



March 11, 2025

FID # 663038310
Vernon County
SW/Correspondence

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Viroqua, WI 54665

Subject: Second Incompleteness Determination for the Feasibility Report for the Proposed
Vernon County Landfill Eastern Expansion, License #3268

Dear Ms. Sanborn:

The Department of Natural Resources (department) has reviewed for completeness the report entitled “Feasibility Report Addendum 1- Proposed Eastern Expansion (WDNR License No. 3268)” dated November 19, 2024. The feasibility report (the report) was prepared by Short Elliot Hendrickson Inc., (SEH) on behalf the Vernon County Solid Waste Department. The department received the report on November 19, 2024. Based on the report review, the department has determined that the feasibility report does not contain the minimum information required by ch. NR 512, Wis. Adm. Code. Therefore, the report is not complete.

A brief summary section is provided below, highlighting areas of the geologic and hydrogeologic investigation that need additional attention. There are areas of the geotechnical investigation that do not yet meet code requirements, interpretations that remain unclear to the department due to lack of corroborating data, and areas of the site that have not yet been sufficiently characterized. The department is prepared to meet with your technical team and discuss these items in detail.

Also included in this letter are Vernon County’s Responses (where applicable) to the initial incompleteness letter issued on December 19, 2023. The department has provided comments for each item noting where additional information is still needed. Vernon County’s responses that appear to have sufficient information to satisfy completeness requirements are marked with a simple “response noted” statement. The final section of the letter contains new comments relevant to Section 4 of Addendum 1.

This information is intended for use by the public as well as the department in reviewing the proposed project. Be sure to provide a copy of all information submitted to the department to each recipient of the feasibility report as required by s. 289.23(4), Wis. Stats.

Summary of Incompleteness Issues

The following summary highlights areas of the of the geotechnical investigation that do not yet meet code requirements, interpretations that remain unclear to the department due to lack of corroborating data, and areas of the site that have not yet been sufficiently characterized.

The department has concluded that the relationship between the perched aquifer and regional aquifer remains not fully defined to the east of the landfill. Mounding in the regional water table around MW-16 and MW-18 is not defined to the extent that would allow tracking of a hypothetical release from the landfill. Additional regional water table elevation data are needed to the east of the MW-16/MW-18 well nests.

The feasibility report states that bedrock coring at the site has resulted in the following observations and conclusions:

- Dissolution cavities and bedrock fractures associated with dolomitic rock are primarily present above groundwater in bedrock on-site.
- Dissolution cavities occur primarily as small voids and do not appear to be interconnected.
- Bedrock in general, is often highly fractured and the fractures are likely interconnected.
- Under hydraulic conditions, fracture bedrock above the water table would likely function as a porous media with only localized shale and clay layers providing limitations to the vertical percolation of water.

However, the geotechnical investigation for the proposed expansion was not able to produce bedrock cores that would provide the capacity to analyze the fracture size and frequency and rock quality designations (RQD) critical to understanding the overall groundwater flow regime at the site. Any bedrock cores produced from the sonic drilling may not provide accurate information with respect to evaluating fractures and RQD because of the potential impact the drilling process has on the material. Sonic cores collected in bedrock are broken up and may have been mechanically fractured/partially pulverized during drilling, which is typical of the drilling method. Given the absence of corroborating evidence, the department assumes these cores are indicative of a highly fractured bedrock environment.

SEH has communicated to the department that obtaining usable bedrock cores at this site for this evaluation or performing geophysical logging in the boreholes designed to evaluate fractures would be very difficult or impossible. The gamma logging that was done may provide some information regarding the continuity of the geological formations; however, the gamma logging is not able to provide information on the fractures and voids. It does not appear that the gamma log marker horizons are sufficient to identify geological horizons as they extend through an apparent facies change to sandstone in the direction of wells MW-17WT and MW-19 (meaning the marker horizons do not serve to indicate a homogenous, isotropic geology, as indicated in the report).

Based on the available information, the department's understanding of the geological site conditions is that the groundwater flow beneath the proposed landfill expansion is controlled by fractured flow through dolomitic bedrock. However, it is not clear if the subsurface at the expansion area is representative of karst conditions. Boring log information (below) from the report identifies a number of features, such as crevices, voids, and water loss that may be indicative of karst conditions. In addition, hydraulic conductivities are fairly high. SEH attempts to provide some explanations related to the fractures and crevices reported in the boring logs, such as discussions about maintaining drilling fluids, the measured hydraulic conductivity in MW-14WT and fractures likely being in the weathered zone. However, without having bedrock cores or the appropriate geophysical data it is difficult to corroborate some of the inferences provided. For example, it is not clear to the department how available data definitively shows the fracture flow is behaving as a homogenous porous media as defined, how it has been determined that voids are not connected, and what is driving water loss during drilling efforts. The concerns with potential karst geology are with both site stability and effective groundwater monitoring capability.

Boring Log Information:

- The boring log for MW-14Z indicates some highly fractured zones
- The log for MW-14WT indicates a void and some fractured zones.
- The boring log for MW-3 indicates dolomite with crevices between 145 and 150 ft.
- The log for MW-4 indicates dolomite, hard with several crevices between 145 and 150 ft.
- The log for MW-5 indicates dolomite, broken up with crevices at 135 to 137 ft and between 158 and 160 ft.
- The log for MW-15WT indicates water loss at 75 ft to termination.

The presence of a perched aquifer associated with dolomitic bedrock may also be evidence that points to potential karst characteristics at this site. The dissolution process that creates karst features results in a complex network of cavities and conduits within the rock, leading to localized areas of high permeability where water can accumulate above less permeable layers, creating perched water tables at higher elevations than the regional groundwater level. This is sometimes more prevalent in the uppermost weathered zone of karst, known as the epikarst, which acts as a perched leaky aquifer due to its high porosity and permeability compared to deeper rock layers. In some cases, layers of less permeable rock or clay can exist within the karst system, acting as a barrier to downward water flow and creating perched aquifers above them.

At this site, the perched aquifer appears to be present in the upper portion of the dolomite, below the Saprolite, which is fractured and weathered bedrock, and flows through the Saprolite where it dips to the east and where the perched aquifer converges with the regional aquifer. Any hypothetical release from the landfill would move through the residuum material and the Saprolite, into the perched aquifer. Movement through the weathered material and fractures and through the perched aquifer is anticipated to be at a comparatively high rate. A concern is whether the monitoring well network would be capable of detecting a release, depending on the location of the release, the location of monitoring wells and the travel rate of the released contaminants.

Underlying carbonate rock is present throughout much of southern, southwestern and eastern Wisconsin with the potential for karst features; however, not all carbonate rock displays karst features or karst features that are significant enough to affect stability and monitoring. At this site, it is the department's opinion that it does not have sufficient information about karst characteristics of the underlying dolomitic rock, with the information currently available. The department has previously suggested that wireline coring or other geophysical methods should be attempted to obtain this information. However, based on the information provided to the department by SEH, it appears that obtaining this information may not be possible. The feasibility report has provided some general or regional geological information; however, this information may not be representative of localized site conditions. Without the information needed to provide a high confidence level of both the stability and monitorability of the proposed landfill, the department would not be able to issue a favorable feasibility determination.

Given the complexity of the geology and hydrogeology at this site, the department is evaluating the need to for an environmental impact statement (EIS) to help assess the site suitability for the proposed expansion. An EIS may provide the department another interpretation of the currently available information and an evaluation of options that may be available to obtain additional geotechnical information to fill in data gaps; however, an EIS would require additional time and costs at Vernon County's expense. The decision on an EIS will be made when the draft environmental analysis is completed.

Other incompleteness items include engineering design issues and the need to collect four rounds of monitoring data from all monitoring wells, including wells installed after the first round of geotechnical investigation. **Please review the sections below for a comprehensive summary of incompleteness items.**

December 19, 2023 Incompleteness Letter Section A - Comments and Responses

1. **DNR Comment- Site-Specific Geotechnical Information [s. NR 512.09(1)(c) and (d), Wis. Adm. Code]:** Soil boring B- 21 does not extend to at least 25 feet below sub-base grade.

Vernon County Response: *Because of the extensive fill in the vicinity of boring B-21, the boring did not extend to at least 25 feet below sub-base grade. During the 2024 addendum field investigation, boring B-22, was completed near the original B-21 and was completed at least 25 feet below sub-base grade. As of October 2024, 20 boring locations (10 are required) have been completed within 300-feet of the proposed 4.0-acre horizontal expansion and extend at least 25 feet below the proposed subbase grade as required within s. NR 512.09(1)(b), Wis. Adm. Code. Borings meeting s. NR 512.09(1)(b), Wis. Adm. Code are provided within Table 1.*

DNR Response Comment: Response noted.

2. **DNR Comment- Site-Specific Geotechnical Information [s. NR 512.09(2)(a), Wis. Adm. Code]:** The minimal requirement to adequately define the water table surface and horizontal gradients is not met to the east of the proposed expansion area, in part because new groundwater monitoring wells MW-15WT and MW- 16WT are dry. The flow toward the merger point of the perched aquifer and regional water table aquifer near the MW-16/MW-16WT groundwater monitoring well point as interpreted in the report needs to be more accurately defined by additional hydrogeological investigation (i.e., data from additional borings and groundwater monitoring wells), as this area would likely be the collection point of a hypothetical discharge from the proposed expansion. Once the assumed merger zone of the perched and regional water tables is confirmed, downgradient regional water table wells will be needed to monitor transport of a hypothetical discharge once it reaches the regional water table as required in s. NR 507.19 (1), Wis. Adm. Code.

