phases I through V of CAMU construction, Interim CAMU cover placement, storm water controls, and cover construction for the North and South BMI Landfills
2. Option Scope Items: Construction of the final CAMU cover system and associated storm water management features overlying the CAMU will be held as Option Scope items that may be added to the contract via Contract Modification at the Owner's sole discretion.
3. Alternative Added/Deleted Items: Bid items including costs associated for additional waste placement greater than 15 percent of initial engineer's estimate. Costs provided in this table shall be Contractor's hourly labor rate and fleet vehicle hourly rates. Contractor shall provide two vendors' rental quotes for equipment used but not listed in the bid schedule. The lesser of the two quotes shall be the daily cost for payment.
4. Alternative Standby Items: Bid items to be used to calculate standby costs. Costs provided in this table shall be fleet vehicle daily rates. If rental equipment is used or if equipment used is not listed in the bid schedule, the Contractor shall provide documentation of two vendor rental quotes and the lesser of the two quotes shall be the daily cost for payment.

C. Incidentals to be included in bid items are described in the associated Section.

## **PART 2 – PRODUCTS**

[NOT USED]

## **PART 3 – EXECUTION**

[NOT USED]

## **PART 4 – MEASUREMENT AND PAYMENT**

[NOT USED]

[END OF SECTION]

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**SECTION 01050**  
**FIELD ENGINEERING**

**PART 1 – GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. This section covers field surveys, contractor design (not including shop drawing designs), as-built documentation, and locations of sampling and testing points.
- B. The Owner shall provide 3rd party quality assurance surveying to verify as-built documentation based on control points and to provide measurement for payment.
- C. The Contractor shall perform all surveying work to complete the Project except where survey work is specifically indicated in the Contract documents to be the Owner's responsibility.
- D. Costs for replacement by the Construction Manager of Construction Manager-established reference monuments damaged or destroyed by the Contractor shall be charged to the Contractor at the actual cost of labor, materials, supplies, and equipment to repair or replace such damaged or destroyed Construction Manager-established monuments and reference points.

**1.02 RELATED SECTIONS**

Section 01100—Project Meetings and Procedures

Section 01300—Submittals

Section 01400—Quality Control

Section 01500—Construction Facilities

Section 01560—Temporary Controls

Section 02200—Earthwork

Section 02205—Remedial Excavating and Filling

**1.03 SUBMITTALS**

- A. Contractor shall submit documentation verifying surveying field supervisor is a Registered Land Surveyor in the State of Nevada.
- B. Original field books and electronic data not related to pay requests.
- C. Survey data and drawings of all sampling and testing location information shall be submitted to the Construction Manager showing coordinates and elevations. Horizontal coordinates shall be within  $\pm 1.0$  foot and vertical locations shall be within  $\pm 0.1$  foot.
- D. Survey information, drawings, survey data reductions, and calculations used to calculate the progress pay estimate quantities to the Construction Manager with each request for progress payment. Survey information shall include copies of original field books and electronic data.

- E. Survey data for final payment for applicable work: The Contractor shall reduce the field notes and calculate final quantities for payment purposes. Documentation shall bear the seal and signature of a Nevada Registered Land Surveyor. Specific submittals include:
  - 1. Measurement or survey field books or field notes, including original field books, electronic data, and note reductions. Field books or notes shall include signatures of all personnel participating in the survey or measurements.
  - 2. Measurement drawings, topographic survey drawings, and cross-section drawings.
  - 3. Calculation sheets used to derive an actual quantity. Each calculation sheet shall clearly indicate the subject, calculations, totals, date, and signature of author.
- F. Written notification to Construction Manager of any survey work or layout work to be done.
- G. Survey as-built data.

#### **1.04 QUALITY ASSURANCE**

- A. The Contractor shall provide experienced construction surveyors. All survey and layout work, and work quantity estimate documentation performed by the Contractor shall be performed under the supervision and direction of a Land Surveyor licensed in the State of Nevada with a minimum of 3 years responsible charge of construction surveys for construction work similar in nature to that required by the Project. The Contractor shall maintain sufficient qualified personnel to perform required surveying work, including having a Registered Land Surveyor in the field overseeing the survey crew(s) at all times that survey work is performed.
- B. The Contractor instruments and other survey equipment shall be accurate, suitable for the surveys required in accordance with recognized professional standards, and in proper condition and adjustment at all times. Any equipment found to be inaccurate (beyond allowable tolerances) or defective shall immediately be repaired or removed from the work site by the Contractor.
- C. Contractor shall establish three reference points at the Eastside Area and an additional three reference points at the CAMU area for project control by QA/QC Survey.

#### **PART 2 – PRODUCTS**

[Not Used]

#### **PART 3 – EXECUTION**

##### **3.01 FIELD SURVEYS**

- A. Field Surveys, at a minimum, shall be performed:
  - 1. initially before any soil disturbance at the CAMU and Eastside,
  - 2. for verification of the final surface at the CAMU Detention Basin and Equilizer Basin,
  - 3. for verification of subgrade, base grade, and final finish grades of East and West CAMU Drainage Channels,
  - 4. for as-built conditions of CAMU Storm Drain
  - 5. for verification of excavated surfaces at Eastside,
  - 6. after slit trench excavations, prior to backfilling,

7. each successive excavated surface that needs to be excavated after conformance sampling,
8. phased liner subgrade at CAMU,
9. for as-built conditions of installed geomembrane showing panel corners, and the location of all recorded defects and repairs,
10. interim waste surface, monthly, at CAMU,
11. final waste surface at CAMU,
12. final interim cover surface,
13. final geosynthetic CAMU and North and South BMI Landfill cover subgrade,
14. final cover surfaces at CAMU and North and South BMI Landfills, and
15. final condition of all site areas disturbed.

B. Electronic survey data submittals shall consist of the following:

1. Hard copy printouts from survey data collector with observations and position of points showing coordinates and elevations.
2. Copy of field books used during data collection.
3. Electronic file of all points used in volume calculations in ASCII format.
4. Electronic files of all drawings in AutoCAD, 2007 format or better, or in a DXF format that can be converted to AutoCAD.
5. Electronic files shall be delivered to the Construction Manager on compact disk.
6. Hard copies of all drawings, cross-sections, and other information generated during survey data collection, including drawings that show control points used for each survey.

C. The Contractor shall utilize 50 foot by 50 foot design grid system provided by Construction Manager during construction. ~~Construction Manager shall provide additional points for visible grade changes and at other significant locations that are not located on the grid system.~~ All initial surveys and grade changes will be based on this grid system. The design grades shall be verified based on this system.

D. Data gathered from incremental surveys performed of a respective surface (liner subgrade, Eastside remediated surfaces, final waste surface at CAMU, etc.) shall be combined and coordinated into a single cumulative composite drawing file that presents the entire surface as it is incrementally developed.

E. The Contractor shall establish the final grade for backfill work by resurveying and staking the grid system points. The Contractor survey work shall demonstrate that drainage patterns have not changed, unless changes were specifically authorized by the Construction Manager. Where it is practical, the Contractor may propose alternate methods for establishing original and final grades within small excavation areas. Such alternate methods shall be approved by the Construction Manager prior to commencing the survey.

F. Horizontal coordinates shall be within  $\pm 1.0$  ft and vertical locations shall be within  $\pm 0.1$  ft.



- G. The Contractor shall conduct such other surveys as are required to calculate payment quantities, document completion of a phase of excavation or backfill, or other documentation required for a complete record of Project activities and actions.
- H. The Construction Manager may at any time use line and grade points and markers established by the Contractor. The Contractor's surveys are a part of the work and may be checked by the Construction Manager. The Contractor shall be responsible for any lines, grades, or measurements which do not comply with specified or proper tolerances, or that are otherwise defective, and for any resultant defects in the work. The Contractor shall be required to conduct resurveys or check surveys to correct errors.
- I. The Contractor shall establish lines and grades necessary to control the work, and shall be responsible for measurements for execution of the work prescribed in these specifications or on the drawings. The Contractor shall establish, place, and replace stakes, markers, and other monuments for survey control, interim checks, and guidance of construction operation.
- J. The Contractor shall provide all materials and equipment for performing survey work, including, but not limited to instruments, stakes, spikes, steel pins, templates, and tools. Except for material that is to be incorporated in the work or left in place, all such materials and equipment shall remain property of the Contractor.
- K. Before commencing any layout of work and surveys, the Contractor shall provide written notice to the Construction Manager so the Construction Manager may witness or independently check such work.
- L. Prior to commencing excavation on existing ditch lines, and/or culverts planned for removal and replacement, a survey of existing features shall be performed by the Contractor. The survey shall be used as a control to establish the ditch/culvert alignment during reconstruction. The survey shall be sufficiently accurate to allow reinstalled and/or replacement ditches, or culverts to perform in a manner that is hydraulically equivalent to the original ditches, or culverts.
- M. On a monthly basis, the Contractor shall provide survey data to the Construction Manager on the excavation and backfill production during the previous month.
- N. Copies of all surveying notes and drawings prepared by the Construction Manager for verification of Contractor surveys shall be made available to the Contractor, when requested.
- O. The Contractor shall secure all field measurements required for proper and accurate fabrication and installation of the work included in this Contract. Exact measurements are the Contractor's responsibility. The Contractor shall furnish or obtain all templates, patterns, and setting instructions required for the installation of all work. All dimensions shall be verified by the Contractor by survey in the field.
- P. Unless otherwise stated in these Specifications, or by Construction Manager approval, tolerances in layout of work shall not exceed the following:

TYPE OF LINE OR MARK	HORIZONTAL POSITION	ELEVATION
Permanent reference points	1 in 10,000	± 0.02 ft.
Reference points for general excavation and earthwork	1 in 2,000	± 0.10 ft.

- Q. The Construction Manager shall perform sufficient field surveys to verify that the Contractor's field survey work is within acceptable tolerances and accurately depicts requirements of the drawings and these specifications. In the event that the Construction Manager's survey differs from the Contractor's survey, the Construction Manager's survey shall govern.
- R. The use of aerial survey for quantity determination shall not be allowed on this Project. All survey work shall be performed with land survey methods that have been approved by the Construction Manager.

## **PART 4 – MEASUREMENT AND PAYMENT**

### **4.01 GENERAL**

- A. No separate measurement or payment shall be made for requirements of this section. Full compensation for conforming to such requirements shall be included in the price bid for Bid Schedule Items of Work and no additional compensation shall be allowed.

[END OF SECTION]

## **SECTION 01100**

### **PROJECT MEETINGS AND PROCEDURES**

#### **PART 1 – GENERAL**

##### **1.01 SCOPE**

- A. This section covers preconstruction meeting, project meetings, regulatory oversight, community relations, site security, permits, final inspection, and project record documents

##### **1.02 RELATED SECTIONS**

Section 01010—Summary of Work

Section 01050—Field Engineering

Section 01300—Submittals

Section 01560 – Temporary Controls

##### **1.03 REFERENCES**

- A. Geosyntec, 2007. “Revised Remedial Action Plan (RAP) Permit Application for Corrective Action Management Unit (CAMU), Henderson, Nevada,” Prepared for Basic Remediation Company, Submitted to Nevada Department of Environmental Protection, March.
- B. Basic Remediation Company (BRC), 2006, “Community Involvement Plan (CIP),” November.
- C. BRC, 2006. “Corrective Action Plan (CAP) For The Basic Remediation Company (BRC) Common Areas Remediation Project,” September.
- D. BRC, 2005. “Perimeter Air Monitoring Plan For Soil Remediation Activities BMI Upper and Lower Ponds and Ditches, Clark County, Nevada,” April
- E. Clark County Department of Comprehensive Planning and U.S. Fish and Wildlife Service, 2000, “Clark County Multiple Species Habitat Conservation Plan (CCMSHCP),” September.

##### **1.04 SUBMITTALS**

- A. Comply with pertinent provisions of Section 01300, "Submittals"
- B. The following shall be submitted prior to issuance of Notice to Proceed:
  - 1. Site Security Plan: The Site Security Plan shall describe the type and number of personnel and the system to be used to ensure that access to the site is restricted to authorized personnel only. The Construction Manager shall review the Plan and return it to the Contractor with comments or approval 5 days after receiving the Plan. The Contractor shall obtain Site Security Plan approval from the Construction Manager prior to beginning any work at the site.
  - 2. Storm Water Pollution Prevention Plan
- C. The Contractor shall submit the following to the Construction Manager daily:
  - 1. Progress Reports
  - 2. Inspection Checklists

- D. The Contractor shall submit weekly inspection reports to the Construction Manager
- E. The Contractor shall submit the following to the Construction Manager monthly:
  - 1. Status Report
  - 2. Inspection Checklist
- F. The Contractor shall submit monthly inspection reports to the Construction Manager
- G. Within 24-hours after a storm event, the Contractor shall submit to the Construction Manager a post-storm inspection checklist
- H. The Contractor shall submit to the Construction Manager incident reports as needed within 24-hours of the incident occurrence.
- I. Job Set of Project Record Documents
- J. If the Work discussed in these Specifications is interrupted for reasons other than inclement weather, the Contractor shall notify the in writing Construction Manager a minimum of 24 hours prior to the resumption of Work.

## **PART 2 – PRODUCTS**

### **2.01 NOT USED**

## **PART 3 – EXECUTION**

### **3.01 PRECONSTRUCTION MEETINGS**

- A. Construction Manager shall arrange a preconstruction meeting with the Contractor within 21 days of notice of award and before receipt of Notice to Proceed (NTP). The preconstruction meeting shall be required prior to issuing NTP.
- B. Authorized representatives of the Contractor, including the Bid Preparer, Project Manager, and On-Site Superintendent shall attend the preconstruction meeting.
- C. Data shall be distributed and/or discussed as necessary by the Construction Manager or Contractor as appropriate. The Project site shall be toured with the Contractor representative present, and at the least, the following items shall be addressed.
  - 1. Organizational arrangement of the forces and personnel, and those of the Contractor, the material and equipment suppliers, Subcontractors, and the Construction Manager.
  - 2. Procedures and protocol for Project communication.
  - 3. Contractor's mobilization schedule. The Contractor shall discuss how equipment, personnel, materials, etc., are to be mobilized throughout this Project and the effects of mobilization on the construction schedule.
  - 4. Construction schedule, work hours, planned overtime, and sequence of work.
  - 5. A narrative of the Contractor's general method of approach for each sequence of the work.
  - 6. Processing of shop drawings, submittals, and other data for Construction Manager for review.
  - 7. Procedures for Field Directives and Change Orders.

8. Rules and regulations governing performance of the work.
9. Training requirements.
10. Procedures for safety and first aid, security, quality control, housekeeping, and related matters.
11. Work quantity measurement and payment request procedures.

### **3.02 PROJECT MEETINGS**

- A. Weekly construction progress meetings shall be conducted between the Construction Manager and Contractor. The Contractor's Project Manager shall attend these construction meetings. The meeting shall be conducted at the Project support facilities area and the time shall be coordinated between the Construction Manager and Contractor.
- B. At a minimum, the following items shall be discussed at the weekly meetings.
  1. Review of applicable specifications.
  2. Review of safety issues.
  3. Required equipment and personnel.
  4. Weekly progress and production.
  5. Two-week look-ahead schedule.
- C. Major Construction Activity meetings shall be conducted between the Construction Manager and Contractor prior to starting each general sequence of construction. Meetings will be conducted prior to each of the following major construction activities
  1. Storm water collection system
  2. CAMU excavation and embankment placement
  3. Liner system installation
  4. Remedial waste excavation and transport and filling
  5. Slit Trench excavation
  6. Cover installation

These meetings may be combined with other Project meetings with the mutual consent of the Construction Manager and Contractor. The intent of these meetings is to review and discuss specification requirements for that particular construction activity. A "dry run" walkthrough of major process may be required prior to starting each sequence, if deemed appropriate by the Construction Manager. The meetings shall assess, as examples

1. Specification Requirements
2. Adequacy of planning and procedures.
3. Availability of equipment, personnel, and materials.
4. Safety, emergency preparedness, and hazard analysis.
5. Regulatory compliance.

The results of these meetings shall be formally documented by the Construction Manager and the applicable portions shall be provided to the Contractor. The Contractor shall address any identified concerns prior to the start of the reviewed work activity.

- D. Plan of the Day (POD) Meetings: The Construction Manager shall hold daily planning meeting that will not exceed 1 hour. Daily planning meetings shall be attended by the Contractor's Project Manager, Operations Superintendent, Project Engineer, and Health and Safety Manager. The Quality Assurance Manager attendance at the POD meetings is optional. The Contractor shall provide a list of all activities planned for the next day. If changes to the daily plan are necessary, the Contractor shall verbally notify the Construction Manager Project Manager as soon as need for the change is identified by the Contractor. The intent of the meeting will be to discuss issues, concerns, and resolutions encountered during the day and the work plan for the next day.
- E. Problem or Work Deficiency Meetings: A special meeting shall be held when and if a problem or deficiency is present or likely to occur. The meeting shall be attended by the Contractor, the Construction Manager, the CQA Site Manager, and other parties as appropriate.

### **3.03 PROJECT REPORTING AND RECORDKEEPING**

- A. The Contractor shall provide the following records to the Construction Manager daily:
  - 1. Daily progress reports documenting daily construction activities. Records include:
    - a. Date, Project Name, Location, and other Identification;
    - b. Summary of weather conditions;
    - c. Summary of construction location(s) and activities;
    - d. Daily production records;
    - e. Equipment and personnel on the project; and
    - f. Meeting summary and attendance record.
  - 2. Inspection Checklist documenting: health and safety, haul roads, surface and storm water, waste placement, security, equipment.
- B. The Contractor shall provide inspection checklists to the Construction Manager weekly:
- C. The Contractor shall provide the following records to the Construction Manager monthly:
  - 1. Inspection Checklist documenting: health and safety, haul roads, surface and storm water, waste placement, security, equipment.
  - 2. Monthly status report summarizing:
    - a. Significant milestones in construction;
    - b. Completed milestones in construction;
    - c. Estimated volumes of soil excavation, engineered fill, waste excavation and disposal or placement in CAMU, operations layer, interim cover, and final cover;
    - d. Estimated quantity of liner system components delivered to the project and/or installed.
- D. The Contractor shall provide inspection checklists to the Construction Manager quarterly:
- E. The Contractor shall provide the following record to the Construction Manager post-storm:

1. Inspection Checklist documenting: health and safety, haul roads, surface and storm water.
- F. The Contractor shall provide incident reports to the Construction Manager as-needed. Incident reports shall summarize all incidents of: injury, fire, shut down, and/or hazardous or toxic Materials Release. The summary report shall include:
- a. Date, time, and type of incident;
  - b. Name and quantity of material(s) involved;
  - c. Assessment of actual or potential hazards to human health or the environment, where applicable; and
  - d. Estimated quantity and disposition of recovered material that resulted from the incident.
- G. The Contractor shall maintain all personnel records onsite and shall make records available to Construction Manager upon request. Records include:
1. Name of the employee filling each position
  2. A written job description including: requisite skill, education, or other qualifications
  3. Assigned duties of employee
  4. Description of training
  5. Records documenting completion of training.

### **3.04 REGULATORY OVERSIGHT**

- A. Authorized agents of the Nevada Department of Environmental Protection (NDEP), Nevada Department of Transportation (NDOT), Clark County, the City of Henderson, and other agencies designated by the Construction Manager shall have right of access to inspect the work covered by the Contract documents during the performance of this Contract. These inspections shall be performed in conjunction with an inspection by the Construction Manager. The Construction Manager shall coordinate inspections with the Contractor.

### **3.05 COMMUNITY RELATIONS**

- A. BRC has developed a Community Involvement Plan (CIP) that shall be made available to the Contractor. The Contractor is expected to facilitate relations with the community to the extent possible during the duration of the Project. The Contractor shall encourage employee participation in community activities, encourage relocation to the community during the Project, and discourage problematic employee behavior. The Contractor shall direct public inquiries to the Construction Manager and shall provide information necessary to respond to public inquiries as requested by the Construction Manager.

### **3.06 ENDANGERED SPECIES**

- A. In accordance with the CCMShCP and the RAP, the Contractor shall contact the City of Henderson if a desert tortoise (*Gopherus agassizii*) is encountered at the BMI Common Areas during construction.
- B. The Contractor shall protect any desert tortoises encountered on Site until the City of Henderson is available to relocate the tortoise off site.

### 3.07 SITE SECURITY

- A. The Contractor shall protect the work and control the site for the duration of the Project, except that control of the project site shall not become the responsibility of the Contractor until the effective date of the Notice to Proceed. Site security, including manned patrols during non-work hours, shall be maintained 24 hours per day, 7 days per week, including shutdown periods.
- B. The Contractor shall submit a Site Security Plan. The Contractor shall identify a primary representative and an alternate representative responsible for day-to-day functions associated with site security. This plan shall be in accordance with the following minimum security requirements outlined in the CAP and RAP for the Eastside and CAMU areas, respectively:
  - 1. Eastside:
    - a. Security shall be 24 hours/day, 7 days a week
    - b. Continuously manned guard station shall be established at site entrance
    - c. Gates shall be kept locked except for periods of continuous ingress/egress
    - d. Fences shall be installed and maintained around exclusion zones
    - e. Visitors shall use sign in/sign out log
    - f. Visitors shall not be allowed in exclusion zone.
  - 2. CAMU:
    - a. Contractor shall establish 24 hours/day, 7 days/week security either with full-time on-site personnel during non manned hours or using remote video equipment
    - b. Contractor shall provide continuously manned guard station at site entrance during working hours.
    - c. Contractor shall be responsible for daily policing of site perimeter
    - d. Contractor shall establish continuously manned guard station at CAMU entrance
    - e. Gates shall be kept locked except for periods of continuous ingress/egress
    - f. Fences shall be installed and maintained around site perimeter.
    - g. Contractor shall report any security problems to the Construction Manager
- C. Communication: Security guards shall have mobile phones and two-way radios as specified in Section 01500.
- D. Exterior Fence Signage:
  - 1. Owner will install and maintain signs for exterior fences at Eastside Area.
  - 2. Contractor shall install and maintain "Danger. Construction Area. No Trespassing" bilingual signs at 100 foot intervals along the CAMU perimeter fence. Signs shall be 18 inch x 12 inch aluminum with red or black 1-inch lettering.
- E. Visitor Access: See Section 01560, Subpart 1.06 Access Control



### **3.08 STORM WATER POLLUTION PREVENTION PLAN**

- A. The Contractor shall develop Storm Water Pollution Prevention Plan(s) (SWPPP) in accordance with the requirements of the Nevada Water Quality Act for all areas where work shall be taking place. The Contractor may divide the site into manageable units and submit a separate SWPPP for each unit. For the BRC Properties, the SWPPP shall be developed to show pollution prevention measures to be applied at various stages of excavation and backfill and measures to be applied after completion of excavation and backfill. The Contractor may not disturb any area until the pertinent SWPPP is accepted by the Construction Manager and the BMP's identified in the SWPPP have been installed.
- B. All SWPPPs prepared by the Contractor must incorporate the following performance requirements:
  - 1. During the Contract performance period, the Contractor shall prevent storm-water runoff from leaving contaminated areas of the Project site. Under no circumstances shall runoff water be allowed to flow from a contaminated area to an uncontaminated or previously decontaminated area. The Contractor shall construct and maintain temporary storm-water pollution-control measures as necessary throughout the duration of the Project.
  - 2. Storm-water runoff shall include runoff water from any source. The Contractor is responsible for controlling storm-water runoff and erosion for all other areas disturbed under this Contract. Temporary erosion-control provisions shall be coordinated with permanent erosion-control features, if any, to the extent practical to assure economical, effective, and continuous erosion control throughout construction.
  - 3. Storm-water pollution and erosion control measures may include, but are not limited to, berms, dams, ditches, sediment/water retention basins, fiber mats, netting, gravel, mulches, grasses, slope drains, silt fences, and other methods as appropriate. Pumping water to runoff water control facilities is also an option. Water removed from contaminated excavations or collected as leachate shall be considered to be contaminated material and shall be used for dust control of contaminated areas.
  - 4. Contractor shall conduct storm water system inspections, at a minimum, after every storm exceeding ½ inch in 24 hours. Storm water conveyance system shall be inspected quarterly during the dry season and weekly during the wet season. Conveyance system shall be inspected for sediment and debris build-up and scour or other damage.

### **3.09 FINAL INSPECTION**

- A. At the completion of this Project, the Contractor representative shall attend the final inspection to document any deficiencies in the completed Project. A Notice of Final Completion Inspection form shall be completed by the Construction Manager, with one copy delivered to the Contractor in accordance with the Terms and Conditions.
- B. The Contractor may request an inspection of work items at the time of completion, but these items shall be inspected again during the final inspection to verify compliance with the Contract.
- C. The Contractor shall schedule all inspections with the Construction Manager.

### **3.10 PROJECT RECORD DOCUMENTS**

- A. Promptly following receipt of the Notice to Proceed, the Contractor shall secure from the Construction Manager, at no charge to the Contractor, ten sets of full-size drawings and specifications. Throughout progress of the Project, the Contractor shall maintain a neat, current, and accurate record of the as-built status of the Project on the job set of the Project record documents. Two sets of the full-size drawings shall be used to record as-built survey data only.

The drawings and these specifications are the Project record documents. As-built documents shall include documentation of all deviations from the original or revised drawings and these specifications.

- B. Upon receipt of the job set, identify each of the documents with the title, "RECORD DOCUMENTS—JOB SET."
- C. Store Record Documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Contractor shall maintain on site, one set of the following record documents and record actual revisions to the Work.
  - 1. Drawings.
  - 2. Specifications.
  - 3. Addenda.
  - 4. Change Orders and other Modifications to the Contract.
  - 5. Reviewed Shop Drawings, product data, and samples.
- F. The Contractor shall thoroughly document changes on each page of the specifications and each sheet of drawings and other documents where such entry is required to show all changes. Documentation shall include the Change Order number as appropriate and shall be initialed and dated by the individual making the entry.
- G. Make entries within 24 hours after receipt of information that a change has occurred.
- H. Project record document entries shall be made using terminology and drafting standards that match those used in the Contract documents. Deviations from standards, if required, shall be noted on glossaries, legends, or other appropriate lists of definitions included in the Project record documents for that work.
- I. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
  - 1. Measured horizontal and vertical location of underground utilities and appurtenances referenced to permanent surface features.
  - 2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible, accessible, and permanent features of the Work.
  - 3. Field changes of dimension and detail.
  - 4. Details not shown on original Construction Drawings.
  - 5. Making entries on drawings
    - a. Use an erasable colored pencil (not ink or indelible pencil) and clearly describe the change by graphic line and note.
    - b. Date and initial all entries.
    - c. Call attention to the entry by a "cloud" drawn around the area or areas affected and reference the Change Order number as appropriate.

- d. In the event of overlapping changes, use a different color for each overlapping changes.
- J. Specifications: Legibly mark and record at each product Section a description of actual products installed, including the following:
1. Manufacturer's name and product model and number.
  2. Product substitutions or alternates utilized.
  3. Changes made by Addenda and Modifications.
- K. Following the completion of each phase cell liner and leachate collection system construction, the Contractor shall provide to the Construction Manager the set of as-built Project record documents for the completed liner and leachate collection system.
- L. Contract drawings and Specifications shall submitted to the Construction Manager at completion of the work in accordance with Section this section. The requirements for submitting as-built survey data shall not relieve the Contractor in any way from the Contractor's responsibility to conform to the requirements of the work.
- M. As-built Project Record Documents
1. The Contractor shall provide surveying services to document as-built conditions for completed work. The Contractor shall provide survey data to confirm that as-built locations of the work conform to the drawings where coordinates and/or elevations are shown. Where the drawings or specifications permit variable locations or detail for specific items of work, the Contractor shall survey the as-built locations or details. Surveys shall be sufficient to define the features or details at any given location.
  2. Submit the job set of as-built Project record documents to the Construction Manager after Construction Manager acceptance of the work. Construction Manager acceptance of the as-built documents is required before any release of payment retainage shall be allowed.
  3. Verification of as-built locations shall be performed by Owner based on control points.

## **PART 4 – MEASUREMENT AND PAYMENT**

### **4.01 GENERAL**

- A. No separate measurement or payment shall be made for requirements of this section. Full compensation for conforming to such requirements shall be included in the price bid for Bid Schedule Items of Work and no additional compensation shall be allowed.

[END OF SECTION]

**SECTION 01110**  
**HEALTH AND SAFETY REQUIREMENTS**

**PART 1 – GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. This section describes the Project health and safety requirements. All work performed shall be conducted in accordance with safety and health regulations promulgated by the Federal and State Occupational Safety and Health Administration (OSHA), Subcontract documents, and other Federal, State, and local agencies.
- B. The Contractor shall protect the health and safety of Contractor employees, visitors, and the public; prevent damage to property, materials, supplies, and equipment; and avoid work interruptions.

**1.02 RELATED SECTIONS**

Section 01010 – Scope of Work

Section 01560 – Temporary Controls

Section 02200 – Earthwork

Section 02205 – Remedial Excavation and Filling

**1.03 REFERENCES**

- A. American National Standards Institute (ANSI)
  - 1. ANSI Z88.2 Practices for Respiratory Protection
  - 2. ANSI Z89.1 Safety Requirements for Industrial Head Protection
  - 3. ANSI Z41.1-75 Men's Safety Toe Footwear
- B. Code of Federal Regulations (CFR)
  - 1. 29 CFR Labor

**1.04 SUBMITTALS**

- A. The Contractor shall submit a Health and Safety Plan to the Construction Manager prior to Notice to Proceed. The Construction Manager shall review the Plan and forward any questions to the Contractor, within 14 days of receipt, but shall not approve the Plan.
- B. Contractor shall submit to Construction Manager resumes for on-site Safety Officer and on-site Safety Technicians.

**PART 2 – PRODUCTS**

[Not Used]

## **PART 3 – EXECUTION**

### **3.01 GENERAL REQUIREMENTS**

- A. The Contractor shall not conduct any work at the site, including mobilization, until Construction Manager has reviewed the Contractor's Health and Safety Plan.
- B. The Contractor shall conduct daily health and safety tailgate meetings and record those in attendance.
- C. The Contractor shall conduct quarterly site specific health and safety meetings to review site specific hazards and incidents of the past quarter.
- D. The Contractor shall maintain and regularly update a site map showing active areas of remediation with exclusion, decontamination, and support zones clearly indicated. Map shall be posted in work area and include general wind direction, evacuation routes, refuge locations, and hospital route.
- E. The Contractor shall maintain on site all training records of employees. Training records shall be made available to Construction Manager upon request.
- F. The Contractor shall maintain records of analytical reports and monitoring data, provided by the Construction Manager or obtained by the Contractor, that document potential health hazards to employees. The Construction Manager will supply monitoring data as required by Federal, State, and local regulations or upon Contractor request.
- G. The Contractor shall provide appropriate safety barricades, signs, and signal lights in accordance with 29 CFR 1926 Subpart G, and 29 CFR 1910.144.
- H. Safety Inspections
  - 1. The Contractor shall conduct and document daily inspections and maintenance of personal protective equipment (PPE). The Contractor shall replace defective PPE promptly to avoid hazardous Project site conditions and practices.
  - 2. The Contractor shall conduct and document daily inspections of the job site, materials, and equipment for unsafe conditions or practices. Corrective action shall be taken promptly to avoid hazardous Project site conditions and practices.
  - 3. The Contractor shall perform initial safety inspections of vehicles, heavy equipment, and materials prior to commencement of work. Vehicles, heavy equipment, or materials that do not meet Federal OSHA standards shall not be used on site unless approved by the Construction Manager.
  - 4. A minimum of one full time, qualified safety officer and one safety technician shall be on-site during all work activities. An on-site safety officer shall be appointed to oversee the performance of the safety engineers. Qualifications should include a B.S. degree in safety engineering or certification by the Board of Certified Safety Professionals. Equivalent experience may be acceptable at the discretion of the Contractor. During waste excavation and placement activities, a minimum of two full time qualified safety officers and two safety technicians shall be on site during all work activities.
- I. Occupational Medical Examination: Prior to work on the site, Contractor and subcontractor personnel assigned to work on a hazardous substance site shall have a medical examination that meets the requirements addressed in 29 CFR 1910.120. The examination shall include, as appropriate, a medical screening for the use of respiratory protective devices and asbestos abatement. Subsequent annual physical examinations are required.

1. Records of all employee physicals and heavy metals sampling, where required, shall be maintained on site by the Contractor. The records shall be made available, at the Construction Manager's request, for review by the Construction Manager.
2. Contractor and subcontractors' personnel entering the site may be required to provide heavy metal baseline sample information prior to start of employment on the site and at the start of each construction season, as directed by the Construction Manager. The Contractor shall provide to the Construction Manager results of each baseline sample analysis, signed by the physician. The results of the baseline analysis shall be submitted to the Construction Manager prior to the Construction Manager authorizing entry to the site. Each person may be required to provide the heavy metals sampling results at the end of each construction season, at termination of employee's work on site, or after completion of the Project, whichever comes first, as directed by the Construction Manager.

### **3.02 HEALTH AND SAFETY PROGRAM AND PLAN**

- A. The Contractor shall have a written Health and Safety Program that complies with all applicable OSHA regulations prior to commencement of work. Certification of such program shall be submitted to the Construction Manager
- B. One site-specific Health and Safety Plan (HASP) shall be developed by the Contractor. The Contractor shall maintain and distribute the HASP. This HASP shall meet OSHA requirements contained in 29 CFR 1910.120 and be prepared and signed by a certified industrial hygienist.
- C. The HASP shall include the following at a minimum:
  1. Site location and description
  2. Scope of work
  3. Project team and organization
  4. Unique issues and concerns
  5. Contaminants or conditions of concern
  6. Personal Protective Equipment (PPE)
  7. Exposure assessment and air monitoring
  8. Activity hazard analysis
  9. Emergency assistance network
  10. General health and safety procedures for waste operations
    - a. Injury and illness prevention
    - b. Health and safety organization
    - c. Personnel training
    - d. Medical surveillance
    - e. PPE
    - f. Site controls
    - g. Personal and equipment decontamination

- h. Emergency response plan
  - i. Documentation
  - j. Thermal stress and severe weather
  - k. General contaminate of concern information
  - l. Biological hazards
  - m. Standard operating procedures
  - n. Common physical hazards and controls
11. The following figures, at a minimum, shall be included:
- a. Site location
  - b. Hospital route
  - c. Sample protective equipment ensembles
  - d. Diagram of site work zones
12. The following tables, at a minimum, shall be included:
- a. Occupational health exposure and toxicological properties for contaminants of occupational health concern
  - b. Activity hazard analysis form
  - c. Emergency supplies
  - d. Typical level D, C, and B decontamination approach
- D. The HASP shall also address the chemicals brought onsite by the Contractor for the Project. The HASP shall reference the MSDS binders.
- E. Employee Termination
- 1. Notification of Employee Termination: The Contractor shall provide to the Construction Manager, within 5 days of termination a list of employees who have entered the BMI Common Areas and are terminated from employment at the Project. This requirement includes employees of subcontractors. Termination physicals are required in accordance with 29 CFR 1910.120 for hazardous waste site workers if a physical has not been performed within the last 6 months prior to termination.
  - 2. An exit physical examination that meets the requirements addressed in 29 CFR 1910.120 shall be conducted at termination, which is defined as termination of employee's work on site or completion of the Project, whichever comes first.
- F. A Spill Prevention and Response Plan shall be contained within the site-specific HASP. The Spill Response Plan shall be maintained in the cab of each haul vehicle.
- G. Consequences of Noncompliance
- 1. Failure of a worker to comply with the health and safety requirements shall be considered ample cause for suspension by the Contractor, pending correction of the problem. Suspension shall be at the Contractor's expense.

2. Repeated or serious violations of health and safety rules and/or requirements by a worker shall be cause to restrict or disqualify the worker from further on-site work. This requirement is at the discretion of the Construction Manager after review of documentation of violations and shall be enforced by the Contractor. Such violations by any Contractor or subcontractor personnel may result in further actions by the Construction Manager up to and including Subcontract Termination for Default in accordance with the Terms and Conditions.

H. The Contractor shall permit only those employees qualified by training and/or experience to operate equipment and machinery. Records of such qualification shall be maintained on site by the Contractor and made available for review upon request by the Construction Manager.

### **3.03 TRAINING REQUIREMENTS**

1. All on-site personnel (except administrative staff):
  - a. 40 hour OSHA HAZWOPER training meeting 29 CFR 1910
  - b. 8 hour OSHA Refresher training meeting 29 CFR 1910
  - c. Respirator Fit Test
2. All on-site supervisors:
  - a. 8 hour OSHA Supervisor training meeting 29 CFR 1910
  - b. Red Cross First Aid and CPR training
3. Contractor shall provide quarterly on-the-job fire training.

### **3.04 CONTAMINATION CONTROL AND MONITORING**

#### **A. Personal Protective Equipment**

1. The Contractor shall supply personal protective equipment (PPE) based on the requirements in the site-specific HASP.
2. PPE shall be supplied and maintained by the Contractor for use by all visitors, Construction Manager, Owner, Owner's consultants, Contractor, and subcontractor personnel for the duration of the Contract.
3. All safety equipment required by OSHA standards shall be provided and maintained by the Contractor except as specifically noted to be the responsibility of others.

#### **B. Personal and Area Monitoring**

1. Owner shall perform perimeter and breathing zone air monitoring for the entire site.
2. Owner shall perform breathing zone monitoring for total organic vapor and dust every 30 minutes during excavation.
3. Owner will conduct perimeter air monitoring during remediation activities. Perimeter air monitoring shall involve continuous MIE Data RAM sampling and GilAir sampling pumps during excavation and waste placement.
4. Personal air monitoring shall be required if breathing and work zone monitoring indicates health and safety problems. The Contractor shall be responsible for personal air monitoring and shall be in accordance with the following:



- a. The Monitoring and Sampling Program shall be in compliance with 29 CFR 1910 and 1926 requirements.
  - b. Contractor personal air monitoring data shall be made available to the Construction Manager by the Contractor.
  - c. The Construction Manager will review the Contractor's monitoring and sampling program and monitoring and sampling results to check the adequacy of controls and to ensure adequate protection of workers, the environment, and the public.
5. Any monitoring data obtained by the Construction Manager throughout the course of work activities performed by the Contractor shall be made available to the Contractor upon initiation of a formal request for this information.
  6. Any tampering with monitoring equipment shall be cause for suspension of affected work, and shall be cause for termination of any employee involved in the tampering.
- C. Work Clothing: Adequate levels of protection for personnel on the Project site shall be identified by task in the site-specific HASP. Clothing such as tank tops, shirts cut off at the midriff, cutoff pants, moon boots, sandals, sneakers, and jogging shoes are considered unacceptable dress and will not be permitted.
1. In general, work clothing should consist of the following:
    - a. Full-length trousers/slacks/jeans in good condition.
    - b. Sturdy work shoes, boots, or other footwear meeting the requirements of ANSI Standards Z41.1-75.
    - c. Shirts that cover the shoulders, with sleeves at least T-shirt length.
    - d. Hard hats that meet the requirements of ANSI Standard Z-89.1.
  2. Orange safety vests or "hunter orange" colored shirts shall be worn at all times. Exception may be granted by the Construction Manager.
  3. When PPE coveralls are required, a worker may wear modesty clothing under the coveralls in lieu of items 1.a and 1.c above (e.g., undershirts, smocks, swim shorts, shorts, leggings). Modesty clothing shall be provided by the Contractor.
- D. Exclusion Zones: All active excavation areas are considered to be restricted for the purposes of access control. The following requirements shall be enforced by the Contractor in these areas from the time that construction begins until the area is cleared for general access or verified uncontaminated by the Construction Manager.
1. Access-Control Points: Access to exclusion zones shall be controlled through a designated Access-Control Point. Workers leaving the exclusion zone shall be monitored by Contractor Personnel for contamination. If contamination is found, workers will be required to perform decontamination activities. Such decontamination shall be directed by the Contractor's safety professional. Install and maintain access-control fencing as shown on the drawings. Establish an Access-Control Point and maintain access-control fencing until conformance sampling results indicate remediation is complete.
  2. The Contractor shall restrict unescorted access to trained personnel.
  3. Workers who willfully fail to follow the established health and safety procedures will be disqualified and restricted from the exclusion zone. Retraining at the Contractor's expense, as a minimum, shall be necessary to regain qualification.

4. The Contractor shall take full responsibility for any Contractor, subcontractor, supplier, vendor, and other contractor-related employees who violate any safety rule.
  5. Exclusion zones shall have a 5 foot temporary boundary fence surrounding all excavations.
- E. Support Zones: All areas that do not contain hazardous substances shall be considered uncontrolled areas. The Contractor shall be responsible for general site security requirements in uncontrolled areas, but is not required to provide access control in these areas in addition to overall site access control. Areas that have been remediated and verified clean may be reclassified as uncontrolled areas.

### 3.05 GENERAL HAZARD REQUIREMENTS

- A. The site-specific HASP shall identify hazards and controls including hazards of using contaminated water for dust control and the recycling of decontamination water.
- B. The Contractor is responsible for inspecting the site before and during construction activities to identify hazards, and shall take all necessary actions to protect the workers, the environment, and the general public against such known hazards. The Contractor shall notify the Construction Manager immediately of any previously unidentified hazards, and of any accidents, injuries, or illness that have occurred. Newly identified hazards shall be discussed during the daily health and safety tailgate meeting.
- C. Buried Utility Lines: Underground utilities (abandoned and active) may be encountered during the performance of the Project. Overhead utilities may be located over work areas. Utilities known or suspected by the Contractor are shown on the drawings. Refer to Section 01010, "Summary of Work," for requirements for Contractor utility location, protection, and replacement.
  1. Manually excavate active utility lines shown on the drawings. Notify the local utility company if:
    - a. The line is not found within 18 inches of the estimated depth at the marked position;
    - b. There is evidence of leaks in utility lines (Do not disturb this ground further until after the responsible utility and the Construction Manager have been notified and the Construction Manager authorizes further work in this area.);
    - c. The line has been nicked, cut, or damaged in any way; or
    - d. The corrosion-protection tape on a steel line has been nicked.
  2. The following actions shall be taken if there is a strong odor of gas or a line is broken:
    - a. Remove the equipment bucket from the immediate vicinity of the break.
    - b. **Do Not** move the equipment. Shut off equipment. Do not restart any vehicles in the area.
    - c. Leave the area immediately.
    - d. Notify the local utility company or the local Fire Department if there is no answer at the utility company. Give the following information: your name, location of incident, nature of incident, and type or color of pipe damaged (if known).
    - e. Secure the area to prevent access by anyone except the utility company.
    - f. Do not attempt to repair or stop the gas flow.

3. Notify the Construction Manager immediately of any utility damage and any suspicious odors or soil discolorations encountered during the work.

