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May 29, 2020

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Subject: Nuclear Metals, Inc. Superfund Site, Concord, Massachusetts
Remedial Design / Remedial Action
Remedial Design Workplan - Response to Initial Comments

The purpose of this letter is to provide a response to comments to support further discussion. It is our understanding that the comments received from EPA and AECOM are the initial comments on the Remedial Design Work Plan, and more detailed comments will be forthcoming.

For easier reference, each comment received is followed by our response.

We look forward to discussing these responses with you.

Sincerely,

Bruce Thompson

Attachment – Responses to Comments

cc: Garry Waldeck, MassDEP
Settling Defendants
Mark Kelley, PE, Haley & Aldrich, Inc.
Carl Elder, PE, Geosyntec Consultants

Appendix A – Sitewide Soils and Sediments

PDI SSS-1 Soil Characterization

- Appendix should ultimately incorporate the additional figures that were provided to EPA/AECOM showing the prior sampling locations that helped to determine where additional samples are needed.
- With the newly proposed soil/sediment sampling locations, is the thought that what is proposed in this PDI will be the majority of the data that needs to be collected prior to developing excavation plans using some sort of spatial averaging technique such as thiessen polygons? Or are the points proposed viewed more as a first pass with significantly more sampling to be done prior to developing excavation boundaries.
- A general comment is that ultimately whatever is proposed for confirmatory sampling will need to consider how the data will feed into a residual risk assessment.

Response: The additional Figures will be included in the RDWP as recommended. The proposed sample locations are intended to be the first pass with step-out sampling to be conducted as needed to adequately develop the lateral and vertical limits to the excavation boundaries. The data outside the established excavation limits will then be used with confirmatory sampling data to determine an exposure point concentration (EPC) for use in evaluating residual risks. Details concerning the methods for establishing EPCs and conducting the residual risk assessment will be provided in the Construction Quality Assurance/Quality Control Plan (CQA/QCP).

PDI SSS-2 DU Penetrator Investigation

- Details on how the top 6-inches of soil will be removed and handled need to be provided, whether added to Report or kept separately as an implementation plan.
- There are references to the gamma detector not being able to detect deeper than a few inches – if so, is it still appropriate to remove soil in 6” increments? Or would the ~3-6” interval not be adequately characterized. The plans also state the detector would be held no more than 4” above ground – if removing up to 6” at time, the bottom of that removed “sheet” of soil would have been up to 10” from the detector. Assume implementation plan would address this sort of question.
- Is there a maximum depth for 6-inch lifts proposed or the plan is to continue until no gamma impacts are noted?
- Has use of a portable XRF been considered for use during the PDI investigations? A review of on-line info indicates detection limits similar to that of the NAI detector (30 mg/kg) but with more specificity.

Response: Details of the DU Survey and soil handling will be prepared in an Implementation Plan. The depth of soil to be removed between scans will be refined based on instrument sensitivity; RSCS will provide details on their instrumentation operation and limitations. Soil screening will continue until no gamma impacts are noted. The use of a portable XRF was considered but that instrument could only be used to quantify uranium in soil samples (i.e., it cannot be used as ground scanning tool like a NAI detector), and since there is not a real time excavation and backfill requirement, there is time to allow for the analytical lab to turn around data for our decisions to backfill or contain the soils.

PDI SSS-3 DU Sub-Slab Investigation

- What is the rationale for the proposed depth (up to ~26 feet) of drilling in these areas, vs. other areas of soil removal where removal below 10 feet bgs is not contemplated. And will there be step out sampling on high hits in these areas extending to these greater depths?
- The concept of the investigations is to look for possible releases from former utilities and cracks in the slab within the building. However, based on construction on top of the former waste handling area, the potential also exists for subsurface contamination present that was left in place or manipulated prior to construction (up to 20 ft below current grade per RI report). Although the response to comments indicated that all borings in building E would be advanced to 20 feet, this did not occur, so there is limited information about contamination levels under the building E slab. Should this be addressed during the sub-slab investigation?
- Is there a concern that once the slab is removed and restored, the former impervious surface could now be subject to precipitation and groundwater infiltration? Should this be evaluated (i.e., consider performing SPLP analyses on high concentration sub-slab samples) or will slab removal be immediately followed by removal of contaminated soil below the slab?