Vernon County Response: *As requested, a 2024 addendum field investigation installed monitoring wells in the southeast portion of the project landfill expansion. Monitoring well MW-18WT was installed within the perched water table and MW-18 and MW-19 were installed within the regional water table. These monitoring wells further refine the perched and regional water tables but overall, the previously interpreted perched and regional water table surfaces are generally representative with the new wells refining flow conditions. The water table surface and horizontal gradients with 2024 addendum field investigation data are described further in Section 4.3 of this report. Perched and regional water table maps from the 2024 addendum field investigation are also provided within Figures 1 through 4 of this report. Past monitoring data, the understanding of unsaturated conditions, and the adequacy of the monitoring system is also described further below.*

Past Monitoring Data

The perched and the regional groundwater systems directly beneath the expansion footprint have been monitored for the last 30 years indicating both surfaces are predictable, and the horizontal gradients are quantifiable.

Unsaturated Conditions

We agree that the merger or transition zone on the east edge of the proposed expansion footprint corresponds with an eastern edge of the perched system. Further discussion on the hydrogeology of the perched water table systems is provided in Section 3.0. The percolation of water in the unsaturated zone occurs through gravity potential via interconnected pores and by moisture potential as a negative pressure due to soil-water interaction. Just like under any geologic conditions, preferred groundwater pathways may occur vertically and horizontally due to lithologic or porosity changes whether the thickness of the unsaturated zone is 10 feet or 100 feet.

A separation between the base of the landfill and groundwater is generally considered a good feature

for landfill development; a minimum of 10 feet separation between landfill base grades and the seasonal high-water table is stipulated by NR 504.6, Wis. Adm. Code. The difference here is the depth to groundwater can exceed 100 feet.

Adequacy of Monitoring System

The groundwater conditions described in Section 5.4.2 are conservative assuming the perched system “merges” or transitions to the regional system and the transition zone could represent a “collection point of a hypothetical discharge”. However, in reality there are only two scenarios for groundwater movement beneath the landfill that the existing monitoring system is already designed to monitor:

- *Saturated groundwater flow: In the presence of saturated conditions, groundwater will move from high hydraulic head to low hydraulic head in the perched system. In the landfill expansion area, current downgradient wells in the perched groundwater system include MW-5A, MW-12, MW-16, MW-17WT, and MW-18WT.*
- *Unsaturated groundwater flow: In unsaturated conditions, the transition zone indicates that infiltrating water will continue its downward vertical percolation until encountering the regional water table because there are no observed seeps or active surface water features at lower elevation in the valley east of the landfill property. For the expansion, downgradient wells in the regional groundwater system include MW-5 and MW-14. Additional wells located downgradient but stratigraphically lower than the regional watertable include MW-3, MW-6, and MW-14Z.*

To address concerns of the WDNR, a 2024 addendum field investigation was completed during July through October 2024. The results of the 2024 addendum field investigation are presented in Section 4.0.

DNR Response Comment: The installation of wells MW-18WT, MW18, and MW19 have provided information to better define, but not fully define, the relationship of the perched water table and the regional groundwater table to the east of the current landfill. However, the mounding in regional water table around MW-16 and MW-18 is not defined to the extent to allow tracking of hypothetical release from the landfill. Additional regional water table elevation data are needed to the east of the MW-16/MW-18 well nests. The text states that groundwater monitoring wells MW-5 and MW-14 serve as downgradient wells in the regional aquifer, but these wells do not define the flow paths to the east and northeast of the landfill should a release occur.

3. **Subsurface Data Analysis [s. NR 512.10(4), Wis. Adm. Code]:** The report appendices do not include raw data for groundwater level measurements. Either field notes/forms or inclusion of measured depth-to-water readings on the data tables would satisfy the requirement.

Vernon County Response: *A table (Appendix C) includes all depth-to-water readings for all six rounds of groundwater level monitoring is provided as required within s. NR 512.10(4), Wis. Adm. Code. Depth-to-water readings for the 2024 addendum field investigation are provided within Appendix J.*

DNR Response Comment: Response noted.

4. **Data Presentation [s. NR 512.11(2)(a), Wis. Adm Code]:** Inferred or questionable lithostratigraphic boundaries are not marked with a dashed line or question mark.

Vernon County Response: *Plans Sheets have been revised to include question marks or dashed lines where lithostratigraphic boundaries or groundwater contours are inferred per s. NR 512.11(2)(a), Wis. Adm. Code. Revised Plan Sheets 4 through 22 are provided. Please note that the*

lithostratigraphic boundaries on cross-sections were drawn based on combining the results from multiple sources or interpretive methods including soil boring logs, geophysical markers horizons, the bedrock contour map, and historical cross-sections.

DNR Response Comment: Response noted.

5. **DNR Comment- Section 1.3.1, Baseline Sampling of New Wells Subsection, Section 4.9, Section 5.4:** Manganese concentrations in groundwater monitoring well MW-14WT are significantly higher than in other groundwater monitoring wells at the facility, including but not limited to upgradient groundwater monitoring wells and groundwater monitoring wells for which manganese exemptions have been previously granted. Additional discussion on the potential source of the manganese in MW-14WT is needed to evaluate the requested exemption under s. NR 140.28, Wis. Adm. Code.

Vernon County Response: *Manganese occurs naturally in groundwater and extreme ranges in manganese concentrations are common locally (USGS, 1995). After further evaluation of the manganese concentrations present at MW-14WT, the following may contribute to the observed concentrations.*

- *Upgradient of the existing and proposed disposal areas, MW-14WT is screened from 1141-1156 feet NAVD within a gray to brown dolostone of the Prairie du Chein aquifer. Representative analyses of water from the St. Peter-Prairie du Chein-Jordan aquifer show a large range in concentrations of manganese (USGS, 1995). The higher concentration of manganese observed may be in part due to the well screened in a slightly different portion of the Prairie du Chein aquifer than other perched water table wells.*
- *Manganese is also often released from soil or bedrock when the soil or bedrock in contact with groundwater is disturbed (for example during drilling) and, as a result, manganese concentrations typically decrease over time to approach pre-drilling levels. While the manganese concentration within MW-14WT varied during the first six sampling events, there is a slight decreasing trend. Additional sampling is required prior to the Plan of Operations submittal and manganese concentrations at MW-14WT will be reevaluated further during the Plan of Operations Report.*

DNR Response Comment: Response noted.

6. **DNR Comment- Section 5, Alternative Geotechnical Investigation Plan and Geophysical Investigation:** Statements and other information provided in the feasibility report, including the boring logs, indicate that there is a respectable amount of fractured or preferential flow in the dolostone for the perched aquifer and the regional aquifer. Fractured and preferential groundwater flow may be challenging to effectively monitor because it may be difficult or impossible to determine the appropriate locations for groundwater monitoring wells with the capability to detect any hypothetical landfill leakage as required in s. NR 507.19 (1), Wis. Adm. Code. In addition, the reported horizontal flow velocities in section 5.4.2.10 of the report indicate a relatively fast groundwater flow regime. A relatively fast flow matrix is consistent with fractured flow behavior and makes it more difficult to effectively monitor groundwater at the landfill. It is not known if additional geotechnical work would provide sufficient additional information regarding the fractured flow matrix. The department is concerned about the ability to effectively monitor groundwater quality at the site. Vernon Co. may propose additional geophysical methods as part of the installation of additional borings and groundwater monitoring wells to define the groundwater flow of the perched aquifer as it converges with the regional aquifer or as part of any other additional work.

Additional geophysical methods to be considered should be applicable to investigation in an open

borehole and may include, but not are not limited to: electrical methods (e.g., resistivity and similar methods) electromagnetic methods (e.g., electromagnetic induction); additional nuclear methods; physical/imaging methods (e.g., caliper log, acoustic televiewer, optical televiewer, video camera); and fluid column methods (applicable to saturated portions of a borehole). Multiple test methods for each borehole would provide additional lines of evidence to predict groundwater flow. Again, it is not known how feasible any of these additional methods would be and if they would yield sufficient additional information or additional information favorable to the expansion of the landfill.

Vernon County Response: *As presented in Section 5.4.1 of the Feasibility Report, we agree fractures and dissolution cavities are present within the bedrock. However, it is also important to understand how and why the fractures and dissolution cavities were formed, the actual observed groundwater flow pathways, the likelihood of significant karst development, and the limitations of other geophysical methods. Each item is further described below. Note additional discussion on the geology and hydrogeology is provided in Section 3.0.*

Origin of Bedrock Fractures and Dissolution Cavities

Dissolution cavities and fractures are present at the site, particularly in the unsaturated zone. As described in Section 5.4.1 of the Feasibility Report, assessment of bedrock coring completed during 2022, and historically at the site, resulted in the following observations and conclusions:

- *Dissolution cavities occur primarily as small voids or vugs and do not appear to be interconnected. This is consistent with the published understanding of the Prairie duChien Group and its hydraulic properties:*
 - *The uppermost bedrock is in the Oneota Dolomite which regionally has been defined as a confining unit; the overlying Shakopee Formation (not present at our site) is defined regionally as an aquifer (Tipping et al, 2006). The predominant rock type/mineral in the Oneota Dolomite is dolomite (Tipping et al, 2006).*
 - *Dolomite is significantly less soluble than calcite, especially in the presence of calcite (Drever, 2002). More dissolution of carbonates occurs in open systems with exposure to the atmosphere where CO₂ is readily available; that is why there is less modern dissolution below the perched water table where atmospheric CO₂ would be less available.*
 - *The secondary porosity (fractures/vugs) are considerably lower in the Oneota than the overlying Shakopee (Tipping et al, 2006).*
- *Shallow bedrock, in general, is often highly fractured and the fractures are likely more interconnected.*

Hydraulic Properties and Groundwater Flow

As described in Section 5.4.2, the “relatively fast” average linear flow velocity calculated at the perched water table (ranging from 587 to over 4000 feet per year) is indicative of a porous media with a hydraulic conductivity similar to sand and gravel with some preferred flow paths. However, it is unlikely for perched groundwater to actually leave the landfill property due to the transition zone present in the downgradient direction of the landfill. The conditions of the low permeability unit within the Oneota Dolomite/Sandstone and where it is compromised to allow the perched water table to diminish and transition to the regional water table is described below in Section 3.0.

