Oregon
John A, Kitzhaber, MD, Governor

Department of Environmental Quality
Northwest Region Portland Office
2020 SW 4th Avenue, Suite 400
Portland, OR 97201-4987
(503) 229-5263
FAX (503) 229-6945
TTY (503) 229-5471

August 9, 2012 *Also Sent Via E-mail*

Robert J. Wyatt
NW Natural
220 N.W. Second Avenue
Portland, OR 97209

Re: Revised Groundwater Source Control Measures Construction Design Report
Shoreline Segments 1 and 2, NW Natural Property and the Northern Portion of the Siltronic Corporation Property
Portland, Oregon
ECSI Nos. 84 and 183

Dear Mr. Wyatt:

The Oregon Department of Environmental Quality (DEQ) reviewed the Revised Groundwater Source Control Construction Design Report[1] (Construction Design Report). In addition, DEQ reviewed NW Natural's November 4, 2011 responses to our September 22, 2011 comments on the Revised Groundwater Source Control Interim Design Report[2] (Revised Interim Design Report). NW Natural's November 4th responses document the changes made to the Construction Design Report. Anchor QEA, LLC prepared the Construction Design Report and the November 4th responses for NW Natural.

The primary purpose of this letter is to:

- Reply to NW Natural's November 4th responses to our September 22nd comments on the Revised Interim Design Report;
- Convey DEQ's comments on the Construction Design Report;
- Inform NW Natural that after the results of the final extraction well design steps are submitted to DEQ and following our review and approval, the overall final design of the Alluvium water-bearing zone (WBZ) hydraulic control and containment (HC&C) system will be complete and construction can proceed. The final extraction well design steps include:
  - Updating the groundwater model and using it to evaluate the HC&C system operating under two reasonable worst-case scenarios representative of seasonal ranges in site-specific groundwater conditions; and
  - Finalizing the designs of the remaining upper Alluvium WBZ extraction wells.
- Notify NW Natural that DEQ approves the control wells, piezometers, observation wells, and monitoring wells included in the groundwater source control performance monitoring network subject to our replies to NW Natural's November 4th responses and comments to the Construction Design Report, including:
  - Adding two piezometers (PZ7-100 and PZ9-110) to the network;
  - Constructing observation wells in the Fill WBZ so the bottom of the screened intervals are located at the top of the upper silt unit;

[1] Anchor QEA, LLC, 2012, "Revised Groundwater Source Control Construction Design Report, NW Natural Gasco Site," January (received January 31, 2012), a report prepared for NW Natural.
[2] Anchor QEA, LLC, 2011, "Draft Groundwater Source Control Final Design Report, NW Natural Gasco Site," May (received May 9, 2011), a report prepared on behalf of NW Natural (recognized by DEQ as the equivalent of the Revised Groundwater Source Control Interim Design Report).

- Equipping monitoring wells WS-8-33, WS-8-59, and WS-12-161 with transducers to assess the limits of the hydraulic influence of the Alluvium WBZ hydraulic control and containment (HC&C) system to the southeast;
- Placing downhole temperature and specific conductance probes in piezometers in the PZ2 and PZ8 clusters and the upper three piezometers in the PZ-7 and PZ9 clusters; and
- Providing documentation on the applicability of the pre-packed monitoring well sump seals for use at the site.

The final extraction well design steps are discussed further under DEQ's comments on the "Well Design Work Plan" and our reply to NW Natural's "Category 1, Comment 12, Section 1.3" response. Subsequent to providing written confirmation that DEQ's modifications to the performance monitoring network are accepted and providing the requested information, NW Natural can proceed with constructing the control wells, piezometers, observation wells, and monitoring wells in Construction Design Report as modified.

The U.S. Environmental Protection Agency (EPA) also reviewed the Construction Design Report and those comments were transmitted by DEQ to NW Natural on July 18, 2012 (see attached). In addition, EPA reviewed this letter and agrees with DEQ on the final extraction well design steps, DEQ's approval of the performance monitoring network as modified above, and the path forward for constructing, testing, and documenting HC&C system construction and installation of the performance monitoring network. Furthermore, EPA informed DEQ that this letter captures their Construction Design Report comments sent July 18th. Consequently, EPA will not expect NW Natural to respond separately to those comments.

This letter also provides a brief background on groundwater source control and the status of the ongoing groundwater source control measures (SCMs) final design and construction process. The letter focuses on the SCMs design work done following submittal of the Revised Interim Design Report. DEQ's September 22, 2011 letter summarizes the overall SCMs planning and design process prior to submittal of that document and should be referred to for additional details and information on this subject.

BACKGROUND

NW Natural is moving forward with final design of groundwater SCMs along the shorelines of the "Gasco" site and the northern portion of the adjoining property owned by Siltronic Corporation (i.e., shoreline segments 1 and 2). Groundwater in the Fill WBZ and the Alluvium WBZ along segments 1 and 2 have been identified as high-priority pathways of contamination from the uplands to the Willamette River that warrant source control. Groundwater source control involves preventing groundwater contamination in the Fill WBZ and the Alluvium WBZ from migrating to the Willamette River, and not mobilizing manufactured gas plant (MGP) dense non-aqueous phase liquids (DNAPLs) where they occur along Segment 1. The principal elements of groundwater source control include; 1) a fully penetrating interceptor trench in the Fill WBZ; 2) a well-based HC&C system for the Alluvium WBZ; 3) a groundwater and DNAPL performance monitoring network and sampling and analytical program to evaluate the operation and performance of the HC&C system; and 4) a water treatment system.

GROUNDWATER SOURCE CONTROL MEASURES DESIGN AND CONSTRUCTION FRAMEWORK

NW Natural prepared the Construction Design Report consistent with the "Framework" for finalizing the design and constructing the HC&C system for the Alluvium WBZ. NW Natural introduced the

Framework during a meeting on October 5, 2011 and proposed the Framework in writing in a letter dated November 4, 2011. The November 4th letter also responds to DEQ's September 22, 2011 comments on the Revised Interim Design Report. The Framework proposes breaking the draft final groundwater SCMs design report discussed throughout DEQ's September 22, 2011 comments letter, into three separate HC&C system design documents. The three HC&C system design documents include the following:

- A Revised Treatment System Design which finalizes the design of the water treatment system.
- A Revised Groundwater Source Control Construction Design Report that finalizes the design of the Alluvial WBZ HC&C system and responds to DEQ's September 22nd comments related to design and construction of the HC&C system.
- A Groundwater Source Control Operations and Performance Monitoring Design Report (Operations Design Report) that will present the results of transient groundwater modeling work; development and selection of HC&C system operational parameters and performance criteria; and recommendations for implementing contingencies measures.

DEQ accepted the Framework for completing the designs and constructing the groundwater treatment system and HC&C system as modified by our letter dated December 7, 2011. Consistent with our December 7th letter, the Framework for completing the HC&C system design and construction elements consists of five general steps to be completed in the following sequence:

- Step 1 – NW Natural submits and DEQ reviews and provides comments on the Revised Treatment System Design[3]
- Step 2 – NW Natural submits and DEQ reviews and approves the Construction Design Report and NW Natural constructs HC&C system
- Step 3 – NW Natural conducts initial full-scale HC&C system operation and testing
- Step 4 – NW Natural submits and DEQ reviews and approves the Operations Design Report
- Step 5 –NW Natural operates HC&C system full-time subsequent to receiving the final individual NPDES permit for the treatment system (i.e., NW Natural and Siltronic pre-treatment facilities and main treatment plant).

The December 7th letter should be referred to for additional information and details on DEQ's decisions regarding the Framework, each of the steps listed above, and planning, designing, and constructing groundwater SCMs, including the Fill WBZ interceptor trench. The Framework agreed to between NW Natural and DEQ is intended to achieve construction and the initial operation/testing of the HC&C system (i.e., Step 2 and Step 3) by the end of 2012.

Framework Status

DEQ considers Step 1 of the framework to be essentially complete. For purposes of project scheduling, NW Natural requested DEQ's review comments on the Revised Treatment System Design by April 2, 2012 to facilitate ordering long-lead treatment equipment. DEQ provided comments on the design document in a letter dated April 5, 2012 that also included EPA's comments as an attachment. The reviews completed by EPA and DEQ did not identify issues that would prevent NW Natural from ordering long-lead equipment, which DEQ understands is proceeding. DEQ is currently reviewing NW Natural's May 25, 2012 response to our April 5th letter.

[3] Sevenson Environmental Services, Inc., 2012, "NW Natural and Siltronic Wastewater Treatment Final Design Report," January (received January 31, 2012 as Appendix E to the Construction Design Report), a report prepared for NW Natural.

Step 2 of the framework for finalizing design and constructing the HC&C system and conducting baseline DNAPL and groundwater monitoring is ongoing. On behalf of NW Natural, Anchor submitted the following work plans concurrently with the Construction Design Report that provide additional details about the work items to be completed under Step 2:

- "Upper Alluvium Extraction Well Design Work Plan, NW Natural Gasco Site, Portland, Oregon" dated January 31, 2012 (Well Design Work Plan); and
- "Work Plan to Assess Baseline Groundwater Conditions, NW Natural Gasco Site, Portland, Oregon" dated January 31, 2012 (Baseline Monitoring Work Plan).

