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23 January 2008

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

Subject: Response to Interim CAMU Design Review Report No. 2
BMI Industrial Complex Remediation Design Review
Henderson, Nevada
Geosyntec Project: SC0313

Dear Mr. Rakvica:

On behalf of Basic Remediation Company (BRC), Geosyntec Consultants (Geosyntec) hereby responds to the 14 January 2008 letter written by Applied Soil Water Technologies, LLC (ASW) to Nevada Department of Environmental Protection (NDEP) regarding the Interim CAMU Design Review. The ASW review focused on the following aspects of the CAMU design:

- Geotextile Separation/Filtration Review;
- Geocomposite Equivalency;
- HELP Model Results;
- Sump Capacity;
- Vadose Zone Monitoring; and
- Grading Plan.

For ease of review, the ASW's discussion will be repeated in italics with Geosyntec's response following.

Geotextile Separation/Filtration Review

Discussion

The design calculations entail three functions, separation, water permittivity and filtration.

We generally agree with the approach and conclusions associated with permittivity and filtration. However we have the following comments;

- *The calculations were based on the assumption that the operations layer would be two-feet thick and comprised of "…on-site material, which has been* *classified as silty sand to well-graded sand (SM, SM-SW according to the Unified Soil Classification System…". Laboratory hydraulic conductivity data from work performed by Converse Consultants presented in their 1999 report was used in the calculations.*

- *The current specifications indicate that the operations layer will be comprised of soils derived from East Side Area and Western Ditch Materials as indicated in the Technical Specification. These materials are described in the Technical Specifications, Section 02205. It is not clear if these materials are consistent with the assumptions used in the calculations, specifically;*
  - *With respect to filtration, the finest soil criteria was used to select the minimum AOS sieve size so it should not be impacted by a difference in soil type, however, it should be acknowledged during construction,*

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 a higher hydraulic conductivity soil. Soil from the Western Ditch will likely be used for operations layer for a majority of the project and is generally a well graded to silty sand material that meets with the design intent. Soils excavated from the Eastside Area will entail silts (represented in GES investigation of silts and sludge materials from Eastside Area) and underlying sandy silt materials that will be mixed during the excavation process (silts are generally thin deposits that will be removed in the total 4 foot thickness of silt and soil mixture) that meets the design intent. Although we agree that the text of the calculation package indicates well graded and silty sand materials will be used, the assumptions in the calculation are sufficiently conservative to allow for finer grained materials to be used as operations layer.

  - *The hydraulic conductivity used in the calculations, 1.2 x 10^{-3} centimeters per second (cm/sec) is most likely conservatively high, however, this should be verified during construction. If soils with a higher hydraulic conductivity are encountered they should not be placed in the operations layer.*

We agree with the factors of safety used in the required permittivity calculations.

Based on our understanding of the soil materials available for use on-site (native or waste materials), clean sands or gravels are not available for use as operations layer and agree that the assumed hydraulic conductivity is conservative. Therefore, we do not believe that hydraulic conductivity testing during construction is warranted.

With respect to separation and related durability of the geotextile we have the following comments;

- *In specifying the required mechanical properties of the geotextile the "…mechanical properties of geotextiles used in applications requiring moderate survivability…" were used. In our opinion, at minimum the*

> *requirements for a geotextile requiring “high survivability” should be used in reference to AASHTO Task Force 25 recommendations used in the calculations.*

The required degree of survivability is based on the subgrade conditions and the construction equipment. Based on the subgrade preparation requirements outlined in the Technical Specifications Section 02200, performance of construction quality assurance, and the limitation of equipment ground pressure on soils overlying the geotextile, moderate survivability geotextile is adequate (Koerner, 1998).

<u>Project Specifications</u>

- *The mechanical material properties referenced in the calculation package include;*
    - *Grab Strength* ≥ *130 lb.*
    - *Puncture Strength* ≥ *40 lb*
    - *Mullen Burst* ≥ *210 lb*
    - *Trapezoidal Tear* ≥ *40 lb*
    - *Ultraviolet Strength Retention* ≥*70%*
- *The project mechanical specifications require;*
    - *Grab Strength* ≥ *190 lb*
    - *Puncture Strength* ≥*110 lb*

> *The designer should justify the omission of at least mullen burst and trapezoidal tear from the project specifications or they should be included.*

Mullen burst and trapezoidal tear properties have been added to the Technical Specifications.