As indicated in Section 5.4.1.3, the average linear flow velocity calculated for the regional water table (248 feet per year), significantly lower than the perched system, is also indicative of a more uniform porous media with a hydraulic conductivity similar to sand. Monitoring of the regional water table over the past 30 years confirms it is consistent and predictable.

Section 5.4.2.6 of the Feasibility Report summarized the horizontal hydraulic conductivity at the Landfill. While some horizontal hydraulic conductivity values were as high as 6.67E-2 cm/sec, all in-field hydraulic conductivity testing indicated the formations screened are responding to testing as porous media without turbulent flow. Turbulent flow would be associated with highly interconnected dissolution cavities or fractures and would not be quantifiable during an in-field hydraulic conductivity test.

As stated above, fractured bedrock is common, and it is likely some fractures are interconnected. The in-field hydraulic conductivity testing indicated the wells are responding to testing as porous media, which indicates that although secondary porosity (interconnected fractures) may be present in the geologic units, the primary porosity (intergranular) dominates flow within the bedrock on-site. Therefore, groundwater within the perched water table, regional water table, and within the deeper aquifer (piezometers) on-site is monitorable.

Limitations on Geophysical Methods

There are a few concerns or issues with proposing geophysics within open boreholes at the Landfill.

- 1. Knowledge gained from geophysics would be on a small scale as only a few additional boreholes is realistic.*
- 2. Open borehole geophysical methods will only work in bedrock if the borehole remains open. During previous investigations, coring has been difficult due to weathering of the saprolite and layered heterogeneity of the dolostone. These characteristics of the bedrock increases the risk of geophysical tools being damaged or caught on uneven surfaces of the borehole wall; these risks are generally not taken due to costs of the equipment and that the borehole will likely not stay open for geophysics to be successfully completed.*

Despite the concerns above, additional methods of geophysics were assessed using the Fractured Rock Geophysical Toolbox Method Selection Tool (FRGT Tool). The FRGT Tool was published in 2015 in a joint effort by the United States Geological Survey, the United States Environmental Protection Agency, and the Environmental Security Technology Certification Program. The FRGT Tool is a spreadsheet-based tool that allows users to input site specific details and goals and then provides an output that summarizes which geophysical methods are feasible and useful for project goals.

The FRGT Tool was used to assess geophysical methods that would be applicable within open boreholes as suggested by the WDNR. The methods that the FRGT Tool output stated might be applicable on-site are listed below.

- Acoustic Televiewer: May be used to assess discrete fractures and lithologic contacts within open boreholes but may not be able to provide results within mud-filled boreholes. Mud was needed to advance borings during the 2022 investigation.*
- Caliper: May be used to assess discrete fractures within borehole. Although this may note fractures within boreholes, it does not determine the interconnection of fractures.*
- Electromagnetic (EM) Induction: May be used to delineate changes in rock types but is susceptible to interference from metal. Also, conductivity of thin beds cannot be determined.*
- Nuclear Magnetic Resonance (NMR): May be used to measure the water content in soils and rock. It may provide the total porosity/water content, pore-size distribution, and/or hydraulic*

conductivity variations and estimates. However, it could only be completed in a few open hole borings and would limit the effectiveness of this method. Flowmeter Logging and Induced Polarization and Normal Resistivity: Requires a waterfilled well or borehole so not applicable on-site as a large portion of the boreholes are set at the water table so only small portion of the borehole is saturated.

After review of the geophysical methods suggested by the FRGT Tool, it has been determined that the completion of additional geophysical methods on-site will only provide additional data on a small-scale and will not aid in the large-scale hydraulic properties of the site. Therefore, no additional geophysical methods are proposed at this time.

DNR Response Comment: The transition of the perched aquifer to the east and southeast of the current landfill is a significant hydrogeologic change that requires site-specific data to evaluate both groundwater flow and the potential stability of a landfill expansion. The existing geophysical assessment (gamma logging in the groundwater monitoring wells) that was proposed in lieu of wireline coring has not provided sufficient geological characterization to fully replace the wireline coring needs defined in s. NR 507.05(2), Wis. Adm. Code (assessment of fracture frequency, rock quality designation, and recovery). Further comments regarding SEH's response to Comment 6 are as follows.

- The marker horizons identified in the gamma log interpretations are not sufficient in themselves to identify geological horizons, and extend through an apparent facies change to sandstone in the direction of wells MW-17WT and MW-19 (meaning the marker horizons do not serve to indicate a homogenous, isotropic geology, as indicated in the report.).
- Sonic cores collected in bedrock are broken up and may have been mechanically fractured/partially pulverized during drilling, which is typical of the drilling method. However, given the absence of corroborating evidence the department assumes these cores are indicative of a highly fractured bedrock environment.
- The literature discussion regarding the origin of bedrock fractures and dissolution cavities is not pertinent to the site-specific scale of geologic characterization required to site a landfill, and requires the type of field verification that either wireline coring or geophysical evaluation can help to provide.
- Regarding the reason's provided for not implementing the suggested geophysical methods, the limitations described with respect scale and the ability to draw connections between borings are potential limitations of all site specific investigations using soil borings and monitoring wells, and the limitations of interpretation posed by an individual process (descriptive logging of the borehole, coring, geophysics, other tests) can be enhanced by using many processes in tandem. SEH's reason to dismiss acoustic televiewer (mud-filled boreholes) is not relevant to the 2024 follow-up investigation, which utilized mud-free sonic drilling techniques. Furthermore, drilling mud can be developed out of the borehole after drilling to facilitate this and other geophysical methods.

7. **DNR Comment- Section 5.4.1.2:** Provide the following additional information and clarification regarding the MW-16 groundwater monitoring well nest drilling.

- a. The MW-16 boring log provided in Appendix J states that the borehole lost water from 70 feet to termination. Further explain the interpretation provided in the report text that the water loss was due to the head pressure exerted by the confinement of weathered sandy dolostone between two shale layers, and whether the pressure/fluid loss characteristics changed after the lower shale layer was penetrated and the borehole advanced through similar sandy dolostone material. In addition, please indicate if a fractured flow regime and/or other reasons were considered as

the cause of the water loss, and why the confining layer was selected as the most probable reason.

- b. Clarify the source of the observation of groundwater at 68.4 feet below ground surface (bgs) on 8/24/2022 (during advancement of MW-16) on the MW-16WT boring log. This information was not provided on the MW-16 boring log.

Vernon County Response: *Additional information on geologic and hydrogeologic conditions in the vicinity of MW-16 were obtained as part of the 2024 addendum field investigation and presented in Section 4.0.*

In reviewing of the field notes, it was determined that water loss began at 60 feet bgs at the MW-16 boring and continue to termination (98 feet bgs). Grout was also noted to be lost during the well construction of MW-16 between the depths of 60 and 78 feet bgs. It was also determined when reviewing the field notes, that MW-15WT had water loss from 75 feet bgs to termination (99 feet bgs). The boring logs for MW-15WT and MW-16 have been revised and included within Appendix D.

While drilling with fluid, the ability of the borehole to contain drilling fluid indicates there are no significant interconnected fractures or solution cavities associated with karst. As indicated in the report, the loss of drilling fluid occurred into unsaturated weathered sandy dolostone from more than 60 feet of fluid pressure within the borehole. The weathered sandy dolostone encountered on-site appears to have a higher porosity and, as a result, provided a pathway for the drilling fluid to travel. While drilling fluid was lost through termination of the borings, drilling mud pressure returned allowing for borehole advancement without needing to seal off that portion of the borehole; therefore, it was determined that the unsaturated pathway within the weathered sandy dolostone could not be extensive in nature and likely a localized horizontal pathway within the weathered sandy dolostone as would be anticipated. The observation of groundwater at 68.4 feet bgs, was measured during drilling at MW-16 on 8/24/2022. The boring was drilled to 85 feet bgs on 8/23/2023 and then left open overnight to allow the water level to stabilize to approximately water table conditions in order to determine appropriate depths for MW-16WT and MW-16. As the water level was observed at 68.4 feet bgs the next day, it was determined that MW-16WT be screened between 65 to 75 feet bgs and MW-16 screened between 92 to 97 feet bgs. This measured water level was noted on MW-16WT to explain the reasoning for well placement. A similar note has also been added to MW-16 to clarify this measured water level.

DNR Response Comment: Response noted.

8. **DNR Comment- Section 5.4.1. 3:** Please clarify the statement that dissolution cavities and fractures are primarily present above groundwater and address or discuss what information indicates the absence of fractures and voids below the water table. Cored borings MW-10, MW-12, and MW-14Z document vugs and fractures, and other boring logs provided in Appendix K document numerous crevices below groundwater in bedrock.

