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Mr. James A. Saric, Remedial Project Manager
U.S. Environmental Protection Agency
Region V, SRF-5J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

DOE-0315-01

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

TRANSMITTAL OF RESPONSE TO COMMENTS TO CALCULATIONS FOR RE-EVALUATION OF DUMPED ROCK FILL SIZE FOR THE BIOINTRUSION BARRIER FOR THE ON-SITE DISPOSAL FACILITY AND REVISED CALCULATIONS BASED ON RESPONSE TO COMMENTS

Enclosed please find a Response to Comment (RTC) document on the Calculations for Re-Evaluation of Dumped Rock Fill for the On-Site Disposal Facility (OSDF). This RTC document was prepared in response to the Ohio Environmental Protection Agency (OEPA) comments that were transmitted to the Department of Energy (DOE) dated January 25, 2001. Also, please find revised calculations based on these RTCs in a phone conversation held on February 5, 2001.

An Ohio Department of Transportation (ODOT) Type C Dumped Rock Fill was originally designed as the material for the Biointrusion Barrier layer of the final cover system. This type of rock is large and not as easy to place as a smaller diameter material. A re-evaluation was performed to try to find a material which:

- Is easier to spread using mechanical equipment.
- Has a higher percentage of voids for better resistance to root penetration.
- Allows the use of a choke stone, which is a standard ODOT material.

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In addition, new information had come available to aid in the re-evaluation including:

- Additional testing on rock available from local quarries was performed and compiled into rock quality scores based on the Uranium Mill Tailings Remediation Act (UMTRA) design approach.

- Additional information from technical literature on internal friction angles of rock fill was available. This information defines internal friction angles for rock under low confining pressures, which are representative of pressures the Biointrusion Barrier layer is subjected.

- The original calculations for oversizing were overly conservative. The UMTRA design approach includes oversize rock, used for applications similar to Biointrusion Barrier layers, for material with a rock quality score less than 80 percent. The original interpretation of oversizing was to take a ratio of 80 percent to that of the rock quality score of the actual source. The UMTRA design approach clearly states that the oversizing is based on the difference of 80 percent and the actual score.

The calculations for the re-evaluation of the Dumped Rock Fill were performed to analyze the rock size of the next smaller ODOT Dumped Rock Fill material size which is Type D Dumped Rock Fill. Type D has a d_{50} of 6 inches according to ODOT Construction Materials and Specifications Section 601.07. The following calculations were performed to show that the ODOT Type D Dumped Rock Fill is an acceptable material for Biointrusion Barrier layer as long as the UMTRA rock scoring is a minimum of 60:

- Manning's roughness coefficient was calculated for a Type D Dumped Rock Fill.

- Using this roughness coefficient and the peak discharge from a 2000-year storm (per Design Criteria Package, 1997) of an erosion gully in the final cover system, the maximum flow per unit width over the rock portion of the gully was calculated. Type D Dumped Rock Fill was assumed to be at the bottom of the channel.

- Friction angles of the Dumped Rock Fill were calculated based on new information from technical literature and the new quarry rock testing.

- From the friction angles and maximum flow per unit width calculated, the required d_{50}, or minimum d_{50} of rock to resist gully advancement, was calculated. This is the minimum d_{50} size of Dumped Rock Fill that can be used prior to oversizing a rock with less than a rock quality score of 80 percent.

- Using the corrected approach of oversizing, the required d_{50} is oversized for the quality of the stone. If the oversizing result is less than that of the d_{50} of an ODOT Type D Dumped Rock Fill, or $d_{50} = 6$ inches, the material for that quarry meets sizing requirements.

- Calculations were then performed on the qualifying material to verify that it meets erosion criteria based on the Hartung and Scheuerlein Method.

- Due to the new void space size in the Dumped Rock Fill, a new choke stone layer was then designed.

Therefore, these calculations show:

- An ODOT Type D Dumped Rock Fill with a quarry rock quality rating of 60 is acceptable to be used as a Biointrusion Barrier layer in the OSDF.

- The ODOT Type D Dumped Rock Fill will meet the erosion resistance requirements for the final cover system.

- AASHTO No. 57 stone can be used as the choke stone layer when ODOT Type D Dumped Rock Fill is used for Biointrusion Barrier layer.

If you have any questions or require additional information, please contact Robert Janke at (513) 648-3124.

