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September 2, 2020 *Sent via electronic delivery*

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Re: Liquefied Natural Gas Tank Basin, Fill Water-Bearing Zone Removal Action Design
NW Natural "Gasco Site"
Portland, Oregon
ECSI #84

The Oregon Department of Environmental Quality (DEQ) reviewed the "Fill Water-Bearing Zone Trench Design," dated August 13, 2020. The submittal presents the NW Natural design for two trenches positioned downgradient of the Liquefied Natural Gas (LNG) Basin. NW Natural is constructing the trenches as a removal action to address groundwater contamination migrating from under the LNG Basin and towards the Willamette River. This letter refers to the design document as the "Draft LNG Basin Trench Design." Anchor QEA, LLC prepared the Draft LNG Basin Trench Design on behalf of NW Natural.

The primary purpose of this letter is to inform NW Natural that DEQ:

- Approves the principal elements of the trench design, including the locations, lengths, alignments, depths, and approach to constructing the two trenches that comprise the removal action; and
- Does not approve Draft LNG Basin Trench Design as the document is incomplete.

DEQ requests that NW Natural revise the Draft LNG Basin Trench Design consistent with the comments provided below, and submit a revised version of the document for review. For clarification, DEQ's comments do not alter the overall design of the trenches. Our comments request additional information and documentation to complete the design document. DEQ recommends that NW Natural move forward with removal action permitting and project planning.

GENERAL COMMENTS

Model Documentation. Section 4.1 provides a brief overview of the groundwater modelling done to evaluate trenches in the Fill WBZ. Appendix D presents and discusses the modelling work in more detail, including the simulations for each of the combinations of one or two trenches and variations of the lengths and alignments. The Draft LNG Basin Trench Design does

not include information regarding modelling assumptions of the model and the potential limitations those assumptions have on the interpretations and conclusions of the various simulations discussed in the document.

DEQ requests that NW Natural include a section in Appendix D discussing model assumptions the associated limitations with information regarding, but not limited to the following:

- **Model Grid-Spacing.** The design document utilizes the site-wide groundwater to assess the hydraulic influence of different combinations of trenches on shallow groundwater capture. The grid-spacing, including the potential influence and/or limitations of spacing on model simulations, should be discussed in the context of the scale of the LNG Basin trench removal action.
- **Selection of Hydraulic Conductivity.** Estimates of hydraulic conductivity (K) presented in the submittal appear to be highly variable. In the majority of samples, the HydrogeoSieveXL results for methods that met the criteria showed a consistent bi-modal distribution. The Kruger, Kozeny, Zunker and Zamarin calculation methods typically yielded K-values 10 to 20 times higher than other methods in the suite. Given the distribution of estimates, it's not clear the geometric mean values assigned to the model are representative of the hydraulic conductivity of the Fill WBZ for modelling purposes. DEQ requests that the Appendix D discuss the use of, and uncertainty with using the geometric mean for groundwater modelling in the context of the HydrogeoSieve results and other data available for the Fill WBZ.
- **Orientation of Hydraulic Gradient.** The document does not mention the change in the orientation of the hydraulic gradient in the Fill WBZ subsequent to completion of the LNG Basin lining project in October 2018. Since completion of the project and dependent on season, the gradient rotates between 10 and 20-degrees north of the gradient prior to basin lining. The capture zone depicted in every LNG Basin Trench Design figure reflects the pre-lining orientation of the gradient. The revised version of the design should acknowledge and discuss the extent and orientation of capture zones in the context of the current gradient, not the previous orientation shown in the current document figures.

Trench Construction Information. Section 5 discusses the components and construction of the trenches. This section is incomplete and requires additional information. In particular, Section 5.5 should be revised to support the basis of design for the trenches and the methods that will be used during installation, including but not limited to additional details regarding construction quality assurance/quality control (QC) requirements that will be implemented during the system construction to ensure the trenches are built and function in accordance with the design. DEQ's specific comments further clarify the information needs.

SPECIFIC COMMENTS

Section 3.1, Model Modifications. The Draft LNG Basin Trench Design describes changes to the site-wide groundwater model in 2018 to reflect the cessation of pumping from the former Koppers Tank Farm and lining the LNG Basin. DEQ previously reviewed and acknowledged the 2018 model modifications. Section 3.1 identifies additional changes to the model for the LNG Basin Design. DEQ requests that the section discuss these modifications and the associated consequences on model output. DEQ further requests that the section explain the rational for modifying the model at the US Moorings property, and document the basis for

selecting a K-value of 40-feet per day for the simulations, including a description of the area over which the K-value was assigned.

Section 3.3, Simulation of Fill WBZ Trench. A brief description of the approach to simulating trenches in the Fill WBZ is provided here. DEQ requests the section provide the basis for using a K-value of 40-feet/day in Equation D-1. DEQ's general comment regarding the influence of grid-spacing on model output applies here.