> *The designer should also verify that the test methods used to develop the AASHTO Task 25 values are the same test methods used in the project specifications.*

AASHTO Task 25 values were obtained with the following ASTM test methods:

ASTM D4632 – Standard Test Method for Breaking Load and Elongation of Geotextile (Grab Method)

ASTM D4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextile

ASTM D4833 – Standard Test Method for Index Puncture Resistance of Geotextile, Geomembranes, and Related Products

These methods are the same methods identified for testing geotextile in Section 02771 of the Technical Specifications.

- *The permittivity requirement from the calculation package is;*
    - *≥ 0.57 sec^{-1}*

- *The project permittivity specification is;*
    - *≥0.6 l/sec*

  The designer should verify that the permittivity value specified in the project's technical specifications meets the minimum required in the calculation package.

The project specification for permittivity of the filter geotextile is specified as 0.6 sec^{-1}, which greater than the permittivity requirement from the calculation package.

- *The project's technical specifications do not specify the polymer that the geotextile shall be manufactured from. The designer should specify a polymer or polymers that are compatible with the waste.*

Due to pricing, non-woven geotextiles used in the construction industry that are available in the United States are manufactured using polypropylene. Non-woven geotextiles manufactured from other polymers, which meet the requirements of the Technical Specifications, would be acceptable for use on this project.

Geocomposite Equivalency Review

<u>Discussion</u>
We agree with the calculation method as proposed by Koerner (1994) and, when using the same criteria, arrived at the same result.

<u>Equivalency Partial Factors of Safety</u>
According to the calculation method four partial factors of safety are accounted for in determining equivalency. These factors of safety include, the factor of safety due to intrusion of the adjacent geotextile into the core of the geonet (FS_{IN}), the factor of safety for creep deformation of the geonet (FS_{CR}), the factor of safety against chemical clogging of the geonet (FS_{CC}), and the factor of safety against biological clogging of the geonet (FS_{BC}).

The partial factors of safety used for the equivalency calculation for this project are as follows: FS_{IN} = 1.0, FS_{CR} = 2.0, FS_{CC} = 1.0 and FS_{BC} =1.0. According to the design method, the recommended range of partial factors of safety at 1.5 to 2.0 times the maximum anticipated stress on the geocomposite are FS_{IN} = 1.5 to 2.0, FS_{CR} = 1.4 to 2.0, FS_{CC} = 1.5 to 2.0 and FS_{BC} =1.5 to 2.0.

It was noted in the design calculations package that the lower factors of safety used were due to factors of safety being accounted for in other related calculations and/or during the anticipated testing of the drainage composite. ASW is requesting for *clarification on how the redundant factors of safety were applied in the equivalency calculations.*

The transmissivity testing outlined in the Technical Specifications requires the use of operations layer soil and a loading of 24 hours, which will effectively model the intrusion of the geotextile into the geonet and therefore the factor of safety was selected as 1.0. The factor of safety for creep was maximized to be conservative. 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. The factor of safety for biological clogging was selected to be 1.0 as the waste material does not contain biodegradable materials that would provide a source of food for biological growth. Furthermore, the geotextile filtration calculation accounts for partial factor of safety values for clogging.

Hydraulic Gradient
The hydraulic gradient used in the flow rate calculation in evaluating a prescriptive aggregate drainage layer was i= 0.02 (minimum slope of base liner system). In the calculation package a hand correction was made changing the hydraulic gradient from 0.02 to 0.10. ASW is requesting that support be provided for this correction.

The hydraulic gradient in the calculation package was changed from 0.02 to 0.10 to facilitate laboratory testing. The minimum, realistic hydraulic gradient achievable in a lab setting is typically 0.10. In addition, because hydraulic gradient is inversely proportional to transmissivity, this generates a more conservative value.