D. Industrial Hygiene/Chemicals Concerns

1. Noise Limitations

- a. Noise level restrictions as specified in Section 01560 and as measured from the property line, shall supersede noise restrictions discussed in this section.
  - b. Construction equipment, including trucks, shall not exceed 85 dB(A) at 50 feet for a stationary noise limit per 40 CFR 202.21.
  - c. Noise surveys shall be conducted by the Contractor on equipment.
  - d. Hearing protection shall be provided by the Contractor and shall be worn when noise levels exceed 85 dB(A). Hearing protection shall be made available to all employees whose noise exposure may exceed an 82-dB(A) 8-hour time-weighted average (TWA). The Construction Manager may monitor the Contractor's equipment and on-site personnel. This monitoring shall be considered incidental to the Contract.
  - e. The Contractor shall institute a hearing conservation program for its employees per 29 CFR 1910.95.
2. The Contractor shall maintain MSDSs on site for all chemicals the Contractor brings onto the Project site. Chemicals include, but are not limited to, cements, fuels, lubricants, bleaches, and cleaners. Material Safety Data Sheet (MSDS) books shall be provided by and made available by the Contractor. The books shall be clearly marked and located in the work space or at the Access-Control Point for chemicals used within the exclusion zone. MSDS books stored in equipment or vehicles are not acceptable.

E. Industrial Safety Concerns

1. Refueling: Refueling shall only be permitted in the refueling area as identified in the Fueling Plan.
2. Storage of Combustible Liquids: When storing 5 gallons or more of combustible liquids, or 5 pounds of flammable gas, a 10B fire extinguisher shall be provided by the Contractor within 50 feet of the storage area.

### 3.06 INCIDENT REPORTING

- A. The Contractor shall provide the Construction Manager a report detailing incidents occurring at the Site. The report shall include:
1. Name, address, and telephone number of the operator;
  2. Name, address, and telephone number of the site;
  3. Date, time, and type of incident;
  4. Name and quantity of material(s) involved;
  5. Extent of injuries, if any;
  6. Assessment of actual or potential hazards to human health or the environment, where applicable; and

7. The estimated quantity and disposition of recovered material that resulted from the incident.

#### **PART 4 – MEASUREMENT AND PAYMENT**

##### **4.01 GENERAL**

- A. Providing for and complying with the requirements set forth in this Section for Health and Safety Requirements shall be incidental to Earthworks, Section 02200, and Remedial Excavation, Section 02205.
- B. Providing for and complying with the requirements set forth in this Section for the Health and Safety Plan shall be considered as incidental to Mobilization, Section 01505.

[END OF SECTION]

## **SECTION 01300 SUBMITTALS**

### **PART 1 – GENERAL**

#### **1.01 DESCRIPTION OF WORK**

- A. This section contains requirements for administrative and work-related submittals such as construction progress schedules, Shop Drawings, test results, operation and maintenance data, and other submittals required by Contract Documents.
- B. Submit required materials to the Construction Manager for proper distribution and review in accordance with requirements of the Contract Documents.

#### **1.02 CONSTRUCTION PROJECT SCHEDULES**

- A. Project Schedules shall be prepared in the form of a horizontal bar chart. The Project Schedule shall include the following items:
  - 1. A separate horizontal bar for each activity. The following shall be included for each activity:
    - a. Activity duration
    - b. Percent complete
    - c. Remaining duration
    - d. Early finish
    - e. Calendar used.
  - 2. A horizontal time scale, which identifies the first workday of each week.
  - 3. A time scale with spacing to allow space for notations and future revisions.
  - 4. Listings arranged in order of early start for each item of the Work.
  - 5. Critical milestone dates and mandatory construction sequence constraints.
- B. The Project Schedule for construction of the Work shall include the following items where applicable:
  - 1. Submittals: dates for beginning and completion of each major element of construction and installation dates for major items. Elements shall include, but not be limited to, the following items which are applicable:
    - a. Mobilization schedule
    - b. Demobilization schedule.
    - c. Major elements for each phase as outline in Section 01010 Subpart 1.02:
    - d. Final site clean-up.
    - e. Show weekly, as of the first day of each week, anticipated percent of completion for each item..
    - f. Show each individual Bid Item with adequate support detail.

C. Schedule Revisions:

1. Weekly to reflect changes in progress of Work.
2. Indicate progress of each activity at submittal date.
3. Show changes occurring since the previous schedule submittal. Changes shall include the following.
  - a. Major changes in scope.
  - b. Logic changes.
  - c. Activities modified since previous submittal such as:
    - i. name changes
    - ii. duration changes
  - d. Revised projections of progress and completion.
  - e. Other identifiable changes that affect the projected project completion.
4. Provide a log of changes made to schedule since last version to define:
  - a. Problem areas, anticipated delays, and impact on schedule.
  - b. Recommended corrective action and its effect.

**1.03 DESIGN SUBMITTALS**

- A. Prepare and submit to the Construction Manager detailed designs and plans for the construction facilities and temporary controls indicated or specified to be designed by the Contractor.
- B. Design submittals include:
  1. Slit Trench Shoring
  2. Excavations deeper than 20 ft bgs
  3. Haul Roads
  4. Decontamination Pads
  5. Debris Storage Area
  6. Access Ramp Design
- C. Each design submittal shall include:
  1. All field, geotechnical, survey, environmental, or other investigations performed to support the design.
  2. Descriptions of all design criteria, assumptions, calculations, or other documents that support the basis of the design.
  3. Blueline or blackline prints, one reproducible hard copy, and one electronic copy of all drawings. Electronic copies shall be in AutoCAD 2007 format or in a format readily convertible to AutoCAD 2007.

4. Notes on the drawings or specifications that explain construction procedures, methods, and performance criteria.
- D. Designs prepared by the Contractor shall bear the seal and signature of a Professional Engineer registered in the State of Nevada.
- E. The designs shall be reviewed by the Construction Manager for acceptability based on comparison with the minimum performance criteria set forth in these specifications and on the drawings. The Construction Manager shall forward, within 14 days after receiving the design documentation, any questions related to the design to the Contractor in writing requesting clarification. The Contractor shall respond in writing within five days after receiving the request for clarification from the Construction Manager.

#### **1.04 SHOP DRAWINGS AND SAMPLES**

- A. Shop Drawings, product data, and samples shall be submitted as required in individual Sections of the Specifications.
- B. The Contractor's Responsibilities:
  1. Review Shop Drawings, product data, and samples prior to submittal.
  2. Determine and verify:
    - a. Field measurements.
    - b. Field construction criteria.
    - c. Catalog numbers and similar data.
    - d. Conformance with Specifications.
  3. Coordinate each submittal with requirements of the Work and Contract Documents.
  4. Notify the Construction Manager in writing, at the time of the submittal, of deviations from requirements of Contract Documents.
  5. Begin no fabrication or Work pertaining to required submittals until return of the submittals with appropriate approval.
  6. Designate dates for submittal and receipt of reviewed Shop Drawings and samples in the construction progress schedule.
- C. Submittals shall contain:
  1. Date of submittal and dates of previous submittals.
  2. Project title and number.
  3. Contract identification.
  4. Names of:
    - a. The Contractor.
    - b. Supplier.
    - c. Manufacturer.

5. Summary of items contained in the submittal.
  6. Identification of the product with identification numbers, and the Drawing and Specification section numbers.
  7. Clearly identified field dimensions.
  8. Details required on the Drawings and in the Specifications.
  9. Manufacturer, model number, dimensions, and clearances, where applicable.
  10. Relation to adjacent or critical features of the Work or materials.
  11. Applicable standards, such as ASTM or Federal Specification numbers.
  12. Identification of deviations from Contract Documents.
  13. Identification of revisions on re-submittals.
  14. 8-in. by 3-in. blank space for the Contractor's proper approval stamp.
  15. The Contractor's stamp, signed, certifying to review of the submittal, verification of the products, field measurements, field construction criteria, and coordination of information within the submittal with requirements of Work and Contract Documents.
- D. Submittal Response – Within 14 days of submittal receipt, Construction Manager will stamp and provide two copies to the Contractor. Construction Manager will respond as follows:
1. No exceptions taken: Contractor shall file submittal and proceed with associated work.
  2. Correct as noted: Contractor shall make corrections noted and ~~resubmit submittal.~~ **proceed with associated work.**
  3. Rejected: Contractor shall not proceed with the associated work.
  4. Revise and resubmit: Contractor shall revise submittal and resubmit to Construction Manager.
  5. Submit Specified Items: Contractor shall submit specified items to provide Construction Manager information for appropriate review of submittal.
- E. Re-submittal Requirements:
1. Re-submittal is required when corrections or changes in submittals are required by the Construction Manager. Re-submittals are required until all comments by the Construction Manager, Design Engineer, or CQA Engineer is addressed and the submittal is approved.
  2. Shop Drawings and Product Data:
    - a. Revise initial drawings or data and resubmit as specified for initial submittal.
    - b. Indicate changes made other than those requested by the Construction Manager.

## **1.05 TEST RESULTS AND CERTIFICATION**

- A. Results of tests conducted by the Contractor on materials or products shall be submitted for review.
- B. Certification of products shall be submitted for review.



## **1.06 SUBMITTAL REQUIREMENTS**

A. Provide complete copies of required submittals as follows.

1. Project Schedule
  - a. Six copies of initial schedule.
  - b. Six copies of each revision.
2. Shop Drawings: Six copies.
3. Certification Test Results: Six copies.
4. Other Required Submittals:
  - a. Six copies if required for review.
  - b. Six copies if required for record.

B. Deliver the required copies of the submittals to the Construction Manager.

### **PART 2 – PRODUCTS**

[Not Used]

### **PART 3 – EXECUTION**

[Not Used]

### **PART 4 – MEASUREMENT AND PAYMENT**

[Not Used]

[END OF SECTION]

## **SECTION 01400 QUALITY CONTROL**

### **PART 1 – GENERAL**

#### **1.01 DESCRIPTION OF WORK**

- A. Monitor quality control over suppliers, Manufacturers, products, services, Site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with Manufacturers' instructions, including each step in sequence.
- C. Should Manufacturers' instructions conflict with Technical Specifications, request clarification from Construction Manager before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work by persons qualified to produce workmanship of specified quality.

#### **1.02 TOLERANCES**

- A. Monitor tolerance control of installed products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with Manufacturers' tolerances. Should Manufacturers' tolerances conflict with Technical Specifications, request clarification from Construction Manager before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

#### **1.03 REFERENCES**

- A. For products or workmanship specified by association, trade, or other consensus standards, complies with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of current issue on date of Notice to Proceed with construction, except where a specific date is established by code.
- C. Obtain copies of standards where required by product Specification sections.

#### **1.04 INSPECTING AND TESTING SERVICES**

- A. The CQA Engineer shall perform construction quality assurance (CQA) inspections, tests, and other services specified in individual Sections of the Specification.
- B. The Contractor shall provide labor and equipment to assist in sample collection as needed for testing as well as assist in the preparation of test locations.
- C. The Contractor shall cooperate with CQA Engineer; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
- D. CQA testing or inspecting does not relieve Contractor, subcontractors, and suppliers from their requirements to perform quality control Work as indicated in the Technical Specifications.
- E. Owner's Surveyor will perform QA monitoring of as-built documents using control points.

**PART 2 – PRODUCTS**

[Not Used]

**PART 3 – EXECUTION**

[Not Used]

**PART 4 – MEASUREMENT AND PAYMENT**

[Not Used]

[END OF SECTION]

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## **SECTION 01500 CONSTRUCTION FACILITIES**

### **PART 1 – GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Construction facilities include furnishing of all equipment, materials, tools, accessories, incidentals, labor, and performing all work for the installation of equipment and for construction of facilities, including their maintenance, operation, and removal, if required, at the completion of the Work under the Contract.

#### **1.02 DESCRIPTION OF WORK**

- A. Construction facilities include, but are not limited to, the following equipment, materials, facilities, areas, and services:
  - 1. Parking Areas.
  - 2. Temporary Roads.
  - 3. Temporary Trailers.
  - 4. Temporary Utilities.
  - 5. Temporary Sanitary Facilities.
  - 6. Lighting
  - 7. Storage of Materials and Equipment.
  - 8. Dust control water storage
  - 9. Temporary Water.
  - 10. Vacuum Truck Staging Area
  - 11. Decontamination Area
  - 12. Construction Equipment.
  - 13. First Aid Facilities.
  - 14. Health and Safety.
  - 15. Security.
- B. Construct/install, maintain, and operate construction facilities in accordance with the applicable federal, state, and local laws, rules, and regulations, and the Contract Documents.

#### **1.03 RELATED SECTIONS**

Section 01100 – Project Meetings and Procedures

Section 01110 – Health and Safety Requirements

Section 02110 – Site Clearing

Section 02200 – Earthwork

Section 02205 – Remedial Excavation and Filling

#### **1.04 SUBMITTALS**

- A. The following submittals shall be submitted prior to issuance of Notice to Proceed:
  - 1. Construction facilities layout plan
  - 2. Staging area layout plan
  - 3. Haul road design plan
  - 4. ~~Debris lined storage area design~~
  - 5. ~~Water management plan: the Construction Manager shall review the Plan and forward any questions to the Contractor, but shall not approve the Plan.~~
- B. Contractor shall submit the Public Haul Road Maintenance and Repair Plan(s) in accordance with the traffic permits as required by the City of Henderson and Nevada Department of Transportation
- C. Debris lined storage area design
- D. Water management plan: the Construction Manager shall review the Plan and forward any questions to the Contractor, but shall not approve the Plan.

#### **1.05 REFERENCES**

- A. Construction Drawings
- B. BRC, 2006. "Corrective Action Plan (CAP) For The Basic Remediation Company (BRC) Common Areas Remediation Project," September.
- C. Geosyntec, 2007. "Revised Remedial Action Plan (RAP) Permit Application for Corrective Action Management Unit (CAMU), Henderson, Nevada," Prepared for Basic Remediation Company, Submitted to Nevada Department of Environmental Protection, March.
- D. Nevada Department of Transportation (NDOT) Traffic Permit No. 91464-2006 dated 13 April 2006.
- E. United States Department of Transportation, Federal Highway Administration: Manual on Uniform Traffic Control Devices, 20 November 2003.

#### **1.06 GENERAL REQUIREMENTS**

- A. Contractor shall not proceed with the construction of any facilities until the initial field survey has been completed. This is a hold point.
- B. Contractor is responsible for furnishing, installing, constructing, operating, maintaining, removing and disposing of the construction facilities, as specified in this Section, and as required for the completion of the Work under the Contract.
- C. Contractor shall maintain construction facilities in a clean, safe and sanitary condition at all times until completion of the Work.

- D. Contractor shall minimize land disturbances related to the construction facilities to the greatest extent possible and restore land, to the extent reasonable and practical, to its original contours by grading in accordance with grading permits
- E. Contractor shall establish construction facilities at locations specified on the Construction Drawings, unless otherwise approved by Construction Manager.
- F. The Contractor shall be responsible for general housekeeping during construction. Upon completion of the Work, the Contractor shall remove all of his equipment, temporary improvements, facilities, construction materials, and trash. All disturbed surface areas shall be re-paved, re-vegetated, or otherwise put into the pre-existing condition before performing the Work, or a condition satisfactory to the Construction Manager.
- G. The following plywood signs shall be placed at the entrance to the Work Areas:
  - 1. Entrance to the CAMU, signs shall be posted in English and Spanish:
    - a. Private Operation: Basic Remediation Company – Corrective Action Management Unit
    - b. Owner: Basic Remediation Company;
    - c. Operator: Weston Solutions, Inc;
    - d. Hours of operation: 24 hours a day; and
    - e. Materials accepted or excluded.
  - 2. Eastside Area and CAMU, signs shall be posted in English and Spanish stating:
    - a. Safety measures at the site;
    - b. Mandating that all instruction from site personnel be obeyed; and
    - c. “Danger. Construction Area. No Trespassing.”

#### **1.07 TEMPORARY ROADS AND PARKING AREAS**

- A. Temporary roads and parking areas are existing private roads that are improved or new private roads constructed by Contractor for convenience of Contractor in the performance of the Work under the Contract.
- B. Transportation of contaminated materials shall be restricted to the haul road corridors as shown on the drawings.
- C. Public haul roads consist of sections of West Warm Springs Road and Boulder Highway between the Eastside Areas and the CAMU, as shown on Construction Drawings.
  - 1. Public haul roads are shown on Construction Drawings. Hauling on public roads shall be on Boulder Highway and West Warm Springs Road only as per Nevada Department of Transportation (NDOT) Permit No. 91464-2006. Contractor is responsible for all conditions of the permit.
  - 2. Prior to beginning work, the Contractor shall perform a walk through with the Construction Manager, City of Henderson, and NDOT personnel. This meeting is part of an overall process to establish a baseline condition of Boulder Highway and West Warm Springs Road. It will also serve as a kick-off meeting with COH and NDOT to determine the following:

- a. Establish a process to monitor the roadway condition.
  - b. Establish a process to repair the roadway when necessary.
3. The Contractor shall prepare a Public Haul Road Maintenance and Repair Plan to monitor and repair the pavement sections used for haul between the Eastside Area and the CAMU, as shown on the Construction Drawings. The plan shall be submitted to both NDOT and COH and shall include:
  - a. Establishing a new pavement section for a specific lane of traffic to be determined by the COH, NDOT, and Contractor
  - b. Determine a routine maintenance program to eliminate major damage to the roadway.
4. The Contractor shall establish necessary improvements to reduce damage to Boulder Highway and West Warm Springs Road prior to commencement of hauling activities.
- D. Submit a Haul Road Plan consisting of a detailed engineering design for the road and drainage facilities to the Construction Manager for approval. Haul roads shall be designed and constructed to safely accommodate the weight and size of vehicles that the Contractor shall use on the haul roads.
- E. Haul Road Plan shall address and include provision for the following:
  1. Coordination of construction with Construction Manager and local utilities, fire, and police departments.
  2. Keep erosion to a minimum and maintain suitable grade and radii of curves to facilitate ease of movement of vehicles and equipment.
  3. Furnish and install longitudinal and cross drainage facilities, including, but not limited to, ditches, structures, pipes and the like.
  4. Maintain drainage paths crossed by haul roads through use of BMP's or paving of ditches depending on haul trucks used. Features shall be designed to withstand the 10 year storm event of 610 cubic feet per second (cfs).
  5. Mud or dirt transported by equipment on paved roads both on-site and off-site shall immediately be vacuumed.
  6. Constructing improvements within the haul-road corridor between the Eastside and CAMU shall be restricted to using clean materials only.
  7. Interior haul roads and parking areas shall facilitate dust control and adequate control for surface runoff. At a minimum, parking areas and haul roads shall have 1" of cap rock maintained throughout the project.
  8. Inspection of the private haul roads and parking areas shall be daily and maintained by the Contractor in accordance with the following criteria:
    - a. The private roads and parking area shall be graded to efficiently carry water off the traveled surface to collection ditches. Ponding on the road or parking surface is unacceptable and shall be immediately corrected by the Contractor.
    - i. Private haul roads and parking areas shall conform to grading requirements specified in Section 01010.

- b. Drainage ditches and culverts intended to handle runoff from the roadway and parking areas shall be installed and maintained in proper condition to prevent ponding adjacent to the roadway. Ponding adjacent to the roadway or on the parking area greater than 3 inches deep or that is suspected to be adversely affecting the structural integrity of the roadway or parking areas shall be immediately corrected by the Contractor.
  - c. Corrugations or washboarding on the roadway surface shall not exceed 2 inches in depth.
  - d. The surface of the road and parking area shall be maintained in a condition that prevents visible dust.
  - e. Potholes greater than 2 feet in diameter and 2 inches in depth shall be immediately corrected by the Contractor.
  - f. Rutting greater than 3 inches deep shall be immediately corrected by the Contractor.
  - g. Loose aggregate on the road surface or aggregate berms on the roadway shoulder or less traveled roadway areas greater than 4 inches in depth shall be immediately corrected by the Contractor.
  - h. Signs, markings, and traffic control devices along the haul road shall conform to the Federal Highway Administration Manual on Uniform Traffic Control Devices for Streets and Highways.
9. If haul road is constructed over existing BMI Landfills, Contractor shall place a minimum of 3 inches of soil over the portion of haul road corridor on the landfill. The Contractor shall not displace BMI Landfill soils in road construction. Contractor shall not construct haul road over completed BMI Landfill cover systems.
10. Haul Roads used for transport of clean materials shall be separate from haul roads used for transport of contaminated materials.
- F. Construction vehicle traffic on public roads shall comply with all applicable traffic control requirements as established by the City of Henderson, Clark County, and the Nevada Department of Transportation (NDOT).

#### **1.08 TEMPORARY FACILITY REQUIREMENTS**

- A. The Contractor shall prepare all surfaces to be adequate for utility and facility installation and to provide adequate stability and durability during the duration of this Contract.
- B. The Contractor shall consider the efficient use of space available at the Project site and schedule material deliveries, equipment use, and other remedial action activities to minimize storage and field facility requirements. The Contractor may locate, arrange, and lay out the facilities to best suit an efficient operation within the parameters defined herein. Obtain Construction Manager approval of building or trailer sizes and locations prior to mobilization.
- C. During the Project mobilization phase, the Contractor shall develop and establish the Project staging and stockpile areas in accordance with Construction Drawings. The staging area shall be used for Contractor construction material storage, laydown yard equipment, prefabrication of Project elements, acceptance testing (as appropriate), storage, uncontaminated construction vehicle parking, construction water source, vehicle maintenance, and any other temporary items associated with the Project. The Project staging area shall not include offices.
- D. Staging areas shall be located at both the Eastside and CAMU Areas in accordance with Construction Drawings.



- E. The staging areas for receipt/storage of clean equipment, supplies, and materials shall not be located in a contaminated or controlled area.
- F. Construction Facilities Layout Plan shall include the location, size, layout, and traffic patterns of the staging, stockpile, and support facility areas at each different stage of the Project.
- G. Except for private vehicles, all vehicles and equipment associated with the Project, but not currently involved in remedial activities, shall be parked in the Contractor's staging area.
- H. All facilities and utilities shall be designed and installed to allow uninterrupted service during all seasons.

## **1.09 LIGHTING REQUIREMENTS**

- A. Illumination shall be in accordance with 29 CFR 1926.56. The following illumination requirements apply.
  - 1. Decontamination pad shall include the following:
    - a. A minimum of 10-foot candles in all working areas.
    - b. Direct lighting shall be available for both sides of any vehicle to eliminate shadowing.
  - 2. Active excavation areas shall include the following:
    - a. A minimum of 3-foot candles in all working areas.
    - b. Lighting shall be placed around perimeter of work area so light is evenly distributed around the perimeter.
  - 3. Equipment staging areas and refueling areas shall have a minimum of 3-foot candles.
  - 4. All minimum illumination guidelines shall be maintained from ground level to a height of six feet.
- B. Lighting shall be in accordance with 19.10.7 Operational performance standards in the Henderson Development Code:
  - 1. Freestanding light fixtures within 50 ft of Eastside western property line shall be no greater than 20 ft in height.
  - 2. Freestanding light fixtures 50 ft to 150 ft from Eastside western property line shall be no greater than 25 ft in height.
  - 3. Freestanding light fixtures at the CAMU and further than 150 ft from the Eastside western property line shall be no greater than 30 ft in height.
  - 4. Height shall be measured from the top of the light fixture to the adjacent grade at the base of the support for the light fixture.
  - 5. All lighting shall be directed downward and away from adjoining property and shall be shielded to prevent unnecessary glare.
- C. Security lighting shall be protected by weather- and vandal-resistant covering, shall be a managed light source, and shall be directed down to minimize glare and intrusiveness.
- D. White, full-spectrum "white light" shall be used at all times.

## 1.10 TEMPORARY TRAILERS

- A. Contractor is responsible for providing Contractor's, Construction Managers, and CQA Engineer's trailer and shall be located at the Eastside Areas staging area. The exact trailer locations shall be coordinated with Construction Manager.
- B. Construction Manager and CQA Engineer's trailer shall be a minimum of one 60 foot single double-wide trailer with two offices at each end. The trailer shall be furnished with six layout tables, eight desks, eight rolling chairs, plan table, drafting stool, plan rack, five – five drawer filing cabinets that can account for legal size, minimum 4' x 8' conference table, and twelve conference chairs. Four five-ft high partitions panels adequate for isolating four desks in the common area shall be provided. Operating heating and air conditioning of sufficient capacity shall be provided. ~~Electric power shall be provided to include a minimum of 4 duplex convenience outlets, illumination at the desks and conference table area, and an outside light.~~ **Electric power shall be every 6 feet with duplex convenience outlets, illumination at the desks and conference table area, and an outside light.** Three outside phone lines and service shall be provided within the trailer.
- C. Trailers shall be equipped with high speed internet capabilities, DSL or cable internet equivalent with an N-wireless modem capable of a minimum download rate of 1.5 mega bit/sec.
- D. Trailers shall be equipped with a black and white printer, copier, scanner combination capable of, at minimum, the following:
  - 1. Copy/print rate of at least 40 pages per minute for 8 ½ inch x 11 inch paper size;
  - 2. Copying/printing/scanning up to 11 x 17 inch pages;
  - 3. Sorting capabilities up to 20 copies;
  - 4. Copy/print/scan 2 sided documents; and
  - 5. Compatible operating system: Windows 2000 through Windows Vista
- E. Trailers shall be equipped with a fax machine capable of printing single pages at a rate of 20 pages per minute.
- F. Trailers shall be equipped with four telephone numbers: one fax line, three voice lines. A minimum of 12 telephone jacks shall be in the trailer capable of reaching all three voice lines. One telephone jack shall be provided for the fax machine.
- G. Contractor is responsible for coordinating temporary trailer utilities with local agencies. Available utilities are shown on the Construction Drawings.

## 1.11 ON-SITE COMMUNICATION

- A. Contractor shall provide Construction Manager with two-way radios for all of the Construction Manager's field staff, Security, the Owner, and the Owner's consultants providing onsite field services (air monitoring, CQA, surveying, conformation sampling).
- B. Additional radios shall be maintained in the trailers on same or dual frequency to monitor site conversations and for contacting contractor representatives.
- C. Permits, licenses, and any equipment necessary for Contractor use of two-way radios shall be the responsibility of the Contractor.

### **1.12 TEMPORARY SANITARY FACILITIES**

- A. Provide temporary male and female sanitary facilities at each office trailer. Sanitary facilities onsite will need to be provide for all employees and persons engaged in the Work, including subcontractors, their employees and authorized visitors, Construction Manager (4 persons), and CQA Engineer (3 persons).
- B. Sanitary facilities include enclosed chemical toilets and washing facilities. These facilities must meet the requirements of local public health standards.
- C. Locate sanitary facilities as approved by Construction Manager, and maintain in a sanitary condition during the entire course of the Work.
- D. Sanitary Facilities shall be placed at both the CAMU and Eastside Areas.
- E. Sanitary Facilities shall be serviced weekly.

### **1.13 TEMPORARY WATER**

- A. Make all arrangements for water needs with the Construction Manager and the City of Henderson.
- B. Provide drinking water for all personnel at the site.
- C. The Contractor shall provide temporary pipes, hoses, and water as required for dust and moisture control during excavation and backfill operations, for the decontamination facilities, and for other remediation requirements. Water can be potable or reclaim water obtained from the City of Henderson. Contractor shall make arrangements with the City for access to water. Reclaimed water access locations are shown on Construction Drawings. Non-potable water sources and trucks shall be clearly marked with "NON-POTABLE WATER."
- D. Available water sources for both potable and reclaimed water are shown on the Construction Drawings. The Contractor is responsible for obtaining a hydrant meter from the City. The Contractor shall not add substances (such as soap) to construction water. The Contractor shall utilize measuring devices that allow him to track the volume of water used. Such usage records shall be maintained and provided to the Construction Manager.
- E. The Contractor shall obtain permission to use an existing potable water source for construction purposes. The Contractor shall make arrangements with the City of Henderson and shall be responsible for payment of all water used by the Contractor.
- F. Any hookups to a domestic potable water supply shall have a backflow- prevention device installed at the service connection to allow cross-connection control.
  - 1. Devices shall be equal in size to the service line and installed per manufacturer's recommendations.
  - 2. All water supply hookups shall be inspected, as required, by the appropriate local governing agency.

### **1.14 STORAGE OF MATERIALS AND EQUIPMENT**

- A. Storage areas shall be presented in the Staging Area Layout Plan. Locations and configurations of approved facilities are subject to the acceptance of the Construction Manager.
- B. Optional staging areas are shown on the Construction Drawings. Confirm staging areas with Construction Manager

- C. Confine all operations, including storage of materials, to approved areas. Store materials in accordance with these Technical Specifications and the Construction Drawings.
- D. Store construction materials and equipment within boundaries of designated areas. Storage of gasoline or similar fuels must conform to state and local regulations and be limited to the areas approved for this purpose by the Construction Manager.
- E. The Contractor shall deliver packaged materials to the site in the manufacturer's original, unopened, labeled containers. Containers shall not be opened until the approximate time of use or as agreed to by the Contractor for the purposes of inspecting and testing.

#### **1.15 ADDITIONAL STORAGE AREAS**

- A. Design of the following storage areas shall be included with the Construction Facilities Layout Plans submittals. Design shall only be resubmitted when revised for a specific phase.
  - 1. VACUUM TRUCK STAGING AREA - The Contractor shall designate and maintain a vacuum truck staging area as shown on the Construction Drawings.
  - 2. DECONTAMINATION AREA - The Contractor shall provide a decontamination area with a concrete pad draining into a collection area at the Eastside Area and CAMU area. Locations of decontamination areas shall be in accordance with Construction Drawings. The Contractor shall provide a storage tank to hold decontamination water prior to disposal. Contractor shall provide additional decontamination areas at the Eastside and CAMU, as needed, consisting of bermed/sloped areas lined with plastic sheeting if necessary. The private haul road between the Decontamination Area and Warm Springs Road shall have a minimum of 3-inches of gravel a minimum of 20-feet wider than the largest truck.
  - 3. DEBRIS STORAGE AREA – The Contractor shall provide an 150 foot (ft) x 60 ft HDPE-lined debris storage area constructed in accordance with Section 02770 of these Specifications. Debris storage area shall be built on top of existing ground with 3-ft lined berms and a sump for collection and removal of rain water. Additional 1-ft berms shall be constructed within the debris storage area to segregate potentially hazardous materials. A minimum 1 foot protection layer of soil, or other material, with particles no larger than 1 inch shall be placed above the HDPE liner prior to debris disposal.

#### **1.16 CONSTRUCTION EQUIPMENT**

- A. Erect, equip, and maintain all construction equipment in accordance with all applicable statutes, laws, ordinances, rules, and regulations or other authority having jurisdiction.
- B. Provide and maintain scaffolding, staging, hoists, barricades, and similar equipment required for performance of the Work. Provide hoists or similar equipment with operators and signals, as required.
- C. Provide, maintain, and remove upon completion of the Work, all temporary rigging, scaffolding, hoisting equipment, debris boxes, barricades around openings and excavations, fences, ladders, and all other temporary work, as required for all Work hereunder.
- D. Construction equipment and temporary work must conform to all the requirements of state, county, and local authorities, OSHA, and underwriters that pertain to operation, safety, and fire hazard. Furnish and install all items necessary for conformity with such requirements, whether or not called for under separate Sections of these Technical Specifications.

## **1.17 ELECTRICITY**

- A. Using existing electrical sources on the property (as shown on the drawings), the Contractor shall provide temporary electric service as required for remediation purposes. The Contractor shall be responsible for any damage to the electrical system caused by the Contractor's improper use of the system.
- B. The Contractor shall verify the existing electrical service capacity and equipment available at the site, and verify the equipment and load requirements of temporary facilities to be provided. The Contractor shall provide any additions or modifications to the minimum allowable services as required by code, utility company, or municipal agency having jurisdiction to connect the required temporary facilities. Such additions or modifications shall include acquiring permits, fees, and all other administrative requirements. Additions or modifications to the minimum electrical service requirements shall be reviewed by the Construction Manager and shall be provided at no additional cost to the Construction Manager. (no change)

## **1.18 TELEPHONE SERVICE**

- A. The Contractor shall be responsible for establishment of service and establishment costs for telephone service including: telephone conduits, telephone hardware, and connection of service lines to the Construction Facilities. The Owner will be responsible for monthly costs associated with telephone use.
- B. The Contractor shall provide telephone with the following capabilities:
  - 1. Minimum capacity of 3 lines;
  - 2. Voicemail;
  - 3. Speaker phone;
  - 4. Redial;
  - 5. Memory;
  - 6. Transfer; and
  - 7. Hold.

## **1.19 WEATHER PROTECTION**

- A. The Contractor shall provide all heating for remedial work that requires cold-weather protection. All temporary heating arrangements shall comply with applicable codes and regulations. Equipment and surroundings shall be kept clean and safe.
- B. Open-flame heating devices or oil burning salamander-type devices may be used when approved by the Construction Manager. Approval shall be dependent on the Contractor's ability to provide adequate safety protection.
- C. The Contractor shall furnish and install temporary enclosures as needed to protect construction from damage due to weather or elements, or to maintain suitable temperature during the installation or finishing of work. At all times, the Contractor shall provide protection against freezing, storms, wind, rain, or heat to maintain work, materials, and equipment free from injury or damage. At the end of each day's work, all work susceptible to damage shall be protected.

## **1.20 TRASH AND DEBRIS CONTROL**

- A. The Contractor shall inspect the site daily and remove uncontaminated trash/debris that has accumulated and properly dispose of it off site.
- B. Uncontaminated debris shall not be disposed of in the HDPE lined containment area.
- C. Contractor generated debris will be properly disposed of off-site at the expense of the Contractor.

## **1.21 HEALTH AND SAFETY**

- A. Provide necessary first aid equipment and supplies, health and safety monitoring equipment and personal protective equipment in accordance with Contractor prepared Site Health and Safety Plan and Section 01110 of these Specifications.

## **1.22 SECURITY**

- A. Make all necessary provisions and be responsible for the security of the Work and the Site until final inspection and acceptance of the Work, unless otherwise directed by the Construction Manager and in accordance with Section 01100, Part 3.07.

## **1.23 TEMPORARY FACILITIES MAINTENANCE AND REMOVAL**

- A. Maintain temporary facilities and controls as long as needed for safe and proper completion of the Project. All installed facilities shall be maintained in a clean, safe, and sanitary condition at all times until completion of the Contract.
- B. The Contractor shall provide janitorial services for all temporary support facilities, including trailers provided by the Contractor, established under the Contract. These services shall include cleaning the floors and restroom facilities twice weekly.
- C. Remove temporary facilities and controls as soon as the progress of the Project permits, as otherwise specified in the Contract documents, or as directed by the Construction Manager.
- D. Upon completion of the Work, or prior thereto, when so required by Construction Manager:
  - 1. If off-road trucks or overloaded trucks are used during remediation activities, upon completion of remedial haul operations, the Contractor shall coordinate with COH and NDOT to replace the entire length of the haul route used during construction down to the subgrade. Reconstruction of Boulder Highway West Warm Springs Road shall be discussed in the Public Haul Road Maintenance and Repair Plans.
  - 2. Interior haul roads shall have the top 6 inch surface removed and disposed of in the CAMU as indicated on the Construction Drawings.
  - 3. Remove and dispose of all construction facilities. Similarly, all areas utilized for temporary facilities shall be returned to near original, natural state, or as otherwise indicated or directed by the Construction Manager.
  - 4. The Eastside and CAMU decontamination apron pads and concrete rubble and pads shall be removed, broken up, tested for contamination, and disposed of off site.
  - 5. At Project completion, demobilize the Contractor's staging area and reclaim support facilities areas installed under this Contract. Regrade areas to match existing contours and promote drainage without erosion.

## 1.24 SITE WATER MANAGEMENT

- A. The Contractor shall:
1. Control and manage storm water runoff;
  2. Control discharges from dewatering activities;
  3. Direct use of clean and contaminated water for dust control; and
  4. Control water levels in all storm water sedimentation ponds on the site.
  5. Monitor leachate levels within the sumps and at no time allow levels within sump to exceed 3 feet in depth **as measured from the top of the geomembrane.**
- B. The Water Management Plan shall describe how the Contractor shall dewater the Eastside Areas and active and inactive CAMU cells and other excavated areas, utilize water at the site, incorporating restrictions placed on the use of water for dust control, use of leachate for dust control, and control of water levels in the ponds. The Contractor shall coordinate the information in the Plan with the requirements of the Contractor Storm Water Pollution Prevention Plan.
- C. During the Contract performance period, and prior to completion of permanent runoff control features, including non-working hours such as holidays, the Contractor shall prevent runoff water from leaving contaminated areas of the Project site. The Contractor shall comply by using techniques that may include, but are not limited to, the following:
1. Excavation of temporary swales, ditches, and/or retention ponds.
  2. Construction of temporary diversion dikes and berms.
  3. Pumping water to runoff water control facilities or using the water for dust control in contaminated areas. Water removed from contaminated excavations or runoff ponds shall be considered to be contaminated.
- D. Adequate runoff water control shall be maintained at all times in contaminated and/or controlled areas where the pre-existing surfaces have been removed or disturbed, and in stockpiles of materials on the Project site, so that water is prevented from flowing from contaminated areas to uncontaminated areas.
- E. Contractor shall prioritize contaminated water disposal in the following ways, in accordance with Health and Safety procedures indicated in the Health and Safety Plan:
1. Dust control of contaminated materials within lined areas of CAMU;
  2. Waste placement moisture conditioning in the CAMU; and
  3. Off-site disposal. If contaminated water is disposed of off-site, Contractor shall:
    - a. Follow waste manifest procedure for hauling of contaminated water.
    - b. Contractor shall be responsible for establishing the waste profile for disposal purposes.
- F. The Contractor shall establish controls to keep runoff water from noncontaminated areas from entering the CAMU and any contaminated area.
- G. The Contractor shall install temporary drainage piping to control overland flow, route natural drainage under temporary roadways, and intercept groundwater flows, if necessary. The Contractor shall select the size and type of piping to be used, and shall be responsible for the

performance of the temporary piping. The Contractor shall adequately compact materials around the drainage piping to ensure protection of the piping and adequacy of fill over the piping. The Contractor shall perform regular maintenance of any temporary piping as necessary to prevent plugging or reduced capacity.

- H. Water coming into contact with waste and operations layer materials shall be handled and disposed of as contaminated water.

## **PART 2 – PRODUCTS**

[Not Used]

## **PART 3 – EXECUTION**

[Not Used]

## **PART 4 – MEASUREMENT AND PAYMENT**

- A. Providing for and complying with the requirements set forth in this Section for Construction Facilities shall be considered as incidental to Mobilization and Demobilization, Section 01505, and payment shall be based on the lump sum price provided on the Bid Schedule.

[END OF SECTION]



**SECTION 01505  
MOBILIZATION / DEMOBILIZATION**

**PART 1 – GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. Mobilization consists of preparatory work and operations, including but not limited to those necessary for the movement of personnel and project safety; including: adequate personnel, equipment, supplies, and incidentals to the project Site; establishment of facilities necessary for work on the project; premiums on insurance for the project and for other work and operations the Contractor must perform or costs the Contractor must incur before beginning work on the project, which are not covered in other bid items.
- B. Demobilization consists of work and operations including, but not limited to, movement of personnel, equipment, supplies, incidentals, and temporary facilities including trailers, haul roads, parking lots, and decontamination pads off-site.

**PART 2 – PRODUCTS**

[Not Used]

**PART 3 – EXECUTION**

[Not Used]

**PART 4 – MEASUREMENT AND PAYMENT**

**4.01 GENERAL**

- A. Providing for and complying with the requirements set forth in this Section for Mobilization and Demobilization shall be lump sum (LS) and payment shall be based on the prices provided on the Bid Schedule.
- B. The Contractor shall include the following specified items as incidental to Mobilization and Demobilization and shall be included in the lump sum costs provided on the Base Bid Schedule. With the noted exceptions, the lump sum costs shall include initial set up and removal, operational and maintenance costs shall be included as incidental to Earthworks and Remedial Excavation and Filling, Sections 02200 and 02205, respectively:
  - 1. Construction Facilities
    - a. Parking Areas
    - b. Temporary Roads
      - i. Haul Road Maintenance and Repair Plan
      - ii. Haul Road Plan
    - c. Temporary Trailers
    - d. Temporary Utilities
    - e. On-site communications
    - f. Weather Protection

- g. Contractor Generated Debris and Trash Control
- h. Temporary Sanitary Facilities: includes initial set-up, maintenance, and removal
- i. Lighting
- j. Material and Equipment Storage
- k. Dust Control Water Storage
- l. Vacuum Truck Staging Area
- m. Decontamination Area
- n. Construction Equipment
- o. First Aid Facilities
- p. HDPE-lined Storage Area
- 2. Contract Close-out
- 3. Temporary Controls:
  - a. Dust Control
    - i. Dust Control and Mitigation Plan
  - b. Pollution Control
    - i. Fuel Plan
  - c. Traffic and Safety Control
    - i. Signs
    - ii. Traffic control equipment: cones, baracades
  - d. Access Control
    - i. Guard Stations
    - ii. Gates and Fences
    - iii. Site Security Plan
  - e. Decontamination
    - i. Decontamination Pad
    - ii. Decontamination Water Storage Tank
  - f. Noise Control
    - i. Equipment Mufflers
- 4. Health and Safety Plan
  - a. Spill Prevention and Response Plan

5. And all other incidentals necessary for mobilization and demobilization.

- C. The Contract Price for Mobilization / Demobilization shall include the provision for movement of equipment onto the job site; removal of all facilities and equipment at the completion of the project; permits; preparation of a Health and Safety Plan; and all other related mobilization and demobilization costs. Price bid for mobilization shall not exceed 10 percent of the total bid for the Project. ~~Fifty percent of the mobilization bid price, less retention, shall be paid on the initial billing provided all equipment and temporary facilities are in place. The remaining 50 percent of the mobilization bid price shall be paid on satisfactory removal of all facilities and equipment on completion of the project.~~

[END OF SECTION]

## **SECTION 01560 TEMPORARY CONTROLS**

### **PART 1 – GENERAL**

#### **1.01 DESCRIPTION OF WORK**

- A. Temporary Controls required during the term of the Contract for the protection of the environment and the health and safety of workers and general public.
- B. Furnishing all equipment, materials, tools, accessories, incidentals, and labor, and performing all work for the installation of equipment and construction of facilities, including their maintenance and operation during the term of the Contract.
- C. Temporary Controls include:
  - 1. Dust Control.
  - 2. Pollution Control.
  - 3. Traffic and Safety Controls.
  - 4. Access Control.
  - 5. Decontamination
  - 6. Noise Control
- D. Perform Work as specified in the Technical Specifications and as required by the Construction Manager. Maintain equipment and accessories in clean, safe and sanitary condition at all times until completion of the Work.

