Bob Wyatt  
Northwest Natural Gas Company  
220 NW 2nd Avenue  
Portland, OR 97209  

Re: Draft Feasibility Study  
Portland Gas Manufacturing site  
ECSI# 1138

Bob:

DEQ staff reviewed the Integrated Feasibility Study, Former Portland Gas Manufacturing Site (Draft FS) prepared by Anchor QEA on your behalf and dated December 21, 2015. In general, the document is excellent. Given the extensive amount of material presented in the report and attachments, we nevertheless have a number of comments for your consideration. Therefore, DEQ approves the report in part, and we recommend a meeting to discuss the comments, after which a revised document addressing our comments should be submitted for final review and approval.

GENERAL COMMENTS

1. **Hot Spot Delineation.** Given the sum of in-water data and information, we believe that subsurface sediments qualify as hot spots based on the combination of highly-concentrated and not reliably containable criteria outlined in DEQ’s Guidance for Identification of Hot Spots (April 23, 1998). Data show a significant volume of subsurface sediment exceeds Table 5-1 PRGs by a factor of 10 or more, meeting the highly-concentrated criterion, while information presented in the FS (and preceding site documents) indicates that subsurface sediment contamination is not reliably contained. This includes the evidence of historical dredging which may have uncovered buried contamination near the seawall, and the presence of a large tar body at mudline which has been attributed to dredging for a City of Portland stormwater conduit. It should be further noted that migration of mobile subsurface contaminants (notably BTEX and naphthalene) appears to be low but has not been entirely ruled out.

The current presence of MGP contaminants at or near mudline, given that site operations ceased approximately 100 years ago, speaks to the potential for disturbance of subsurface sediment through either natural (flooding, etc.) or human activity. We therefore feel that consideration of subsurface contamination as hot spots is appropriate. This is not expected to significantly impact the FS as a remedial option is already included (RAA-5) that contemplates full removal; we remain comfortable with the proposed remedial action (RAA-4) subject to the comments presented in this letter.

2. **Contaminant Concentrations at Leave Surface.** As indicated in our email dated 10/9/15 and discussed in a subsequent site meeting, DEQ has requested that the FS (and later RD/RA
activities) evaluate the feasibility of removing any high concentration sediments that are exposed during remedial actions outlined under proposed remedial alternative 4 (RAA-4). This would be based on both existing data and additional characterization that will be completed during remedial design.

3. **Groundwater-to-Surface Water Migration.** DEQ has *not* concluded that upland groundwater is “not a significant source of contamination to the river”, but instead that contamination is localized in vertical and aerial extent, and it is appropriate to address this contaminant source, as necessary, through development and implementation of the in-water remedy. Please address this comment in discussing the conceptual site model (Section 3.4), remedial action objectives and goals (Sections 5.1 and 5.2), etc.

Please provide more discussion regarding this pathway, including contaminant concentrations in 75’ bgs wells relative to PRGs, the predicted in-water discharge point for groundwater contaminants, and the degree to which remedial alternatives address potential groundwater impacts to surface water.

4. **Cap Modeling.** As noted in our comments for Appendix B, cap modeling “runs” should be extended beyond 100 years, and the results presented and discussed in the final FS.

5. **Green Remediation.** We recommend that the FS include a qualitative analysis of the green remediation principles, specifically in the analysis of remedial action alternatives and the recommended remedial actions. Some of the concepts presented in DEQ’s Green Remediation Policy (11/2/2011) fit well with the alternatives recommending partial dredging combined with (enhanced) natural recovery elements.

6. **Other.** DEQ notes that the following pre-design work mentioned in the report is appropriate and necessary:
   - Diver survey of debris, including the prominent debris areas both upriver and downriver of the main tar body (Section 3.3.1).
   - Sediment cores/diver survey to refine extent of the surface tar and hot spot concentrations (Section 6.2).
   - Potential bench scale testing of amendments/literature review (Appendix B, page B-13).
   - Cap armor material specifications (Appendix C, page C-10 & C-11).

**SPECIFIC COMMENTS**

**Section 1.1, second bullet.** Please update considering our comments on site remedial action objective presented below (Section 5.1). Also, we would prefer to characterize remedial action to address potential upland groundwater concerns as “treatment at the exposure point” rather than “source control”.

**Section 3.3.1.** Under the first bullet, “ambient urban background concentrations from upstream of the site (as derived from LWG 2011)” were not, to our knowledge, approved as primary sediment screening levels.

