



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1 – NEW ENGLAND
5 POST OFFICE SQUARE – SUITE 100
BOSTON, MASSACHUSETTS 02109-3912**

May 1, 2018

Mr. Peter Britz, Environmental Planner
City of Portsmouth Planning Department
1 Junkins Avenue
Portsmouth, NH 03801

RE: Coakley Landfill Superfund Site
March 21, 2018, *Draft Deep Bedrock Investigation Work Plan*

Dear Mr. Britz:

The United States Environmental Protection Agency (USEPA) is in receipt of the *Draft Deep Bedrock Investigation Work Plan* (the "Draft Work Plan") submitted on March 21, 2018, by CES, Inc., on behalf of the Coakley Landfill Group (CLG). The Draft Work Plan was submitted in response to USEPA's letter of January 18, 2018, directing the CLG to initiate a bedrock investigation at the Coakley Landfill Superfund Site (the "Site").

As stated in the January 18, 2018 letter, USEPA, in consultation with the New Hampshire Department of Environmental Services (NHDES), has determined that because of the increased use of groundwater from bedrock in the area of the Site, the lack of any direct measurements from the deep bedrock aquifer at the Site, and the discovery of new contaminants that have different fate and transport characteristics from the contaminants historically investigated at the Site, an investigation must be conducted on the bedrock aquifer at the Site. The overall objective of this investigation will be to identify and characterize any hydro-geologic pathways in deep overburden and bedrock, along with groundwater conditions in the deep bedrock at the Site and adjacent areas, to characterize the potential for the migration of site-related contaminants to local receptors.

Following submittal of the Draft Work Plan, USEPA, NHDES and its' representatives met with CLG and its representatives to discuss the details of the Draft Work Plan and to discuss questions and comments related to the Draft Work Plan. That meeting was held at NHDES offices in Portsmouth, NH on March 30, 2018 (minutes attached). Based on review of the Draft Work Plan, which USEPA and NHDES have determined did not provide details requested in USEPA's January 18, 2018 letter, and the discussion during the meeting on March 30, 2018, USEPA provides the following comments and conditions to be incorporated in to a Final Work Plan:

1. The CLG shall identify data quality objectives for the bedrock investigation, and shall prepare a sampling and analysis plan (SAP) and health and safety plan (HASP) specific to the bedrock investigation.

2. Section 1.2 of the Draft Work Plan details the approach to the investigation, but fails to specify the evaluation and identification of contaminants of concern (COCs) (nature of contamination), identification of contaminated media (characterization), distribution of contaminants in each media (delineation) and contaminant migration pathways for those media (fate & transport), including potential intermedia transport processes, as key elements of the approach. These elements are critical components of any bedrock investigation and should be discussed in this section.
3. Prior to installation of the two well couplets specified in Section 5, Phase II of the Draft Work Plan, surface geophysics shall be performed in the vicinity of the proposed well locations to identify subsurface bedrock features that may further refine placement of the new wells and/or confirm previously identified lineament interpretations for the Site. Based on the results of the surface geophysics, and after consultation with USEPA and NHDES, the proposed locations can be adjusted to make a best attempt at intercepting key subsurface bedrock features identified by the surface geophysics. Although, the well locations shall not be moved more than 50 feet from the current proposed locations. The CLG shall describe the surface geophysics to be used, which may include electrical resistivity, seismic reflection/refraction, and low frequency ground penetrating radar.
4. In addition to the two well couplets to be installed as specified in Section 5, Phase II of the Draft Work Plan, USEPA and NHDES have concluded through the review of historic site data (lineament study, contaminant migration pathways and orientation of surface water features west of the landfill) that an additional well couplet is warranted near the western GMZ boundary just north of the Greenland/North Hampton town line. Surface geophysics shall be performed at this location to identify subsurface bedrock features that may further refine placement of this well location.
5. The two well couplets specified in Section 5, Phase II of the Draft Work Plan, plus the additional well couplet to be installed near the western GMZ boundary just north of the Greenland/North Hampton town line, shall be drilled no later than June 30, 2018. Downhole geophysical surveying shall be conducted immediately following the drilling of the wells. Packer interval sampling shall be conducted immediately following receipt of the borehole geophysical data and consultation with USEPA and NHDES regarding which fracture zones shall be isolated for sampling.
6. The Draft Work Plan indicates that a review of the remedial investigation files had identified 11 bedrock monitoring wells (Table 2 lists 13 open boreholes) as being open boreholes varying in depth from 100 feet to 252 feet below ground surface, and that a site reconnaissance would be conducted to determine the viability of these wells for downhole geophysical logging and packer testing and that “up to four wells (if viable) will be selected for testing using an approach similar to the new deep bedrock wells.” The CLG shall prepare a table that provides the well location and characteristics as identified in the boring logs, along with the current condition, depth and viability for testing. This table shall be prepared and submitted to USEPA and NHDES following review and inspection of these wells. For those wells that are determined to not be viable for testing, the table shall indicate if the well can be repaired or redeveloped to facilitate the testing. Downhole geophysical logging and packer testing as specified in the Draft Work Plan shall be