Section 4.1, Modeling Evaluation of Alternative Trench Alignments. The section indicates that trenches in Pacific Terminals (PacTerm) Tank Basin that are either 100-feet or 150-feet long will capture the "entire footprint of the LNG Basin." The section further indicates that adding an additional trench that is either 30-feet or 50-feet in length "...provides little benefit in terms of capture near the LNG Basin." DEQ disagrees with this information for the following reasons:

- Consistent with previous discussions, DEQ considers the "footprint" of the LNG Basin to be the full-width of the basin (i.e., from rim-to-rim) normal to the gradient. Under "dry season" simulations, the 100 or 150-foot long trench may not fully capture groundwater over the width of the basin. In addition, under average conditions the capture zone associated with the 100-foot long trench does not encompass monitoring well MW-49F and vicinity (i.e., groundwater exhibiting the highest concentrations of benzene continues to flow towards the river.
- Adding either the 30-foot or 50-foot trench benefits groundwater capture by: 1) expanding the capture zone west and further downgradient of MW-49F (i.e., encompasses the monitoring well and more of the plume exhibiting the highest concentrations of contaminants); and 2) expanding the width of the capture zone to the west, lengthening shallow groundwater flowpaths around the capture zone and increasing the travel time of contaminated groundwater to the river.

Section 4.2, Selection of Trench Alignment. The document indicates that modelling completed to support trench selection indicates a 100-foot long trench is sufficient to hydraulically capture shallow groundwater under the LNG Basin footprint. DEQ's comment to Section 4.1 regarding the 100 or 150-foot long trench applies here.

Section 4.3, Modelling Evaluation of Selected Trench Alignment. The section provides a general description of the modelling completed to support design. The text should clarify that steady-state simulations produce fully developed capture zones (i.e., cover maximum extent), and the orientation of the capture zone is controlled by the model and does not reflect the direction of the groundwater gradient in the Fill WBZ. Current information indicates that the orientation of the hydraulic gradient in the Fill WBZ generally ranges between approximately 10 and 25-degrees east of north (i.e., rotated 10 to 20-degrees north of those shown in figures).

Section 4.4.1, Extreme Weather Conditions. An evaluation of trench capture zones during periods of site-specific weather extremes is provided here. DEQ requests clarification on whether the "extreme wet condition" (high) flow estimates represents an instantaneous peak value for groundwater extraction rates, or an average over some period of time.

Section 4.4.2, Non-Uniform Distribution of Hydraulic Conductivity. This section describes the approach for simulating the influence of non-uniform K-values along the alignment of each

trench. DEQ requests additional information regarding the method used to proportion K-values given the grid-cell spacing is 20-feet and the trenches may be oriented across (not along) cell boundaries. DEQ also requests information on whether the ends of the trenches contribute measurably to flows. A table or figure may be useful to address this comment.

Section 5.1, Trench, Alignment, Depth, and Width. DEQ's comments on this section of the Draft LNG Basin Trench Design include the following:

- According to the 2nd to the last paragraph, the width of the trenches will be based on the bucket width. The bucket width does not appear to be provided in the document. DEQ requests clarification from NW Natural on the minimum design requirement for the width of the trenches to be effective at achieving the targeted capture zones.
- The design document does not discuss the QC measures that will be implemented in the field during trench pipe installation to ensure the installed piping meet the design criteria by being set at the bottom of the trench, and that subsequent placement of the fill will to prevent damage to the pipes. The section is incomplete without this information and should be revised accordingly.
- A pipe weight is shown in the design details, but the design specifications for the pipe weight should be included in the submittal.

Section 5.2, Construction Method. The first paragraph indicates that the Contractor will sound the bottom of the trench every 10-feet to determine "…the excavation is at least the minimum required depth and within 1.0 foot vertically of the design depth prior to pipe installation." The design should present the depth and elevations of the trench bottom and the bottom of sumps, in the context of the depth/elevation of the bottom of the silt unit. DEQ notes that depending on location, the minimum thickness of the silt unit is approximately 4-feet along the trench alignments. Precautions should be taken to preserve to the maximum extent practicable the thickness of the silt by ensuring the excavation is not taken vertically deeper than the design.

Section 5.4.2.1, Surface Completion/Primary Trench. If the material source is known please include the source information in the report. At a minimum, grain size and material density should be measured for the inert source material - What additional chemical or physical testing planned for the overlying surface material at the top of each trench?

Section 5.5.1, Connection to Groundwater Treatment System/Pumps, Controllers, and Piping. Comments on the section are provided below according to topic:

- **Piping.** DEQ's comments on piping include the following:
  - DEQ requests verification that; 1) the strength of the thin-walled, SDR pipe is sufficient for the overburden pressures within the trench and that deformation of the collection pipe will not occur during placement of the fill; and 2) all piping is chemically resistant with respect to MGP NAPL.
  - All conveyance piping should be pressure tested to assess for leaks following installation and prior to the initiation of system start-up and testing. Testing requirements and acceptance criteria should be identified in the revised design document.
  - DEQ recommends that tracer wire be installed above piping. If the design includes tracer wire, DEQ requests it be shown on the plan details.