DEQ's perspective on the status of the work items identified in both work plans is provided below.

Well Design Work Plan

The Well Design Work Plan provides additional technical information for completing the work described in Section 3.2.2.2.1 (Well Location and Screen Depth) and Section 3.2.2.2.2 (Well Materials, Construction, and Development) of the Construction Design Report. In addition, the work plan applies to Appendix K (Well Construction and Development Plan). The Well Design Work Plan identifies the work items and the sequence of work agreed to by NW Natural and DEQ to finalize design of the upper Alluvium WBZ extraction wells.

The Well Design Work Plan consists of seven work items, or tasks. The status of each task is summarized below.

<u>Task 1 – Compile Existing Specific Capacity Data and Well Efficiency Information:</u> This task is complete. Table 3-2 of the Construction Design Report provides this information. DEQ requests the table be updated with new information as it becomes available during future extraction well drilling, installation, and step-drawdown testing.

<u>Task 2 – Conduct Push Probes at Each Upper Alluvium Extraction Well Location to Obtain Soil Samples from the Projected Screen Zones:</u> This task is complete. Push-probe drilling and material sampling occurred at the locations of upper Alluvium WBZ extraction wells PW-1U, PW-2U, PW-3U, PW-4U, PW-5U, PW-6U, PW-11U, PW-12U, PW-13U, and PW-14U. Grain-size analyses have been performed on samples as approved by DEQ.

<u>Task 3 – Design Well Screen and Annular Backfill from the Grain-size Data:</u> This task remains to be completed. Based on grain-size tests completed under Task 2, NW Natural recommended and DEQ approved the use of 20-slot wire-wrapped stainless steel screen and filter packs consisting of 16x30 graded-sand for use at extraction wells PW-2U, PW-3U, PW-5U, and PW-6U. DEQ understands the results of the grain-size tests and NW Natural's recommendations for constructing the remaining upper Alluvium WBZ extraction wells will be submitted to DEQ for review and approval in the near future.

<u>Task 4 - Install Four of the Upper Alluvium Extraction Wells:</u> This task is complete. Construction, development, and step-drawdown testing of upper Alluvium extraction wells PW-2U, PW-3U, PW-5U, and PW-6U are complete.

<u>Task 5 – Install Upper Alluvium Monitoring Wells:</u> DEQ considers this task to be complete. For clarification, the Well Design Work Plan called for installing monitoring wells MW-35U, MW-33U, MW-37U, and MW-26U to measure water levels during step-drawdown testing at extraction wells PW-

2U, PW-3U, PW-5U, and PW-6U respectively. Given questions regarding the details of monitoring well construction and in the interest of moving the HC&C system final design process forward, DEQ proposed and NW Natural accepted an alternative approach. The alternative relied on using existing monitoring wells and installing purpose-specific piezometers to monitor water levels during step-drawdown testing. Monitoring wells MW-35U, MW-33U, MW-37U, and MW-26U are components of the groundwater SCMs performance monitoring network which DEQ approves subject to conditions listed above.

Task 6 – Conduct Step-drawdown Tests at Each of the Four New Upper Alluvium Extraction Wells: This task is complete. Step-drawdown testing of upper Alluvium WBZ extraction wells PW-2U, PW-3U, PW-5U, and PW-6U was completed shortly after each well was installed. Based on the initial test results indicating unexpectedly low specific capacities, these extraction wells were redeveloped and retested along with extraction wells PW-8-38 and PW-9-92. Redevelopment measurably increased the capacities of the referenced extraction wells.

Task 7 – Incorporate the New Data into the MODFLOW Model: This task remains to be completed. The task includes NW Natural: 1) providing the results of step-drawdown tests to EPA and DEQ for review; 2) incorporating step-drawdown test results and EPA/DEQ comments on groundwater modeling into the site MODFLOW model; and 3) using the updated MODFLOW model to; a) confirm that previous simulations of the HC&C system operating under a reasonable worst-case site scenario of maximum groundwater flux remain valid; and b) evaluate the long-term operation of the HC&C system under a reasonable worst-case site scenario of minimum available drawdown for the upper Alluvium WBZ extraction wells.

The work completed to date has been done consistent with the Well Design Work Plan and with DEQ's approval. Task 3 will be complete subsequent to DEQ's review and approval of NW Natural's recommendations for constructing upper Alluvium WBZ extraction wells PW-1U, PW-4U, PW-11U, PW-12U, PW-13U, and PW-14U. Regarding Task 7, DEQ issued our comments on the MODFLOW model and modeling work, along with EPA's comments on the Construction Design Report by e-mail on July 18, 2012. For completeness, DEQ's July 18th e-mail is attached to this letter. NW Natural submitted the step-drawdown data package to DEQ for review on August 1, 2012. Subsequent to DEQ's review and approval of the step-drawdown data for use in the MODFLOW model (Task 7, Item #2), the modeling work performed using the updated MODFLOW model (Task 7, Item #3a,b), and the designs of PW-1U, PW-4U, PW-11U, PW-12U, PW-13U, and PW-14U (Task 3), the overall final design of the HC&C system will be complete and Step 3 of the Framework will proceed, including HC&C system construction and initial operation/testing.

Baseline Groundwater Work Plan

The Baseline Monitoring Work Plan corresponds to certain portions of Section 3.2.2.5 (Performance Monitoring) of the Construction Design Report. The work plan also applies to Appendix M (TarGOST® DNAPL Boring Procedures) and Appendix O (Sampling and Analysis Plan). The work plan identifies the work items agreed to between NW Natural and DEQ to establish baseline conditions for the occurrence of DNAPLs and groundwater chemistry prior to starting up the HC&C system on a full-time basis. Baseline data will be used to assess potential DNAPL mobilization and monitor groundwater chemistry trends after the system is operating full-time. The Baseline Monitoring Work Plan should be referred to for additional information about each of the work items.

The Baseline Groundwater Work Plan consists of four tasks; the status of each is summarized below.

Task 1 – Baseline DNAPL Mobilization Monitoring TarGOST® Borings: This task remains to be completed. This letter provides DEQ's comments on the Construction Design Report relevant to this work item (i.e., Section 3.2.2.5.3; Appendix M) and our replies to NW Natural's responses to the September 22, 2011 letter commenting on the Revised Interim Design Report (see DEQ's reply to "Category 1, Comment 21, Section 3.2.2.5.3, Targost Sampling").

Task 2 – Baseline DNAPL Mobilization Monitoring TarGOST® Borings: This task is complete except as indicated by DEQ. Consistent with the Baseline Monitoring Work Plan and with DEQ's approval, NW Natural completed the baseline TarGOST® borings at extraction well locations PW-2U, PW-3U, PW-5U, PW-6U, and 14U. That said, observations made during push-probe drilling at the remaining upper Alluvium WBZ extraction well locations indicate TarGOST® logging should also be conducted at the PW-11U location prior to the initial operation and testing of the HC&C system.

Task 3 – Baseline Monitoring of DNAPL Entering Extraction Wells, Monitoring Wells, and Piezometers: This task remains to be completed. The list of extraction wells, the proposed installations in the performance monitoring network, and the DNAPL monitoring frequency are provided in Table 3-5 of the Construction Design Report. As shown by Table 3-5 and consistent with the current DEQ-approved monitoring programs for the Gasco and Siltronic sites, DNAPL measurements are being conducted on an ongoing basis at many existing installations which are also included in the performance monitoring network. That said, the goals and objectives of baseline DNAPL monitoring will not be met until the extraction wells, control wells, piezometers, observation wells, and monitoring wells are drilled and constructed, and DNAPL measurements are made according to the Construction Design Report as modified by DEQ's comments. This letter identifies the final design steps for extraction wells. This letter also provides DEQ's approval to install the control wells, piezometers, observation wells, and monitoring wells in the performance monitoring network subject to the comments provided in this letter. DEQ's clarifying comments on the DNAPL monitoring frequency are provided below (see DEQ's replies to "Category 1, Comment 21, Section 3.2.2.5.3, Monitoring and Recovery of DNAPL Entering Wells" and "Category 1, Comment 22 and Comment 23, Section 3.2.2.5.4, DEQ's Specific Comments, pages 11 and 12").

Task 4 – Baseline Water Quality Monitoring: This task remains to be completed. Table 3-5 of the Construction Design Report lists the piezometers, observation wells, and monitoring wells proposed for the performance monitoring program and the sampling frequency. As shown by Table 3-5 and consistent with the current DEQ-approved monitoring programs for the Gasco and Siltronic sites, groundwater chemistry is being monitored on an ongoing basis at many existing installations which are also included in the performance monitoring network. However, the goals and objectives of baseline groundwater monitoring will not be met until additional piezometers, observation wells, and monitoring wells are drilled and constructed, and sampling and analysis are performed according to the Construction Design Report. This letter provides DEQ's approval to install the control wells, piezometers, observation wells, and monitoring wells in the performance monitoring network subject to the comments provided in this letter. DEQ's clarifying comments on the performance monitoring program are provided below (see DEQ's replies to "Category 1, Comment 22 and Comment 23, Section 3.2.2.5.4, DEQ's Specific Comments, pages 11 and 12").

