Anchor Environmental, L.L.C.
1423 3rd Avenue, Suite 300
Seattle, Washington 98101
Phone 206.287.9130
Fax 206.287.9131

Memorandum

To: Sean Sheldrake, U.S. Environmental Protection Agency

From: Ryan Barth and Carl Stivers, Anchor Environmental, L.L.C.

CC: Rick Wadsworth, Parametrix
Robert Wyatt, NW Natural
Patty Dost, Schwabe Williamson & Wyatt

Date: March 26, 2008

Re: Proposed Revised Long-Term Pilot Cap Monitoring Approach – NW Natural "Gasco" Site

The purpose of this memorandum is to summarize a revised post-removal long-term monitoring approach for the removal action area at the NW Natural "Gasco" site (Site). Two years of post-removal long-term monitoring has been completed, and evaluation of the monitoring results shows that a revised approach is warranted to continue to collect useful information relevant to the identified post-removal monitoring objectives.

Introduction

NW Natural entered into an Administrative Order on Consent (Order) with the U.S. Environmental Protection Agency (EPA) on April 28, 2004, to perform a time-critical removal action at the Site (EPA 2004) (Figure 1). The Order requires that NW Natural perform a number of actions associated with removing a tar body (as defined in the Order) from the riverbank and nearshore sediments adjacent to the Site. The removal action included placement of an engineered pilot cap over a portion of the removal action area following completion of the dredging (as shown on Figure 2). A total of five monitoring events over 2 years have been completed since completion of the removal action to meet the monitoring requirements defined in the Order and to provide supplemental information to support an evaluation of capping as a potential remedy for future remediation at the Site.

To provide some context to the proposed revised monitoring approach discussed herein, it is important to recognize that NW Natural is in the process of evaluating and designing upland

source controls in coordination with the Oregon Department of Environmental Quality (DEQ). To facilitate this evaluation, NW Natural recently completed two phases of offshore investigations, which provided additional information documenting groundwater advection adjacent to the Site, including the pilot cap area. NW Natural is in the process of designing an upland groundwater barrier wall and extraction system that will severely reduce groundwater advection rates to the offshore sediments and capture dissolved phase chemical groundwater discharges migrating from the uplands. The source control evaluation and measures are discussed further in this memorandum.

Summary of Monitoring Objectives

The Order requires NW Natural to conduct long-term monitoring of the removal action area to monitor the performance of the interim remedy with respect to the Removal Action Objectives (RAOs) identified in Section II of the Statement of Work (SOW) attached to the Order. The RAOs relevant to post-construction monitoring include:

- Evaluating the cap's ability to isolate residual sediment contamination left in place following the removal action
- Monitoring for seepage of product in the low spot created by the removal action
- Providing information that contributes to the efficient performance of any anticipated long-term remedial actions.

In addition to these RAOs, the long-term monitoring approach was designed to include supplemental monitoring of the engineered pilot cap performance to help evaluate contaminant loading through the pilot cap and determine whether capping might be an effective remedy for future remediation at areas of the Site with conditions similar to those in the pilot cap area.

Summary of Existing Monitoring Approach

The post-removal monitoring objectives, approach, data interpretation, and reporting were defined in the EPA-approved Monitoring and Reporting Plan (MARP; Anchor 2006). The MARP (Anchor 2006) identified the following monitoring activities necessary to achieve the post-removal monitoring RAOs:

- Completion of visual monitoring and diver reconnaissance surveys
- Completion of bathymetry surveys and cores through the pilot cap area to monitor changes in mudline elevation and assess changes in cap and fringe cover thickness

- Collection of sediment cores in the bathymetric "low spot" created by the removal action and in the pilot cap area to evaluate the nature and extent of any potential seepage of non-aqueous phase liquid (NAPL; e.g., tar oil and tar)

The MARP (Anchor 2006) identified the following monitoring activities to achieve the pilot cap monitoring specific objectives:

- Collection of discrete and time-integrated near-bottom surface water samples overlying the pilot cap to evaluate the potential pathway between pilot cap porewater and near-bottom surface water
- Collection of pilot cap porewater to document the temporal and spatial variations in porewater chemical concentrations within the cap, the relationship with bulk sediment chemistry results (obtained from co-located cores), and the relationship with discrete and time-integrated near-bottom surface water concentrations.

Following submittal of the MARP (Anchor 2006), NW Natural volunteered to collect samples of depositional sediment both within and outside the pilot cap area to monitor the current sediment concentrations resulting from river-wide source loadings, in addition to the required RAO and pilot cap monitoring specific objectives.

On behalf of NW Natural, Anchor Environmental, L.L.C. (Anchor) performed the above post-removal monitoring activities in:

- March 2006 (Year 0 Event 1)
- August 2006 (Year 0 Event 2)
- December 2006 (Year 0 Event 3)
- September 2007 (Year 1 Event 1)
- November 2007 (Year 1 Event 2)

A summary and evaluation of the Year 0 monitoring results was submitted to EPA in September 2007 (Anchor 2007a) in the *Final Annual Data Evaluation Monitoring Report – Year 0 Long-Term Pilot Cap Monitoring*. The Year 1 Event 1 monitoring data were submitted to EPA in the *Data Summary Report – Year 1 Event 1 Long-Term Pilot Cap Monitoring* in February 2008 (Anchor 2008b). The Year 1 Event 2 samples are still being analyzed and undergoing data validation. These data are anticipated to be submitted to EPA in April 2008, followed by

submittal of the *Annual Data Evaluation Monitoring Report – Year 1 Long-Term Pilot Cap Monitoring* in May or June 2008.

Summary of Year 0 and Year 1 Monitoring Results – Removal Action Objectives

A brief summary of the monitoring results relative to the post-removal monitoring RAOs is provided in the following sections. These results support the rationale for the proposed revised monitoring approach.

Evaluation of Cap Physical Isolation and Stability

The pilot cap's performance as a physical barrier to underlying residual contamination, as well as the pilot cap's integrity and stability following the first year of post-removal monitoring, was evaluated through completion of the following activities:

- Three diver reconnaissance surveys (March and August 2006 and September 2007)
- Five bathymetry surveys (March, August, and December 2006 and August and October 2007)
- The collection of nine cores through the pilot cap in each of five monitoring events (March, August, and December 2006 and September and November 2007)

The diver reconnaissance surveys consistently showed a layer of recently deposited sediment ranging in thickness from approximately 2 to 8 inches overlying the pilot cap and surrounding fringe cover. The diver hand probing (every 10 to 20 feet) within the pilot cap area and fringe cover area consistently indicated that the pilot cap was stable and the armor layer withstood flows during the winter high flow events. The diver hand probing also indicated that the fringe cover material was placed with relatively minor mixing with the underlying sediments and remained relatively stable without an overlying armor layer. The diver only encountered a single area within the fringe cover area during August 2006 where the depositional sediment was not underlain by fringe cover material. Per the removal design, no dredging was conducted in this isolated area to protect the corner oil-fuel pipeline dolphin. As shown by each of the monitoring event isopach surveys (Anchor 2007a and Anchor 2008b), the steep side slope created by the dredging in this area was naturally reconfigured following the removal action, resulting in movement of the placed fringe cover.

The core samples through the pilot cap documented the presence of the armor layer overlying the pilot cap material and directly measured the thickness of the pilot cap layer at nine separate locations during each of the five monitoring events. These core samples, as well as each of the Year 0 and Year 1 bathymetry surveys, documented that the pilot cap layer and overlying armor layer are stable.

Product Seepage Monitoring

Eleven cores were collected within the removal action area during each of the Year 0 and Year 1 monitoring events. Nine of these cores were collected within the pilot cap area and two within the hydraulic low spot created by the dredging just channelward of the pilot cap area. No seepage of NAPL (e.g., tar oil or tar) was observed in any of the cores collected. In addition, no shoreline product seepage was identified during any of the visual monitoring events.

Long-Term Remedy Information

The Year 0 and Year 1 Event 1 monitoring activities identified that the pilot cap and fringe cover design gradations are more than adequate for the range of physical conditions encountered since construction was completed in late October 2005. The relatively small mixing layer (in most cases 0.5 centimeters [cm] to 2 cm) that was identified between the pilot cap layer and the underlying sediments, coupled with the documented stability of the pilot cap layer and overlying armor layer, indicates that a cap can be effectively placed with minimal mixing with underlying sediments and can be maintained to physically isolate underlying sediments during the river conditions so far encountered.

