Engineering for a Better World
FEEZOR
ENGINEERING, INC.

September 10, 2013

Ms. Charlene S. Fitch, P.E.
Chief, Engineering Section
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102-0176

Mr. Brandon Doster, P.E.
Chief, Federal Facilities Section

RE: North Quarry Contingency Plan — Part 2, Bridgeton Landfill, LLC, Permit Number 0118912, St. Louis County – Response to August 20, 2013 Comments Gamma Cone Penetration Test Work Plan and Gamma Cone Penetration Test Health and Safety Plan

Dear Ms. Fitch and Mr. Doster:

On behalf of our client, Bridgeton Landfill, LLC (hereinafter Bridgeton Landfill), Feezor Engineering, Inc (FEI) hereby submits revised versions of the *Gamma Cone Penetration Test Work Plan* and the *Gamma Cone Penetration Test Health and Safety Plan* based upon comments received by the Missouri Department of Natural Resources (MDNR), the Missouri Department of Health and Senior Services (MDHSS) and the U.S. Environmental Protection Agency (USEPA) on August 20, 2013. This letter lists the comments presented and provides a response to each of the 31 enumerated comments in the August 20, 2013 MDNR comment letter.

Responses contained in the letter and the two amended plans were prepared under the direction of a Missouri Professional Engineer (Daniel Feezor, P.E., MO P.E. Number E-30292). Technical contributors to these documents include P.J. Carey and Associates, P.C., Engineering Management Support, Inc., Auxier and Associates, Inc., and Civil and & Environmental Consultants, Inc.

Based upon our understanding, and discussions within the August 28, 2013 teleconference between Bridgeton Landfill, MDNR, MDHSS, and USEPA representatives, the overall approach to the Isolation Barrier investigation will consist of a two-phased investigation. The MDNR is interested in core samples, and analytical results from all eight radioisotopes. While Bridgeton Landfill has agreed to modify the original conceptual investigation plan to incorporate such sampling, the time needed to develop this entirely new set of work plans and schedules is greater than the 20 day response window. Because it is the shared interest of all parties to continue progress towards conducting the investigation, Bridgeton Landfill is submitting this Response to Comments along with

406 East Walnut Street • Chatham, IL 62629
Phone (217) 483-3118 • Fax (217) 483-2356

revised versions of the previously submitted plans, modified in response to agency comments, within the 20 day response time frame. As discussed within the August 28, 2013 teleconference, Bridgeton Landfill is currently developing and will submit an additional Work Plan and Health and Safety Plan for the coring technology selected, which will include a Sampling and Analysis section describing the sampling frequency and the analytical methods required for the eight radioisotopes.

This comment response submission will focus on the Gamma Cone Penetration Test Work Plan and Health and Safety Plan, so this phase of the investigation can be initiated, and the initial results can be used in the Isolation Barrier Design. The GCPT can be used to determine porewater pressures developed during the penetration. Porewater pressure dissipation, after a push, can also be monitored for correlation to time rate of consolidation and permeability. Cone penetration test data can be used to interpret subsurface stratigraphy, and through use of site specific correlations, can provide data on engineering properties of soils intended for use in design and construction of earthwork projects. Therefore, this technology, coupled with the Gamma collection device, can provide the necessary design parameters for the Isolation Barrier. While the design is in progress, a confirmation sampling event (Phase 2 Investigation) can be implemented which will provide the necessary assurances that the barrier would be installed in an area that is devoid of unacceptable radiological materials.

This letter will respond to the comments included with your letter dated August 20, 2013. A revised Gamma Cone Penetration Work Plan and Gamma Cone Penetration Health and Safety Plan have been submitted for your consideration.

General Comments:

1. ***Definition of Radiological Impact Material (RIM)****. The document needs to be clear on what is meant by radiologically impacted material. The last sentence of the first paragraph of Section 4.1 of the Contingency Plan- Part 2 states, "It is proposed that the Isolation Barrier be located at the shallowest practical location outside of the radiological materials." The Appendix D- Isolation Barrier Schedule and Gamma Cone Penetration Test (GCPT) Work Plan (hereafter referred to as the "Work Plan") goes on to use the term "radiologically impacted material" followed by "above background" and elsewhere references the Supplemental Feasibility Study which calculated radiologically impacted material (RIM) as material greater than five (5) pCi/g above background. The Work Plan should use the term "radiological materials" to be consistent with the Contingency Plan Part 2 as well as the First Agreed Order, Section 22.B.iii, when discussing suitable locations for the isolation barrier. The Work Plan shall define the term "radiological materials" as any material with radiological readings above a statistically determined background concentration.*

Response:
Bridgeton Landfill continues to believe that 5 pCi/g above background is the appropriate standard for definition of radiologically impacted materials. This level, set as the level for unrestricted use for the West Lake and FUSRAP remedial actions, is appropriately protective for defining the barrier location. We are enclosing for your review a summary memo prepared by EMSI providing additional information on the protectiveness of the 5 pCi/g above background standard. Because this standard is relevant for the second phase of the investigation, coring and lab analysis, we would suggest that Phase 1, the GCPT study, move forward while we work to answer any remaining questions on this issue.