#### **1.02 RELATED SECTIONS**

Section 01505 – Mobilization/Demobilization

Section 02820 – Chain Link Fence

#### **1.03 SUBMITTALS**

- A. Dust Control Permit and Mitigation Plan
- B. Fuel Plan
- C. Site Security Plan
- D. Decontamination Plan

#### **1.04 REFERENCES**

- A. Construction Drawings
- B. BRC, 2006. "Corrective Action Plan (CAP) For The Basic Remediation Company (BRC) Common Areas Remediation Project," September.
- C. BRC, 2005. "Perimeter Air Monitoring Plan For Soil Remediation Activities BMI Upper and Lower Ponds and Ditches, Clark County, Nevada," April

- D. PBS&J, 2006, "Landwell Haul Route: Traffic Control Plan, Boulder Highway and Warm Springs Road intersection," Prepared for The Landwell Company, April.
- E. Geosyntec, 2007. "Revised Remedial Action Plan (RAP) Permit Application for Corrective Action Management Unit (CAMU), Henderson, Nevada," Prepared for Basic Remediation Company, Submitted to Nevada Department of Environmental Protection, March.
- F. Nevada Department of Transportation (NDOT) Traffic Permit No. 91464-2006 dated 13 April 2006.
- G. United States Department of Transportation, Federal Highway Administration: Manual on Uniform Traffic Control Devices, 20 November 2003.

## **1.05 DUST CONTROL**

- A. Provide dust control measures in-accordance with the Technical Specifications, Dust Control Permit, Mitigation Plan, and Perimeter Air Monitoring Plan. Dust control measures must meet requirements of applicable laws, codes, ordinances.
- B. The Contractor is responsible for applying for, obtaining, and complying with a Dust Control Permit and Mitigation Plan for construction activities through the Air Pollution Control District of the Clark County Health District. An example Dust Control Permit and Mitigation Plan is included as Appendix C of the Corrective Action Plan (CAP).
- C. Dust control consists of transporting water, furnishing required equipment, testing of equipment, additives, accessories and incidentals, and carrying out proper and efficient measures wherever and as often as necessary to reduce dust nuisance, and to prevent dust originating from construction operations throughout the duration of the Work.
- D. Dust suppression shall include all roadways, stockpiles, excavations, and other areas.
- E. Dust suppression activities shall be conducted as necessary, 7 days per week, 24 hours per day, including holidays.
- F. The Contractor shall take necessary measures to eliminate dust. Visible dust is not allowed. The Contractor may use techniques that include, but are not limited to, the following:
  - 1. Minimize disturbance of vegetated areas.
  - 2. Enforcement of lower speed limits on all vehicles traveling within the Project site.
  - 3. Suppressing dust generation by spraying the area with water or a Construction Manager-accepted dust retardant.
- G. Adequate moisture content shall be maintained at all times in contaminated areas where the pre-existing surfaces have been removed or disturbed, and in materials that have been stockpiled on the job site, so that dust shall not be generated.
- H. The Contractor shall protect all areas from any refuse or dust generated by the work.
- I. The Contractor shall provide surface covering to maintain mud-free conditions at the ingress/egress locations of the facility support area and at Project access locations indicated on the drawings. The Contractor shall maintain the covering for the duration of the Project.
- J. The Contractor shall not use contaminated leachate for dust control in uncontaminated or previously remediated areas. Contaminated water shall not be used for dust-control purposes on the haul road.

## **1.06 POLLUTION CONTROL**

### **A. Pollution of Waterways:**

1. Perform Work using methods that prevent entrance or accidental spillage of solid or liquid matter, contaminants, debris, and other objectionable pollutants and wastes into watercourses, flowing or dry, and underground water sources.
2. Such pollutants and wastes shall include, but shall not be limited to, refuse, earth and earth products, garbage, cement, concrete, sewage effluent, industrial waste, hazardous chemicals, oil and other petroleum products, aggregate processing tailings, and mineral salts.

### **B. Existing Eastside Area pollutants shall be disposed of at the HDPE lined disposal cell, and tested by the Owner. Pollutants shall be transported for disposal off-site.**

### **C. Contractor shall be responsible for disposal of pollutants resulting from Contractor's operations.**

### **D. Contractor shall only perform fueling activities and maintenance and repair activities in designated areas as shown on the Construction Drawings and in accordance with the Fuel Plan.**

### **E. Contractor shall be responsible for pollution that results from refueling, maintenance, or repair of construction equipment, or work activities resulting in pollutant release.**

### **F. All trucks shall be driven across gravel aprons prior to entering Warm Springs Road to remove loose soil. Gravel aprons shall extend from decontamination area to West Warm Springs Road.**

### **G. Storage and Disposal of Petroleum Product:**

1. Petroleum products covered by this Section include gasoline, diesel fuel, lubricants, and refined and used oil. During project construction, store all petroleum products in such a way as to prevent contamination of all ground and surface waters and in accordance with local, state, and federal regulations.
2. Lubricating oil may be brought into the project area in steel drums or other means, as the Contractor elects. Store used lubricating oil in steel drums, or other approved means, and return them to the supplier for disposal. Do not burn or otherwise dispose of at the Site.
3. Secondary containment shall be provided for products stored on site, in accordance with the Contractor provided Storm Water Pollution Prevention Plan.

### **H. Contaminated Material Spills**

1. In the event of a spill of contaminated material in an uncontrolled area, a total Project work stoppage shall be initiated by the Contractor. During the work stoppage, safety and procedural reviews, determination of root causes, and corrective actions shall be determined by the Construction Manager and implemented by the Contractor prior to resuming the work. No compensation shall be provided to the Contractor for work stoppages that result from spills. Work shall not be resumed without Construction Manager approval.
2. In the event of spillage at Boulder Highway crossing, Contractor shall immediately sweep and vacuum spilled materials.

### **I. At the daily conclusion of transport operations, Contractor shall vacuum the Boulder Highway crossing and public rights of way.**

## **1.07 TRAFFIC AND SAFETY CONTROLS**

### **A. Traffic controls shall be in accordance with the Owner provided Traffic Control Plan.**

- B. Post construction areas and roads with traffic control signs or devices used for protection of workmen, the public, and equipment. Signs and devices must conform to the American National Standards Institute (ANSI) Manual on Uniform Traffic Control Devices for Streets and Highways.
- C. Interior private haul roads shall direct trucks to pond excavations, decontamination areas, refueling area, truck wash and repair, and designated disposal areas within the CAMU. Contractor shall post weather-proof signs along haul roads indicating active areas of remediation and waste placement.
- D. Remove signs or traffic control devices after they have finished serving their purpose. It is particularly important to remove any markings on road surfaces that under conditions of poor visibility could cause a driver to turn off the road or into traffic moving in the opposite direction.
- E. Provide flag persons, properly equipped with International Orange protective clothing and flags, as necessary, to direct or divert pedestrian or vehicular traffic.
- F. Barricades for protection of employees must conform to the portions of the ANSI Manual on Uniform Traffic Control Devices for Streets and Highways, relating to barricades.
- G. Guard and protect all workers, pedestrians, and the public from excavations, construction equipment, all obstructions, and other dangerous items or areas by means of adequate railings, guard rails, temporary walks, barricades, warning signs, sirens, directional signs, overhead protection, planking, decking, danger lights, etc.
- H. Construct and maintain fences, planking, barricades, lights, shoring, and warning signs as required by local authorities and federal and state safety ordinances, and as required to protect all property from injury or loss and as necessary for the protection of the public, and provide walks around any obstructions made in a public place for carrying out the Work covered in this Contract. Leave all such protection in place and maintained until removal is authorized by the Construction Manager.
- I. At the beginning of haul operations for the day, the Contractor shall inspect light signals at Boulder Highway and West Warm Springs Road intersection. Traffic and pedestrian light shall be in good, working order. If light signals are inoperable, Contractor shall provide flag persons, properly equipped with International Orange protective clothing and flags, as necessary, to direct or divert pedestrian or vehicular traffic.

## **1.08 ACCESS CONTROL**

- A. As remediation progresses, the Contractor shall maintain contamination-control boundaries between "clean" areas and exclusion areas.
- B. Perimeter fencing shall be installed and/or repaired to restrict, reduce, or eliminate access by the public, livestock, and wildlife into the work area. Interior fencing shall be installed at the Eastside Areas around the remediation area. Fence type(s) shall be in accordance with Section 02820 of these specifications and as indicated on the drawings. Fencing shall be placed and moved as necessary to minimize disruption to ongoing operations at the Project site and adjacent properties.
- C. The Contractor shall maintain CAMU site perimeter fences, gates, and signs to prevent intrusion by the general public. Maintenance includes keeping fences taut, performing all minor repairs that do not require additional materials, and placement of signs as designated by the Construction Manager. The Contractor shall remove or thin trees/brush so that the signs are visible.
- D. The Contractor shall install and maintain Eastside Area exclusion zone fences, and gates to prevent access by individuals without proper training. Maintenance includes keeping fences taut, performing all minor repairs that do not require additional materials designated by the Construction Manager. Eastside Area site perimeter fence will be maintained by Owner. Owner will provide and maintain site perimeter signs.

- E. Private and personal vehicles not used for authorized construction purposes shall not access the controlled areas. Parking of private or personal vehicles shall be restricted to the designated support facilities area near the Eastside Areas and CAMU work areas as shown on the Construction Drawings. All Contractor vehicles shall comply with applicable licensing regulations.
- F. The Contractor shall provide gate attendants' offices at the Eastside access gate and CAMU access gate off Warm Spring Rd. to be continuously manned and serve as a checkpoints.
- G. Contractor shall maintain a sign-in/sign-out log for all visitors. Contractor is responsible for logged visitors while visitors are on-site. Visitors shall not enter remedial excavation exclusion or support zones without documented proof of current training in accordance with Title 29 of the Code of Federal Regulations (CFR) Part 1910.120. Contractor shall provide tailgate health and safety briefing to all visitors prior to entering exclusion zone.

#### **1.09 DECONTAMINATION**

- A. Construction equipment shall be decontaminated as follows prior to leaving both the Eastside and CAMU areas:
  - 1. Personnel shall be dressed in proper PPE
  - 2. Trucks shall be decontaminated such that there is no visible soil material build-up on sides, mud-flaps, undercarriage, or tires when leaving decontamination areas.
  - 3. Contractor shall steam clean equipment as recommended in the CAP. An alternative method of decontamination shall be permitted if shown by Contractor to be more economical and as effective as steam cleaning.
  - 4. Decontamination water shall be pumped from the collection area into a storage tank. Water shall be sampled if disposed of off-site at the Owner's expense.
- B. Contractor shall provide personnel at access points to inspect trucks prior to entering public roadways. Trucks shall be inspected for caked soil and mud as well as tarps or covers over waste materials.

#### **1.10 NOISE CONTROL**

- A. The Contractor is responsible for managing site construction noise at levels in accordance with Sections 19.10.7 and 19.14 of the City of Henderson Development Code.
- B. The following sound levels are the maximum allowed at the Eastside area, as measured from the property line, during the given times:

Time of Day	Maximum Permitted Sound Level (dBA) Outdoors
7 am to 9 pm	65 – Daytime
9 pm to 7 am	60 – Nighttime
24 hour	70 (Not to exceed for greater than 15 minutes in a 24-hr period)

- C. The following sound levels are the maximum allowed at the CAMU area, as measured from the property line, during the given times:



Time of Day	Maximum Permitted Sound Level (dBA) Outdoors
5 am to 8 pm	73 – Daytime
8 pm to 5 am	73 – Nighttime
24 hour	73 (Not to exceed for greater than 15 minutes in a 24-hr period)

- D. If the noise is not smooth and continuous or is not present between the hours of 10 pm and 7 am, one or more of the following corrections shall be applied to the above sound levels:

Noise Source/Timing	Correction in dBA
Daytime operation only	+5
Noise source operates less than 20 percent of any one hour period	+5
Noise source operates less than 5 percent of any one hour period	+10
Noise of impulsive character such as hammering	-5
Noise of periodic character such as humming or screeching	-5

- E. Noise shall be measured by a sound level meter or noise dosimeter meeting current American Standards Institute (ASI) Specification for Sound Level Meter, S1.4 (1983) Type S2A and set to use the A-weighted network with slow meter response.
- F. Contractor shall not operate equipment with unmuffled exhausts.
- G. Contractor shall not operate equipment with sound control devices less effective than those provided on the original equipment.

#### **1.11 MAINTENANCE**

- A. Maintain all temporary controls in good working conditions during the term of the Contract for the safe and efficient transport of equipment and supplies, and for construction of permanent works.

#### **1.12 STATUS AT COMPLETION**

- A. Upon completion of the Work, or prior thereto as approved by the Construction Manager, remove all temporary controls and restore disturbed areas.

### **PART 2 – PRODUCTS**

[Not Used]

### **PART 3 – EXECUTION**

[Not Used]

## **PART 4 – MEASUREMENT AND PAYMENT**

### **4.01 GENERAL**

- A. Providing for and complying with the requirements set forth in this Section for establishing and removing Temporary Controls shall be considered as incidental to Mobilization and Demobilization, Section 01505, and payment shall be based on the lump sum price provided on the Bid Schedule.
- B. Providing for and complying with the requirements set forth in this Section for operations and maintenance of Temporary Controls shall be considered as incidental to Earthworks and Remedial Excavation, Sections 02200 and 02205, respectively, and payment shall be based on the unit prices provided on the Bid Schedule.

[END OF SECTION]

**SECTION 01700  
CONTRACT CLOSEOUT**

**PART 1 – GENERAL**

**1.01 CLOSEOUT PROCEDURES**

- A. Contractor shall submit written certification that the Technical Specifications, CQA Plan, and Drawings have been reviewed, Work has been inspected, and that Work is complete and in accordance with the Technical Specifications, CQA Plan, and Drawings and ready for Construction Manager's inspection.

**1.02 RELATED SECTIONS**

Section 01505 – Mobilization/Demobilization

**1.03 FINAL CLEANING**

- A. Contractor shall execute final cleaning prior to final inspection.
- B. Contractor shall clean equipment and fixtures to a sanitary condition.
- C. Contractor shall remove waste and surplus materials, rubbish, and construction facilities from the construction Site.

**1.04 AS-BUILT DOCUMENTATION**

- A. Contractor shall provide Construction Manager with all record documents.

**PART 2 – PRODUCTS**

[Not Used]

**PART 3 – EXECUTION**

[Not Used]

**PART 4 – MEASUREMENT AND PAYMENT**

**4.01 GENERAL**

- A. Providing for and complying with the requirements set forth in this Section for Contract Closeout shall be considered as incidental to Mobilization and Demobilization, Section 01505, and payment shall be based on the lump sum price provided on the Base Bid Schedule.

[END OF SECTION]

## **SECTION 02010 DEMOLITION**

### **PART 1 – GENERAL**

#### **1.01 DESCRIPTION OF WORK**

- A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings.
- B. The Contractor shall remove, transport, dispose, and pay all costs thereof, the materials to be demolished as shown on the Construction Drawings.

#### **1.02 RELATED SECTIONS**

Section 02110 – Site Clearing

#### **1.03 REFERENCES**

- A. Construction Drawings

#### **1.04 DEFINITIONS**

- A. Clean Debris: Clean debris are demolished materials which is not contaminated as verified by analytical testing, or debris originally located within the CAMU Area, and can be disposed of in a municipal, solid waste landfill.
- B. Contaminated Debris: Contaminated debris are demolished materials outside of the Eastside Area Ponds found to be contaminated by analytical testing and cannot be disposed of in a municipal, solid waste landfill.

#### **1.05 SUBMITTALS**

- A. The Contractor shall submit to the Construction Manager a description of equipment and methods proposed for the removal, transport, and disposal of materials to be demolished at least 7 days prior to the start of activities covered by this Section.

### **PART 2 – PRODUCTS**

### **PART 3 – EXECUTION**

#### **3.01 GENERAL**

- A. The Contractor shall be responsible for demolition, removal, transport, and off-site disposal of the existing chain link fence as shown on the Construction Drawings.
- B. The Contractor shall be responsible for removing and proper off-site disposal of surficial debris from within the limits of work. If Eastside Area surficial debris exhibits evidence of containing potentially hazardous materials, it shall be stockpiled separately within the HDPE-lined Debris Storage Area as described in Section 01500 of these Specifications. Eastside Area debris stockpiled in the lined debris storage area will be tested by the Owner prior to release from site.
- C. The Contractor shall not demolish any materials outside of the areas specified on the Drawings without prior written approval by the Construction Manager. Any unauthorized demolition of property features shall be repaired, to the satisfaction of the Construction Manager, at the Contractor's expense.

### **3.02 DISPOSAL**

- A. Eastside and CAMU Area clean debris shall be disposed off in an off-site municipal solid waste facility.
- B. Eastside debris found to be hazardous through testing shall be disposed of at an off-site hazardous waste facility.
- C. Contractor shall not place any demolition materials or surficial debris, hazardous or non-hazardous, within the CAMU.

## **PART 4 – MEASUREMENT AND PAYMENT**

### **4.01 GENERAL**

- A. Providing for and complying with the requirements set forth in this Section for clean debris disposal shall be per ton (TON) and payment shall be based on the unit price for clean debris/vegetation disposal provided on the Base Bid Schedule.
- B. Providing for and complying with the requirements set forth in this Section for contaminated debris disposal shall be per ton (TON) and payment shall be based on the unit price for contaminated debris/vegetation disposal provided on the Base Bid Schedule.

[END OF SECTION]

## **SECTION 02110 SITE CLEARING**

### **PART 1 – GENERAL**

#### **1.01 DESCRIPTION OF WORK**

- A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings.
- B. The Contractor shall remove and dispose of all debris, vegetation, other organic and deleterious material, and other materials not suitable for Engineered fill materials that exist within the designated construction limits.

#### **1.02 RELATED SECTIONS**

Section 02200 – Earthwork

Section 02770 – Geomembrane

#### **1.03 REFERENCES**

- A. Construction Drawings

#### **1.04 DEFINITIONS**

- A. Clean Vegetation/Debris: Clean vegetation/debris is vegetation/debris which is not contaminated as verified by analytical testing, or vegetation originally located within the CAMU Area, and can be disposed of in a municipal, solid waste landfill.
- B. Contaminated Vegetation/Debris: Contaminated vegetation/debris outside of the Eastside Area Ponds is vegetation found to be contaminated by analytical testing and cannot be disposed of in a municipal, solid waste landfill.

### **PART 2 – PRODUCTS**

[Not Used]

### **PART 3 – EXECUTION**

#### **3.01 GENERAL**

- A. The Contractor shall be responsible for all clearing and grubbing operations within the limits of work.
- B. No open burning of combustible materials shall be allowed.
- C. All materials removed during the site clearing operations shall be disposed of properly off site.
- D. Prior to site clearing, Contractor shall have implemented SWPPP.

### **3.02 CAMU CLEARING**

- A. All vegetation, debris, deleterious and other organic material not suitable for Engineered fill materials shall be removed completely from within the construction limits and disposed of off site.

### **3.03 EASTSIDE CLEARING**

- A. Vegetation and debris cleared from the Eastside Area shall be stored in the HDPE-Lined Debris Storage Area until determination is made for off-site municipal or hazardous landfill disposal.
- B. Debris will visible indication of contamination cleared from the Eastside Area shall be stored in the HDPE-Lined Debris Storage Area until determination is made for off-site municipal or hazardous landfill disposal.
- C. Owner will sample debris and vegetation for hazardous materials and bioaccumulation. Debris shall be disposed of at an off-site municipal or hazardous landfill at the Contractor's expense. If testing indicated debris is hazardous, it shall be disposed of within 30 days.
- D. Discolored soils beneath debris shall be sampled by the Owner and disposed of at an off-site hazardous landfill.

## **PART 4 – MEASUREMENT AND PAYMENT**

### **4.01 GENERAL**

- A. Providing for and complying with the requirements set forth in this Section for clean vegetation disposal shall be per ton (TON) and payment shall be based on the unit price for clean debris/vegetation disposal provided on the Base Bid Schedule.
- B. Providing for and complying with the requirements set forth in this Section for contaminated vegetation disposal shall be per ton (TON) and payment shall be based on the unit price for contaminated debris/vegetation disposal provided on the Base Bid Schedule.

[END OF SECTION]

## **SECTION 02200 EARTHWORK**

### **PART 1 – GENERAL**

#### **1.01 DESCRIPTION OF WORK**

- A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings.
- B. The Work shall include, but not be limited to excavating, hauling, placing, moisture conditioning, backfilling, compacting, grading, stockpiling, and subgrade preparation, including subgrade preparation for storm water pipeline and appurtenances. Earthwork shall conform to the dimensions, lines, grades and sections shown on the Drawings or as directed by the Construction Manager.
- C. Construction of the final CAMU cover system and associated storm water management features overlying the CAMU will be held as an Option Scope that may be added to the contract via Contract Modification at the Owner's sole discretion. If the Owner decides to exercise its option to add the Option Scope, the Construction Manager will notify the Contractor no later than 30 days after receipt of the final Eastside Area confirmation sampling

#### **1.02 RELATED SECTIONS**

Section 01025 — Measurement and Payment

Section 02110 — Site Clearing

Section 02205 — Remedial Excavating and Filling

Section 02771 — Geotextile

Section 02772 — Geosynthetic Clay Liner

Section 02773 — Geocomposite

Section 03400 — Cast-in-Place Concrete

#### **1.03 REFERENCES**

- A. Construction Drawings
- B. Clark County Area Uniform Standard Specifications (CCAUSS) and Clark County Area Uniform Standard Drawings (CCAUSD).
- C. Geosyntec, 2007 “Construction Quality Assurance Plan for the Construction of the Corrective Action Management Unit, Basic Remediation Company, Henderson, Nevada,” August.
- D. Latest version of American Society for Testing and Materials (ASTM) standards:
  - ASTM D 422     Standard Method for Particle-Size Analysis of Soils



- ASTM D 1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>))
- ASTM D 2216 Standard Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
- ASTM D 2487 Standard Test Method for Classification of Soils for Engineering Purposes
- ASTM D 2922 Standard Test Methods for Density of Soil and Soil-Aggregate In-Place by Nuclear Density Methods (Shallow Depth)
- ASTM D 3017 Standard Test Method for Water Content of Soil and Rock In-Place by Nuclear Methods (Shallow Depth)
- ASTM D 3080 Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions
- ASTM D 4318 Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- E. Latest version of American Association of State Highway and Transportation Officials (AASHTO) standards:
- AASHTO T 180 Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

#### 1.04 SUBMITTALS

- A. Prior to beginning earthwork, Contractor shall perform baseline topographic survey on a minimum 50-foot grid and at all grade breaks. Baseline topographical survey shall be submitted to the Construction Manager within 20 working days of notice to proceed.
- B. The Contractor shall submit to the Construction Manager a notice of completion for within 24 hours of completed excavation, engineered fill, prepared subgrade and cover layer as-built survey to provide the Owner with sufficient time to verify as-built surveys
- C. The Contractor shall submit to the Construction Manager laboratory test data for cover soils demonstrating shear strength cohesion. **Shear strength tests shall be conducted at 90 percent maximum dry density.**
- D. The Contractor shall submit to the Construction Manager the GPS excavation control methods the Contractor has available for use.
- E. The Contractor shall submit to the Construction Manager the Stockpile Plan prior to Notice to Proceed.
- F. **The Contractor shall submit to the Construction Manager product data sheets and manufacturer's recommendations for soil binder material that will be used.**

#### 1.05 QUALITY ASSURANCE

- A. The Contractor shall ensure that the materials and methods used for Earthwork meet the requirements of the Construction Drawings and this Section. Any material or method that does not conform to these documents, or to alternatives approved in writing by the Construction Manager shall be rejected and shall be repaired or replaced by the Contractor.

- B. The Contractor shall be aware of and accommodate all monitoring and field/laboratory conformance testing required by the CQA Plan. This monitoring and testing, including random conformance testing of construction materials and completed work, shall be performed by the CQA Engineer. If nonconformances or other deficiencies are found in the materials or completed work, the Contractor shall be required to repair the deficiency or replace the deficient materials.

## **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, and protect products brought to the Project site in accordance with this Section.
- B. Stockpiles
  - 1. Stockpile materials at locations in accordance with the Stockpile Plan or as agreed to by the Contractor and the Construction Manager. Stockpiles shall be located so as not to interfere with other aspects of the work.
  - 2. Clear stockpile areas and install erosion and sedimentation controls before depositing fill or excavated materials on approved stockpile areas.
  - 3. Prevent segregation of fill materials and mixing of one type of fill material with other types.

## **PART 2 – PRODUCTS**

### **2.01 MATERIALS**

- A. Engineered fill shall consist of on-site relatively homogeneous, natural soils that contain <5% of debris, foreign objects, large rock fragments (greater than 6 inches in maximum dimension), roots, and organics. No materials larger than 6 inches shall be allowed within the Engineered fill. The Engineered fill shall be classified according to the Unified Soil Classification System (per ASTM D 2487) as SC, ML, CL, SM, SW, SP, GW, GP, GM, GC, or combinations of these materials. The Contractor may propose the use of other soil types as Engineered fill, but then such use shall be at the sole discretion of the Engineer.
- B. Cover soil shall consist of on-site relatively homogeneous, natural soils that are free of debris, foreign objects, large rock fragments (greater than 6 inches in maximum dimension), roots, and organics. The first lift of cover soil placed directly overlying the geosynthetic components of the cover system shall have a maximum particle size of 1 inch. The cover soil shall be classified according to the Unified Soil Classification System (per ASTM D 2487) as SC, ML, CL, SM, SW, GW, GM, GC, or combinations of these materials. The Contractor may propose the use of other soil types as cover soil, but then such use shall be at the sole discretion of the Engineer. Cover soil shall have a remolded minimum shear strength of 32 degrees and 500 psf cohesion at 90% compaction, based on Modified Proctor, at optimum moisture content, **as measured by ASTM D3080.**
- C. Operations layer shall consist of Eastside Area or Western Ditch materials conforming to Specifications in Section 02205.
- D. Prepared subgrade is defined as the material directly underlying the geosynthetic liner system which shall meet the requirements listed above for Engineered fill. No materials larger than 3/4 inch shall project or protrude from the surface of the prepared subgrade. Prepared subgrade limits are the top inside edge of the perimeter anchor trench.

- E. Pipe Trench Backfill shall be in accordance with CCAUSS Section 208 and the Construction Drawings.
- F. Anchor Trench Backfill materials shall meet the requirements listed above for the Engineered Fill.
- G. Slit Trench Backfill shall consist of earthen materials excavated from the slit trenches that are separated and earthen materials adjacent to the slit trenches.
- H. Structure Embankment shall conform to CCAUSS Section 207 and the requirements shown on the Construction Drawings.
- I. Aggregate base for storm water channels and CAMU Base Road shall conform to CCAUSS Section 704.03.04 for Type II Aggregate Base and the Construction Drawings.
- J. Grouted Riprap atop 6-inch Type II aggregate base along the embankment channels shall have D50 = 12-inch rip rap. Grouted rip rap shall be in accordance with CCAUSS Section 610 and the Construction Drawings.
- K. Grout shall be in accordance with CCAUSS Section 706 and the Construction Drawings.
- L. Final cover side slope surface treatment layer (gravel mulch) shall be 3/4-inch "Vista Gold" by Vista Landscape, Henderson, NV; telephone (702) 565-6611, or Construction Manager approved equal.
- M. Soil binder shall be long lasting plant derived material such as pitch and rosin emulsion, polymeric emulsion blends, or Portland cement based material as approved by the Construction Manager

## **2.02 EQUIPMENT**

- A. The Contractor shall furnish, operate, and maintain compaction equipment as is necessary to produce the required in-place soil density and moisture content.
- B. The Contractor shall furnish, operate and maintain tank trucks, pressure distributors, or other equipment designed to apply water uniformly and in controlled quantities to variable surface widths.
- C. The Contractor shall furnish, operate, and maintain miscellaneous equipment such as scarifiers or disks, earth excavating equipment, earth hauling equipment, and other equipment, as necessary for Earthwork construction.
- D. Equipment used in spreading the cover layer material on top of the geosynthetic liner system shall be restricted to the following maximum allowable equipment ground pressures:

<b>MAXIMUM ALLOWABLE EQUIPMENT GROUND PRESSURE (psi)</b>	<b>INITIAL LIFT THICKNESS OF OVERLYING AGGREGATE (ft)</b>
<10	1.0
<20	2.0
>20	3.0

### **PART 3 – EXECUTION**

#### **3.01 FAMILIARIZATION**

- A. Prior to implementing any of the work in this Section, the Contractor shall become thoroughly familiar with the site, the site conditions, and all portions of the work falling within this and other related Sections.
- B. Inspection:
  - 1. The Contractor shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of the work specified in this Section may properly commence without adverse impact.
  - 2. If the Contractor has any concerns regarding the installed work of other Sections, the Construction Manager shall be notified in writing prior to commencing work. Failure to notify the Construction Manager or continuance of the work of this Section shall be construed as Contractor's acceptance of the related work of all other Sections.

#### **3.02 SITE PREPARATION**

- A. Prior to performing any earthworks on the site, the ~~Owner and~~ Contractor shall perform a baseline topographic survey. The survey, at a minimum shall be performed on a 50 foot grid and account for grade breaks and other topographic features affecting volume of earthworks. This survey shall be conducted by a Professional Land Surveyor licensed in the state of Nevada. This survey shall serve as the starting point for earthwork quantities, both excavation and fill placement.
- B. The Contractor shall perform demolition and site clearing in accordance with the Construction Drawings and Sections 02010 and 02110 of these Specifications prior to any Earthwork activity.
- C. Prior to performing earthworks on the site, the Contractor shall install drainage and erosion-control measures in accordance with the SWPPP.

#### **3.03 GENERAL EXCAVATION**

- A. The Contractor shall excavate materials to the limits and grades shown on the Drawings.
- B. All excavated materials not used for Engineered Fill shall be stockpiled in accordance with the Stockpile Plan or in an area designated by the Construction Manager in accordance with Subpart 3.06 of this Section.

- C. Excavated materials shall be used onsite only. Contractor shall not export excavated CAMU soils.
- D. Excavations in native soil shall not have slopes steeper than 2.1H:1V, unless otherwise indicated on the Construction Drawings or when approved by the Construction Manager.
- E. No excavations deeper than 4 feet with side slopes steeper than 2:1 (horizontal:vertical) shall be made unless otherwise indicated on the Construction Drawings or without the prior approval of the Construction Manager. When shoring is required, the design and inspection of such shoring shall be the Contractor's responsibility and shall be subject to the review of the Construction Manager prior to use. No personnel shall Work within or next to an excavation requiring shoring until such shoring has been installed, inspected, and approved by an engineer registered in the State of Nevada. The Contractor shall be responsible for any fines imposed due to violation of any laws and regulations relating to the safety of the Contractor's personnel.
- F. Excavations shall be kept free from water.
- G. The Contractor shall notify the Construction Manager at once of springs, seeps, or wet zones found in excavations.
- H. Oversized materials encountered within the excavation or that result from screening operations of clean fill shall be segregated and stockpiled in accordance with the Stockpile Plan and Subpart 2.06 of this Section or in a location approved by the Construction Manager.
- I. Permanent Ditches and Channels:
  - 1. Cut ditches and channels accurately to the cross sections, grades, and elevations indicated on the drawings. Do not cut below indicated grades without prior Construction Manager authorization.
  - 2. Do not deposit excavated material within 4 feet from the edge of a ditch or channel, unless the material is fill placed as indicated and specified.
  - 3. Keep completed ditches and channels free from blockage or obstruction by leaves, brush, sticks, trash, sediment, and other debris.
  - 4. Storm water ditch excavation through the Western Ditch shall be excavated 2.5 feet lower than grades shown on Construction Drawings. Excavated Western Ditch soil shall be stockpiled over the Western Ditch within the footprint of the Cell II in accordance with the Stockpile Plan. The storm water ditch shall immediately have 2.5 foot over excavation backfilled with clean soil to the grades shown on the construction drawings.

### **3.04 ANCHOR TRENCH EXCAVATION**

- A. The Contractor shall excavate the anchor trench to the limits and grades shown on the Drawings.
- B. All excavated materials not used for Anchor Trench Backfill or Engineered fill shall be stockpiled in areas shown on Construction Drawings or as designated by the Construction Manager in accordance with Subpart 3.06 of this Section and the Stockpile Plan.

### **3.05 SUBGRADE SURFACE PREPARATION**

- A. The subgrade shall be prepared and made suitable as a foundation for placement and compaction of soil material and geosynthetic components of liner system, where applicable. The prepared subgrade shall be proof-rolled and meet the requirements outlined in Subpart 2.01. The subgrade shall be firm and able to support the Contractor's construction equipment without the development of depressions or ruts. In addition, the subgrade shall provide adequate support such that the overlying fill material may be placed and compacted to the specified density.

### **3.06 STOCKPILING**

- A. Soil shall be stockpiled in areas shown on Construction Drawings and in accordance with the Stockpile Plan, or as designated by the Construction Manager. Stockpile shall be free of incompatible soil, clearing, clearing debris, or other objectionable materials.
- B. Stockpiles shall be no steeper than 2H:1V (Horizontal:Vertical) or other slope approved by the Construction Manager, graded to drain, sealed by tracking parallel with the direction of the slope with a dozer or other means approved by the Construction Manager, and dressed daily during periods when fill is taken from the stockpile. The Contractor shall employ temporary erosion and sediment control measures (i.e. silt fence) in accordance with the Contractor prepared SWPPP or as directed by the Construction Manager around stockpile areas.
- C. Western Ditch soil excavated during Phase IIIA shall be stockpiled over the Western Ditch within Cell II or placed within the lined areas of the CAMU as waste fill in accordance with Section 02205 of these Specifications.

### **3.07 PIPE TRENCH EXCAVATION AND BACKFILL**

- A. See CCAUSS Sections 206, 207, and 208.
- B. Trench excavation and backfill shall conform to the lines and grades shown on the Construction Drawings.

### **3.08 ENGINEERED FILL, SLIT TRENCH BACKFILL, AND ANCHOR TRENCH BACKFILL**

- A. The Engineered Fill, Slit Trench Backfill, and Anchor Trench Backfill shall be placed to the lines and grades shown on the Drawings.
- B. Soil used for the Engineered Fill, Slit Trench Backfill, and Anchor Trench Backfill shall be on-site materials meeting the requirements of Subpart 2.01 of this Section.
- C. Soil used for the Engineered Fill, Slit Trench Backfill, and Anchor Trench Backfill shall be placed in a loose lift that results in a compacted lift thickness of no greater than 12 inches. The maximum permissible pre-compaction soil clod size is 6 inches.
- D. Each 12-inch horizontal lift of Engineered Fill and Slit Trench Backfill placed against a slope shall be keyed into the slope a minimum of 3 feet, as measured horizontally from the top of the 12-inch lift.
- E. The Contractor shall compact each lift to at least 90 percent of its modified Proctor maximum dry density (ASTM D 1557) at a moisture content of between -4% and +4% of

the optimum moisture content for the soil. The Contractor shall utilize compaction equipment suitable for achieving the soil compaction requirements.

- F. Contaminated water shall not be used for moisture conditioning or as dust control of final cover soils.
- G. During wetting or drying, the material shall be regularly disced or otherwise mixed so that uniform moisture conditions in the appropriate range are obtained.

### **3.09 STRUCTURE EXCAVATION AND EMBANKMENT**

- A. This shall include, but not be limited to, the following: detention basins, footings for riprap, concrete-lined storm water channels, aggregate-lined storm water channels, and cut-off walls for concrete aprons
- B. Refer to CCAUSS Sections 206 and 207 for Structure Excavation and Structure Backfill, respectively.

### **3.10 FINAL COVER SOIL**

- A. Place only when underlying drainage aggregate and filter geotextile or geocomposite installation is complete including all Construction Quality Control (CQC) and CQA work and approved by the Construction Manager.
- B. The subgrade to the cover soil consists of a geotextile or geocomposite. Therefore, the Contractor shall avoid tearing, puncturing, folding, or damaging in any way the filter geotextile or geocomposite geotextile during placement of the cover layer material.
- C. Any damage to the geosynthetic liner system which is caused by the Contractor or representatives of the Contractor shall be repaired by the Geosynthetics Installer at the expense of the Contractor.
- D. The Contractor shall compact each final lift of final cover soil to at least 90 percent of its modified Proctor maximum dry density (ASTM D 1557) at a moisture content between -4% and +4% of the optimum moisture content for the soil. The Contractor shall utilize compaction equipment suitable for achieving the soil compaction requirements.
- E. The cover soil material shall be placed out in front of the equipment used to place the cover layer such that a 1-foot minimum thickness requirement is maintained at all times between the geosynthetic materials and the wheels or tracks of the equipment used to place the cover layer material.
- F. Care must be exercised by the operators of tracked equipment to avoid sharp pivoting turns that could displace the cover layer material and result in damage to the liner system.
- G. Contaminated water shall not be used for moisture conditioning or as dust control of final cover soils.
- ~~H. A 2 inch layer of ¾ inch gravel mulch shall be placed on side slopes exceeding 5H:1V.~~
- H. A 2 inch layer of ¾ inch gravel mulch shall be placed on side slopes equal and greater than 5H:1V for all CAMU and BMI Landfill Covers.



- I. Soil binder shall be placed on top deck areas less than 5H:1V. Soil binder shall be applied at rates as recommended by the manufacturer for the prevention of water and wind induced erosion on exposed soils.

### **3.11 AGGREGATE BASE**

- A. Aggregate base placement and compaction shall be in accordance with CCAUSS Section 301 and 302 for Type II aggregate base. Aggregate base shall be compacted to not less than 95% compaction as determined by AASHTO T 180.

### **3.12 GROUTED RIPRAP**

- A. Grouted rip rap shall be placed in accordance with Section 610 of the CCAUSS and the Construction Drawings.

### **3.13 FIELD TESTING**

- A. The minimum frequency and details of quality control testing for engineered fill and final cover soil are provided below. The Contractor shall provide equipment and operators to accommodate testing. This testing shall be performed by the CQA Engineer and is not separate from the testing outlined in the CQA Plan (i.e. QC and QA testing are the same and will not be duplicated). The Contractor shall take this testing frequency into account in planning the construction schedule.

1. Engineered fill and final cover soil material quality control testing:
  - a. particle-size analyses conducted in accordance with ASTM D 422 at a frequency of one test per 10,000 yd<sup>3</sup>;
  - b. Atterberg Limits conducted in accordance with ASTM D 4318 at a frequency of one test per 10,000 yd<sup>3</sup>;
  - c. soil classification tests conducted in accordance with ASTM D 2487 at a frequency of one test per 10,000 yd<sup>3</sup>; and
  - d. modified Proctor compaction tests conducted in accordance with ASTM D 1557 at a frequency of one test per 10,000 yd<sup>3</sup>/lift.
2. The CQA Engineer shall perform conformance tests on placed and compacted engineered fill and cover soil to evaluate compliance with these Specifications. These tests shall include in-situ moisture content and dry density. The frequency and procedures for moisture-density testing are given in the CQA Plan. At a minimum, the dry density and moisture content of the soil shall be measured in-situ in accordance with ASTM D 2922 and ASTM D 3017, respectively.
3. A special testing frequency shall be used by the CQA Engineer when visual observations of construction performance indicate a potential problem. Additional testing shall be considered when:
  - a. the rollers slip during rolling operation;
  - b. the lift thickness is greater than specified;
  - c. the fill is at improper and/or variable moisture content;



- d. fewer than the specified number of roller passes are made;
  - e. dirt-clogged rollers are used to compact the material;
  - f. the rollers do not have optimum ballast; or
  - g. the degree of compaction is doubtful.
4. During construction, the frequency of testing shall be increased by the CQA Engineer in the following situations:
- a. adverse weather conditions;
  - b. breakdown of equipment;
  - c. at the start and finish of grading;
  - d. if the material fails to meet specifications; or
  - e. the work area is reduced.

**B. Defective Areas:**

1. If a defective area is discovered in the Earthwork, the CQA Engineer shall evaluate the extent and nature of the defect. If the defect is indicated by an unsatisfactory test result, the CQA Engineer shall determine the extent of the defective area by additional tests, observations, a review of records, or other means that the CQA Engineer deems appropriate. If the defect is related to adverse site conditions, such as overly wet soils or surface desiccation, the CQA Engineer shall define the limits and nature of the defect.
2. Once the extent and nature of a defect is determined, the Contractor shall correct the deficiency to the satisfaction of the CQA Engineer. The Contractor shall not perform additional work in the area until the CQA Engineer approves the correction of the defect.
3. Additional testing may be performed by the CQA Engineer to verify that the defect has been corrected. This additional testing shall be performed before any additional work is allowed in the area of deficiency. The cost of the additional testing **after failure** shall be borne by the Contractor.

**3.14 SURVEY CONTROL**

- A. The Contractor shall perform all surveys necessary for construction layout and control.

**3.15 CONSTRUCTION TOLERANCE**

- A. The Contractor shall perform the Earthwork construction to within  $\pm 0.1$  ft on areas with a slope less than 10 percent and  $\pm 0.2$  ft on areas with a slope greater than 10 percent of the grades indicated on the Drawings.

**3.16 PROTECTION OF WORK**

- A. The Contractor shall use all means necessary to protect completed work of this Section.

- B. At the end of each day, the Contractor shall verify that the entire work area is left in a state that promotes drainage of surface water away from the area and from finished work. If threatening weather conditions are forecast, at a minimum, compacted surfaces shall be seal-rolled to protect finished work.
- C. In the event of damage to prior work, the Contractor shall make repairs and replacements to the satisfaction of the Construction Manager.

## **PART 4 – MEASUREMENT AND PAYMENT**

### **4.01 GENERAL**

- A. Providing for and complying with the requirements set forth in this Section for CAMU Excavation shall be measured as Lump Sum (LS) and payment shall be based on the lump sum price provided on the Bid Schedule. Specified items incidental to CAMU Excavation include:
  - 1. Anchor trench excavation
  - 2. Storm water channel excavation
  - 3. Stockpiling
  - 4. Prepared subgrade
  - 5. And all other incidentals necessary for a complete CAMU excavation.
- B. Providing for and complying with the requirements set forth in this Section for CAMU Engineered Fill shall be measured as Lump Sum (LS) and payment shall be based on the lump sum price provided on the Bid Schedule. Anchor trench backfill shall be incidental to CAMU Engineered Fill. This lump sum shall include all incidentals necessary for a complete CAMU Engineered Fill.
- C. Providing for and complying with the requirements set forth in this Section for Slit Trench Backfill shall be measured as compacted and moisture conditioned in-place cubic yards (CY), and payment shall be based on the unit price provided on the Bid Schedule. Incidental to Slit Trench Backfill shall be slit trench cover excavation. This lump sum shall include all incidentals necessary for a complete slit trench backfill.
- ~~D. Providing for and complying with the requirements set forth in this Section for the BMI Landfills Cover Soil shall be measured as Lump Sum (LS), and payment shall be based on the lump sum price provided on the Bid Schedule. Incidental to the BMI Landfill Cover Soil shall be soil binder. This lump sum shall include all incidentals necessary for a complete Cover soil placement on the BMI Landfills.~~
- D. Providing for and complying with the requirements set forth in this Section for the BMI Landfills Cover Soil shall be measured as Lump Sum (LS), and payment shall be based on the lump sum price provided on the Bid Schedule. Incidental to the BMI Landfill Cover Soil shall be soil binder and gravel mulch. This lump sum shall include all incidentals necessary for a complete Cover soil placement on the BMI Landfills.
- E. Providing for and complying with the requirements set forth in this Section for CAMU Cover Soil shall be measured as in-place cubic yards (CY), and payment shall be based on the unit price provided on the Option Scope Bid Item Schedule. Incidental to CAMU Cover

soil shall be gravel mulch rip-rap and soil binder. The unit price shall include all incidentals necessary for a complete CAMU cover soil placement.