The appearance of elevated pilot cap sediment and porewater concentrations indicates that upland hydraulic source control should be implemented to manage groundwater advection prior to cap placement. As previously mentioned and further discussed below in the section titled **Evaluation of Mechanism Governing Observed Pilot Cap Sediment and Porewater Concentrations**, NW Natural is currently designing a groundwater barrier wall and extraction system that will severely reduce the groundwater advection to the river and capture chemicals in upland groundwater.

Summary of Year 0 and Year 1 Monitoring Results – Pilot Cap Monitoring Specific Objectives

The pilot cap monitoring objectives were achieved through the collection of pilot cap porewater samples and discrete and time-integrated near-bottom surface water samples from the pilot cap area, as well as from upstream and downstream ambient stations. As presented in the *Final Annual Data Evaluation Monitoring Report – Year 0 Long-Term Pilot Cap Monitoring* (Anchor 2007a) and *Data Summary Report – Year 1 Event 1 Long-Term Pilot Cap Monitoring* (Anchor 2008b), detections of polycyclic aromatic hydrocarbons (PAHs) were detected above identified screening levels in each of these media during each of the Year 0 and Year 1 Event 1 monitoring events. The discrete and time-integrated near-bottom surface water benzene, toluene, ethylbenzene, and xylene (BTEX) concentrations also showed detectable concentrations above the identified screening levels during the Year 0 Event 2 monitoring.

Evaluation of the monitoring data collected to date and incorporation of technical comments provided by EPA (2006, 2007a, 2007b, and 2007c) on the various monitoring submittals identified the following primary findings relative to the pilot cap monitoring specific objectives:

1. Groundwater advection mediated transport of chemicals into the pilot cap is likely contributing to cap contamination observed at the pilot site. Because this result occurred much more quickly (within approximately 6 months) than the cap model predicted, it necessarily indicates that the groundwater velocity through this area is relatively high. As discussed later in the section titled **Additional Information to Support Evaluation of Groundwater Advection**, the seepage meters installed across the Site documented that the seepage in the pilot cap area was significantly higher relative to other areas.
2. The pilot cap chemical concentrations are likely attributed to partitioning from the contaminated underlying sediments carried by groundwater advection, as well as contaminated groundwater migration from the uplands through the pilot cap.
3. The PAH and BTEX distributions were spatially and temporally similar in the pilot cap sediment and porewater, indicating a consistent source loading.
4. The pilot cap concentrations are at least in part affected by mixing with residual sediments during cap placement.

5. The observed depositional sediment concentrations above the pilot cap were generally elevated relative to the depositional sediment collected from the fringe cover area outside of the pilot cap area during Year 0 Event 3 and Year 1 Event 1.
6. The observed discrete and time-integrated near-bottom surface water concentrations in the pilot cap area were elevated relative to the upstream and downstream ambient monitoring stations during the Year 0 Event 2 low river elevations. This trend was not observed for the Year 1 Event 1 low river elevations.

Proposed Revised Monitoring Approach – Removal Action Objectives

Under this proposal, the post-removal RAO objectives required by the Order would continue to form the basis for, and meet, the required removal action area monitoring. A summary of NW Natural's proposed monitoring activities to achieve the RAOs is detailed in the following sections. All monitoring is proposed to continue over the next 2 years (Year 2, 2008 and Year 3, 2009), at which time the need for and content of any further monitoring will be discussed with EPA.

Evaluation of Cap Physical Isolation and Stability

NW Natural proposes to conduct the following monitoring activities related to cap physical isolation and stability:

- Diver reconnaissance surveys once per summer during low river elevations. These surveys would cover the identical area that is identified in the MARP (Anchor 2006). As requested by EPA in their comment letter dated April 18, 2007 (EPA 2007a), the diver will conduct hand probing and visual inspection of the depositional material overlying the pilot cap armor layer approximately every 10 feet and use similar equipment and lighting techniques to those used during the Year 0 Event 2 reconnaissance survey to document the findings. Due to safety concerns associated with high river flows and limited visibility due to elevated turbidity, diver reconnaissance surveys are not proposed during the winter months.
- Bathymetric surveys during summer low and winter high river elevation conditions. Mean annual discharges and elevations in the Willamette River in Portland are historically the highest from December through June. Therefore, a single high river elevation survey will be conducted between December and June and a single low

elevation survey between July and November. In accordance with the MARP (Anchor 2006), the surveys will cover the entire area previously bounded by the outer area containment system to monitor changes in mudline elevation and assess changes in pilot cap and fringe cover thickness.

Product Seepage Monitoring

NW Natural proposes to continue to monitor for the presence of product (i.e., tar or oil) in the hydraulic low spot created by the removal action during the annual low river elevation diver reconnaissance surveys discussed above. These surveys will facilitate diver monitoring and hand probing of depositional sediments overlying the fringe cover in the hydraulic low spot at approximately 10-foot intervals for a distance of approximately 50 feet along two transect locations (i.e., transects 60-2 and 120-2; Figure 2) in the hydraulic low spot.

Long-Term Remedy Information

NW Natural proposes to continue to monitor the stability of the pilot cap armor and adjacent fringe cover to determine if the design gradations remain stable under the range of physical conditions encountered until implementation of the Site-wide remedy. The proposed semi-annual bathymetry surveys and annual diver reconnaissance surveys will provide the needed information for this objective.

Proposed Revised Monitoring Approach – Pilot Cap Monitoring Specific Objectives

The pilot cap monitoring specific objectives defined in the MARP (Anchor 2006) were not required by the Order. Therefore, these objectives should be adjusted as necessary to obtain the most relevant understanding of the pilot cap performance. The following sections summarize the proposed revised monitoring approach relevant to each of the six key monitoring findings discussed as part of the summary of pilot cap monitoring results.

Additional Information to Support Evaluation of Groundwater Advection

NW Natural proposes no additional monitoring to support an evaluation of the magnitude of groundwater discharge through the pilot cap area. This information has already been collected by NW Natural under the DEQ process.

On behalf of NW Natural, Anchor conducted a series of investigations in the Willamette River offshore of the Site during the period from July 2006 to October 2007 in coordination with DEQ. The results of these investigations are summarized in the *Offshore Investigation Report* (Anchor 2008a) submitted to DEQ on February 15, 2008 and subsequently provided to EPA on February 27, 2008. The investigations included the installation of ultrasonic seepage meters at seven locations adjacent to the Site, including a single meter within the pilot cap area (station GS-PC1SM; Figure 3), to verify groundwater discharge and provide general level estimates of groundwater discharge rates within the river sediments adjacent to the Site. Seepage meters were previously deployed adjacent to portions of the Site and the Siltronic property by the Lower Willamette Group (LWG) in 2005. Due to construction activities associated with the tar body removal action, no meters were installed in the direct vicinity of the removal action area.

A description of the seepage meter field procedures is described in the *Proposed Groundwater Seepage Meter Deployment Scope of Work – Gasco Site* (Anchor 2007b), and a detailed description of these meters is provided in the *Portland Harbor RI/FS Round 2 Groundwater Pathway Assessment Sampling and Analysis Plan – Attachment 1 Field Sampling Plan Groundwater Plume Discharge Mapping* (Integral 2005). In summary, ultrasonic seepage meters conduct time-series flow rate measurements, which capture both positive and negative discharge at the water-sediment interface. The maximum battery power for the meters is approximately 3 days, and sampling was conducted for this full duration at each of the seven stations through October 2 to 6, 2007. This sampling time frame was planned to be seasonally consistent with the 2005 LWG sampling period (i.e., August 1 to September 9, 2005) during low river elevations. A brief summary of the seepage meter results at the pilot cap monitoring stations (i.e., GS-PC1SM) is provided in this section.

The time series plot of groundwater discharge relative to river elevation is presented in Figure 4. Measurable discharge (i.e., greater than 0.5 cm/day) and recharge (less than -0.5 cm/day) was identified at numerous times during the data collection period, with a mean discharge of 1.03 cm/day. The maximum discharge observed was approximately 10 cm/day, which occurred at the meter placed directly on the pilot cap. This maximum discharge was significantly higher than the maximum discharge observed outside the pilot cap area, which

ranged from approximately 0.5 to 4.5 cm/day. The data clearly show that the pilot cap area is one of preferential and at least periodic high magnitude groundwater discharges, well above the mean discharge observed in other locations offshore of the Site. The observed flow variations at this station were dissimilar to the other monitoring stations, showing a distinct peak in discharge bounded by long periods of low discharge or recharge. The data does not show a correlation with the river elevations (Figure 4) and no apparent effect related to regional rainfall conditions (Figure 5).