Vernon County Response: *As described in the response to Comment 6, more dissolution of carbonates occurs in open systems...that is, exposed to the atmosphere where CO₂ is readily available; that is why there are a greater amount of dissolution cavities and fractures above groundwater and less dissolution below the perched water table where CO₂ may be less available. Additionally, the secondary porosity (fractures/vugs) are considerably lower in the Oneota than the overlying Shakopee, and they decrease even more with depth. In addition, Tipping et al (2006) describe an unconformity between the Shakopee and the top of the Oneota Dolomite that would indicate historic weathering and*

erosion in the upper Oneota Dolomite.

Drilling methods used on-site have varied over time. Traditional coring methods had a history of low recovery and therefore, in 2003, versa sonic was used to core borings MW-1RZ, MW-13P, and MW-14Z in attempts to improve recovery. While the use of sonic generally provided higher recovery within the unconsolidated zone, it had variable success with accurately logging actual bedrock conditions. The following further outlines the precautions that need to be used when interpreting the sonic boring logs completed on-site.

- As stated within the 2003 Feasibility Report, “Note that the cores obtained from MW-1RZ, MW-13P, and MW-14Z had generally higher fracture frequencies and lower RQD values than those obtained previously from MW-7 and MW-10. This probably reflects the fact that the recent cores were drilled using the versa-sonic method” (Central Wisconsin Engineers, Inc., August 2003).*
- No further description is provided on the versa sonic boring logs (e.g. mineralization along fractures, freshness of breakage) for the fracture zones that are noted and therefore, it cannot be determined if they were naturally formed or mechanically formed. Therefore, the “highly fractured zones” that are noted on the MW-14Z boring log are most likely less competent portions of bedrock (higher percentage of sand or silt) which fractured more readily during drilling. This is also most likely the case for other versa sonic boring logs completed on-site (MW-1RZ and MW-13P). The use of versa sonic provides high recovery and is useful but additional caution needs to be used when interpreting the boring logs. Other boreholes on-site were further reviewed and assessed in reference to fractures, vugs, or crevices noted below the water table. Notes on these boreholes are provided below.*
- Please note that MW-12 was not logged separately; MW-10 was cored, and the same log was used for the shallower nested wells MW-11 and MW-12. The boring log for MW-10 notes “occasional small vugs” and “numerous small vugs” below the water table but does not describe any fractures or crevices below the water table. A majority of RQD’s below the water table are above 70%, indicating competent bedrock.*
- MW-7 was cored with methods similar to MW-10 and notes minor vugs at depths below the water table, fractures were observed. RQD percentage ranges from 16% to 90% between the depth to water table (approximately 118 feet bgs) and boring termination. The lowest RQD’s (16 to 23%) are present at depths where sandstone interbeds are noted and therefore, the low RQD’s are noting the change in lithology from a hard dolostone to an interbedded dolostone, which fracturing from drilling is more likely.*
- MW-6 was logged from cuttings only and does not note any fractures, vugs, or crevices below the water table.*
- MW-5 was logged from cuttings only and does note two “crevices” below the water table. Since this borehole was not cored, the crevices noted are most likely notes from the driller on rods dropping during drilling. Monitoring well MW-5 was set at the depth of one of the crevices noted within the boring log. Slug testing was then completed at MW-5 and a hydraulic conductivity of 2.6E-04 cm/sec was measured. This hydraulic conductivity value suggests that this crevice is not highly interconnected, as the formation responded predicably and not as turbulent flow.*

During the 2024 addendum field investigation, Rotasonic drilling methods were utilized to increase

recovery and aid in determined depth to water. The 2024 boreholes are reviewed assessed in reference to fractures, vugs, or crevices below.

- *B-22: Sporadic vugs were noted within the dolostone encountered within B-22. No fractures or crevices were encountered within B-22. A void was thought to occur during drilling as the driller's note a drop in the drilling rods but once the soil was observed, it was discovered the "void" was a zone of weathered dolostone.*
- *MW-16Z: Sporadic vugs were noted within the dolostone encountered within MW-16Z. No fractures or crevices were encountered within MW-16Z.*
- *MW-18: No vugs, fractures, or crevices were encountered within MW-18.*
- *MW-19Z: No vugs, fractures, or crevices were encountered within MW-18*

As stated previously, fractures in bedrock are common and some fractures are likely to be interconnected. The 30 years of monitoring of on-site groundwater elevations confirm that the perched water table and regional water table are consistent. Fractures may be present and may be interconnected but the groundwater at the site is predictable and monitorable. Additional discussion on the geology and on-site coring efforts is provided in Section 3.0.

DNR Response Comment: The lack of wireline coring and geophysics makes it difficult to confirm the conclusions stated in the above response. The sonic cores were of sufficient recovery to indicate large voids do not appear to be present but are not of sufficient quality to evaluate the extent of fracturing within the formations. In absence of additional site-specific evidence, the department's default assumption is reported fractures in previous boring logs are accurate.

9. **DNR Comment- Section 5.4.1.4 Geophysical Horizons:** Explain the access issues that prevented geophysical investigation at the MW-16/ MW-16WT groundwater monitoring well nest, and whether the access issues are ongoing.

Vernon County Response: *Geophysics was not able to be completed at the MW-16/MW-16WT location due to steep slopes and muddy conditions at the time geophysics was completed. The MW-16WT/MW-16 well nest was able to be accessed for geophysics during September 2024. Surface water drainage will be updated with the proposed expansion and the access to MW-16/MW-16WT will be improved.*

DNR Response Comment: Response Noted.

10. **DNR Comment- Section 5.4.2.4, Section J-J' and Flow Net:** Based on the information provided in the feasibility report, the department questions the assumption stated in this section and others that the site represents a homogenous, isotropic system due to soil classifications and hydraulic conductivity values. Other comments pertinent to this section and the other sections referenced in the flow net assumptions discussion are as follows:

- a. Hydraulic conductivity values within each of the three dolostone zones identified (perched water table, regional water table, piezometers) vary by two or more orders of magnitude.
- b. Variations in lithology within the residuum layer and portions of saprolite and competent bedrock above groundwater, and variations in vertical hydraulic conductivity measurements, do not provide sufficient evidence to support a low likelihood of potential impacts from the landfill to the water table.
- c. Based on the limited data, vertical gradients within the upper portion of the regional water table formation vary by approximately one order of magnitude.

- d. Bedrock quality data with respect to fracture regimes or voids collected during the geotechnical investigation are limited; however, it is observed in Section 5.4.1.3 that bedrock is highly fractured in general with a likelihood of interconnected fractures. Boring logs are marked with zones consisting of fractures, vugs and voids.

Depending on the resolution of this comment and the results of any further groundwater investigation at the landfill, the flow net presented in cross section J-J' may need to be modified. The department notes that map view flow nets of both the perched water table and regional water table may enhance understanding of flow from the proposed expansion area to and within groundwater.

Vernon County Response: *The flow net (Plan Sheet 21) provides flow lines for the regional water table in the direction of groundwater flow (south to north) across the proposed expansion area. Based on the geologic descriptions and hydraulic conductivities of the monitoring wells in reference to the regional water table the assumption of a homogenous, isotropic system can be used. There are some shale interbeds noted within the MW-10 and MW-14Z locations but the interbedding noted is on a small scale that cannot be addressed within a flow net at this scale.*

As stated within Section 5.4.2.6 of the Feasibility Report, the hydraulic conductivity values within the regional water table vary by two orders of magnitude ($1.86E-4$ cm/sec to $6.67E-2$ cm/sec). A range of two orders of magnitude within the same geologic unit is typical. Unconsolidated soil and bedrock generally have spatial variations that cause differences in hydraulic conductivity that span one or two orders of magnitude. For assumptions needed to create a flow net, a range of two orders of magnitude can still be considered homogeneous and isotropic.

A flow net cannot be accurately constructed for the perched water table due to the lack of a consistent lower boundary condition. The degree of saturation between the perched water table and the regional water table is unmeasurable and therefore, a lower boundary condition cannot be accurately determined, and an accurate flow net cannot be constructed (U. S. EPA, 1986).

DNR Response Comment: The flow net provided with cross-section J-J' has no data to confirm regional water levels at the MW-10/11/12 well nest or to evaluate regional water levels under B-22 (or in the entire transition zone where the perched aquifer migrates down to the regional water table). Therefore, the department considers the flow net to be inferred in this area, and that a more complex flow regime is likely. Regional water table data is also lacking at the MW-3/4P/6 well nest. In addition, please provide additional discussion and evidence to support the statement that two orders of magnitude hydraulic conductivity difference can represent a homogenous and isotropic aquifer.

11. **DNR Comment- Appendix J:** Explain the differences in the SEH boring logs and the Braun Intertec Logs for the same borings, in particular differences in total borehole depth (B-19 and B-20), differences in depth to bedrock/saprolite (B-18 through B-20, MW-14WT, MW-16, MW-17WT), and differences in bedrock/saprolite lithology (B-20, MW-16, MW-17WT).