DEQ's comments on the DNAPL and groundwater performance monitoring program, including the numbers, locations, and depths of installations; the monitoring frequency; and the plan for collecting samples for laboratory analysis, are provided below. DEQ comments are organized consistent with NW

Natural's November 4, 2011 response and the relevant sections of the Construction Design Report. As indicated above, DEQ approves the performance monitoring network and monitoring program subject to the comments provided in this letter.

Fill WBZ Interceptor Trench

DEQ notes the agreed-to Framework focuses on designing and constructing the Alluvium WBZ HC&C system. Regarding the Fill WBZ interceptor trench, in the interest of completing the Construction Design Report and constructing the HC&C system in 2012, DEQ agreed to allow NW Natural and Siltronic to initiate trench construction after the HC&C system is in-place. DEQ's current position on the length and alignment of the trench, and sequence and schedule of trench construction remain the same as communicated to NW Natural and Siltronic in our September 22, 2011 letter commenting on the Revised Interim Design Report and in our December 7, 2011 letter. DEQ continues to request initiation of trench construction within: 1) six months of completing the initial phase of HC&C system operation/testing (i.e., within six months of completing Step 3), or 2) no later than six months after initiating full-time operation of the HC&C system (i.e., within six months of completing Step 5). DEQ's September 22nd and December 7th letters should be referred to for additional information on our position.

Consistent with agreements made between NW Natural and DEQ, Appendix J of the Construction Design Report includes NW Natural's proposed interceptor trench approach provided in the Revised Interim Design Report as a placeholder for the work to be performed in the future. Future work will include a geotechnical investigation to evaluate the trench alignment described in our September 22nd letter, and finalizing trench construction methods. The Construction Design Report indicates that, "Immediately following submittal of the revised OPDR [i.e., Operations Design Report], NW Natural will submit a work plan for a geotechnical investigation, designed to determine the feasibility of relocating the interceptor trench or constructing the trench in sections, as suggested by DEQ." Consistent with DEQ's comments regarding the length of the trench, the scope of the geotechnical investigation should extend along the property line between the Gasco and U.S. Moorings sites and beyond the WS-8 monitoring well cluster on the Siltronic property.

NW NATURAL'S NOVEMBER 4, 2011 RESPONSES TO DEQ'S SEPTEMBER 22, 2011 COMMENTS ON THE REVISED INTERIM DESIGN REPORT

NW Natural responded to DEQ's September 22, 2011 comments on the Revised Interim Design Report in a letter dated November 4, 2011. The November 4th response letter forms the basis for preparing the Construction Design Report in the context of the Framework. Attachment B of the November 4, 2011 letter organizes NW Natural's responses into three general categories. One category (Category 1) is intended to identify DEQ comments that NW Natural understands are related to design and construction of the Alluvium WBZ HC&C system. The second category is based on NW Natural's understanding that DEQ's comments involve additional evaluations of post-construction operation and performance (Category 2). A third category of responses (Category 3) identifies DEQ comments that NW Natural is not prepared to agree with and which require additional discussion with DEQ.

DEQ's replies to NW Natural's November 4, 2011 response letter are provided below. For clarification, DEQ has not replied to NW Natural's responses regarding Fill WBZ interceptor trench, the Treatment System Design, and/or the MODLOW model and groundwater modeling. DEQ's comments and/or replies on these topics have previously been provided in letters dated September 22, 2011 and December 7, 2011 (Fill WBZ interceptor trench) and April 5, 2012 (Treatment System Design), and the July 18, 2012 e-mail (MODFLOW model and modeling work).

General Comments

Groundwater SCMs Remedial Action Objectives. NW Natural indicates in the November 4, 2011 response that DEQ's September 22, 2011 general comment on source control remedial action objective (RAOs) would be addressed in the Construction Design Report (see Category 1, Comment 1). DEQ's September 22nd letter indicates that after dispute resolution the focus of source control is the groundwater pathway. Furthermore, DEQ clarifies that the objectives for groundwater source control are to prevent migration of contaminated groundwater from the uplands to the Willamette River along shoreline segments 1 and 2 in a manner that minimizes DNAPL mobilization resulting from operating groundwater SCMs along the portion of Segment 1 where DNAPL occurs. DEQ understands from the last paragraph of Section 1.2 that NW Natural agrees with these SCMs objectives. Furthermore, DEQ understands and accepts that NW Natural will be using the results of the initial operations and testing phase to develop and select HC&C system operational parameters and performance criteria that achieve these objectives. Operational parameters and performance criteria will be presented in the Operations Design Report.

Consistent with agreements reached between NW Natural and DEQ, evaluations of DNAPL remedial alternatives will be conducted in the uplands FS. Remedial alternatives evaluations will include, but are not be limited to, the vertical barrier NW Natural recommended in the DNAPL/Groundwater FFS[4] (i.e., the SCM recommended to physically prevent DNAPL from migrating to the river).

DEQ notes that Sections 1.1 and 1.2 of the Construction Design Report provide a general overview of the background of the source control planning and design process, including development of groundwater source control objectives. DEQ believes sections 1.1 and 1.2 do not adequately document available information on the development of groundwater SCMs objectives, including the objectives that came out of the December 2011 dispute settlement. The section of DEQ's September 22, 2011 letter summarizing the SCMs planning and design process and development of RAOs, should be referred to for additional details and information on this subject.

HC&C System Operations and Performance Criteria. Many of NW Natural's Category 1 and Category 2 responses recommend selecting HC&C system operational and performance criteria based on "transient" groundwater modeling. NW Natural proposes performing transient modeling following construction and initial testing of the HC&C system and during preparation of the Operations Design Report. DEQ approved NW Natural's transient modeling proposal in the July 18, 2012 e-mail transmitting our comments on Appendix F (Model Documents) of the Construction Design Report. In addition, DEQ acknowledges and accepts NW Natural's proposal to develop and select specific operational parameters (e.g., ΔH value, limits on extraction well pumping rates) and performance criteria (e.g., horizontal and vertical gradients needed to minimize DNAPL mobilization while hydraulically controlling and containing groundwater in the Alluvium WBZ) based on the data collected during initial operations/testing of the HC&C system. However, DEQ does not approve constructing the HC&C system without additional information on how the information needed to develop and select operational parameters and performance criteria will be indentified and evaluated.

The general approach to conducting initial operations and testing phase of the HC&C system is described in Section 3.2.2 of the Construction Design Report. DEQ requests that NW Natural supplement Section 3.2.3 with information that:

[4] Anchor QEA, LLC, 2007, "Groundwater/DNAPL Source Control Focused Feasibility Study – NW Natural 'Gasco' Site," October 12 (amended November 9th), and report prepared for NW Natural.

- Identifies sources of uncertainty associated with the data to be collected during the initial operations/testing phase and used for purposes of developing and selecting HC&C system operational parameters and performance criteria, and
- Describes how the uncertainties will be addressed or evaluated during testing.

As indicated in DEQ's general comments to the Revised Interim Design Report, NW Natural's presumption that during Segment 2 pilot well tests groundwater level changes and gradient changes observed between pre-pumping and pumping periods were due entirely to the influence of extraction wells could lead to overestimating the effectiveness of the HC&C system. DEQ's request is intended to address this comment by identifying potential factors unrelated to the extraction wells and evaluating their potential influence during the initial operations/testing. Processes that influence water level measurements (e.g., measurement error in transducers and electronic water level sensors) and/or cause water level fluctuations (e.g., river stage fluctuations, river stage changes) represent sources of uncertainty for data collection during initial testing.

DEQ believes identifying sources of uncertainty and developing approaches for evaluating them during testing will focus data collection objectives relevant to long-term HC&C system operations and is necessary for the initial operations/testing phase to be successful.

Specific Comments

DEQ's replies to NW Natural's November 4, 2011 Category 1 responses are provided below.

Category 1, Comment 3, General Comments, Page 9, Uplands Source Control and the In-water Sediment Remedy (also Category 2, Comment 3). NW Natural's response to this comment is not acceptable. DEQ requested NW Natural to evaluate how the long-term sediment remedy objective of reversing gradients from the river to the uplands will be reconciled with the source control objective of minimizing DNAPL movement. DEQ also requested clarification from NW Natural on the operational priorities of the HC&C system in the context of the in-water remedy. NW Natural's response indicates DEQ's comments would be addressed in the Construction Design Report. However, the information DEQ requested does not appear to be included in the document. DEQ requests NW Natural to indicate where in the Construction Design Report the comment is addressed, or provide the requested information and evaluations in the Operations Design Report.

Category 1, Comment 4, General Comments, pages 9 and 10, Performance Monitoring, Monitoring Well Network. DEQ's replies to NW Natural's November 4, 2011 responses are provided below.

<u>1st bullet, Page 11.</u> Section 3.2.2.5.1 of the Construction Design Report addresses DEQ's comments requesting descriptions of the data collection objectives of the performance monitoring well network.

<u>2nd bullet, Page 11.</u> Table 3-5 addresses DEQ's comment requesting the data collection objectives be identified for piezometers, observation wells, and monitoring wells in the performance monitoring well network.

<u>3rd bullet, Page 11.</u> Table 3-5 addresses DEQ's comment requesting identification of the data collection objectives for each monitoring well.