Response: The initial borings proposed through the slab are intended to correspond to locations where utility penetrations and or cracks in the slab were identified during the Building NTCRA. It is unknown if there was significant vertical migration of material or if impacts are hung up in the shallow soils. The deeper analysis will allow for us to determine potential migration of compounds of concern (e.g., potential source to groundwater) and to eliminate the need to chase vertical migration throughout the area beneath the slabs or only within limits of utilities and/or cracks in the slab. Up to two additional borings will be conducted within Building E footprint to supplement the one currently shown on the Figures. Updated Figures will be prepared for the revised RDWP.

The concept we expect to explore for slab and soil removal is to conduct slab removal and impacted soil remediation progressively, to avoid exposure of large areas of impacted soil to precipitation. This process would start with removal of a section of the slab cover, then removal of the corresponding slab section, then remediation of that section of soil (to the extent soil remediation is needed). The work would then move to the next section of slab and continue until the entire slab and soil remediation is completed. There may or may not be any backfill needed to achieve reasonable finished grades other than loam and seeding to mitigate for future erosion. Regardless, we will coordinate finish grading and surface treatments with the Reuse Committee. The recharge areas that the buildings cover is significant, and it may be beneficial to allow for natural recharge to occur within the Building footprints following slab and soil removal. This will be part of the groundwater plume evaluations by Geosyntec.

PDI ISS-4 Cooling Pond, Bog, and Landfill Excavation Evaluations

- What is the purpose of the geophysical/test pit excavation of the septic system? Is the removal of the septic system appurtenances required/anticipated? If the septic system and its components were not to be removed, is there another area of the property where a new system could feasibly be installed for re-use? If not, there would be concerns about asking whoever redevelops the property to deal with potentially contaminated septic system material removal.
- If sheeting is anticipated to be required for the sediment removal in the bog, characterization (soil type and thickness) of the materials underlying the peat will be required to design the sheeting requirements. How deep are the hand probes anticipated to be? Characterization of the underlying materials is also likely to be required in the slope stability modeling. Can any of the transects proposed in the Proposed Slope Stability Investigation Plan shown in Appendix C, Figure 4 be extended to collect deeper data in and beneath the bog?
- It was previously believed that the Cooling Water Pond and sediments are 'perched' above the groundwater table, so it's not clear why potential recontamination of sediment is now a concern. Is the purpose of the evaluation to confirm this is the case under all hydrologic conditions? IF so, multiple rounds of measurements should be considered, because the differences in head are potentially seasonal. It should also be noted that existing sediment COCs targeted for removal (PCBs, copper) are not groundwater contaminants.
- There seems to be a limited amount of historic and proposed sampling for sediment in the cooling water pond, outside of the piezometer points proposed to be added. Should sediment samples be collected at these points to further refine the amount of removal required, or is it viewed as unnecessary because of the nature of the material in the pond (i.e., layer of "pond muck" just needs to be removed across the whole thing).

Response: We expect to remove or abandon the existing septic systems as part of the remedy. The Ground Penetrating Radar (GPR) is intended to confirm the locations of the septic system components, with some limited test pits to field truth the GPR and to collect some samples for chemical characterization of the soils underlying the leach field. In addition, the GPR and test pits will identify if drums or other debris is buried between the gabion walls north of the Cooling Water Recharge Pond (pond).

Sheeting or other temporary excavation support may be needed on the outboard side of excavations for sediment removal in the sphagnum bog to protect adjacent areas of the bog. Extensive measures would be required to provide drill rig access and protect the bog to obtain deep subsurface information during the PDI. Sediment samples from the bog will be collected during the PDI to depths possible without a rig. The Implementation Plan will provide a series of alternate methods of sediment collection. Although strength data may not be collected, grain size distribution and correlations with other borings nearby will be made to establish appropriate data if sheeting is needed to temporarily support the sediment excavation. Additional information determined to be necessary for design of temporary excavation support would be obtained during construction when heavy equipment access is established, and protective measures are in place.

The purpose of the piezometers is to evaluate the vertical gradients from the underlying sand to the soft accumulated sediment within the cooling pond. The perched condition may not be the case as there is limited addition of water into the pond under current hydrologic conditions. The seasonal low water condition of the pond will tie into the limits of “Land Under Water” as defined in the Wetlands Protection Act, so seasonal data of groundwater measured in the piezometers and the surface water elevations will be collected and used to develop the footprint of the future pond. It is understood that PCBs and copper are not necessarily compounds associated with groundwater, but they are the drivers for the sediment removal. We expect there is an upward gradient from the underlying sand into the softer sediment within the pond. The chemistry of this underlying sand layer needs to be better understood to make sure there are not compounds of concern in groundwater that could preferentially sorb onto newly placed organic soil that may become the new sediment benthic layer of the pond.