2. **Calculating Background.** *The Work Plan shall include methods to collect additional laboratory samples to establish representative radiological background levels at this site. A statistically defensible number of samples shall be collected within known uncontaminated areas to calculate background levels. The Department has previously cautioned on using a limited number of samples to calculate background levels via comments on the Supplemental Feasibility Study (SFS) Work Plan.*

Response:
This topic was also discussed in detail during the August 28, teleconference. It was agreed that a two-phased investigation approach will be conducted, a GCPT Phase, and a boring program phase. Background concentrations will not be needed for the GCPT phase, as existing impacted borings will be used to check the sensitivity of the gamma counter on the GCPT device.

The Phase 2 investigation boring program will have core samples tested for the eight radionuclides of concern. As discussed above, Radiologically Impacted Material will be defined as material which contains radionuclides at a concentration of 5 pCi/g above background. Therefore, background concentrations will have to be utilized for comparative analysis. Existing background concentrations for these radionuclides have been established as part of the West Lake Superfund Site Remedial Investigation and Feasibility Study. These background concentrations are reasonable consistent with background concentrations established and utilized for the North St. Louis County Formerly Utilized Site Remedial Action Program sites. If the existing background concentrations already established are deemed unacceptable, new background concentrations for the eight radionuclides will have to be reassessed. However, it is important to note that such an assessment will take from two to six months, creating additional delay in the completion of the evaluation.
Given the relative similarity of existing background analysis, it is not expected that a new more extensive background evaluation would result in a substantially different result. Because of the shared interest of all parties in completing the evaluation in order to continue progress with design planning and location confirmation for the thermal barrier, Bridgeton Landfill hopes to have continued discussions with MDNR on the usefulness of a time consuming new background investigation.

Should a new background evaluation be deemed necessary by MDNR, a 1,000 to 2,000 square meter area will be selected as a reference area. Gamma radiation levels and the concentrations of radionuclides of concern in this area's soil will be systematically assayed.

The surface of the area will be surveyed with a hand-held GPRSS (Global Positioning Radiometric Scanning System) to collect a representative population of surface gamma measurements. A minimum of 1,000 gamma measurements will be recorded during this survey.

MARSSIM guidance will be used to determine the number of soil samples required to characterize the reference area survey unit. A triangular reference grid with a random start-point and the proper number of nodes will be established over the survey unit. Soil samples will be collected at each node and assigned a unique identification number. These samples will be tracked using chain-of-custody records and sent to an accredited laboratory for radiological analysis. The resulting data will be validated and entered into a digital database for future use.

No edits have been included in the revised GCPT Work Plan to address this issue, as this issue will be addressed in the future Phase 2 Investigation Work Plan.

3. ***Core Samples.*** *The subsurface investigation shall include continuous soil core samples from a subset of sampling locations to verify the contents of the subsurface material encountered by the GCPT as well as to collect soil samples for laboratory confirmatory analyses. Since the GCPT will rely solely on sensors built into the cone tip, retrieval of continuous soil cores will be vital to verify the readings received from the GCPT. Core samples shall be collected near GCPT locations along the potential barrier alignments and advanced to native materials which will give the most valuable information on subsurface conditions (e.g. type of solid waste encountered), barrier construction geotechnical data as well as verification of GCPT readings. Please note that if elevated radiological readings are encountered at the first proposed alignment, additional continuous soil cores to the south may be warranted. A sonic drill rig is ideal for obtaining such continuous soil cores in these type geological conditions. The GCPT may be conducted prior to the core samples being completed. The GCPT can be conducted prior to the core sampling.*

Response:
This topic was also discussed in detail during the August 28, teleconference. It was agreed that a two-phased investigation approach will be conducted, and GCPT Phase, and a boring program phase. Further details pertaining to the Phase 2 boring program will be included in the Phase 2 Investigation Work Plan. No edits have been included in the revised GCPT Work Plan to address this issue, as this issue will be addressed in the future Phase 2 Investigation Work Plan.

4. ***Replacing Well D-14.*** *Section 4.2, first sentence of last paragraph states, "As discussed in the GCPT Work Plan, the investigation will also confirm the depth to native material and provide additional information on the general contents of the subsurface material (i.e. rock, municipal solid waste, construction and demolition waste, etc.)." Furthermore, the GCPT Work Plan, Section 3.1, fourth sentence of the first paragraph states, "In addition, information is to be collected at each location regarding the stratigraphy, nature, and geotechnical properties of the materials as well as liquid levels, as relates to the design of the barrier system." In order to obtain all necessary information regarding hydrogeology and groundwater characteristics for the design of the barrier system, the existing monitoring well D-14 shall be repaired or replaced during this investigation since it is the only well in the vicinity of the proposed barrier alignments. During recent sampling events it has been verified that monitoring well D-14 is damaged at a depth of approximately 30 feet below ground surface. This well no longer meets Missouri Well Construction Rules and therefore any data collected such as potentiometric surface is questionable. Information regarding the groundwater level, flow rates, and potential contaminants is crucial to the design of the barrier. This information will be used to determine the ideal barrier alignment, plans for dewatering of trenches, and final disposition of any water encountered during construction. Additional wells along the proposed barrier alignments may also be necessary to obtain this information.*

Response:
As explained previously, the GCPT can be used to determine porewater pressures developed during the penetration. Porewater pressure dissipation, after a push, can also be monitored for correlation to time rate of consolidation and permeability. Cone penetration test data can be used to interpret subsurface stratigraphy, and through use of site specific correlations, can provide data on engineering properties of soils intended for use in design and construction of earthwork projects. Therefore, the GCPT will provide the necessary design information for the Isolation Barrier design and allow for appropriate planning of liquids management during construction.