4th bullet, page 11. NW Natural's response is not acceptable. DEQ's general comment on evaluation HC&C system operational parameters and performance criteria applies here.

1st bullet, page 12. DEQ's comment is addressed by NW Natural agreeing to abandon monitoring well MW-17-79 and installing MW-38U.

2nd bullet, page 12. DEQ's comment regarding installing a control well in the upper Alluvium WBZ between extraction wells PW-5U and PW-14U is addressed by NW Natural agreeing to install monitoring well MW-37U.

3rd bullet page 12. DEQ's comment regarding installing monitoring wells in the lower portion of the upper Alluvium WBZ at the locations of extractions wells PW-11U, PW-12U, PW-13U, and PW-14U is addressed by NW Natural agreeing to install monitoring wells MW-34U, MW-31U, MW-28U, and MW-27U respectively.

DEQ's request for the new monitoring wells referenced to be equipped with transducers is also addressed. As shown by Table 3-5, the news wells will either be set-up as control wells or with transducers to collect water level data.

Category 1, Comment 5, General Comments, page 10, DNAPL Monitoring. DEQ's replies to NW Natural's response are provided below.

1st bullet on page 13 and page 14. DEQ's comment is addressed by the figures provided in Appendix Q of the Construction Design Report, which have been revised to show observations of sheen. DEQ requests NW Natural to update figures 2-3 through 2-8 of the Construction Design Report with information as it becomes available during push-probe drilling performed to support extraction well designs.

2nd bullet, page 14. NW Natural's response is not acceptable. DEQ's general comment on evaluation HC&C system operational parameters and performance criteria applies here.

3rd bullet, page 14. As discussed above, DEQ approved baseline TarGOST® borings near the locations of extraction wells PW-02U/L, PW-03U/85/118, PW-05U/L, PW-06U/L, and PW-14U via an e-mail sent April 13, 2012. This work is complete. Based on push-probe drilling work completed since that time, TarGOST® logging should also be conducted at the PW-11U location prior to the extraction well being installed.

Category 1, Comment 12, Section 1.1. DEQ acknowledges that consistent with our comment NW Natural included copies of DEQ's August 9, 2010 and October 27, 2010 letters in Appendix B. To fully address our comment, a copy of the requested January 3, 2011 e-mail is attached to this letter for completeness and for NW Natural's information. Copies of the January 3rd e-mail should be included in future submittals as appropriate.

Category 1, Comment 12, Section 1.3. NW Natural did not respond to DEQ's comment indicating extraction wells should be constructed so as not to restrict uplands remedial actions (e.g., excavation removal). Extraction wells are located in the vicinity of additional SCMs (e.g., Fill WBZ interceptor trench) and/or remedial actions (e.g., riverbank removal, replacement, stabilization; sheet-pile vertical barrier) that will or could be constructed along the same length of shoreline. Consequently, there is the potential for future construction work to compromise the installations. DEQ recommends constructing

the wells to increase their structural stability (e.g., completing extraction wells with oversized large-diameter concrete seals which extend through the fill into the upper Alluvium). This is an item requiring resolution before extraction wells are constructed. NW Natural should be advised measures may need to be taken to protect existing extraction wells during construction to prevent damage.

Category 1, Comment 13, Section 2.1.4, 2nd paragraph. NW Natural's response is not acceptable without additional supporting information. The Construction Design Report indicates NW Natural further reviewed the evidence of DNAPL detected with ultraviolet (UV) light at Boring GS-09. Based on the additional review, except for UV light other evidence of DNAPL was not observed (e.g., sheen, tar, or oil were not visually observed). Consequently, NW Natural believes the previously reported occurrence of DNAPL at the GS-09 location at elevation -25-feet results from UV light reacting with naturally occurring material in sediment (i.e., UV light detections are not related to MGP contamination). DEQ requests additional information to support NW Natural's conclusions, including but not limited to documentation that UV light sources detect naturally occurring material and the types of material, and observations made at the site and/or sampling and analytical results which show UV light detections are not related to MGP contamination.

Regarding the occurrence of DNAPL at depth in Boring GS-09, DEQ would remind NW Natural of our previous comments on the GS-series borings and DNAPL migration from the uplands to the river. DEQ previously indicated in our March 26, 2010 comments to the Interim Design Report that the twelve GS-series are too few and spaced to far apart (approximately 200 feet apart) to make determinations regarding DNAPL migration from the uplands to under the river. DEQ requests this issue be incorporated into the uplands FS scoping and planning process.

Category 1, Comment 13, Section 2.1.4, 2nd paragraph. NW Natural's response is acceptable. DEQ's request for uplands cross-sections showing groundwater chemistry data for benzene, naphthalene, toluene, cis-1,2-dichloroethene, vinyl chloride, total cyanide, and free cyanide is addressed by figures 2-11a, 2-11b, and 2-11c.

Category 1, Comment 13, Section 3.1.1. DEQ's general comment regarding groundwater source control objectives applies here.

Category 1, Comment 13, Section 3.1.1.1, last paragraph (NOTE…comment may apply to the last paragraph of Section 3.2.1.1). NW Naturals response is acceptable. DEQ requested NW Natural to acknowledge detections of total cyanide in the Willamette River. The Construction Design Report now indicates dissolved total cyanide was detected in at least four samples at concentrations ranging from less than 10 to 140 micrograms per liter (µg/L, or parts per billion).

Category 1, Comment 14, Section 3.1.3. NW Natural response is not acceptable as it does not address DEQ's comment. The Construction Design Report indicates that, "When a well is shut down for maintenance, the system will automatically increase the pumping rate on the adjacent wells to maintain capture." DEQ's comment expresses concern that increasing flow rates during maintenance or replacement of an extraction well could cause excessive drawdown in the upper Alluvium WBZ extraction well(s) and/or increase mobilization of DNAPL. DEQ requests this scenario be further evaluated during preparation of the Operations Design Report.

Category 1, Comment 14, Section 3.1.3, last paragraph page 14. NW Natural's response is acceptable. DEQ requested information regarding the capacity of the treatment system backup generators to operate during floods. The Construction Design Report now indicates, "…the treatment plant and

backup power system are designed to operate under flood conditions up to the elevation of the 100- year flood event, if necessary."

Category 1, Comment 14, Section 3.2.1.1, 6th paragraph. NW Natural's response is not acceptable as it appears to be incomplete. DEQ acknowledges the source control sampling plan has been revised to include total, available, and free cyanide. DEQ also notes that NW Natural's response agrees to run laboratory splits on selected available cyanide samples. However, DEQ's request for laboratory splits does not appear to be included in the Construction Design Report. Consistent with our September 22, 2011 comment, split sampling should be conducted and coordinated with DEQ.

Category 1, Comment 16, Section 3.2.1.6, 4th paragraph. DEQ's comment is addressed by the figures provided in Appendix Q of the Construction Design Report. DEQ requests NW Natural to update figures 2-3 through 2-8 of the Construction Design Report with information as it becomes available during drilling performed to support extraction well designs.

Category 1, Comment 17, Section 3.2.1.7. NW Natural requests a meeting to discuss how DEQ's DNAPL wettability and transport rate comment(s) should be used for designing the performance monitoring program. For clarification, the comment was intended to communicate DEQ's disagreement with NW Natural's assertion that estimates of DNAPL travel are, "…conservative approximations of the potential distances that DNAPL could travel, and the true estimate would be less if the capillary term was factored into the calculation." As indicated in our September 22, 2011 comment and previous correspondence, the MGP DNAPL near the shoreline exhibits intermediate or neutral wettability. Consequently, the affect of capillary forces on DNAPL transport is reduced or limited. DEQ continues to believe observations and measurements of DNAPL occurrence under the former Tar Ponds Area provide a sound technical basis for estimating transport rates. Using this information, DNAPL mobility is likely greater than the "conservative" estimates NW Natural discusses in this section of the Construction Design Report and presents in Table 3-3. DEQ believes this information highlights the importance of including potential DNAPL movement in the evaluation and selection of HC&C system operational parameters and performance criteria. DEQ is available to meet if NW Natural considers further discussions of this topic are needed.

Category 1, Comment 17, Section 3.2.1.8. NW Natural's response requests DEQ to clarify our reference to additional information in the June 9, 2009 and March 26, 2010 letters. Respectively, the June 9, 2009 and March 26, 2010 letters provide additional background information and context for DEQ's: 1) approval of NW Natural's proposal to implement DNAPL removal after construction of the HC&C system and vertical barrier; and 2) acceptance of NW Natural's recommendations to defer evaluations of DNAPL removal and the vertical barrier to the uplands FS.

Category 1, Comment 19, Section 3.2.2.2.1, 2nd paragraph page 30 (also Category 2, Comment 11). NW Natural's response is acceptable. DEQ accepts NW Natural's recommendation to evaluate the need for extraction wells PW-9U and PW-10U based on the initial operation/testing of the HC&C system. In addition to evaluating the addition of PW-9U and PW-10U to the HC&C system, DEQ requests the results of the initial operation/testing phase be used to conduct a full review of contingency measures that should be implemented before full-scale full-time operation of the HC&C system proceeds. DEQ further requests the list of contingency measures include adding groundwater extraction wells and/or installations for DNAPL removal, increasing or decreasing groundwater extraction rates, lowering submersible pumps into extraction well sumps, and adding DNAPL removal pumps to extraction wells. The Operations Design Report should address both of DEQ's requests.