The sampling of the existing sediment will be expanded if the depth of the soft sediment is far greater than the amount necessary to be removed based on the chemical testing data. From a constructability perspective, it is anticipated that all the soft sediment will be removed across the entire footprint and not surgically remove only a portion of the soft sediment.

PDI SSS-5 Barrow Source Eval

- No initial comments

Response: There are some existing monitoring wells that are critical to the long-term monitoring and future monitoring of the ISS by Geosyntec so the limits of potential borrow material excavation will need to be updated to reflect these well locations. The general intent of the borrow source investigations will not be changed, but actual locations of borings may be adjusted if excavation of soils is not feasible if the network of wells is needed according to Geosyntec.

Appendix B – ISS PDI

PDI ISS-1 Sitewide Groundwater Monitoring

- Are results for metals total or dissolved? Concern about increasing concentration of natural U at shallow bedrock well ML-3-3 (barcad) at a concentration of 28 ug/L, higher than historically seen and approaching clean-up criteria. Presence of 1,4-dioxane indicates site related.

Response:

Total concentrations for metals are discussed in text and presented on tables and figures. For clarity, a table of all results for metals (total and dissolved) will be provided.

Although, the November 2019 detection at ML-3-3 is the highest reported for this well and the concentration is near the MCL, concentrations have been highly variable at this well and the 2019 detection is just slightly above the historical maxima for this well (26 µg/L) reported for the sample collected on 1 September 1999.

- Plume outline and iso-concentration lines under building for DU in overburden are heavily inferred and doesn't explain the DU at MW-SD01. How will RA injection locations be determined (i.e., more accurate 30 ug/L iso-concentration outline)?

Response:

The inferred DU isoconcentration contours are based on the most recent available groundwater data from November 2019. The DU concentration at MW-SD01 has fluctuated since the RI and may represent a stringer of elevated DU that has migrated south of MW-S06. However, the U concentration at MW-SD01 has not exceeded the MCL of 30 ug/L during 15 years of monitoring; therefore, this well is outside the area where ISS injections are likely to be considered for the RA. The concentrations detected at MW-S06 and MW-SD06 further bound the U plume downgradient of the former building.

Collection of groundwater data from beneath the former building is suggested in several EPA comments, so a well couplet will be installed through the former building slap west of MW-8A. This couplet would better define the DU plume beneath the former building and determine if the DU plume may be migrating south of MW-S02 and MW-SD02 toward MW-SD01.

This couplet will be constructed like MW-S02 and MW-SD02 with a well screened in deep overburden and a well screened across the water table. These wells they may be helpful for the ISS pilot test in overburden as an additional monitoring couplet. However, these wells are likely to be destroyed when slabs are removed so they are unlikely to serve as long-terms wells at the site. As mentioned in the RDWP, continuing monitoring is planned at MW-S/SD02 and MW-S/SD06.

- The results of MW-SO2 are discussed, citing historical results and claiming there is a significant decline in concentrations. But a review of the historical data shows results have fluctuated widely, without a clear trend. So it appears more data will need to be collected before definitively stating concentrations have declined. Is there a conceptual reason for why the results of this well have fluctuated so widely?

Response:

Concentrations have indeed been variable over time and MW-S02/SD02 will continue to be sampled. We are unsure as to the reason for this variability except to say that there is some variability at MW-8A where, there was a significant drop in DU concentration from 2013 to 2017, which was also observed at MW-S02. As noted above, an additional well couplet beneath the building is also proposed.

- Figure 2-5 is useful for looking at historical DU concentrations in overburden wells and comparing them to current ones. Please provide a similar figure for uranium in bedrock.

Response:

In the past, a figure has been presented with the historical U concentrations in bedrock wells. We will update this figure with recent data and provided it to EPA.

- A discussion of why uranium concentrations appear to be attenuating (i.e., biological activity) would be helpful, and if it has any implications on the remedy selection. It is notable that 1,4-D concentrations have not declined while uranium in bedrock has declined significantly.

Response:

As documented in Section 5.2.2.1 of the RI Report, it was hypothesized that solubilization of uranium bearing minerals in bedrock occurred as a result of altered bedrock groundwater geochemistry due to impacts from the Holding Basin. It may be that the decrease in U concentrations in bedrock is due to 1) removal of historical mechanisms that mobilized bedrock uranium (i.e. natural uranium in bedrock is no longer being released) and 2) dilution by non-impacted groundwater from upgradient areas.