It is not clear how other factors, such as the historic presence of a drainage feature in the pilot cap area, the nature of the dredge area cutting into the bank, the underlying pilot cap, or the armor layer may affect the discharge patterns at this station. However, it is likely that these features likely contribute to increase seepage in the pilot cap area, and therefore the observed pilot cap concentrations should not be considered indicative of concentrations that would be expected in other capped areas elsewhere at the Site.

Evaluation of Mechanism Governing Observed Pilot Cap Sediment and Porewater Concentrations

EPA's comments on the *Annual Data Evaluation Monitoring Report – Year 0 Long-Term Pilot Cap Monitoring* (Anchor 2007a) dated August 7, 2007 stated that future monitoring investigations should be designed to address the question: "Is cap sediment contamination a result of groundwater advection through underlying sediments or migration from upland groundwater sources, or both?" NW Natural proposes no additional monitoring to evaluate this question given 1) sufficient information already exists to document that both mechanisms contribute to the observed cap concentrations; 2) no known sampling technologies exist that facilitate a direct differentiation between these two mechanisms given the Site conditions; and 3) NW Natural is in the process of designing an upland groundwater barrier wall and extraction system that will severely reduce groundwater advection rates to the offshore sediments and capture dissolved phase chemical groundwater discharges migrating from the uplands. Each of these issues is further discussed in this section.

EPA's question regarding the mechanisms governing the observed pilot cap chemical concentrations was addressed by NW Natural during a series of investigations in the

Willamette River offshore of the Site during the period from July 2006 to October 2007 (discussed above). The investigation was conducted in two phases (termed Phase 1 and Phase 2 Steps 1 and 2) and the objectives included the collection of information necessary to address the following data gaps:

- Determine how the vertical and lateral extent of chemicals in groundwater along the shoreline may be related to chemical concentrations that have already been measured in upland groundwater.
- Understand how the vertical and lateral extent of chemicals in groundwater beneath the river and transition zone water (TZW) may be related to chemical concentrations measured in upland groundwater.
- Understand how groundwater and TZW concentrations may be related to direct historical deposition of materials in the river.
- Determine if the chemical concentrations in the biologically active TZW in navigation channel sediments have been directly impacted by historical deposition of waste materials in the river.

To achieve these objectives, Anchor conducted barge mounted drilling to complete borings along four offshore transects: transects A, B, C, and D (Figure 3). Twelve borings were drilled along transect A, with seven of the borings drilled to basalt bedrock, and 106 groundwater samples and 83 sediment samples were tested for cyanide species, semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs), and metals. Boring station GS-06 on transect A was located directly shoreward of the pilot cap and likely provides the most representative groundwater and sediment data relevant to the pilot cap monitoring findings. The Phase 2 Steps 1 and 2 investigations included the collection of a total of 30 borings along transect B, C, and D, with eight of the borings drilled to refusal. In this phase, 105 groundwater samples and 21 sediment samples were tested for cyanide species, SVOCs, VOCs, and metals. A detailed summary of the Phase 1 and Phase 2 analytical results is provided in the *Offshore Investigation Report* (Anchor 2008a). A brief summary of the results is presented in this section. For the purposes of this summary, the discussion is limited to naphthalene and benzene, as they are among most mobile chemicals of interest (COI) and were often observed at the highest concentrations in the pilot cap sediment and porewater.

Review of the Phase 1 transect A groundwater and sediment chemistry profiles shows the highest concentrations of benzene and naphthalene are associated with the occurrence of shallow tar or NAPL in borings GS-08 (tar), -09, and -10 (NAPL) (Figures 6 and 7). The NAPL and tar present in shallow shoreline sediments is sourced from manufactured gas plant (MGP) residuals that were discharged to overland drainages to the river (HAI 2007). Also, given the extensive dredge, fill, and movement of soils/sediments of this shoreline over time (HAI 2007), these materials may have been relocated to varying sediment depths. Comparison of the transect A benzene groundwater and sediment concentrations shown on Figures 6 and 8 show that concentrations in shallow sediment are generally higher than groundwater concentrations from similar sample intervals. These sediment concentrations are much higher than would be expected from adsorption of dissolved phase groundwater contaminants moving through these sediments, indicating that they derive from the historical discharge of MGP materials to the sediments, as discussed previously. In contrast, the benzene and naphthalene concentrations (Figures 8 and 9) in deeper alluvial sediments are generally lower than the groundwater concentrations from similar sample intervals (Figures 6 and 7), indicating the sediment contamination at depth results from adsorption from the upland groundwater plume.

The Phase 2 Steps 1 and 2 investigations focused on defining the nature and extent of groundwater contamination beyond the shoreline, specifically in the portion of the river channel identified by the LWG as a possible groundwater discharge zone. Review of the subsurface groundwater profiles shows that the distribution of benzene and naphthalene in groundwater below the river channel is complex and is largely a function of the long history of manufacturing at the Site, variations in operational practices over time, the types of products that were manufactured, historic direct discharge of MGP residuals to the river, and groundwater transport from upland sources. The elevated benzene concentrations at depth are likely due to groundwater transport from the former effluent settling pond area on the upland portion of the Site. Naphthalene also occurs at depth further offshore with groundwater transport resulting in higher naphthalene concentrations in the deepest groundwater samples.

The Phase 2 investigations also included screening (i.e., visual and using an Ultraviolet Light Box) for the presence of NAPL and the collection and analysis of sediment samples at

depths of 0 to 2 feet, 5 to 7 feet, and 13 to 15 feet below the mudline. The maximum depth of NAPL detected was 10 feet below mudline in the B and C transects, except for boring GS-B7, where NAPL was detected in the 13- to 15-foot sample. There were no indications of NAPL in any of the samples from the D transect. As with the groundwater samples, the sediment subsurface profiles showed detectable concentrations of benzene and naphthalene. As expected, these analyte concentrations are much higher in the sediment samples that contain NAPL. A summary of the benzene and naphthalene sediment concentrations along the relevant cross-sections are provided in Figures 10 to 19, and 3-dimmensional schematics in are presented in Figures 20 and 21.

Overall, the offshore investigations show a clear combination of groundwater sourced chemical concentrations in deeper sediments overlain by shallow historical direct discharge of MGP-related materials to the surface sediments. This investigation also clearly shows that chemicals transported into the pilot cap must originate to some extent from both types of sources. Determining the exact percentage contribution of sediment versus upland groundwater sourced chemicals in the cap is likely not directly measurable by any technique. Further, such a determination is not necessary to understand the basic reason for the observed pilot cap concentrations.

More importantly, NW Natural is currently in the process of designing an upland groundwater barrier and extraction system in coordination with DEQ. This system is being designed to severely reduce groundwater advection rates to the sediments and capture upland sourced groundwater plumes. Operation of this system will eliminate the primary mechanism that is causing chemical movement through the offshore sediments or any cap placed there in the future.

Additional Evaluation of Spatial and Temporal Pilot Cap Concentration Trends

NW Natural proposes no additional monitoring to evaluate spatial and temporal trends in the pilot cap sediment and porewater. The primary purpose of understanding spatial trends would be to understand the mechanisms of chemical transport, which, as previously discussed, are already understood. Temporal trends (if they exist) might reveal to what extent concentrations are reaching steady state within the cap, but such information is not

critical to the determination already made, given that control of groundwater advection is necessary for a capping remedy to be successful at the Site.

To date, the post-removal monitoring has included monitoring of pilot cap sediment and porewater at approximately nine stations during four separate monitoring events (data collected during the Year 1 Event 2 is not yet available) that were conducted during both summer low flow and winter high flow periods. As summarized in the *Annual Data Evaluation Monitoring Report – Year 0 Long-Term Pilot Cap Monitoring* (Anchor 2007a) and *Data Summary Report – Year 1 Event 1 Long-Term Pilot Cap Monitoring* (Anchor 2008b), the data show no consistent observable spatial or temporal trends for the pilot cap sediment and/or pilot cap porewater media. Sufficient data has already been collected to document the absence of spatial or temporal trends for these media.

Additional Evaluation of Relative Contribution of Observed Cap Sediment Concentrations Due to Cap Placement

NW Natural proposes no additional monitoring to evaluate the relative contribution of chemicals caused by mixing of the pilot cap material with the post-dredge surface sediments during cap placement. Placement of the cap material necessarily caused some relative entrainment of residual sediments into the pilot cap layer. Given the relatively elevated post-dredge sediment surface concentrations (ranging from approximately 273 milligram per kilogram [mg/kg] to 4,741 mg/kg total PAHs), even minor mixing could have affected the observed pilot cap sediment and/or porewater concentrations. However, given other findings of the pilot cap monitoring and the offshore investigation, it appears that regardless of any physical mixing, even cap designs that eliminate mixing (e.g., through placement of geotextile layers), would be problematic in this area without upland controls of the groundwater advection rates.