Sincerely,

Johnny Reising

FEMP:Jalovec

Johnny W. Reising
Fernald Remedial Action
Project Manager

Enclosures

cc w/enclosures:
N. Hallein, EM-31/CLOV
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T. Walsh, Fluor Fernald, Inc./46
ECDC, Fluor Fernald, Inc./52-7

RESPONSES TO OHIO ENVIRONMENTAL PROTECTION AGENCY COMMENTS ON THE CALCULATIONS FOR RE-EVALUATION OF DUMPED ROCK FILL FOR THE ON-SITE DISPOSAL FACILITY (20100-CA-0001, REVISION 0)

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

GENERAL AND SPECIFIC COMMENTS

Commenting Organization: Ohio EPA Commentator: GeoTrans, Inc.
Section #: Purpose Pg. #: 1/36 Line #: 18 Code: C
Original Comment #: 1

Comment: Text under the third bullet describes changes in interpretation to the UMTRA design approach. However, scoring methodology for rock testing is unreferenced and is not described. Sizing based on these scores may not be appropriate and cannot be adequately reviewed without documentation of rock scoring techniques.

Response: The scoring methodology for rock testing is as described in the UMTRA design approach (Revision II, December 1989, Pages 78 and 79) and the Nuclear Regulatory Commission (NRC) 1990 document titled "Final Staff Technical Position, Design of Erosion Protection Covers for Stabilization of Uranium Mill Tailings Sites." The NRC document (Page D27, Table D1) used the same scoring methodology for rock testing as the UMTRA design approach. The only difference is that freeze-thaw testing was not conducted in the approach described in the NRC document.

Action: No action.

Commenting Organization: Ohio EPA Commentator: GeoTrans, Inc.
Section #: Purpose Pg. #: 1/36 Line #: 18 Code: C
Original Comment #: 2

Comment: Text under the third bullet describes changes in interpretation to the UMTRA design approach. A more thorough discussion of the methodology used in the re-interpreted rock sizing, including a reference to the procedures employed, would be useful.

Response: The text under the third bullet addresses interpretation of the UMTRA design approach for "oversizing" rock exhibiting a rock score for durability of less than 80. The UMTRA document (Page 80) states "Oversizing is determined by the numerical difference between the minimum rock score of the materials being placed and 80 percent." The NRC document referred to in the response to Comment No. 1 also states oversizing as the difference between the minimum rock score and 80 percent (Pages D-25 and D-26). The original calculation for oversizing used the ratio of the rock score and 80 percent rather than the difference. Thus, as part of the reevaluation the difference between the rock score and 80 percent was used for oversizing the rock, consistent with the UMTRA/NRC design approach.

Action: No action.

Commenting Organization: Ohio EPA Commentator: GeoTrans, Inc.
Section #: Calculations Pg. #: 29/36 Line #: 8 Code: C
Original Comment #: 3

Comment: In the original design, methods cited in Cedergren (1977) were used in gradation design. The specific purpose of the design is to prevent fines from piping downward in underlying strata. Cedergren states in equation 5.2 that:

$$\frac{D_{15filter}}{D_{85soil}} \leq 5$$

However, a ratio of 15 from the vegetative soil layer (VSL) to the granular filter (GF) is indicated without explanation. Please provide justification for this using this ratio.

Response: The ratio of 15 was selected based on guidance presented in Cedergren (1989) for protecting a plastic clay soil from piping into a filter. The gray and brown till (CL) material expected for use as a vegetative soil material is a plastic clay. Cedergren states "If the protected soil is a plastic clay, the piping ratio often can be much higher than 5 or 10.". Based on a review of geotechnical data for the brown and gray tills, typical hydraulic conductivities have been achieved on the order of 10^{-7} and 10^{-8} cm/sec, which is consistent with a plastic clay with a low potential for piping. Thus, considering the guidance quoted above from Cedergren a ratio of 15 was selected as a filter criteria between the granular filter and choke stone layers. Furthermore the value of d_{85} used in the calculation was conservatively selected as the minimum value for 63 samples tested (see Page 30 of 36 of calculation).

Action: Add the following to Page 28 of 36 under <u>Vegetative Soil Layer to Granular Filer</u> for Case 1.