conducted for all the bedrock boreholes that are determined to be viable for testing, or can be repaired or redeveloped. A final list of wells considered to be viable for further testing should be prioritized, including the rationale for selecting each location.

7. The CLG shall update the well inventory for the Site and include all overburden and bedrock wells and all non-Site wells (residential, water supply, irrigation, etc.) that are currently or were historically monitored. The CLG shall develop figures depicting the bedrock monitoring well network at the Site along with all other non-Site bedrock wells that are identified and currently or historically monitored. The final report shall also make recommendations for any additional monitoring control necessary to fully characterize the extent of the contaminant plume at the Site, in all key media and zones.
8. The CLG shall conduct mapping of the bedrock outcrops along the Breakfast Hill Golf Course and utility easements west/northwest of the Site to identify fracture orientations and other important geologic features in the intervening area between the landfill and the northwestern developments.
9. The CLG shall develop an updated contour map of the elevation of the top-of-bedrock surface that incorporates all existing data and information, along with the new data and information obtained through this investigation.
10. The CLG shall develop a proposal for conducting a pumping test(s) in appropriate locations and scales of investigation to assess bedrock fracture connectivity.
11. The bedrock investigation shall include an evaluation of existing lineament interpretations relative to the potential for contaminant migration from the Site. The lineament data shall also be considered and incorporated into the updated map of the bedrock surface.
12. Along with the well couplets to be installed to characterize the expanded GMZ and near the western GMZ boundary just north of the Greenland/North Hampton town line, additional bedrock boreholes may be required to fully characterize the potential for contaminant migration in bedrock. USEPA and NHDES may specify the need for additional bedrock boreholes based on the data and information gathered as part of the initial phases of the bedrock investigation.
13. Section 3.3.1 of the Draft Work Plan cites horizontal velocities of 64.1 to 320 ft/yr to the east. However, the groundwater contour map in Figure 10 does not show any component of flow to the east, and the discussion throughout section 3.3.1 repeatedly states that there is no current flow to the east. A similar condition is cited for the south or southwest vector velocity given for the Lafayette Terrace area, where there is no flow to the south shown on Figure 10. This interpretation should be reviewed and corrected as appropriate based on data collected as part of this investigation.
14. Section 3.3.2 of the Draft Work Plan discusses vertical hydraulic gradients between bedrock and overlying units. The CLG shall collect water elevation data quarterly from the existing monitoring network, and any new wells installed, or existing and redeveloped, during the bedrock investigation to further understand/ confirm vertical gradients in

bedrock and gradients between overburden and bedrock hydraulic units. This data shall be used to further inform the characterization of the hydraulic gradient between surface water, wetlands and bedrock, and identify data gaps related to this interaction.