- F. Providing for and complying with the requirements set forth in this Section for the Storm Water Channel Excavation and Embankment shall be measured as Lump Sum (LS), and payment shall be based on the lump sum price provided on the Bid Schedule. The following are considered incidental to Storm water channel excavation and embankment:

1. Subgrade preparation
2. Aggregate base
3. All other necessary incidentals for complete installation of storm water channels.

- G. Providing for and complying with the requirements set forth in this Section for the Storm Water Detention Basin Excavation and Embankment shall be measured as Lump Sum (LS), and payment shall be based on the lump sum price provided on the Bid Schedule. Lump sum shall include all necessary incidentals for complete installation of storm water detention basins.

- ~~H. Providing for and complying with the requirements set forth in this Section for the Storm Water Collection Improvements Concrete Channel at the CAMU shall be measured as Lump Sum (LS), and payment shall be based on the lump sum price provided on the Bid Schedule. The following are considered incidental to Storm Water Collection Improvements:~~

- ~~1. Cast in place concrete~~
- ~~2. Rip Rap~~
- ~~3. Aggregate base~~
- ~~4. Subgrade Preparation~~
- ~~5. All necessary incidentals for complete installation of storm water concrete channels.~~

- H. Providing for and complying with the requirements set forth in this Section for the Storm Water Collection Improvements- Riprap at the CAMU shall be measured as Lump Sum (LS), and payment shall be based on the lump sum price provided on the Bid Schedule. The following are considered incidental to Storm Water Collection Improvements:

1. Rip Rap
2. Aggregate base
3. Subgrade Preparation
4. All necessary incidentals for complete installation of storm water concrete channels.

- I. Providing for and complying with the requirements set forth in this Section for Aggregate Base Road shall be measured as in place square feet (SF), lump sum (LS) and payment shall be based on the unit price lump sum price provided on the Option Scope Bid Schedule. The unit price shall include all incidentals necessary for a complete aggregate base road installation.

J. Providing for and complying with the requirements set forth in this Section for CAMU cover embankment channel grouted rip rap shall be measured as Square Foot (SF), and payment shall be based on the unit price provided on the Option Scope Bid Schedule. Specified items incidental to CAMU cover embankment channel rip rap are as follows:

1. Grout
2. Aggregate Base
3. Subgrade preparation
4. All other necessary incidentals for a complete CAMU cover embankment channel installation.

K. Providing for and complying with the following incidentals shall be included in the Earthworks and Remedial Excavation and Filling, Sections 02200 and 02205, costs on the Bid Schedules:

1. Construction and Dust Control Water
2. Uncontaminated Dewatering
3. Contaminated Water Management
4. Dust Control
5. Vacuum Trucks
6. Spill Clean up
7. Health and Safety
  - a. Personal Protective Equipment
  - b. Monitoring
8. Operations and Maintenance of the following items:
  - a. Parking Areas
  - b. Temporary Roads
  - c. Temporary Trailers
  - d. Temporary Utilities
  - e. On-site communications
  - f. Weather Protection
  - g. Contractor Generated Debris and Trash Control
  - h. Temporary Sanitary Facilities
  - i. Lighting

- j. Material and Equipment Storage
  - k. Dust Control Water Storage
  - l. Vacuum Truck Staging Area
  - m. Decontamination Area
  - n. Construction Equipment
  - o. First Aid Facilities
  - p. HDPE-lined Storage Area
  - q. Dust Control
  - r. Pollution Control
  - s. Traffic and Safety Control
  - t. Access Control
  - u. Decontamination
  - v. Noise Control
9. And all other incidentals necessary for Earthwork

[END OF SECTION]

**SECTION 02205**  
**REMEDIAL EXCAVATING AND FILLING**

**PART 1 – GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings.
- B. The work shall include, but not be limited to the following:
  - 1. Excavating contaminated materials from the slit trenches, western ditch, and eastside area.
  - 2. Temporary Excavation Support.
  - 3. Dewatering and site drainage during excavation of contaminated materials and subsequent slit trench backfill.
  - 4. Procedures for handling hazardous and suspected hazardous substances.
  - 5. Verifying depth and lateral extent of contamination in excavations.
  - 6. Loading, hauling, placement, moisture conditioning, and compaction of waste materials within the CAMU.
  - 7. Placement of interim and daily cover.

**1.02 RELATED SECTIONS**

Section 01010—Summary of Work

Section 01025—Measurement and Payment

Section 01300—Submittals

Section 01400—Quality Control

Section 01500—Construction Facilities

Section 01560—Temporary Controls

Section 02050—Demolition

Section 02110— Site Clearing

Section 02200— Earthwork

**1.03 REFERENCES**

- A. Construction Drawings
- B. Geosyntec, 2007, “Construction Quality Assurance (CQA) Plan for the Construction of the Corrective Action Management Unit (CAMU), Henderson, Nevada,” September.

- C. Geosyntec, 2007, "Remedial Alternative Study (RAS) for the Slit trench Area, Henderson, Nevada," July.
- D. Conceptual Drainage Study
- E. Pond and Sludge Dewatering Studies:
  - 1. Pincock Allen & Holt, 2004 "Assessment of Geotextile Tube Dewatering Technology for Timet Ponds, Henderson, Nevada," Prepared for Basic Remediation Company, July.
  - 2. Hart Crowser, 2004, "Draft: Assessment of Geotextile Tube Dewatering Technology for Timet Ponds, Henderson, Nevada," Prepared for Basic Remediation Company, November.
  - 3. Ocean and Coastal Consultants, Inc, 2005, "Timet Ponds Drying Recommendations," April.
- F. BRC, Environmental Resources Management (ERM), and Daniel B. Stevens & Associates (DBS&A), 2007, "BRC Closure Plan: BMI Common Areas, Clark County, Nevada," May.
- G. BRC, 2006. "Corrective Action Plan (CAP) For The Basic Remediation Company (BRC) Common Areas Remediation Project," September.
- H. Geosyntec, 2007. "Revised Remedial Action Plan (RAP) Permit Application for Corrective Action Management Unit (CAMU), Henderson, Nevada," Prepared for Basic Remediation Company, Submitted to Nevada Department of Environmental Protection, March.
- I. BRC and MWH, 2005, "BRC CAMU area, 2005 soil, soil vapor, groundwater, and slit trench investigation report," October.
- J. DBS&A, 2006, "Conceptual Site Model, Proposed CAMU Site, Henderson, Nevada," October.
- K. Daniel B Stephens & Associates, Inc, 2006 "Conceptual Site Model, Proposed CAMU Site, Henderson Nevada," October.
- L. Latest Version of American Society for Testing and Materials (ASTM) Standards:
 

ASTM D 1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified
ASTM D 2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2216	Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D 2435	Standard Test methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading

ASTM D 2922	Standard Test Methods for Density of Soil and Soil-Aggregate In-Place by Nuclear Density Methods (Shallow Depth)
ASTM D 3017	Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method

#### 1.04 SUBMITTALS

- A. Comply with pertinent provisions of Section 01300, "Submittals."
- ~~B. The following shall be submitted prior to Notice to Proceed:~~
  - ~~1. Waste Excavation Plan, including:~~
    - ~~a. Excavation Plan (for excavations deeper than 20 feet)~~
    - ~~b. Temporary Excavation Support Design~~
  - ~~2. The Contractor shall submit to the Construction Manager the GPS excavation control methods the Contractor has available for use.~~
  - ~~3. Access Ramp Design and Analysis~~
- B. Waste Excavation Plan, including:
  - 1. Excavation Plan (for excavations deeper than 20 feet)
  - 2. Temporary Excavation Support Design
- C. Notice of discovery of hazardous or suspect hazardous substances
- D. Hazardous or suspect hazardous substances disposal location data
- E. Asbestos-containing material (ACM) disposal location data
- F. Preliminary and Final Results of Quality Control Tests and Waste Characterization
- ~~G. Asbestos-as-built location submittal~~
- G. The Contractor shall submit to the Construction Manager the GPS excavation control methods the Contractor has available for use.
- H. Pre-excavation Survey
- I. Post-excavation Survey
- J. Access Ramp Design and Analysis

#### 1.05 QUALITY ASSURANCE

- A. The Contractor shall provide dust and sediment control in accordance with the provisions of Section 01560, "Temporary Controls," and the SWPPP.



- B. The Contractor shall ensure that the materials and methods used for Remedial Excavation meet the requirements of the Construction Drawings and this Section. Any material or method that does not conform to these documents, or to alternatives approved in writing by the Construction Manager shall be rejected and shall be repaired or replaced by the Contractor.
- C. The Contractor shall be aware of and accommodate all monitoring, field/laboratory conformance, and conformance testing required by the CQA Plan and Closure Plan. This monitoring and testing, including random conformance testing of construction materials and completed work, shall be performed by the CQA Engineer. If nonconformances or other deficiencies are found in the materials or completed work, the Contractor shall be required to repair the deficiency or replace the deficient materials.

## **1.06 SEQUENCING AND SCHEDULING**

- A. The Contractor shall obtain clearances from Construction Manager at the following hold points before proceeding.
  - 1. Acceptance of Excavation Plan and Water Management Plan; before starting excavation or dewatering work in contaminated areas.
  - 2. Authorization for over-excavation beyond expected depth of contamination; before starting over-excavation.
  - 3. Verification that cleanup criteria are met and surveying of excavation is complete; before placing backfill or other clean material in excavated areas.
  - 4. Authorization to resume work or move equipment; before proceeding in an area where suspected hazardous substances are observed.
  - 5. Acceptance of changes to excavation and dewatering plan before affecting the changes.

## **PART 2 – PRODUCTS**

### **2.01 MATERIALS**

- A. Eastside Contaminated Material: Soil- and sludge-like materials originating in Eastside Area ponds identified in Construction Drawings. This includes the top 6-inches of haul road soils to be removed at the conclusion of Eastside excavation and hauling operations. These materials are to be excavated, moisture conditioned, transported, and placed within the CAMU.
- B. Slit Trench Cover Soil – soil material, containing no debris or visible signs of waste, overlying the slit trench waste material to be segregated and stockpiled and used for backfilling portions of the slit trenches upon completion of slit trench waste removal.
- C. Slit Trench Contaminated Material: Debris or debris intermingled with soil containing, but not limited, to the following materials; metal scraps, newspaper, dark brown to black oily residue/sludge, cement, glass, black fine material, plastic bottles, rope, charred wood, red brick, clay with hydrocarbon odor, rusted metal pipe fragments with insulation material coating, rubber cord, belt pieces, paper including empty DDT bags, wood, fabric, plastic, paper bags, chalky white powder, concrete, plastic sheeting, cardboard, greenish white powder, and debris and soils containing PCB's. See BRC CAMU area, 2005 soil, soil vapor,

groundwater, and slit trench investigation report prepared by BRC and MWH for boring logs and Drawings for locations of borings and approximate limits of slit trenches.

- D. Western Ditch – Contaminated soils that are located within the Phase II, Phase IIIA, and western stormwater channels within and around the CAMU, as indicated on the Construction Drawings. Western Ditch soils shall be excavated as part of the Phase II, Phase IIIA and the stormwater channel construction and shall be placed within the CAMU. Stockpiling of Phase IIIA and stormwater channel contaminated soil shall be over the Western Ditch within Phase II. Limits of Western Ditch Phase II contaminated soils excavation are the prepared subgrade for the liner system construction and vertical walls, as shown on the Construction Drawings, along the northern and southern limits of the Western Ditch extending from the existing surface to the Phase II liner system prepared subgrade. Limits of Western Ditch Phase IIIA contaminated soils excavation are the prepared subgrade for the liner system construction, vertical walls, and anchor trenches as shown on the Construction Drawings. The limits of the Western Ditch within the storm water channel are 2.5 feet below grades shown on the Construction Drawings through the width of the Western Ditch as shown on the Construction Drawings.
- E. Operations Layer materials: Eastside Area or Western Ditch materials. ~~meeting the requirements listed in Section 02200 Subpart 2.01 for Engineered Fill, except that~~ The 12 inches of layer material to be placed directly overlying the geocomposite shall have a maximum particle size of 1 inch. The upper 12 inches of the 24 inch layer shall have a maximum particle size of 6 inches. The Eastside Area and Western Ditch materials shall be screened, as necessary, to meet the requirements for the operations layer.
- F. Interim Cover – clean, non-contaminated earthen material used to cover exposed debris waste materials within the CAMU. Final side slopes where run-off water can exit the lined areas of the CAMU shall be covered with 1 foot of interim cover upon completion of waste placement for the day. Interim slopes between phases shall be covered with standard 6 mil visqueen. Soil shall not be placed over visqueen when waste placement proceeds to adjacent cell in the following work phase. Interim slopes shall be covered prior to forecasted precipitation events. One foot of soil material below the final cover system geosynthetic materials shall be final interim cover.
- G. Daily Cover – Eastside Area materials shall be used to cover slit trench material daily. A minimum of 6-inches of soil material shall be used to cover exposed slit trench waste.

## **2.02 EXCLUSION ZONE ACCESS CONTROL FENCES**

- A. Temporary exclusion zone fence shall be ~~made of plastic and~~ a minimum of 5 feet high.

## **2.03 EQUIPMENT**

- A. The Contractor shall furnish, operate, and maintain compaction equipment as is necessary to produce the required in-place soil density and moisture content.
- B. The Contractor shall furnish, operate and maintain tank trucks, pressure distributors, or other equipment designed to apply water uniformly and in controlled quantities to variable surface widths.
- C. The Contractor shall furnish, operate, and maintain miscellaneous equipment such as scarifiers or disks, earth excavating equipment, earth hauling equipment, and other equipment, as necessary for Remediation Excavation and waste placement.

- D. Equipment used in spreading the operations layer material on top of the geosynthetic liner system shall be restricted to the following maximum allowable equipment ground pressures:

MAXIMUM ALLOWABLE EQUIPMENT GROUND PRESSURE (psi)	INITIAL LIFT THICKNESS OF OVERLYING MATERIALS (ft)
<10	1.0
≤20	2.0
21-50	3.0
51-80	4.0
81+	5.0

### **PART 3 – EXECUTION**

#### **3.01 GENERAL REQUIREMENTS**

- A. Contractor's Health and Safety Plan shall address hazards associated with Remedial excavation and provide appropriate guidance for the required Level B Personal Protective Equipment.
- B. The Contractor shall establish the required lines, levels, contours, and datum before excavating and backfilling.
- C. The Contractor shall keep work involving contaminated materials separated from uncontaminated earthwork.
- D. Contaminated materials shall only be stockpiled in contaminated areas.
- E. Surface-water run-off from contaminated areas shall be controlled so that it does not flow onto uncontaminated areas.
- F. Excavated spoil, equipment, and materials shall be kept at a sufficient setback from excavations to prevent cave-ins or bank slides.
- G. The following shall be protected from damage by traffic or construction activities.
1. Bench marks and survey monuments.
  2. Utilities not specified for removal.
  3. Monitoring wells not to be abandoned or destroyed.
  4. Archaeological artifacts encountered during the work.
- H. If utilities are uncovered during excavation activities, utilities shall be supported and backfilled in accordance with City of Henderson specifications upon verification of cleanup.

- I. No excavations deeper than 4 feet with side slopes steeper than 2:1 (horizontal:vertical) shall be made unless otherwise indicated on the Construction Drawings or without the prior approval of the Construction Manager and the Construction Manager. When shoring is required, the design and inspection of such shoring shall be the Contractor's responsibility and shall be subject to the review of the Construction Manager prior to use. No personnel shall Work within or next to an excavation requiring shoring until such shoring has been installed, inspected, and approved by an engineer registered in the State of Nevada. The Contractor shall be responsible for any fines imposed due to violation of any laws and regulations relating to the safety of the Contractor's personnel.
- J. Contractor shall survey remediated surface after each disturbance so depth and volume of additional removed material can be calculated.

### **3.02 SLIT TRENCH PERSONAL PROTECTIVE EQUIPMENT**

- A. To provide adequate protection of workers, Level B Personal Protective Equipment (PPE) shall be required at all times in the slit trench excavation work area and waste placement areas within the CAMU. Level B PPE shall, at a minimum, consist of:
  - 1. Self Contained Breathing Apparatus (SCBA);
  - 2. Protective clothing;
  - 3. Outer and inner gloves;
  - 4. Outer boots;
  - 5. Safety glasses;
  - 6. Hard hat; and
  - 7. Hard-toed boots.
- B. Level B PPE shall be worn at CAMU during placement of slit trench wastes until daily cover is placed.
- C. Contractor shall provide a safe working space for personnel within the limits of excavations.
- D. Exclusion zone fencing and delineation and decontamination zones and supplies shall be provided by the Contractor at all times during waste excavation.

### **3.03 SITE PREPARATION**

- A. The Contractor shall lay out the boundaries of contaminated and uncontaminated materials, based on the available information, prior to the start of remedial work in each excavation area identified in the Excavation Plan. Do not begin clearing, grubbing, or excavation in an excavation area until the boundaries are established.
- B. The Owner shall provide weather-proof signage with the pond identification, ditch section, or other identifiers and initial excavation depths at all Eastside Area remediation locations. Contractor shall place and maintain signs at ponds.
- C. Clear and grub brush, roots, and similar material down to the existing ground surface in accordance with Section 02110.

### **3.04 EXCAVATION, DEWATERING, AND RUNOFF CONTROL**

- A. Waste Excavation Plan: The Contractor shall prepare a plan for excavating contaminated areas and hauling the materials to the CAMU. The Waste Excavation and Haul Road Plan shall be coordinated with dewatering plans described in the Water Management Plan submitted in accordance with Section "01500 Construction Facilities". At a minimum, the Plan shall include the following information:
1. Overall excavation sequence for Slit Trench excavation including Temporary Excavation Support, showing how work shall progress, and in what order Slit Trenches shall be excavated.
  2. Overall excavation sequence for Western Ditch and Eastside Area excavations showing how work shall progress, and in what order ponds shall be excavated.
  3. Contractor shall limit removal of overburden to expose a maximum of 40,000 Square Feet of Slit Trench waste at any time.
  4. Methods for mixing of dry soils and wet sludges to moisture content less than optimum.
  5. Procedures for handling surface water during construction to minimize contaminated runoff that needs to be collected and treated.
  6. Procedures for odor control.
  7. Procedures for excavations around monitoring wells and active utility lines.
  8. Daily cover of exposed slit trench waste materials placed within the CAMU.
  9. A statement of how contaminated waters shall be prevented from mixing with uncontaminated waters and from flowing onto uncontaminated areas.
  10. The Contractor shall obtain Construction Manager approval of any substantive changes to the Plan before implementing changes.
- B. The Contractor shall excavate clean, non-contaminated over-burden material at slit trenches until visible signs of contaminated materials are evident.
- C. Materials not in accordance with the sizing requirements of Subpart 3.08 B of these Specifications shall be crushed or cut to conform to sizing requirements unless otherwise approved by Construction Manager.
- D. The Contractor shall stockpile clean, non-contaminated slit trench over-burden material in accordance with Section 02200, Subpart 3.06, which shall be used as Slit Trench Backfill.
- E. The Contractor shall remove contamination from areas which have been re-contaminated or were previously clean and have become contaminated as a result of Contractor's actions, at no additional cost to the Owner.
- F. The Contractor shall excavate contaminated slit trench materials until the Construction Manager visually verifies the bottom of contamination is reached. Slit trench excavation shall be in accordance with the following:

1. Excavations shall be continuously monitored by the Construction Manager. Monitoring shall be conducted either visually or with instrumentation as appropriate to ensure only contaminated material is removed from the excavation.
  2. Contractor shall not excavate beyond the approximate depth of contamination except as required for verification or as otherwise authorized in advance by the Construction Manager. Minimize to the extent possible by selective (NOT PRECISION) excavating of clean material to limit the placement of clean material in the CAMU. Contractor shall stop excavating and notify the Construction Manager if there are no visible signs of contaminated material even if the expected depths of excavation have not been reached. The 1:1 slopes shown on the drawings are not required until equipment and or personnel enter the excavation. Slit trench excavations shall be protected with temporary fencing as an exclusion zone. Contractor is not entitled to payment for unauthorized over-excavation.
  3. Excavation of contaminated materials shall be considered unclassified excavation. All debris and materials encountered shall be removed and sized as part of excavation activities as described in Subpart 3.08 B. of this section.
- G. The Contractor shall excavate contaminated eastside materials to the estimated depths indicated on the Construction Drawings.
1. Excavations shall proceed from east to west and from upgradient to downgradient to prevent recontamination of remediated surfaces.
  2. Excavations shall be continuously monitored by the Construction Manager. Monitoring shall be conducted either visually or with instrumentation as appropriate to ensure only contaminated material is removed from the excavation.
  3. Contractor shall not excavate beyond the approximate depth of contamination except as required for verification or as otherwise authorized in advance by the Construction Manager.
  4. Contractor shall bench and slope excavations in accordance with 29 CFR 1926 Subpart P – excavations (Appendix B). Excavations deeper than 20 feet shall be designed by a Registered Professional Engineer licensed in the State of Nevada. Portions of the walls shall be flattened or backfilled to support vehicle traffic or soil handling activities.
  5. The Contractor shall coordinate with the Construction Manager as needed to identify areas that are ready for Construction Manager verification and that all required contaminated materials have been removed from the excavated areas. Verification procedure shall be in accordance with Subpart 3.04 of this Section.
  6. Excavation of contaminated materials shall be considered unclassified excavation. Only soil- and sludge-like materials from eastside areas shall be disposed of in the CAMU. Encountered debris shall be dispositioned according to the requirements of Section 02010
- H. In accordance with Contractor's Water Management Plan, keep working areas free of standing water so that excavation and verification work can be performed in dry conditions.
1. Excavations lying below groundwater shall be dewatered at the time of construction.

2. Divert and control isolated seeps or springs within work areas.
3. Divert and control storm-water runoff, and other surface waters in working areas.
4. Use best management practices identified in Contractor's SWPPP.

I. Temporary Excavation Support

1. Vertical excavations required to remove the slit trenches shall be supported by temporary retaining walls (such as soldier beam and lagging or sheet pile walls with tieback anchors) as shown on the Construction Drawings.
2. The temporary retaining walls shall be designed by the Contractor, or specialty wall Subcontractor, and stamped by a Registered Professional Engineer in the State of Nevada. The temporary retaining walls shall be designed in accordance with the following criteria:
  - a. The wall shall be designed to resist lateral loads from a soil with a unit weight of 117 pounds per cubic foot, a friction angle of 35 degrees, and no cohesion.
  - b. The wall shall be designed to resist lateral loads from a surcharge on the back of the wall from potential vehicular traffic of 100 pounds per square foot acting vertically behind the top of wall.
  - c. The bottom of the wall shall be embedded a minimum of 5 feet below the bottom of the maximum excavation depth to satisfy global stability requirements.
  - d. The wall shall be supported by tie back anchors to minimize movement of the top of the wall.
3. If groundwater is encountered during the construction of the wall, dewatering shall be required to drawdown the water table at least 5 feet below the bottom of the proposed excavation.
4. The design of the temporary wall support shall be submitted to the Construction Manager for the project for review at least 30 days prior to the start of wall construction.
5. The Contractor is responsible for all construction permits for the wall.
6. Contractor shall remove temporary excavation support above ground surface to a minimum of 3 ft below the design liner subgrade surface if support is left in place after excavation and backfill are complete.

**3.05 EASTSIDE VERIFICATION PROCEDURES**

- A. When excavation depth indicated on the Construction Drawings is reached, Contractor shall suspend work activities at the pond for Verification Procedures. Work suspension at the pond shall continue until the Construction Manager receives confirmation sampling laboratory results. Upon receipt of results, approximately 45 to 65 days after sampling, Construction Manager shall direct Contractor to remove additional materials from the pond or proceed with measurement survey.
1. Contractor shall assume that additional excavation will be required once in each area to achieve satisfactory confirmation sample results. If additional excavation is

required for a second time in a given area, the Contractor shall be compensated on a time and materials basis.

- B. Contractor shall sectioned off verification area with a rope barrier to indicate the verification process has engaged and all contaminated equipment and personnel shall stay out of the area.
- C. Excavation may continue in areas where verification measurements are not being performed.
- D. If an area fails to meet cleanup criteria
  - 1. The Contractor shall return to the affected area and continue excavation as directed by Construction Manager.
  - 2. Suspend excavation as directed to allow the Construction Manager to take additional verification measurements.
  - 3. Continue this cycle until verification measurements confirm that the cleanup criteria have been met.
- E. If an area meets cleanup criteria
  - 1. The Contractor shall not begin backfilling, if backfilling is required by the drawings or specifications, until the Construction Manager gives written authorization.
  - 2. The area shall be delineated as "clean" by the Contractor by means of a visible barrier and no equipment, materials, or personnel shall be allowed to enter the verified area from an unverified area.

### **3.06 HAZARDOUS AND SUSPECTED HAZARDOUS SUBSTANCES**

- A. Hazardous and suspected hazardous substances include, but are not limited to, substances listed in B below. Other substances may be identified by the Construction Manager that shall be designated to be included in this category.
- B. Stop work and notify Construction Manager immediately if evidence of previously unidentified suspect hazardous substances not shown on drawings is found. Typical evidence of suspected hazardous substances may include:
  - 1. Soil or other materials that are odorous or that emits organic vapors or trace gases.
  - 2. Soil with unusual texture or consistency, such as crystals or sludge-like material.
  - 3. Free liquids, other than ordinary surface water or groundwater.
  - 4. Sustained readings of 5 parts per million (minimum) of organic vapors, measured with a photo-ionization detector at the air/soil contact in freshly disturbed soil.
  - 5. Surface water or groundwater with a visible sheen or phase separation.
  - 6. Tanks, cisterns, sumps, drain lines, landfills, or surface impoundments.
  - 7. Containers suspected to contain chemical waste or products and leaking or empty containers associated with staining or discoloration.



8. Casings or internal components of lead-acid batteries.
  9. Electrical transformers or capacitors.
  10. Workers experiencing unusual physical sensations such as dizziness, headache, nausea, or metallic taste in mouth.
  11. Plants or animals that are dead or have inhibited growth that may be attributed to contamination.
  12. Conditions designated by Construction Manager as evidence of suspected hazardous substances.
- C. Immediately notify workers to stay away from area of suspected hazardous substance. Install a physical barrier, such as a rope barrier, around the area until further direction is provided by the Construction Manager. Leave equipment and tools that contacted the suspected hazardous substance in place until Construction Manager gives clearance to remove equipment and tools.
- D. Apply suitable health and safety measures in accordance with the Contractor's Health and Safety Plan, whenever working with or near suspected hazardous substance or hazardous substance.

### **3.07 INTERIM COVER PLACEMENT**

- A. Interim cover consisting of 1 foot of clean, non-contaminated soil shall be placed on final side slopes or other areas where run-off water can enter the storm water channels upon completion of waste placement for the day.
- B. The Contractor shall ensure a minimum 6-mil visqueen is placed over the slopes which could allow run-off to enter unlined areas of the CAMU. Visqueen shall be placed when precipitation is forecasted. Interim cover shall be placed above areas of exposed side slope. Interim cover shall be placed from the bottom of the slope upwards. Soil shall not be placed above visqueen. **The visqueen shall be nailed and/or sufficiently weighted to prevent wind uplift. Damaged visqueen shall be replaced prior to next forecasted storm event. The Contractor shall berm or cover the top of waste, or otherwise channel contaminated storm water, to prevent clean, unlined areas of the CAMU and external storm water channels from encountering contaminated storm water.**
- C. At the conclusion of waste placement, a 1-foot layer of final interim cover shall be placed across the entire CAMU top. The geosynthetic materials shall overlie this interim cover as shown on the Construction Drawings.
- D. Final interim cover shall be compacted to ~~85~~ **90** percent (minimum) of ASTM D1557 maximum dry density at less than or equal to optimum moisture content.
- E. Surface of final interim cover shall have no projections or protrusions greater than 3/4 -inch.

### **3.08 OPERATIONS LAYER PLACEMENT**

- A. Place only when underlying drainage aggregate and filter geotextile or geocomposite installation is complete, including all Construction Quality Control (CQC) and CQA work, **and approved by Construction Manager.**

- B. The subgrade to the operations layer consists of a geotextile or geocomposite. Therefore, the Contractor shall avoid tearing, puncturing, folding, or damaging in any way the filter geotextile or geocomposite geotextile during placement of the operations layer material.
- C. Any damage to the geosynthetic liner system which is caused by the Contractor or representatives of the Contractor shall be repaired by the Geosynthetics Installer at the expense of the Contractor.
- D. ~~Operations layer shall be compacted to 85 percent (minimum) of ASTM D1557 maximum dry density at less than or equal to optimum moisture content.~~ The operations layer shall be compacted with 4 passes by a D-6 dozer, or equivalent upon approval by Construction Manager. Moisture content shall be less than or equal to optimum.
- E. The operations layer material shall be placed out in front of the equipment used to place the operations layer such that a 1-foot minimum thickness requirement is maintained at all times between the geosynthetic materials and the wheels or tracks of the equipment used to place the operations layer material.
- F. Care must be exercised by the operators of tracked equipment to avoid sharp pivoting turns that could displace the operations layer material and result in damage to the liner system.
- G. The Contractor shall not push operations layer material down the side slope. All soil materials shall be placed from the toe of slope upward.
- H. The operations layer placed on the sideslopes shall be placed to a maximum vertical height above the horizontal surface of 10 ft at a slope inclination no steeper than 2.1H:1V as shown on the Drawings.

### **3.09 WASTE ACCEPTANCE CRITERIA**

- A. Dispose of the following slit trench materials in the CAMU, subject to sizing, placement restrictions, and other special management as specified in Subpart ~~3.08-B~~ 3.11.I of this Section.
  - 1. Soil, organic soil matter, and rock fragments. Spread and compact as contaminated fill.
  - 2. Pieces of wood, concrete, and masonry. Process, size, and place.
  - 3. Structural steel members and similar long items. Size and place.
  - 4. Other structural debris. Size and place.
  - 5. Pipes and ducts. Process, size, and place.
  - 6. Geomembranes and similar products from decommissioned ponds, ditches, and other temporary facilities. Process and size.
  - 7. Tires excavated from contaminated areas. Process, size, and place.
  - 8. Free liquids that do not pass the paint filter test, but do not contain hazardous or suspect hazardous substances. Dewater or stabilize to pass the paint filter test before placement.

9. Sludges that require stabilization for efficient handling, but do not contain hazardous or suspect hazardous substances. Stabilize as necessary before placement.
  10. Containerized waste and already packaged asbestos. Handle and place.
  11. Lead-based paint and objects coated with such paint. Place as specified for debris and oversized materials.
  12. Contaminated trash and debris from construction operations. Place as specified for organic materials.
  13. Other materials as directed by the Construction Manager.
- B. Dispose of the following slit trench materials in the CAMU only if specified procedures for hazardous or suspect hazardous substances have been observed and if suitable pretreatment has been performed. Disposal is subject to sizing, placement restrictions, and other special management as specified.
1. Free liquids or sludges containing hazardous or suspect hazardous substances.
  2. Waste oils, volatile organic compounds, and similar wastes.
  3. Asbestos requiring protective packaging.
  4. Automotive batteries.
  5. Materials with highly concentrated contaminants, such as metallic sludges.
  6. Substances that may pose imminent safety or health hazards.
- C. Dispose of only eastside soil- and sludge-like materials from ponds as shown on Construction Drawings in CAMU.
- D. Do not dispose of the following materials in the CAMU.
1. Contractor-owned items that can be readily decontaminated.
  2. Tires used by the Contractor in the course of the Project.
  3. Materials containing hazardous or suspect hazardous substances that have not been properly characterized or subjected to suitable pretreatment.
  4. Debris from the eastside area.
  5. Other materials considered by the Construction Manager to be unsuitable for disposal in the CAMU.
  6. Trash and debris generated during construction of the CAMU.
- E. The Construction Manager shall determine the acceptability of contaminated materials not falling clearly under any of the waste acceptance criteria.
- F. The Construction Manager may direct in specific cases that materials subject to special management, with or without pretreatment, be disposed off site and not within the CAMU.

Off-site disposal of contaminated materials originating on the site is the responsibility of the Owner under this contract.

### 3.10 MATERIAL PLACEMENT IN CAMU

- A. Layout and staging of ramps and haul roads within the CAMU and an analysis of the ramps that demonstrates that geosynthetics shall be adequately protected and that the ramps shall not be unstable during the placement process.
- B. The Contractor shall be responsible for protecting geosynthetics during waste placement. Any damage to geosynthetics caused by the Contractor shall be repaired by the Geosynthetics Installer at the expense of the Contractor.
- C. The Contractor shall be responsible for removing, or otherwise managing, all fluids within the CAMU through all seasons of the year for the duration of the Project. All fluids from the CAMU shall either be used for dust control in contaminated areas or shall be properly disposed of off-site.
- D. During placement of contaminated material, the top surface shall be placed so that the surface is graded at a slope no flatter than 3 percent and side slopes shall be no steeper than 3H:1V.
- E. Contaminated material shall be placed parallel to surfaces sloped at 10H:1V or flatter shall be considered horizontal lifts. If surfaces to receive fill are steeper than 10H:1V, place fill in horizontal lifts abutting the surface.
- F. Daily cover consisting of 6 inches of eastside materials shall be placed over the entire surface of exposed Slit Trench contaminated material placed in the CAMU.
- G. Dust suppression requirements apply at all times.
- H. Contaminated water used for dust control shall not come into contact with clean, interim cover soils or unlined areas of the CAMU.
- I. Material Sizing and Processing: Process the following slit trench materials to be placed in the CAMU.
  - 1. Wood, Concrete, Masonry: Cut or break up to a maximum 3-foot size measured in any dimension.
  - 2. Structural Steel Members, Pipes, Ducts, Other Long Items: Cut into maximum 10-foot lengths.
  - 3. Concrete, Clay Tile, and Other Pipes: Crush concrete and clay tile pipes. Crush other pipes and ducts that are 6 inches or greater in diameter or, if crushing is impractical, cut pipes and ducts in half longitudinally. Do not crush asbestos-cement pipe.
  - 4. Rubber Tires Excavated at the Site: Cut into two halves around the circumference.
  - 5. Geomembranes: shred to a maximum strip size of 3 ~~inches~~ feet by 3 ~~inches~~ feet.
  - 6. Other Sheet Material: Cut into strips a maximum of 4 feet wide by 4 feet long.
- J. Material Blending and Conditioning

1. Eastside area excavated material shall be mixed with sludge contained in the lined TIMET ponds as needed to achieve moisture content less than or equal to optimum moisture content. Solidified waste shall be transported and disposed of in the CAMU.
  2. Dry material if blending cannot achieve optimum or less moisture content.
  3. Do not add water (except to minimum extent needed for dust control) after material is delivered to CAMU.
  4. Remove materials within the CAMU that do not achieve specified moisture content. Re-blend or recondition material at a location within the CAMU that allows sufficient area for re-blending or reconditioning to meet specification requirements. Perform removal, re-blending or reconditioning, and replacement at no extra cost to the Owner.
- K. Spreading and Compacting: Place contaminated materials, and soil-like materials with particle dimensions of 6 inches (maximum) as compacted contaminated fill.
1. Spread contaminated fill in 1 foot maximum thickness horizontal lifts, measured before compaction.
  2. Lifts placed parallel to surfaces sloped at 10 (horizontal) to 1 (vertical) or flatter shall be considered horizontal lifts. If surfaces to receive fill are steeper than 10 (horizontal) to 1 (vertical), place fill in horizontal lifts abutting the surface. Lifts shall be placed across the entire base area for each phase prior to proceeding with subsequent lifts.
  3. Placement of contaminated fill shall begin at bottom of slope and progress to top of slope in horizontal lifts. Under no circumstances shall materials be pushed down the side slopes.
  4. Compact to 85 percent (minimum) of ASTM D 1557 maximum dry density, at less than or equal to optimum moisture content.
- L. Dewatering in CAMU: During placement of contaminated materials into the CAMU, during periods of temporary shutdown, and during other inactive periods after contaminated materials have been placed into the CAMU, the Contractor shall be responsible for dewatering the CAMU at a rate that shall allow all work to be accomplished in dry conditions and that shall maintain less than 3 feet of fluid levels in the leachate collection system sump **as measured from the top of the geomembrane**. All water removed from the CAMU shall be discharged for use as dust control or taken off site and shall be coordinated with the Contractor's approved Water Management Plan.
- M. **Placement of materials in the CAMU shall conform to the following requirements as specified in the following sections:**

Material	Maximum Size	Minimum Distance from Base Liner	Minimum Distance from Side-slope Liner	Minimum Distance from Final Cover Liner	Minimum Width of Compacted Eastside Material prior to material placement
Wood/ Concrete/	3 ft (any	15 ft	15 ft	15 ft	N.S.

Masonry	direction)				
Structural Steel Members/ pipes/ ducts/ other long items	10 linear ft	15 ft	15 ft	15 ft	N.S.
Rubber Tires Excavated at the Site	Cut in half	15 ft	15 ft	15 ft	N.S.
Geomembranes	3 ft x 3 ft	6 ft	15 ft	15 ft	N.S.
Other Sheet Material	4 ft x 4 ft	6 ft	15 ft	15 ft	N.S.
Slit Trench Material: Non-hazardous	<6"	6 ft	6 ft	6 ft	150 ft
	>6"	15 ft	15 ft	15 ft	150 ft
Slit Trench Material: Hazardous or Suspected Hazardous	<6"	6 ft	100 ft	6 ft	150 ft
	>6"	15 ft	100 ft	6 ft	150 ft

N.S. – Not Specified

N. ~~M.~~ Restrictions for Placement of Materials in CAMU

1. The Contractor shall remove all clean fill ramps used for construction of the CAMU prior to placement of contaminated materials in the CAMU. Any clean fill ramps placed over the liner shall be removed to within 2 feet of the liner in all areas. Portions of clean fill ramps over liners that are left in place shall not exceed 2,000 yd<sup>3</sup>/ramp.
2. Materials must be placed into the CAMU in a manner that prevents damage to the geosynthetic components and does not produce slope stability failures.
3. A minimum of a 150-foot-wide, 4-foot-thick layer of compacted contaminated material **above the 2-foot thick operations layer, for a total of 6-feet of compacted contaminated material** must be placed across the CAMU bottom ahead of the working face of Slit Trench contaminated material subsequently placed in the CAMU.
4. Vehicle access to the CAMU is limited to access ramps authorized by the Construction Manager. Under no circumstances shall any vehicles access the CAMU over the sideslopes.
5. Alternatives to access ramps can be proposed by the Contractor. Such proposals shall include relevant analyses and be submitted to the Construction Manager for evaluation.

O. ~~N.~~ Requirements for Access Ramps

1. Design and analyses must be performed to verify that each ramp has a minimum factor of safety against slope failure of 1.5 when considering the transient loading of the equipment that shall use the access ramp. The analyses shall consider both internal failure of the ramp and block failure of the ramp at the geosynthetic/liner interface. Ramp design and analysis shall be stamped by a Registered Professional Engineer in the State of Nevada and shall be experienced and competent in the field of geosynthetic liner design and related construction operations.
  2. Construction of ramps for use during placement of contaminated materials must begin at the bottom of the slope and progress to the top of the slope. Under no circumstances shall materials be pushed down the sideslopes.
  3. The Contractor shall not construct more than two ramps per phase into/out of the CAMU for use during placement of contaminated materials.
  4. All parts of the ramp(s) shall be at least 100 feet horizontally away from any part of any sump.
- P. ~~Q~~-Selective Placement of Materials: Place the following materials at specified locations in CAMU.
1. Hazardous or Suspected Hazardous Substances: May be dispersed throughout CAMU.
    - a. The Contractor shall prepare and maintain records of the vertical and horizontal location within the CAMU of each load of hazardous or suspected hazardous substances placed in the CAMU to within  $\pm 0.5$  foot. The recorded vertical and horizontal locations shall be at approximately the centers of the areas where these substances are spread. Records also shall include a description of the materials placed at each location. Each location shall be plotted on the as-built drawings with ties to field survey data and other related records.
    - b. Hazardous or suspected hazardous substances shall be transported to the disposal site and disposed in an area of the CAMU that is at least 100 feet horizontally from the CAMU sideslopes at the level of contaminated material where the substances shall be buried. The substances shall be placed in one layer and shall be covered immediately with at least 2 feet of soil, compacted as specified for the contaminated material placement.

Q. ~~P~~-Asbestos Handling and Placement

1. The vertical and horizontal limits of each Asbestos Containing Material (ACM) disposal area in the CAMU shall be surveyed to within  $\pm 0.5$  foot and shown on the as-built drawings.
2. All ACM shall be buried within 24 hours with at least 2 feet of eastside material.
3. After ACM has been transported, work areas and transport vehicles shall be cleaned with significant assurance that no asbestos fibers shall become airborne when other work takes place. Decontamination water from asbestos decontamination shall be segregated from site decontamination water and disposed of off site at an appropriate treatment and/or disposal facility. Asbestos decontamination water shall not be used for dust control.

4. The Contractor shall conduct required air monitoring during all ACM handling, transport, and disposal processes. The Contractor must obtain clearance from the Construction Manager prior to re-deploying any equipment or supplies that were used to handle, transport, or dispose of ACM.
  5. Provide PPE as required in the Contractors Health and Safety Plan during ACM handling, transport, and placement. Contractor shall provide adequate PPE to all site workers who may come in contact with ACM at no additional cost to the Owner.
- R. ~~Q~~ Debris and Oversized Material: Place sized debris, bulky special-management waste, and material with particle dimensions greater than 6 inches as follows:
1. Do not place debris or oversized material in the following parts of the CAMU.
    - a. All materials placed from the outer extent (CAMU side) of the operational protective layer to a point 15 feet (measured laterally) from the CAMU liner or final cover system shall have a maximum particle size of 6 inches. No other debris or oversized material with particle dimensions greater than 6 inches may be placed within this zone.
    - b. Material placed further than 100 ft (measured laterally) from the CAMU liner shall be placed per all current requirements of the Construction Drawings and Construction Specifications. Place large debris and bulky items individually, at widely separated locations in the lower part of the CAMU.
  2. Where individual placement is impractical, place debris and oversized material in piles or rows 2 to 3 feet high, spaced no less than 100 feet apart (measured horizontally).
  3. Place debris and oversized material to avoid nesting or creation of large voids. Fill voids with loose soil to minimize open space.
  4. Surround debris and oversized material with soil, placed and compacted as specified.

### **3.11 FIELD QUALITY CONTROL**

- A. Observation by Construction Manager: Do not place contaminated materials in the CAMU unless the Construction Manager is present to observe the work. Construction Manager may waive observation at Construction Manager's discretion.
- B. Sampling: Take the number and size of samples required to perform the specified tests.
- C. Contractor shall provide equipment and operator for testing, testing shall be performed by CQA Consultant: Test for in-place density and moisture content.
  1. Reference Density: ASTM D1557. Provide maximum dry density and optimum moisture content for each distinct type of material or contaminated soil being placed.
    - a. Obtain one test (minimum) per distinct type of material or contaminated soil to be placed in the CAMU.
  2. In-Place Density: ASTM D 1556, ASTM D 2167, or ASTM D 2922.
    - a. One test (minimum) per 2,500 cubic yards placed, or fraction thereof.