Vernon County Response: *Discrepancies within total depths of boring was discussed with the field staff and borings logs have been revised as applicable (Appendix D). SEH boring logs B-18 and B-19 still differ from Brauns boring logs due to differing interpretation of end of boring. At boring B-18 and B-19 a split spoon was attempted but refusal occurred within the first 6 inches and no recovery occurred. Therefore, the SEH boring logs for B-18 and B-19 end at 29.5 feet below ground surface or refusal. Brauns boring logs for B-18 and B-19 have an end of boring depth of 31 feet below ground surface, which would be the bottom of the attempted split spoon if all 18-inches were achieved.*

The difference in lithology and depth to saprolite/bedrock descriptions are due to different specialties of the SEH and Braun personnel. The SEH personnel on-site were geologists performing directly under the supervision of a licensed Professional Geologist (PG) and who specialize in geologic descriptions, lithology, and environmental conditions. Braun Intertec provided geotechnical services and did not view conditions in reference to bedrock weathering. Therefore, some differences in lithology and depth to saprolite/bedrock are present between SHE and Braun boring logs. SEH boring logs were used for all geologic interpretation, while all geotechnical information is provided by Braun.

DNR Response Comment: Response noted.

12. **DNR Comment- Table 5-4:** Clarify the “Frozen” designation for the March 2023 water table elevation at MW-17WT. Given that the static water level in this groundwater monitoring well is generally significantly below ground surface, a frozen water surface does not seem likely.

Vernon County Response: *On March 1, 2023, ice surrounding the inside of the PVC casing on MW-17WT most likely occurred from condensation accumulation at the “frost line” inside of the well, despite the monitoring well plug being tightly sealed. This obstruction made it unfeasible to obtain a water level measurement and/ or groundwater sample.*

DNR Response Comment: Response noted.

13. **DNR Comment- General Submittal Requirements [s. NR 500.05(6)(g), Wis. Adm. Code]:** The local survey grid used does not appear to be referenced to state plane coordinates or other datum accepted by the department, and the department did not find discussion or documentation that the coordinate system is based on monuments in the field.

Vernon County Response: *All existing construction is based on local site coordinates. All proposed construction presented in the Feasibility Study is also based on local site coordinates. A formula for converting coordinates for the proposed expansion to the Wisconsin State Plane coordinate system is presented on a revised Plan Sheet 2 and survey transformations are provided within Appendix E.*

DNR Response Comment: Response noted.

14. **DNR Comment- Performance Standards [s. NR 504.04(4)(d), Wis. Adm. Code] and General Submittal Requirements [s. NR 512.05, Wis. Adm. Code]:** The department was unable to locate in Appendix Q the recent nitrate + nitrite data that was referenced in Section 5.4.3.1. These data are necessary to justify how applicable s. NR 140.28, Wis. Adm. Code criteria are met.

Vernon County Response: *As noted within Section 5.4.3.1.1 of the Feasibility Report, a groundwater exemption of nitrate+nitrite for MW-6 is proposed as there are nine sampling events of nitrate+nitrite and all exceed the PAL. These nine events were completed between 1989 and 1995 so it is unclear why an exemption was never requested for nitrate+nitrite previously at the MW-6 location. No recent nitrate+nitrite data has been collected at the MW-6 location, but this exemption request is made using the historical data provided within Appendix Q. The MW-6 data provided within Appendix Q of the Feasibility Report is provided again within Appendix F of this Addendum.*

DNR Response Comment: Response noted.

15. **DNR Comment- Proposed Physical Changes [s. NR 512.16(2)(b), Wis. Adm. Code]:** The discharge rates provided are anticipated during active operations and do not compare to existing rates or rates anticipated following closure conditions.

Vernon County Response: *There should be no significant impacts or changes to aquatic resources including the potential impacts to streams, wetlands, ponds, lakes, and flowages. Primary local surface water flowages include the Seas Branch Creek and an unnamed tributary. The northern portion of the site drains to the north to Seas Branch Creek. Surface water from the southern portion of the site drains to the to an unnamed tributary which then flows northeast to Seas Branch Creek and then east to the west fork of the Kickapoo River. More regionally surface water drainage is to the southeast towards the Kickapoo River.*

Relatively minor surface water modeling parameter changes account for pre- and post-development conditions. Less than 10 percent imperviousness is added with gravel for development. Surface water model runoff calculations for pre- and post-development vegetation and soil types representing existing and proposed expansion landfill areas are similar. Existing and proposed vegetation conditions are grassland and soils for each are specified hydrologic soils group D. The difference is that soils on the landfill cover are assumed to be compacted. There are currently no direct discharge points or impacts to nearby wetlands. The surface water control system proposed for the expansion will not create any impacts to wetlands.

DNR Response Comment: Provide narrative on the sequencing of the removal of the existing stormwater pond and the construction of the proposed stormwater pond and how stormwater will be handled during that time.

16. **DNR Comment- Environmental Review [s. NR 512.16(2)(e), Wis. Adm. Code]:** Please provide clarification regarding whether the perimeter access road will be designed on the east side of the proposed expansion and how that may affect perimeter storm water ditches, toe drains, and other engineering features. Revise the plan set for consistency in depiction of the eastern side of the landfill.

Vernon County Response: *To conserve borrow soils, to minimize site traffic and minimize stormwater runoff, access roads will not be constructed on the eastern side of the final landfill expansion during final closure. Final access will be provided on the landfill's outboard slopes. Access roads will be presented on the Plan of Operation development drawings.*

DNR Response Comment: Provide further clarification on what final access will be provided on landfills outboard slope means and what that is compared to a traditional perimeter road. Provide clarification on if any operational or construction restrictions will come about due to not having an access road on the east face including but not limited to picking litter downslope of the landfill on the east face, leachate seeps on the landfills eastern outboard slope, perimeter fence, and constructability of final cover on the eastern face.

17. **DNR Comment- Existing Environment [s. NR 512.16(3), Wis. Adm. Code]:** The report does not discuss the dominant animal species found in the area of the expansion.

Vernon County Response: *The following information is added to Section 10.3.2. The proposed expansion area is in an upland prairie that covers the broad ridge between Westby and Viroqua and*

extends two miles to the west. This prairie-woodland interface provides good habitat for many types of mammals, birds, reptiles, amphibians, and invertebrates.

- *Mammals: white tail deer, fox squirrel, coyote, beaver, river otter and others.*
- *Birds: bald eagle, green herons, cerulean warbler, and many others.*
- *Reptiles: eastern garter snake, common snapping turtle, eastern painted turtle, and northern water snake.*
- *Amphibians: American bullfrog, green frog, northern leopard frog, eastern American toad, and spring peeper.*
- *Invertebrates: insects, arachnids, annelids, and mollusks.*

Reference: Kickapoo Valley Reserve (<http://kvr.state.wi.us/Natural-Features/Plants-Animals>)

DNR Response Comment: Response noted.

18. **DNR Comment- Environmental Review [s. 512.16(2)(c), Wis. Adm. Code]:** The report does not discuss the miles of access roads (or estimated length using other units) to be constructed.

Vernon County Response: Final access road design will be completed in the Plan of Operation and shown on the development plans. Specific area quantities will be provided.

DNR Response Comment: The estimation of length of access roads is required during the feasibility determination phase by s 512.16(2)(c), Wis. Adm. Code. Please provide an estimate of the anticipated length of access roads. Please note that this is only an estimate and can be modified in the plan of operation.

19. **DNR Comment- Environmental Review [s. 512.16(2)(d), Wis. Adm. Code]:** The report does not discuss the potential for post-closure gas production, emissions, or discharges.

Vernon County Response: The potential for emissions and discharges listed in NR 512.16(2)(d) and as addressed in Section 10.2.4 of the Feasibility Report will largely decrease post closure. The potential for operational and construction related emissions such as engine exhaust, dust, and noise will greatly decrease due to the absence of heavy construction equipment and waste hauling vehicle traffic that would otherwise be present during active operations. Similarly, the potential for leachate generation, odors, and impacts to groundwater will be greatly reduced due to the placement of an impervious final cover and the continued operation of the leachate extraction system post closure. Landfill gas (LFG) generation potential will decrease post closure as the landfill achieves organic stability and the waste degrades over time.

The potential for increased storm water runoff post closure will be reduced by the storm water control features implemented in the Expansion design. These will be further presented in the forthcoming Plan of Operation. Generally, storm water runoff could potentially increase as compared to pre-development conditions as storm water will be routed off the final cover as opposed to captured by the waste and into the leachate collection system during active operations. However, the storm water control features for the Expansion will be designed considering post closure conditions and in accordance with applicable standards of NR 504 and NR 151. Additionally, the potential for storm water runoff to pick up contaminants will be greatly reduced post closure due to the restored vegetated surface of the final cover.

DNR Response Comment: Response noted.

20. **DNR Comment- Section 6.3 and 8.8.1, Maximum Open Area:** Clarify the maximum open acreage of landfill in these sections of the narrative.

Vernon County Response: *The statements in Section 6.3 and values used in Table 6-3 concerning open and closed areas are correct. The statement concerning landfill areas open and closed to leachate infiltration in Section 8.8.1 shall be corrected in accordance with the following paragraph. The maximum open acreage of the landfill anticipated is approximately 9.58 acres with 5.00 acres being closed. As shown on Table 6-3, this corresponds to final closure area C-1 (5.0 acres) being closed, and final closure areas C-2 (4.64 acres) and C-3 (4.94 acres) being open, which represents the entire proposed horizontal and vertical expansion area.*

DNR Response Comment: Response Noted

21. **DNR Comment- Section 8.8.2 Geotextile:** Clarify the minimum thickness of the geotextile used.

Vernon County Response: *Geotextile thicknesses will be specified in conjunction with aggregate gradation design during the Plan of Operation preparation process. All landfill geotextile will be greater than or equal to 12 oz/yd².*

DNR Response Comment: Response Noted

22. **DNR Comment- Table 8-1:** Include quantities of structural fill needed for support berms and other structure features for the expansion in the soil balance table.