- **Non-Aqueous Phase Liquid (NAPL).** Comments regarding NAPL are provided below.
  - The potential presence of NAPL in the trench warrants including explosion proof motors in the pumps specified in the design. The pump specifications should be provided in the revised version of the design document.
  - At a minimum, LEL readings should be collected from the vault and cleanouts at the trench and any enclosures along the discharge conveyance lines to ensure volatile vapors aren't accumulation in the trench or sump area. These measurements should be collected before and during system start-up operations, as well as during routine operations. The LNG Basin Trench Design should be revised accordingly.
- **Fail-Safes.** The design document does not include information regarding the built-in fail-safes integrated into the system operational controls. For example, shut-down of the Gasco Pre-Treatment Facility should automatically trigger shut-down of the trench pumps.
- **NPDES Permit Modifications.** The revised design should describe the groundwater treatment plant NPDES permit requirements, including NPDES permit number and any specific trench system upgrades that are needed to comply with the NPDES permit, or any changes to the permit necessary for treatment of trench discharge. If the NPDES permit is updated, DEQ requests that a copy of the authorized updated permit be included as an appendix to the revised design document.
- **System Start-up and Testing.** The revised LNG Basin Trench Design should include a plan for the initial start-up, development, and testing of the trenches, and for system operations during the initial weeks and months subsequent to starting the system. The plan should include a site visit schedule, identify field measurements, and provide copies of field forms for recording the details of system operations during site visits.
- **Excavated Material and Waste Management.** The revised design should include a section that discusses the handling and management of excavated soil and other wastes during and project implementation and subsequent to completion.

Section 6.2, Monitoring. DEQ requests that additional piezometers be incorporated into the removal action monitoring plan to evaluate the hydraulic influence of the trenches at the following locations:

- Approximately half-way between the two trenches within the Pacterm Basin to confirm the overlap of the two trench capture zones; and
- Near the northwestern edge of the LNG Basin approximately half-way between monitoring wells MW-06-32 and MW-43F to assess the western extent of the capture zone.

Figure 6-1 should be revised accordingly.

Section 7, Schedule. DEQ requests that the schedule shown by Figure 7-1 be revised to include a line item for start-up activities. Please also identify the permits that will be required and estimated submittal dates and associated agency review times. The schedule includes a line item for "Pretreatment System Expansion." The schedule appears to be the only reference to the expansion in the draft design document. DEQ requests that the revised LNG Basin Trench Design include a section describing modifications to the Gasco Pretreatment Facility associated with the trench removal action.

Appendix D. DEQ's comments on the appendix include the following:

- DEQ's general comments on the orientation of the hydraulic gradient applies to figures D-2a through D-2c and D-3a through D-3c in the appendix.
- The assumed recharge rate of 50% of precipitation for unvegetated pervious surfaces (with no surface water runoff) appears low, and suggests 50% of rainfall is evaporating from areas of with surfaces of bare soil and/or gravel. A value of 50% may underestimate likely recharge. DEQ expects to revisit these assumptions after sufficient performance monitoring data has been collected.

Appendix E. The appendix is incomplete without a drawing clearly showing piping runs and connections between the individual trenches and/or to the Gasco Pre-Treatment Facility, including the locations of, and the details for tie-ins.

- **Figure G-03.** The figure shows existing site conditions within the removal action project area. DEQ requests that site features (e.g., PacTerm Marine Fuel Storage Tanks, PacTerm Tank Basin, LNG Tank Basin, PacTerm Truck Loading Rack) be added to the figure for reference.
- **Drawing C-03.** Comments regarding the figure include the following:
  - Detail 1 – The ground surface should be mounded to allow for potential surface subsidence and to encourage rainfall runoff from the trench. A minimum depth for the uppermost backfill material should specified on the drawing. DEQ recommends a minimum of 5-feet for the surface material. The material compaction requirements should be included in Section 5.4.2 of the revised document.
  - Detail 1 or 2 – Consistent with Section 5.2, DEQ requests that the detail show or indicate that pipe weights will be attached at 10-foot intervals.
  - Detail 3 – DEQ has a number of comments regarding this detail.
    - A perforated 18-inch diameter sump is shown. The potential for NAPL to occur along the trench alignments is recognized. The sump should use blank pipe to retain any NAPL accumulation for removal.
    - The pipe labelled "6" DR17 HDPE LONG-SWEEP (6' RADIUS) ELBOW AND 6" HDPE PIPE 18" should also be identified as a "cleanout riser."
    - DEQ requests that a detail for cleanout riser-pipe surface completions be added to the drawing.

Appendix F. DEQ requests that the cut sheets for pumps, transducers, motor controllers, and other equipment be provided in the revised version of the design document. Also provide calculations for required head and estimated head loss for the water discharged along each conveyance line.

NEXT STEPS

DEQ requests that NW Natural revise the Draft LNG Basin Trench Design consistent with our comments, and submit the revised version of the document on or before September 30, 2020.

DEQ acknowledges and appreciates the work that NW Natural is doing to address groundwater contamination migrating downgradient of the LNG Basin towards the Willamette River. Please contact me with questions regarding this letter.

Sincerely,

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Cc: ECSI No. 84 File