The subject of Well D-14 is outside the scope of this investigation. However, Bridgeton Landfill agrees that this well does not meet the Missouri Well Construction Rules. Bridgeton Landfill does not believe that this well can be repaired in any way which would meet Missouri Well Construction Rules. Upon direction of MDNR, Bridgeton Landfill is willing to properly abandon this well and to attempt to replace it within 50 feet of the existing location. However, in order to comply with Missouri Well Construction Rules and good practice to prevent cross contamination, the new well will not be drilled in refuse, and if no location can be found devoid of existing refuse for replacement, well D-14 will not have a replacement following its proper abandonment.

5. ***Alpha and Beta Emitters.*** *The Work Plan states that the GCPT will only detect gamma radiation. West Lake Landfill Operable Unit 1, Area l also contains alpha and beta emitters such as Thorium-230. In order to measure for alpha and beta emitting radionuclides, continuous soil core samples shall be collected from a subset of sample*

locations to obtain laboratory samples for radionuclide analyses, such as Thorium-230, as well as verification of gamma readings from the GCPT. See General Comment #3 for locations of continuous soil cores.

Response:
The purpose of the GCPT investigation is to identify subsurface radioactive material that may be present. The process is qualitative in nature and is not intended to be quantitative. Once the initial data is collected from the GCPT investigation (Phase 1) and a proposed location for the thermal barrier is determined, soil samples will be taken within the proposed barrier alignment to perform a more complete analysis (Phase 2).

The soil core samples will be taken immediately following the GCPT investigation in Phase 1 of the project, and will be extracted using sonic drilling, GeoProbe drilling, or other available and appropriate technologies.

The samples will be collected using Auxier Procedure 3.3. The soil samples will be taken at various depth locations of the core boring sample. Biased samples will be taken at locations of radioactivity as identified by field radiation detection instruments. Other samples will also be taken where no radiation is detected by such radiation detection instruments. This procedure will be detailed in the Phase 2 Investigation Work Plan.

6. ***Other Hazardous Substances.*** *In addition to radiological contaminants, West Lake Landfill Operable Unit 1, Area 1 has the potential for containing chemical contaminants such as volatile organic compounds, semi-volatile organic compounds, heavy metals, and hazardous substances such as asbestos. The Work Plan shall also include provisions for sampling for hazardous chemicals and substances which may pose health risks to isolation barrier workers. Such samples can be collected from the continuous soil cores as discussed in the previous comments.*

Response:
It was agreed that a two-phased investigation approach will be conducted, a GCPT Phase, and a boring program phase. Further details pertaining to the Phase 2 boring program will be included in the Phase 2 Investigation Work Plan. No edits have been included in the revised GCPT Work Plan to address this issue, as this issue will be addressed in the future Phase 2 Investigation Work Plan.

7. ***Data Comparability.*** *The Department notes that previous investigations conducted during the Remedial Investigation for Operable Unit 1 utilized other analytical methods besides gamma radiation detection to identify radiological materials. Additional analytical methods shall be included that are comparable to the historical data collection such as laboratory soil samples for Uranium-238, Uranium-235, and Thorium-232 decay chain radionuclides (see Remedial Investigation Report dated April 10, 2000). These additional analytical methods can be obtained by collecting continuous soil core samples as described in the previous comments.*

Response:
The Phase 1 Investigation will only include gamma scanning using the GCPT technology. Further details pertaining to the Phase 2 boring program (which will include core samples) will be included in the Phase 2 Investigation Work Plan. No edits have been included in the revised GCPT Work Plan to address this issue, as this issue will be addressed in the future Phase 2 Investigation Work Plan.

8. ***Sampling Locations.*** *The array of proposed GCPT sampling locations shall be extended to the newly installed perimeter fence to the south of Operable Unit 1, Area 1 in the vicinity of WL-120 to ensure that no radiological material is present on the Bridgeton Landfill side of the barrier (see Figure 3). The distance between sampling locations should be similar to those at the potential barrier alignment (i.e. same spacing as GCPT 12-1 through 16-1). If elevated radiological readings are encountered at the fence line, the sampling locations shall be continued outside the fence toward the North Quarry until the perimeter of elevated radiological readings is found.*

Response:
Bridgeton Landfill agrees to modify the scope of the GCPT analysis in response to this comment. Ten additional GCPT samplings will be performed. With the addition of the additional GCPT sampling sites, this will result in a total of 68 sites. The added sampling sites will be at a spacing similar to that of the current proposed GCPT sampling locations (see Figure 3).

9. ***Screening and Decontamination Procedures.*** *In general the screening and decontamination procedures are poorly presented and widely distributed throughout the Work Plan. A new section dedicated to screening and decontamination procedures should be created (such as 3.4 Screening and Decontamination Procedures) and compile the relevant discussions from Section 3.2.1.3 GCPT Rig Decontamination, Section 3.3.4 GCPT Logging, Section 3.3.5 Decontamination, and Section 3.3.6 Radiological Contamination Screening and Exit Procedures. Under no circumstances shall wash water be discharged onto the ground without prior characterization.*

Response:
A new Section 3.4 – Contamination Surveys and Decontamination Procedures, has been developed as suggested. Wash water will be collected in a container or in a plastic-lined collection area. The water will be sampled, characterized, and handled as appropriate based upon characterization.