A ratio of 15 is selected based on guidance presented in Cedergren (1989) for protecting a plastic clay soil from piping into a filter. The gray and brown till (CL) material expected for use as a vegetative soil material is a plastic clay. Cedergren states "If the protected soil is a plastic clay, the piping ratio often can be much higher than 5 or 10." Based on a review of geotechnical data for the brown and gray tills, typical hydraulic conductivities have been achieved on the order of 10^{-7} and 10^{-8} cm/sec, which is consistent with a plastic clay with a low potential for piping. Thus, considering the guidance quoted above from Cedergren a ratio of 15 was selected as a filter criteria between the granular filter and choke stone layers.

Commenting Organization: Ohio EPA Commentator: GeoTrans, Inc.
Section #: Calculations Pg. #: 29/36 Line #: 14 Code: C
Original Comment #: 4

Comment: The previous comments states that the ration from the filter to the overlying soil should be less than or equal to 5. The calculated ration between the granular filter and choke stone (CS) is indicated as being less than 5, where it is in fact 5.3. We understand that this apparent discrepancy results from rounding and the use of one significant figure. Moreover, the ration of 5 is usually conservative (Cedergren, 1977, Page 183). However, it would be helpful to identify and explain these apparent discrepancies within the calculation narrative.

Response: Agree. The calculated ratio d_{15}/d_{85} rounded to one significant digit to the right of the decimal place, would be 5.3. The calculated ratio was presented as a whole number consistent with the criteria being defined as a whole number. Thus, the calculated ratio presented as 5 is a correct interpretation. Furthermore, it is agreed that the criteria of ≤ 5 is conservative for the materials considered.

Action: Provide explanation of rounding of calculated ratio to a whole number on Page 29 of 36

Commenting Organization: Ohio EPA Commentator: GeoTrans, Inc.
Section #: Calculations Pg. #: 3/36 Line #: 1 Code: C
Original Comment #: 5
Comment: Step 7 states that allowable flow using the Hartung and Scheuerlein Method is less than the expected maximum flow calculated for the site, both using $D_{50} = 6$ inches. Based upon this statement, $D_{50} = 6$ is not acceptable, contrary to what was stated in the calculation narrative and what appears to be supported by the calculations. Please clarify this apparent misstatement.

Response: Agree. The referenced text misstates the relative magnitude of the maximum and allowable flows per unit width used in the Hartung and Scheuerlein Method for evaluation of the resistance of the Biointrusion Barrier to gully advancement. The maximum flow rate per unit width of 2.5 cubic feet per second per feet (cfs/ft) (q_{max}) is less than the allowable flow rate per unit width of 3.87 cfs/ft (q_{all}). Thus, consistent with the results of analyses performed using the Stephenson Method (oversized in accordance with guidance from the UMTRA document), a D_{50} of 6 in. is adequate for sizing the Biointrusion Barrier material.

Action: Revise the last sentence under Step 3 on Page 2 of 36 to read: "Based on this calculation, the Maximum flow per unit width for the 2,000-year storm in the erosion gully (q_{max}) is 2.50 cfs/ft. Revise the second sentence under Step 7 on Page 3 of 36 to read: "The allowable flow per unit width for riprap with $D_{50} = 6$ inches calculated using the Hartung and Scheuerlein method is greater than the maximum flow per unit width calculated in Step 3."

Commenting Organization: Ohio EPA Commentator: GeoTrans, Inc.
Section #: General Comment Pg. #: Line #: Code: C
Original Comment #: 6
Comment: No justification or description for the departure from the maximum particle size of 18 inches is given, and no new maximum particle size is specified, even though the previous design specified $D_{50} = 12$ inches and the revised design specifies $D_{50} = 6$ inches. It is anticipated that material of this size (up to 18 inches) would have posed handling and placement problems that could influence system effectiveness. Please cite changes in grain size maxima and D_{50} dimensions and provide documentation supporting the changes.

Response: The maximum particle size of 18 inches is based on design criteria in the DCP (Section 2.6.6, Part A, Bullet 5). This bullet reads as follows:

"The maximum dimension of the Biointrusion Barrier material should be no more than one-half of the barrier thickness (i.e., not more than 18 in.) for a 3-foot thick barrier thickness (design consideration)."