- b. Additional density tests whenever definite changes in moisture content or quality of compaction are observed.
    - c. At least one density test per shift in which contaminated fill is placed, regardless of volume placed.
  - 3. In-Place Moisture Content: ASTM D 2216, ASTM D 3017, or ASTM D 4643. Obtain one test with each in-place density test.
- D. One-Dimensional Consolidation: ASTM D 2435
  - 1. Obtain one in-situ Shelby Tube Sampler (minimum) per 50,000 cubic yards placed.
- E. Correction of Nonconforming Work
  - 1. Either re-work or remove and replace materials that do not conform to specified density or moisture content requirements.
  - 2. Perform additional density and in-place moisture content tests as needed to identify the limits of the nonconforming materials.
  - 3. Continue rework or removal and replacement until the compacted material conforms to the specified density and moisture content requirements, at no additional cost to the Owner.

### **3.12 SURVEY CONTROL**

- A. Prior to any disturbance of soils, Contractor shall perform initial layout survey.
- B. Contractor shall provide post excavation grade survey map with 0.5 foot contour intervals.

## **PART 4 – MEASUREMENT AND PAYMENT**

### **4.01 GENERAL**

- A. Providing for and complying with the requirements set forth in this Section for slit trench backfill shall be measured by Cubic Yard (CY) and payment shall be based on the unit price provided in the Base Bid Schedule. Slit trench cover soil excavation shall be incidental to slit trench backfill.
- B. Providing for and complying with the requirements set forth in this Section for waste and debris excavation shall be measured by the in-place Cubic Yard (CY) of material excavated from the Eastside Area, Slit Trenches, and Western Ditch. Measurement shall be accomplished by calculating the volume of material excavated based on the Owner's field survey cross-sections taken before start of waste/debris excavation and post excavation. Field survey cross-sections shall be taken at intervals not to exceed 50 feet, at major grade breaks, and at other significant locations as agreed to by the Construction Manager and Contractor. Payment will be provided based on the following bid schedules and estimated volume of soil:
  - 1. Base Bid Schedule: remediated volumes within +/-15 percent of the estimated quantity for excavated material placed in the CAMU. Payment will be made based on the unit price provided on the base bid schedule; and

2. Alternative Bid Items Schedule: remediated volumes above 15 percent of the estimated quantity for excavated material placed in the CAMU, if necessary. Payment will be based on a time and materials basis at the unit prices proved on the alternative bid items schedule.

Payment shall be based on the unit prices provided on the bid schedules. Specified items incidental to the Waste Soil Excavation item on the Base Bid Schedule include:

1. Access Ramp Design
  2. Waste Excavation Plan
  3. Temporary excavation support
  4. Material excavation, screening, processing, moisture conditioning, transporting, placing, and compaction in the CAMU
  5. Eastside material used for operations layer
  6. Odor Control
  7. Excavation Dewatering
  8. Contaminated Water Dewatering
  9. Temporary Exclusion Zone Control Fencing
  10. Daily cover
  11. Visqueen
  12. All other incidentals necessary for complete remedial excavation and filling of the CAMU.
- C. Measurement for special procedures or activities directed by the Construction Manager for handling, management, or treatment of hazardous or suspected hazardous substances shall be in accordance with the Alternative Bid Item Schedule to be Add/Deleted from Scope. Payment for special procedures or activities directed by the Contractor for handling, management, or treatment of hazardous or suspected hazardous substances shall be on a time and materials basis in accordance with prices provided on the Alternative Bid Item Schedule. These costs shall include all necessary incidentals to complete the alternative bid items.
- D. Providing for and complying with the requirements set forth in this section for PCB contaminated soil excavation shall be by ton of PCB contaminated material excavated from the Slit Trenches, as defined on the Drawings. Payment for the excavating, transport, and disposal of PCB contaminated soil shall be made by unit price bid per ton excavated from the Slit Trenches. The unit price shall include all necessary incidentals for complete PCB contaminated soil excavation, transport, and disposal. The volume of PCB contaminated waste excavation shall be deducted from the Slit Trench Excavation volume described in A.
- E. Providing for and complying with the following incidentals shall be included in the Earthworks and Remedial Excavation and Filling, Sections 02200 and 02205, costs on the Bid Schedules:

1. Construction and Dust Control Water
2. Uncontaminated Dewatering
3. Contaminated Water Management
4. Dust Control
5. Vacuum Trucks
6. Spill Clean up
7. Health and Safety
  - a. Personal Protective Equipment
  - b. Monitoring
8. Operations and Maintenance of the following items:
  - a. Parking Areas
  - b. Temporary Roads
  - c. Temporary Trailers
  - d. Temporary Utilities
  - e. On-site communications
  - f. Weather Protection
  - g. Contractor Generated Debris and Trash Control
  - h. Temporary Sanitary Facilities
  - i. Lighting
  - j. Material and Equipment Storage
  - k. Dust Control Water Storage
  - l. Vacuum Truck Staging Area
  - m. Decontamination Area
  - n. Construction Equipment
  - o. First Aid Facilities
  - p. HDPE-lined Storage Area
  - q. Dust Control
  - r. Pollution Control

- s. Traffic and Safety Control
  - t. Access Control
  - u. Decontamination
  - v. Noise Control
9. And all other incidentals necessary for Remedial Excavation and Filling
- F. Providing for and complying with the requirements set forth in this Section, Interim Cover shall be measured by the in-place cubic yard (cy) of material placed as determined by field survey cross sections taken at maximum 50 foot spacing and at major grade breaks. Payment shall be based on the Bid Schedule Item "Interim Soil Cover."

[END OF SECTION]

**SECTION 02225  
DRAINAGE AGGREGATE**

**PART 1 – GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings.
- B. Construction of the final CAMU cover system and associated storm water management features overlying the CAMU will be held as an Option Scope that may be added to the contract via Contract Modification at the Owner's sole discretion. If the Owner decides to exercise its option to add the Option Scope, the Construction Manager will notify the Contractor no later than 30 days after receipt of the final Eastside Area confirmation sampling

**1.02 RELATED SECTIONS**

Section 02200 —Earthwork

Section 02711 — Polyethylene Pipe

Section 02712 — Corrugated Polyethylene Pipe

Section 02771 — Geotextile

**1.03 REFERENCES**

- A. Construction Drawings
- B. Geosyntec, 2007 “Construction Quality Assurance Plan for the Construction of the Corrective Action Management Unit, Basic Remediation Company, Henderson, Nevada,” August.
- C. Latest Version of American Society for Testing and Materials (ASTM) Standards:
  - ASTM C 33      Standard Specification for Concrete Aggregates
  - ASTM C 136    Test Method for Sieve Analysis of Fine and Coarse Aggregates
  - ASTM D 2434   Standard Test Method for Permeability of Granular Soils (Constant Head)

**1.04 SUBMITTALS**

- A. The Contractor shall submit to the Construction Manager for approval, at least 7 days prior to the start of construction, Certificates of Compliance for proposed aggregate materials. Certificates of Compliance shall include, at a minimum, typical gradation and source of aggregate materials.

**1.05 QUALITY ASSURANCE**

- A. The Contractor shall ensure that the materials and methods used for Drainage Aggregate meet the requirements of the Drawings and this Section. Any material or method that does

not conform to these documents, or to alternatives approved in writing by the Construction Manager shall be rejected and shall be repaired or replaced by the Contractor.

- B. The Contractor shall be aware of all monitoring and field/laboratory conformance testing required by the CQA Plan. This monitoring and testing, including random conformance testing of construction materials and completed work, shall be performed by the CQA Engineer. If nonconformances or other deficiencies are found in the materials or completed work, the Contractor shall be required to repair the deficiency or replace the deficient materials.

## **PART 2 – PRODUCTS**

### **2.01 MATERIALS**

- A. Aggregate shall meet the requirements specified in ASTM C-33 and shall have a maximum particle size of 1-inch. Aggregate shall have a minimum permeability of  $1 \times 10^{-2}$  cm/sec when tested in accordance with ASTM D 2434.

### **2.02 EQUIPMENT**

- A. The Contractor shall furnish, operate, and maintain hauling, placing, and grading equipment as necessary for aggregate placement.

## **PART 3 – EXECUTION**

### **3.01 FAMILIARIZATION**

- A. Prior to implementing any of the work in this Section, the Contractor shall become thoroughly familiar with the site, the site conditions, and all portions of the work falling within this and other related Sections.
- B. Inspection:
  - 1. The Contractor shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of the work specified in this Section may properly commence without adverse impact.
  - 2. If the Contractor has any concerns regarding the installed work of other Sections, the Construction Manager shall be notified in writing prior to commencing work. Failure to notify the Construction Manager or continuance of the work of this Section shall be construed as Contractor's acceptance of the related work of all other Sections.

### **3.02 PLACEMENT**

- A. Place only when underlying geosynthetic installation is complete, including all CQC and CQA work, **and approved by Construction Manager.**
- B. Place to the lines, grades, and dimensions shown on the Drawings.
- C. The subgrade to the aggregate consists of a geotextile overlying a geomembrane. The Contractor shall avoid tearing, puncturing, folding, or damaging in any way the geosynthetic materials during placement of the aggregate material.
- D. Any damage to the geosynthetic liner system which is caused by the Contractor or his representatives shall be repaired by the Geosynthetic Installer at the Contractor's expense.

- E. No density or moisture requirements are specified for placement of the aggregate material.
- F. All equipment to be used in placing the aggregate material must be approved in writing by the Construction Manager prior to use. The Contractor shall provide a list of the equipment to be used for placing the aggregate material and the necessary technical information (equipment specifications) on each piece of equipment to be approved at least two working days prior to use.
- G. Place filter geotextile overlying aggregate as shown on the Drawings and as specified in Section 02771.

### **3.03 FIELD TESTING**

- A. The minimum frequency and details of quality control testing are provided below. This testing shall be performed by the CQA Engineer. The Contractor shall take this testing frequency into account in planning the construction schedule.
  - 1. Aggregates quality control testing:
    - a. particle-size analyses conducted in accordance with ASTM C-136 at a frequency of one test per 5,000 yd<sup>3</sup>;
    - b. permeability tests conducted in accordance with ASTM D 2434 at a frequency of one test per 10,000 yd<sup>3</sup>.

### **3.04 CONSTRUCTION TOLERANCE**

- A. The Contractor shall perform the aggregate construction to within +0.1 ft of the thickness indicated on the Drawings.

### **3.05 PROTECTION OF WORK**

- A. The Contractor shall use all means necessary to protect all work of this Section.
- B. In the event of damage, the Contractor shall make repairs and replacements to the satisfaction of the Construction Manager.

## **PART 4 – MEASUREMENT AND PAYMENT**

### **4.01 GENERAL**

- A. Providing for and complying with the requirements set forth in this Section for Drainage Aggregate shall be incidental to leachate collection polyethylene pipe and corrugated polyethylene pipe.

[END OF SECTION]

**SECTION 02711**  
**LEACHATE COLLECTION POLYETHYLENE PIPE**

**PART 1 – GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings.

**1.02 RELATED SECTIONS**

Section 02225 — Drainage Aggregate

Section 02771 — Geotextile

**1.03 REFERENCES**

- A. Drawings
- B. Construction Quality Assurance (CQA) Plan
- C. Latest Version of American Society for Testing and Materials (ASTM) Standards:
  - ASTM F 714 Specification for Polyethylene Plastic Pipe (SDR-PR) Based on Outside Diameter
  - ASTM D 1248 Specification for Polyethylene Plastics Molding and Extrusion
  - ASTM D 2657 Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
  - ASTM D 3035 Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter
  - ASTM D 3350 Specification for Polyethylene Plastic Pipe and Fitting Materials

**1.04 DEFINITIONS**

- A. Standard Dimensional Ratio (SDR) is defined as the actual outside pipe diameter divided by the wall thickness.

**1.05 SUBMITTALS**

- A. The Contractor shall submit, at least 14 days prior to installation of this material, to the Construction Manager, certificates of compliance for the pipe materials and fittings to be furnished.
- B. The Contractor shall submit, at least 14 days prior to installation of this material, to the Construction Manager, copies of certifications for each operator responsible for welding pipe.
- C. The Construction Manager shall supply a surveyor to document the as-built conditions of the piping. The Contractor shall notify and allow the Construction Manager sufficient time to survey piping prior to backfilling the pipe.



- D. Contractor shall submit Manufacturer Butt-Fusion Training documentation for HDPE Pipe Joining Technicians

## **1.06 QUALITY ASSURANCE**

- A. The Contractor shall ensure that the materials and methods used for polyethylene pipe meet the requirements of the Construction Drawings and this Section. Any material or method that does not conform to these documents, or to alternatives approved in writing by the Construction Manager shall be rejected and shall be repaired or replaced by the Contractor.

## **PART 2 – PRODUCTS**

### **2.01 PIPE**

- A. HDPE pipe sizes shown on the Drawings and specified in this Section reference nominal inside diameter. Pipe size shall be in accordance with ASTM F 714 and ASTM D 3035.
- B. Pipe shall be 4-inch, 12-inch, and 18-inch diameter, and shall be HDPE with a minimum standard dimension ratio (SDR) of 13.5, and have a cell classification of 345434C in accordance with ASTM D 3350.
- C. Pipe shall conform to the following requirements:
  - 1. Pipe and fittings shall contain no recycled compound except that generated in the Manufacturer's own plant and from resin of the same specification as the raw material supplier.
  - 2. Pipe and fittings shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions, or other deleterious defects, being uniform in color, capacity, density, and other physical properties.
- D. The following information shall be continuously marked on the pipe or spaced at intervals not exceeding 5 feet.
  - 1. Name and/or trademark of the pipe Manufacturer.
  - 2. Nominal pipe size.
  - 3. Standard Dimensional Ratio (SDR).
  - 4. PE 3408.
  - 5. A production code from which the date and place of manufacture can be determined.

## **PART 3 – EXECUTION**

### **3.01 GENERAL**

- A. When shipping, delivering, and installing pipe, fittings, and accessories, do so to ensure a sound, undamaged installation. Provide adequate storage for all materials and equipment delivered to the job site. Handle and store pipe and fittings in accordance with the Manufacturer's recommendation.

### **3.02 PLACING AND LAYING PIPE**

- A. Follow the Manufacturer's recommendations when hauling, unloading, and stringing the pipe.
- B. Protect liners and other geosynthetic materials from damage while installing the leachate collection and removal systems.
- C. HDPE solid and perforated pipe shall be installed as shown on the Drawings.
- D. HDPE pipe shall be inspected for cuts, scratches, or other damages prior to installation. Any pipe showing damage, which in the opinion of the Construction Manager shall affect performance of the pipe, must be removed from the Site. The Contractor shall replace any material found to be defective at no additional cost to the Construction Manager.
- E. The Contractor shall place HDPE solid and perforated pipe in such a manner that does not damage the pipe.
- F. The Contractor shall place the drainage aggregate material around the polyethylene pipe so as to not deform or otherwise damage the pipe and fittings. Special care shall be taken when placing pipe bedding material beneath the spring-line of the pipe and fittings.
- G. The Contractor shall clean out pipe interior, as necessary, to remove debris that may affect performance of pipe.

### **3.03 JOINING PIPE**

- A. All pipe fusion shall be performed by the Supplier, or a by fusion operator certified by the Manufacturer.
- B. Join the polyethylene pipe by the method of thermal butt fusion, as outlined in ASTM D 2657. Electro-fusion couplings shall not be used. Perform butt-fusion joining of pipe and fittings in accordance with the procedures established by the pipe Manufacturer. Of particular importance is the use of proper interface pressures and heater plate temperatures.
- C. Do not perform pipe fusion on wet or excessively dirty pipe or when conditions are unsuitable for the work. Secure open ends of pipe when work is not in progress, so that no water, earth, or other substance shall enter the pipe or fittings. Plug, cap, or valve off ends of pipe left for future connections, if any.
- D. In order to allow the joining operation to continue in adverse weather conditions, a shelter may be required for the joining machine. Particular caution should be exercised to prevent water from entering the pipe and from coming in contact with the heater plate.
- E. Only fully trained personnel shall be allowed to perform the fusion, installation, supervision, or inspection of polyethylene fusion joints.
- F. Pipe joints made with couplings can be slipped fitted for perforated pipe. Solid wall pipe shall be joined with butt fusion or fusion coupler methods only.

## **PART 4 – MEASUREMENT AND PAYMENT**

### **4.01 GENERAL**

- A. Providing for and complying with the requirements set forth in this Section for 4-inch , 12-inch, and 18-inch HDPE solid wall and perforated pipe, fittings, and gravel shall be measured as lump sum (LS), and payment shall be based on the lump sum price for LCRS HDPE piping and gravel provided on the Bid Schedule. Specified items incidental to LCRS HDPE piping and gravel include:

1. Filter geotextile
2. Drainage aggregate
3. And all other incidentals necessary for a complete installation of LCRS HDPE Pipe

[END OF SECTION]

**SECTION 02712**  
**CORRUGATED POLYETHYLENE PIPE**

**PART 1 – GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings.
- B. Construction of the final CAMU cover system will be held as an Option Scope that may be added to the contract via Contract Modification at the Owner's sole discretion. If the Owner decides to exercise its option to add the Option Scope, the Construction Manager will notify the Contractor no later than 30 days after receipt of the final Eastside Area confirmation sampling

**1.02 RELATED SECTIONS**

Section 02200 — Earthwork

**1.03 REFERENCES**

- A. Construction Drawings
- B. Site Construction Quality Assurance (CQA) Plan
- C. Latest Version of American Society for Testing and Materials (ASTM) Standards:
  - ASTM F 405                      Standard Specification for Corrugated Polyethylene (CPE) Pipe and Fittings
- D. Latest American Association of State Highway and Transportation Officials (AASHTO) Standards:
  - AASHTO M252M-96              Corrugated Polyethylene Drainage Pipe

**1.04 SUBMITTALS**

- A. The Contractor shall submit, at least 14 days prior to installation of this material, to the Construction Manager, certificates of compliance for the pipe materials and fittings to be furnished.
- B. The ~~Construction Manager~~ Contractor shall supply a surveyor to document the as-built conditions of the piping. The Contractor shall notify and allow the Construction Manager sufficient time to survey piping prior to backfilling the pipe. Owner shall verify survey as-built conditions using control points.

**1.05 QUALITY ASSURANCE**

- A. The Contractor shall ensure that the materials and methods used for corrugated polyethylene pipe meet the requirements of the Drawings and this Section. Any material or method that does not conform to these documents, or to alternatives approved in writing by the Construction Manager shall be rejected and shall be repaired or replaced by the Contractor.

## **PART 2 – PRODUCTS**

### **2.01 PIPE**

- A. HDPE pipe sizes shown on the Drawings and specified in this Section reference nominal inside diameter. Pipe material, markings, properties, and size shall be in accordance with AASHTO M252.
- B. Pipes shall be corrugated polyethylene pipe with a smooth interior wall, Type SP with Class 2 perforations in accordance with AASHTO M252.

## **PART 3 – EXECUTION**

### **3.01 GENERAL**

- A. When shipping, delivering, and installing pipe, fittings, and accessories, do so to ensure a sound, undamaged installation. Provide adequate storage for all materials and equipment delivered to the job site. Handle and store pipe and fittings in accordance with the Manufacturer's recommendation.

### **3.02 PLACING AND LAYING PIPE**

- A. Follow the Manufacturer's recommendations when hauling, unloading, and stringing the pipe.
- B. Corrugated polyethylene solid and perforated pipe shall be installed as shown on the Drawings.
- C. Corrugated polyethylene pipe shall be inspected for cuts, scratches, or other damages prior to installation. Any pipe showing damage, which in the opinion of the Construction Manager shall affect performance of the pipe, must be removed from the site. Replace any material found to be defective.

### **3.03 CONSTRUCTION TOLERANCE**

- A. The Contractor shall perform the work to within  $\pm 0.1$  ft of the grades indicated on the Drawings.

## **PART 4 – MEASUREMENT AND PAYMENT**

### **4.01 GENERAL**

- A. Providing for and complying with the requirements set forth in this Section for 4-inch HDPE perforated and solid wall CPE pipe and fittings shall be measured in linear feet (LF), and payment shall be based on the unit price provided on the Option Scope Bid Schedule. Specified items considered incidental to 4-inch Corrugate Polyethylene Pipe include:
  - 1. Filter Geotextile
  - 2. Drainage Aggregate
  - 3. And all other incidentals necessary for a complete installation of HDPE CPE Pipe.

[END OF SECTION]

**SECTION 02770**  
**GEOMEMBRANE**

**PART 1 – GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings
- B. Construction of the final CAMU cover system will be held as an Option Scope that may be added to the contract via Contract Modification at the Owner's sole discretion. If the Owner decides to exercise its option to add the Option Scope, the Construction Manager will notify the Contractor no later than 30 days after receipt of the final Eastside Area confirmation sampling

**1.02 RELATED SECTIONS**

Section 02771 — Geotextile

Section 02772 — Geosynthetic Clay Liner

Section 02773 — Geocomposite

**1.03 REFERENCES**

- A. Construction Drawings
- B. Geosyntec, 2007 “Construction Quality Assurance Plan for the Construction of the Corrective Action Management Unit, Basic Remediation Company, Henderson, Nevada,” August.
- C. Latest version of the American Society for Testing and Materials (ASTM) standards:
  - ASTM D 638 Standard Test Method for Tensile Properties of Plastics
  - ASTM D 792 Standard Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement
  - ASTM D 1004 Standard Test Method of Initial Tear Resistance of Plastic Film and Sheeting
  - ASTM D 1505 Standard Test Methods for Density of Plastics by Density-Gradient Technique
  - ASTM D 1603 Standard Test Method for Carbon Black in Olefin Plastics
  - ASTM D 5321 Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method
  - ASTM D 5397 Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
  - ASTM D 5596 Recommended Practice for Microscopical Examination of Pigment Dispersion in Plastic Compounds

ASTM D 5641	Practice for Geomembrane Seam Evaluation by Vacuum Chamber
ASTM D 5820	Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes
ASTM D 5994	Standard Test Method for Measuring Core Thickness of Textured Geomembranes
ASTM D 6392	Test Method for Determining the Integrity of Non-reinforced Geomembrane Seams Produced using Thermo-Fusion Methods.

#### **1.04 QUALIFICATIONS**

- A. The Geomembrane Manufacturer shall be responsible for the production of geomembrane rolls from resin and shall have sufficient production capacity and qualified personnel to provide material meeting the requirements of this Section and the construction schedule for this project.
- B. Geosynthetics Installer:
  1. The Geosynthetics Installer shall be responsible and shall provide sufficient resources for field handling, deploying, seaming, temporarily restraining (against wind), and other aspects of the deployment and installation of the geomembrane and other geosynthetic components of the project.
  2. The Geosynthetics Installer shall have successfully installed a minimum of 10,000,000 ft<sup>2</sup> of polyethylene geomembrane on previous projects. The Geosynthetics Installer shall provide documentation of installations to the Construction Manager.
  3. The installation crew shall have the following experience.
    - a. The Superintendent shall have supervised the installation of a minimum of ~~2,000,000~~ 5,000,000 ft<sup>2</sup> of polyethylene geomembrane on at least five (5) different projects. The Superintendent shall provide documentation of installations to the Construction Manager.
    - b. At least one seamer shall have experience seaming a minimum of 1,000,000 square feet of polyethylene geomembrane using the same type of seaming apparatus to be used at this site. Seamers with such experience shall be designated “master seamers” and shall provide direct supervision over less experienced seamers. The master seamer shall provide documentation of experience to the Construction Manager.
    - c. All other seaming personnel shall have seamed at least 100,000 square feet of polyethylene geomembrane using the same type of seaming apparatus to be used at this site. Personnel who have seamed less than 100,000 square feet shall be allowed to seam only under the direct supervision of the master seamer or Superintendent. The other seamers shall provide documentation of seaming experiences to the Construction Manager.
- C. Contractor shall provide resumes for all geomembrane installation technicians with documentation of Manufacturer training on seaming geomembrane.

## **1.05 WARRANTY**

- A. The Geosynthetic Installer shall furnish the Construction Manager a 20-year written warranty against defects in materials. Warranty conditions concerning limits of liability shall be evaluated by, and must be acceptable to, the Construction Manager.
- B. The Geosynthetic Installer shall furnish the Construction Manager with a 1-year written warranty against defects in workmanship. Warranty conditions concerning limits of liability shall be evaluated by, and must be acceptable to, the Construction Manager.

## **1.06 SUBMITTALS**

- A. The Geosynthetic Installer shall submit the following documentation on the resin used to manufacture the geomembrane to the Construction Manager for approval 21 days prior to transporting any geomembrane to the site.
  - 1. Copies of quality control certificates issued by the resin supplier including the production dates and origin of the resin used to manufacture the geomembrane for the project.
  - 2. Results of tests conducted by the Geomembrane Manufacturer to verify the quality of the resin used to manufacture the geomembrane rolls assigned to the project.
  - 3. Certification that no reclaimed polymer is added to the resin during the manufacturing of the geomembrane to be used for this project, or, if recycled polymer is used, the Manufacturer shall submit a certificate signed by the production manager documenting the quantity of recycled material, including a description of the procedure used to measure the quantity of recycled polymer.
- B. The Geosynthetic Installer shall submit the following documentation on geomembrane roll production to the Construction Manager for approval 21 days prior to transporting any geomembrane to the site.
  - 1. Quality control certificates, which shall include:
    - a. roll numbers and identification; and
    - b. results of quality control tests, including descriptions of the test methods used, outlined in Part 2.02 of this Section.
  - 2. The manufacturer warranty specified in Part 1.05.A of this Section.
- C. The Geosynthetic Installer shall submit the following information to the Construction Manager for approval 21 days prior to mobilization.
  - 1. A drawing showing the installation layout identifying geomembrane panel configurations, dimensions, details, locations of seams, as well as any variance or additional details that deviate from the Drawings. The layout shall be adequate for use as a construction plan and shall include dimensions, details, etc. The layout drawings, as modified and/or approved by the Construction Manager, shall become part of these Specifications.
  - 2. Copy of Geosynthetic Installer's letter of approval or license by the Geomembrane Manufacturer.



3. Installation capabilities, including:
  - a. information on equipment proposed for this project;
  - b. average daily production anticipated for this project; and
  - c. quality control procedures.
4. A list of completed facilities for which the installer has installed a minimum of 10,000,000 ft<sup>2</sup> of polyethylene geomembrane, in accordance with Part 1.04 of this Specification. The following information shall be provided for each facility:
  - a. the name and purpose of the facility, its location, and dates of installation;
  - b. the names of the owner, project manager, and geomembrane manufacturer;
  - c. name of the supervisor of the installation crew; and
  - d. thickness and surface area of installed geomembrane.
5. In accordance with Part 1.04, a resume of the Superintendent to be assigned to this project, including dates and duration of employment, shall be submitted at least 14 days prior to beginning geomembrane installation.
6. In accordance with Part 1.04, resumes of all personnel who shall perform seaming operations on this project, including dates and duration of employment, shall be submitted at least 14 days prior to beginning geomembrane installation.
- D. A Certificate of Calibration less than 12 months old shall be submitted for each field tensiometer prior to installation of any geomembrane. Certificates of Calibration shall be renewed as necessary to provide certificates less than 12 months old throughout project duration.
- E. During installation, the Geosynthetic Installer shall be responsible for the timely submission to the Construction Manager of **Quality Control documentation**.
  - ~~1. Quality control documentation; and~~
  - ~~2. Subgrade acceptance certificates, signed by the Geosynthetic Installer, for each area to be covered by geosynthetic materials.~~
- F. Upon completion of the installation, the Geosynthetic Installer shall be responsible for the submission to the Construction Manager of a warranty from the Geosynthetic Installer as specified in Part 1.05.B of this Section.
- G. The Geosynthetic Installer shall submit the following documentation on welding rod to the Construction Manager for approval 21 days prior to transporting welding rod to the site:
  1. Quality control documentation, including lot number, welding rod spool number, and results of quality control tests on the welding rod.

## **1.07 QUALITY ASSURANCE**

- A. The Geosynthetic Installer shall ensure that the materials and methods used for installation of the geomembrane meet the requirements of the Drawings and this Section. Any material

or method that does not conform to these documents, or to alternatives approved in writing by the Construction Manager, shall be rejected and shall be repaired or replaced by the Geosynthetic Installer.

- B. The Geosynthetic Installer shall be aware of and accommodate all monitoring and conformance testing required by the CQA Plan. This monitoring and testing, including random conformance testing of construction materials and completed work, shall be performed by the CQA Engineer. If nonconformances or other deficiencies are found in the Geosynthetic Installer's materials or completed work, the Geosynthetic Installer shall be required to repair the deficiency or replace the deficient materials.

## **PART 2 – PRODUCTS**

### **2.01 GEOMEMBRANE PROPERTIES**

- A. The Geomembrane Manufacturer shall furnish double-sided, 60-mil textured geomembrane having properties that comply with the required property values shown in Table 02770-1.
- B. In addition to the property values listed in Table 02770-1, the geomembrane shall:
1. Contain a maximum of 1 percent by weight of additives, fillers, or extenders (not including carbon black).
  2. Not have striations, pinholes (holes), bubbles, blisters, nodules, undispersed raw materials, or any sign of contamination by foreign matter on the surface or in the interior.

### **2.02 MANUFACTURING QUALITY CONTROL**

- A. Rolls:
1. The Geomembrane Manufacturer shall continuously monitor geomembrane during the manufacturing process for defects.
  2. No geomembrane shall be accepted that exhibits any defects.
  3. The Geomembrane Manufacturer shall measure and report the geomembrane thickness at regular intervals along the roll length.
  4. No geomembrane shall be accepted that fails to meet the specified thickness.
  5. The Geomembrane Manufacturer shall sample and test the geomembrane at a minimum of once every 50,000 ft<sup>2</sup> to demonstrate that its properties conform to the values specified in Table 02770-1. At a minimum, the following tests shall be performed:

<u>Test</u>	<u>Procedure</u>
Thickness	ASTM D 5994
Specific Gravity	ASTM D 792 Method A or ASTM D 1505
Tensile Properties	ASTM D 638
Puncture Resistance	ASTM D 4833
Carbon Black	ASTM D 1603
Carbon Black Dispersion	ASTM D 5596

6. Tests not listed above but listed in Table 02770-1 need not be run at the 1 per 50,000 ft<sup>2</sup> frequency. However, the Geomembrane Manufacturer shall certify that these tests are in compliance with this section and have been performed on a sample that is identical to the geomembrane to be used on this project. The Geosynthetic Installer shall provide the test result documentation to the Construction Manager.
  7. Any geomembrane sample that does not comply with the requirements of this Section shall result in rejection of the roll from which the sample was obtained and shall not be used for this project. **If a geomembrane sample fails to meet the quality control requirements of this Section the Geomembrane Manufacturer shall sample and test, at the expense of the Manufacturer, rolls manufactured in the same lot, or at the same time, as the failing roll. Sampling and testing of rolls shall continue until a pattern of acceptable test results is established to bound the failed roll(s).**
  8. If a geomembrane sample fails to meet the quality control requirements of this Section, the roll shall be rejected and shall not be delivered to site.
- B. The Geomembrane Manufacturer shall permit the CQA Engineer to visit the manufacturing plant for project specific visits. If possible, such visits shall be prior to or during the manufacturing of the geomembrane rolls for the specific project.

## **2.03 LABELING**

- A. Geomembrane rolls shall be labeled with the following information.
1. thickness of the material;
  2. length and width of the roll;
  3. name of Geomembrane Manufacturer;
  4. product identification;
  5. lot number; and
  6. roll number.

## **2.04 TRANSPORTATION, HANDLING AND STORAGE**

- A. Handling and care of the geomembrane prior to and following installation at the site shall be the responsibility of the Geosynthetic Installer. The Geosynthetic Installer shall be liable for all damage to the materials incurred prior to final acceptance of the liner system by the Construction Manager.
- B. Geosynthetic Installer shall be responsible for storage of the geomembrane at the site. The geomembrane shall be protected from excessive heat or cold, dirt, puncture, cutting, or other damaging or deleterious conditions. Any additional storage procedures required by the Geomembrane Manufacturer shall be the Geosynthetic Installer's responsibility. Geomembrane rolls shall not be stored or placed in a stack of more than two rolls high.
- C. The geomembrane shall be delivered at least 30 days prior to the planned deployment date to allow the Construction Manager adequate time to coordinate conformance testing on the geomembrane samples as described in Part 3.05 or this Section. If the CQA Engineer visited the manufacturing plant and performed the required conformance sampling,

geomembrane can be delivered to the site within the 14 days prior to the planned deployment date as long as there is sufficient time for the CQA Engineer to complete conformance testing and confirm that the rolls shipped to the site are in compliance with this Section.

D. The CQA Engineer shall follow Chain-of-Custody procedures for sample transportation.

## **PART 3 – GEOMEMBRANE INSTALLATION**

### **3.01 FAMILIARIZATION**

A. Prior to implementing any of the work described in this Section, the Geosynthetic Installer shall become thoroughly familiar with all portions of the work falling within this Section.

B. Inspection:

1. The Geosynthetic Installer shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the work of this Section may properly commence without adverse effect.
2. If the Geosynthetic Installer has any concerns regarding the installed work of other Sections, he shall notify the Construction Manager in writing prior to the start of the work of this Section. Failure to inform the Construction Manager in writing or installation of the geomembrane shall be construed as the Geosynthetic Installer's acceptance of the related work of all other Sections.

C. A pre-installation meeting shall be held to coordinate the installation of the geomembrane with the installation of other components of the composite liner system.

### **3.02 GEOMEMBRANE DEPLOYMENT**

~~A. Prior to geomembrane deployment, Geosynthetic installer shall verify subgrade meets the requirements of Section 02200 for subgrade preparation. The Contractor shall provide the Construction Manager with a subgrade acceptance certificate.~~

A. Layout Drawings:

1. The Geosynthetic Installer shall deploy the geomembrane panel in general accordance with the layout drawing submitted to the Construction Manager.

B. Field Panel Identification:

1. A geomembrane field panel is a roll or a portion of roll cut in the field.
2. Each field panel shall be given an identification code (number or letter-number). This identification code shall be agreed upon by the Construction Quality Assurance Manager and Geosynthetic Installer.

C. Field Panel Placement:

1. Field panels shall be installed, as approved or modified, at the location and positions indicated on the layout drawings.
2. Field panels shall be placed one at a time, and each field panel shall be seamed immediately after its placement. Panels shall be overlapped so that the flow of liquid

above the liner is across the top of the weld and not into the flap area of the fusion weld (shingled to allow water to cross seam).

3. Geomembrane shall not be placed when the ambient temperature is below 40°F or above 104°F, unless otherwise authorized in writing by the Construction Manager.
  4. Geomembrane shall not be placed during any precipitation, in the presence of excessive moisture (e.g., fog, dew), in an area of ponded water, or in the presence of excessive winds.
  5. The Geosynthetic Installer shall ensure that:
    - a. Vehicular traffic shall be limited to vehicles that exhibit a ground pressure less than that of foot traffic pressure.
    - b. Equipment used does not damage the geomembrane by handling, trafficking, or leakage of hydrocarbons (i.e., fuels).
    - c. Only hook knives are used to cut geomembrane.
    - d. Personnel working on the geomembrane do not smoke, wear damaging shoes, bring glass onto the geomembrane, or engage in other activities that could damage the geomembrane.
    - e. The method used to unroll the panels does not scratch or crimp the geomembrane and does not damage the supporting soil or geosynthetics.
    - f. The method used to place the panels minimizes wrinkles (especially differential wrinkles between adjacent panels). The method used to place the panels results in intimate contact with adjacent components.
    - g. Temporary ballast and/or anchors (e.g., sand bags), not likely to damage the geomembrane, are placed on the geomembrane to prevent wind uplift. **Sand bags shall be filled with sand material with a maximum particle size of ½ inch.**
    - h. The geomembrane is especially protected from damage in heavily trafficked areas.
    - i. Any rub sheets to facilitate seaming are removed prior to installation of subsequent panels.
  6. Any field panel or portion thereof that becomes seriously damaged (torn, twisted, or crimped) shall be replaced with new material. Less serious damage to the geomembrane may be repaired, as approved by the CQA Engineer. Damaged panels or portions of damaged panels that have been rejected shall be removed from the work area. Any damaged materials shall be replaced at the Geosynthetic Installers' expense.
- D. If the Geosynthetic Installer intends to install geomembrane between one hour before sunset and one hour after sunrise, he shall notify the Construction Manager in writing prior to the start of the work. The Geosynthetic Installer shall indicate additional precautions, which shall be taken during these installation hours. The Geosynthetic Installer shall provide proper, adequate illumination for work during this time period.

### 3.03 FIELD SEAMING

#### A. Seam Layout:

1. In corners and at odd-shaped geometric locations, the number of field seams shall be minimized. No horizontal seam shall be along a slope with an inclination steeper than 10 percent. Horizontal seams shall be considered as any seam having an alignment exceeding 20 degrees from being perpendicular to the slope contour lines, unless otherwise approved by the Construction Manager. No seams shall be located in an area of potential stress concentration.

#### B. Personnel:

1. All personnel performing seaming operations shall be qualified as indicated in Part 1.04 of this Section. No seaming shall be performed unless a "master seamer" is present on-site.

#### C. Weather Conditions for Seaming:

1. Unless authorized in writing by the Construction Manager, seaming shall not be attempted at ambient temperatures below 40°F or above 104°F. If the Geosynthetic Installer wishes to use methods that may allow seaming at ambient temperatures below 40°F or above 104°F, he shall use a procedure approved by the Construction Manager.
2. A meeting shall be held with the Geosynthetic Installer and Construction Manager to establish acceptable installation procedures. In all cases, the geomembrane shall be dry and protected from wind damage.
3. Ambient temperatures shall be measured between 0 to 6 in. above the geomembrane surface.

#### D. Overlapping:

1. Geomembrane panels shall be sufficiently overlapped for welding and to allow peel tests to be performed on the seam. Any seams that cannot be destructively tested because of insufficient overlap shall be treated as failing seams.

#### E. Seam Preparation:

1. Prior to seaming, the seam area shall be clean and free of moisture, dust, dirt, debris of any kind, and foreign material.
2. If seam overlap grinding is required, the process shall be completed according to the Geomembrane Manufacturer's instructions within 20 minutes of the seaming operation and in a manner that does not damage the geomembrane. The grind depth shall not exceed ten percent of the geomembrane thickness.
3. Seams shall be aligned with the fewest possible number of wrinkles and "fishmouths."

#### F. General Seaming Requirements:

1. Fishmouths or wrinkles at the seam overlaps shall be cut along the ridge of the wrinkle to achieve a flat overlap. The cut fishmouths or wrinkles shall be seamed and

any portion where the overlap is insufficient shall be patched with an oval or round patch of geomembrane that extends a minimum of 6 in. beyond the cut in all directions.

2. Any electric generator shall be placed outside the area to be lined or mounted in a manner that protects the geomembrane from damage. The electric generator shall be properly grounded.

G. Seaming Process:

1. Approved processes for field seaming are extrusion welding and fusion welding. Only equipment identified as part of the approved submittal specified in Part 1.06 shall be used.
2. Extrusion Equipment and Procedures:
  - a. The Geosynthetics Installer shall maintain at least one spare operable seaming apparatus on site.
  - b. Extrusion welding apparatus shall be equipped with gauges giving the temperature in the apparatus.
  - c. Prior to beginning a seam, the extruder shall be purged until all heat-degraded extrudate has been removed from the barrel.
  - d. A smooth insulating plate or fabric shall be placed beneath the hot welding apparatus after use.
3. Fusion Equipment and Procedures:
  - a. The Geosynthetic Installer shall maintain at least one spare operable seaming apparatus on site.
  - b. Fusion-welding apparatus shall be automated vehicular-mounted devices equipped with gauges giving the applicable temperatures and speed.
  - c. A smooth insulating plate or fabric shall be placed beneath the hot welding apparatus after use.

H. Trial Seams:

1. Trial seams shall be made on fragment pieces of geomembrane to verify that seaming conditions are adequate. Trial seams shall be conducted on the same material to be installed and under similar field conditions as production seams. Such trial seams shall be made at the beginning of each seaming period, beginning of the day and after lunch, for each seaming apparatus used each day. The trial seam sample shall be a minimum of 5-ft long by 1-ft wide (after seaming) with the seam centered lengthwise for fusion equipment and at least 3-ft long by 1-ft wide for extrusion equipment. Seam overlap shall be as indicated in Part 3.03.D of this Section. The CQA Engineer shall be present during trial seaming.
2. The CQA Engineer shall collect four adjoining coupon specimens, each 1-in. wide, cut from the trial seam sample by the installer using a die cutter to ensure precise 1-in. wide coupons. The coupons shall be tested by the CQA Engineer in peel (outside (fusion only) and inside track) and shear using an electronic readout field tensiometer

in accordance with ASTM D 4437 6392, at a strain rate of 2 in./min., and they shall not fail in the seam (i.e., Film Tear Bond (FTB), which is failure in the parent material, is required). The required peel and shear seam strength is listed in Table 02770-2. Ideally, samples shall be conditioned at  $23 \pm 2^\circ\text{C}$  at a relative humidity of  $50 \pm 5\%$  for two hours prior to testing. If test conditions vary from these conditions, a 1-in. wide coupon of the parent geomembrane material (no weld) shall be tested in the same manner as the seam specimens to determine the break strength at this condition.

3. If a coupon specimen fails, the entire operation shall be repeated. If the additional coupon specimen fails, the seaming apparatus and seamer shall not be accepted and shall not be used for seaming until the deficiencies are corrected and two consecutive successful trial seams are achieved.

I. Nondestructive Seam Continuity Testing:

1. The Geosynthetic Installer shall nondestructively test for continuity on all field seams over their full length. Continuity testing shall be carried out as the seaming work progresses, not at the completion of all field seaming. The Geosynthetic Installer shall complete any required repairs in accordance with Part 3.03.K of this Section. The following procedures shall apply:
  - a. Vacuum testing in accordance with ASTM D 5641.
  - b. Air pressure testing (for double-track fusion seams only) in accordance with ASTM D 5820 and the following:
    - i. Energize the air pump to a pressure between 25 and 30 pounds per square inches, close valve, and sustain the pressure for not less than 5 minutes.
    - ii. If loss of pressure exceeds 3 pounds per square inches, or does not stabilize, locate faulty area and repair in accordance with Part 3.03.K of this Section.
    - iii. Cut opposite end of air channel from pressure gauge and observe release of pressure to ensure air channel is not blocked.
    - iv. Remove needle, or other approved pressure feed device, and seal repair in accordance with Part 3.03.K of this Section.
  - c. Spark testing shall be performed if the seam cannot be tested using other nondestructive methods.