10. ***Isolation Break*** *Plan Regardless of the Work Plan results (i.e. although unlikely, if the entire testing zone has RIM, etc.), an Isolation Break plan must be submitted that separates the subsurface smoldering event from OU 1 Area 1.*

Response:

This comment is outside the scope of the current document, so will not be addressed in this response. Bridgeton Landfill will continue its ongoing discussions with MDNR and EPA regarding contingency planning.

11. Section 4.2 of the Contingency Plan *- Part 2 does not give a clear schedule for the GCPT investigation. Include verbiage that clearly indicates the GCPT investigation will begin immediately following approval of the Work Plan.*

Response:

The GCPT investigation will begin immediately following approval of the Work Plan, however, an estimated lead time of 4 weeks will be needed to schedule the firm that will be performing the GCPT work. In addition, time is needed to schedule and provide Hazwoper and other training needed. This training can occur during the GCPT company lead time. Surficial vegetative clearing and road preparation can occur after training has been completed, but before the GCPT rig mobilizes. It is expected the entire GCPT investigation can occur in 2 months after approval is received from MDNR .

12. Appendix D, Section 1.3, Goals of the Investigation. *Please add additional primary goals to be consistent with language in Section 4 of the Contingency Plan- Part 2:*

- *Determine depth to native material*
- *Determine type of waste/subsurface material (i.e. rock, municipal solid waste, construction and demolition waste, etc.).*

Response:
The above two items have been added to Appendix D, Section 1.3, Goals of the Investigation.

13. Appendix D, Section 2.1, Prior Investigation Methods. *The fourth sentence states that eight radionuclides were identified as contaminants of concern but only seven are listed.*

Response:
Appendix D, Section 2.1, Prior Investigation Methods, has been amended to include Thorium 232.

14. Appendix D, Section 2.3, SFS Estimate of RIM Boundary. *For the purposes of this investigation, any radiological readings above background will define radiological materials (See General Comment # 1). Therefore, this section needs to be revised to explain what is defined by radiologically impacted material (RIM). If the definition of RIM from the Supplemental Feasibility Study (SFS) will still be used to depict boundaries of areas to be excavated under a cleanup scenario, a distinction between the SFS RIM and radiological materials above background will need to be made.*

Response:
See response to comment No. 1.

15. ***Appendix D, Section 3.2, Gamma Cone Penetration Testing (GCPT).*** *The last sentence of the second paragraph of this section states, "The advance rate is approximately one inch (1 ") per minute." Is this advance rate correct?*

Response:
Per ConeTec, Inc., the advance rate of the probe is approximately 2 cm/second which is the ASTM Standard. Appendix D, Section 3.2, Gamma Cone Penetration Testing (GCPT), has been amended accordingly.

16. ***Appendix D, Section 3.2.1.2.1, CPT Device (Lithology Calibration).*** *This section describes the use of previous boring locations WL-108, WL-111, and WL-119 to "calibrate" the GCPT sensor to various zonation conditions. Review of these bore logs included in the Appendix reveals that there is no "zonation" identified in the majority of the boring strata. The purpose of the GCPT is to fill in the data gaps from the previous investigation such as the lack of zonation detail in these bore logs (i.e. soil, rock, municipal solid waste, construction and demolition waste, etc.). Therefore, the Department does not understand how these bore logs can be used to "calibrate" the device. Other means to calibrate and/or verify the sensor readings shall be used such as collecting continuous soil core samples from a subset of locations as described in previous comments.*

Response:
The GCPT device correlation will only be between waste and in-situ alluvium, as it pertains to lithology. Appendix D, Section 3.2.1.2 has been modified to further explain the correlation.

17. ***Appendix D, Section 3.2.1.2.2, Gamma Sensor (Radiologically Impacted Material Calibration).*** *Due to the heterogeneity of radiological contamination, the use of previous borings (PVC-38) to calibrate the gamma sensor is not advisable. Background measurements shall be established within a known uncontaminated area, preferably outside of Operable Unit I, Area l. If calibration to a radiological reading is required, discreet soil samples can be collected directly from the contaminated interval. A range of gamma readings from the GCPT should be verified with discreet soil samples to determine if the sensor can accurately measure impacted radiological materials slightly above background and not just highly contaminated materials versus non-detect. This section should also describe a method to perform a response check of the GCPT instrument at the beginning and end of each day to verify the detector's response.*

Response:
The use of boring holes PVC-38 and PVC-28 are to correlate the readings obtained by the GCPT device in a boring known to have increased levels of radiation. This procedure will

ensure that the device is operating as expected as the sensitivity to radiation is confirmed. As recommended by the USEPA in General Issue comment number 2, Bridgeton Landfill will also include a boring location of low or intermediate gamma readings to further define the relative sensitivity of the GCPT device. As such, boring hole PVC-28 will be added as an additional correlation site. Appendix D, Section 3.2.1.2.2, Gamma Sensor (Radiologically Impacted Material Correlation), has been amended accordingly.