Category 1, Comment 19, Section 3.2.2.2.1, last paragraph. NW Natural's response is acceptable. DEQ understands from Section 3.2.2.2.1 of the Construction Design Report that screen intervals were adjusted on figures 2-3a through 2-3c to avoid fine-grained layers where feasible while maintaining a consistent elevation between extraction wells. DEQ requests the objective of avoiding crossing fine-grained layers to be carried forward during drilling and installation of the remaining extraction wells. In other words, the final depth interval for the screen will be based on observations made during drilling at that location, and avoiding crossing fine-grained layers will be a factor in selecting the actual screen depth interval.

Category 1, Comment 19, Section 3.2.2.2.2, 1st paragraph. NW Natural's November 4, 2011 response and the Construction Design Report, including the Framework, address DEQ's comment that requested the following information be provided:

1. Rational for changing the diameters of extraction wells from 8-inch to 6-inch;
2. Evaluations of specific capacity and well efficiency information available from previous extraction well tests; and
3. Acknowledgment that screen slot sizes and filter pack material will be selected for each of the upper Alluvium WBZ extraction wells based on sieve analyses conducted on material collected from the screen intervals.

NW Natural's response combined with the additional details provided in the first paragraph of Section 3.2.2.2.2 address Item #1. Item #2 is addressed by Table 3-2 of the Construction Design Report and the final design step involving modeling the minimum available drawdown scenario. Regarding Item #2, DEQ expects previous comments regarding the HC&C system flow rates required to maintain negative ΔH values through river and tidal stages will be addressed by the initial phase of HC&C operation/testing and the transient groundwater modeling to follow. In addition, future submittals that use specific capacity to estimate drawdowns and/or pumping rates at extraction wells (see Table 3-4a and Table 3-4b), should make it clear that specific capacity values are not constant and decline with increasing flow rates. The Framework approach to selecting screen slot sizes and filter pack material for upper Alluvium WBZ extraction wells (e.g., PW-2U, PW-3U, PW-5U, and PW-6U) based on sieve analyses, and the recently completed redevelopment work completed at extraction wells PW-2U, PW-3U, PW-5U, PW-6U, PW-8-38, and PW-9-92 address Item #3.

Besides the three items listed above DEQ believes the recently completed extraction well redevelopment work determined the root cause of poor well efficiency in certain extraction wells (e.g., PW-9-92). Consequently, the text in Section 3.2.2.2.2 of the Construction Design Report discussing screen slot size, sand pack material, and well efficiency should be revised or removed for purposes of preparing future documents.

Category 1, Comment 19, Section 3.2.2.2.2, 2nd paragraph. NW Natural response regarding the use of DNAPL funnels is acceptable. NW Natural will equip installations with DNAPL funnels. DEQ's comments regarding sealing around the sumps of extraction wells, monitoring wells, and/or observation well sumps were addressed prior to constructing upper Alluvium extraction wells PW-2U, PW-3U, PW-5U, and PW-6U. The approach developed for these four wells establish the protocol for sealing the sumps around extraction wells in the HC&C system. The sealing method is approved by the Oregon Water Resources Department (WRD) and DEQ for the project and involves the following general steps: 1) drilling to the bottom depth of the borehole using roto-sonic equipment and 10-inch diameter tools; 2) placing bentonite chips in the 10-inch casing over the depth interval of the sump; 3) allowing the chips to hydrate for approximately 30 minutes; 4) extracting a "plug" of the bentonite chip seal using 6-inch roto-sonic tools; and 5) inserting the extraction well sump into the void created by removal of the bentonite

plug. Regarding sealing the bottoms of monitoring and observation wells, WRD and DEQ approve the use of pre-packed bentonite seals manufactured for the purpose of sealing a 3-foot long, 2-inch diameter sump in a 6-inch borehole. Approval is subject to NW Natural providing WRD and DEQ with manufacturer's information to document the pre-packed sump seal is designed for use in situations equivalent to constructing monitoring wells at the Gasco site. Documentation should include case studies and/or references to state and/or federal agencies that have accepted the pre-packed sumps for such use.

Category 1, Comment 20, Section 3.2.2.3, 5th paragraph. NW Natural's response to DEQ's comment about adding DNAPL removal pumps is acceptable. The Construction Design Report indicates that within the portion of Segment 1 where DNAPL occurs, each of the upper Alluvium WBZ extraction wells will be equipped with DNAPL recovery pumps. The document further indicates that pumps can be added to extraction wells elsewhere as needed. DEQ requests NW Natural to include the addition of DNAPL recovery pumps to the list of contingency measures. DEQ's comment regarding handling F002 listed hazardous waste is discussed in Section 3.2.2.3 (Conveyance and Control System) of the Construction Design Report. In addition, NW Natural's May 25, 2012 response to DEQ's April 5, 2012 comments on the Treatment System Design (Appendix E) presents a preliminary waste-stream determination intended to address identification, handling, and management of contaminated media, including media potentially containing F002 listed hazardous waste. DEQ requests all aspects of contaminated media management related to groundwater source control, including performance monitoring, be incorporated into the operations manual to be prepared for the HC&C system and treatment system.

Category 1, Comment 20, Section 3.2.2.4, 4th paragraph. NW Natural's response to this comment is acceptable. DEQ requested clarification on whether the extraction well wellhead designs presented in the Revised Interim Design Report included the piping needed to deliver Aqua Gard treatment media downhole. The Construction Design Report indicates, "…the same 1-inch diameter tube that will hold the transducer cable will be used for the Aqua Gard treatments." DEQ also acknowledges figures 3-9a and 3-9b (formerly figures 3-7a and 3-7b) have been revised accordingly.

Category 1, Comment 20, Section 3.2.2.5.2, 3rd paragraph. DEQ does not accept NW Natural's response. DEQ's comment requested NW Natural to select a subset of installations in the performance monitoring network for concurrent continuous monitoring of temperature and specific conductance during HC&C system operation. Section 3.2.2.5.2 of the Construction Design Report indicates temperature probes will be placed in installations and proposes to measure specific conductance in the field during groundwater sampling events. DEQ understands this could mean measurements are only made semi-annually. DEQ considers this to be infrequent to monitor changes in water quality trends. NW Natural's response also indicates specific conductance data is not needed for purposes of assessing hydraulic capture. DEQ disagrees. Besides hydraulic containment, NW Natural asserts the HC&C system will reverse groundwater gradients and induce river water to flow into the subsurface and back towards the uplands. DEQ considers it important to monitor the associated water quality changes to document this situation as it represents a line of evidence for evaluating HC&C system performance. DEQ continues to request collection of specific conductance and temperature data. As indicated in our September 22, 2011 comments to the Revised Interim Design Report, specific conductance is likely a more sensitive parameter for measuring subsurface water quality changes than temperature alone. Lacking a proposal from NW Natural, DEQ requests the piezometers in the PZ2 and PZ8 clusters, and the upper three piezometers in the PZ-7 and PZ9 clusters be equipped with temperature and specific conductance probes to address this comment.

Category 1, Comment 20, Section 3.2.2.5.2, 6th and 7th paragraphs. DEQ does not accept NW Natural's to this comment. DEQ's general comment on evaluation HC&C system operational parameters and performance criteria applies here.

Category 1, Comment 21, Section 3.2.2.5.2, 7th paragraph. NW Natural's response is acceptable. In response to DEQ's comments, NW Natural revised Table 3-5 to show monitoring wells MW-21-165, MW-18-180, MW-19-180, MW-5-175, WS-14-161, and WS-11-161 will be equipped with transducers to monitor water level elevations. This data will be used to assess the influence of the HC&C system below the deeper aquitard and demonstrate gradient reversal(s) are being achieved and maintained in this zone.

Category 1, Comment 21, Section 3.2.2.5.2, last paragraph. NW Natural's response is acceptable. In response to DEQ's comment regarding adding piezometers to the performance monitoring program, NW Natural added piezometers PZ8-5 and PZ8-50 offshore from extraction well PW-10, and piezometers PZ9-5, PZ9-50, and PZ9-150 offshore from extraction well PW-2U/L.

Category 1, Comment 21, Section 3.2.2.5.3, Targost Sampling. NW Natural's response to DEQ's comments regarding conducting Targost® logging adjacent to extraction wells is acceptable. Targost® borings have been added to the DNAPL baseline monitoring program to assess changes in DNAPL thickness and/or depth at extraction wells PW-2U, PW-3U, PW-5U, PW-6U, PW-11U, and 14U. Based on our review of the Construction Design Report, DEQ approves the three "zones" shown on Figure 3-12 within which Targost Monitoring Areas (TMAs) will be located. DEQ believes selecting the locations of TMAs within these zones is critical to achieving the goals and objectives of DNAPL monitoring. The locations of TMAs should be selected based on multiple lines of evidence including, but not necessarily limited to, the results of the initial operation and testing of the HC&C system; cross-sections depicting evidence of DNAPL updated to include observations made during the drilling of extraction wells and control wells, observation wells, and monitoring wells in the performance monitoring network; and estimates of DNAPL transport rates developed by NW Natural and DEQ. Recommendations for locating TMAs should be included in the Operations Design Report.