Vernon County Response: *The volume for support berms and other earthwork features are included in the Common "Earthwork" Columns of Table 8-1.*

DNR Response Comment: Response Noted

23. **DNR Comment- Section 11, Need and Design Capacity:** Resolve the following apparent discrepancies in the needs and site life analysis:

- a. The starting estimated disposal rate for the landfill provided in Table 11-7 (59,000 cubic yards) is not consistent with the average waste acceptance rate at the landfill presented in Table 11-2 (25,235 cubic yards). Evaluate the service area and needs analysis factors to explain this discrepancy and whether a more representative starting disposal rate would be appropriate.
- b. The annual growth rate used in Table 11-5 is 1.56% which is taken from Table 11-2. However, this annual growth rate is significantly higher than the annual population growth rate of 0.22%. While the 1.56% growth rate may be the most conservative calculated from Table 11-2, the actual waste volumes accepted at the landfill fluctuate slightly from year to year. The 1.56% growth rate does not represent a rate that is exponential in growth to be compounded annually like the behavior of a population growth rate. Furthermore, the latest trend is a declining waste acceptance rate at the landfill. If the population growth rate is used, the proposed expansion volume would exceed a 15-year site-life. The department is allowed to approve landfills with a maximum 15-year site-life. Please provide any additional explanation available regarding this that may assist the department in its determination of estimated site-life.

Vernon County Response: *The design capacity of the proposed Expansion was based on historic*

tonnage data collected at the existing facility. Historic, site-specific data, was used to calculate anticipated future waste quantities, factoring in growth in waste generation, over the maximum 15-year life of the Expansion per NR 504.05(3). The projected site life of the Expansion based on historic tonnage data and calculated growth rate was presented in Table 11-5. Using a five-year average of the most recent tonnage data, a starting disposal rate of 25,235 CY (assuming a 1,500 lbs/CY waste density conversion) was utilized for this calculation. A second method (per capita method) for calculating waste quantities and evaluating need of the facility was presented in the FR which utilized the calculated statewide per capita average disposal rate and applying it back to the service area population to estimate waste generation. The second method calculated an annual service area waste disposal, or generation, rate of 59,000 CY which was not used for determining design capacity of the Expansion. The first method is the preferred method as it is based on empirical data collected at the existing facility. The second method is a good gauge for estimating the amount of waste potentially generated within the overall service area and gives an approximation of waste capture and waste potentially leaving the service area.

As discussed in Section 11.3.3, several waste growth rates were calculated utilizing historical tonnage data collected at the facility. The average annual disposal rate from year to year was chosen for calculating future waste growth over the life of the Expansion as it was most conservative. Growth rates ranged from 1.56% to 2.39% of which any these rates within this range are representative of the existing facility's increase in waste disposal over time. Waste growth rates were utilized as opposed to only population growth rate as other factors such as economic development/redevelopment, new industries, weather related disaster/damagers, etc. can lead to increased generation in non-MSW waste types like C&D waste. It is reasonable to infer that MSW generation can be commensurate with population growth, however population growth alone may not be commensurate with other wastes accepted at the facility. Therefore, using population growth rate alone would potentially exclude growth in other non-MSW streams.

Waste received by a solid waste facility can fluctuate from year to year. These fluctuations could be caused by a variety of factors such as new waste diversion efforts, hauler compliance/noncompliance in terms of contractual agreements, increase/decrease in local redevelopment or new development, economy, changes in population, new waste streams, etc. The recent trend experienced during 2020 to 2022 is not expected to be a lasting trend and is likely due to several reasons stated previously. In 2023, the facility received 18,415 tons of waste suggesting the facility may be returning to an increasing trend. Waste tonnage data provided by Vernon County for 2023 is included in Appendix G.

DNR Response Comment: Response noted.

24. **DNR Comment- Appendix S, Leachate Treatment Agreements [s. NR 512.13(3), Wis. Adm. Code]:** The leachate treatment agreements provided have expired prior to the submittal of this feasibility report. Provide updated leachate treatment agreements.

Vernon County Response: *The City of Viroqua Leachate Treatment Agreement provided within Appendix S is the active leachate agreement between the Vernon County Landfill and the City of Viroqua. The agreement states, "this agreement shall remain in effect for the period of time that the County is required to dispose of leachate from the County's solid waste disposal facility".*

The La Crosse County Leachate Treatment Agreement provided within Appendix S is the active leachate treatment agreement between the Vernon County Landfill and La Crosse County. The agreement states an automatic renewal.

The City of Sparta and the Vernon County Landfill currently have a draft leachate treatment agreement which is provided within Appendix H. A final copy will be provided to the WDNR once

completed.

DNR Response Comment: Response Noted

25. **DNR Comment- Plan Sheet 32, Detail 3-32, Leachate Extraction Building (Phase VII):** Please clarify the thickness of clay liner and rooting zone layer, as these thicknesses are inconsistent with other details provided on the plan sheets and in the narrative.

Vernon County Response: *The detail formerly recognized as Detail 3-32 on Plan Sheet 32 in the Feasibility Report has been revised and is attached as Detail 3-33 on Plan Sheet 33 and depicts a 5 ft. thick clay liner and 2 ft. thick rooting zone.*

DNR Response Comment: Provide clarification on revised detail 3-33 in the addendum, on if the final cover design is using a geocomposite drainage layer or a sand drainage layer. Feasibility addendum 01 detail 3-35 and the feasibility report narrative section 8.14.4 both note a sand drainage layer.

26. **DNR Comment- Appendix R, Sub Appendix B, Sheet 16 Leachate Headwells:** This sheet notes that multiple headwells on the landfill are damaged; please provide a current list of the headwells on site and the status of them as well as provide a history of headwells that are damaged, lost, or abandoned.

Vernon County Response: *A Plan Modification Request was submitted to the WDNR on October 2, 2020, summarizing the status of the headwells and requesting approval to use alternatives. This Plan Modification Request proposed to perform head monitoring at leachate cleanouts CO-3S, CO-7S, CO-3N, and CO-6N and leachate headwells LHW-5 and LHW-6. This Plan Modification Request was approved by the WDNR on February 9, 2021. The Plan Modification Request and the WDNR Approval Letter are included within Appendix I.*

The following is a summary of the leachate headwells history that was summarized within the October 2, 2020, Plan Modification Request.

- *The 2005 plan of operation approval (July 29, 2005) require monthly leachate head well monitoring be conducted at six leachate head wells. The head wells specified included 3 vertical well heads (LHW-1, LHW-2 and LHW-3) that existed at the time of the approval, and three horizontal side slope head wells (LHW-4, LHW-5, and LHW-6). At the time of the 2005 approval, only horizontal LHW-5 was installed.*
- *Upon investigation, LHW-1 could not be located (presumably abandoned as its location is in the same vicinity as an access road), and LHW-2 and LHW-3 are obstructed approximately 20 feet below the waste surface, which is 10-15 feet above the bottom of the well and top of liner. The vertical wells are very apparently bent and bowed, likely due to waste settlement forces, especially on the side slope. Discussions with site personnel indicate the vertical leachate head wells have been hit several times during mowing and site operations. It is likely each well is damaged in multiple locations, and it is likely that attempts to repair or refurbish the wells would be unsuccessful and costly.*
- *It also does not appear that horizontal LHW-4 was installed during the 2008 Phase II, Module 3 liner construction. Of the original six leachate head wells in the plan of operation, only LHW-5 and LHW-6 remain in usable condition. Inspection of both leachate head wells did not indicate any damage or issue.*

DNR Response Comment: Provide narrative on why LHW-5 and LHW-6 need to be abandoned as noted in addendum 01 plan sheet 25. Provide discussion on if both need to be abandoned or if sweep bends can be installed to continue monitoring these two or what could be installed in their place to give each a replacement measurement and how they would be equivalent or greater.

27. **DNR Comment- Plan Sheets:** Provide a plan sheet with labeled leachate headwells, cleanouts, and leachate lines for the entire site with the proposed expansion.

Vernon County Response: *Plan Sheet 25, Existing and Phase VII Through IX Leachate Collection System has been added to show labeled headwells, cleanouts, and leachate collection lines for the entire site with the proposed expansion.*

DNR Response Comment: Response Noted.

28. **DNR Comment- Plan Sheet 24, Plan Sheet 33, Detail 2-33, Leachate Headwell:** Please provide narrative on the general design of the sweep bend noted on Plan Sheet 24 Note 8 for the leachate collection line cleanouts.

Vernon County Response: *The existing cleanout riser will be removed and a 6-inch PVC to HDPE stainless steel transition fitting will be connected. A 6-inch SDR 11 HDPE pipe will continue horizontally through a manufacturer recommended minimum 13-foot bend radius to exit the landfill directly to the south at the phase boundary through a vertically oriented 6-inch SDR11 HDPE 22.5 degree long radius bend. The full pipe length will be bedded on a minimum of 4-inch leachate pipe bedding aggregate and covered with a minimum 12-inch pipe bedding aggregate. This design will be depicted on a more detailed drawing in the Plan of Operation.*

DNR Response Comment: Response Noted.

29. **DNR Comment- Plan Sheet 23 Horizontal Footprint:** Please discuss the design rationale behind the divot in the waste limits between exiting Phase III Modules 1&2 and proposed Phase VII and the exiting Phase III Modules 3&4 and proposed Phase IX.