J. Destructive Testing:

1. Destructive seam tests shall be performed on samples collected from selected locations to evaluate seam strength and integrity. Destructive tests shall be carried out as the seaming work progresses, not at the completion of all field seaming.
2. Sampling:
  - a. Test locations shall be determined during seaming, and may be prompted by suspicion of excess crystallinity, contamination, offset seams, or any other potential cause of imperfect seaming. The CQA Engineer shall be responsible for coordinating the locations. The Geosynthetic Installer shall not be informed in



advance of the locations where the seam samples shall be taken. The CQA Engineer reserves the right to increase the sampling frequency.

- b. Obtain 1 sample (minimum) for each 500 linear feet, or fraction thereof, of fusion welded seam for each welding machine/welding technician combination.
- c. After completing a number of consecutive destructive sample laboratory tests for each welding machine/welding technician combination, as outlined in the following table, the frequency for the specific welding machine/welding technician may be adjusted as indicated in the following table.

Number of Destructive Samples per Welding Machine/Welding Technician	Failures	Frequency (ft)
0-10	$0 \geq 1$	500/500
11-20	$0 \geq 1$	750/500
21+	$\leq 1 \geq 2$	1000/750

- d. Destructive testing of extrusion seams may be conducted upon scrap material that has been extrusion welded past the initial startup seam for the shift if the footage of extrusion weld for the shift is less than 200 linear feet and if the Contractor concurs
- e. Samples shall be cut by the Geosynthetic Installer at the locations designated by the CQA Engineer as the seaming progresses in order to obtain laboratory test results before the geomembrane is covered by another material. Each sample shall be numbered and the sample number and location identified on the panel layout drawing. All holes in the geomembrane resulting from the destructive seam sampling shall be immediately repaired in accordance with the repair procedures described in Part 3.03.K of this Section. The continuity of the new seams in the repaired areas shall be tested according to Part 3.03.I of this Section.
- f. Two strips of dimensions 1-in. wide and 12 in. long with the seam centered parallel to the width shall be taken from either side of the sample location. These samples shall be tested in the field in accordance with Part 3.03.J.3 of this Section. If these samples pass the field test, a laboratory sample shall be taken. The laboratory sample shall be at least 1-ft wide by 42-inches long with the seam centered lengthwise. The sample shall be cut into three parts and distributed as follows:
  - i. One portion 12-in. long to the Geosynthetic Installer.
  - ii. One portion 18-in. long to the Geosynthetic CQA Laboratory for testing.
  - iii. One portion 12-in. long to the Construction Manager for archival storage.

### 3. Field Testing:

- a. The two 1-in. wide strips shall be tested in the field tensiometer in the peel mode. The CQA Engineer has the option to request an additional test in the shear mode. If any field test sample fails to meet the requirements in Table 02770-2, then the procedures outlined in Part 3.03.J.5 of this Section shall be followed.

4. Laboratory Testing:

- a. Testing by the Geosynthetics CQA Laboratory shall include “Seam Strength” and “Peel Adhesion” (ASTM D 4437) with the 1-in. wide strip tested at a rate of 2 in./min. At least 5 specimens shall be tested for each test method (peel and shear). Four of the five specimens per sample must pass both the shear strength test and peel adhesion test when tested in accordance with ASTM D-4437 6392. The minimum acceptable values to be obtained in these tests are indicated in Table 02770-2. Both inside and outside tracks of the dual track fusion welds shall be tested in peel.

5. Destructive Test Failure:

- a. The following procedures shall apply whenever a sample fails a destructive test, whether the test is conducted by the Geosynthetic CQA's laboratory, the Geosynthetic Installer laboratory, or by a field tensiometer. The Geosynthetic Installer shall have two options:
  - i. The Geosynthetic Installer can reconstruct the seam (e.g., remove the old seam and reseam) between any two passed destructive test locations.
  - ii. The Geosynthetic Installer can trace the welding path to an interim location, a minimum of 10 feet from the location of the failed test (in each direction) and take a small sample for an additional field test at each location. If these additional samples pass the field tests, then full laboratory samples shall be taken. These full laboratory samples shall be tested in accordance with Part 3.03.J.4 of this Section. If these laboratory samples pass the tests, then the seam shall be reconstructed between these locations. If either sample fails, then the process shall be repeated to establish the zone in which the seam should be reconstructed. All acceptable seams must be bounded by two locations from which samples passing laboratory destructive tests have been taken. In cases exceeding 150 ft of reconstructed seam, a sample taken from within the reconstructed zone must pass destructive testing.
- b. Whenever a sample fails, the CQA Engineer may require additional tests for seams that were formed by the same seamer and/or seaming apparatus or seamed during the same time shift.

K. Defects and Repairs:

1. The geomembrane shall be inspected before and after seaming for evidence of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane shall be clean at the time of inspection. The geomembrane surface shall be swept or washed by the Installer if surface contamination inhibits inspection.
2. Each suspected location, both in seam and non-seam areas, shall be nondestructively tested using the methods described Part 3.03.I of this Section, as appropriate. Each

location that fails nondestructive testing shall be marked by the CQA Engineer and repaired by the Geosynthetic Installer.

3. When seaming of a geomembrane is completed (or when seaming of a large area of a geomembrane is completed) and prior to placing overlying materials, the CQA Engineer shall identify all excessive geomembrane wrinkles (Wrinkles with a height to width ratio greater than 1H:6W, e.g., 2" height over 12" width). The Geosynthetic Installer shall cut and reseam all wrinkles so identified. The seams thus produced shall be tested like any other seams.
4. Repair Procedures:
  - a. Any portion of the geomembrane exhibiting a flaw, or failing a destructive or nondestructive test, shall be repaired by the Geosynthetic Installer. Several repair procedures exist. The final decision as to the appropriate repair procedure shall be agreed upon between the CQA Engineer and the Geosynthetic Installer. The procedures available include:
    - i. patching, used to repair holes larger than 1/16 inch, tears, undispersed raw materials, and contamination by foreign matter;
    - ii. abrading and reseaming, used to repair small sections of extruded seams;
    - iii. spot seaming, used to repair minor, localized flaws;
    - iv. capping, used to repair long lengths of failed seams; and
    - v. removing bad seam and replacing with a strip of new material seamed into place (used with long lengths of fusion seams).
  - b. In addition, the following criteria shall be satisfied:
    - i. surfaces of the geomembrane that are to be repaired shall be abraded no more than 20 minutes prior to the repair;
    - ii. all surfaces must be clean and dry at the time of repair;
    - iii. all seaming equipment used in repair procedures must be approved;
    - iv. the repair procedures, materials, and techniques shall be approved in advance, for the specific repair, by the CQA Engineer;
    - v. patches or caps shall extend at least 6 in. beyond the edge of the defect, and all corners of patches shall be rounded with a radius of at least 3 in.; and
    - vi. the geomembrane below large caps shall be appropriately cut to avoid water or gas collection between the two sheets.
5. Repair Verification:
  - a. Each repair shall be nondestructively tested using the methods described in Part 3.03.I of this Section, as appropriate. Repairs that pass the nondestructive test shall be taken as an indication of an adequate repair. Failed tests shall require the repair to be redone and retested until a passing test results. At the discretion of the CQA Engineer, destructive testing may be required on large caps.

### 3.04 ANCHORAGE

- A. Temporary anchorage of the geomembrane shall be in accordance with the Construction Drawings and consist of the geomembrane extended approximately 10 ft from the toe of the waste slope and have two feet of operations layer placed on top. The edge of the geomembrane shall be protected with plywood.
- B. Temporary anchor trenches shall be as shown on the Construction Drawings.
- C. Permanent anchorage shall be as shown on the Construction Drawings and in accordance with the Specifications for Anchor Trenching in Section 02200.

### 3.05 MATERIALS IN CONTACT WITH THE GEOMEMBRANE

- A. The Geosynthetic Installer shall take all necessary precautions to ensure that the geomembrane is not damaged during its installation. During the installation of other components of the liner system by the Contractor, the Contractor shall ensure that the geomembrane is not damaged. Any damage to the geomembrane shall be repaired by the Geosynthetic Installer, at the expense of the Contractor.
- B. Soil and aggregate materials shall not be placed over the geomembranes at ambient temperatures below 40°F or above 104°F, unless otherwise specified.
- C. All attempts shall be made to minimize wrinkles in the geomembrane.
- D. Equipment shall not be driven directly on the geomembrane. Equipment shall only be driven above operations layer.

### 3.06 CONFORMANCE TESTING

- A. Samples of the geomembrane shall be removed by the CQA Engineer and sent to a Geosynthetic CQA Laboratory for testing to ensure conformance with the requirements of this Section. The Geosynthetic Installer shall assist the CQA Engineer in obtaining conformance samples. The Geosynthetic Installer and Construction Manager shall account for this testing in the installation schedule. Only material that meets the requirements of Part 2.02 this Section shall be installed. **Conformance sampling may be conducted at the manufacturing facility prior to shipment to the site.**
- B. Samples shall be selected by the CQA Engineer in accordance with this Section and with the procedures outlined in the CQA Plan.
- C. Samples shall be taken at a minimum frequency of one sample per 100,000 ft<sup>2</sup>.
- D. The CQA Engineer may increase the frequency of sampling in the event that test results do not comply with the requirements of Part 2.02 of this Section.
- E. The following tests shall be performed by the CQA Engineer:

<u>Test</u>	<u>Test Method</u>
Specific Gravity	ASTM D 792 or D 1505
Thickness	ASTM D 5994
Tensile Properties	ASTM D 638
Carbon Black Content	ASTM D 1603
Carbon Black Dispersion	ASTM D 5596

- F. Any geomembrane that is not certified in accordance with Part 1.07.C of this Section, or that conformance testing indicates do not comply with Part 2.02 of this Section, shall be rejected. The Geosynthetic Installer shall replace the rejected material with new material.

### **3.07 GEOMEMBRANE ACCEPTANCE**

- A. The Geosynthetic Installer shall retain all ownership and responsibility for the geomembrane until accepted by the CQA Engineer.
- B. The geomembrane shall be accepted by the CQA Engineer when:
1. the installation is completed;
  2. all documentation is submitted;
  3. verification of the adequacy of all field seams and repairs, including associated testing, is complete; and
  4. all warranties are submitted.

### **3.08 PROTECTION OF WORK**

- A. The Geosynthetic Installer and Contractor shall use all means necessary to protect all work of this Section.
- B. In the event of damage, the Geosynthetic Installer shall make all repairs and replacements necessary, to the satisfaction of the CQA Engineer.

## **PART 4 – MEASUREMENT AND PAYMENT**

### **4.01 GENERAL**

- A. Providing for a complying with the requirements set forth in this Section for textured HDPE geomembrane for the CAMU Liner Geosynthetic System shall be measured as Lump Sum (LS), including geomembrane in the anchor trench to the limits shown on the Drawings, and payment shall be included with the lump sum price for CAMU Liner System geosynthetic materials provided on the Base Bid Schedule.
- B. Providing for a complying with the requirements set forth in this Section for textured HDPE geomembrane for the North and South BMI Landfill Cover systems shall be measured as Lump Sum (LS), including geomembrane in the anchor trench to the limits shown on the Drawings, and payment shall be included with the lump sum price for North and South BMI Landfill Cover liner systems lump sum price provided on the Bid Schedule.
- C. Providing for a complying with the requirements set forth in this Section for textured HDPE geomembrane for the CAMU Cover system shall be measured as in-place square feet (SF), including geomembrane in the anchor trench to the limits shown on the Drawings, and payment shall be included in the unit price for CAMU Cover- geosynthetic system provided on the Option Scope Bid Schedule.
- D. The Lump Sum costs shall include all incidentals necessary for a complete installation of Geomembrane liner.

**TABLE 02770-1  
REQUIRED HDPE GEOMEMBRANE PROPERTIES**

PROPERTIES	QUALIFIERS	UNITS	SPECIFIED VALUES	TEST METHOD
<u>Physical Properties</u>				
Thickness	Average Minimum	mils mils	60 54	ASTM D 5994
Specific Gravity	Minimum	N/A	.940	ASTM D 792 Method A or ASTM D 1505
<u>Mechanical Properties</u>				
Tensile Properties (each direction)				
1. Tensile (Break) Strength Tensile (Break) Strength	Minimum	lb/in	90	ASTM D 638
2. Elongation at Break		%	100	
3. Tensile (Yield) Strength		lb/in	126	
4. Elongation at Yield		%	12	
Puncture	Minimum	lb	90	ASTM D 4833
Tear Resistance	Minimum	lb	42	ASTM D 1004
Interface Shear Strength	-	-	Note 1	ASTM D 5321
<u>Environmental Properties</u>				
Carbon Black Content	Range	%	2-3	ASTM D 1603
Carbon Black Dispersion	N/A	none	Note 2	ASTM D 5596
Environmental Stress Crack	Minimum	hr	300	ASTM D 5397

- Notes: (1) Interface shear strength test(s) shall be performed, by the CQA Engineer, on the composite liner system in accordance with Section 02772 — Geosynthetic Clay Liner.
- (2) Minimum 8 of 10 in Categories 1 or 2; 10 in Categories 1, 2, or 3.

**TABLE 02770-2  
REQUIRED GEOMEMBRANE SEAM PROPERTIES**

PROPERTIES	QUALIFIERS	UNITS	SPECIFIED VALUES	TEST METHOD
<u>Shear Strength</u> <sup>(1)</sup>				
Fusion	minimum	lb/in	120	ASTM D 6392
Extrusion	minimum	lb/in	120	ASTM D 6392
<u>Peel Adhesion</u>				
FTB <sup>(2)</sup>				
Fusion	minimum	lb/in	91	ASTM D 6392
Extrusion	minimum	lb/in	78	ASTM D 6392

Notes: (1) Also called “Bonded Seam Strength”.

(2) FTB = Film Tear Bond means that failure is in the parent material, not the seam. The maximum seam separation is 25 percent of the seam area.

[END OF SECTION]

## **SECTION 02771 GEOTEXTILE**

### **PART 1 – GENERAL**

#### **1.01 DESCRIPTION OF WORK**

- A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings
- B. The work shall include, but not be limited to, delivery, storage, placement, and seaming of the various geotextile components of the project.
- C. Filter geotextile shall be used overlying the drainage aggregate. A UV protective geotextile shall be used overlying the exposed portions of geosynthetic components of the side slope liner system.
- D. Construction of the final CAMU cover system and associated storm water management features overlying the CAMU will be held as an Option Scope that may be added to the contract via Contract Modification at the Owner's sole discretion. If the Owner decides to exercise its option to add the Option Scope, the Construction Manager will notify the Contractor no later than 30 days after receipt of the final Eastside Area confirmation sampling

#### **1.02 RELATED SECTIONS**

Section 02200 — Earthwork

Section 02225 — Drainage Aggregate

Section 02770 — Geomembrane

Section 02773 — Geocomposite

#### **1.03 REFERENCES**

- A. Drawings
- B. Construction Quality Assurance (CQA) Plan
- C. Latest version of American Society for Testing and Materials (ASTM) standards:
  - ASTM D 3786 Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabric-Diaphragm Bursting Strength Test Method
  - ASTM D 4355 Standard Test Method for Deterioration of Geotextile from Exposure to Ultraviolet Light and Water
  - ASTM D 4491 Standard Test Method for Water Permeability of Geotextile by Permittivity
  - ASTM D 4533 Standard Test Method for Trapezoid Tearing Strength of Geotextile
  - ASTM D 4595 Standard Test Method for Wide Width Tensile Properties of Geosynthetics



- ASTM D 4632 Standard Test Method for Breaking Load and Elongation of Geotextile (Grab Method)
- ASTM D 4751 Standard Test Method for Determining Apparent Opening Size of a Geotextile
- ASTM D 4833 Standard Test Method for Index Puncture Resistance of Geotextile, Geomembranes, and Related Products
- ASTM D 5261 Standard Test Method for Measuring Mass Per Unit Area of Geotextile

#### **1.04 SUBMITTALS**

- A. The Geosynthetic Installer shall submit to the Construction Manager, at least 21 days prior to geotextile delivery, the following information regarding the proposed geotextile:
1. manufacturer and product name;
  2. minimum property values of the proposed geotextile and the corresponding test procedures;
  3. projected geotextile delivery dates; and
  4. list of geotextile roll numbers for rolls to be delivered to the site.
- B. At least 21 days prior to geotextile placement, the Geosynthetic Installer shall submit to the Construction Manager the manufacturing quality control certificates for each roll of geotextile. The certificates shall be signed by responsible parties employed by the geotextile manufacturer (such as the production manager). The quality control certificates shall include:
1. lot, batch, and/or roll numbers and identification; and
  2. results of quality control tests, including a description of the test methods used.
- C. The Contractor shall submit to the Construction Manager within 21 days after geomembrane installation, as-built conditions of installed geomembrane. As-built shall have locations of panel corners and all recorded defects and repairs.

#### **1.05 QUALITY ASSURANCE**

- A. The Geosynthetic Installer shall ensure that the geotextile and installation methods used meet the requirements of the Drawings and this Section. Any material or method that does not conform to these documents, or to alternatives approved in writing by the Construction Manager, shall be rejected and shall be repaired or replaced by the Geosynthetic Installer.
- B. The Geosynthetic Installer shall be aware of all monitoring and conformance testing required by the CQA Plan. This monitoring and testing, including random conformance testing of construction materials and completed work, shall be performed by the CQA Engineer. If nonconformances or other deficiencies are found in the Geosynthetic Installer's materials or completed work, the Geosynthetic Installer shall be required to repair the deficiency or replace the deficient materials.

## PART 2 – PRODUCTS

### 2.01 GEOTEXTILE PROPERTIES

- A. Geotextile suppliers shall furnish materials in which the “Minimum Average Roll Values”, as defined by the Federal Highway Administration (FHWA), meet or exceed the criteria specified in Table 02771-1.
- B. The geotextile shall be nonwoven materials, suitable for use in filter/separation applications and woven geotextile for use as a UV protective layer.

### 2.02 MANUFACTURING QUALITY CONTROL

- A. The geotextile shall be manufactured with quality control procedures that meet or exceed generally accepted industry standards.
- B. The Geotextile Manufacturer shall sample and test the geotextile to demonstrate that the material conforms to the requirements of these Specifications.
- C. Any geotextile sample that does not comply with this Section shall result in rejection of the roll from which the sample was obtained. The Geosynthetic Installer shall replace any rejected rolls.
- D. ~~If a geotextile sample fails to meet the quality control requirements of this Section the Geotextile Manufacturer shall sample and test, at the expense of the Manufacturer, rolls manufactured in the same lot, or at the same time, as the failing roll. Sampling and testing of rolls shall continue until a pattern of acceptable test results is established to bound the failed roll(s).~~ If a geotextile sample fails to meet the quality control requirements of this Section the Manufacturer shall sample and test, at the expense of the Manufacturer, rolls manufactured in the same lot, or at the same time, as the failing roll. Sampling and testing of rolls shall continue until a pattern of acceptable test results is established to bound the failed roll(s).”
- E. Additional sample testing may be performed, at the Geotextile Manufacturer's discretion and expense, to identify more closely any non-complying rolls and/or to qualify individual rolls.
- F. Sampling shall, in general, be performed on sacrificial portions of the geotextile material such that repair is not required. The Geotextile Manufacturer shall sample and test the geotextile, at a minimum once every 100,000 ft<sup>2</sup>, to demonstrate that the geotextile properties conform to the values specified in Table 02771-1. At a minimum, the following manufacturing quality control tests shall be performed on each type of geotextile:

<u>Test</u>	<u>Procedure</u>	<u>Filtration</u>	<u>UV Protective</u>
Grab strength	ASTM D 4632	Yes	No
Puncture strength	ASTM D 4833	Yes	No
Mullen Burst	ASTM D 3786	Yes	No
Trapezoidal Tear	ASTM D 4533	Yes	No
Permittivity	ASTM D 4491	Yes	No

A.O.S.	ASTM D 4751	Yes	Yes
Wide Width Tensile	ASTM D 4595	No	Yes

- G. The Geotextile Manufacturer shall comply with the certification and submittal requirements of this Section.

## **2.03 PACKING AND LABELING**

- A. Geotextile shall be supplied in rolls wrapped in relatively impermeable and opaque protective covers.
- B. Geotextile rolls shall be marked or tagged with the following information:
1. manufacturer's name;
  2. product identification;
  3. lot or batch number;
  4. roll number; and
  5. roll dimensions.

## **2.04 TRANSPORTATION, HANDLING, AND STORAGE**

- A. The Geosynthetic Installer shall be liable for any damage to the materials incurred prior to and during transportation to the site.
- B. The geotextile shall be delivered to the site at least 30 days prior to the planned deployment date to allow the CQA Engineer adequate time to perform conformance testing on the geotextile samples as described in Part 3.06 of this Section.
- C. Handling, unloading, storage, and care of the geotextile prior to and following installation at the site, is the responsibility of the Geosynthetic Installer. The Geosynthetic Installer shall be liable for any damage to the materials incurred prior to final acceptance by the Construction Manager.
- D. The Geosynthetic Installer shall be responsible for storage of the geotextile at the site.
- E. The geotextile shall be protected from sunlight, excessive heat or cold, puncture, or other damaging or deleterious conditions. The geotextile shall be protected from mud, dirt, and dust. Any additional storage procedures required by the geotextile Manufacturer shall be the responsibility of the Geosynthetic Installer.

# **PART 3 – EXECUTION**

## **3.01 FAMILIARIZATION**

- A. Prior to implementing any of the work described in this Section, the Geosynthetic Installer shall become thoroughly familiar with the site, the site conditions, and all portions of the work falling within this Section.

B. Inspection:

1. The Geosynthetic Installer shall carefully inspect the installed work of all other Sections and verify that all such work is complete to the point where the installation of this Section may properly commence without adverse effect.
2. If the Geosynthetic Installer has any concerns regarding the installed work of other Sections or the site, the Construction Manager shall be notified, in writing, prior to commencing the work. Failure to notify the Construction Manager or installation of the geotextile shall be construed as Geosynthetic Installer's acceptance of the related work of all other Sections.

### **3.02 PLACEMENT**

- A. Geotextile installation shall not commence until CQA conformance evaluations, by the CQA Engineer, of previous work are complete, including evaluations of the Contractor's survey results to confirm that the previous work was constructed to the required grades, elevations, and thicknesses. Should the Contractor begin the work of this Section prior to the completion of CQA evaluations, he does so at his own risk. The Contractor shall account for the CQA conformance evaluations in the construction schedule.
- B. The Geosynthetic Installer shall handle all geotextile in such a manner as to ensure they are not damaged in any way.
- C. The Geosynthetic Installer shall take any necessary precautions to prevent damage to underlying materials during placement of the geotextile.
- D. After unwrapping the geotextile from its opaque cover, the filtration geotextile shall not be left exposed for a period in excess of 15 days unless a longer exposure period is approved in writing by the geotextile manufacturer.
- E. The Geosynthetic Installer shall take care not to entrap stones, excessive dust, or moisture in the geotextile during placement.
- F. The Geosynthetic Installer shall anchor or weight all geotextile with sandbags, or the equivalent, to prevent wind uplift.
- G. The Geosynthetic Installer shall examine the entire geotextile surface after installation to ensure that no foreign objects are present that may damage the geotextile or adjacent layers. The Contractor shall remove any such foreign objects and shall replace any damaged geotextile.

### **3.03 SEAMS AND OVERLAPS**

- A. On slopes steeper than 10 horizontal to 1 vertical, geotextiles shall be continuous down the slope; that is, no horizontal seams are allowed. Horizontal seams shall be considered as any seam having an alignment exceeding 20 degrees from being perpendicular to the slope contour lines, unless otherwise approved by the Construction Manager.
- B. Geotextile shall be continuously sewn (i.e., spot sewing is not allowed) using a "single prayer" seam, with the stitching a minimum of 1.5 inches from the edge of the geotextile.
- C. Geotextile shall be sewn with polymeric thread, having similar strength characteristics as the geotextile.

### 3.04 REPAIR

- A. Any holes or tears in the geotextile shall be repaired using a patch made from the same geotextile. Geotextile patches shall be sewn into place no closer than 1 inch from any panel edge. Should any tear exceed 50% of the width of the roll, that roll shall be removed and replaced.
- B. Where geosynthetic materials underlie the geotextile being placed, care shall be taken to remove any soil or other material that may have penetrated the torn geotextile.

### 3.05 PLACEMENT OF SOIL MATERIALS

- A. The Contractor shall place soil materials on top of the geotextile in such a manner as to ensure that:
  - 1. the geotextile and the underlying materials are not damaged;
  - 2. minimum slippage occurs between the geotextile and the underlying layers during placement; and
  - 3. excess stresses are not produced in the geotextile.
- B. Equipment shall not be driven directly on the geotextile.
- C. Unless otherwise approved in writing by the Construction Manager, all equipment operating on materials overlying the geotextile shall comply with Section 02200 and Section 02225.

### 3.06 CONFORMANCE TESTING

- A. Samples of the geotextile materials shall be removed by the CQA Engineer after the material has been received at the site and sent to a Geosynthetic CQA Laboratory for testing to ensure conformance with the requirements of this Section. This testing shall be carried out, in accordance with the CQA Plan, prior to the start of the work of this Section.
- B. Samples of each geotextile shall be taken, by the CQA Engineer, at a minimum frequency of one sample per 200,000 ft<sup>2</sup>.
- C. The CQA Engineer may increase the frequency of sampling in the event that test results do not comply with requirements of Part 2.01 of this Section until passing conformance test results are obtained for all material that is received at the site. This additional testing shall be performed at the expense of the Contractor.
- D. The following conformance tests shall be performed:

<u>Test</u>	<u>Procedure</u>	<u>Filtration</u>	<u>UV Protective</u>
Grab strength	ASTM D 4632	Yes	No
Puncture strength	ASTM D 4833	Yes	No
Mullen Burst	ASTM D 3786	Yes	No
Trapezoidal Tear	ASTM D 4533	Yes	No

Permittivity	ASTM D 4491	Yes	No
A.O.S.	ASTM D 4751	Yes	Yes
Wide Width Tensile	ASTM D 4595	No	Yes

- E. Any geotextile that is not certified in accordance with Part 1.04 of this Section, or that conformance testing results do not comply with Part 2.01 of this Section, shall be rejected. The Geosynthetic Installer shall replace the rejected material with new material.

### **3.07 PROTECTION OF WORK**

- A. The Geosynthetic Installer shall use all means necessary to protect all work of this Section.
- B. In the event of damage, the Geosynthetic Installer shall make repairs and replacements to the satisfaction of the Construction Manager at the expense of the Contractor.

## **PART 4 – MEASUREMENT AND PAYMENT**

### **4.01 GENERAL**

- A. Providing for and complying with the requirements set forth in this Section for Filtration Geotextile shall be measured as incidental to:
1. Base Bid Schedule: LCRS HDPE piping and gravel on the Base Bid Schedule; and
  2. Option Scope Bid Schedule:
    - a. CAMU Cover – 4-inch Corrugated Polyethylene Pipe
    - b. Aggregate Road Base
- B. Providing for and complying with the requirements set forth in this Section for UV Protection Geotextile shall be measured included as incidental to the CAMU Liner System Geosynthetic Materials, including UV Protection Geotextile in the anchor trench to the limits shown on the Drawings.
- C. The bid item costs shall include all incidentals necessary for a complete installation of Geotextile.

**TABLE 02771-1  
REQUIRED PROPERTY VALUES FOR GEOTEXTILE**

PROPERTIES	QUALIFIERS	UNITS	FILTER SPECIFIED VALUES	UV PROTECTIVE SPECIFIED VALUES	TEST METHOD
<u>Type</u>			nonwoven	woven	(-)
Mass per unit area	minimum	oz/yd <sup>2</sup>	6 <sup>(1)</sup>	-	ASTM D 5261
<u>Filter Requirements</u>					
Apparent opening size (O <sub>95</sub> )	maximum	mm	0.21	0.43	ASTM D 4751
Permittivity	minimum	s <sup>-1</sup>	0.6	-	ASTM D 4491
<u>Mechanical Requirements</u>					
Grab strength	minimum	lb	130	-	ASTM D 4632
Puncture strength	minimum	lb	40	-	ASTM D 4833
Mullen Burst	minimum	psi	210	-	ASTM D 3786
Trapezoidal Tear	minimum	lb	40	-	ASTM D 4533
Wide Width Tensile Strength	minimum	ppi	-	110	ASTM D 4595
<u>Durability</u>					
Ultraviolet Resistance @ 500 hours	minimum	%	70	70	ASTM D 4355

Notes: (1) For information purposes only, not a required property.

[END OF SECTION]

**SECTION 02772**  
**GEOSYNTHETIC CLAY LINER**

**PART 1 – GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings
- B. The work shall include, but not be limited to, delivery, storage, placement, anchorage, and seaming of the GCL.
- C. Construction of the final CAMU cover system will be held as an Option Scope that may be added to the contract via Contract Modification at the Owner's sole discretion. If the Owner decides to exercise its option to add the Option Scope, the Construction Manager will notify the Contractor no later than 30 days after receipt of the final Eastside Area confirmation sampling

**1.02 RELATED SECTIONS**

Section 02200 — Earthworks

Section 02770 — Geomembrane

**1.03 REFERENCES**

- A. Drawings
- B. Construction Quality Assurance (CQA) Plan
- C. Latest Version American Society of Testing and Materials (ASTM) Standards:
  - ASTM D 2216 Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
  - ASTM D 5321 Determination of the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method
  - ASTM D 5887 Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens using a Flexible Wall Permeameter
  - ASTM D 5888 Guide for Storage and Handling of Geosynthetic Clay Liners
  - ASTM D 5890 Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners
  - ASTM D 5891 Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners
  - ASTM D 5993 Test Method for Measuring Mass per Unit Area of Geosynthetic Clay Liners



#### **1.04 QUALIFICATIONS**

- A. The Manufacturer shall be a well-established firm with more than ten years of documented experience in the manufacturing of GCL.
- B. The Geosynthetic Installer shall install the GCL and shall meet the requirements of Section 02770 and this Section.

#### **1.05 SUBMITTALS**

- A. At least 21 days before transporting any GCL to the site, the Manufacturer shall provide the following documentation to the Construction Manager for approval.
  - 1. documentation of Geomembrane Manufacturer's experience in manufacturing GCL.
  - 2. list of material properties, including test method, to which are attached GCL samples.
  - 3. projected delivery dates for this project.
  - 4. Manufacturing quality control certificates for each shift's production, signed by responsible parties employed by the Manufacturer (such as the production manager).
  - 5. The quality control certificates shall include:
    - a. roll numbers and identification; and
    - b. results of quality control tests, including description of test methods used, outlined in Part 2.01 of this Section.
  - 6. The Manufacturer shall certify that the GCL meets all the properties outlined in 2.01 of this Section.
- B. Contractor shall submit to Construction Manager results of interface shear test(s) performed on the proposed geosynthetic and soil components in accordance with ASTM D 5321 as specified in Subpart 2.02 of this Section.
- C. During installation, the Geosynthetic Installer shall be responsible for the timely submission to the Construction Manager of:
  - 1. Quality control documentation; and
  - 2. Subgrade acceptance certificates, signed by the Geosynthetic Installer, for each area to be covered by geosynthetic materials.

#### **1.06 CONSTRUCTION QUALITY ASSURANCE MONITORING**

- A. The Geosynthetic Installer shall ensure that the materials and methods used for the GCL meet the requirements of the Drawings and this Section. Any material or method that does not conform to these documents, or to alternatives approved in writing by the Construction Manager, shall be rejected and shall be repaired or replaced.
- B. The Geosynthetic Installer shall be aware of all monitoring and conformance testing required by the CQA Plan. This monitoring and testing, including random conformance testing of construction materials and completed work, shall be performed by the CQA Engineer. If nonconformances or other deficiencies are found in the materials or completed

work, the Geosynthetic Installer shall be required to repair the deficiency or replace the deficient materials.

## **PART 2 – PRODUCTS**

### **2.01 MATERIAL PROPERTIES**

- A. The flux of the GCL shall be no greater than  $1 \times 10^{-8}$  m<sup>3</sup>/m<sup>2</sup>-sec, when measured in a flexible wall permeameter in accordance with ASTM D 5887 under an effective confining stress of 5 pounds per square inch.
- B. The GCL shall have the following minimum dimensions:
  - 1. the minimum roll width shall be 15 feet; and
  - 2. the liner length shall be long enough to conform with the requirements specified in this Section.
- C. The bentonite component of the GCL shall be applied at a minimum concentration of 0.75 pound per square foot, when measured at a water content of less than or equal to 0 percent.
- D. The geotextile components of the GCL shall have a minimum combined mass per unit area of 9 oz/yd<sup>2</sup> in accordance with ASTM D 5261.
- E. The GCL shall meet the required property values listed in Table 02772-1.
- F. The bentonite shall be adhered to the backing material(s) in a manner that prevents it from being dislodged when transported, handled, and installed in a manner prescribed by the Manufacturer. The method used to hold the bentonite in place shall not be detrimental to other components of the lining system.
- G. An alternative GCL having a textured vapor barrier (i.e., geomembrane) as an integral component of the GCL may be provided. If an alternative GCL is used, the textured HDPE vapor barrier component shall be placed against the prepared subgrade and shall meet the following requirements:
  - 1. have an average thickness of 30-mils in accordance with ASTM D 5994;
  - 2. not have striations, pinholes, or bubbles on the surface or in the interior; and
  - 3. be produced so as to be free of holes, blisters, undispersed raw materials, or any sign of contamination by foreign matter.

### **2.02 INTERFACE SHEAR TESTING**

- A. Interface Shear test(s) shall be performed on the proposed geosynthetic and soil components in accordance with ASTM D 5321. Tests shall be performed on several geosynthetic interfaces as outlined below.
  - 1. Hydrated GCL interface - the GCL shall be underlain by prepared subgrade compacted to 90% of the maximum dry density (ASTM D 1557) at the optimum moisture content and overlain by a textured 60-mil HDPE geomembrane, geocomposite, and operations layer material. The geosynthetic components of the liner system shall be allowed to “float” (i.e., not fixed) such that the failure surface can occur between any of the interfaces.

- a. Before shearing, the GCL shall be hydrated under a loading of 240 psf (11 Kpa) for 48 hours. The test shall be performed at normal stresses of 1, 2, and 3 psi at a shear rate of no more than 0.04 in./min. (1 mm/min.).
  - b. The results of this test shall have a peak apparent friction angle in excess of 20 degrees.
2. Hydrated GCL interface - the GCL shall be underlain by prepared subgrade compacted to 90% of the maximum dry density (ASTM D 1557) at the optimum moisture content and overlain by a textured 60-mil HDPE geomembrane, geocomposite, and operations layer material. The GCL component of the liner system shall be allowed to "float" (i.e., not fixed) such that the failure surface can occur at the top, bottom, or internal GCL interfaces.
  - a. Before shearing, the GCL shall be hydrated under a loading of 240 psf (11 Kpa) for 48 hours. The test shall be performed under saturated conditions, at normal stresses of 20, 40, and 80 psi at a shear rate of no more than 0.04 in./min. (1 mm/min.).
  - b. The results of this test shall have a post-peak apparent friction angle in excess of 12 degrees.
3. Hydrated GCL interface - If a GCL containing a geomembrane vapor barrier (i.e. Gundseal) is to be used, one additional shear strength test shall be performed. The GCL shall be underlain by prepared subgrade compacted to 90% of the maximum dry density (ASTM D 1557) at the optimum moisture content and covered by a textured 60 mil HDPE geomembrane, geocomposite, and operations layer material.
  - a. The test shall evaluate the interface between the bentonite side of an unhydrated (i.e., dry) GCL containing a geomembrane vapor barrier and a textured 60 mil HDPE geomembrane. The test shall be set up such that the failure occurs between the bentonite component of the GCL and the textured geomembrane. The test shall be performed under dry conditions, at normal stresses of 20, 40, and 80 psi at a shear rate of no more than 0.04 in./min. (1 mm/min.).
  - b. The acceptance criterion for the interface between the GCL consisting of a geomembrane vapor barrier component and the overlying geomembrane shall be as follows:

$$\tan^{-1} (0.25 \tan \delta_{\text{hydrated}} + 0.75 \tan \delta_{\text{unhydrated}}) \geq 12^{\circ}$$

where  $\delta_{\text{hydrated}}$  is the post-peak apparent friction angle in degrees determined in test No. 2 and  $\delta_{\text{unhydrated}}$  is the post-peak apparent friction angle in degrees determined in test No. 3.

### 2.03 MANUFACTURING QUALITY CONTROL

- A. The GCL shall be manufactured with quality control procedures that meet or exceed generally accepted industry standards.
- B. The Manufacturer shall sample and test the GCL to demonstrate that the material complies with the requirements of this Section.
- C. Any GCL sample that does not comply with this Section shall result in rejection of the roll from which the sample was obtained. The Manufacturer shall replace any rejected rolls.

- D. If a GCL sample fails to meet the quality control requirements of this Section, the Construction Manager shall require that the Manufacturer sample and test, at the expense of the Manufacturer, rolls manufactured in the same lot, or at the same time, as the failing roll. Sampling and testing of rolls shall continue until a pattern of acceptable test results is established to bound the failed roll(s).
- E. Additional sample testing may be performed, at the Manufacturer's discretion and expense, to more closely identify any non-complying rolls and/or to qualify individual rolls.
- F. Sampling shall, in general, be performed on sacrificial portions of the GCL material such that repair is not required. The Manufacturer shall sample and test the GCL to demonstrate that its properties conform to the requirements stated herein. At a minimum, the following tests shall be performed by the Manufacturer: dry mass per unit area and index flux at frequencies of at least 1 per 50,000 ft<sup>2</sup> and 1 per 200,000 ft<sup>2</sup>, respectively.
- G. The Manufacturer shall comply with the certification and submittal requirements of this Section.

#### **2.04 PACKING AND LABELING**

- A. GCLs shall be supplied in rolls wrapped in impermeable and opaque protective covers.
- B. GCLs shall be marked or tagged with the following information:
  - 1. Manufacturer's name;
  - 2. product identification;
  - 3. lot number;
  - 4. roll number; and
  - 5. roll dimensions.

#### **2.05 TRANSPORTATION, HANDLING AND STORAGE**

- A. Handling, storage, and care of the GCL, prior to and following installation, is the responsibility of the Geosynthetic Installer, until final acceptance by the Construction Manager.
- B. The GCL shall be stored and handled in accordance with ASTM D 5888.
- C. The Geosynthetic Installer shall be liable for all damage to the materials incurred prior to and during transportation to the site.
- D. The GCL shall be on-site at least 30 days prior to the scheduled installation date to allow for completion of conformance testing described in Part 3.08 of this Section.

### **PART 3 – EXECUTION**

#### **3.01 FAMILIARIZATION**

- A. Prior to implementing any of the work described in this Section, the Geosynthetic Installer shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of this Section may properly commence without adverse impact.
- B. Inspection:

1. The Geosynthetic Installer shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of this Section may properly commence without adverse impact.
  2. If the Geosynthetic Installer has any concerns regarding the installed work of other Sections, he should notify the Construction Manager in writing prior to commencing the work. Failure to notify the Construction Manager or installation of the GCL shall be construed as Geosynthetic Installer's acceptance of the related work of all other Sections.
- C. A pre-installation meeting shall be held to coordinate the installation of the GCL with the installation of other components of the lining system.

### **3.02 SURFACE PREPARATION**

- A. The Geosynthetics Installer shall provide certification in writing that the surface on which the GCL shall be installed is acceptable. This certification of acceptance shall be given to the Construction Manager prior to commencement of ~~geomembrane~~ **GCL** installation in the area under consideration.
- B. Special care shall be taken to maintain the prepared soil surface so no loose materials greater than 1-inch are on the subgrade.
- C. No GCL shall be placed onto an area that has been softened by precipitation or that has cracked due to desiccation. The soil surface shall be observed daily to evaluate the effects of desiccation cracking and/or softening on the integrity of the prepared subgrade. Subgrade shall have no cracks larger than 1/16-inch and there shall be no visible damp/wet areas.
- D. Subgrade shall conform to requirements of Section 02200, Subpart 2.01.

### **3.03 CREST ANCHORAGE SYSTEM**

- A. The anchor trench shall be excavated, prior to GCL placement, to the lines and grades shown on the Drawings.
- B. No loose soil shall be allowed in the anchor trench beneath the GCL.
- C. The GCL shall be temporarily anchored in the anchor trench until all geosynthetic layers are installed in the anchor trench as shown on the Drawings.

### **3.04 HANDLING AND PLACEMENT**

- A. The Geosynthetic Installer shall handle all GCL in such a manner that they are not damaged in any way and so that they do not become hydrated prior to, or during, installation.
- B. In the presence of wind, all GCLs shall be sufficiently weighted with sandbags to prevent their movement.
- C. Any GCL damaged by stones or other foreign objects, or by installation activities, shall be repaired in accordance with Part 3.07 by the Geosynthetic Installer.
- D. If an alternative GCL is used, the vapor barrier portion of the GCL shall be installed against the underlying prepared subgrade.

- E. The GCL shall not be installed on an excessively moist subgrade or on standing water. The GCL shall be installed in a way that prevents hydration of the GCL prior to completion of construction of the liner system.
- F. The GCL shall not be installed during precipitation or other conditions that may cause hydration of the GCL.
- G. All hydrated GCL shall be removed and replaced by the Geosynthetic Installer.

### **3.05 WESTERN DITCH LINER INSTALLATION**

- A. GCL installers conducting GCL installation above the Western Ditch Area shall have current 40 hour Occupational Safety and Health Administration Hazardous Waste Operations and Emergency Response Standard (OSHA HAZWOPER) training.
- B. PPE required by the Contractor's Health and Safety Plan shall be worn while installing GCL above Western Ditch Area.

### **3.06 OVERLAPS**

- A. On slopes steeper than 10 horizontal to 1 vertical, all GCL shall be continuous down the slope; that is, no horizontal seams shall be allowed on the slope. Horizontal seams shall be considered as any seam having an alignment exceeding 20 degrees from being perpendicular to the slope contour lines, unless otherwise approved by the Construction Manager.
- B. All GCL shall be overlapped in accordance with the Manufacturer's recommended procedures. As a minimum, along the length (i.e., the sides) of the GCL the overlap shall be 6 inches, and along the width (i.e., the ends) the overlap shall be 12 inches.
- C. GCL shall be seamed in accordance with Manufacturer's bentonite seaming recommendations as follows:
  - 1. CETCO Super groove and Gundseal: No bentonite required.
  - 2. All others: bentonite application rate of one quarter pound per linear foot.

### **3.07 MATERIALS IN CONTACT WITH THE GCL**

- A. Geomembrane installation shall immediately follow the GCL installation. All GCL that is placed during a day's work shall be covered with geomembrane before the Geosynthetic Installer leaves the site at the end of the day. The edges of GCL placement should be covered each day and protected from hydration due to storm water run-on.
- B. Material shall not be placed on a GCL that is hydrated.
- C. Installation of other components of the liner system shall be carefully performed to minimize damage to the GCL.
- D. Vehicular traffic shall be limited to vehicles that exhibit a ground pressure less than that of foot traffic pressure.
- E. Installation of the GCL in appurtenant areas, and connection of the GCL to appurtenances shall be made according to the Drawings. The Geosynthetic Installer shall ensure that the GCL is not damaged while working around the appurtenances.