NW Natural recommends conducting Targost® logging after the HC&C system has operated for one, three, and five years, and basing future DNAPL monitoring on this data. DEQ does not approve this approach. Given the time between construction and initial testing of the HC&C system and full-time operation, and the uncertainty associated with DNAPL occurrence and movement, DEQ requests baseline Targost® monitoring be conducted within a reasonable timeframe (e.g., approximately three months) prior to initiation of full-time operation and six months and one year after start-up. The frequency of DNAPL monitoring using Targost® equipment will be reviewed after one year of data are collected with the HC&C system operating.

DEQ notes the second to the last paragraph of this section has been replaced by the procedures developed under the Framework for conducting Targost® logging at extraction wells PW-2U, PW-3U, PW-5U, PW-6U, PW-11U, and 14U. Future submittals should reflect these procedures.

Category 1, Comment 21, Section 3.2.2.5.3, Monitoring and Recovery of DNAPL Entering Wells. NW Natural's response is acceptable subject to the clarification DEQ provides here. DEQ acknowledges Table 3-5 of the Construction Design Report was revised consistent with our comment (see Note 5) to indicate that during the first year of HC&C system operation DNAPL measurements will be made daily for the first week, weekly for the next 3 weeks, every other week for the remainder of the first quarter, and monthly for the remainder of the first year of operation. For clarification and consistent with our September 22, 2011 comment, the change to monthly gauging of DNAPL will be made subsequent to

DEQ's approval based on our review of the measurements made during the first three months of HC&C system operation.

Category 1, Comment 22 and Comment 23, Section 3.2.2.5.4, DEQ's Specific Comments, pages 11 and 12. NW Natural's responses are acceptable. Section 3.2.2.5.4 of the Construction Design Report has been revised consistent with DEQ's September 22, 2011 comments to indicate that during the first year of operating the HC&C system the analyte list and sampling frequency for piezometers, observation wells, and monitoring wells will be consistent with DEQ's requests. The sampling locations, sampling frequencies, and analyte list are detailed in Table 3-5 and Appendix O (see Table O-1) respectively. DEQ accepts NW Natural's proposal to recommend changes to the analyte list, sampling locations, and/or sampling frequencies based on an evaluation of the system data collected during the first year of operation. NW Natural will provide the technical basis for any recommendations to DEQ for review and approval before any modifications to the performance monitoring program are made. The one-year monitoring period and data review also applies to extraction wells which will be sampled monthly after start-up.

The one-year data collection and review timeframe does not currently apply to samples collected for analysis of inorganic parameters indicative of river water ("river parameters") and DNAPL measurements made in extraction wells and installations in the performance monitoring network. Upon further consideration DEQ approves limiting sampling and analysis of "river parameters" to piezometers constructed in the Alluvium WBZ. For the first year of HC&C system operation DEQ requests "river parameters' to be analyzed for on a monthly basis. Based on review of the first year of data and pending DEQ's approval, the sampling frequency may be modified. Regarding DNAPL measurements, DEQ's approval will be needed before NW Natural changes the gauging frequency from every other week to monthly at the end of the first quarter of operation.

In summary, except for DNAPL measurements changes to the performance monitoring program will be made based on the data collected from extraction wells, monitoring wells, observation wells, and piezometers after one year of HC&C system operation. Changes to the frequency of DNAPL measurements will be considered based on the information collected during the first quarter of HC&C system operation. As indicated in our reply above, the frequency of DNAPL monitoring using Targost® equipment will be reviewed after one year of data are collected (see "Category 1, Comment 21, Section 3.2.2.5.3, Targost Sampling).

For clarification, DEQ's September 22, 2011 comments and NW Natural's November 4, 2011 response apply to the HC&C system performance monitoring program. DEQ understands the performance monitoring program is laid-out in Table 3-5 and takes effect upon full-scale full-time start-up. Given the performance monitoring network will be constructed before the end of 2012, and full-time full-scale operation of the HC&C system is projected for initiation in December 2013, DEQ requests that new installations be sampled quarterly until start-up occurs. This request is consistent with the agreed-to approach for any new monitoring well constructed in the uplands, the current approved groundwater monitoring program, and Table 3-5 (see Note 3) of the Construction Design Report. After the HC&C system is operating and consistent with DEQ's comments, two samples will be collected from installations in the performance monitoring network during the first six months of to assess potential changes in groundwater chemistry trends during HC&C system operation.

DEQ's comments also request turbidity to be included in the list of field water quality parameters measured during monitoring well purging. NW Natural addressed this comment by revising Appendix O

(see Section 3.1) to indicate turbidity will be monitored during observation/monitoring well purging with the goal of reducing turbidity to a value less than 50 NTU prior to sampling.

Category 1, Comment 23, Section 3.2.2.5.5. NW Natural's response is acceptable. Consistent with DEQ's comment this section has been revised to indicate, "…DEQ will have remote access to view system monitoring displays and will be copied on alarm notifications that affect system operation or require equipment repair."

Category 1, Comment 24, Table 3-2. NW Natural's response is acceptable. For clarification, DEQ's comment was limited to information obtained during step-drawdown and/or constant discharge aquifer tests completed at one or more extraction wells. That said, for completeness the version of the table provided should include hydraulic conductivity estimates derived from variable head testing preformed by Siltronic. It is understood that the extraction well flow rates were much greater than the averages shown on the table for variable head testing. The table should also present the peak flow rates in addition to the averages. Both flow rates should be used with the corresponding drawdowns to calculate the specific capacity for each extraction well. DEQ requests the table be updated with new information as it becomes available during future extraction well tests.

Category 1, Comment 24, Table 3-4. NW Natural's response is acceptable. Table 3-5 (formerly Table 3-4) has been revised to indicate which control well is associated with each extraction well(s), that DNAPL measurements will be made at monitoring wells within the portion of shoreline Segment 1 where DNAPL occurs (see Note 5) on a schedule DEQ approves, and that DNAPL measurements will be made at extraction well PW-2L.

Category 1, Comment 24, Table 4-1. NW Natural's response is acceptable as Table 4-1 in the Construction Design Report includes general permitting information for constructing an outfall to convey and discharge treated water to the Willamette River.

Category 1, Comment 24, Figure 1-2. NW Natural's response is acceptable as Figure 1-2 in the Construction Design Report shows property and/or leasehold boundaries consistent with DEQ's comment.

Category 1, Comment 24, Figure 2-8. DEQ's comments to "Comment 13, Section 2.1.4, 2nd paragraph" applies here.

Category 1, Comment 24, Figure 2-9b. NW Natural's response is acceptable as Figure 2-9b in the Construction Design Report has been revised to include groundwater level measurements made by Siltronic on May 19, 2010 at monitoring wells completed in the upper Alluvium WBZ.

Category 1, Comment 24, Figure 2-14. NW Natural's response is acceptable. Consistent with DEQ's comment, the interpreted width of the plume associated with releases of chlorinated volatile organic compounds from the Siltronic property is now depicted to extend beyond the MW-5 monitoring well cluster on the Gasco Site.

Category 1, Comment 24, Figure 3-4a. NW Natural's response is acceptable as Figure 3-6a (formerly Figure 3-4a) in the Construction Design Report has been modified to clarify the mobility potential of the DNAPL body beneath the Koppers, Inc. leasehold and NW Natural's Liquid Natural Gas plant.

Category 1, Comment 24, Figures 3-7a and 3-7b. NW Natural's response is acceptable. Consistent with DEQ's comment, the "Well Flange – Top" details on figures 3-9a and 3-9b (formerly figures 3-7a and 3-7b) in the Construction Design Report have been modified to indicate the 1-inch diameter transducer tube will be used to deliver Aqua Gard treatment media downhole.

Category 1, Comment 27, Appendix K, Section 3. NW Natural's response is acceptable. Consistent with DEQ's comment, turbidity will be monitored during observation/monitoring well development and the goal for development is to reduce turbidity to a value less than 50 NTU.

Category 1, Comment 27, Appendix K, Section 4. NW Natural's response to DEQ's comments about managing soil and groundwater investigation-derived waste is acceptable. NW Natural should note that DEQ's reply to "Comment 28, Appendix O, Section 4" applies here. NW Natural's response requests information on the status of the Special Waste Management Plan (SWMP) and the opportunity to review the draft document. For clarification, the SWMP is prepared by the originator of the material to be disposed and the receiving facility. The jointly prepared document is reviewed by DEQ.

Category 1, Comment 28, Appendix O, Section 3.1. NW Natural's response regarding turbidity is acceptable, however, the response to DEQ's request for additional details about sample collection is incomplete. Consistent with DEQ's comment, NW Natural will monitor turbidity during observation/monitoring well sampling and the goal for development is to reduce turbidity to a value less than 50 NTU. Regarding sample collection, the current groundwater monitoring program includes collecting and analyzing selected samples for dissolved metals analysis to compare with the total metals results. Although Section 3.2.2.3.4 of the Construction Design Report mentions that dissolved metals are included in the performance monitoring program, Appendix O does not provide information regarding how dissolved metals samples will be collected and/or handled. Furthermore, there is no information provided in the appendix regarding extraction well and/or outfall sampling. Appendix O should be revised accordingly. DEQ believes the final approved performance monitoring program will likely be incorporated into an HC&C system operations manual. If this is the case, Appendix O should make this clear.

