West Valley Demonstration Project

Doc. ID Number	WVDP-513
Revision Number	REV. 0
Revision Date	05/04/2010

NORTH PLATEAU PERMEABLE TREATMENT WALL INSTALLATION

QUALITY SUMMARY PLAN

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1.0 INTRODUCTION

This Quality Summary Plan has been prepared by AMEC Geomatrix Inc. (AMEC), in cooperation with West Valley Environmental Services, LLC (WVES) and URS Washington Division to provide a reference for the project team leading up to and during the installation of a Permeable Treatment Wall (PTW) at the West Valley Demonstration Project (WVDP), North Plateau (the Site). The purpose of the PTW installation is to mitigate the spread of a strontium-90 (Sr-90) plume migrating in groundwater at the North Plateau. The PTW consists of an 860 foot long trench that is continuously backfilled with zeolite treatment media. This Plan provides a summary of quality assurance and control procedures, which are planned to promote the successful deployment of the PTW, and is organized into two primary sections: zeolite backfill material and PTW construction.

2.0 ZEOLITE BACKFILL MATERIAL

The WVDP will be supplied approximately 2,000 tons of natural zeolite product from the Bear River Zeolite (BRZ) mine near Preston, Idaho for use as treatment media in the PTW. Quality Assurance (QA) and Quality Control (QC) measures will be enacted to ensure that the zeolite product received for use in the PTW is of similar quality, including physical and chemical nature, to the zeolite material that previously underwent treatability testing, as discussed below, at the State University of New York at Buffalo (UB).

2.1 Zeolite Quality Assurance

WVES maintains an internal QA Program (WVDP-111) that will apply to the activities performed to implement the design and construction of the North Plateau Sr-90 Plume Permeable Treatment Wall (PTW) including procurement of zeolite treatment media. The purpose of the WVES QA Program is to ensure the achievement of quality in a planned and systematic manner, consistent with 10 CFR 830.120, DOE O 414.1C, and ASME NQA-1.

2.1.1 Background

Treatability testing was performed by UB on two candidate natural zeolite materials, one from Teague Mineral Products (TMP) mine near Adrian, Oregon, and one from BRZ mine near Preston, Idaho. Both were evaluated for potential use in a PTW designed to remove Sr-90 from shallow groundwater at the WVDP. The evaluation included:

- Static batch testing to assess the removal of strontium by cation exchange;
- Mechanical testing to evaluate the grain size distribution in the zeolite samples;
- Laboratory permeability testing to estimate the hydraulic conductivity of the candidate materials, and;
- Dynamic column tests to further assess potential long-term efficacy of the ion-exchange process by the candidate zeolites; the column testing was the primary method that provided the data for predictive modeling as part of the PTW design phase (UB, 2009).

At the conclusion of the treatability testing, the BRZ product was selected as the most appropriate material for use in the PTW. Considering the full suite of treatability tests, several clear advantages of the BRZ zeolite relative to the TMP product were evident as discussed in UB's 2009 report (UB, 2009). The Bear River zeolite is identified by Bear River (http://www.bearriverzeolite.com) as the following:

- CAS Number: 1318-02-1
- Chemical name: Potassium-calcium-sodium-aluminosilicate
- Synonym: Clinoptilolite
- Mineral Component: 85% Clinoptilolite balance opaline silica
- Cation Exchange Capacity (CEC): 1.5 to 1.8 meq/gram (as ammonium, -N)
- Maximum Water Retention: >55 WT %
- Overall Surface Area: 24.9 square meters/gram
- Bulk Density (Weight): Approx. 55 - 60 pounds per cubic foot
- Hardness: Moh's no. 4
- Color: Pale green
- Mesh/Grain Size: 14x40 (used in UB's study)

The key quality control parameters that were associated with UB's studies and the assessment of the effectiveness of the zeolite in removing Sr-90 from groundwater are CEC and gradation (grain/mesh size). Moisture content is also discussed herein, however, moisture content does not affect the performance of the zeolite nor the QC associated with zeolite.

2.1.2 Trial Shipment of Zeolite

A trial shipment of zeolite product was sent from the BRZ mine in Preston, Idaho to Holland, Michigan as part of a trial trenching demonstration performed by the Dewind Dewatering Company (Dewind) at their Holland yard during the week of November 9, 2009. Dewind is a one-pass trenching contractor whose technology was being demonstrated on a trial basis for use in constructing the PTW. The BRZ mine was contracted by Dewind to produce and ship four truckloads of zeolite product, each truck containing 20 supersacks of 14 x 40 gradation zeolite. The supersacks each weighed approximately one metric ton (2,200 lbs). All of the product arrived at the Dewind facility during the week of November 2, 2010 and was temporarily stored in a building on site to await the trenching demonstration which took place the following week.