15. Section 3.3.3 of the Draft Work Plan concludes that because there was no 1,4-dioxane and very little PFAS detected in the Chinburg well, and that only low concentrations have been detected in water supply wells R-3 and 339BHR, that there is no 'significant' pathway to the north. USEPA and NHDES do not agree with this conclusion. The continued detection of 1,4-dioxane and PFAS at R-3 and 339BHR provides evidence that there may be a pathway from the landfill, along the lineaments associated with the bedrock trough west of the Chinburg well that extend to the north and that offsite migration may be ongoing via pathways not intersected by the Chinburg well.
16. Section 5 of the Draft Work Plan references Figure 12 which was not provided.
17. Any data gathered from monitoring wells GZ-109, MW-6, GZ-122, GZ-125 and GZ-130, which are identified in Table 2 and included with the boreholes for which viability will be determined and possibly surveyed and sampled, shall be evaluated to characterize southern migration potential.
18. Figures and Tables:
 - Figures 2 and 4 include cross section designations and it is not clear if these cross sections are represented in Figure 5 or 6, or both.
 - Figure 3 may be more effective if the depth to till is reported for each well location and if each well is designated as overburden or bedrock. Similar figures for marine deposits and glacial outwash deposits should be included, along with the cross sections.
 - It is difficult to distinguish photolineament lines in Figures 4 and 8. New figures and maps developed from the bedrock investigation shall distinguish the photolineament lines so that they are discernable from edges, directions, contours and boundaries and other lines shown on the figure. The lineament analysis should be supplemented with data from other studies completed within the study area by the USGS, local water purveyors, and others.
 - Figure 10 – Based on the measured groundwater elevations in wells OP-5, FPC-9A, and GZ-117, there appears to be a small, but discernable, eastern component of groundwater flow. Understanding that the 5-foot contour intervals do not provide sufficient definition of groundwater contours to show eastern groundwater flow in this area, the data warrant further consideration of this flow component.
 - Figure 11 – How is it that the eastern boundary of the drainage divide correlates exactly with extent of landfill and Greenland/Rye town line? Updated LiDAR data shall be used to update surficial conditions and to develop surface topography mapping.
 - Table 2 – MW-6 and any other bedrock open borehole that is not screened, should not include a screen length designation. The screen length should be given as 'Not Applicable' for any open boreholes. Future tables shall provide specific fracture zones that have been isolated for sampling as identified from the downhole geophysics.

The CLG shall prepare a Final Work Plan that incorporates the comments and conditions above and includes a schedule for implementation of the Final Work Plan and submission of a final report. The Final Work Plan shall be submitted within 20 days of receipt of this letter.

Section VI.10 of the 1999 OU-2 Consent Decree provides USEPA approval/ disapproval authority of the CLG proposed supervising contractor. The pending bedrock investigation is significantly more technical in nature than the annual monitoring activities and therefore warrants a review of the qualifications of the supervising contractor. USEPA hereby requests that the CLG submit a statement of qualifications and project experience, specific to experience with the investigation and remediation of sites affected by contaminated groundwater in bedrock, for its current supervising contractor and any other contractors that the CLG may be considering for developing and implementing the Final Work Plan. The statement of qualifications shall be submitted within 10 days of receipt of this letter.

If you have any questions or comments regarding this letter, you can contact me at (617) 918-1882 or Hull.Richard@epa.gov.

Sincerely,

A handwritten signature in cursive script, appearing to read "RW Hull".

Richard W. Hull, Remedial Project Manager
New Hampshire and Rhode Island Superfund Program

cc: Andrew Hoffman, NHDES
William Brandon, USEPA
Jim Murphy, USEPA
RuthAnn Sherman, USEPA

Meeting Summary
CLG draft Deep Bedrock Investigation Work Plan
March 30, 2018, 11:00 – 1:00
NHDES Portsmouth Regional Office

Present: Skip Hull, Bill Brandon, Jim Murphy, EPA; Drew Hoffman, NHDES; James Soukup, Weston Solutions/Consultant to NHDES; Peter Britz, CLG; Mike Deyling, David Chapman, CES/Consultant to CLG