Category 1, Comment 28, Appendix O, Section 4.1. NW Natural's response is acceptable. Section 3.1 has been revised to clarify that dedicated tubing or piping will be installed in all wells for use with sample collection pumps. A dedicated bailer will only be used to collect samples in the event of pump failure.

Category 1, Comment 28, Appendix O, Section 5.3.2.1.3. NW Natural's response is acceptable. The sampling and analysis plan has been revised to indicate that ice used to cool samples during transport to the laboratory will be sealed in durable plastic bags and that upon receipt the laboratory will measure the temperature of the cooler.

Category 1, Comment 28, Appendix O, Section 5.3.2.1.4. NW Natural's response is not acceptable. DEQ requested confirmation that field quality assurance samples will be collected on a daily basis during sampling events. Although NW Natural agreed to add this clarification, the appendix does not appear to have been revised. The clarification should be added to address DEQ's comment and for completeness.

Category 3, Comment 1. DEQ considers NW Natural's comments regarding potential delays to implementing the HC&C system to be unwarranted. DEQ is working with NW Natural with the goal of constructing the HC&C system before the end of 2012. DEQ acknowledges and agrees with NW Natural's comment about completing the uplands risk assessment as soon as possible so the uplands FS can be initiated.

Category 3, Comment 2. NW Natural expresses concern here that DEQ may require the U.S. Moorings site to be included in the groundwater SCMs being designed and implemented on the Gasco Site. In addition, NW Natural indicates that the site characterization associated with this work would cause unacceptable delays in implementing groundwater source control on the Gasco Site. DEQ acknowledges NW Natural's concerns, but does not agree considering U.S. Moorings in the design and/or construction of groundwater SCMs will delay source control implementation.

NW Natural has committed to achieving groundwater source control along shoreline segments 1 and 2. To determine groundwater source control is being achieved for the Alluvium WBZ, NW Natural will monitor and fully evaluate the extent and effectiveness of groundwater capture resulting from operating the HC&C system, including in the northern portion of the Gasco Site. The information provided by NW Natural in the Construction Design Report indicates the HC&C system will capture groundwater in the upper Alluvium WBZ beneath the southern portion of the U.S. Moorings site (see figures 3-2a and 3-2b). Consequently, NW Natural's evaluations of HC&C system performance and effectiveness will include the southern portion of the U.S. Moorings site.

As discussed in previous correspondence and this letter, work for the Fill WBZ interceptor trench will be conducted after the HC&C system is constructed. NW Natural proposes to prepare and submit a work plan for a geotechnical investigation to evaluate DEQ's requests for the trench length and alignment. This letter indicates the scope of the geotechnical investigation should include the northern portion of the Gasco Site along the property line with U.S. Moorings. Including the area along the property line in the geotechnical investigation and subsequent interceptor trench evaluations will achieve source control of the Fill WBZ sooner than postponing the work to be done separately at a later time.

Category 3, Comment 3. DEQ disagrees with NW Natural's entire comment and stands by our position on the Fill WBZ interceptor trench communicated in the September 22, 2011 letter commenting on the Revised Interim Design Report, the December 7, 2011 letter on the Framework, and this letter.

Category 3, Comment 4. DEQ acknowledges NW Natural's concerns regarding our request to include visual observations of sheen on cross-sections as evidence of DNAPL. The basis for DEQ's request is explained in previous correspondence, most recently in our September 22, 2011 letter commenting on the Revised Interim Design Report. As DEQ communicated to NW Natural previously, DNAPL mobilization is a significant factor for selecting the operational parameters and performance criteria for the HC&C system. In addition, DNAPL movement is an important element for monitoring HC&C system performance. Regarding sheen, DEQ disagrees with NW Natural on whether sheen is evidence of DNAPL. By definition, petroleum sheen is a thin layer of non-aqueous phase liquid present on the surface of water. In the Alluvium WBZ, DEQ considers observations of sheen to be evidence of DNAPL. Furthermore, depending on subsurface conditions and location specific considerations, the appearance of sheen could be used as a line of evidence for DNAPL migration. The purpose of the baseline DNAPL monitoring work is to establish an initial set of conditions that will be used to assess future observations and make informed decisions regarding the observations. For example, depending on previous DNAPL monitoring results and the location specifics of the installation, the appearance of sheen could be used to trigger changes in the DNAPL monitoring frequency or the schedule for conducting Targost® logging. DEQ believes this topic warrants further discussion and the approach for handling sheen observations should be presented in the Operations Design Report.

CONSTRUCTION DESIGN REPORT

In addition to replying to NW Natural's November 4, 2011 response to our September 22, 2011 comments on the Revised Interim Design Report Report, DEQ has comments on the Construction Design Report which are provided below.

Section 1.4. NW Natural provides the general timeframe for implementing groundwater SCMs in this section of the Construction Design Report. In addition, a general overview of the process for completing the uplands Risk Assessment and Feasibility Study (FS), and remedy design and implementation is described. DEQ would add that consistent with agreements reached between NW Natural and DEQ, the hot spot determination for the uplands is going to be conducted separately from the Risk Assessment. The results of the hot spot determination will be fully incorporated into any FS scoping and planning document.

Section 2.1.3. As DEQ indicated in our comments to the Revised Interim Design Report, depending on location the Fill WBZ consists of fill material made up of varying proportions of MGP waste, including spent oxide material, lampblack, carbon pitch, tar, and/or oil. Future submittals containing descriptions of the fill and/or the Fill WBZ should include this information.

Section 3.2.1.1. NW Natural continues to indicate DEQ required a series of investigations to be conducted in the Willamette River to, "…determine the nature and extent of contamination in offshore groundwater and river sediments." As indicated in previous correspondence, including our comments to the Revised Interim Design Report, although DEQ did oversee the in-water work referenced by NW Natural and documented in the Offshore Investigation Report[5], our primary interest was in assessing ongoing uplands contaminant transport pathways as sources of contamination to the river and river sediments. This data was incorporated into the Groundwater/DNAPL FFS and the SCMs planning and design process. The objective of a significant amount of the work performed during the offshore investigation was supporting the Portland Harbor in-water RI/FS being performed by the Lower Willamette Group under EPA's oversight. Furthermore, offshore investigatory work supplied surface water, sediment, transition zone water, and shallow groundwater data to assist planning of the in-water sediment project also being overseen by EPA. Future descriptions of these offshore investigations should include this information.

Section 3.2.1.4. NW Natural continues to indicate the groundwater modeling done using March 27, 2000 water level data "…represents a reasonable worst-case condition based on water level data." As indicated in previous correspondence including our comments to the Revised Interim Design Report, the simulations calibrated to the March 2000 water level data are considered to be representative of a reasonable worst-case scenario where groundwater extraction rates and treatment system flow rates are concerned (i.e., representative of a specific scenario). The simulations were used to further evaluate the potential maximum total extraction rate and total treatment flow rate of the HC&C system and treatment system respectively. NW Natural should make this clear in future submittals as not doing so could result in people with less familiarity of the project misunderstanding the purpose of the referenced modeling work.

Section 3.2.1.6. The Construction Design Report indicates that during the initial Targost® logging work completed in 2007 and 2008, DNAPL was defined to, "…include tar, mobile oil, and residual oil." DEQ

[5] Anchor QEA, LLC, 2008, "Offshore Investigation Report - NW Natural 'Gasco' Site," February, a report prepared for NW Natural.

considers the definition to be invalid based on the current understandings of the nature of MGP wastes on the NW Natural and Siltronic properties. For clarification, DEQ does not consider tar or oil present at residual levels to be DNAPL. Although tar can be considered a highly viscous liquid, from the standpoint of mobility tar in the Fill WBZ is essentially immobile under prevailing temperatures in the subsurface. DEQ considers oil at residual levels in the Fill WBZ and Alluvium WBZ to be potentially mobile as coalescence and movement could occur in response to changes in subsurface hydraulic conditions (e.g., increase in hydraulic gradient). DEQ's March 26, 2010 letter commenting on the Interim Design Report[6] also discusses the relative mobility and occurrence of tar and oil and DNAPL.

DEQ comments on the Interim Design Report and the Revised Interim Design Report previously addressed NW Natural's assertion that the TarGOST® technology, "…is reliable for the detection of the presence of tar and oil, but cannot differentiate between tar and oil or determine if the material is mobile." Consistent with previous correspondence, DEQ disagrees with NW Natural's description of the technology as it ignores site-specific considerations. Based on the material properties of MGP waste and the subsurface geology at the Gasco and Siltronic sites, DEQ considers the Targost® technology to be a reliable method for identifying mobile DNAPL in the alluvium (i.e., below the top of the upper silt unit). In other words, identification of MGP waste in the alluvium with the Targost® equipment reliably indicates DNAPL (i.e., oil) migrated to those depth intervals. In future submittals NW Natural should revise this sentence to read as follows:

> "Based on site-specific considerations, the technology is reliable for detecting the presence of tar and DNAPL in the fill. Positive responses by the Targost® probe in the alluvium reliably indicate the presence of DNAPL (i.e., oil) that has migrated to those depth intervals. However, the Targost® technology cannot determine whether DNAPL in the alluvium has reached a stable subsurface configuration (i.e., stopped moving) based on a single logging event."