**Section 3.3.2.1, upstream area discussion.** The reference here and elsewhere in the document to the potential that elevated contamination detected southwest of the debris mound may have resulted from
side-casting of sediments during installation of the force main sewer suggests that there is contamination at depth in the vicinity of the sewer line that may not be included in the locality of the facility. This may not be an issue assuming the area is largely depositional and there is no concern about maintenance of the line that might release additional contaminants. Please discuss.

**Section 3.3.2.1, downstream area discussion.** This section includes a statement that no PRG exceedances were identified in subsurface sediments; however, it does not appear that there is much subsurface data in this area. Nearby PGM-11B had elevated levels of naphthalene at depth and naphthalene is specifically mentioned, two sentences later, as being detected at a low proportion in this area. Please include in this section a qualifying statement that identifies the limited nature of subsurface investigation.

**Section 3.3.3.2.** Text should include some discussion of the fact that dissolved concentrations are often higher than totals in transition zone samples. This might include discussion of the variation expected in analytical instrument response, as a means to interpret the significance of the magnitude of these differences. The report should document that implications associated with analytical uncertainty are addressed in the sensitivity analyses conducted on cap modeling parameters.

**Section 3.3.4.3.** We agree that elevated contaminants in upland groundwater are localized, both vertically and horizontally. DEQ has not concluded that groundwater contamination does not pose a threat, but that the threat is limited and can be appropriately addressed through in-water remedial work.

**Section 3.4.** Text notes that sedimentation has occurred near the sea wall. In the interest of balanced discussion, it should be noted that little or no sedimentation appears to have occurred in contaminant-impacted areas closer to the river channel, including over the tar body area.

**Section 3.6.** It is DEQ’s conclusion at this time that so-called “peripheral areas” are likely associated with PGM site activities. We acknowledge that the “connection” to PGM-10 contamination is less compelling but nevertheless believe that its inclusion is appropriate.

**Section 3.6.** The second sentence states that the LOF circumscribes all site-related contamination in surface sediments, but this is not necessarily true since contaminants outside this area may be site-related, just not distinguishable from ambient concentrations. It would be better to indicate that the LOF encompasses all areas where surface sediment exceeds PRGs.

**Section 4.3.** There are other state approval considerations that are potentially applicable, including Oregon Hazardous Waste Management act, the Oregon Solid Waste management act, potentially the Oregon Air Pollution control law, Oregon Occupational Safety and health code.

**Section 4.3.2.** See General Comment #1 above.

**Section 4.3.3.1** suggests that removal-fill permits apply to the Willamette because it is designated as Essential Salmonid Habitat (ESH). We believe the permit applies because it is waters of the state regardless of whether it is ESH or not. Also, it is unknown whether DSL will agree that the substantive requirements of their permit are achieved by the USACE permit process, as they have provided a substantive determination in other cases (almost equivalent to a permit).

**Section 5.1.**
- A more explicit discussion of addressing the groundwater-to-surface water pathway is requested.
- Please add hot spot removal and/or treatment, to the extent feasible, as an RAO.
- Contaminants should either be cited consistently in the RAOS or removed.

Section 5.2.1. PRGs and hot spots should be applied to both surface and subsurface sediment. See General Comment #2 above. Scenarios in which deeper contamination might become available to in-water receptors include migration of contaminants in porewater, erosion, dredging, and through excavation of surface sediment to remove highly-contaminated sediment/tar.

Section 5.2.3. In discussion prior to FS development, DEQ indicated that remedial actions at the site are to achieve PRGs presented in Table 5-1. It has yet to be determined what represents a “reasonable time frame” for doing so. In general, DEQ favors remedial actions that achieve protective levels shortly after remedy implementation, in particular where surface sediment or porewater concentrations significantly exceed PRGs.

Section 5.3. See General Comment #1 on hot spots re: they should not be confined to the upper 1 foot of sediment), and note that the “highly mobile” and “not reliably containable” criteria need to be evaluated consistent with DEQ’s guidance.

Section 5.4. The discussion of background concentrations presented in this section and Table 5-3 is somewhat problematic due to the intricacies of the statistical methods used to determine values and the databases upon which the analyses are based. For example, DEQ’s 2013 background values are upper prediction limits not directly comparable to means, and the downtown reach data are highly biased to likely source areas and consequently result in averages that are likely higher than regional background values. Some caveats should be added to the discussion on background; however, we do not anticipate this will change the evaluation completed and agree that the lines of evidence are generally consistent as they impact definition of the locality of the facility. Also, background generally refers to naturally occurring concentrations; so a better title for Table 5-3 would be “Upstream Contaminant Concentrations.”