Decreasing U concentrations and the lack of a continuing source has implications for the bedrock remedy which is why we have proposed testing short term pumping as a possible remedy. More specifically, data show that U concentrations in bedrock are attenuating (e.g., wells MW-BM03 and MW-BS03 in the centerline of the plume have shown a >50% decrease in U concentrations since 2013). Also, the maximum U concentration in bedrock is currently only about 70 ppb so another 50% reduction in U concentrations would yield bedrock groundwater near or below the MCL. Given this, we feel that it is prudent to stay openminded to a pumping approach since it may enhance effective attenuation which is ongoing and the pumping tests proposed as a PDI are needed to provide design information for ISS in bedrock.

- What is the geochemistry of overburden under slab (i.e., more anerobic than groundwater on both sides of slab)? Ate there potential issues on conditions being altered once the slab is removed?

Response:

Table 2-2B provides geochemistry of MW-8A and MW-S02 which are water table wells located immediately upgradient and downgradient from the slab, respectively. These wells both have aerobic and oxidizing groundwater with DO in the 8-9 mg/L range, ORP between 100 and 200 mV. pH of water at these wells is 5.95 to 6.25. These data would indicate that groundwater beneath the slab is aerobic and oxidizing with a pH near 6. Of these wells, MW-S02 is a reflection of groundwater migrating from beneath the slab - groundwater at this well is not, geochemically, very different from water at MW-8A on the upgradient side of the slab so groundwater geochemistry does not change underneath the slab. This is not surprising given the 50-60 feet of the unsaturated zone at the site. As mentioned above, a well couplet beneath the former Building D slab is being proposed.

- Have there been shifts in groundwater flows due to differences in recharge from precipitation since the building was removed and roof drains are no longer directed to the cooling water pond?

Response:

Although the buildings have been removed, the foundation slabs remain in place and an impermeable rubber membrane was installed on top of the slabs. The roof drains, which formerly discharged to the Cooling Pond, have been sealed and the precipitation runs off the slab as sheet flow and infiltrates into the surrounding ground surface, with no preferential direction to the flow. Although, the water levels in the Cooling Pond have been lower (de maximis, personal communication and 19 May 2020 Site visit), the groundwater flow direction and gradients in overburden inferred from the November 2019 data are generally similar to those reported in the RI report.

- Section 2.4.3 references VOCs detected above the cleanup level. What is the plan to meet cleanup levels for these VOCs – continue with 1,4-d extraction approach and hope for attenuation?

Response:

VOCs above clean-up levels exist but are smaller in their distribution and exceedance level compared to 1,4-dioxane. So, like the approach used for the NTCRA, treatment for VOCs is combined with treatment for more widely-distributed 1,4-dioxane with an understanding that capturing 1,4-dioxane will also capture VOCs (and knowing that the advanced oxidation treatment approach used for 1,4-dioxane destruction will also treat VOCs).

The highest VOCs are detected in three wells located upgradient of the Holding Basin HB-10, HB-10S, and HB-11 where PCE ranged from 7.7 to 42 µg/L. In the same three wells TCE ranged from 1.7 to 10 µg/L. TCE was also detected at 7.8 µg/L in a sample collected from MW-T10. Historically, the PCE concentration at HB-10 ranged from 25.5 to 73.1 µg/L with the maximum detected in 2011. At HB-10S, the November 2019 detection of 42 µg/L is the second highest detected compared to 60 µg/L 2005, and at HB-11 the November 2019 detection (7.7 µg/L) is the lowest detection compared to historical results of 8.1 and 22 µg/L detected in 2005. At MW-T10, the November 2019 TCE detection falls within the historical range of between 0.82 µg/L 2005 to 10.1 µg/L in

2013. TCE detections at wells HB-10, HB-10S and HB-11 have historically been below 3 µg/L. In general, VOC concentrations are within 10-fold of the MCL; in comparison, 1,4-dioxane concentrations are several orders of magnitude above the MCL.

Although, PCE and TCE concentrations in some wells exceed the Vapor intrusion Screening Levels (VISL), the depth to water in the wells near the Holding Basin exceeds 30 feet, and at wells MW-T10 and MW-S17 the depth to impacted groundwater is deeper than approximately 55 feet, therefore vapor intrusion does not appear to be a concern. Further, groundwater in the vicinity of higher PCE/TCE concentrations (i.e., near wells HB-10/10S/11) will be encapsulated by the vertical wall and cap as proposed in RDWP - Appendix C Holding Basin Containment.