Vernon County Response: *In order to provide a continuous composite base liner system (5-ft of compacted clay and 60-mil HDPE Geomembrane) and to maintain continuous 4:1 maximum final closure slope, the expansion was controlled on a continuous line at the limits of composite liner as shown in Detail 3/34 in the Feasibility Report Drawings. The geometry of the final closure slopes, waste slopes, proposed perimeter berms and existing perimeter berm along the eastern side of the existing MSW landfill, create a horizontal change for the limits of waste as the waste slopes rise up and over the berm elevation along the composite liner splice as shown in Detail 7/30 in the Drawings. This "divot" is the result of liner design constraints placed at a convergence of slopes to maintain continuous liner limits to ensuring the integrity of the composite liner.*

DNR Response Comment: Response Noted.

30. **DNR Comment- Storm Water Controls:** Please discuss the impacts of the expansion to the existing sedimentation basin.

Vernon County Response: *Expansion of the Vernon County Landfill will have significant impacts on the existing sedimentation basin. The existing basin is located within the footprint of the landfill expansion and therefore is being moved to the east outside of the expansion footprint. The existing basin was sized to manage runoff from the existing landfill footprint. The landfill expansion will increase the amount of runoff draining to the basin. Therefore, the size of the existing basin is inadequate and needs to be enlarged to manage the increased runoff. There are four key criteria that were analyzed to meet the NR 504.09 standards. The criteria are:*

1. *settling the 0.015 mm particle in the 25-yr, 6-hour storm*

2. conveying the 25-yr, 6-hour storm through the primary spillway
3. conveying the 100-yr, 24-hour storm through the emergency spillway
4. dewatering the basin in no less than 3 days.

The table below summarizes the design calculations of the existing and proposed basins in order to meet criteria 1-3 above. Criteria 4 will be met during final design of the sedimentation basin and dewatering structure during the Plan of Operation. The table below shows the proposed basin is designed approximately 2-3 times larger than the existing basin.

DNR Response Comment: Response Noted.

December 19, 2023 Incompleteness Letter Section A – Comments and Responses

1. **DNR Comment-** The following apparent typographical errors are noted for the record.
 - a. Plan Sheet 9: Based on the groundwater elevation data presented, the date in the title should be May 2023.
 - b. Plan Sheet 15. The label of the D' location should be east instead of west.

Vernon County Response: *A revised Plan Sheet 9 and Plan Sheet 15 are provided.*

DNR Response Comment: Response Noted.

February 1 2024 Email from DNR to Vernon County – Comments and Responses

1. **DNR Comment-** Generally, there are a number of gaps in the geologic and hydrogeologic information presented within the feasibility report. Items that remain not well understood include groundwater flow conditions around the southeast corner of the expansion area where SEH has interpreted a merger zone between the perched and regional aquifers. Groundwater flow information presented here appears to be largely interpretive given the number of data points available. For example, you have defined equipotential lines and a complex groundwater flow regime with very few data points (e.g., MW-12, MW-16, and MW-17WT), most of which are seated outside of the southeast area. The grey area shown on Plan Sheets 4 through 7 indicating the merger zone of the perched and regional water tables, appears to have been defined with a single data point (MW-16) from dry wells. The characterization of this area is further confused by what appears to be a contradiction in the information presented in cross section (Plan Sheet 17, cross section F-F') vs. the water table maps 4-7. In cross-section, the merger point is shown at MW-16, but in maps 4-7 the area of the merger shown in gray is a much larger area. It is not well understood how this interpretation was developed given the lack of corresponding geologic and hydrogeologic data.

Vernon County Response: *Groundwater conditions at the site conform to anticipated conditions for the geologic units present and applying hydrogeologic principles and concepts. We have based much of our understanding of groundwater conditions on the hydrogeologic studies completed on the Prairie du Chien Group by Tipping, R. G., Runkel, A. C., Alexander, E. C., Jr., Alexander, S. C., and J. A. Green, 2006, Evidence of Hydraulic Heterogeneity And Anisotropy in the Mostly Carbonate Prairie du Chien Group, Southeastern Minnesota (in Sedimentary Geology 184 (2006) 305-330).*

Tipping, et al. (2006) establishes the overlying Shakopee Formation of the Prairie du Chien Group as an aquifer and the "intervals of relatively unfractured rock serve as confining units" within the underlying Oneota Dolostone (illustrated in the figure to the left). Fetter (1988) defines a confining layer as ". . . a

geologic unit as having little or no intrinsic permeability". Tipping et al. (2006) describes the layered heterogeneity of the Prairie du Chien in relationship to depositional environmental and erosional history. Although the Shakopee Formation is not present, regionally the lower portion of Oneota Dolostone (present onsite) consists of rock with low intrinsic permeability that inhibits downward percolation of groundwater. Given the depth to the regional water table occurs 100 to 135 feet below the landfill site, the presence of an intervening lower permeability rock (generally falling below the elevation of 1120 feet defined by the H2 marker horizon identified on gamma logs) provides the optimum conditions needed to develop a perched groundwater system, particularly when underlain by the higher permeability rock found in the basal Oneota Dolostone and underlying Jordan Sandstone. The continuity of a perched groundwater system depends on favorable hydrogeologic conditions remaining continuous and consistent. However, at the Vernon County Landfill, the lateral extent of the low permeability unit becomes compromised within a valley where much of the bedrock has weathered into saprolite and residuum (MW- 16WT/MW-16/MW-16Z) or where lithology changes (MW-19/MW-19Z). This is clearly illustrated in the geologic cross-section G-G' (Plan Sheet 18) and K-K' (Plan Sheet 22) and shown in the figure to the right.

Across the landfill property, the only location in which the elevation of 1120 feet (H2 marker horizon) has been weathered to saprolite is in the southeast. Based on the water level observations in well nests MW-16WT/-16/-16Z and MW-19/-19Z, it is clear that the intrinsic permeability of the confining unit has been compromised through the weathering process or changes in lithology. Fetter (1988) describes a perched aquifer as where ". . . water moves laterally above the low permeability layer up to the edge then seeps downward toward the main water table . . ." In addition, the perched water table maps included in the Feasibility Study (Plan Sheets 4 and 5) apply principles described by Freeze & Cherry (1979) for the formation of a perched water table (shown to the left) indicating an increase in hydraulic gradient in the transition between the edge of a perched water table and the regional water table (using a river in this example to depict a discharge point).

A portion of the high perched water table map from August 2024 (Figure 1) is also shown to the left depicting the increase in hydraulic gradient along the transition zone applying the Dupuit-Forchheimer Theory of Free-Surface Flow (Freeze & Cherry, 1979).

It is difficult to illustrate groundwater conditions in the transition zone in the plan view. Therefore, to clarify groundwater conditions, the grayed area depicting the transition zone has been removed in Plan Sheets 4 through 7. Instead, refer to the intersecting geologic cross-sections in Plan Sheet 18 (G-G') and Plan Sheet 22 (K-K') illustrating the weathered bedrock's role in locally altering perched water table conditions. This relationship between the perched water table and regional water table has been well documented in research publications and is illustrated well in the following publications:

- Runkel, A. C., Tipping, R. G., Meyer, J. R., Steenberg, J. R., Retzler, A. J., Parker, B. L., Green, J. A., Barry, J. D., & Jones, P. M. (2018). A multidisciplinary-based conceptual model of a fractured sedimentary bedrock aquitard: improved prediction of aquitard integrity. *Hydrogeology Journal*, 26(7), 2133- 2159. <https://doi.org/10.1007/s10040-018-1794-2>.
- Nimmo, J. R., Creasey, K. M., Perkins, K., & Mirus, B. B. (2016). Preferential flow, diffuse flow, and perching in an interbedded fractured-rock unsaturated zone. *Hydrogeology Journal*, 25, 421-444. <https://doi.org/10.1007/s10040-016-1496-6>.

DNR Response Comment: The purpose of the feasibility process is to determine site-specific feasibility of siting a landfill at a particular location. The literature cited in this response could be used to guide a site-specific investigation but does not replace the need for developing a site-specific understanding of the merger zone between the perched and regional aquifers. The relationship between the perched and regional aquifers is somewhat better defined with new well information, but mounding of regional water table near the MW-18 well nest is not fully defined or understood resulting in gaps in the monitoring

network as mentioned in the response to Section 2.1, Comment 2. Additionally, the fact that MW-15WT is dry appears to present a data gap in the area of the merger zone as well.

2. **DNR Comment-** Additionally, the geological cross-sections show both the perched water table and the regional water table; however, the cross-sections and narrative in section 5.4.2 of the report don't show or attempt to explain what supports the perched aquifer above the regional aquifer, other than touching on vertical gradients that appear to be showing the presence of low permeability formations restricting downward groundwater movement. The cross-sections generally depict the two water levels for each through the same geological formation. It may be that there is currently not sufficient geotechnical information to provide a better explanation for what supports the perched aquifer. However, understanding geological formation that supports the perched aquifer may help to understand where and how it converges with the regional aquifer or the overall flow between the two aquifers.