Additional Monitoring of Depositional Sediment Concentrations within and Surrounding the Pilot Cap

NW Natural proposes continued monitoring of depositional sediment concentrations both within the pilot cap area and in the fringe cover area surrounding the pilot cap area to support further evaluation of the potential concentration differences observed in these areas.

The observed concentration differences between the pilot cap and fringe cover areas could be due to remaining high concentrations of chemicals in sediments along the shoreline. Visual monitoring during low river elevations has indicated periodic sheens along various portions of the shoreline, as well as the presence of tar from areas not targeted during the removal action. These nearshore chemicals in sediments may be resulting in localized increased chemical concentrations in nearby cap sediments. The proposed monitoring approach will continue to measure this potential effect by collecting sediments at the current monitoring stations (i.e., PCM-02, PCM-06, PCM-09, PCM-14, and PCM-15). Two additional stations are proposed, one approximately at pilot cap station PCM-04, and the other at approximately diver transect location 120-2 (Figure 2). These additional stations may help further discern any relationship between nearshore remaining sediment contamination and spatial chemical trends in recently deposited sediments.

The field sampling procedures, laboratory analysis procedures, method reporting limits, and analyte list (i.e., full Portland Harbor analyte list) will be identical to those currently used for the post-removal monitoring conducted to date. Sampling will be conducted once each during summer low and winter high river elevation conditions within the same general time frame as the bathymetry surveys. Consistent with the depositional sediment sampling conducted to date, samples will only be collected if the fringe cover material is visually observable beneath the overlying depositional material.

Additional Monitoring of Near-Bottom Surface Water Concentrations at the Pilot Cap and Upstream and Downstream Ambient Sampling Stations

NW Natural proposes continued monitoring of the discrete near-bottom surface water concentrations at the nine pilot cap monitoring stations, as well as the single downstream and three upstream stations currently sampled. The primary objective of this monitoring would be to continue to attempt to understand whether this area of preferential groundwater discharge contributes to elevated surface water chemical concentrations relative to “other concentrations” in the vicinity of the Site but outside the pilot cap area.

The field sampling procedures, laboratory analysis procedures, method reporting limits, and analyte list (i.e., total and dissolved organic carbon; total suspended solids; total, free and amenable cyanide; sulfides; total and dissolved iron; PAHs; and BTEX) will be identical

to those defined in the MARP (Anchor 2006). Sampling will be conducted concurrent with the depositional sediment sampling identified above during summer low and winter high river elevations. The samples will be collected prior to conducting any other monitoring activities to minimize potential sampling artifacts created by disturbance of the mudline.

NW Natural proposes to discontinue the collection of time-integrated near-bottom surface water samples via deployment of semipermeable membrane devices (SPMDs) for the following reasons: 1) the U.S. Geologic Service (USGS) calculator spreadsheet (see MARP Appendix A Attachment A; Anchor 2006) defaults to no detectable naphthalene concentration when the exposed water temperatures are 10 degrees Celsius (encountered during the Year 1 Event 2 monitoring event); 2) SPMDs provide two similar yet different concentrations for each sample based on the exposure adjustment factor (EAF) used, both of which are theoretically correct; and 3) the time-integrated and discrete near-bottom surface water concentrations have generally been consistent during each of the monitoring events except during Year 1 Event 2 when the discrete concentrations were nearly always greater (i.e., more conservative) than the time-integrated concentrations.

Results Reporting – Revised Monitoring Approach

The data reduction, analysis, interpretation, and reporting for the visual surveys, bathymetry surveys, diver reconnaissance surveys, and depositional sediment and discrete near-bottom surface water sampling will be in accordance with the MARP (Anchor 2006), except that the discrete near-bottom surface water results will no longer be compared to pilot cap porewater and time-integrated near-bottom surface water concentrations. The reporting contents and schedule will be identical to those defined in the MARP (Anchor 2006).

If any results indicate failure of the cap to meet any of the RAO objectives, EPA will be immediately notified via email once the information is known to NW Natural. This will be followed up with results memos as necessary to fully inform EPA of the issue identified and the data relevant to the issue.

Additional Project Controls

Pursuant to the Code for Federal Registration (CFR) Title 33, Part 165, NW Natural submitted a request to the U.S. Coast Guard (USCG) for the establishment of a regulated navigation area (RNA) for the pilot cap area. The proposed RNA is to be used to preserve the integrity of the pilot cap by prohibiting activities that would cause inappropriate disturbance of the engineered pilot cap material, which was placed to isolate underlying contaminated sediments. The request is still being processed by the USCG. Once the RNA is established, NW Natural will notify EPA.

NW Natural submitted a Private Aids to Navigation Application (CG-2554) to the USCG for the installation of four buoys demarcating the location of the pilot cap area. The buoys are proposed to be maintained in place until EPA determines that the pilot cap and/or additional underlying contaminated sediment should be removed as part of a future final remediation of the Site, or NW Natural provides other written notification for their removal. The application is still being processed by the USCG. Once the application is approved, NW Natural will notify EPA of the anticipated schedule for installation of the buoys.

Contingency Response and Adaptive Management Process

If a condition occurs that requires attention, a tiered adaptive management process will be implemented as defined in the MARP (Anchor 2006).

REFERENCES

Anchor Environmental, L.L.C. 2006. Final Monitoring and Reporting Plan – Post-Construction. Prepared for U.S. Environmental Protection Agency. Prepared on behalf of NW Natural. March 2006.

Anchor Environmental, L.L.C. 2007a. Annual Data Evaluation Monitoring Report – Year 0 Long-Term Pilot Cap Monitoring. Prepared for U.S. Environmental Protection Agency. Prepared on behalf of NW Natural. September 2007.

Anchor. 2007b. Memorandum RE: Proposed Groundwater Seepage Meter Deployment Scope of Work – Gasco Site. Prepared for Oregon Department of Environmental Quality. Prepared on behalf of NW Natural. August 22, 2007.

Anchor Environmental, L.L.C. 2008a. Offshore Investigation Report – NW Natural "Gasco" Site. Prepared on behalf of NW Natural. February 2008.

Anchor 2008b. Data Summary Report. Year 1 Event 1 Long-Term Pilot Cap Pilot Cap Monitoring. Prepared for U.S. Environmental Protection Agency. Prepared on behalf of NW Natural. February 2008.

Environmental Protection Agency, U.S. (EPA). 2004. Administrative Order on Consent for Removal Action between NW Natural and the U.S. Environmental Protection Agency. April 28, 2004.

Environmental Protection Agency, U.S. (EPA). 2006. EPA Letter to NW Natural with Subject: GASCO Removal Action; Review of GASCO Data Summary Report, Long-Term Pilot Cap Monitoring. November 17, 2006.