### 3.08 REPAIR

- A. Any holes or tears in the GCL shall be repaired by placing a GCL patch over the hole. On slopes steeper than 10 percent, the patch shall overlap the edges of the hole or tear by a minimum of 2 feet in all directions. On slopes 10 percent or flatter, the patch shall overlap the edges of the hole or tear by a minimum of 1 foot in all directions. The patch shall be secured with a water-based adhesive or hot air welded in place, in accordance with the manufacturers approved installation methods.
- B. Care shall be taken to remove any soil or other material, which may have penetrated the torn GCL.
- C. The patch shall not be nailed or stapled.

### 3.09 ANCHORAGE

- A. Temporary anchorage of the GCL shall be in accordance with the Construction Drawings and consist of the GCL extended approximately 10 ft from the toe of the waste slope beneath the geomembrane.
- B. Temporary anchor trenches shall be as shown on the Construction Drawings.
- C. Permanent anchorage shall be as shown on the Construction Drawings and in accordance with the Specifications for Anchor Trenching in Section 02200.

### 3.10 CONFORMANCE TESTING

- A. Samples of the GCL shall be removed by the CQA Engineer and sent to a Geosynthetic CQA Laboratory for testing to ensure conformance with the requirements of this Section. The Geosynthetic Installer shall assist the CQA Engineer in obtaining conformance samples. The Geosynthetic Installer shall account for this testing in the installation schedule. **Conformance sampling may be conducted at the manufacturing facility prior to shipment to the site.**
- B. Samples shall be taken at a minimum frequency rate of one sample per 100,000 square feet.
- C. ~~The CQA Engineer may increase the frequency of sampling in the event that test results do not comply with the requirements of Part 2.01 of this Section until passing conformance test results are obtained for all material that is received at the site. This additional testing shall be performed at the expense of the Contractor.~~ **If a GCL sample fails to meet the quality control requirements of this Section the GCL Manufacturer shall sample and test, at the expense of the Manufacturer, rolls manufactured in the same lot, or at the same time, as the failing roll. Sampling and testing of rolls shall continue until a pattern of acceptable test results is established to bound the failed roll(s).**
- D. As a minimum, the following conformance tests shall be performed: mass per unit area and index flux. All tests shall be carried out at a frequency of one sample per 100,000 ft<sup>2</sup> and 400,000 ft<sup>2</sup>, respectively. In addition, the CQA Engineer shall perform a minimum of two interface shear strength tests in accordance with Part 2.02.
- E. Any GCL that is not certified by the Manufacturer in accordance with Part 1.05 of this section or that does not meet the requirements specified in Part 2.01 shall be rejected and replaced by the Geosynthetic Installer.

### 3.11 PROTECTION OF WORK

- A. The Geosynthetic Installer shall use all means necessary to protect all work of this Section.
- B. In the event of damage, the Geosynthetic Installer shall immediately make all repairs and replacements necessary to the approval of the Construction Manager.
- C. Contractor shall be responsible for protecting GCL from hydration from precipitation, dust spraying activities, or any other activities which could lead to GCL hydration.

### PART 4 – MEASUREMENT AND PAYMENT

- A. Providing for a complying with the requirements set forth in this Section for CAMU Liner GCL shall be measured as Lump Sum (LS), including GCL in the anchor trench to the limits shown on the Drawings, and payment shall be included with the lump sum price provided on the Base Bid Schedule for Liner System Geosynthetic Materials.
- B. Providing for a complying with the requirements set forth in this Section for North and South BMI Landfill Cover GCL shall be measured as Lump Sum (LS), including GCL in the anchor trench to the limits shown on the Drawings, and payment shall be included with the lump sum price provided on the Base Bid Schedule for North and South BMI Landfill Cover System Geosynthetic Materials.
- C. Providing for a complying with the requirements set forth in this Section for CAMU Cover GCL shall be measured as square foot (SF), including GCL in the anchor trench to the limits shown on the Drawings, and payment shall be included with the unit price provided on the Option Scope Bid Schedule for CAMU Cover Geosynthetic System.
- D. The bid item costs shall include all incidentals necessary for a complete installation of GCL.



**TABLE 02772-1  
REQUIRED GCL PROPERTY VALUES**

PROPERTIES	QUALIFIERS	UNITS	SPECIFIED <sup>(1)</sup> VALUES	TEST METHOD
<u>Liner System Properties</u>				
Interface Shear Strength	minimum	degrees	12 (liner) 20 (cover)	ASTM D 5321 <sup>(2)</sup>
<u>GCL Properties</u>				
Bentonite Content <sup>(4)</sup>	minimum	lb/ft <sup>2</sup>	0.75	ASTM D 5993
Bentonite Swell Index	minimum	mL/2g	24	ASTM D 5890
Bentonite Fluid Loss	maximum	mL	18	ASTM D 5891
Hydraulic Flux	minimum	m <sup>3</sup> /m <sup>2</sup> -s	1 x 10 <sup>-8</sup>	ASTM D 5887 <sup>(3)</sup>
Moisture Content (Bentonite)	maximum	percent	25	ASTM D 2216

Notes: (1) All values represent minimum average roll values (i.e., any roll in a lot should meet or exceed the values in this table).  
(2) Interface shear strength testing shall be performed, by the CQA Engineer, in accordance with Part 2.02 of this Section.  
(3) Hydraulic flux testing shall be performed under an effective confining stress of 5 pounds per square inch.  
(4) Measured at a moisture content of 0 percent.

END OF SECTION

**SECTION 02773  
GEOCOMPOSITE**

**PART 1 – GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings
- B. The work shall include, but not be limited to, delivery, storage, placement, and seaming of the geocomposite.
- C. Geocomposite shall be used overlying the geomembrane and underlying the operations layer on the floor and side slopes for the base liner system. Geocomposite shall be used overlying the geomembrane for the final cover liner system.
- D. Construction of the final CAMU cover system will be held as an Option Scope that may be added to the contract via Contract Modification at the Owner's sole discretion. If the Owner decides to exercise its option to add the Option Scope, the Construction Manager will notify the Contractor no later than 30 days after receipt of the final Eastside Area confirmation sampling.

**1.02 RELATED SECTIONS**

Section 02200 — Earthwork

Section 02770 — Geomembrane

Section 02771 — Geotextiles

**1.03 REFERENCES**

- A. Drawings
- B. Construction Quality Assurance (CQA) Plan
- C. Latest version of American Society for Testing and Materials (ASTM) standards:
  - ASTM D 413. Standard Test Method for Rubber Property-Adhesion to Flexible Substrate.
  - ASTM D 792. Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
  - ASTM D 1603. Standard Test Method for Carbon Black in Olefin Plastics.
  - ASTM D 4491. Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
  - ASTM D 4533. Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
  - ASTM D 4632. Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

ASTM D 4716. Standard Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products.

ASTM D 4751. Standard Test Method for Determining Apparent Opening Size of a Geotextile.

ASTM D 4833. Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

ASTM D 5199. Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.

ASTM D 5261. Standard Test Method for Measuring Mass per Unit Area of Geotextiles.

#### **1.04 QUALIFICATIONS**

- A. The manufacturer shall be a well-established firm with more than one year documented experience in the manufacturing of geocomposite.
- B. The Geosynthetic Installer shall install the geocomposite and shall meet the requirements of Section 02770 and this Section.

#### **1.05 SUBMITTALS**

- A. The Geosynthetic Installer shall submit to the Construction Manager, at least 21 days prior to geocomposite delivery, the following information regarding the proposed geocomposite:
  - 1. manufacturer and product name;
  - 2. manufacturer documentation of at least 1-year of experience manufacturing geocomposite
  - 3. minimum property values of the proposed geocomposite and the corresponding test procedures;
  - 4. projected geocomposite delivery dates; and
  - 5. list of geocomposite roll numbers for rolls to be delivered to the site.
- B. At least 21 days prior to geocomposite placement, the Geosynthetic Installer shall submit to the Construction Manager the manufacturing quality control certificates for each roll of geocomposite. The certificates shall be signed by responsible parties employed by the geocomposite manufacturer (such as the production manager). The quality control certificates shall include:
  - 1. lot, batch, and/or roll numbers and identification; and
  - 2. results of quality control tests, including a description of the test methods used.

#### **1.06 CONSTRUCTION QUALITY ASSURANCE MONITORING**

- A. The Geosynthetic Installer shall ensure that the geocomposite and installation methods used meet the requirements of the Drawings and this Section. Any material or method that does not conform to these documents, or to alternatives approved in writing by the Construction Manager, shall be rejected and shall be repaired or replaced by the Geosynthetic Installer.

- B. The Geosynthetic Installer shall be aware of and accommodate all monitoring and conformance testing required by the CQA Plan. This monitoring and testing, including random conformance testing of construction materials and completed work, shall be performed by the CQA Engineer. If nonconformances or other deficiencies are found in the Geosynthetic Installer's materials or completed work, the Geosynthetic Installer shall be required to repair the deficiency or replace the deficient materials.

## **PART 2 – PRODUCTS**

### **2.01 GEOCOMPOSITE PROPERTIES**

- A. The Geocomposite Manufacturer shall furnish geocomposites having properties that comply with the required property values shown in Table 02773-1. The Geocomposite Manufacturer shall provide results of tests performed using the procedures listed in Table 02773-1, as well as certification that the materials meet or exceed the specified values.
- B. Geotextiles shall be thermally bonded to both sides of the geonet component of geocomposite material rather than chemically bonded.
- C. Geocomposite suppliers shall furnish materials in which the "Minimum Average Roll Values", as defined by the Federal Highway Administration (FHWA), meet or exceed the criteria specified in Table 02773-1.
- D. The geocomposite's geotextile components shall be nonwoven materials, suitable for use in filter/separation and cushion applications.

### **2.02 MANUFACTURING QUALITY CONTROL**

- A. The geocomposite shall be manufactured with quality control procedures that meet or exceed generally accepted industry standards.
- B. The geocomposite Manufacturer shall sample and test the geocomposite to demonstrate that the material conforms to the requirements of these Specifications.
- C. Any geocomposite sample that does not comply with this Section shall result in rejection of the roll from which the sample was obtained. The Geosynthetic Installer shall replace any rejected rolls.
- D. If a geocomposite sample fails to meet the quality control requirements of this Section the geocomposite Manufacturer shall sample and test, at the expense of the Manufacturer, rolls manufactured in the same lot, or at the same time, as the failing roll. Sampling and testing of rolls shall continue until a pattern of acceptable test results is established to bound the failed roll(s).
- E. Additional sample testing may be performed, at the geocomposite Manufacturer's discretion and expense, to identify more closely any non-complying rolls and/or to qualify individual rolls.
- F. Sampling shall, in general, be performed on sacrificial portions of the geocomposite material such that repair is not required. The Geocomposite Manufacturer shall sample and test the geocomposite, at a minimum once every 100,000 ft<sup>2</sup>, to demonstrate that the geocomposite properties conform to the values specified in Table 02773-1. At a minimum, the following manufacturing quality control tests shall be performed on the geotextile component of the geocomposite:

<u>Test</u>	<u>Procedure</u>
Mass per unit area	ASTM D 5261
Grab strength	ASTM D 4632
Puncture strength	ASTM D 4833
Mullen Burst	ASTM D 3786
Trapezoidal Tear	ASTM D 4533
Permittivity	ASTM D 4491
A.O.S.	ASTM D 4751

- G. At a minimum, the following manufacturing quality control tests shall be performed on the geonet component of the geocomposite:

<u>Test</u>	<u>Procedure</u>
Specific gravity	ASTM D 792
Nominal thickness	ASTM D 5199

- H. At a minimum, the following manufacturing quality control tests shall be performed on the geocomposite:

<u>Test</u>	<u>Procedure</u>
Transmissivity	ASTM D 4716
Peel strength	ASTM D 413

- I. The geocomposite Manufacturer shall comply with the certification and submittal requirements of this Section.

## **2.03 PACKING AND LABELING**

- A. Geocomposite shall be supplied in rolls wrapped in relatively impermeable and opaque protective covers.

- B. Geocomposite rolls shall be marked or tagged with the following information:

1. manufacturer's name;
2. product identification;
3. lot or batch number;
4. roll number; and
5. roll dimensions.

## **2.04 TRANSPORTATION, HANDLING, AND STORAGE**

- A. The Geosynthetic Installer shall be liable for any damage to the materials incurred prior to and during transportation to the site.

- B. The geocomposite shall be delivered to the site at least 30 days prior to the planned deployment date to allow the CQA Engineer adequate time to perform conformance testing on the geocomposite samples as described in Part 3.06 of this Section.
- C. Handling, unloading, storage, and care of the geocomposite prior to and following installation at the site, is the responsibility of the Geosynthetic Installer. The Geosynthetic Installer shall be liable for any damage to the materials incurred prior to final acceptance by the Construction Manager.
- D. The Geosynthetic Installer shall be responsible for storage of the geocomposite at the site.
- E. The geocomposite shall be protected from sunlight, excessive heat or cold, puncture, or other damaging or deleterious conditions. The geocomposite shall be protected from mud, dirt, and dust. Any additional storage procedures required by the geocomposite Manufacturer shall be the responsibility of the Geosynthetic Installer.

## **PART 3 – EXECUTION**

### **3.01 FAMILIARIZATION**

- A. Prior to implementing any of the work described in this Section, the Geosynthetic Installer shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of this Section may properly commence without adverse impact.
- B. Inspection:
  - 1. The Geosynthetic Installer shall carefully inspect the installed work of all other Sections and verify that all work is complete to the point where the installation of this Section may properly commence without adverse impact.
  - 2. If the Geosynthetic Installer has any concerns regarding the installed work of other Sections, he should notify the Construction Manager in writing prior to commencing the work. Failure to notify the Construction Manager or installation of the geocomposite shall be construed as Geosynthetic Installer's acceptance of the related work of all other Sections.
- C. A pre-installation meeting shall be held to coordinate the installation of the geocomposite with the installation of other components of the lining system.

### **3.02 HANDLING AND PLACEMENT**

- A. The Geosynthetic Installer shall not begin geocomposite installation until all QC/QA documentation is complete for underlying materials.
- B. The Geosynthetic Installer shall handle all geocomposite in such a manner that it is not damaged in any way.
- C. The Geosynthetic Installer shall inspect and verify geomembrane surface below geocomposite is free of loose soil and rocks. ~~greater than 1 inch~~. Geosynthetic installer shall remove loose soil and rocks from geomembrane surface prior to geocomposite placement.
- D. Install the geocomposite down the slope not across the slope. Place ends into the anchor trenches in such a manner as to continually keep the geocomposite in tension.

- E. Precautions shall be taken to prevent damage to underlying layers during placement of the geocomposite.
- F. In the presence of wind, all geocomposites shall be sufficiently weighted with sandbags or the equivalent to prevent movement.
- G. The geocomposite shall be positioned by hand after being unrolled to minimize wrinkles.
- H. Care shall be taken during placement of geocomposites not to entrap dirt or excessive dust in the geocomposite that could cause clogging of the drainage system, and/or stones that could damage the adjacent geomembrane. If dirt or excessive dust is entrapped in the geocomposite, it should be cleaned prior to placement of the next material on top of it. Care shall be exercised when handling sandbags, to prevent rupture or damage of the sandbags.
- I. Geocomposites shall only be cut using a hooked utility blade.
- J. After unwrapping the geocomposite from its opaque cover, the geocomposite shall not be left exposed for a period in excess of 15 days.

### **3.03 OVERLAPS AND SEAMS**

#### **A. Geonet Components:**

- 1. The geonet components shall be overlapped a minimum 4 in. along the length. The geonet shall be overlapped by a minimum 1 ft. across the width.
- 2. Geonet overlaps shall be secured by tying with nylon cable ties. Tying devices shall be white or yellow for easy inspection. Metallic devices shall not be used.
- 3. Seaming of the geonet shall be performed by wrap-ties at 12-in. centers for end of panels and at 5-ft centers for edge of panel seams.
- 4. No end-of-panel seams shall be placed on slopes exceeding 10 %.

#### **B. Geotextile Components:**

- 1. The bottom layers of geotextile shall be overlapped. The top layers of geotextiles shall be continuously sewn.
- 2. Polymeric thread, with chemical resistance properties equal to or exceeding those of the geotextile component, shall be used for all sewing.

### **3.04 PLACEMENT OF OVERLYING MATERIALS**

#### **A. All overlying materials shall be placed in such a manner as to ensure that:**

- 1. The geocomposite and underlying materials are not damaged;
- 2. Minimal slippage occurs between the geocomposite and underlying layers; and
- 3. Excess tensile stresses are not produced in the geocomposite.
- 4. Equipment shall not be driven directly on the geocomposite.

5. Unless otherwise approved in writing by the Construction Manager, all equipment operating on the materials overlying the geotextile shall comply with Section 02200 and Section 02225.

### **3.05 ANCHORAGE**

- A. Temporary anchorage of the geocomposite shall be in accordance with the Construction Drawings and consist of the geocomposite extended approximately 10 ft from the toe of the waste slope and have two feet of operations layer placed on top.
- B. Visqueen shall be placed around liner system anchorage as shown on the Construction Drawings.
- C. Temporary anchor trenches shall be as shown on the Construction Drawings.
- D. Permanent anchorage shall be as shown on the Construction Drawings and in accordance with the Specifications for Anchor Trenching in Section 02200.

### **3.06 CONFORMANCE TESTING**

- A. Samples of geocomposite shall be removed by the CQA Engineer and sent to a Geosynthetic CQA Laboratory for testing to ensure conformance with the requirements of this Section. The Geosynthetic Installer shall assist the CQA Engineer in obtaining conformance samples. **Conformance sampling may be conducted at the manufacturing facility prior to shipment to the site.** The Geosynthetic Installer shall account for this testing in the installation schedule.
- B. Samples shall be taken at a minimum frequency rate of one sample per 200,000 square feet.
- C. The CQA Engineer may increase the frequency of sampling in the event that test results do not comply with the requirements of Part 2.01 of this Section until passing conformance test results are obtained for all material that is received at the site. This additional testing shall be performed at the expense of the Contractor.
- D. **If a geocomposite sample fails to meet the quality control requirements of this Section the Manufacturer shall sample and test, at the expense of the Manufacturer, rolls manufactured in the same lot, or at the same time, as the failing roll. Sampling and testing of rolls shall continue until a pattern of acceptable test results is established to bound the failed roll(s).**
- E. ~~D.~~ As a minimum, transmissivity and peel strength shall be performed on each sample.
- F. Any geocomposite that is not certified by the Manufacturer in accordance with Part 1.05 of this section or that does not meet the requirements specified in Part 2.01 shall be rejected and replaced by the Geosynthetic Installer.

### **3.07 PROTECTION OF WORK**

- A. The Geosynthetic Installer shall use all means necessary to protect all work of this Section.
- B. In the event of damage, the Geosynthetic Installer shall immediately make all repairs and replacements necessary to the approval of the Construction Manager.



## **PART 4 – MEASUREMENT AND PAYMENT**

### **4.01 GENERAL**

- A. Providing for a complying with the requirements set forth in this Section for CAMU Liner Geocomposite shall be measured as Lump Sum (LS), including Geocomposite in the anchor trench to the limits shown on the Drawings, and payment shall be included with the lump sum price provided on the Base Bid Schedule for Liner System Geosynthetic Materials.
- B. Providing for a complying with the requirements set forth in this Section for North and South BMI Landfill Cover Geocomposite shall be measured as Lump Sum (LS), including Geocomposite in the anchor trench to the limits shown on the Drawings, and payment shall be included with the lump sum price provided on the Base Bid Schedule for North and South BMI Landfill Cover System Geosynthetic Materials.
- C. Providing for a complying with the requirements set forth in this Section for CAMU Cover Geocomposite shall be measured as square foot (SF), including Geocomposite in the anchor trench to the limits shown on the Drawings, and payment shall be included with the unit price provided on the Option Scope Bid Schedule for CAMU Cover Geosynthetic System.
- D. The bid item costs shall include all incidentals necessary for a complete installation of Geocomposite.

**TABLE 02773 - 1**  
**GEOCOMPOSITE PROPERTY VALUES**

PROPERTIES	QUALIFIER	UNITS	SPECIFIED VALUES <sup>(1)</sup>		TEST METHOD
			Base Liner	Final Cover	
Geonet Component:					
Specific gravity	Minimum		0.935	0.935	ASTM D 792
Carbon black content	Range	%	2 – 3	2 – 3	ASTM D 1603
Nominal thickness	Minimum	mils	200	200	ASTM D 5199
Geotextile Components:					
Mass per unit area	Minimum	oz/yd <sup>2</sup>	8	6	ASTM D 5261
<u>Filter Requirements</u>					
Apparent opening size	Maximum	mm	0.21	0.21	ASTM D 4751
Permittivity	Minimum	1/s	0.6	0.5	ASTM D 4491
<u>Mechanical Requirements</u>					
Grab strength	Minimum	lb	190	130	ASTM D 4632
Puncture strength	Minimum	lb	110	40	ASTM D 4833
Mullen Burst	Minimum	psi	350	210	
Trapezoidal Tear	Minimum	lb	85	40	
Geocomposite:					
Transmissivity	Minimum	m <sup>2</sup> /s	<del>6-9.2</del> x 10 <sup>-5</sup> (2)	5 x 10 <sup>-4</sup> (3)	ASTM D 4716
Peel Strength	Minimum	gm/in	500	500	ASTM D 413

Notes:

1. All values except transmissivity represent minimum average roll values (i.e., any roll in a lot should meet or exceed the values in this table).
2. The design transmissivity is the hydraulic transmissivity of the base liner geocomposite measured using water at 68°F ±3°F (20°C ±1.5°C) with a hydraulic gradient of 0.1 under a compressive stress of not less than ~~7,000~~ 12,000 psf. For the test, the geocomposite shall be sandwiched between a layer of operations material and a textured 60-mil HDPE geomembrane. The minimum test duration shall be 24 hours and the report for the test results shall include measurements at intervals over the entire test duration.
3. The design transmissivity is the hydraulic transmissivity of the final cover geocomposite measured using water at 68°F ±3°F (20°C ±1.5°C) with a hydraulic gradient of 0.1 under a compressive stress of not less than 300 psf. For the test, the geocomposite shall be sandwiched between a layer of cover soil material and a textured 60-mil HDPE geomembrane. The minimum test duration shall be 24 hours and the report for the test results shall include measurements at intervals over the entire test duration.

END OF SECTION

**SECTION 02820**  
**CHAIN LINK FENCE**

**PART 1 – GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings
- B. The Work shall include construction of footers, construction of posts, rails, and bracing, placement and securing the fence fabric, construction and installation of swing gates, and all other Work incidental to construction of a completed fence as shown on the Drawings and as described in this Section.

**1.02 RELATED SECTIONS**

Section 01025 – Measurement and Payment

Section 01050 – Field Engineering

Section 01300 – Submittals

Section 01400 – Quality Control

Section 01500 – Construction Facilities

Section 01560 – Temporary Controls

Section 02200 – Earthwork

Section 03400 – Cast-in-Place Concrete

**1.03 REFERENCES**

- A. Construction Drawings
- B. Latest Version of American Society for Testing and Materials (ASTM) Standards:
  - ASTM A 153     Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
  - ASTM A 392     Zinc-Coated Steel Chain Link Fence Fabric
  - ASTM A 1043   Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials to Site in good condition, in unopened packaging, and with labels intact. Inspect materials upon delivery and replace damaged or contaminated materials.
- B. Store materials above ground, under cover, in a dry place, and in a manner to prevent damage or staining.

- C. Handle materials to prevent damage to surfaces, edges, and ends. Replace damaged materials at no additional cost to the Construction Manager.

## **1.05 SUBMITTALS**

- A. The Contractor shall submit to the Construction Manager, at least 14 days prior to installation of fence material, certificates of compliance with the fence Manufacturer's specifications and that the material meets or exceeds all internal quality control requirements and the requirements of this Section.
- B. The Contractor shall submit the locations of the fence posts shall be surveyed by the Surveyor, and shall be included in the Record Drawings in accordance with Section 01050 of these Specifications.

## **1.06 QUALITY ASSURANCE**

- A. The Contractor shall ensure that the materials and methods used for security chain link fence construction meet the requirements of the Manufacturer, the Drawings, and this Section. Any material or method that does not conform to these documents, or to alternatives approved in writing by the Construction Manager shall be rejected and shall be repaired or replaced by the Contractor to the satisfaction of the CQA Engineer at the Contractor's expense.

## **PART 2 – PRODUCTS**

### **2.01 SECURITY FENCE FABRIC**

- A. Fence height shall be consistent with fence currently on site.
- B. Fence fabric: 2" by 2" mesh size, 11 gauge core size, hot-dip zinc galvanized steel wire.
- C. Fence fabric shall be a commercial-grade fence system, as supplied by Master-Halco, or shall be equivalent in core material, metallic-coating material, and all coating processes and strengths.
- D. Manufacturer shall warranty the fence materials against defects and deterioration, other than normal wear and tear, for a minimum of 12 years.
- E. Fabric selvages shall be twisted (barbed) on the top and knuckled on the bottom.
- F. The heights of fabric shall be sufficiently long so that no horizontal splices are required.

### **2.02 FRAMEWORK**

- A. Framework includes all posts and rails.
- B. Fencing framework shall be made of tubular galvanized steel pipe that conforms to ASTM F 1043, Group 1a. The framework shall be standard weight, schedule 40 steel pipe, galvanized by the hot-dip method, with a minimum average of 1.8 ounces per square foot of zinc-coated surface.
- C. Dimensions of the framework components shall be as shown on the Drawings.

## **2.03 FOOTERS**

- A. Post footers shall be made with concrete rated at a minimum of 2,500 pounds per square inch (psi) and shall be constructed to the dimensions as shown on the Construction Drawings.

## **2.04 SWING GATES**

- A. Gates frames shall be of the same materials and coatings as for the fence fabric and framework.
- B. Dimensions of the gates and gate components shall be as shown on the Construction Drawings.
- C. Gate frame members shall be welded at joints for a rigid connection.
- D. Contractor shall provide and install the following hardware for each gate:
  - 1. Hinges: provide hinges of type to, size, and material to suit gate size. Hinges shall be non-liftoff type, offset to permit 180 degree gate opening.
  - 2. Latch: exit control lock and cylinder, as shown on the Drawings.
  - 3. Latch rail: steel plate, weld to stiles at interior side of gate to receive and protect latch.

## **2.05 HARDWARE**

- A. Hardware shall include bolts, tension rods, and truss rods.
- B. Hardware shall be made of galvanized steel as per ASTM A 153.
- C. Bolts shall be 3/16" diameter self drilling hex head TEK screws with flat washers, as manufactured by Hilti, Red Head, or approved.
- D. Tension rods shall be in standard lengths to equal full height of fabric, with maximum cross section to suit fabric openings. Provide one tension rod for each gate post and corner post.
- E. Truss rods shall be minimum 3/8" diameter threaded, galvanized steel rod and turnbuckle.

## **2.06 FITTINGS**

- A. Fittings include: tension and brace bands, caps, eye tops, rail ends, sleeves, and tie wires.
- B. All fittings, except tie wires, shall be hot-dip galvanized steel. Tie wires shall be zinc-coated steel wire.

## **PART 3 – EXECUTION**

### **3.01 GENERAL**

- A. ~~In the Eastside Area, Contractor shall erect fence around the perimeter of the active work area shown on the Construction Drawings, while the Owner maintains existing site perimeter fence.~~

- B. When shipping, delivering, and installing all fence materials, do so to ensure a sound, undamaged installation. Provide storage for all materials and equipment delivered to the Site that is protective of stored materials. Handle and store materials in accordance with the Manufacturer's recommendations.
- C. Prior to installation, examine surfaces designated to receive Work described in the Section for conditions adversely affecting the finished Work. Repair or replace surfaces not meeting tolerances or quality requirements governing substrate construction prior to initiating this Work.
- D. Do not begin installation and erection before construction of the concrete secondary containment portion of the Work is complete.

### **3.02 INSTALLATION**

- A. Install materials in accordance with accepted shop drawings and Manufacturer's printed instructions.
- B. Provide top and interim rails as shown on Drawings. Install each as one piece between posts. Offset as necessary to allow for depth of fabric.
- C. Place chain link fabric on the outside of the area to be enclosed. Secure one end and apply sufficient tension to remove all slack before making attachments elsewhere. Tighten the fabric to provide a smooth uniform appearance, free from sag.
- D. Set line posts equidistant at 10 foot (maximum) spacings.
- E. Set terminal (end, corner, and pull) and gate posts at 500 foot (maximum) spacings.
- F. Install braces and truss rods at gate posts and terminal posts.
- G. Install fence fabric 1 inch above ground level.
- H. Cut the fence fabric at the terminal posts.
- I. Cut fabric by untwisting on picket and attach each span independently at all terminal posts. Install tension rods with bolts and washers at 15" on center.
- J. Fasten fabric to all posts, rails, and gate frames with bolts and washers at 15" on center.
- K. Clearances: install fencing and gates with a maximum 1/2" clearance between the perimeter of the fabric and the framing, between the framing and adjacent construction, and between the perimeter of each gate leaf and surrounding construction. Close off gaps exceeding 1/2" at the direction of the Construction Manager.

### **3.03 GATES**

- A. Install gates plumb, level and secure, for full operation without interference. Adjust hardware for smooth operation and lubricate where necessary. Gates shall open outward from the area to be secured.
- B. Set keepers, stops, and other accessories into concrete as indicated and in accordance with manufacturer's instructions.
- C. Adjust hardware for smooth operation and lubrication where necessary

### **3.04 CLEANING UP**

- A. During the progress of the Work, the premises shall be kept free of debris and waste. Upon completion, remove from the Site and dispose of all debris and surplus materials in a lawful manner.
- B. At completion of Work, touch up minor damage to all surfaces to the satisfaction of the Construction Manager. Protect completed Work until final acceptance by the Construction Manager.
- C. Repair of Galvanized Surfaces: use galvanize repair compound (stick form) or other method to repair galvanized surfaces. Comply with manufacturer's instructions.

### **3.05 SURVEY**

- A. The locations of the fence posts shall be surveyed by the Surveyor, and shall be included in the Record Drawings in accordance with Section 01050 of these Specifications.

## **PART 4 – MEASUREMENT AND PAYMENT**

### **4.01 GENERAL**

- A. Providing for and complying with the requirements set forth in this Section for chain link fence shall be included with the Mobilization and Demobilization lump sum costs provided on the Base Bid Schedule.
- B. The bid item costs shall include all incidentals necessary for a complete installation of Chain Link Fence.

END OF SECTION]

**SECTION 03400**  
**CAST-IN-PLACE CONCRETE**

**PART 1 – GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings
- B. The Work shall include, but not be limited to, procurement, delivery, subgrade preparation, formwork, concrete placement, control joints, surface treatment, and curing.

**1.02 RELATED SECTIONS**

Section 02200 – Earthwork

**1.03 REFERENCES**

- A. Construction Drawings
- B. Geosyntec, 2007 “Construction Quality Assurance Plan for the Construction of the Corrective Action Management Unit, Basic Remediation Company, Henderson, Nevada,” August.
- C. Clark County Area Uniform Standard Specifications (CCAUSS) and Clark County Area Uniform Standard Drawings (CCAUSD).
- D. Latest version of American Concrete Institute (ACI) standards:
  - ACI 117 Tolerances for Concrete Construction and Materials
  - ACI 211.1 Selecting Proportions for Normal, Heavyweight, and Mass Concrete
  - ACI 301 Structural Concrete for Buildings
  - ACI 304R Measuring, Mixing, Transporting, and Placing Concrete
  - ACI 308 Standard Practice for Curing Concrete
  - ACI 318 Building Code Requirements for Reinforced Concrete
  - ACI 347R Formwork for Concrete
- E. Latest version of the American Society for Testing and Materials (ASTM) standards:
  - ASTM A185 Welded Steel Wire Fabric for Concrete Reinforcement
  - ASTM A497 Welded Deformed Steel Wire Fabric for Concrete Reinforcement
  - ASTM A 615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
  - ASTM C 33 Concrete Aggregates



ASTM C 39	Compressive Strength of Cylindrical Concrete Specimens
ASTM C 94	Ready- Mixed Concrete
ASTM C 127	Specific Gravity and Adsorption of Coarse Aggregate
ASTM C 128	Specific Gravity and Adsorption of Fine Aggregate
ASTM C 143	Slump of Hydraulic Cement Concrete
ASTM C 150	Portland Cement
ASTM C 171	Sheet Materials for Curing Concrete
ASTM C 172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 192	Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 260	Air Entraining Admixtures for Concrete.
ASTM C 293	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading)
ASTM C 309	Liquid Membrane - Forming Compounds for Curing Concrete
ASTM C 403	Time of Setting of Concrete Mixtures by Penetration Resistance
ASTM C 494	Chemical Admixtures for Concrete
ASTM C 618	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM D 1751	Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.
ASTM D 1752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
F. Latest version of Federal Standards (FS):	
FS TT-C-800	Curing Compound, Concrete, for New and Existing Surfaces.

#### **1.04 SUBMITTALS**

- A. At least 14 days prior to construction of the concrete, Contractor shall submit a mix design for the type of concrete to the Construction Manager. The Contractor shall submit a complete list of materials including types, brands, sources, amount of cement, fly ash, pozzolans, retardants, and admixtures, and applicable reference specifications for the following:
1. Slump design based on total gallons of water per cubic yard.
  2. Type and quantity of cement.
  3. Brand, type, ASTM designation, active chemical ingredients, and quantity of each admixture.

4. Compressive strength based on 28-day compression tests.

**B. Delivery Tickets:**

1. Provide duplicate delivery tickets with each load of concrete delivered, one for Contractor's records and one for Construction Manager, with the following information:
  - a. Date and serial number of ticket.
  - b. Name of ready-mixed concrete plant, operator, and job location.
  - c. Type of cement, admixtures, if any, and brand name.
  - d. Cement content, in bags per cubic yard (CY) of concrete, and mix design.
  - e. Truck number, time loaded, and name of dispatcher.
  - f. Amount of concrete (CY) in load delivered.
  - g. Gallons of water added at job, if any, and slump of concrete after water was added.
  - h. Identification of mix design number.

- C. Contractor shall submit Record Drawings presenting the dimensions, locations and elevations of the features.

**1.05 MANUFACTURER QUALITY CONTROL (MQC)**

- A. Aggregates shall be sampled and tested in accordance with ASTM C 33.
- B. Concrete test specimens shall be made, cured, and stored in conformity with ASTM C 192 and tested in conformity with ASTM C 39.
- C. Slump shall be determined in accordance with ASTM C 143.

**1.06 LIMITING REQUIREMENTS**

- A. Unless otherwise specified, each concrete mix shall be designed and concrete shall be controlled within the following limits:
  1. Concrete slump shall be kept as low as possible, consistent with proper handling and thorough compaction. Unless otherwise authorized by the Construction Manager, slump shall not exceed 4 in.
  2. The admixture content, batching method, and time of introduction to the mix shall be in accordance with the manufacturer's recommendations for minimum shrinkage and for compliance with this Section. A water-reducing admixture may be included in concrete.

## **PART 2 – PRODUCTS**

### **2.01 CONCRETE**

#### **A. Concrete Materials**

1. Portland cement concrete shall be in accordance with CCAUSS Section 501.
2. Cement: ASTM C150 Sulphate Resistant-Type V low alkali Portland type only, gray color; shall conform to CCAUSS Section 701.
3. Fine and Coarse Aggregates: Shall conform to ASTM C33, and Section 706 of the Standard Specifications. Coarse aggregates shall be 1 ½ inches maximum size, except otherwise specified within.
4. Water: Clean and not detrimental to concrete. Water shall be of potable quality.

### **2.02 FORM MATERIALS**

- #### **A. Conform to ACI 301.**

### **2.03 REINFORCEMENT**

- #### **A. Reinforcing materials shall be in accordance with CCAUSS Section 713. Reinforcing Steel: ASTM A615; Grade 60; plain or deformed billet steel bars, as noted on Drawings.**
- #### **B. Welded Steel Wire Fabric: Plain type, ANSI/ASTM A185; in flat sheets; uncoated.**
- #### **C. Tie Wire: Annealed steel, minimum 16 gage size.**
- #### **D. Dowels: ASTM A615; 40 ksi yield grade, plain steel, uncoated finish.**

### **2.04 ACCESSORIES**

- #### **A. Concrete curing materials and admixtures shall be in accordance with CCAUSS Section 702. Curing Compound: FS TT-C-800, Type 1, 30 percent solids.**
- #### **B. Joint material shall conform to CCAUSS Section 707, except as otherwise noted on drawings or by Engineer.**

### **2.05 ADMIXTURES**

- #### **A. Air Entrainment: ASTM C260.**
- #### **B. Chemical Admixture: ASTM C494, Type A - water reducing, or Type D water reducing and retarding.**

### **2.06 CONCRETE MIX**

- #### **A. Concrete shall conform to the requirements of CCAUSS Section 501 and to the requirements of ASTM C94, subject to the modifications and supplemental requirements contained in these Specifications.**
- #### **B. Concrete mix shall be Class AA - 3,000 psi, 28 day compressive strength.**

- C. The Contractor is hereby cautioned that the cement contents shown above are minimum values and for general information. The contractor or concrete supplier shall, at its own expense, furnish additional quantities of cement as required to consistently obtain the compressive strengths designated above. Mix design shall be per governing agency standards and specifications.

## **PART 3 – EXECUTION**

### **3.01 SUBGRADE PREPARATION**

- A. Subgrade preparation shall be in accordance with Section 02200.
- B. Subgrade shall be graded to the lines and elevations as shown on the Drawings.
- C. Standing water, mud, debris, and foreign matter shall be removed before concrete is placed.

### **3.02 INSPECTION**

- A. Provide written verification that compacted granular base is ready to support paving and imposed loads.
- B. Provide written verification that gradients and elevations of base are correct.
- C. Beginning of installation means acceptance of existing conditions.

### **3.03 PREPARATION**

- A. Moisten base to minimize absorption of water from fresh concrete.
- B. Notify Construction Manager a minimum of 24 hours prior to commencement of concreting operations.

### **3.04 FORMING**

- A. Place and secure forms to correct location, dimension, and profile.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint fillers vertical in position, in straight lines. Secure to formwork during concrete placement.

### **3.05 REINFORCEMENT**

- A. Place reinforcement at mid-height of slabs-on-grade unless otherwise indicated on Drawings.
- B. Interrupt reinforcement at joints as shown on Drawings.
- C. Provide dowelled joints at interruptions of concrete with one end of dowel lubricated to allow longitudinal movement.

### **3.06 FORMED JOINTS**

- A. Locate joints as specified herein or shown on the plans.

- B. Make all joints perpendicular and straight.
- C. Contraction Joints.
  - 1. Contraction joints shall be constructed every 10 feet (maximum) and shall conform to CCAUSS Section 613 unless otherwise noted on Drawings or by the Construction Manager.
  - 2. Contraction joints shall be constructed every 10 feet (maximum) by using steel templates not less than 1/8 inch nor more than 3/16 inch in thickness. The templates shall be removed as soon as the concrete has set sufficiently to hold its shape. Where concrete is placed by slipform methods, the contraction joints every 10 feet may be provided by cutting into the fresh concrete to a minimum depth of 1-1/2 inches to create a plane of weakness. The edges of such joints shall be rounded to provide a neat workmanship appearance.
  - 3. Immediately after the forms are removed, the Construction Manager shall inspect the contraction joints carefully. Any concrete or mortar that has sealed across the joint shall be cut neatly and removed.
- D. Expansion joints.
  - 1. Expansion joints, 1/2 inch in thickness, shall be constructed every 30 feet and at changes in direction by using premolded expansion joint filler and shall conform to CCAUSS Section 613 unless otherwise noted on Drawings or by the Construction Manager.

### **3.07 PLACING CONCRETE**

- A. Place concrete in accordance with ACI 301 and CCAUSS Section 502.
- B. Ensure reinforcement, inserts, embedded parts, formed joints and dowels are not disturbed during concrete placement.
- C. Place concrete continuously between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.
- D. Place concrete to straight line pattern.

### **3.08 FINISHING OF CONCRETE SURFACES**

- A. All finished or formed surfaces shall conform accurately to the shape, alignment, grades and sections as shown or requested. Surfaces shall be free of fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous, hard surface.
- B. Exposed vertical corners of all concrete structures shall be given a 3/4 inch chamfer. Forms shall not be removed until permission to do so has been received from the Construction Manager.
- C. Excessive floating of surfaces while the concrete is plastic shall not be permitted. Exposed uniformed surfaces of concrete shall be given the following finishes: Area paving – broom finish; Other surfaces – steel trowel finish.

- D. Dusting on of dry cement or sand to absorb excess moisture shall not be permitted. Unless otherwise shown, the edges of all exposed horizontal surfaces shall be finished with an edging tool to a radius of ½ inch.
- E. All concrete surfaces on which pedestrians can walk shall be finished such that the minimum static coefficient of friction between the surface and normal hard soled shoes shall be in strict accordance with ADA Guidelines, latest edition.

### **3.09 CURING**

- A. Place curing compound on exposed concrete surfaces immediately after finishing. All structural concrete shall be cured by being moist for fourteen (14) days after placing or, at the option of the Contractor, may be cured by use of a curing compound meeting the requirements of CCAUSS Section 702, and which has been approved by the Engineer and Construction Manager.
- B. The curing compound shall be applied in accordance with the manufacturer's instructions at a minimum coverage rate of 150 square feet per gallon in such a manner as to cover the surface with a uniform film which will seal thoroughly.

### **3.10 FIELD QUALITY CONTROL**

#### **A. Concrete Tests**

- 1. A set of four (4) concrete cylinders shall be taken for every 75 cubic yards, or fraction thereof, of each class of concrete placed each day. One (1) additional test cylinder will be taken during cold weather and cured on site under the same conditions as the concrete it represents.
- 2. One (1) slump test shall be per 20 cubic yards, or fraction thereof, of concrete.
- 3. Maintain records of placed concrete items. Record data, location of placement, quantity, air temperature, and test samples taken.
- 4. Portland cement concrete shall be subject to the requirements and test methods contained in CCAUSS Section 501.02.03. ASTM C 293 shall be performed at a frequency of 1 test per 300 cubic yards of concrete.
- 5. The determination of compressive strength in psi shall be made by testing 6 inch diameter by 12 inch cylinders, made and cured in accordance with ASTM C31 and ASTM C39. Tests and analysis of the aggregates and of the resulting concrete will be made by the Construction Manager and the mixes used shall be changed whenever, in the opinion of the Construction Manager, such change is necessary or desirable to secure the required workability, density, impermeability, surface finish and strength; and the Contractor shall be entitled to no additional compensation because of such changes. The cost of laboratory tests on cement, aggregate, and concrete will be borne by the Contractor. The Contractor shall assist the Construction Manager in obtaining specimens for testing.

### **3.11 PROTECTION**

- A. Immediately after placement, protect concrete from premature drying, excessive hot or cold temperatures, and mechanical injury.