Section 6.1. We are concerned about the use of the 3x (PRG) multiplier for subsurface sediment. Please further justify with more substantive discussion of “subsurface exceedances between one and three times the PRGs...observed at upstream background locations”, or use 1x as a default. Regardless, we do not expect this to have a substantive impact on site remedy.

Section 6.2. See General Comment #2 above.

Section 6.3 provides the rationale for delineating the sediment management areas, but does not provide the basis for the sub-delineations; e.g., A1, A2; D1,2 , and 3; C1, C3.

Section 7.1.2 and elsewhere. Typically, capping is considered an engineering control and meets the definition of providing a barrier to exposure. Consequently, the determination that engineering controls are not feasible in this section is somewhat confusing.

Section 7.2.1. The second bullet should indicate that removal followed by capping may be feasible. Note also that some removal and treatment is screened in for future consideration as subsequent text indicates potentially treating the tar deposits to make it acceptable for disposal in Subtitle D landfill.

Section 8.1.2.1. See General Comment #1 above.
Section 8.1.2.3, second bullet refers to an estimated 24 surface sediment samples to monitor contaminant changes over time. This is something to work out during remedial design. Incremental sampling or at least some form of composite sample over identified decision units to reduce potential for spatial heterogeneity in concentrations is a preferred methodology for this task.

Section 8.1.5, first bullet. It is unclear how cap and buffer depths were achieved based on the elevations indicated. The -31.7 feet referenced for Areas C2 and D1 provides for 5 feet but the cap cross-section requires a 30” cap plus 24” buffer which is 5.5 feet. For Area C1 3 feet is designated but only 2.5 feet (12” cover plus 18” buffer) seems to be required.

Section 8.1.5, second bullet. Cross section 3-6a suggests some dredging may be needed on the west end of SMA E to meet the depth requirements for full treatment cap with 2’ buffer.

Section 8.1.6, first bullet. Please explain why a 2.5:1 slope is specified here for SMA C1 but for RAA-4 it is 3:1.

Section 8.1.6, second bullet. Please clarify how the contaminant profile in Area D3 makes removal ineffective in this area.

Section 8.2. The comparison of remedial action alternatives does not include a discussion of the extent to which hot spots are addressed. This should be presented for the sake of completeness.

Section 8.2.4.2. DEQ notes that RAA-3 would specify treatment caps in certain areas; e.g., C3, A2, when an amended cover would be equally effective. Consequently, it may not be justified to rank RAA-3 as more effective than RAA-4.

Section 8.3.2.2. The residual risk evaluation indicates that Site risks are expected over approximately 30% of the LOF following (Year 0) remediation activities, with excess risk to be “quickly dissipated” by Year 7. We have some concern over this timeline for completely addressing excess risk throughout the LOF. Please discuss to what extent modifications to RAA-4 might decrease recovery time.

Section 8.3.3. We agree that points of compliance will need to be defined in the RD/RA process. Preliminarily, we are envisioning sediment compliance being based on incremental sampling, and porewater compliance based on individual sampling locations with, perhaps, statistical analysis to determine whether excess risk is present on an area-wide basis.

Tables 5-1 and 5-2. Please remove screening table labeling indicating that PRG and hot spot values are only applicable to surface sediment. Surface sediment contamination is assumed to pose a risk where PRGs are exceeded, while elevated contamination in subsurface sediment poses a potential risk (based on a variety of factors).

Figure 8-3. Please present a “key” for the stacked bars as was included in Figure E-1.

Appendix A

General. DEQ notes that three different projections are presented in the natural recovery analysis. We appreciate the thoroughness that went into the evaluation. DEQ would like to note that according to Dr.
Danny Reible, recovery projections can be very helpful for evaluating relative time frames between various remedial options, but they shouldn’t be considered accurate for absolute time frames.

**General.** Based on data presented in the section, it appears that conditions at locations PGM-02 and -04 are not only “non-depositional” but modestly erosional. The most notable erosion area within the LOF is located between PGM-19 and the tar body. Also, tar body locations (PGM-15 and 16) apparently show no evidence of sediment deposition. Please discuss.