WVES arranged to sample the zeolite prior to and following the shipment to assess the effects, if any, that shipping may have (or have had) on the zeolite product. Before the zeolite product was shipped, sampling was performed by both BRZ and WVES personnel at the mine facility. WVES collected composite samples from each truck load and were tested for grain size distribution and moisture content by ASTM C136/D422 and D2216 respectively. Following

delivery at the Dewind facility in Michigan, samples were again collected by WVES personnel and tested for grain size distribution and moisture content. In addition to a representative sample from one supersack of zeolite, WVES also collected a discrete sample of the material from bottom of a supersack where the greatest potential for product degradation and settling (product fining) was expected to occur.

The trial shipment demonstrated that the BRZ product is resilient with truck transportation not impacting the quality of the material. For example, at the base of the supersacks where the greatest amount of particle size degradation would be expected, no apparent fining was observed indicating the product was not substantially affected by the shipping process. Overall, grain size distribution data showed only slight fining of the material with the post-shipment samples showing from approximately 1.3% to 5.3% passing the #40 (0.425 mm) sieve versus approximately 1% to 3% passing for the pre-shipment samples. Also, the trial showed that fully tarping (i.e., covering) a load of zeolite (when shipped by truck) was sufficient to protect the zeolite material from the elements during transport (e.g., substantial rain was experienced in route). The moisture encountered during transport however, did not appear to substantially increase the moisture content of the material as measured upon arrival at the Holland site. The shipping trial also demonstrated the following:

- Grain size distribution values for samples of zeolite collected prior to shipping were very similar (average results within 2% passing the #40 sieve) between the BRZ laboratory's results and WVES's subcontracted laboratory's results. The in-house procedures for grain size determination used by BRZ are therefore concluded to be comparable to outside laboratory procedures.

- Moisture content results for pre-shipment samples varied by an average of approximately 11% between BRZ (in-house testing) and WVES's subcontracted lab. The difference in the moisture content values is attributed to BRZ applying a substantially shorter drying time for the samples (as intended) than the drying time applied by the WVDP subcontracted laboratory which followed ASTM D2216. BRZ applied a shorter drying time than the standard by the ASTM method to avoid overdrying and removal of the molecular water within the crystalline structure of the zeolite (zeolite is a hydrous aluminosilicate) which would overestimate the moisture content. Future testing of moisture content for zeolite samples will be modified to reduce the drying time as discussed herein.

2.2 Product Specifications

Conformance to zeolite product specifications will assure that the material shipped to WVDP and received for installation in the PTW will perform in a similar manner as the material tested during the UB treatment testing phase. The following is a summary of materials specifications that apply to zeolite (such specifications have been incorporated into zeolite procurement documents).

Zeolite aggregate intended for use in the PTW will be virgin material mined from the BRZ mine (Preston, Idaho). The aggregate is to be free from building debris, soil, metal refuse, organic material and coatings, or any non-naturally occurring chemical

constituents or naturally occurring chemicals at levels above regulatory limits. The following quality control parameters apply to the zeolite;

- Zeolite will have gradations (i.e., grain size distribution) as specified in Table 1. This specified gradation results in a product resembling coarse to medium sand that will maximize the exposed and available cation exchange sites while maintaining adequate permeability to allow groundwater to freely flow through the material.

TABLE 1

GRADATION OF ZEOLITE

Particle Size Screen mesh # (mm)	Zeolite (Percent Larger)
#14 (1.18 mm)	0 – 10
#40 (0.425 mm)	90 – 100

- Zeolite will exhibit chemical properties consistent with the zeolite used during the laboratory test program (UB, 2009), which provided data used in the PTW design. Typical CEC values were greater than or equal to 1.5 milliequivalent/gram (meq/g). The CEC of zeolite is the capacity of the zeolite to exchange cations between sites on the mineral's crystal structure and an aqueous solution (e.g., groundwater) surrounding the zeolite. The CEC is measured by washing the zeolite in an ammonium solution and then quantifying the cations that are exchanged by the ammonium ions. UB has developed a washing procedure specific to cations of interest in the WVDP groundwater. That procedure was utilized during the treatability testing and will again be used for zeolite production QC CEC analysis.

Moisture content of the zeolite also will be tested as a volume control method because the product will be procured on a weight basis. This testing will ensure that the quantity of zeolite procured and delivered is sufficient to adequately fill the PTW per design specifications. Moisture content does not affect the performance of the zeolite. The intended requirement is:

- Zeolite will have a moisture content of less than 11.0% by weight per ASTM D 2216 (modified- see Table 2 below).