- Section 2.4.5.1 references other metals detected above the cleanup level. What is the plan to meet cleanup levels for these metals?

Response:

In bedrock, these metals will be removed with uranium as a result of pumping at the proposed bedrock extraction wells. In overburden, treatability studies include analysis for metals to evaluate whether these are sequestered by Apatite II.

PDI ISS-2 Pumping and Rebound for Uranium

- Has the timeframe for evaluating potential rebound been considered? Concerns that what may be a reasonable rebound monitoring period may be too long in terms of coordinating future injections with any other ongoing site work?

Response:

Uranium in bedrock has attenuated since the RI/FS as noted above. Also, the amount of mass representing the U plume in bedrock is very small. The concept of pumping as a pre-design test is to explore if we can pump groundwater (and U from bedrock) – this will also provide an indication about whether it is feasible to pump ISS amendments into bedrock. Thus, pumping from bedrock is an analog to testing the implementability of ISS in bedrock and may have the added benefit of removing enough mass to show that U concentrations can decrease to MCLs reasonably quickly via attenuation. Therefore, there is ISS information to be gained from pumping <u>plus</u> a potential to see if pumping bedrock can be a more straightforward means for achieving project goals.

The timeframe for evaluating potential rebound has been considered, however, we have concluded that we cannot fully evaluate this until we have pumping data. When we have results for bedrock yields and contaminant concentrations over the time of pumping, we will communicate with the project team to discuss the viability of a pumping alternative, and if needed, a schedule and methods for injection testing will be proposed.

- A general note is that reaching the threshold to determine “yes pumping was effective we don’t need in-situ treatment” may be difficult to define. For example, would need to agree on rebound monitoring period. Also, if an area of bedrock shows a concentration of uranium in the high 20 mg/l range, at what point do we say it is sufficient even though the ROD called for in-situ treatment which would theoretically provide more long term certainty about the effectiveness of the remediation. Thinking about this in the context of forgoing the in-situ bedrock treatment requiring an ESD or ROD amendment—may be a difficult bar to get over.

Response:

As described in comments above, U in bedrock is attenuating and this is expected to continue. Pumping is proposed as a means to test a key component the implementability of an ISS remedy for BR (i.e., the ability to deliver amendments into bedrock) while also removing mass and potentially identifying an alternative approach which achieves project goals more straightforwardly (i.e., pumping or pumping with natural attenuation).

However, we agree that the threshold at which it could be determined whether pumping is effective or not would be difficult to define. As stated above, when we have results for bedrock yields and contaminant concentrations over the time of pumping and after pumping, we will communicate with the project team to discuss the viability of a pumping alternative, and if needed, a schedule and methods for injection testing will be proposed.

- Is there concern about the potential for open boreholes to spread contamination in bedrock?

Response:

Although there is a potential for open borehole flow to spread contamination in bedrock, the vertical hydraulic gradients within bedrock inferred from November 2019 data for well pairs MW-BS03/BM03 and MW-BS15/BM15 indicate upward gradients at these locations located along the centerline of the uranium and 1,4-dioxane plumes. This indicates that there is a low risk of spreading contamination to deeper bedrock.

Open boreholes are recommended to have wells which produce enough yield. The investigation program also includes testing to determine where water bearing fractures are along the borehole. If strong downward gradient are observed in BR wells, then we may propose individual sealed well screens within the borehole or even a solid FLUTe™liner.

PDI ISS-3 Pilot Test in Overburden

- Should injections into till be considered as it is possible source of back diffusion?

Response:

ISS injections are not planned for till because the till is not believed to be a significant source zone or migration pathway for DU. Concentrations of DU in monitoring wells screened in till in the pilot test area are significantly lower than in sand (e.g., 59.8 ug/L in MW-T24 versus 2,675 ug/L in MW-S24). Given the relatively low hydraulic conductivity of the till and how thin till is, ISS treatment is targeted toward the stratified drift units where the majority of DU mass is located and U mass flux is occurring; overburden ISS includes injections into the deep overburden which will sequester U potentially migrating up from till.

- Ultimately, is the vision that the ROI for all injection points would overlap in the area of the overburden where the MCL is exceeded? Or is the idea that some of the overburden with levels exceeding the DU MCL would be left to “flow through” reactive zones and ultimately be treated. Given how long it took DU in overburden to spread across the property, what sort of timeframe would this look like?