Vernon County Response: *Conditions in the lower Oneota Dolostone that developed the perched water table are well documented in previous research and publications as described in the response to Comment 1. In addition, the localized weathered condition of the confining unit that modifies the lateral extent of the perched water table system are also clearly described in the response to Comment 1. Research by others on the Prairie du Chien Group confirms its heterogeneity and anisotropy. Tipping et al. (2006) describes the “. . . Oneota confining unit [as] consisting of thickly bedded dolostone”. Bedded geologic units are commonly indicative of layered heterogeneity, with the perched groundwater at the Vernon County Landfill always observed above the H2 marker horizon defined by gamma logs. The geologic-cross-sections clearly illustrate that the lateral extent of the low permeability unit has become compromised within the valley on-site near MW- 16 where much of the bedrock has weathered into saprolite and residuum and near MW-19 where the lithology changes to sandstone. As long as the bedrock is dolostone and has not been weathered below approximately 1120 feet, the perched water table will be present and provides an appropriate upper monitoring system.*

In addition, the hydraulic gradient depiction of the transition zone must be gradual as shown on geologic cross-sections and water table contour maps; it would be impossible for the perched groundwater system to persist, likely over thousands of years, if the transition depicted significant flow velocity because the perched system would have drained dry. Routine purging and sample collection over the past 30 years have confirmed the sustainability of this perched groundwater system.

DNR Response Comment: The department concurs that the additional data support a gradual hydraulic gradient within the transition zone. However, as mentioned throughout, literature assumptions do not replace the development of a site-specific understanding of the geology of the transition zone.

3. **DNR Comment-** As stated in Comment 2 of the December 19, 2023, letter and as noted in Comment 1 above, additional hydrogeological investigation (data from additional test borings and groundwater monitoring wells) is needed to adequately define the water table surface(s) and flow regime in the area of the merger point between the perched aquifer and regional water table aquifers. Equipotential lines on Plan Sheets 4 and 5 to the north, west, and east of the interpreted merger zone are based largely on data from two dry monitoring wells (MW-15WT and MW-16WT). Therefore, many of the equipotential lines shown are inferred and should be represented with dashed lines or question marks (refer to Comment 4 of the December 19, 2023 letter).

Additional investigation could allow for additional perched aquifer wells to confirm the interpreted flow regime, or to provide data for an alternate flow scenario. A few potential areas to consider as starting points for additional investigation include, but are not limited to, the following areas:

- a. A test boring and groundwater monitoring well or well nest in the southern portion of the proposed expansion area, in the general area of test boring B-21, could better define flow to the

- west of the currently interpreted merger zone and could provide geotechnical data in the vicinity of the sump area of the proposed expansion, which is an area where additional pressure on top of a landfill liner would typically be expected. This would also provide an opportunity to obtain geotechnical information at least 25 feet below sub-base grade in this area (refer to Comment 1).
- b. Completion of a test boring and groundwater monitoring well nest between existing groundwater monitoring well nest MW-5/MW-5A and the currently interpreted merger zone, such as the MW-5R/MW-5AR well nest proposed on Plan Sheet 29, could better define groundwater flow in this area.
 - c. A test boring and groundwater monitoring well or well nest to the southeast of MW-15WT could better define groundwater flow in this area and could provide data that the merger zone area and groundwater flow from a potential release from the expansion area is adequately understood and preclude the need to characterize groundwater flow further on the eastern portion of the merger zone.

Vernon County Response:

- a. *As requested by the WDNR, additional boring B-22 was completed near the previously completed boring B-21 to a depth of at least 25 feet below the proposed sub-base grades. It should be noted that drilling through the perched water table may compromise the natural barrier properties of the low permeability unit supporting the perched water table. Therefore, B-22 was only drilled to the top of the perched water table so to not compromise the confining layer. Additional drilling was completed, outside the disposal area, to install additional longterm monitoring system wells; these additional wells are used to further define groundwater conditions in support of the groundwater monitoring system.*
- b. *Concur; the installation replacement wells for MW-5/MW-5A were completed as part of the 2024 addendum field investigation as described in Section 4.0. The wells completed were MW-18WT (perched water table) and MW-18 (regional water table).*
- c. *Due to the existing topography and direction of groundwater flow in the perched water table, installation of a well or well nest to the southeast of well MW-15WT, while would be ideal, the area is not accessible by drilling equipment and a well installation is not feasible. Given the direction of groundwater flow in the perched water table, the location of the proposed replacement wells for MW-5/MW-5A provide the best monitoring location and accessible location on the east side of the landfill expansion area. Details on the completed replacement wells (MW-18WT and MW-18) are provide in Section 4.0. Because water was observed during the installation of well MW-15WT, the well will be maintained and monitored for water levels to provide additional information for the perched water table contours.*

DNR Response Comment: Refer to the department's comments regarding the data gaps that remain in relation to the mounding of the regional water table near MW-18 (Response to comment 1 above and Section 2.1 comment 2). Additional test borings and well drilling performed in response to this letter could provide additional opportunity to utilize wire-line coring or geophysics to enhance site specific data and understanding.

4. **DNR Comment-** The department considered comments made during the January 19, 2024 Teams call that borehole geophysical methods that are not specific to saturated boreholes would only provide data specific to the individual boreholes, and does not concur with this assessment. The use of borehole geophysics could provide fracture and/or potential flow data that has the potential for interpretation between boreholes as does inspection of wireline cores. If the landfill feels strongly that borehole geophysics will not be effective, they may consider revisiting wireline coring of the additional test borings and select what they feel is the better option. The landfill could also consider inter-point methods such as dye tracing or surface imaging geophysical investigation techniques to augment the geotechnical investigation data.

Vernon County Response: *As described in Section 2.1, the application of other borehole geophysical methods was evaluating using FRGT Tool, developed by the USGS and EPA and determined too many limitations to add any value. While seismic surficial geophysical methods are better at distinguishing geologic units, electrical resistivity methods may distinguish saturated and unsaturated conditions with proper placement of nodes; at the landfill site, the topographic changes and the presence of the existing landfill limit the usefulness of these methods.*

Dye tracing tests are used for tracking and tracing various flows from an injection point to a reception point. For groundwater, a tracer is typically introduced into the aquifer through a naturally occurring recharge feature such as a sinkhole and monitored through reception points such as seeps or surface water features. There are no karst or recharge features on the landfill site and there are no seeps or surface water features. Introducing a dye and flushing it to move through 100 feet of unsaturated conditions is not practical.

Similarly, fracture analysis is generally conducted from aerial photographs, from visible quarry bottoms, and/or through tightly spaced drilling programs where caliper logs, localize dye traces, or visible fractures can be mapped and correlated. The conditions at the landfill are not conducive to fracture analysis techniques.

Therefore, any further investigation of the underlying natural conditions will need to have very clear objectives as presented within the Summary of Hydrogeologic Conditions in the Proposed Expansion Area Table provided below.

Note that because of the unsaturated conditions within the residuum, saprolite, and dolostone below the footprint of the proposed expansion, in the event that leachate does penetrate the 60 mil HDPE liner and the 5-feet of compacted clay it would move through the 77 feet of the unsaturated material through gravity potential and moisture potential; the moisture potential is a negative pressure due to the soil-water interaction and is likely greater than gravity potential under very dry conditions (Fetter, 1988). However, although the high clay content and liquid limit of the residuum results in very high moisture potential, the limited interconnectivity of pore spaces in clay will reduce rates of percolation through the unsaturated material.

The table below summarizing the hydrogeologic conditions in the proposed expansion area, including the information collected during the 2024 Addendum Field Investigation.

DNR Response Comment: Refer to the Section 2.1 Comment 6 response above.

Section 4 of Addendum 1 – New Comments

1. **Section 4.3.2.1:** The department does not concur that the gamma geophysical analysis confirms consistency of bedrock geology, given the extension of horizon markers through the apparent transition of sandstone to the east. In addition, the gamma geophysical analysis did not provide sufficient data regarding the specific geology and fracture zones to replace the requirement for wireline coring, which was the original intent of the geophysical investigation.
2. **Section 4.3.6.1:** The extent of mounding and the northwesterly flow component near MW-18 requires further definition, as noted in previous comments.
3. **Section 4.3.8.1:** Flow net accuracy is uncertain in area of MW 10/11/12 and through the perched water transition zone due to lack of data, as noted in the response to the Section 2.1 comment 10 comment above.
4. **Section 4.3.13.1:** The department notes the change in perched water hydraulic conductivity is most noticeable toward sandstone zone (MW-17WT). Please further define the geology supporting the perched

water zone in the MW-17WT area.

5. **Section 4.3.14.1:** Two rounds of analytical data have been reported to date for the five monitoring wells and piezometers installed during 2024 (MW-16Z, MW-18WT, MW-18, MW-19, and MW-19Z). Section NR 507.18(1)(b), Wis. Adm. Code requires a minimum of four baseline samples to be collected for a proposed facility prior to the plan of operation (with eight baseline rounds total). These four rounds of data are also necessary for the identification and review of any needed exemption requests under s. NR 140.28, Wis. Adm. Code. Please submit the minimum four rounds of data for the wells installed in 2024 as well as any additional wells installed as part of the feasibility investigation. Any additional exemptions needed under s. NR 140.28, Wis. Adm. Code, along with justification of the proposed exemptions, should be requested in an addendum to the feasibility report.

This incompleteness determination is not a denial of your report, but merely indicates that additional information is needed to continue the review. Submittal of this information does not ensure a favorable determination, nor does it preclude the department from requiring additional information if continued review indicates it is needed. Upon receipt of the additional information, the department has 60 days to determine whether or not the feasibility report is complete. Please do not hesitate to contact Mark Peters, Hydrogeologist at (608) 516-0820 or mark.peters@wisconsin.gov or Colin Maus, Waste Management Engineer at (608) 516-2462 or colin.maus@wisconsin.gov if you have any questions about this letter.

Sincerely,



Bridget Kelly
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cc: Brian Kent- SEH (bkent@sehinc.com)
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