2.3 Zeolite Quality Control

A QC program will be implemented by BRZ and WVES to verify that the physical and chemical properties of the zeolite product meets the BRZ's published product specifications and is consistent with the zeolite used in the UB testing. QC testing will be performed both before and following shipping to the project site.

Based on representations by BRZ as to the uniformity of the zeolite geologic deposit and the similar mechanical testing results from BRZ's and WVES's sampling of the zeolite during the trial shipment, WVDP has calculated a reasonable, representative number of samples to be 33 based on a 95% confidence level, a 17% margin of error, and a population of approximately 2,000 supersacks produced. Therefore, QC testing will be performed, managed and documented by Lots of sixty 2,200 lb (one metric ton)

supersacks. This will allow BRZ and WVES to organize and document all of their sampling and testing data by Lot, which will then be the basis for WVES tracking and approval or rejection of the product as it is produced, shipped and received. WVES anticipates that the zeolite will be shipped by truck; each hauling 20 supersacks loaded onto a single flatbed truck trailer. The Lot size will then be equivalent to three truckloads of zeolite.

2.3.1 Pre-shipment Quality Control

BRZ will apply a QC Program while processing zeolite for shipment that will include QC testing of the zeolite product to assure that material meets the specifications identified herein and to be included in procurement documents. Based on the sample frequency and Lot size determined above, QC testing will consist of the tests and frequencies given in Table 2 below:

TABLE 2

PRE-SHIPMENT TESTING

Test	Method	Minimum Frequency
Sieve Analysis	ASTM C 136	For each Lot, once at the beginning and once at the end of the Lot's production.
Moisture	ASTM D 2216 (modified)[1]	For each Lot, once at the beginning and once at the end of the Lot's production.
Cation Exchange Capacity (CEC) Testing by UB	UB Modified Ammonium Chloride method	Once per Lot (composite).

1. Moisture determination by ASTM method D 2216 will be modified to decrease the drying time so as not to dehydrate the crystalline water within the zeolite mineral. The drying time will be limited to 2 hours.

Sieve analysis and moisture analysis will be conducted by the BRZ lab with an estimated analysis turnaround time of 7 days. CEC will be performed by UB with an estimated analysis turnaround time of 20 days.

Samples analyzed for CEC will consist of a composite (total of ~50 – 100 grams) of at least 10 individual grab samples representative of the zeolite produced within the Lot.

The grab samples will be randomly obtained across the Lot production to provide an accurate representation of the product Lot. UB will review the results of the CEC analysis and verify that the material demonstrates chemical properties consistent with the zeolite used during the laboratory test program (UB, 2009).

BRZ will utilize sample IDs that provide correlation between sampled material and material to be shipped to the WVDP in the associated Lot.

2.3.2 Post-shipment Quality Control

Upon delivery of the zeolite to the project site, WVES will conduct post-shipment QC activities. WVES will inspect zeolite supersack markings/labels to confirm only approved Lots have been received.

An unapproved Lot that is inadvertently received will be segregated from the approved Lots and/or labeled. From approved Lots, WVES will collect samples to test for material gradation using test methods in Table 3. Post-shipment gradation testing will be used to confirm the particle size condition of the zeolite following shipment and before it is utilized at the WVDP.

Because of the challenging logistics of storing the many supersacks that will arrive at the WVDP, two samples may be collected from a given zeolite Lot upon arrival. The samples will be collected from different, random supersacks in the Lot, one sample to be sent out immediately for sieve analysis testing and the remaining sample to be held in reserve. If the first sample exceeds the gradation specification, the reserve sample may be submitted for testing and a determination of the product acceptance may be made as discussed below.

TABLE 3

POST-SHIPMENT SAMPLING

Test	Method	Minimum Frequency
Sieve Analysis	ASTM C 136	1 sample per Lot

2.4 Product Acceptance and Corrective Action

2.4.1 Pre-Shipment

The WVDP will authorize, via e-mail or other written communication to BRZ, shipment of zeolite to the project site by individual Lots. Authorization will be based on pre-shipment QC sample results that satisfy the product requirements set forth in the above Product Specifications.

Zeolite product Lots that do not meet the requirements of Section 2.2 based on pre-shipment QC test results, will be rejected by WVES. Lot rejection notices will be forwarded (by e-mail or other written communication) to BRZ. If a Lot is rejected for any reason, WVES may require certain actions by BRZ, including increasing sampling frequency to assure that future Lots meet specifications. For example, if three or more consecutive Lots are rejected by WVES (because pre-shipment data continues to fall outside the limits specified in Section 2.2), the sampling frequency may potentially be increased.