Response:

It is likely that treatment of groundwater flowing through the reactive zones will result in decreased DU concentrations downgradient of the reactive zones, and the timeframe for treatment downgradient of the reactive zones will be assessed as part of the pilot test. In each of the two pilot test areas, the performance monitoring well network includes monitoring wells within the injection ROIs and downgradient from the injection ROIs. Spacing of injection points, the degree of ROI overlap and the expected timeframe to achieve the MCL will part of full-scale design and based on DU concentration trends in pilot test monitoring wells along with estimated seepage velocities from hydraulic conductivity and recently hydraulic gradient data (as well as results from tracers injected during the ISS pilot test).

- What about testing injection into the holding basin? Does not appear to be proposed under this PDI or as part of the holding basin PDI. Sufficiently different material it may require its own testing, have significantly different ROI, etc? What about sequencing injections in the HB vs. constructing the containment wall?

Response:

There is significant risk to the liner as well as human health when working in/through the holding basin. Soils from beneath the holding basin will be collected and tested in the laboratory as described in Appendix E of the RDWP, but field pilot testing is not planned for the holding basin. Results of the ISS pilot testing performed immediately outside of the holding basin will be used to design ISS for saturated soils beneath the holding basin. Since the formation is the same beneath and immediately outside the holding basin, and all the sludge emplaced in the Holding Basin has been removed, we do not recommend incurring the risks and logistical challenges associated with working inside the holding basin when the injectability of ISS amendments into the aquifer can be equivalently tested using pilot-scale injection outside of the holding basin.

ISS Injections will likely be performed before constructing the containment wall to avoid having ISS injections potential damage the wall.

- Pilot test 1 assumes a ‘granular’ reagent and pilot test 2 assumes a ‘soluble’ reagent. Shouldn’t the reagent type for each area be determined by the results of the treatability studies?

Response:

As described in Section 4.3.1 of Appendix B, the reagent(s) for the ISS pilot tests will be selected based on the results of the treatability study (Appendix E). The ISS injection approach presented in the RDWP was developed to provide EPA with a pilot test design for each type of potential reagent (solid versus liquid). If reagents identified by treatability studies warrant a change in the injection approach, then these testing programs will be updated/modified prior to implementation.

PDI ISS-3 Pilot Test in Overburden

- No initial comments/questions

Appendix C – HB PDI

PDI-HB-1 Bedrock and Soil Characterization For Containment Wall Design

- Is there a concern of spreading contamination with the bedrock borings?
- The plan acknowledges portions of the pumphouse infrastructure may need to be removed, but what is the ultimate plan for the pumphouse foundation itself?
- The PDI appears to assume a Hydromill will be used to install the containment wall. Are any other technologies under consideration, and if so, will the boring program provide the necessary data?
- Is the bedrock data proposed to be collected also sufficient for any possible bedrock grouting that would be required to encapsulate the HB material?

Response: The borings proposed are all intended to be advanced with casing and using a drive and wash drilling method above the bedrock. This method will limit the potential to dragging contaminants downward during the drilling process. The rock core will be conducted through the cased hole, and the observation wells or CMTs will be grouted or installed with bentonite to isolate zones and to minimize the migration of contaminants from one lithology to another.

Based on our review of existing foundation details of the pump house and the alignment of the proposed containment wall, it is expected that much of the existing pump house foundation can remain as the wall will contain the majority of the pump house. A shallow portion of the pump house building slab will be removed for the construction of the containment wall. Test pits are proposed on the north and south sides of the pump house to confirm the design drawings are accurate and that our proposed limited foundation removal is feasible and appropriate.

The PDI assumes that a hydromill will be used to construct the portion of the wall below bedrock as necessary. It is likely that a clam shell bucket will be used under slurry to excavate the portion of the containment wall above bedrock. It may be more efficient to switch over the tooling from clam shell to hydromill at the top of glacial till, as the till is expected to be very dense with cobbles and boulders that are difficult to excavate with a clam shell. The proposed borings and soil samples being collected are suitable for other construction methods including secant piles or even grouting of discontinuities encountered in the bedrock.

PDI-HB-2 Seismic Evaluation

- No initial comments, might benefit from some sort of presentation on this given the uniqueness.

PDI-HB-3 Bench Scale Testing of Wall Mix Designs

- This section would benefit from additional discussion of why these specific mixes were selected. Are alternative pozzolanic materials and mixtures being considered?

Response: The mix designs will be developed as part of the PDI. A total of five will be developed that meet the strength and hydraulic conductivity parameters to be determined during this data collection phase. It is anticipated that one alternative admixture to the mix design is Xypex that would reduce the hydraulic conductivity of the concrete significantly.