The Ohio Department of Transportation (ODOT) Type D Dumped Rock Fill selected for use as the Biointrusion Barrier material specifies a D_{max} of 12 inches which is consistent with the above design criteria. The change of D_{50} from 12 inches (corresponding to ODOT Type C Dumped Rock Fill) to 6 inches (corresponding to ODOT Type D Dumped Rock Fill) is based on analyses performed using the Stephenson Method and Oversizing performed in accordance with the UMTRA document. The methods used and calculations are presented in Attachments 5 and 6 of the calculation.

Action: No action.

Commenting Organization: Ohio EPA Commentator: GeoTrans, Inc.
Section #: General Comment Pg. #: Line #: Code: C
Original Comment #: 7
Comment: Design and specification changes are not well documented. It would be useful to provide a list of changes with the reason for the change, location of supporting calculations and references and a summary of how the change might influence other design elements or specifications.

Response: Following approval of these calculations, changes to certified-for-construction (CFC) documents (e.g., Technical Specifications and Construction Quality Assurance Plan) will proceed in accordance with Design Change Notice (DCN) procedures. The DCNs for changes to CFC documents will be forwarded to OEPA for approval.

Action: Issue DCNs after approval of Biointrusion Barrier calculation.

Commenting Organization: Ohio EPA Commentator: GeoTrans, Inc.
Section #: Attachment 7 Pg. #: 21/36 Line #: 9.1.2 Code: C
Original Comment #: 8
Comment: The mean roughness height refers to the D_{50} = 0.305 m (12 inches) for the riprap. This is incorrect; the new specification calls for a D_{50} = 6 inches. It appears that D_{50} = 6 inches was used in the calculations. Please clarify and correct.

Response: Agree. As stated in the comment, the value of D_{50} shown on Page 21 of 36 with the equation for calculating mean roughness height is incorrect. However, calculations performed for mean roughness height shown on Page 23 of 26 use the correct value of D_{50} (i.e., 0.152 m)

Action: Revise Section 9.1.2 text on Page 21 of 26 which reads "Where: D_{50} – mean diameter of riprap (=0.305 m)" to read "where: D_{50} = mean diameter of riprap (=0.152 m)."

Commenting Organization: Ohio EPA Commentator: GeoTrans, Inc.
Section #: Attachment 7 Pg. #: 21/36 Line #: 9.1.2 Code: C
Original Comment #: 9
Comment: The mean roughness height refers to the D_{50} = 0.305 m (12 inches) for the riprap. This is incorrect; the new specification call for a D_{50} = 6 inches. It appears that D_{50} = 6 inches was used in the calculations.

Response: Agree. As stated in the comment, the value of D_{50} shown on Page 21 of 36 with the equation for calculating mean roughness height is incorrect. However, calculations performed for mean roughness height shown on Page 23 of 26 use the correct value of D_{50} (i.e., 0.1524 m)

Action: Revise Section 9.1.2 text on Page 21 of 26 which reads "Where: D_{50} – mean diameter of riprap (=0.305 m)" to read "where: D_{50} = mean diameter of riprap (=0.152 m)".

Commenting Organization: Ohio EPA Commentator: GeoTrans, Inc.
Section #: General Pg. #: Line #: Code: C
Original Comment #: 10

Comment: Different Q_{max} assumptions appear to be used between the revised and original designs. Q_{max} for the 2,000-year event is used in some places and PMP is used in others. The revised design appears to meet design requirements using Q_{max}, but not using the PMP. Please provide justification and supporting calculation using the appropriate flow assumption.

Response: The 2,000-year and PMP storm events were considered in the original design calculations. However the DCP (Section 2.8.4 Bullet 1) establishes the 2,000-year storm event as the applicable design criteria. The referenced DCP bullet reads as follows:

"Permanent runoff control structures for the OSDF will be designed to limit interruption and damage (i.e., washout) of the OSDF in the 2,000-year, 24-hour storm event (design criteria for assumption of a DOE Performance Category 2 Facility)."

Therefore, the Q_{max} used in the revised calculation was based on the 2,000-year storm event.

Action: Replace the second sentence under Step 3 on Page 2 of 36 with the following:

"The calculation was performed using a peak discharge of 4.33 cfs for the 2,000-year storm event obtained from the Final Design Package calculation Final Cover System Erosion Resistance, Revision 0. The 2,000-year event is the applicable storm as defined in Section 2.8.4, Part A, Bullet 2 of the Phase III Design Criteria Package, Revision 0."