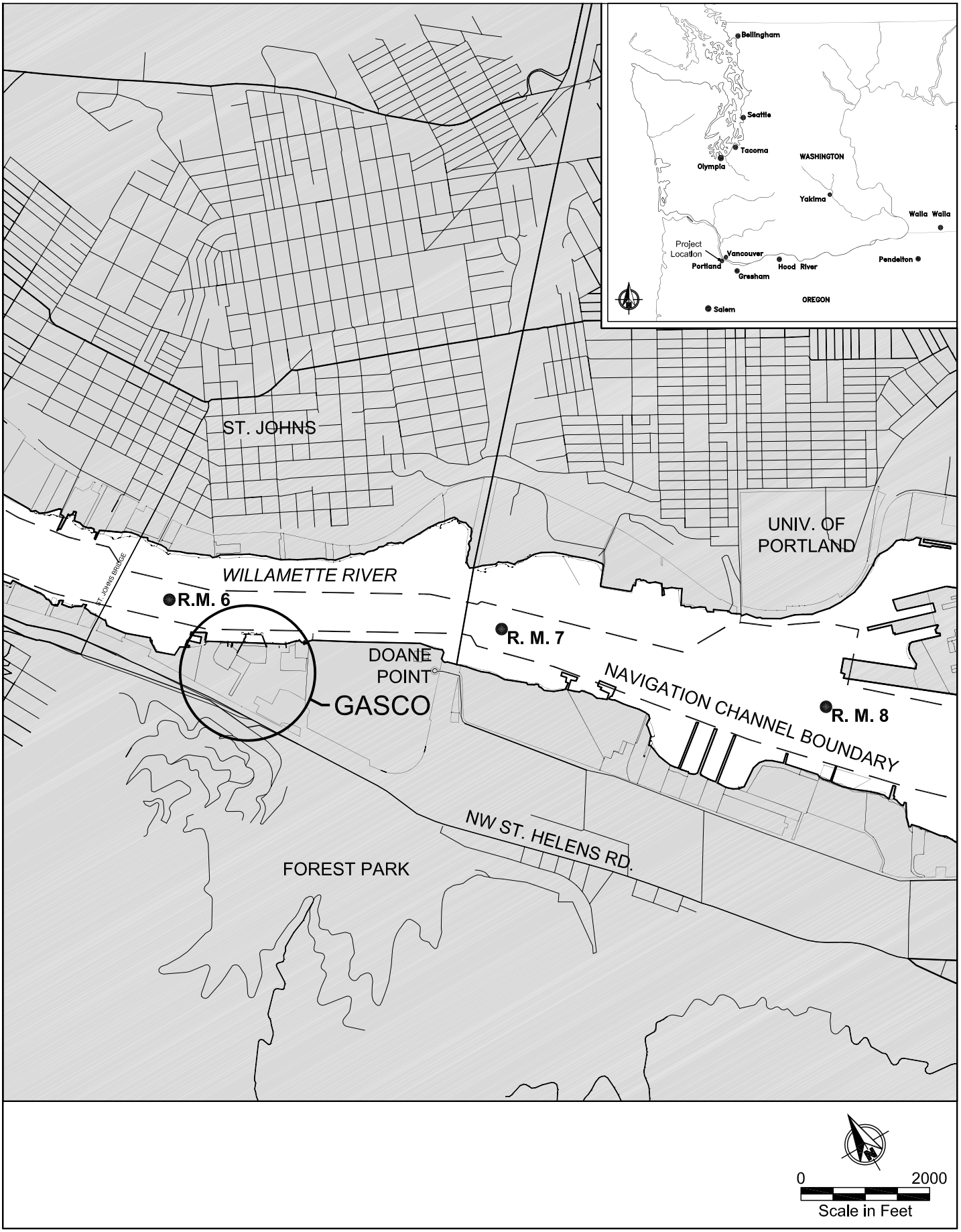
Environmental Protection Agency, U.S. (EPA). 2007a. EPA Letter to NW Natural with Subject: GASCO Removal Action; NW Natural Responses to EPA Comments on Year 0, Event 1 Long-Term Monitoring Data Summary Report and the NW Natural Year 0, Event 2 Long-Term Monitoring Data Summary Report. April 18, 2007.

Environmental Protection Agency, U.S. (EPA). 2007b. EPA Letter to NW Natural with Subject: GASCO Removal Action; EPA Comments on the Annual Data Evaluation Monitoring Report, Year 0 Long-Term Pilot Cap Monitoring. June 2007 & Data Summary Report, Long-Term Monitoring Data Summary Report.

Environmental Protection Agency, U.S. (EPA). 2007c. EPA Letter to NW Natural with Subject: REVISED Annual Data Evaluation Monitoring Report, Year 0 Long-Term Pilot Cap Monitoring, September 2007. November 9, 2007.

Hahn and Associates, Inc. (HAI). 2007. Remedial Investigation Report, NW Natural – Gasco Facility. HAI Project No. 2708. DEQ ECSI No. 84. Portland, Oregon.

Integral Consulting, Inc. 2005. Portland Harbor RI/FS Round 2 Groundwater Pathway Assessment Sampling and Analysis Plan – Attachment 1 Field Sampling Plan Groundwater Plume Discharge Mapping. Prepared for the Lower Willamette Group. July 1, 2005.



Feb 29, 2008 10:18am heriksen K:\Jobs\000029-GASCO\00002902\00002902-01.dwg FIG 1

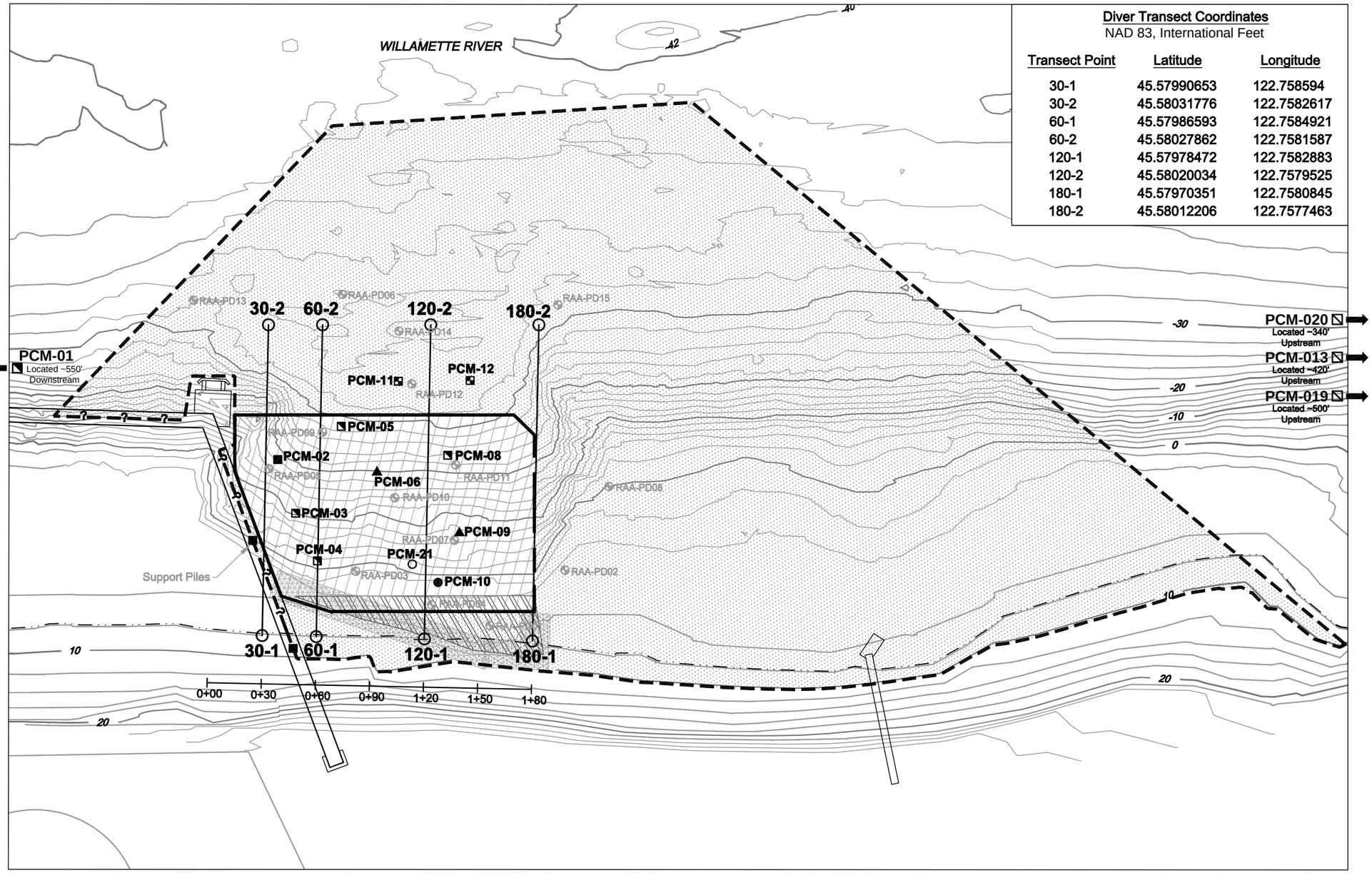
ANCHOR ENVIRONMENTAL, L.L.C.