2.4.2 Post-Shipment

Lot numbers (labeled on the supersacks) received at the WVDP will be compared to the Lot numbers previous approved for shipping from BRZ. Unapproved Lot(s) inadvertently received, will be segregated from the approved lots and/or labeled.

Approved Lots will undergo post-shipment QC sampling for sieve analysis testing as described above. By Lot, zeolite will be segregated and/or labeled by WVES QA as “Conditionally Released” awaiting approval of post-shipment test data. Zeolite product that does not meet the gradation criteria in Table 1 based on post-shipment testing will be conditionally held by WVES from use in the PTW. Conditionally held Lots may be retested (archived sample analyzed)

and the test results may be compared with the Lot's original post-shipment sample results. The Lot will be accepted for use if an averaging of the two results meets the acceptance criteria for gradation. The Lot will be rejected, labeled and/or segregated as such (to prohibit use within the final design extents of the PTW) if the resulting average is still in non-conformance. For product shipments deemed unacceptable by WVES based on post shipment sampling, BRZ mine will be required to develop and implement a corrective action and expedite shipment of an acceptable replacement zeolite to the WVDP.

3.0 PTW CONSTRUCTION

The PTW will be installed using a single-pass trencher capable of installing a 3-foot-wide zeolite wall to a maximum depth of 30 feet below grade surface. The single-pass trencher moves along the alignment and brings existing soil to the surface using a chain-saw-like cutting boom mounted on a tracked machine, similar to an excavator. The trench is immediately backfilled behind the cutting boom using a delivery system that resembles a moving trench box. Zeolite backfill material is loaded into a conveyor system at the front of the trencher that continuously delivers backfill material to a hopper located on top of the moving trench box system.

This section describes the quality control requirements and activities associated with construction of the PTW. WVES will maintain oversight of the PTW installation subcontractor in compliance with the WVES QA program. During construction activities, subcontractors will conduct work in accordance with their own standard procedures for construction.

3.1 PTW Construction Quality Planning

Quality procedures and testing will be implemented by WVES designated field engineer throughout the PTW system installation. Before PTW installation begins, the Subcontractor will be required to submit a Trenching Plan for review and approval by WVES. The Trenching Plan will include at a minimum, the following items:

- Trencher assembly and disassembly process (step by step description).
- Expected rate of advancement.
- Means and methods for laying out the work and providing staking (or other means) for monitoring PTW installation performance.
- Means and methods of adding zeolite material to the trencher during trenching operations.
- Zeolite dust control measures.
- Trencher spoils management showing how to transfer the spoils away from the trencher, and how to prevent the spoils material from making contact with the tracks and undercarriage of the equipment.
- Means and methods for adding water to the zeolite, so that the zeolite exiting the shielded section (Trench Box) of the trencher is fully saturated and creates equilibrium with existing hydrostatic and soil pressure. Also provide information on how the water will be provided to the trencher.
- Diagram of how the trencher enters the ground at the start of the trench and how it exits the ground at the end of the trench with the understanding that "full depth of trench" is needed at both the beginning and end of the trench.

- Means and methods utilized to address large boulders or other objects in the ground that the trencher cannot normally bring to the surface with the cutters on the excavator.
- Means and methods for visually showing the depth of cutter below grade and the baseline station as the machine advances.
- Means and methods for preventing groundwater or added water from passing from the zeolite addition side to the cutter side of the excavator.

WVES and the Subcontractor will conduct a Pre-Job Briefing before PTW installation begins in accordance with standard WVES procedures to promote clear communications between the subcontractor(s), WVES engineering, and WVES operations.

3.2 PTW Construction Quality Control

WVES will monitor and verify the following design parameters during installation in order to achieve the intended performance of the PTW:

- PTW alignment;
- PTW installation depth; and
- Zeolite quantity added to estimate the PTW thickness (width).

Quality control requirements for these parameters are presented below.

3.2.1 PTW Alignment

The Subcontractor will be required to survey the PTW alignment prior to installation, and the location will be maintained using offset survey markers. The PTW alignment will be marked-off at 5 foot station intervals so that WVES can verify the PTW installation is within design alignment tolerance. Subcontractor shall stop PTW installation activities immediately if WVES indicates a deviation of +/- 1.0 ft from the design alignment and respond according to Section 3.2.4 below. The Subcontractor may request minor changes to the alignment to facilitate installation or to maintain safe equipment operation. No change to the alignment will be allowed without explicit approval of WVES.

The PTW alignment will be verified during the installation phase, and a final survey will be conducted following installation. As-built drawings will be prepared to document the final alignment.