PDI-HB-4 Characterization of Soils for Cover Design and Slope Stability

- *No initial comments/questions*

PDI-HB-5 Seepage Analysis for Containment Wall Design

- General question – how much effort is it worth spending to determine if containment wall can be advanced only to till vs. bedrock, considering how much of a problem it would be if evaluation determined only till was necessary but it did turn out to be a pathway. Could the design recover from that?

Response: The level of effort to evaluate the containment wall embedment into glacial till is minor once the model is set up. The design is to be a robust design that looks at the containment wall as an effective cutoff to existing and future groundwater flow pathways. The glacial till may be too thin to provide an effective cutoff so depending on the subsurface conditions the evaluation of the wall embedded into the till may be eliminated from the analysis. In the event till is at least 10 ft. think across the entire wall footprint then the seepage will be evaluated with the toe embedment of the wall within the till strata.

Appendix D – 1,4-D and VOCs in GW

- Two of the proposed open bedrock wells for uranium (BEW-1, BEW2) are not proposed for 1,4-dioxane rebound testing. What is the rationale, given that the 1,4-dioxane exceeds the MCL at both locations? Data viewed as unnecessary? To avoid managing uranium contaminated GW?

Response:

The 1,4-dioxane remedy is intended to provide containment, like the NTCRA. This differs from the U remedy which is to pump bedrock from throughout the plume to remove mass.

Given this difference in goals from pumping, wells for 1,4-dioxane rebound testing are focused on reducing mass in the highest concentration BR. However, samples collected during pumping of BEW-1 and BEW-2 can be analyzed for 1,4-dioxane.

- Is there a need to determine if there is a source or to define the impacts upgradient of MW-BS7-2? This well shows a relatively high concentration and there are no nearby bedrock wells with lower concentrations. Figure 2-7 of appendix B showing the 1,4-dioxane plume indicates the iso-concentration line for the cleanup criteria of 0.46 ug/L has not been defined north and east of this single well.

Response:

MW-BS7-2 is located immediately downgradient of the holding basin which is a source of contamination at the site, so while an upgradient well would be prudent at most site, such a well is not necessary for NMI since the holding basin can be presumed as the source. Also, a well upgradient of MW-BS7-2 would need to be installed through the HB which poses high risk.

Given that the 1,4-dioxane remedy is being design for physical containment within the holding basin and hydraulic containment downgradient, knowing 1,4-dioxane concentrations upgradient of MW-BS7-2 would not change the remedy. Therefore, we do not recommend installing a well which would be a high-risk event when the resulting information would not change the conceptual remedy. If H&A wells around the HB can provide groundwater samples, then these may be analyzed for 1,4-dioxane, but again, the data would not change the pumping design for 1,4-dioxane.

Appendix E – Treatability Study

- General: Has Sandia National Laboratory's hydroxyapatite barrier approach been considered for pilot study testing? AN apatite barrier is formed in situ in soil by injection of chelated calcium and phosphate solutions which combine following microbial degradation of the calcium citrate to precipitate hydroxyapatite. It has been demonstrated to be particularly successful in sequestering uranium. IT is a patented technology but may be worth considering.

Response:

This is a good question that deserves a little background. As part of the RI, we had discussions with scientists from the Pacific Northwest National Laboratory – PNNL, located at the Hanford Site. PNNL used a soluble phosphate and calcium amendment to form apatite in-situ. We sent them our data and after reviewing our hydrogeologic regime and groundwater geochemistry, their recommendation was to use solid apatite if it could be injected directly and not rely on a liquid amendment that needs to have an in-situ reaction occur as a precursor to the sequestration reaction. In fact, it was the recommendation of Dr. Dawn Wellman, Division Director at PNNL, that led us to investigate the use of Apatite II from PIMS. Based on conversation with PNNL, we did not consider trying to form apatite in-situ and did not evaluate the chemistry of the reaction with conditions at NMI. So, while the Sandia approach could be feasible at NMI it requires biological and chemical reactions to occur in-situ to form apatite as a precursor to the sequestration reaction of U to apatite. A simpler and more reliable approach is to inject apatite directly as suggested by scientists at PNNL.

We are happy to discuss alternatives after results of the treatability testing are known.

- Why is STPP proposed for bedrock only, why is SMP propose for overburden only?