Figure 1
Vicinity Map
NW Natural "Gasco" Site
Portland, Oregon

Legend:

- Support Pile Location
- Extent and Elevation of 18 in Thick Cap
- Extent and Elevation of 6 in Thick Cover
- Reactive Organo-Clay Mat (RCM) Location
- Lateral Extents of Surf Zone Armoring d50 = 3 inches
- PCM-06 ▲ Co-located Core, Porewater, Near-Bottom Surface Water & Depositional Surface Sediment Sample
- PCM-02 ■ Co-Located Core, Near-Bottom Surface Water & Depositional Surface Sediment Sample
- PCM-03 ◪ Co-Located Core, Porewater & Near-Bottom Surface Water Sample
- PCM-21 ○ Co-Located Core & Near-Bottom Surface Water Sample
- PCM-10 ● Near-Bottom Surface Water Sample
- PCM-01 ◪ Background Near- Bottom Surface Water Sample
- PCM-11 ◪ Seepage Monitoring Core
- PCM-14 ◑ Depositional Surface Sediment Sample
- RAA-PD13 Post-Dredge Surface Sediment Sample (October 2005)

0 60
Scale in Feet



Diver Transect Coordinates
NAD 83, International Feet

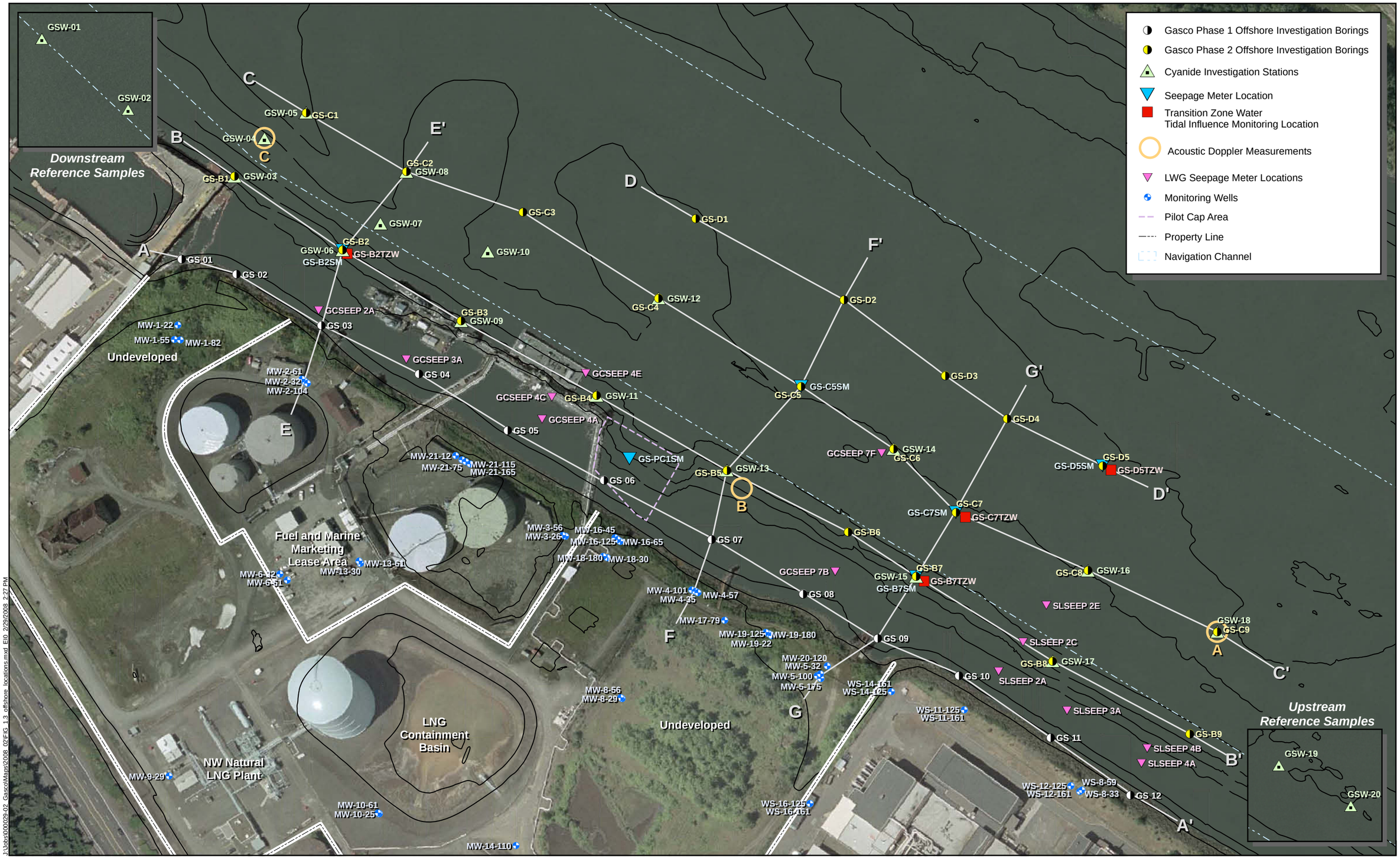
Transect Point	Latitude	Longitude
30-1	45.57990653	122.758594
30-2	45.58031776	122.7582617
60-1	45.57986593	122.7584921
60-2	45.58027862	122.7581587
120-1	45.57978472	122.7582883
120-2	45.58020034	122.7579525
180-1	45.57970351	122.7580845
180-2	45.58012206	122.7577463

Notes:
1. Post-cap bathymetric contours produced from survey provided by Blue Water Engineering dated October 31, 2005.
2. Upland topography directed by Anchor Environmental as part of upland investigation (2002).
3. Horizontal Datum: Oregon State Plane North NAD 83 (ft).
4. Vertical Datum: NAVD 88 (ft).

Feb 29, 2008 10:20am heriksen K:\Jobs\000029-GASCO\00002902\00002902-192.dwg FIG 2

ANCHOR ENVIRONMENTAL, L.L.C.

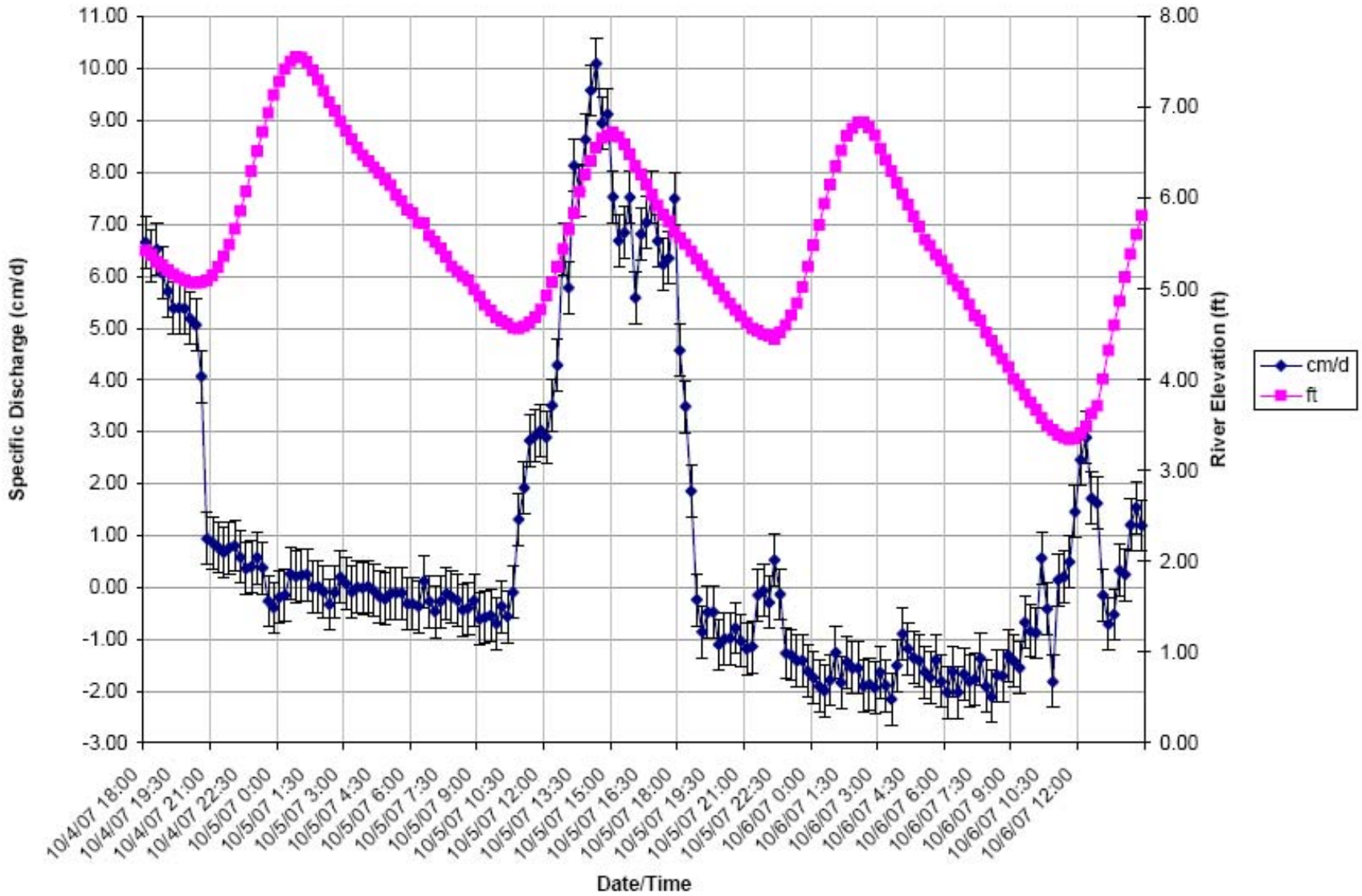
Figure 2
Year 1 Event 1 Diver Transect Surveys
NW Natural "Gasco" Site
Portland, Oregon