Maximum Stress
In the calculation package an anticipated maximum height of the waste fill is expected to be 60-feet. According to our review of the construction drawings the anticipated height of the waste fill including the final cover system is anticipated to be between 75-feet to 90-feet in the Phase I and Phase II portion of the facility.

The maximum height will be between 75 feet and 90 feet in Phases I and II. The calculation has been revised and is included as an attachment to this letter.

Project Specifications
For the base liner system the project's technical specifications require that the normal load applied to the system during transmissivity testing is only 7,000 psf. The normal load required in the technical specifications should be consistent with the design calculations.

The Technical Specifications have been updated to reflect a normal stress of 12,000 psf.

HELP Model Results

A review of the Hydrologic Evaluation of Landfill Performance (HELP) model results was performed.

> *Discussion*
>
> *Due to the overall intent of the design, to minimize the infiltration of water into the CAMU facility upon completion of construction, we are in agreement that the modeling should be performed to accommodate liquid introduced to the area within containment during construction activities to provide a worst case scenario event. However, it is our opinion that that the HELP model might not present the best interpretation of a high intensity short duration storm event that is typical of the project area. Especially since the evaluated area is in containment and any surface runoff would eventually report to the LCRS. Additionally the HELP model accounts for evaporation and evapotranspiration which would also provide less conservative results.*

Geosyntec agrees that runoff should not be accounted for in the HELP modeling. However, the pipe size does not need to be increased since the 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. The current model presented in the RAP accounts for no evapotranspiration with a leaf area index set to 0. Evaporation in the model is set to 18 inches, which is considered conservative for the project area.

> *It should also be noted that according to the design report, the 25 year 24 hour storm event is anticipated to generate 2.3-inches of precipitation.*

The HELP modeling was evaluated over a 20 year period using a worst case condition of the first shovel full of waste having been placed in the lined area (HELP model was set up with no waste). The modeling resulted in a peak daily rain event of 1.83 inches. As the waste placement in the cells will occur over a short period of time (greater than 5,000 CY per day waste placement is anticipated), it is highly unlikely that the cell will be fully exposed to a rain event of this magnitude without having waste placement well underway.

Sump Capacity

A review of the sump capacity was performed.

> *Discussion*
>
> *Sump Volumes*
>
> *Regarding the peak daily flows for the sumps evaluated, it is unclear as to what values were used to calculate those volumes. ASW is requesting that the variables for the sump calculations be presented for clarification.*

The average daily values used in the sump sizing calculations were based on the average annual totals (average annual total/365 days/year). The following table presents the sump calculation values:

Location	Average Yearly Drainage Collected (cu. ft.)	Area (acre)	Annual Total (cu.ft.)	Average Daily Value (cu. ft.)	Sump
Unit 1	3244	3.34	10835.0	29.7	1
Unit 2	1817	5.98	10865.7	29.8	1
Unit 3	1655	10.9	18039.5	49.4	2
Unit 4	1818	11.9	21634.2	59.3	2
Unit 5	1770	13.3	23541.0	64.5	3
Unit A	14113	2.84	40080.9	109.8	1
Unit B	14115	3.15	44462.3	121.8	2

Therefore the totals for Sumps 1, 2, and 3 are as follows:

Sump 1 = 29.7 ft^3 + 29.8 ft^3 + 110 ft^3 = 169 ft^3

Sump 2 = 49.4 ft^3 + 59.3 ft^3 + 122 ft^3 = 231 ft^3

Sump 3 = 64.5 ft^3 = 65 ft^3

The three sumps have since been split into four sumps, with sump 2 now becoming two different sumps. This provides for a conservative sump sizing as sump 2 was used to calculate the size of all of the sumps in the calculation package. When runoff is included in these values, the sump designs are still conservative with the following values:

	Average Yearly Drainage Collected (cu. ft.)	Average Yearly Runoff Collected (cu. ft.)	Area (acre)	Annual Total (cu.ft.)	Average Daily Value (cu. ft.)	Sump
Unit 1	3244	19	3.34	10898.4	29.9	1
Unit 2	1817	17	5.98	10967.3	30.0	1
Unit 3	1655	13	10.9	18181.2	49.8	2
Unit 4	1818	16	11.9	21824.6	59.8	2
Unit 5	1770	15	13.3	23740.5	65.0	3
Unit A	14113	18	2.84	40132.0	110.0	1
Unit B	14115	19	3.15	44522.1	122.0	2

The totals for sumps 1, 2, and 3 with runoff included are 169 ft^3, 231 ft^3, and 65 ft^3, respectively.