Response:

The use of STPP for BR and SMP for overburden is based on solubility and reaction timing and hence the ability to distribute the amendments into BR versus overburden. The table on page 2 of Appendix E describes these properties and why each chemical was selected, but in summary STPP is selected for BR because it is more soluble and slower to react so it may better distribute in BR where permeability is lower. In overburden, permeability is higher so distribution should be less challenging and therefore SMP is preferred.

TS-ISS-1 Holding Basin Soils

- The well proposed for low uranium concentration appears to have much lower native metals concentration than typically seen in other wells. Is this considered representative of groundwater in contaminated areas? Another well to consider would be MW-SD01, which appears more similar in composition and has DU of 8 ug/L.

Response:

We understand your concern and are consider alternative wells for low concentration groundwater. We are looking at groundwater geochemistry at several wells to pick this source.

- Does it make sense to evenly mix the amendments in the column? When in reality injections would not result in even mixture across the HB area?

Response:

We are not trying to model an individual fracture in the columns. Rather, we are modeling groundwater flowing through the bulk aquifer with apatite emplaced. As such, the columns will model the average apatite mix as a percent of aquifer materials.

If the goal of the treatability testing was to model a fracture, we cannot do it in a 3-inch column because lenses are horizontal and discontinuous, and lenses will work within the aquifer as a system. If we wanted to attempt to model this, we'd have to create a large "sand box" model to represent the discontinuous lenses within an aquifer. Creating this type of a physical model is infeasible due to cost and challenges related to accurately representing the aquifer (e.g., depositional layering). Instead, column tests are designed to look at bulk treatment for a percent apatite in soil, and then pilot tests are performed to assess in-situ performance.

- When running the column test in the different influent redox scenarios across the 4 weeks, how do you account for uranium not just having been flushed out during the earlier parts of the column test? Can you accurately compare effluent concentrations in week one to week four, or is it more just to see if there is remobilization, and the exact concentrations aren't important because it is relative?

Response:

The changing redox is to look at remobilization (e.g., will there be an increase in U concentration in effluent after changing redox of influent).

- Is there a threshold for results which would indicate that neither the apatite or ZVI appear to have worked adequately?

Response:

Ideally, we will achieve U under 30 ppb, but this is not necessarily needed in the treatability study. The treatability study looks at percent U reduction for what we feel is an achievable amount of apatite that can be emplaced. This percent reduction for a treatment zone determined in treatability testing will be extrapolated to site needs as part of design to determine extent/amount of treatment zones.

TS-ISS-2 Overburden Groundwater

- Again, does it make sense to evenly mix the amendments in the column tests, or can a ISRZ from an injection be more closely simulated.

Response:

A 3-inch column is too small to model physical characteristics of amendment distribution and the aquifer. Columns are intended to represent the treatment area as a whole and not an individual lens.

- Why are the amendments proposed to be tested only with the most highly contaminated groundwater? Would it not make sense to also test groundwater contaminated at levels closer to the MCL to see if adequate treatment is still achieved?

Response:

ISS is not like a biological reaction where certain mass is needed to support a reaction. As a chemical reaction, ISS is more akin to a GAC system where if treatment achieves goals at higher concentrations it is very likely to work at lower concentration. Nevertheless, field pilot testing is designed to be implemented in higher and lower concentration areas of the overburden U plume to confirm the effectiveness of the technology throughout the overburden plume.

TS-ISS-3 Bedrock Groundwater

- Any ability / opportunity to test bedrock that is collected for potential back diffusion of uranium prior to going through rest of the batch/column protocol?

Response:

The site was impacted decades ago and there is clear evidence of decreasing U concentrations in BR (see also response to prior comment about the mechanisms causing attenuation of U in bedrock). We don't feel that a laboratory back diffusion experiment, which artificially extracts U, would be more insightful regarding attenuation of U at the site than the ongoing record of GW data. Based on groundwater data from the bedrock U plume, we also don't think a release of U from back diffusion is likely.

- Again, is there value in testing less highly contaminated bedrock groundwater closer to the MCL?

Response:

Highly contaminated is a relative term. The highest contaminated BR groundwater is 70 ppb (~2x the MCL). Given the nature of sequestration (i.e., similar to sorption with GAC), if it is effective for groundwater with U closer to 70 ppb then it is very likely to be effective for groundwater >30 ppb.

<u>Appendix J – QAPP</u>

- Worksheets 35 and 36 are listed in the table of contents but not provided in the QAPP, please forward.
- The text states Appendix J-1 is available on the portal, but it does not appear to be.

*no comments/questions on other appendices for the time being.