A daily response check of the GCPT will be performed with a check source such as a container of potassium carbonate (K_2CO_3) (which contains the naturally occurring isotope potassium-40) or a button source. This response check will be performed at the beginning and end of each day. Appendix D, Section 3.2.1.2.2, Gamma Sensor (Radiologically Impacted Material Correlation), has been amended accordingly.

18. ***Appendix D, Section 3.2.1.3, GCPT Rig Decontamination.*** *The first sentence states, "Contamination will be evaluated per the CPT rig operator's decontamination procedure, and will at a minimum consist of scanning all rods which were advanced below the ground surface." More detail on the decontamination procedures of the drill rods is needed including what equipment is being used to scan the drill rods. See General Comment #9 regarding compilation of decontamination procedures.*

Response:
Tool strings (push rod probes) will be washed/wiped as they are removed from the ground to remove visible dirt and mud. Tools will then be cleaned with soapy water and wiped dry. Sections of the tool string will be sampled with a swipe to detect any removable activity on the surface of the tool string between sampling locations. The swipe samples will screened in the field with a Ludlum Model 12 coupled to a Model 43-5 alpha detector. A final measurement of alpha and beta activity will be performed using a Ludlum 2929 coupled to a 43-10-1 or a low-background alpha/beta counter such as a XLB-5. Please see Appendix D, new Section 3.4.

19. ***Appendix D, Section 3.2.1.3, GCPT Rig Decontamination.*** *The fifth sentence of this section states, "The wash water will be discharged onto the ground within the Area 1 decontamination pad and allowed to infiltrate into the gravel surface." Due to the potential to encounter radiological and other contaminants, the wash water shall be containerized and characterized prior to disposal. If acceptable, the wash water can be disposed into the leachate collection system. Any solids generated during drilling activities should also be containerized and characterized for proper disposal. See General Comment #9 regarding compilation of decontamination procedures.*

Response:
Wash water will be collected, characterized and handled as appropriate based upon characterization. All wash water will be disposed at a permitted facility. Likewise, any solid radioactive waste will be containerized and characterized for proper disposal. Please see Appendix D, new Section 3.4.

20. Appendix D, Section 3.3.1 Land Clearing. *The fourth sentence of the first paragraph states, "The vegetation will be cleared by selective woody vegetation removal techniques which allow small track mounted machines to cut and grind the vegetation in place." This activity should be kept to a minimum. Extra effort shall be given to find suitable paths that do not require grubbing. Additional provisions should be included in the Work Plan to minimize/eliminate the use of machines that will grind vegetation and instead use handheld equipment to clear/prune vegetation where practicable.*

Response:
Bridgeton Landfill will work with its subcontractor to minimize grinding of vegetation as much as possible. If appropriate and indicated, vegetation may be wetted before grinding. It is Bridgeton Landfill's goal to minimize any airborne particles generated by the vegetation clearing process. As recommended, extra effort will be given to finding suitable paths that do not require grubbing, and the use handheld equipment to clear/prune vegetation will be used where practicable. Appendix D, Section 3.3.1 Land Clearing, has been amended to reflect this change.

In response to this comment and Appendix E, Comment 2, from the Missouri Department of Health and Senior Services, we would refer to the March 30, 2009, Vegetative Sampling Results Summary from Engineering Management Support, Inc. This report concludes that no significant radiological uptake has occurred in the vegetation. The report also states that the vegetation debris generated during the clearing/grubbing effort will be much less of a respiratory hazard than that of soil due to particle size. Also, the vegetation material has a very high moisture content and therefore will not become airborne.

21. Appendix D, Section 3.3.1 Land Clearing. *The third sentence of the second paragraph states, "The paths will be guided by an onsite health physicist who will conduct an overland gamma scan." Please include more detail on the overland gamma survey including the procedure and methodology.*

Response:
A Ludlum 2221 ratemeter/scaler mated to a Ludlum 44-20 3x3" NaI detector will be used to survey selected portions of ground surface within and around Area 1. This instrument will be coupled to a Trimble GPS and operated in the ratemeter mode. This mode will allow the gamma count rate from the instrument to be collected at one-second intervals and assigned to its specific measurement location (latitude and longitude).

The operator will hold the detector approximately 30 cm above the ground surface and advance across the areas of interest in a series of straight lines at a rate of approximately one meter per second. The separation distance between the lines will be approximately 1.5 meters. After the survey, the field data will be processed using a combination of industry-standard commercial computer applications. Because all data points will be tied to a spatial coordinate, a map of the data will identify areas of surface soil containing

RIM. These areas can then be located in the field and avoided or covered. Appendix D, Section 3.3.1 Land Clearing, has been amended to include this information.

22. Appendix D, Section 3.3.1 Land Clearing. *The last paragraph contains a couple typographical errors. The word "about" in the third sentence should be replaced with "above". The word "truck" in the fifth sentence should be replaced with "trunk".*

Response:
These typographical errors have been corrected in Appendix D, Section 3.3.1 Land Clearing.