**Model Calibration, Table A-7.** Long-term monitoring data should be used to validate and potentially calibrate the models used.

**Appendix A, Figure A-6, and Table A-3.** The logarithmic linear regression model may be a useful approach for generally estimating degradation rates used in the transport model, so long as they are validated by other information. While empirical models of this type can be informative regarding general trends, DEQ is cautious regarding emphasis of, or attempting to derive specific values from, these models for the following reasons: the value of the coefficient of determination (R²) as a measure of goodness of fit varies depending on the units of the y-axis, the results in log space will not be the same as the original units. The regression equation would also be different if the y and x-axes were switched. This effect is attributable to the fact the ordinary least squares (OLS) method assumes the x variable is measured without error, which is rarely the case with environmental measurements. For these specific regressions a more complete consideration of regression diagnostics is appropriate. Additional evaluation is appropriate to consider, among other issues, influence of data points with high leverage, validity of model assumptions such as linearity and homoscedascity, and use of other regression quality measures such as AIC, mallows Cp, and other metrics. This level of evaluation will provide insight regarding their usefulness for estimating specific values, and estimation of the precision around those values. If regressions are found not to be useful, then alternative methods beyond OLS can be considered that are more robust to violations of the assumptions required in OLS.

Notwithstanding the foregoing, the regressions performed in Appendix A appear to provide some useful insights. Regression diagnostics should be presented and the source code and data used provided for reproducibility.

Please indicate how was the factor of 10 for black carbon derived. DEQ acknowledges that this is likely conservative, but was this based on a professional judgment, or another means?

**Section 2.1.1.3.** It would appear accurate to reference the presumed or estimated dredge prism given the lack of precise information on where 1989 dredging occurred. Please edit to clarify.

**Section 2.1.2.2.** Please confirm that breasting barges were always used in the past, and will be required in the future. Is such a requirement memorialized anywhere?

**Section 3.** DEQ has not concluded that upland groundwater contamination is “not a significant source of contamination to the river”, but instead that contamination is localized in vertical and aerial extent, and it is appropriate to address this contaminant source, as necessary, in development and implementation of the in-water remedy. Also, the timber seawall face is expected to modify the groundwater flow path beneath the river; “isolation” is largely conjectural with respect to upland contamination at 75’ bgs. Please modify discussion
Section 4.2. In the third paragraph of page A-19, recovery times ranging from a few years to a few decades are indicated as “generally...acceptable for natural recovery”. This would appear to depend on a number of site-specific factors including the magnitude of risk exceedances, receptors (human versus ecologic, T&E versus non-T&E), etc. Please cite references used to support this statement.

Section 4.3.3.1: The Boudreau fate and transport model is implemented with a series of ordinary differential equations (ODEs) solved numerically using Eulers method. Please provide the VBA code implementation for DEQ review.

Section 4.3.3.2: EMNR predictions for the four critical locations that were used in the MNR evaluation (PGM-6, PGM-10, PGM-14, and G783/C783) incorporate the placement of a six-inch sand cover. Less than 50% (6 of 16) of model runs indicate that PRGs would be acceptable immediately after placement, with other runs indicating that would take up to 7 years to achieve PRGs for individual PAHs. Questions: 1) do the exceedance ratios in Table A-7 represent the “worst-case” results from the various modeling runs; and 2) how might the results change with modest modifications to “enhancements”?

Appendix B

General. Text indicates that cap designs will result in contaminant concentrations below PRGs for at least 100 years. Has any modeling been done looking out beyond 100 years? Given that the proposed remedy involves a large source mass, limited source reduction, and estimated long time frames for biodegradation, is would seem prudent to determine whether there is a point at which the adsorptive/sequestration capacity of activated carbon might be reached, and breakthrough might occur. This is of particular concern in units D and E where limited natural recovery might occur, contaminant flux rates are higher, and a high volume of residual source material will be present under the proposed remedial alternative.