ANCHOR ENVIRONMENTAL, L.L.C

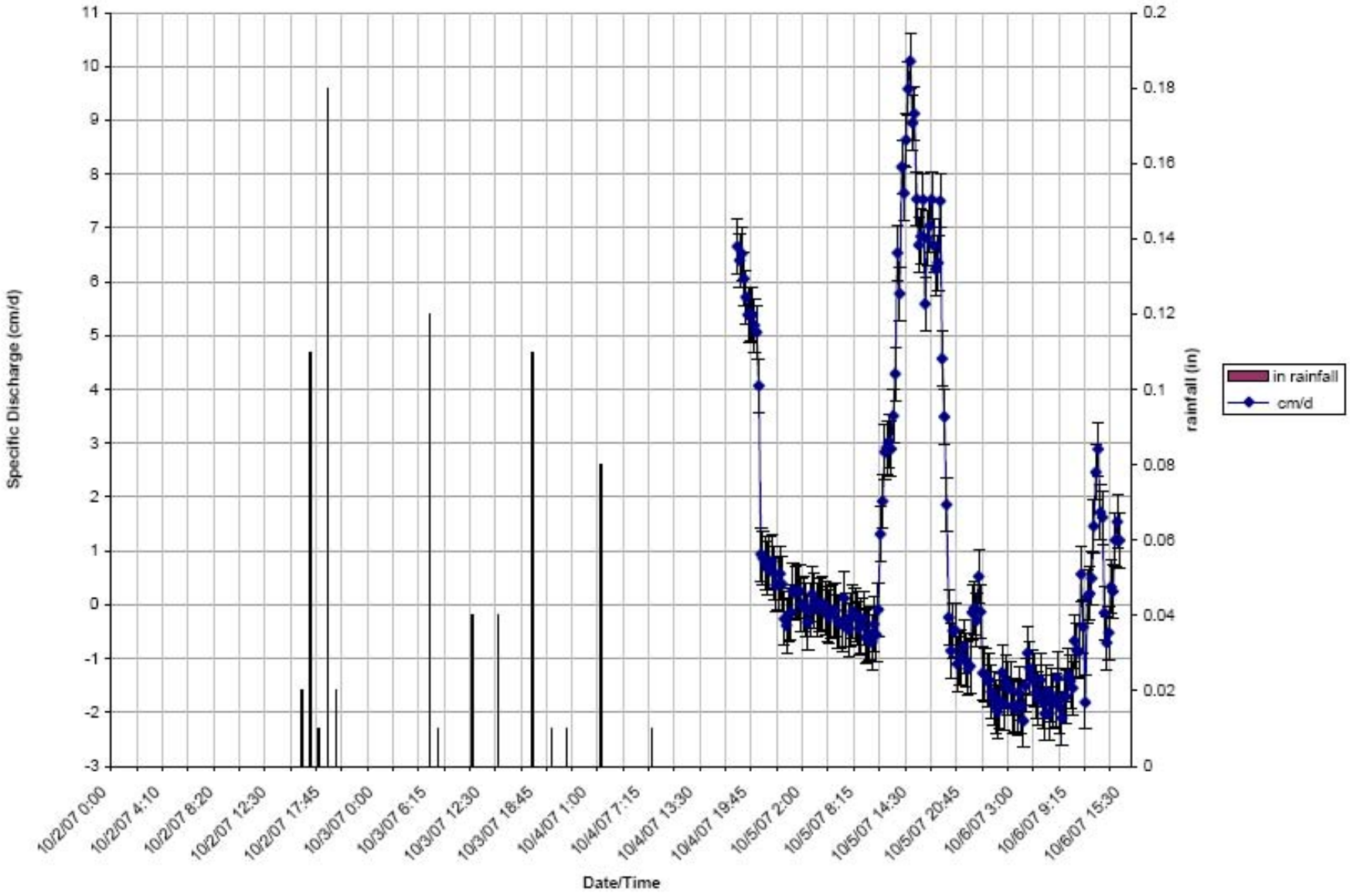
0 175
Scale in Feet
1 inch equals 175 feet

Figure 3
Offshore Sampling Locations
NW Natural - Gasco Site
Portland, Oregon



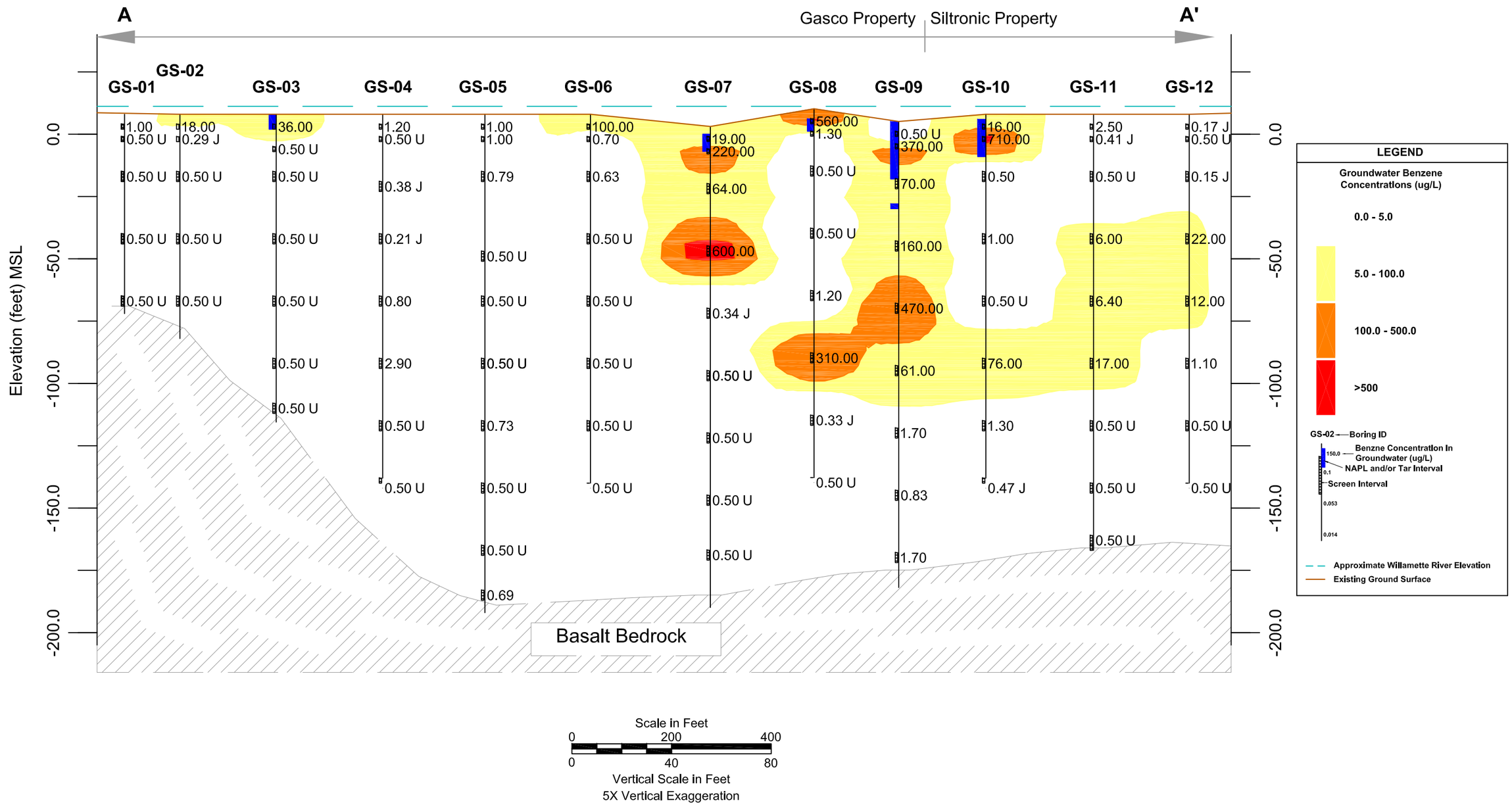
ANCHOR ENVIRONMENTAL, L.L.C.