Intro / Background

CLG presented a brief history of the bedrock investigation process to date. Initial discussions were conducted at a technical meeting in March 2017 and subsequent discussions during 2017 focused around refinements and specifics (geophysics) of the locations and installation of the GMZ compliance wells. The request for a formal bedrock investigation work plan was made by EPA in January 2018. CLG's plan has been to incorporate the intent of the letter and provide a framework for the work plan by reviewing data from the two RI's, existing info available through USGS, UNH, and Aquarion, and incorporating that relevant data along with 30 years of site monitoring data. CLG is confident that its information and data about the overburden and shallow bedrock to date is reliable. Their understanding is that deep bedrock is considered to be approximately 300 feet into bedrock as many of the residential wells are in the 200 to 300-foot depth range.

CLG Assumptions / Observations

CLG has observed and maintains that the preferential groundwater flow direction at the site is west and north, where the nearest residential wells, plus the Chinburg well are located. While it is possible that there may be easterly flow from the site, residents in those areas are on public water. Thus, CLG's view is that the primary focus of the investigation should be west, northwest, and north of the site.

CLG's estimation is that the levels of contaminants in groundwater is stable overall around the site. With the exception of two water supply wells, 1,4-dioxane is not being seen. CLG believes that PFAS at 1-3 ppt levels at area residential wells may be expected as background concentrations. The golf course clubhouse well is an exception, but its use is different from the residential wells. CLG has discussed use of residential wells for geophysical surveying, and while they may be helpful, there is hesitancy to include wells not under their control for any work beyond sampling. They would consider taking over Chinburg well pending discussion on access and ownership specifics.

Other observations from CLG:

- The Packer testing of Chinburg well was useful and high angle fractures, competent sections of rock and some deeper fractures were noted among other observations.
- Beneficial information was obtained through communication with Aquarion – many of their wells are gravel wells. Not many bedrock supply wells currently exist within the company's water supply system.
- CLG believes that Berrys Brook and Little River are gaining streams.
- The Falls Way/Ridgecrest Drive residential area is outside the watersheds impacted by the Coakley Landfill.

CLG's basic approach is to complete the GMZ compliance wells, but is still unsure on the exact location of the well closest to Breakfast Hill Road and would like to discuss further today. CLG assumes a full testing package on these wells and can talk specifics today. Among questions to answer through the

bedrock investigations is whether there is information that indicates that contaminants are migrating down into deep bedrock and toward off-site receptors above applicable standards..

Public access to data and info

There was discussion of how prescribed the reporting should be as CLG develops new information during this “research phase”. The assumption is that all info would be made available to the public particularly related to decision points, i.e., a decision to do geophysics on wells based on boring logs, etc. It is envisioned that information exchanged would be comprehensive, but informal to keep things moving. Emails, letter reports, and tech memos can be used to transmit info and be made available to the public via NHDES’ OneStop database and the EPA webpage.

Review / comparison of site figures and maps.

There appears to be inconsistencies in lining up the various historic and current maps/figures which contain GMZ boundaries, the expansion lines, town lines, wetland boundaries, lineament interpretations, and other features/information which have been overlaid on figures at different points since the original RI. **Needs to be reviewed / corrected.**

Discussion of surface geophysics

EPA & NHDES noted that observation and inclusion of surface geophysics has been insufficient in determining the exact location of the proposed NW area GMZ compliance wells. Surface geophysics can be easily accomplished and would provide more confidence that wells are in the right zone and these methods should apply to any additional well installations moving forward, including the drilling of the GMZ compliance wells scheduled for June.

While there may be some surface geophysical info (seismic survey by Weston) available from the RI period that can be obtained and potentially utilized, the methods used back then for surface geophysics were quite primitive compared to methods available today. The better approach would be to look at what was done in those days supplemented by modern methods and put together a model. Due to the lack of geophysical surveying since the RI, there is a need for a lot of upfront work to provide a better result.