This comment also applies to Appendix M (Targost® DNAPL Boring Procedures).

In addition, the first three sentences in the third paragraph of this section should be revised in future submittals to be consistent with the referenced figures as follows:

> "Figure 3-6a shows the nature and extent of tar and DNAPL in the fill. Figure 3-6b shows the areal extent of DNAPL in the alluvium above the depth of 100 feet bgs. Figure 3-6c shows the areal extent of DNAPL in the alluvium below 100 feet bgs."

Section 3.2.2.5.2, Capture Assessment. During a meeting and conference call on November 30, 2011, EPA and DEQ requested additional analysis and supporting information on the concept NW Natural proposes for hydraulic containment of the deep Alluvium WBZ (i.e., alluvium beneath the truncated deeper aquitard). Due to the nature of the alluvium and the gradients caused by the HC&C system compared to the river, NW Natural predicts that groundwater in the deep Alluvium WBZ will be drawn to extraction wells. NW Natural provided supporting information in the April 12, 2012 supplement[7] to Appendix F of the Construction Design Report. Based on the information provided in the April 12th Supplement, DEQ preliminarily accepted NW Natural's proposed concept for containment.

Consistent with DEQ's December 7, 2011 letter on the Framework, NW Natural's proposed concept will also be demonstrated using field data collected from existing and/or proposed installations. DEQ

---

[6] Anchor QEA, LLC, 2009, "Groundwater Source Control Interim Design Report, NW Natural Gasco Site," November (received November 10, 2009), a report prepared on behalf of NW Natural.
[7] Anchor QEA, LLC, 2012, "NW Natural Gasco site: Documentation of Groundwater Model Modifications Since 2008," April 12, a memorandum prepared for NW Natural.

understands NW Natural added piezometer PZ6-115 to the performance monitoring network for this purpose. DEQ approves construction of PZ6-115, but concludes two more installations are warranted to assess the concept across Segment 1. DEQ requests piezometers be installed at an approximate elevation of -100 at the PZ7 cluster (PZ7-100) and -110 feet at the PZ-9 cluster (PZ9-110)

In addition, to requesting additional piezometers, DEQ has the following comments on the performance monitoring network and data collection and presentation.

- Head distribution maps and/or drawdown figures should be used to illustrate the influence of the HC&C system on water levels in the upper Alluvium.
- Measurement of heads within extraction wells is not ideal for evaluating hydraulic containment due to well inefficiencies. Consistent with EPA guidance, NW Natural should identify wells or install additional wells or piezometers near extraction points to more accurately represent groundwater elevations within the aquifer. Alternatively, NW Natural should explain how water levels at extraction wells will be predicted using the MODFLOW model and discuss the uncertainties and limitations on using the model for that purpose.
- In general, observation wells constructed in the Fill WBZ should be completed so the bottom of the screened interval is located at the top of the upper silt unit. Based on DEQ's review of figures 2-3a, 2-3b, and 2-3c, the depths of completion for observation wells OW-1-F, OW-5F, and OW-10-F should be adjusted upward or downward as appropriate to meet this objective.
- Table 3-5 should be revised to indicate monitoring wells WS-8-33, WS-8-59, and WS-12-161 will be equipped with transducers to assess the southern limits of the hydraulic influence of the HC&C system.
- NW Natural proposes to maintain an inward hydraulic gradient based on 3-day averages. This implies that inward gradients will not be constantly maintained throughout the 3-day periods. DEQ considers 3-day averages to be adequate for determining hydraulic control/containment in the uplands. However, this is not the case under the river where groundwater and sediment contamination extend along the entire flow path. Consequently, the potential exists for contaminant loading and sediment recontamination to occur to some extent each time an outward gradient reestablishes itself.
- In addition to using particle-tracking to depict capture zones at multiple depth intervals, NW Natural should develop vertical gradient contour maps to support evaluation of hydraulic control/containment along representative cross-sections.

DEQ notes that first two bulleted items are relevant to presenting data in support of the final design step and future evaluations of HC&C system performance. The third and fourth bulleted items are relevant to constructing installations in the performance monitoring network and collecting data for performance monitoring. The last two bulleted items are more relevant to the Operations Design Report.

Section 3.2.3. DEQ's general comment on operational parameters and performance criteria apply here.

Section 4. The Construction Design Report continues to indicate NW Natural submitted the application for an NPDES permit in February 2011. As indicated in DEQ's September 22, 2011 comments letter, the the application was not complete until the Land-Use Compatibility statement was received by DEQ in May 2011. This information should be incorporated into future submittals.

Figure 5-1. The schedules shown in the Construction Design Report (see Figure 5-1) and attached to the Well Design Work Plan indicate the Operations Design Report will be submitted in late March 2013. The schedule does not appear to include a line item for the interceptor trench geotechnical investigation work

plan. For clarification, DEQ requests the geotechnical investigation work plan to be submitted within the same timeframe as the Operations Design Report. In addition, the schedule should include a line item for submitting a "construction completion report" which DEQ requests under "Next Steps" in lieu of submitting a revised version of the Construction Design Report.

Appendix K, **Section 1.** The appendix should be revised to indicate that drilling and well installation will occur on the NW Natural and Siltronic properties and that where the location of underground utilities is uncertain, "NW Natural or Siltronic representatives" will pre-approve the drilling location. In addition, as DEQ has indicated previously, where roto-sonic equipment is concerned the drilling method does not typically provide "cores" of subsurface material (i.e., intact undisturbed samples over the drilled interval). Considerable disturbance occurs during drilling, removal of the material from the casing, and bagging the material.

Appendix K, Section 2.1. NW Natural should revise this appendix consistent with the methods, procedures, and protocols DEQ approved under the Framework and used for upper Alluvium extraction wells PW-2U, PW-3U, PW-5U, and PW-6U, including selecting well screen and sand pack material, constructing extraction wells, including sealing the sump; and developing screen intervals.

Appendix O, Section 4. NW Natural's response is not acceptable. The Sampling and Analysis Plan should be revised to include the information regarding managing investigation-derived waste (IDW) provided in Section 4 and Section 4.2 of Appendix K, including indicating that:

> "After the work is complete and analytical results are received, residual soils and liquids will be evaluated for disposal method consistent with Oregon Department of Environmental Quality (DEQ) regulations and procedures currently in place and being used by NW Natural and Siltronic."

Consistent with our September 22, 2011 comments on the Revised Interim Design Report, the IDW management procedures currently being used by NW Natural and Siltronic are laid-out in DEQ's March 27, 2008 and April 8, 2010 letters. NW Natural should be advised the procedures currently in-place may be modified or replaced by the final CMMP developed for the HC&C system, treatment system, and performance monitoring program.

NEXT STEPS

DEQ believes this letter combined with our April 5, 2012 comments on the Treatment System Design, our September 22, 2011 and December 7, 2011 comments on the Fill WBZ interceptor trench, and the July 18, 2012 e-mail providing comments on the MODFLOW model and ongoing modeling work, completes our review and reply to NW Natural's November 4, 2011 response and provides our comments on the Construction Design Report. Furthermore, based on our involvement in reviewing and approving each task in the Well Design Work Plan, DEQ concludes NW Natural has substantially addressed comments regarding designing and constructing extraction wells. Subsequent to completing and submitting the final extraction well design steps and following DEQ's review and approval, NW Natural should move forward with constructing the HC&C system. DEQ approves installation of the control wells, piezometers, observation wells, and monitoring wells in the performance monitoring network as presented in the Construction Design Report and as modified by this letter.

For clarification, given the Framework for completing the designs of the treatment system, HC&C system, and performance monitoring network, DEQ is not requesting the Construction Design Report to be revised and resubmitted. That said NW Natural should prepare a report documenting the actual

completed construction of the HC&C system and performance monitoring network. This construction completion report should be submitted to DEQ within the same timeframe as the Operations Design Report.

Please feel free to contact me with questions regarding this letter.

Sincerely,

Dana Bayuk
Project Manager
Portland Harbor Section

Attachments: DEQ's July 18, 2012 e-mail
NW Natural January 3, 2011 e-mail

Cc: Patty Dost, Pearl Legal Group
John Edwards, Anchor QEA
Ben Hung, Anchor QEA
John Renda, Anchor QEA
Carl Stivers, Anchor QEA
Rob Ede, Hahn & Associates
Myron Burr, Siltronic Corporation
Tom McCue, Siltronic Corporation
Alan Gladstone, Davis Rothwell Earle and Xochihua
James Peale, Maul Foster & Alongi, Inc.
Ted Wall, Maul Foster & Alongi, Inc.
Christine Budai, ACOE
Mark Ader, EPA
Chip Humphrey, EPA
Kristine Koch, EPA
Sean Sheldrake, EPA
Lance Peterson, CDM
Scott Coffey, CDM
Jim Anderson, NWR/PHS
Rob Burkhart, NWR/WQ
Tom Gainer, NWR/PHS
Henning Larsen, NWR/SRS
Matt McClincy, NWR/PHS
ECSI No. 84 File
ECSI No. 183 File