23. Appendix D, Section 3.3.2 Near-Surface Preparation. *The second paragraph of this section describes removal of surficial layers of concrete and other inert rubble with a track hoe prior to the GCPT investigation. This activity should be kept to a minimum. The text should be revised to state this and also include provisions to survey and log the depth of any such material that is relocated, if necessary.*

Response:
Any removal of any surficial concrete or other rubble will be kept to an absolute minimum. The GCPT approach is intended to disturb the soil as little as possible, if at all. This activity was included as a contingency response in case subsurface materials interfered with the investigation path. If any material removal is needed, a radiation survey will be performed of any such materials moved and records will be maintained. Appendix D, Section 3.3.2 Near-Surface Preparation, has been modified to reflect this information.

24. Appendix D, Section 3.3.4, GCPT Logging. *The third to last sentence of the first paragraph states, "After the boring is completed, the GCPT rig will be decontaminated within the non-radiological decontamination area if no RIM was encountered." Please clarify why the GCPT rig will be decontaminated if no RIM is encountered, such as decontamination for non-radiological contaminants. Also please consolidate screening and decontamination procedures (see General Comment #9).*

Response:
If radioactive contamination is detected, the equipment will be moved to the radiological decontamination pad. Any loose material will be removed by brushing and wiping with wet rags. After loose material has been removed, the equipment will be surveyed again for both alpha and beta surface activity. If fixed or removable activity exceeding the release limits is found, the rig will be decontaminated and resurveyed. After a piece of equipment is cleared for release, or if no radioactive contamination is detected, the equipment will moved to the non-radiological pad where it will be washed to remove visible traces of dirt and mud prior to its release. This final housekeeping can be performed in an uncontrolled area and any water generated from the previously released equipment will be considered unimpacted. See Appendix D, new Section 3.4.

25. Appendix D, Section 3.3.4, GCPT Logging*. The last sentence of this section states, "Each sounding hole will be filled with bentonite-coated pea gravel from the surface." Missouri Well Construction Rules, 10 CSR 23-6.050(A), states that test holes with no surface casing must be filled with grout via tremie to within two feet (2') of the ground surface.*

Response:
This issue was discussed in the August 28, 2013 teleconference. There was mutual agreement that minimizing pipes into the boreholes such as tremie pipes would be advantageous, and the MDNR would work with Bridgeton Landfill in obtaining the necessary variances needed to comply with 10 CSR 23-6.050(A).

26. Appendix D, Section 3.3.5, Decontamination. *The discussion in this section should be compiled into a new section titled Screening and Decontamination Procedures (see General Comment #9).*

Response:
See response to Comment 9.

27. Appendix D, Section 3.3.6, Radiological Contamination Screening and Exit Procedures. *The discussion in this section should be compiled into a new section titled Screening and Decontamination Procedures (see General Comment #9).*

Response:
See response to Comment 9.

28. Appendix D, Table 1. *This table does not include a trigger for commencing with construction of the isolation barrier (i.e. there needs to be a decision point between the last two boxes that coincides with the triggers in Part 1 of the Contingency Plan).*

Response:
A decision point has been added between the last two boxes of Appendix D, Table 1, as requested.

29. Appendix E, Section 5.3, Chemical Hazards. *This section does not mention the potential for encountering hazardous waste, putrescible waste, and landfill gases during the GCPT exercise. No action plan has been provided to investigate, characterize, and abate potential exposure to chemicals. Methodology to monitor for encroachment into contaminated soils or detecting vapors emitted from within borings should be provided. The Health and Safety Plan (HSP) should discuss the potential for exposures, and include a contingency plan to protect workers from exposure. Worker protection standards must be met in the event these potential hazards are encountered. Update the HSP accordingly****.***

Response:
The Health and Safety Plan has been amended to include information on chemical hazards.

30. ***Appendix E, Section 5.4.2, Radiological Controls.*** *This section should include procedures for use of real-time measurement devices such as dose rate meters and dosimeters to measure worker exposure to radioactivity.*

Response:
Electronic Personal Dosimeters will be issued to workers on this jobsite. The dosimeters will be collected and read at the end of each shift. These results will be considered monitoring data. Doses of record will be determined from TLD monitoring badge for that individual. Appendix E, Section 5.4.2, Radiological Controls has been amended to include this information (Health and Safety Plan).

31. ***Appendix E, Section 6, Training.*** *This section of the Health and Safety Plan does not include specific training requirements of on-site workers. Please include specific training that meets the requirements of 29 CFR 1910.120 and other general training such as General Employee Training (GET) and General Employee Radiological Training (GERT). The Department expects workers to meet these training requirements at similar sites.*

Response:
Workers will receive training in accordance with 29 CFR 1910.120 and will include General Employee Training (GET) and General Employee Radiological Training (GERT). Appendix E, Section 6, Training, has been amended to reflect this information (Health and Safety Plan).

Thank you again for your cooperation in this matter. If you have any questions, please feel free to contact me.

Sincerely,

Daniel R. Feezor, P.E.
Feezor Engineering, Inc.
dfeezor@feezorengineering.com

Attachments: September 9, 2013 memo from Engineering Management Support, Inc. re: Definition of Radiologically Impacted Material (RIM)

MEMORANDUM

To: Dan Feezor, P.E., Feezor Engineering Inc.

From: Paul Rosasco, P.E.