There was extended discussion of technologies to consider regarding running a geophysical line along Breakfast Hill Road: seismic reflection, seismic refraction tomography, multi-channel analysis of surface waves; ground roll energy which is slightly different than the refraction method, ground penetrating radar. Another method that could be useful is (ERT) electrical resistance tomography.

There was additional discussion regarding different methods to map and characterize the bedrock fracture system, including mapping outcrops; surface geophysics; borehole geophysics; groundwater elevation monitoring. In addition to methods of micro-locating a well, there is a more regional/ large scale type of geophysics which includes looking for regional features in a larger area such as the golf course or the utility easement. Aquarion has done a lot of mapping in preparation for siting of its water supply wells and other similar info is publically available.

Existing bedrock boreholes

CLG has identified eleven existing bedrock boreholes that were established as part of the RI but which have not been surveyed or recently sampled. CLG will inspect these wells to determine viability and will survey and sample where possible. There are 11 bedrock boreholes that will be located and inspected during the spring monitoring round.

Exact Location of the GMZ wells

There was extended consideration of potentially revising the location of the GMZ wells. If moved at all, they would need to be kept within the GMZ extension zone as well as remaining in the general area where access has been provided by the property owner.

There was discussion of EPA's previous comment that there is a fracture pathway along Berrys Brook that should be considered when locating the well in the north/northwest near Breakfast Hill Road. It appears that the Chinburg well may not have intersected subsurface features which could have provided more extensive information. There was consideration of the approach of first drilling a shallow bedrock well attempting to hit any subsurface features (photolineament pathway along Berry Brook), followed by drilling the deep bedrock well. While there was general agreement that additional info gathering would be useful, that effort would delay the installation of the wells. The agencies will consider this further, but all generally agreed that the GMZ wells should not be delayed as they are multi-purpose. Some level of surface geophysics can be completed to micro-locate the wells without deferring the drilling schedule. Other type of work that is more regional geophysics on a larger scale can follow. There may be need for additional wells if data collected from surficial geophysics, bedrock outcrop mapping and borehole geophysics of existing boreholes warrant.

Wetlands / Surface water

There is an additional complexity to the site if the contaminants have gotten out into the wetland via surface water. While discussing the feasibility of doing lateral transects, perpendicular to fracture zones in the wetlands northwest of the site, it was noted that the wetlands are difficult to access regarding surface geophysics. It may be more feasible to do any potential work further south.

CLG already knows there is discharge into the stream, so they didn't focus on that aspect. They don't have sufficient information to determine where the groundwater is coming into the stream from the subsurface. There was discussion whether seepage is going to be a significant part of the conceptual model and tools that would be involved in such an evaluation. Measuring seepage can help with contaminant and water level info and flux rate (groundwater discharge rate into surface water), overhead temperature survey and use of infrared technology were discussed as simple tools. There are known surface water impacts, but no clarity if the surface water recharges the groundwater or if the groundwater in turn migrates to bedrock. While there are some leachate seeps near the landfill and some concentrations in stream, it's possible that the wetlands may be recharging bedrock in wet/dry conditions, with the opposite occurrence in the reverse condition.

CLG commented that the discussion is morphing into everything about the site away from the deeper bedrock and that EPA/NHDES has always agreed that the overburden model was accurate. The agencies acknowledged that, noting that there is a lot of history that's been accepted over the years. Five year reviews require these types of exercises. There is always an ongoing review of whether the remedy is still performing and is protective which includes a review of past conclusions.

CLG noted that they have been performing a lot more work including the sampling of residential wells and the upcoming fish tissue sampling yet not finding anything. The agencies noted that the fundamental question we are trying to answer is whether the deep bedrock is or could potentially impact deep bedrock residential wells. The approach is to go with the deep bedrock study and if other things come out of it, we can follow.

Next steps

EPA will send out a written response to the CLG's draft workplan providing specific comments and direction for the bedrock investigation. In the meantime, CLG will perform surface geophysics to micro-locate the new GMZ compliance wells. CLG will also initiate inspection and review of existing bedrock boreholes that had not previously been surveyed (geophysical data collection) or sampled for emerging contaminants.