### **3.12 SURVEY**

- A. The Surveyor shall locate the features of the concrete structure. The dimensions, locations and elevations of the features shall be presented on the Surveyor's Record Drawings.

## **PART 4 – MEASUREMENT AND PAYMENT**

### **4.01 GENERAL**

- A. Providing for and complying with the requirements set forth in this Section for LCRS Cast-In-Place Concrete Anchors shall be on a per-anchor basis (EA) and payment shall be based on the unit price for LCRS Concrete Anchors provided on the Bid Schedule.
- B. Providing for and complying with the requirements set forth in this Section for Storm water collection improvements at the CAMU – Concrete Channel shall be lump sum (LS), and payment shall be based on the Lump Sum price provided on the Bid Schedule. Specified items incidental to storm water improvements – concrete channel are:
  - 1. concrete channel
  - 2. aggregate base
  - 3. subgrade preparation
- C. The bid item costs shall include all incidentals necessary for a complete installation of Cast-in-Place Concrete.

[END OF SECTION]

**SECTION 03410**  
**REINFORCED CONCRETE PIPE**

**PART 1 – GENERAL**

**1.01 DESCRIPTION OF WORK**

- A. The Contractor shall furnish all labor, materials, tools, supervision, transportation, and equipment necessary to perform all Work specified herein and as shown on the Construction Drawings

**1.02 RELATED SECTIONS**

Section 02200 – Earthwork

**1.03 REFERENCES**

- A. Construction Drawings
- B. Clark County Area Uniform Standard Specifications (CCAUSS) and Clark County Area Uniform Standard Drawings (CCAUSD)
- C. Construction Quality Assurance (CQA) Plan
- D. Latest version of American Concrete Institute (ACI) standards:
- |           |  |
|-----------|--|
| ACI 117   | Tolerances for Concrete Construction and Materials               |
| ACI 211.1 | Selecting Proportions for Normal, Heavyweight, and Mass Concrete |
| ACI 301   | Structural Concrete for Buildings                                |
| ACI 304R  | Measuring, Mixing, Transporting, and Placing Concrete            |
| ACI 308   | Standard Practice for Curing Concrete                            |
| ACI 318   | Building Code Requirements for Reinforced Concrete               |
| ACI 347R  | Formwork for Concrete  |
- E. Latest version of the American Society for Testing and Materials (ASTM) standards:
- |            |   |
|------------|---|
| ASTM A 615 | Deformed and Plain Billet-Steel Bars for Concrete Reinforcement |
| ASTM C 33  | Concrete Aggregates   |
| ASTM C 39  | Compressive Strength of Cylindrical Concrete Specimens          |
| ASTM C 94  | Ready- Mixed Concrete   |
| ASTM C 127 | Specific Gravity and Adsorption of Coarse Aggregate             |
| ASTM C 128 | Specific Gravity and Adsorption of Fine Aggregate               |
| ASTM C 143 | Slump of Hydraulic Cement Concrete                              |



ASTM C 150	Portland Cement
ASTM C 171	Sheet Materials for Curing Concrete
ASTM C 192	Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 309	Liquid Membrane - Forming Compounds for Curing Concrete
ASTM C 403	Time of Setting of Concrete Mixtures by Penetration Resistance
ASTM C 494	Chemical Admixtures for Concrete
ASTM C 618	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

#### **1.04 SUBMITTALS**

- A. At least 14 days prior to construction of the concrete, Contractor shall submit a mix design for the type of concrete to the Construction Manager. The Contractor shall submit a complete list of materials including types, brands, sources, amount of cement, fly ash, pozzolans, retardants, and admixtures, and applicable reference specifications for the following:
  1. Slump design based on total gallons of water per cubic yard.
  2. Type and quantity of cement.
  3. Brand, type, ASTM designation, active chemical ingredients, and quantity of each admixture.
  4. Compressive strength based on 28-day compression tests.
- B. Delivery Tickets:
  1. Provide duplicate delivery tickets with each load of concrete delivered, one for Contractor's records and one for Construction Manager, with the following information:
    - a. Date and serial number of ticket.
    - b. Name of ready-mixed concrete plant, operator, and job location.
    - c. Type of cement, admixtures, if any, and brand name.
    - d. Cement content, in bags per cubic yard (CY) of concrete, and mix design.
    - e. Truck number, time loaded, and name of dispatcher.
    - f. Amount of concrete (CY) in load delivered.
    - g. Gallons of water added at job, if any, and slump of concrete after water was added.
    - h. Identification of mix design number.

- C. Contractor shall submit Record Drawings presenting the dimensions, locations and elevations of the features.

#### **1.05 MANUFACTURER QUALITY CONTROL (MQC)**

- A. Aggregates shall be sampled and tested in accordance with ASTM C 33.
- B. Concrete test specimens shall be made, cured, and stored in conformity with ASTM C 192 and tested in conformity with ASTM C 39.
- C. Slump shall be determined in accordance with ASTM C 143.

#### **1.06 LIMITING REQUIREMENTS**

- A. Unless otherwise specified, each concrete mix shall be designed and concrete shall be controlled within the following limits:
  - 1. Concrete slump shall be kept as low as possible, consistent with proper handling and thorough compaction. Unless otherwise authorized by the Construction Manager, slump shall not exceed 4 in.
  - 2. The admixture content, batching method, and time of introduction to the mix shall be in accordance with the manufacturer's recommendations for minimum shrinkage and for compliance with this Section. A water-reducing admixture may be included in concrete.

### **PART 2 – PRODUCTS**

#### **2.01 REINFORCED CONCRETE PIPE**

- A. Reinforced Concrete Pipe (RCP) shall be in accordance with CCAUSS Sections 601, 603, 708, and the Construction Drawings.

#### **2.02 MANHOLES**

- A. Manholes shall be in accordance with CCAUSS Section 609 and the Construction Drawings.

### **PART 3 – EXECUTION**

#### **3.01 GENERAL**

- A. RCP: Refer to CCAUSS Sections 601, 603, 708, and the Construction Drawings for pipe execution.
- B. Manholes: Refer to CCAUSS Section 609 and the Construction Drawings for execution.

### **PART 4 – MEASUREMENT AND PAYMENT**

#### **4.01 GENERAL**

- A. Providing for and complying with the requirements set forth in this Section for Reinforced Concrete Pipe and Manholes and Inlets shall be measured as Lump Sum (LS), and payment shall be based on the lump sum price for Storm water collection improvements at CAMU – storm drain piping provided on the Bid Schedule. Incidental to RCP and Manholes are:

1. Earthworks
2. Backfill
3. Subgrade Preparation
4. All other necessary incidentals for a complete installation of RCP pipe, manholes, and inlets.

[END OF SECTION]

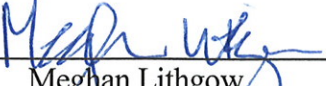
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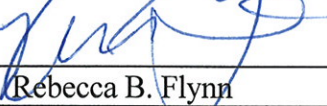
ATTACHMENT C  
6 oz/yd<sup>2</sup> Puncture Protection Calculation

COMPUTATION COVER SHEET

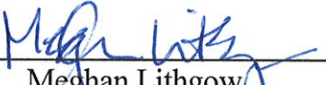
Client: BRC Project: BRC CAMU Project/  
Proposal No.: SC0313  
Task No. 04

Title of Computations CUSHION FABRIC CALCULATIONS

Computations by: Signature  2/22/08  
Printed Name Meghan Lithgow Date  
Title Staff Engineer

Assumptions and Procedures Checked by: Signature  2/22/08  
Printed Name Rebecca B. Flynn Date  
(peer reviewer) Title Senior Staff Engineer

Computations Checked by: Signature \_\_\_\_\_  
Printed Name Gregory T. Corcoran, P.E. Date  
Title Principal Engineer

Computations backchecked by: Signature  2/22/08  
(originator) Printed Name Meghan Lithgow Date  
Title Staff Engineer

Approved by: Signature \_\_\_\_\_  
(pm or designate) Printed Name Gregory T. Corcoran, P.E. Date  
Title Principal Engineer

Approval notes: \_\_\_\_\_

Revisions (number and initial all revisions)

No.	Sheet	Date	By	Checked by	Approval
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

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Written by:	<u>M. Lithgow</u>	Date:	<u>02/19/08</u>	Reviewed by:	<u>G. Corcoran</u>	Date:	<u></u>
Client:	<b>BRC</b>	Project:	<b>BRC CAMU</b>	Project/ Proposal No.:	<b>SC0313</b>	Task No.:	<b>04</b>

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**CUSHION FABRIC CALCULATIONS  
BRC CAMU  
HENDERSON, NEVADA**

**OBJECTIVE**

The project involves placement of a composite liner system for the Corrective Action Management Unit (CAMU) in Henderson, Nevada. The proposed liner system is shown in Attachment A. The objective of this calculation is to evaluate the maximum particle sizes of soil/aggregate materials adjacent to the geotextile in the leachate collection system that will not puncture or damage the geotextile. Specifically, this calculation will consider the maximum pressure exerted by equipment after backfilling an operations layer and traffic loads are imposed to evaluate the survivability of the proposed 6 oz/yd<sup>2</sup> geotextile.

**SUMMARY OF ANALYSIS**

The analyses suggest that the proposed geotextile with a mass per unit area of 6 oz/yd<sup>2</sup> placed over aggregate with a maximum particle size of 1.0 inches and overlain by 1 ft of operations layer soil with a maximum particle size of 1-inch will be adequate to ensure the survivability of the geotextile during operations construction.

**SITE CONDITIONS**

The proposed composite liner system in the area of interest will be comprised of the following components, from top to bottom (Figure 1):

- First 1-ft lift of operations layer material with a maximum particle size of 1-inch;
- a 6 oz/yd<sup>2</sup> nonwoven separation/filter geotextile;
- 1 ft of leachate collection aggregate surrounding leachate collection pipe;
- a 16 oz/yd<sup>2</sup> nonwoven cushion geotextile;
- 60-mil (1.5 mm) HDPE geomembrane, textured on both sides;

Written by: <u>M. Lithgow</u>	Date: <u>02/19/08</u>	Reviewed by: <u>G. Corcoran</u>	Date: _____
Client: <b>BRC</b>	Project: <b>BRC CAMU</b>	Project/ Proposal No.: <b>SC0313</b>	Task No.: <b>04</b>

- a geosynthetic clay liner (GCL); and
- prepared subgrade.

For this analysis, we will specifically be analyzing the 6 oz/yd<sup>2</sup> nonwoven separation/geotextile for its survivability during installation.

## APPROACH

Koerner has evaluated the geotextile survivability of the installation process in his text titled, "Designing with Geosynthetics" (Koerner, 1999). The design methods and conclusions of these papers were used for the analysis herein.

According to Koerner's approach, the important parameters that affect the puncture protection of geotextiles are: overlying pressure, mass per area of the geotextile, and the particle size and shape of the material overlying the geotextile. For the analysis herein, the overlying pressure and the mass per unit area of the geotextile are given and the maximum particle size is evaluated for the geotextile.

## ANALYSES

$$F_{\text{reqd}} = p'd_a^2 S_1 S_2 S_3 \quad (\text{Attachment B})$$

where:

- $F_{\text{reqd}}$  = required vertical force to be resisted;
- $d_a$  = average diameter of the puncturing aggregate or sharp object;
- $p'$  = pressure exerted on the geotextile;
- $S_1$  = protrusion factor =  $h_h/d_a$ ;
- $S_2$  = scale factor to adjust the ASTM D4833 puncture test value (which uses an 8.0 mm diameter probe) to the diameter of the actual puncturing object =  $d_{\text{probe}}/d_a$ ;
- $S_3$  = shape factor to adjust the ASTM D4833 flat puncture probe to the actual shape of puncturing object =  $1-A_p/A_c$  (values for  $A_p/A_c$  range

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Written by: <u><b>M. Lithgow</b></u>	Date: <u><b>02/19/08</b></u>	Reviewed by: <u><b>G. Corcoran</b></u>	Date: _____
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from 0.8 for rounded sand, to 0.7 for run-of-bank gravel, to 0.4 for crushed rock, to 0.3 for shot rock);

$A_p$  = projected area of puncturing particle; and

$A_c$  = area of smallest circumscribed circle around puncturing particle.

$$F_{reqd} = p'd_a^2 S_1 S_2 S_3$$

$p' = 10 \text{ psi} \times (6.894 \text{ kPa}/1 \text{ psi}) = 69 \text{ kPa}$  (note: 10 psi is maximum allowable load on 1-ft lift of operations layer in accordance with Technical Specifications)

$$d_a = 1.0 \text{ inch} \times (25.4 \text{ mm}/1 \text{ inch}) = 25.4 \text{ mm}$$

$$h_h = 0.5 \text{ inch}$$

$$d_{probe} = 8.0 \text{ mm}$$

$$S_1 = h_h/d_a = 0.5/1 = 0.5$$

$$S_2 = d_{probe}/d_a = 8.0 \text{ mm}/25.4 \text{ mm} = 0.31$$

$$S_3 = 1 - A_p/A_c = 1 - 0.4 \text{ (crushed rock)} = 0.6$$

$$F_{reqd} = (69 \text{ kPa})(1000 \text{ Pa}/1 \text{ kPa})(25.4 \times 0.001 \text{ mm}/1 \text{ m})^2(0.5)(0.31)(0.6) = 4.14 \text{ N}$$

The proposed 6 oz/yd<sup>2</sup> geotextile has a puncture strength of approximately 40 lbs (178 N). A cumulative reduction factor is calculated to account for installation and site specific criteria which may affect geotextile strength properties. The cumulative reduction factor is determined as follows:

$$\prod RF = RF_{ID} \times RF_{CR} \times RF_{CD} \times RF_{BD}$$

where:

$\prod RF$  = Cumulative reduction factors

$RF_{ID}$  = Reduction factor for installation damage = 2.5 (Attachment A)

$RF_{CR}$  = Reduction factor for creep = 2.5 (Attachment A)



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Written by: M. Lithgow Date: 02/19/08 Reviewed by: G. Corcoran Date: \_\_\_\_\_  
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$RF_{CD}$  = Reduction factor for chemical degradation = 1.5 (Attachment A)

$RF_{BD}$  = Reduction factor for biological degradation = 1.0 (Attachment A)

The ultimate puncture strength ( $F_{Ult}$ ) is reduced by the cumulative reduction factor as follows:

$$F_{allow} = F_{Ult} \times \frac{1}{\prod RF} = 178N \times \frac{1}{2.5 \times 2.5 \times 1.5 \times 1.0} = 18.9N$$

The factor of safety is as follows:

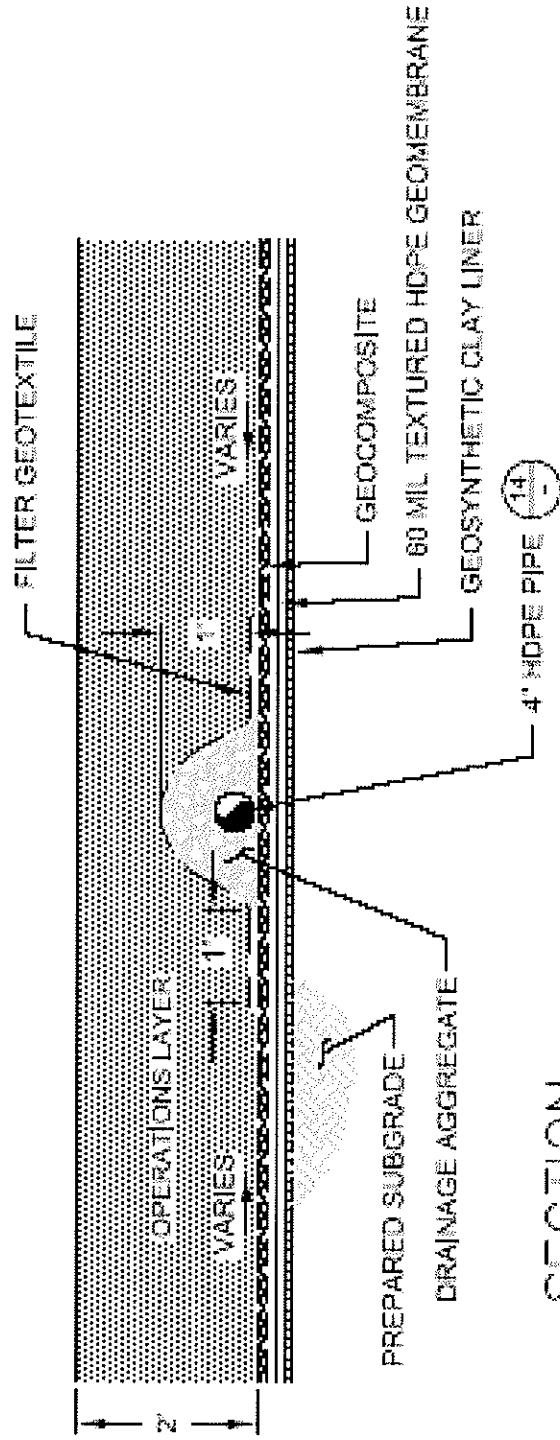
$$FS = \frac{F_{allow}}{F_{reqd}} = \frac{18.9}{4.14} = 4.57, \text{ which is acceptable}$$

## CONCLUSIONS

The proposed 6 oz/yd<sup>2</sup> nonwoven geotextile with a puncture strength of 40 lbs placed over an aggregate layer with a maximum particle size of 1.0-inch will be adequate to survive the installation process.

## REFERENCES

Koerner, R.M., "Designing with Geosynthetics", 4<sup>th</sup> Ed., Prentice Hall, Upper Saddle River, 1999. (Attachment A)



SECTION  
CROSS SECTION LORS COLLECTION LATERAL  
SCALE: 1" = 2'  
S0403104-1000 Depends On Sectioning

Figure 1

properties will sort out into their respective categories and uses, but most organizations are looking at the complete collection of tests as they were presented here.

Table 2.10 is a summary table of geotextile properties. The rapidly changing market and its demands make it difficult to give accurate values, but for typical commercially available geotextiles, Table 2.10 gives the range of current values. For the specific values of specific types of geotextiles, the respective manufacturers should be consulted.

## 2.4 ALLOWABLE VERSUS ULTIMATE GEOTEXTILE PROPERTIES

It is important to recognize that many of the preceding geotextile test properties represent idealized conditions and therefore result in the maximum possible numeric values when used directly in design; that is, they result in upper-bound values. In the design-by-function concept described in Section 2.1.3, the factor of safety was formulated around an allowable test value (Eqs. 2.2a and 2.2b). Thus, most laboratory test values cannot generally be used directly; they must be suitably modified for the in situ conditions. This could be done directly in the test procedure, for example, by conducting a completely simulated performance test; but in most cases this simply is not possible. Simulating installation damage, performing long-term creep testing, using site-specific liquids, reproducing in situ pore-water stresses, providing complete stress state modeling, and so on, are generally not feasible. To account for such differences between the laboratory measured test value and the desired performance value, two approaches can be taken:

1. Use an extremely high factor of safety at the end of a problem.
2. Use reduction factors on the laboratory-generated test value to make it into a site-specific allowable value.

The latter alternative of *reduction factors*† will be used in this book. By doing this, the usual value of the factor of safety can be used in the final analysis. Our approach will be to refer to the general laboratory-obtained value as an *ultimate* value and to modify it by reduction factors to an *allowable* value.

### 2.4.1 Strength-Related Problems

For problems dealing with geotextile strength, such as in separation and reinforcement applications, the formulation of the allowable values takes the following form. Typical values for reduction factors are given in Table 2.11. Note that these values, however, must be tempered by the site-specific considerations. If the laboratory test includes the mechanism listed, it appears in the equation as a value of 1.0.

$$T_{\text{allow}} = T_{\text{ult}} \left( \frac{1}{\text{RF}_{ID} \times \text{RF}_{CR} \times \text{RF}_{CD} \times \text{RF}_{BD}} \right) \quad (2.24a)$$

$$T_{\text{allow}} = T_{\text{ult}} \left( \frac{1}{\text{IRF}} \right) \quad (2.24b)$$

†In previous editions of this book, reduction factors were called partial factors of safety. This edition is changed to reflect the current trend in agency specifications and the more appropriate terminology.



TABLE 2.11 RECOMMENDED REDUCTION FACTOR VALUES FOR USE IN EQ. (2.24a)

Application Area	Range of Reduction Factors			
	Installation Damage	Creep*	Chemical Degradation	Biological Degradation
Separation	1.1 to 2.5	1.5 to 2.5	1.0 to 1.5	1.0 to 1.2
Cushioning	1.1 to 2.0	1.2 to 1.5	1.0 to 2.0	1.0 to 1.2
Unpaved roads	1.1 to 2.0	1.5 to 2.5	1.0 to 1.5	1.0 to 1.2
Walls	1.1 to 2.0	2.0 to 4.0	1.0 to 1.5	1.0 to 1.3
Embankments	1.1 to 2.0	2.0 to 3.5	1.0 to 1.5	1.0 to 1.3
Bearing capacity	1.1 to 2.0	2.0 to 4.0	1.0 to 1.5	1.0 to 1.3
Slope stabilization	1.1 to 1.5	2.0 to 3.0	1.0 to 1.5	1.0 to 1.3
Pavement overlays	1.1 to 1.5	1.0 to 2.0	1.0 to 1.5	1.0 to 1.1
Railroads (filter/sep.)	1.5 to 3.0	1.0 to 1.5	1.5 to 2.0	1.0 to 1.2
Flexible forms	1.1 to 1.5	1.5 to 3.0	1.0 to 1.5	1.0 to 1.1
Silt fences	1.1 to 1.5	1.5 to 2.5	1.0 to 1.5	1.0 to 1.1

\*The low end of the range refers to applications which have relatively short service lifetimes and/or situations where creep deformations are not critical to the overall system performance.

where

$T_{\text{allow}}$  = allowable tensile strength,  
 $T_{\text{ult}}$  = ultimate tensile strength,  
 $RF_{ID}$  = reduction factor for installation damage,  
 $RF_{CR}$  = reduction factor for creep,  
 $RF_{CD}$  = reduction factor for chemical degradation,  
 $RF_{BD}$  = reduction factor for biological degradation, and  
 $PIRF$  = value of cumulative reduction factors.

Note that Eq. (2.24a) could have included additional site-specific terms, such as reduction factors for seams and intentionally made holes. It also could have been formulated with fractional multipliers (values  $\leq 1.0$ ) placed in the numerator of the equation or on the opposite side of the equation, as with the *load-factor design method*. It has been put in this form following other studies (e.g., Voskamp and Risseuw [63]). While the equation indicates tensile strength, it can be applied to burst strength, tear strength, puncture strength, impact strength, and so on.

## 2.4.2 Flow-Related Problems

For problems dealing with flow through or within a geotextile, such as filtration and drainage applications, the formulation of the allowable values takes the following form. Typical values for reduction factors are given in Table 2.12. Note that these values must be tempered by the site-specific conditions, as in Section 2.4.1. If the laboratory test includes the mechanism listed, it appears in the equation as a value of 1.0.

$$q_{\text{allow}} = q_{\text{ult}} \left( \frac{1}{RF_{SCB} \times RF_{CR} \times RF_{IN} \times RF_{CC} \times RF_{BC}} \right) \quad (2.25a)$$

Attachment A (2/5)



(upper-bound) assumptions stated above. The tensile force being mobilized is related to the pressure exerted on the stone as follows [64].

$$T_{\text{reqd}} = p'(d_v)^2[f(\epsilon)] \quad (2.29)$$

where

- $T_{\text{reqd}}$  = required grab tensile force;
- $p'$  = applied pressure;
- $d_v$  = maximum void diameter  $\approx 0.33 d_a$ , where
- $d_a$  = average stone diameter; and
- $f(\epsilon)$  = strain function of the deformed geotextile;  
 $= \frac{1}{4} \left( \frac{2y}{b} + \frac{b}{2y} \right)$ , where
- $b$  = width of stone void, and
- $y$  = deformation into stone void.

Example 2.8 illustrates the design procedure above.

### Example 2.8

Given a 700 kPa truck-tire inflation pressure on a stone-base course consisting of 50 mm maximum-size stone with a geotextile beneath it, calculate (a) the required grab tensile stress on the geotextile, and (b) the factor of safety for a geotextile whose grab strength at 33% is 500 N with cumulative reduction factors of 2.5 and  $f(\epsilon) = 0.52$ .

**Solution:** (a) Using an empirical relationship that  $d_v = 0.33 d_a$  and  $f(\epsilon) = 0.52$ , the required grab tensile strength from Eq. (2.29) is as follows.

$$\begin{aligned} T_{\text{reqd}} &= p'(d_v)^2(0.52) \\ &= p'(0.33d_a)^2(0.52) \\ &= 0.057 p' d_a^2 \\ &= 0.057(700)(1000)(0.050)^2 \\ &= 100 \text{ N} \end{aligned}$$

(b) The factor of safety for a 500 N grab tensile geotextile at 33% strain with cumulative reduction factors of 2.5 is as follows.

$$\begin{aligned} \text{FS} &= \frac{T_{\text{allow}}}{T_{\text{reqd}}} \\ &= \frac{500/2.5}{100} \\ &= 2.0 \quad \text{which is acceptable.} \end{aligned}$$

### 2.5.4 Puncture Resistance

The geotextile must survive the installation process. This is not just related to the function of separation; indeed, fabric survivability is critical in all types of applications—without it the best of designs are futile (recall Figure 2.19). In this regard, sharp stones,

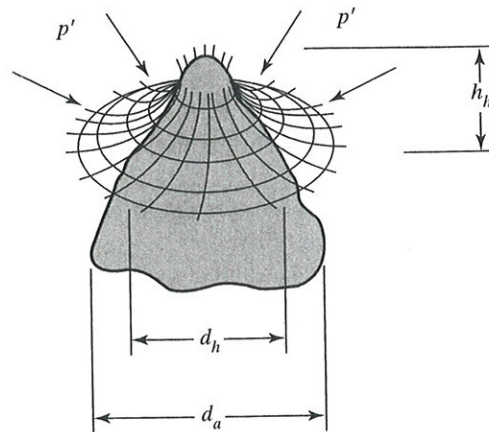
(Attachment A, 3/5)

process acting on the geotextile in the mode: tensile stress is locked into position it. A lateral or in-plane force of aggregate is forced along the grab tensile force we can estimate the stone wedges itself down where  $S \sim d/2$  and  $l_f =$  deformation or stone breakage can

is independent of particle size 33% given the idealized

2.30 Geotextile being subjected to tensile stress as surface pressure is applied and stone base attempts to spread laterally.





**Figure 2.31** Visualization of a stone puncturing a geotextile as pressure is applied from above.

tree stumps, roots, miscellaneous debris, and other items, either on the ground surface beneath the geotextile or placed above it, could puncture through the geotextile after backfilling and traffic loads are imposed. The design method suggested for this situation is shown schematically in Figure 2.31. For these conditions, the vertical force exerted on the geotextile (which is gradually tightening around the protruding object) is as follows:

$$F_{\text{reqd}} = p' d_a^2 S_1 S_2 S_3 \quad (2.30)$$

where

- $F_{\text{reqd}}$  = required vertical force to be resisted;
- $d_a$  = average diameter of the puncturing aggregate or sharp object;
- $p'$  = pressure exerted on the geotextile (approximately 100% of tire inflation pressure at the ground surface for thin covering thicknesses);
- $S_1$  = protrusion factor =  $h_h/d_a$ ;
- $h_h$  = protrusion height  $\leq d_a$ ;
- $S_2$  = scale factor to adjust the ASTM D4833 puncture test value (which uses an 8.0 mm diameter puncture probe) to the diameter of the actual puncturing object =  $d_{\text{probe}}/d_a$ ;
- $S_3$  = shape factor to adjust the ASTM D4833 flat puncture probe to the actual shape of puncturing object =  $1 - A_p/A_c$  (values for  $A_p/A_c$  range from 0.8 for rounded sand, to 0.7 for run-of-bank gravel, to 0.4 for crushed rock, to 0.3 for shot rock);
- $A_p$  = projected area of puncturing particle;
- $A_c$  = area of smallest circumscribed circle around puncturing particle.

#### Example 2.9

What is the factor of safety against puncture of a geotextile from a 50 mm stone on the ground surface mobilized by a loaded truck with a tire inflation pressure of 550 kPa traveling on the surface of the base course? The geotextile has an ultimate puncture strength of 200 N, according to ASTM D4833.


(Attachment A 4/5)



**Solution:** Using the full stress on the geotextile of 550 kPa and the values 0.33, 0.15, and 0.6 for the factors  $S_1$ ,  $S_2$ , and  $S_3$ , respectively,

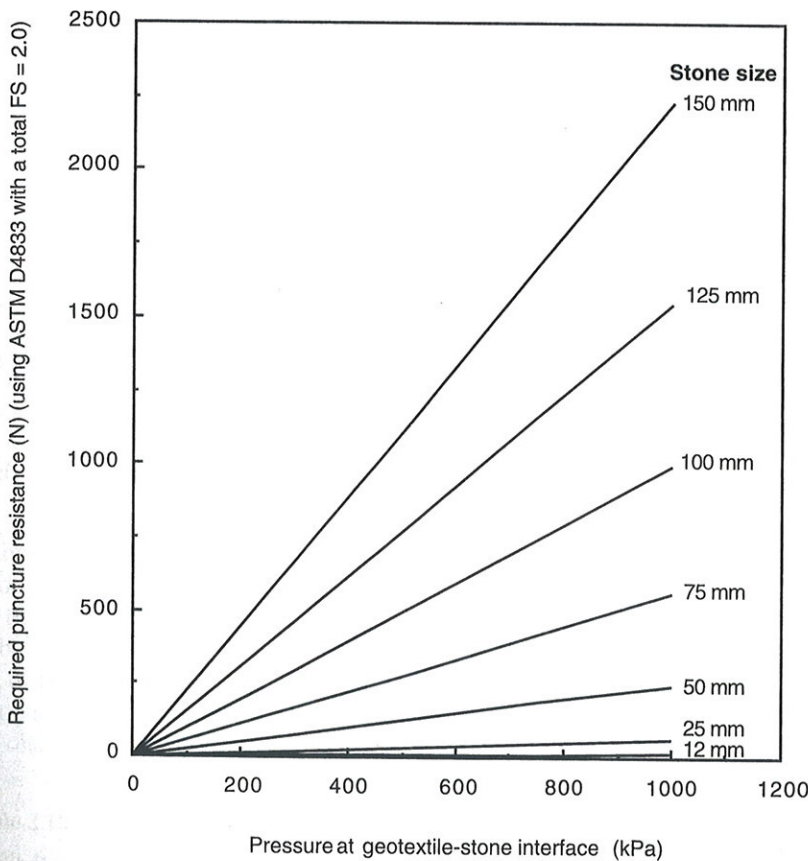
$$\begin{aligned} F_{\text{reqd}} &= p'd_a^2 S_1 S_2 S_3 \\ &= (550)(1000)(50 \times 0.001)^2 (0.33)(0.15)(0.6) \\ &= 40.8 \text{ N} \end{aligned}$$

Assuming that the cumulative reduction factors are 2.0, the factor of safety is as follows:



$$\begin{aligned} FS &= \frac{F_{\text{allow}}}{F_{\text{reqd}}} \\ &= \frac{200/2.0}{40.8} \\ &= 2.4 \quad \text{which is acceptable} \end{aligned}$$

Using the following assumptions (which can be modified as desired), a design guide can be developed as shown in Figure 2.32: the geotextile has an angular subgrade



**Figure 2.32** Puncture resistance design guide based on cumulative reduction factors of 2.0, a factor of safety of 2.0, and conditions stated in text.

(Attachment A, 5/5)

**ATTACHMENT D**  
**Revised Geocomposite Equivalency Calculation**



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Client: Parsons Project: BRC CAMU Project/Proposal No.: HL0389 Task No.: 02

**DRAINAGE COMPOSITE EQUIVALENCY DEMONSTRATION  
BRC CAMU  
HENDERSON, NEVADA**

**OBJECTIVE**

The objective of this analysis is to evaluate the hydraulic performance of a drainage composite, and compare it to the prescriptive leachate collection layer, consisting of drainage aggregate, within the BRC CAMU. A drainage composite, consisting of two 8 oz/sy nonwoven geotextiles bonded to either side of a geonet, is proposed. This analysis will demonstrate equivalence or performance exceedance of the drainage composite to the prescriptive 1-foot thick (0.3m) aggregate drainage layer. The method of analysis will compare the current transmissivity of the aggregate drainage layer and the equivalent transmissivity of the drainage composite.

**SUMMARY OF ANALYSIS**

The calculations suggest that a drainage composite having a transmissivity of  $9.2 \times 10^{-5} \text{ m}^2/\text{sec}$ , at a maximum stress of 12,000 psf (574 kN/m<sup>2</sup>) and a hydraulic gradient of 0.10, will provide equivalence to the aggregate drainage layer.

**METHOD OF ANALYSIS**

The analysis was performed using procedures recommended by Koerner (1994). The procedure first evaluates the flow rate (transmissivity) through the aggregate drainage layer, using the basic flow equation described by Darcy, and then calculates the equivalent flow rate (transmissivity) of the drainage composite, and includes appropriate partial factors of safety for geosynthetic materials.

**ANALYSIS**

This calculation evaluates the flow rate within the drainage composite.

• **FLOW RATE (TRANSMISSIVITY) OF THE AGGREGATE DRAINAGE LAYER**

The maximum flow rate within the leachate collection zone is determined from Darcy's Law by the equation:

$$q = K i A$$



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where:

$q$  = flow rate within the leachate collection layer ( $\text{m}^3/\text{sec}$ )

$K$  = hydraulic conductivity ( $\text{m}/\text{sec}$ )

$i$  = hydraulic gradient (dimensionless)

$A$  = area of flux ( $\text{m}^2$ )

The following properties will be used for the aggregate drainage layer material.

$$K = 1 \times 10^{-2} \text{ cm/sec} = 1 \times 10^{-4} \text{ m/sec.}$$

$$i = 0.02 \text{ (minimum slope of base liner system)}$$

$$A = (1 \text{ ft} \times 1 \text{ ft}) = 1 \text{ ft}^2 = 0.093 \text{ m}^2$$

The hydraulic conductivity is the prescriptive minimum value for the aggregate drainage layer, and the hydraulic gradient is a function of the minimum base slope of the cell. The area of flux is based on the unit thickness of the aggregate drainage layer (1 foot minimum).

Therefore,

$$\begin{aligned} q_{\text{req}} &= (1 \times 10^{-4} \text{ m/sec.})(0.02)(0.093 \text{ m}^2) \\ &= 1.86 \times 10^{-7} \text{ m}^3/\text{sec} \end{aligned}$$

This maximum flow rate through the aggregate drainage layer, is the required flow through the drainage composite ( $q_{\text{req}}$ ).

The allowable flow rate is obtained from laboratory testing for design purposes. This value is determined using appropriate safety factors against the required flow rate. The factor of safety is expressed as the ratio of the allowable flow rate ( $q_{\text{all}}$ ) to the required flow rate ( $q_{\text{req}}$ ).

$$FS = q_{\text{all}} / q_{\text{req}}$$

Similarly, the factor of safety equation can be expressed as the ratio of allowable to required in plane flow, transmissivity ( $\theta$ ), where the factor of safety equals:

$$FS = \theta_{\text{all}} / \theta_{\text{req}}$$

Where the transmissivity is calculated by:

$$\theta_{\text{req}} = q_{\text{req}} / (i \times W) \quad (\text{Attachment A})$$



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$W = \text{unit width of the drainage layer} = 1 \text{ ft} = 0.3408 \text{ m}$

Therefore,

$$\theta_{\text{req}} = \frac{(1.86 \times 10^{-7} \text{ m}^3/\text{sec})}{(0.3048 \text{ m})(0.02)}$$

$$= 3.05 \times 10^{-5} \text{ m}^2/\text{sec}.$$

The transmissivity of the aggregate drainage layer then becomes the minimum required transmissivity ( $\theta_{\text{req}}$ ) of the drainage composite.

#### • TRANSMISSIVITY OF THE DRAINAGE COMPOSITE

To ensure that the transmissivity of the proposed drainage composite meets or exceeds the required values over the life of the landfill, the required transmissivity must be increased through the use of appropriate partial factors of safety. These partial factors of safety make the adequate adjustment between the laboratory transmissivity values for drainage composite and actual field conditions.

As seen in Attachment A, Koerner suggests four factors of safety which should be accounted for: the intrusion of the adjacent geotextile into the core of the geonet ( $FS_{\text{IN}}$ ), creep deformation of the geonet ( $FS_{\text{CR}}$ ), factor of safety against chemical clogging of the geonet ( $FS_{\text{CC}}$ ), and factor of safety against biological clogging of the geonet ( $FS_{\text{BC}}$ ). Partial factor of safety values were applied to the geotextile in the filtration geotextile calculation to account for flow through the geotextile component of the drainage composite.

Attachment A shows the ranges for the partial factors of safety. For the purposes of the calculations made, the factors of safety were assumed to be:

$FS_{\text{IN}} = 1.0$  (Accounted for during the testing of the drainage composite)

$FS_{\text{CR}} = 2.0$

$FS_{\text{CC}} = 1.5$

$FS_{\text{BC}} = 1.0$  (Accounted for in the Filter Calculation)

The ultimate transmissivity of the drainage composite then becomes:

$$\theta_{\text{ultimate}} = \theta_{\text{req}} * (\Sigma FS)$$



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$\Sigma$  FS = product of all the partial factors of safety for the site specific conditions

The ultimate transmissivity of the drainage composite is then calculated as:

$$\begin{aligned}\theta_{\text{geonct}} &= \theta_{\text{req}} * (\Sigma \text{ FS}) = 3.05 * 10^{-5} \text{ m}^2/\text{sec} [1.0 * 2.0 * 1.5 * 1.0] \\ &= 9.2 * 10^{-5} \text{ m}^2/\text{sec}\end{aligned}$$

- **MAXIMUM STRESS**

The maximum height of the waste fill is 60 ft (18.3 m). Assuming a unit weight of 136 pcf and a factor of safety of 1.5, this translates to a overburden stress of approximately 12,000 psf (574 kPa).

- **CONCLUSIONS**

The required transmissivity of the geocomposite shall be  $9.2 * 10^{-5} \text{ m}^2/\text{sec}$  at a maximum stress of 12,000 psf and a gradient of 0.1.

## **REFERENCES**

Koerner, R.M. (1994) "Designing with Geosynthetics", 3rd Edition, Prentice Hall, New Jersey (*Attachment A*)



transportation-related systems, such as roads and walls, the problem does not appear to be too serious. In waste leachate related systems (e.g., landfill leachate collection systems), it might be another story. At the bottom of a landfill, temperatures are high, ample carbon (as a biological food source) is available, and bacteria and fungi could indeed thrive. Whether oxygen is available or not only dictates whether aerobic or anaerobic conditions prevail. No data regarding microorganisms in geonets are presently available, although research is currently ongoing. Procedurally, one must use a high flow rate factor of safety, or have systems designed so that flushing is possible. This area begs for future inquiry.

The last environmental consideration, resistance to light and weather, is not felt to be a serious concern for most situations in which geonets are used. Polyethylene is resistant to weather-related degradation, and carbon black is included in all of the known products. Nevertheless geonets should be covered as soon as possible after placement.

#### 4.1.6 Allowable Flow Rate

As described previously, the essence of the design-by-function concept is the establishment of an adequate global factor of safety. For geonets, where flow rate is the primary function, this takes the following form:

$$FS = \frac{q_{allow}}{q_{req}} \quad (4.3)$$

where  $FS$  = the global factor of safety (to handle unknown loading conditions or uncertainties in design methods, etc.),  
 $q_{allow}$  = the allowable flow rate as obtained from laboratory testing, and  
 $q_{req}$  = the required flow rate as obtained from design of the actual system.

Alternatively, one could also work from a transmissivity basis to obtain the equivalent relationship.

$$FS = \frac{\theta_{allow}}{\theta_{req}} \quad (4.4)$$

where  $\theta$  is the transmissivity under similar definitions as above. As described previously, however, it is preferable to design with flow rate rather than transmissivity because of nonlaminar flow conditions in geonets.

Concerning the allowable value, which comes from hydraulic testing of the type just described, one must assess the realism of the test setup in contrast to the actual field system. If it does not model real life adequately, then some adjustments to the laboratory value must be made. This is often the case. Thus the laboratory-

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ATTACHMENT A, #1/2

3/14/79

Table 4.2 Recommended preliminary factor of safety values for determining allowable flow rate or transmissivity of geonets

Application Area	Partial Factor of Safety Value in Equation 4.5			
	$FS_{IN}$	$FS_{CR}^*$	$FS_{CC}$	$FS_{BC}$
Sport fields	1.0 to 1.2	1.0 to 1.5	1.0 to 1.2	1.1 to 1.3
Capillary breaks	1.1 to 1.3	1.0 to 1.2	1.1 to 1.5	1.1 to 1.3
Roof and plaza decks	1.2 to 1.4	1.0 to 1.2	1.0 to 1.2	1.1 to 1.3
Retaining walls, seeping rock and soil slopes	1.3 to 1.5	1.2 to 1.4	1.1 to 1.5	1.0 to 1.5
Drainage blankets	1.3 to 1.5	1.2 to 1.4	1.0 to 1.2	1.0 to 1.2
Surface water drains for landfill caps	1.3 to 1.5	1.2 to 1.4	1.0 to 1.2	1.2 to 1.5
Secondary leachate collection (landfills)	1.5 to 2.0	1.4 to 2.0	1.5 to 2.0	1.5 to 2.0
Primary leachate collection (landfills)	1.5 to 2.0	1.4 to 2.0	1.5 to 2.0	1.5 to 2.0 *

\*These values assume that the  $q_w$  value was obtained using an applied normal pressure of 1.5 to 2 times the field-anticipated maximum value. If not, values must be increased.

done at the proper design load and hydraulic gradient and that this testing yielded a short-term between-rigid-plates value of 1.2 gal./min.-ft.

**Solution:** Since better information is not known, average values from Table 4.2 are used.

$$\begin{aligned}
 q_{allow} &= q_{ult} \left[ \frac{1}{FS_{IN} \times FS_{CR} \times FS_{CC} \times FS_{BC}} \right] \quad (4.5) \\
 &= 1.2 \left[ \frac{1}{1.1 \times 1.1 \times 1.1 \times 1.2} \right] \\
 &= 1.2 \left[ \frac{1}{1.60} \right] \\
 &= 0.75 \text{ gal./min.-ft.}
 \end{aligned}$$

#### Example:

What is the allowable geonet flow rate to be used in the design of a secondary leachate collection system? Assume that laboratory testing at proper design load and proper hydraulic gradient gave a short-term between-rigid-plates value of 1.2 gal./min.-ft.

**Solution:** Average values from Table 4.2 are used; however, note the large reduction.

## 4.2 DESIGNING FC

This section will discuss designing for geonets in a transportation-related field.

### 4.2.1 Theoretical

Design by function

For geonets see the aforementioned

where  $q_{allow} = 1$   
 $q_{reqd} = 1$

As stated previously, for saturated conditions, the flow rate, name of equations 4.1 and

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5mm  
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