Specific Comments.
- Organoclay is not recommended for use based on modeling results as a much larger amount of this material would be needed (compared to activated carbon[AC]). Another downside to organoclay is illustrated by recent data from the McCormack &Baxter site, indicating that the material had degraded over time and particles of it may be responsible for some of the contaminant detections observed in the armor layer.
- In Table B-2, the absence of a tidal response in proposed remediation areas B1 and B2 is difficult to understand given the moderate to strong response observed in neighboring areas adjacent to the seawall. Please discuss.
- The sensitivity runs shown in Table B-5 include a run for location PGM-15 (max seepage rate) where GAC weight percent exceeds 5%, which is usually the maximum considered acceptable before adverse benthic impacts can occur. [In many applications the dose is set to the existing TOC; i.e. if sediment is 2%, add 2% AC.] It would be interesting to have additional analysis to show how much cap thickness would need to be increased, compared to how much additional AC would need to be added, to meet the RAOs in case there would be some advantage. In all cases, the statement is made that it would not be necessary to increase the cap thickness, but DEQ is not clear on how the decision is made to increase GAC or thickness.
- We did not find where the report documents the TOC assumed for sediment in the armor layer in evaluating achievement of sediment PRGs. Since TOC will be higher in depositing sediment it will sorb more contaminant and sediment concentrations will be higher than estimated for 0.1% sand cap material. Please clarify.
• We would like to see modeling results carried out until you start to see the effects of source depletion as shown for fluorene in Figure B-4C. Since the concentration increases are pretty steep after 100 years for naphthalene at PGM-15 and 16 (Figure B-4A and B) it would be helpful to see that eventually they level out and go down.

Appendix C

General. Anchoring and spudding are not addressed as having a potential to impact on sediment or capping materials in the remediation area. Please discuss including whether there is a prohibition on anchoring and/or spudding.

Section 4. The propwash analysis assumes:
• there will be no vessel activity next to (within 50 feet) of the seawall that might impact uncapped remediation areas (A1, A2, B1, and B2);
• large vessels (including the Rose Fleet) will not be using propellers for navigation in the remediation area, being positioning next to the seawall by “standard” tugs; and
• in all cases, breasting barges will be present to limit vessels to a minimum of 50 feet from the seawall.

Please discuss whether there is a potential for other river traffic to use waters in the contamination area, and potentially impact either sediment or capping materials. These would include recreational boaters, commercial barges, or “service” boats including fire boats. Also, indicate whether a prohibition on area use may be necessary to confirm assumptions presented here (for example, requirement for breasting barge use, a probation on anchoring including “spuds”, etc. Note that for propwash analysis, DEQ would typically require analysis using the horse power and speeds associated with the largest fire boat in the area, and potentially tourist vehicles such as Portland Spirit. Please indicate whether the standard tug propwash analysis “covers” these types of boats.

Section 6. The report states that 1.5*D_{100} or 2*D_{50}, whichever is greater, is the minimum layer thickness. We could not find D_{100} values listed.

Other. There is an area immediately south of the tar body, located within the LOF, which has been identified as an impediment to navigation as recently as 2015. It appears to contain debris, which may account (in part) for its prominence. Sampling has been completed in this area. DEQ will require sampling and/or a diver survey to confirm that significant contamination is not present in this area. Please discuss.

Appendix D

Thank you for providing this information, which is of course subject to review by state and federal regulatory agencies.

Appendix E

General. We understand that the presented information on dredging, capping and covering, long-term monitoring, etc. are presented for general purposes, with final details are to be worked on in the RD/RA document. With that in mind the following comments are presented:
- Monitoring on a five-year basis will be adequate in particular in the years immediately following remedy implementation.
- Long-term monitoring will need to include an element of monitoring based on “special events”, whether it is a significant seismic event, flooding of a certain scale, or potential human disturbance of the cap or MNA areas.
- In addition to sediment sampling, porewater or other monitoring protocols may be necessary.

Section 3.2. It is unclear to what extent, if any, the easement costs discussed in this section and presented in Table E-2 factor in restrictions that may be necessary in the remediation area, for example prohibitions on anchoring. If restrictions are not in place, DEQ may require more frequent monitoring to confirm that no disturbance occurs as the result of these activities.

Table E-2. Supporting documentation is not provided for much of the information presented in this table, and projected costs are quite high for a number of the “big ticket” items including mobilization and demobilization, pre-design sampling and engineering, etc. along with a 40 percent cost contingency. The presented information is, however, adequate for the purposes of the FS.

Please contact me after you have had an opportunity to review these comments. We recommend a meeting to discuss the comments and any questions or concerns you may have, and plan for moving forward with site work.

Respectfully,

Daniel Hafley, RG
Senior Project Manager/Hydrogeologist
NWR Cleanup Section

Cc: DEQ NWR Cleanup files, ECSI# 1138