Subject: Definition of Radiologically-Impacted Material (RIM)

Date: September 9, 2013

Per your request, Engineering Management Support, Inc. (EMSI) has evaluated the Missouri Department of Natural Resources (MDNR) comment on the definition of radiologically-impacted material (RIM) included in the Gamma Cone Penetration Test (GCPT) Work Plan. MDNR's comment on this is included below followed by our evaluation of the appropriateness of the criteria used in the GCPT Work Plan.

1. ***Definition of Radiological Impact Material (RIM)****. The document needs to be clear on what is meant by radiologically impacted material. The last sentence of the first paragraph of Section 4.1 of the Contingency Plan- Part 2 states, "It is proposed that the Isolation Barrier be located at the shallowest practical location outside of the radiological materials." The Appendix D-Isolation Barrier Schedule and Gamma Cone Penetration Test (GCPT) Work Plan (hereafter referred to as the "Work Plan") goes on to use the term "radiologically impacted material" followed by "above background" and elsewhere references the Supplemental Feasibility Study which calculated radiologically impacted material (RIM) as material greater than five (5) pCi/g above background. The Work Plan should use the term "radiological materials" to be consistent with the Contingency Plan Part 2 as well as the First Agreed Order, Section 22.B.iii, when discussing suitable locations for the isolation barrier. The Work Plan shall define the term "radiological materials" as any material with radiological readings above a statistically determined background concentration.*

Response:

Use of the 5 picocurie per gram (pCi/g) plus background criteria for total radium and total thorium is an appropriately conservative basis for identification of radiologically-impacted material (RIM) for placement of a possible contingent thermal barrier located between the North Quarry Landfill of the Bridgeton Landfill and Radiological Area 1 of the adjacent West Lake Landfill. The protectiveness of this criterion is discussed below. The possible effects of a subsurface smolder event (SSE) on

---

Engineering Management Support Inc.

7220 West Jefferson Ave. Suite 406
Lakewood, Colorado 80235

Telephone (303) 940-3426
Telecopier (303) 940-3422

possible occurrences of radionuclides at activity levels below this criterion but above background are also discussed.

EPA has developed guidance that addresses the appropriateness of using standards promulgated for cleanup of sites under the Uranium Mill Tailings Radiation Control Act (UMTRCA) for use in developing cleanup levels for other sites that contain radium and thorium isotopes (Luftig and Weinstock, 1998)[1]. The following paragraphs summarize pertinent points from this guidance as it relates to use of UMTRCA criteria as a basis for identification of radiological materials relative to the gamma cone penetrometer testing (GCPT) for the North Quarry Contingency Plan.

On January 5, 1983, EPA promulgated in Subpart B of 40 CFR Part 192 (48 FR 590 to 606) *Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites.* Specifically, these standards state:

> Remedial actions shall be conducted so as to provide reasonable assurance that, as a result of residual radioactive materials from any designated processing site:
>
> (a) The concentration of radium-226 in land averaged over any area of 100 square meters shall not exceed the background level by more than--
>
> (1) 5 pCi/g, averaged over the first 15 cm of soil below the surface, and
> (2) 15 pCi/g, averaged over 15 cm thick layers of soil more than 15 cm below the surface.

These standards were developed specifically for the cleanup of uranium mill tailings at 24 sites designated under Section 102(a)(1) of UMTRCA (Title I sites). The purpose of these standards was to limit the risk from inhalation of radon decay products in houses built on land contaminated with tailings, and to limit gamma radiation exposure of people using contaminated land (see 48 FR 600).

Subpart B of 40 CFR Part 192 contains two different soil standards. The concentration criterion for surface soil (5 pCi/g above background of radium-226) is a health-based standard. The relevant source of health risk for surface soil is exposure to gamma radiation, which is the basis for this standard. EPA determined that the concentration criterion for subsurface soil (15 pCi/g of radium-226) is not a health-based standard, but rather was developed for use in limited circumstances to allow the use of field measurements rather than laboratory analyses to determine when buried tailing had been detected. Conditions at the West Lake Landfill are not sufficiently similar to the limited circumstances identified by EPA to allow for use of the subsurface criterion at the West Lake Landfill.

The 5 pCi/g above background standard was initially developed for a single radioisotope (radium-226) to control the hazard from radiation. In Subpart E of 40 CFR Part 192 (48 FR45947)

[1] Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites, Stephen D. Luftig and Larry Weinstock, OSWER Directive 9200.4-25, February 12, 1998.

Standards for Management of Thorium Byproduct Materials Pursuant to Section 84 of- the Atomic Energy Act of 1954, as Amended, EPA determined that these standards were suitable for remediation of radium-228 at Title II sites (see 48 FR 45944 and the FEIS for *Standards for the Control of Byproduct Materials from Uranium or Processing (40 CFR 192) Volume I, Appendix G: Thorium Mill Tailings).* Because the risk from uranium and thorium byproducts is additive, and because the 5 pCi/g and 15 pCi/g standards are based on total acceptable risk, whenever the 5 pCi/g and/or 15 pCi/g standards are used as relevant and appropriate requirements (or to-be-considered criteria [TBC's]) at CERCLA sites with some combination of radium-226 and radium-228, EPA has determined that these soil standards should apply to the combined level of contamination of radium-226 and radium-228 above background.