Maximum Head on Liner System

> *The leachate storage calculation in the drainage layer allows for the leachate pool to extend approximately 50 feet from the sump while allowing a maximum head of 1 foot on the liner system. Therefore there will be a minimum of 2 feet of head on top of the liner system in the sumps. We do understand that a vadose zone monitoring system will be installed beneath the sumps. However, we recommend that the technical specifications outline the importance for the contractor to remove water from the sumps in a timely fashion minimize the head on the liner in and around the sump locations.*
>
> *The operations manual and monitoring requirements should also emphasize this point.*

Section 01500, Part 1.24.A.5 of the technical specifications requires the contractor to not allow the liquid level in the sump to exceed 3 feet (2 foot deep sump plus 1 foot depth over lined area adjacent to sump).

> *Sump Locations*
> *It should also be noted that according to the construction drawings there will be a total of four sumps installed within the CAMU facility whereas the sump calculations considered three different sump locations.*

The additional sump has divided two previous areas flowing into one sump. Since the sumps have all been sized the same to account for the largest amount of leachate collected, the new sump is conservatively large.

Vadose Zone Monitoring System
A review of the vadose monitoring system was performed.

> *According to the construction drawings sheet No. 36 of 45, Details-LCRS, details are not provided for the vadose zone monitoring pipe installation and associated components. It is not clear in the drawings whether there is secondary containment provided beneath the collection pipe. If a resistive barrier is intended beneath the vadose zone monitoring collection pipe then details should be provided.*

The vadose zone monitoring sump is to be lined with 60 mil HDPE geomembrane.

Grading Plan
A review of the grading plan presented in the construction drawings was performed.

Discussion

> *The grading plan at the base of the landfill appears to be adequate based on the major design premise that there will be minimal leachate generation.*
>
> *During construction and prior to completion of the final cover there is the potential for water to be collected at various portions of the facility and pool (e.g. the south side of Phase 1 prior to completion of Phase 2). It is our opinion that a design storm should be agreed on that will need to be accounted for during construction and during the*

interim stage prior to completion of the final cover. After this storm is agreed on either;

1. *The Owner retains a firm to prepare a detailed storm water control plan that accounts for various stages of construction and details the approximate volume of water that could be generated within the landfill and how the water should be handled, or*
2. *A detailed specification and separate bid item be prepared and added to the contract that clearly defines the contractors responsibilities with respect to storm water control that includes at a minimum the items listed in 1 above.*

Section 01500 of the technical specifications requires the Contractor to prepare a Water Management plan describing methods of handling water in CAMU cells and other excavation areas.

Interim cover composed on non-contaminated material is specified to be placed over the waste in areas where storm water has the potential to wash landfilled material off of the lined area. Consideration should also be given to the potential for stormwater flows to concentrate at the haul roads and wash material off of the lined area.

Section 01500 of the technical specifications requires the Contractor to prepare a Water Management plan describing methods of handling water in CAMU cells and other excavation areas. Also, the Contractor is required to develop a storm water pollution prevent plan which will address concerns of stormwater flows over the haul roads and lined areas.

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

Sincerely,

Digitally signed by Greg Corcoran
DN: CN = Greg Corcoran, C = US, O = Geosyntec, OU = San Diego
Date: 2008.01.22 22:06:40 -08'00'

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

Gregory T. Corcoran, P.E.
Principal

Attachments: Revised Technical Specifications
Revised Geocomposite Equivalency Calculation Package

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