3.2.2 PTW System Installation Depth

During February 2010, soil borings were installed along the proposed PTW alignment to determine the depth to the underlying clay (Lavery till) that the PTW is intended to be keyed into. Thirty-four borehole locations were planned. Three additional borings were placed between initial borings in the area where the greatest depths to till were found to confirm that the maximum depth had been identified. The final design depths were established to maintain a minimum of three-foot key into the till layer.

The PTW system installation depth will be verified by monitoring the trencher cutter boom height relative to a fixed survey benchmark or the ground surface. WVES will verify and document that the PTW installation at each 5-ft station is consistent with the design depth. Subcontractor shall stop PTW installation activities immediately as

directed by WVES if the installed depth deviates +/- 0.5 ft from the design depth and respond according to Section 3.2.4 below.

Additionally, confirmation borings will be installed following installation to verify the PTW depth. The final confirmation borings will be installed post PTW installation in coordination with the performance monitoring well installation activities as described in the PTW Performance Monitoring Plan (AMEC, 2010) (to be incorporated and issued as a WVDP document).

3.2.3 Zeolite Width within the PTW

The actual width of the zeolite material installed within the PTW can only be measured directly at the surface. Indirect measures will be implemented to confirm that the minimum design thickness was successfully installed within the PTW.

These measurements generally consist of tracking the volume of zeolite installed over a given length of PTW at a given depth (referred to herein as a section). The rate of zeolite volume installed per design unit volume will be monitored continuously during the PTW installation. WVES will monitor and record the weight and volume of zeolite that is used to backfill the PTW trench. Each section shall correlate with the stations established above. WVES will compare the estimated design weight/volume of zeolite for each section to the actual zeolite installed and calculate an estimated installed PTW width. The Subcontractor will be required to stop PTW installation activities immediately if WVES observes a deviation of +/- 0.5 ft from the design width and the subcontractor will respond according to Section 3.2.4 below.

The general equation for estimating the average installed zeolite width is:

$$Width_{Zeolite} = \frac{Weight_{Zeolite}}{Depth_{Trench} \bullet Length_{Trench} \bullet Density_{Zeolite}}$$

The in-place density of the installed zeolite will be verified through core sample collection during completion of the post PTW installation confirmation borings described in Section 3.2.2. Core samples will be sent to a geotechnical laboratory to estimate the in place density. Additionally, core samples will be visually assessed in the field to document the in-place condition of the zeolite. Field measurements, observations, geotechnical laboratory results and calculations will be documented on forms and retained in the project files.

3.2.4 Deviation from Design Tolerances

WVES will stop the subcontractor if the trencher moves outside the limits specified as discussed above. The Subcontractor will provide a verbal means of recovery to WVES at which point the trenching may resume. If the Subcontractor cannot successfully rectify the deficiency, work will again be stopped and the Subcontractor shall be required to provide a written plan for recovery, which must be approved by WVES before proceeding.

WVES will work closely with the trenching subcontractor to determine the course of action in cases where the deviations from the design parameters are not readily correctable by the Subcontractor. Corrective actions may include changing the speed of the trencher unit, changing the speed/level of the zeolite feed system, modifying the water addition rate to the zeolite feed, or other subcontractor-controlled parameters.

Results from the installation monitoring and post PTW installation borings will be documented by WVES to create as-built drawings and to assist in performance monitoring evaluations. Sections of the wall that are not installed to the full design specifications may be targeted for additional focused performance monitoring as described in the Performance Monitoring Plan (AMEC, 2010) (to be incorporated and issued as a WVDP document).

4.0 DEVIATIONS FROM PLAN

Deviations from this Plan will be documented and approved by WVES QA and the Project Manager (or designee) in writing, or if appropriate, this Plan will be revised accordingly.

5.0 QUALITY ASSURANCE RECORDS

QA and QC records will be administered by the WVDP prior to, during, and following the zeolite product procurement process and PTW construction. Contract documents, submittals, certifications, test results, shipping records, Lot approvals/rejections, calculations, inspection records, and video and photographic documentation records will be maintained by the project.

6.0 REFERENCES

University at Buffalo (UB) 2009, Final Report, Laboratory Testing of Zeolite Materials, October 8.

AMEC Geomatrix Inc., 2010, Performance Monitoring Plan - Draft, North Plateau Permeable Treatment Wall, March 18. (to be incorporated and issued as a WVDP document).

WVDP RECORD OF REVISION

Rev. No.	Description of Changes	Revision On Page(s)	Dated
0	Original Issue	All	05/04/10
	EA and QA are affected by this issuance.		