EPA has also determined that in order to meet a permanent clean-up objective for radium-226 and radium-228 of 5 pCi/g above background, there needs to be reasonable assurance that the preceding radionuclides in the series will not be left behind at levels that will permit the combined radium activity to build up to levels exceeding this level after completion of the response action. At a minimum, this would generally mean that thorium-230 (the parent of radium-226) and thorium-232 (the parent of radium-228) should be cleaned up to the same concentrations as their radium progeny. Therefore, whenever the 5 pCi/g and/or 15 pCi/g standards are used as relevant and appropriate requirements (or TBC's) at CERCLA sites with some combination of thorium-230 and thorium-232, these soil standards should apply to the combined level of thorium-230 and thorium-232 above background.

As indicated in the EPA guidance, the cleanup level of 5 pCi/g plus background is protective from exposure to radiation under an uncontrolled (residential land use) scenario. EPA has determined that cleanup of UMTRCA sites using the 5 pCi/g and 15 pCi/g soil standards under 40 CFR 192 is consistent with an upper bound of 15 millirems per year (mrem/yr) effective dose equivalent (EDE) under a rural residential exposure scenario for radium-226, radium-228 and thorium-232 and is much more stringent for thorium-230.[2] EPA has also determined that for land uses other than residential (e.g., commercial/industrial, recreational) the UMTRCA cleanup standards are more stringent for all four radionuclides.[2] Therefore, use of the 5 pCi/g plus background cleanup standard for delineation of radioactively impacted material will be protective of all possible exposure scenarios that could occur at the West Lake Landfill.

MDNR has requested additional information on the possible impacts of a subsurface smoldering event on low levels of radionuclides (i.e., below the 5 pCi/g above background level). Potential occurrences of low levels of radionuclides on the interior (Bridgeton Landfill side) of a possible contingent thermal barrier do not pose any significant risks of impacts.

A possible occurrence or lateral extension of an SSE into an area containing low levels of radionuclides would not cause any changes or significant impacts. There would be no increase in gamma or alpha radiation emissions. Emission of gamma or alpha radiation from radionuclides is a

[2] Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination, Stephen D. Luftig and Larry Weinstock, OSWER Directive No. 9200.4-18, August 22, 1997.

function of radioactive decay. Radioactive decay is a function of time and the half-lives of the various radionuclides. This decay occurs independent of temperature or pressure conditions and therefore, increases in temperature or pressure that may occur as a result of an SSE will not increase or otherwise affect the rates of radioactive decay of radionuclides.

Because rate of decay would not be affected, there would be no increase in radon production. But it is possible that changes in surrounding soil could change the rate of release of radon to the air. Vaporization of the entrained moisture within the refuse and RIM could result in an increase in interstitial vapor pressure in the vicinity of the heat front as a result of the conversion of the entrained moisture from liquid to vapor (i.e., a steam front). Although occurrence of an SSE is not expected to increase radon emanation (some literature suggests that a reduction in pore water content could result in a decrease in radon emanation), occurrence of an SSE could potentially result in a slight, temporary increase in radon migration rates due to the increased interstitial vapor pressure gradients in the immediate area of the increased heat front associated with an SSE and potential increases in gas phase permeability due to decreased pore water content. Essentially, the gas pressure may speed the rate at which gas moves to the surface, and the drying of the surrounding soil may allow vapors to move through soil more quickly.

Radon has a relatively short half-life and during the time it takes gas to move from the subsurface to the surface, some radon will naturally attenuate through radioactive decay. An increase in radon migration rates would decrease the radon attenuation because the increased migration rate would leave less time for decay of radon in the subsurface. Therefore the increased migration rate could result in a temporary increase in the rate of radon exhalation – release to air. Such potential, temporary increases in radon migration and exhalation rates are expected to be localized due to the localized nature of the heat/steam fronts. Measurements conducted as part of the Remedial Investigation[3] indicated that the overall radon flux from Area 1 was 13 $pCi/m^2/sec$ compared to the established standard of 20 $pCi/m^2/sec$. Review of the radon flux measurements data indicates that the radon flux values measured in the area between the extent of RIM (i.e., the extent of total radium or total thorium above the 5 pCi/g criterion) and the North Quarry Landfill were very low, ranging from 0.1 to 0.5 $pCi/m^2/sec$. Therefore, the existing radon flux of materials that are below the 5 pCi/g above background level is very low and any possible reductions in radon attenuation that could result from occurrence in an SSE in this area are not expected to increase the overall radon flux above the risk-based regulatory standard of 20 $pCi/m^2/sec$. It is also noteworthy that the 5 pCi/g above background standard was developed for surficial soils – so deemed protective even in the absence of the attenuation that would result from migration through soil cover or other barrier (e.g., a possible ethylene vinyl alcohol [EVOH] barrier layer associated with possible contingent actions for the North Quarry Landfill).

Based on this analysis, use of the 5 pCi/g above background criterion to identify the extent of RIM is both appropriately conservative and consistent with established EPA guidance and risk-based criteria. Possible occurrences of radionuclides at levels below the 5 pCi/g criterion even on the

[3] Remedial Investigation Report, West Lake Landfill Operable Unit 1, Engineering Management Support, Inc., April 10, 2000.

"SSE-side" of a possible contingent thermal barrier would not result in any additional risks or impacts, even assuming maximum migration and without even accounting for radon reduction associated with the proposed enhanced capping system (e.g. EVOH cap) that may be implemented as part of contingent actions for the North Quarry Landfill.