Figure 4
Monitoring Station GS-PC1 Groundwater Discharge Versus River Elevation
NW Natural – Gasco Site
Portland, Oregon



ANCHOR ENVIRONMENTAL, L.L.C.

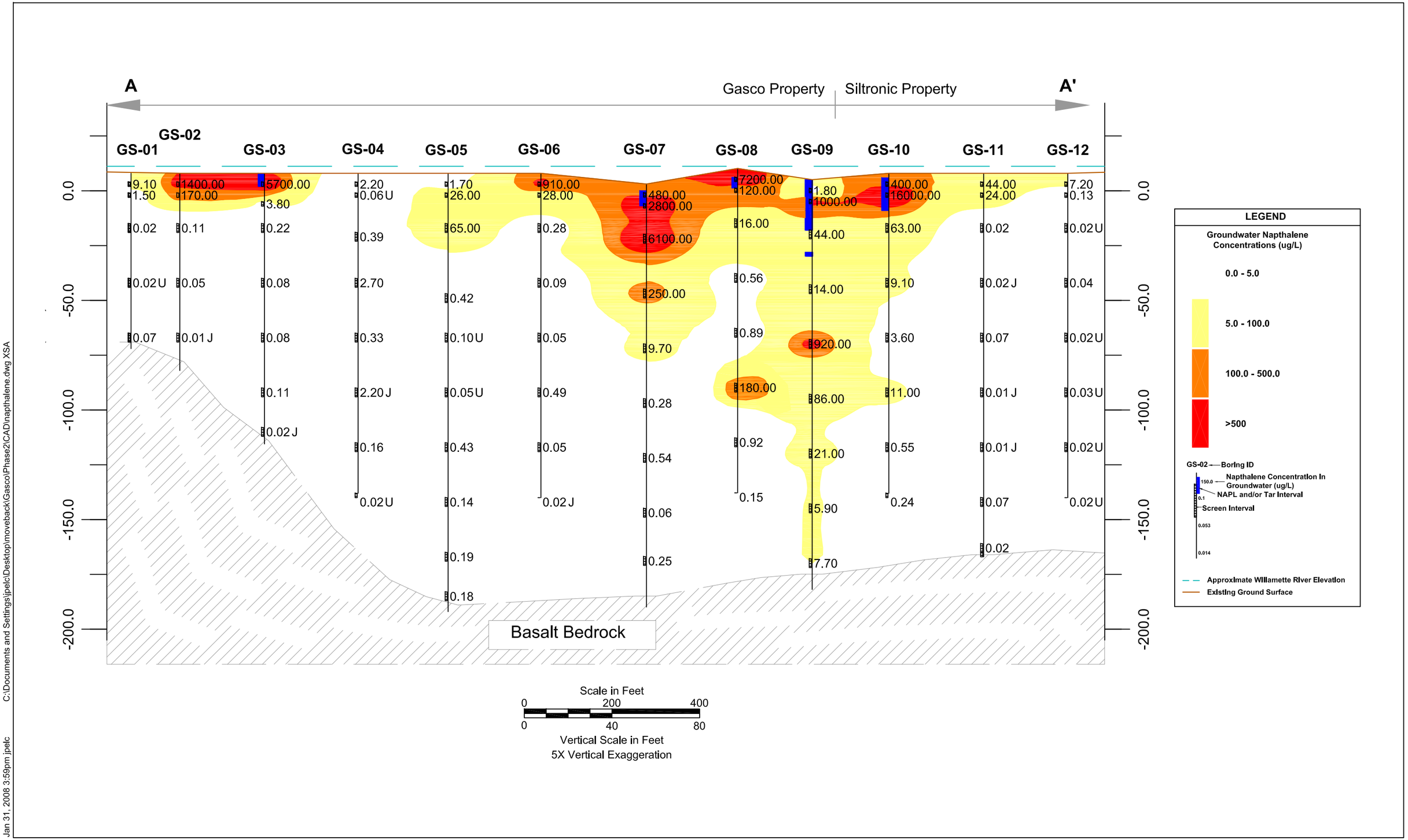
Figure 5
Monitoring Station GS-PC1 Groundwater Discharge Versus Precipitation
NW Natural – Gasco Site
Portland, Oregon



Jan 31, 2008 3:52pm jpelc C:\Documents and Settings\jpelc\Desktop\moveback\Gasco\Phase2\CAD\benzene.dwg A

ANCHOR ENVIRONMENTAL, L.L.C.

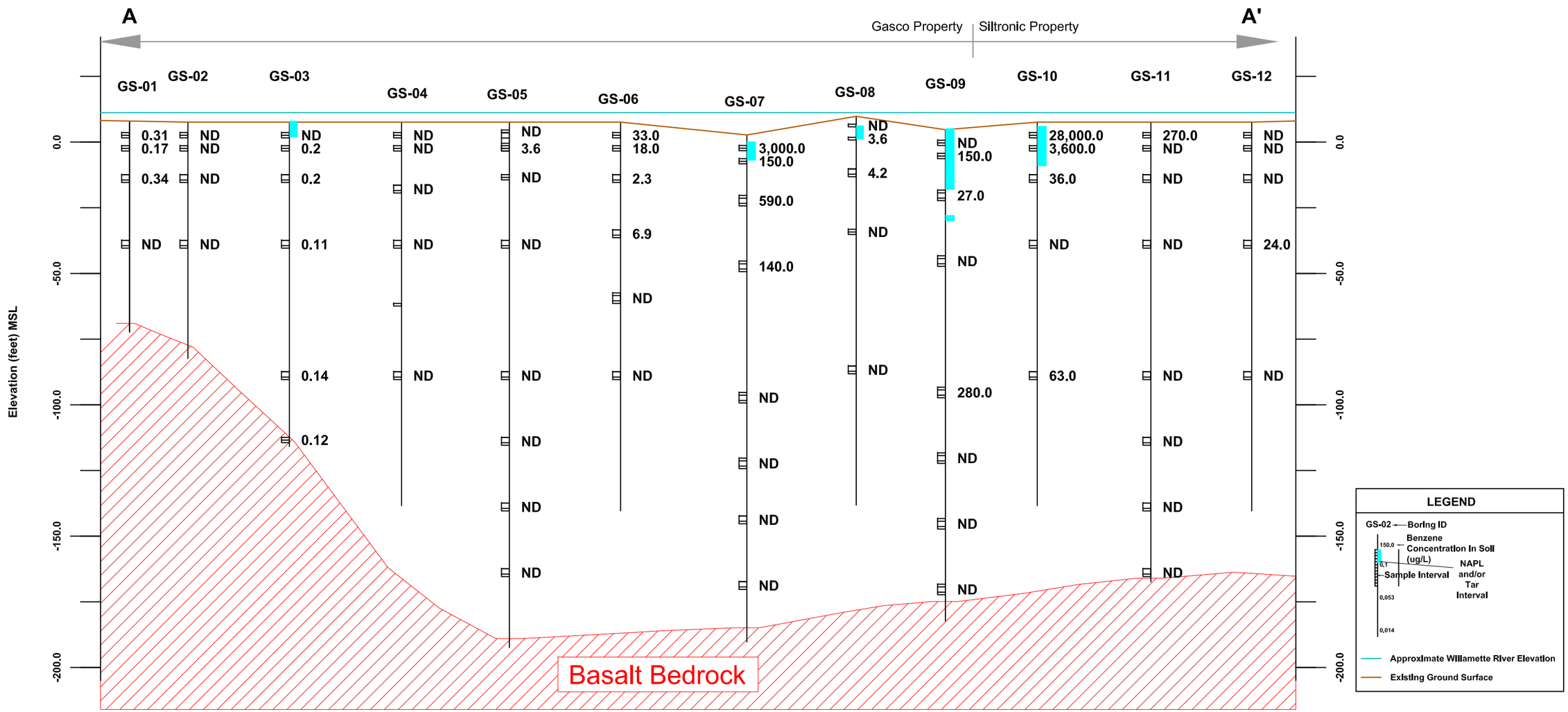
Figure 6
Subsurface Profile A-A'
Benzene Concentrations in Groundwater
Gasco, Portland, Oregon



Jan 31, 2008 3:59pm jpelc C:\Documents and Settings\jpelc\Desktop\moveback\Gasco\Phase2\CAD\napthalene.dwg XSA

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 7
Subsurface Profile A-A'
Napthalene Concentrations in Groundwater
Gasco, Portland, Oregon



Notes:
1. Vertical Datum: City of Portland
2. Horizontal Datum: Oregon State Plane NAD(83)
3. See Boring Logs for Sample Details

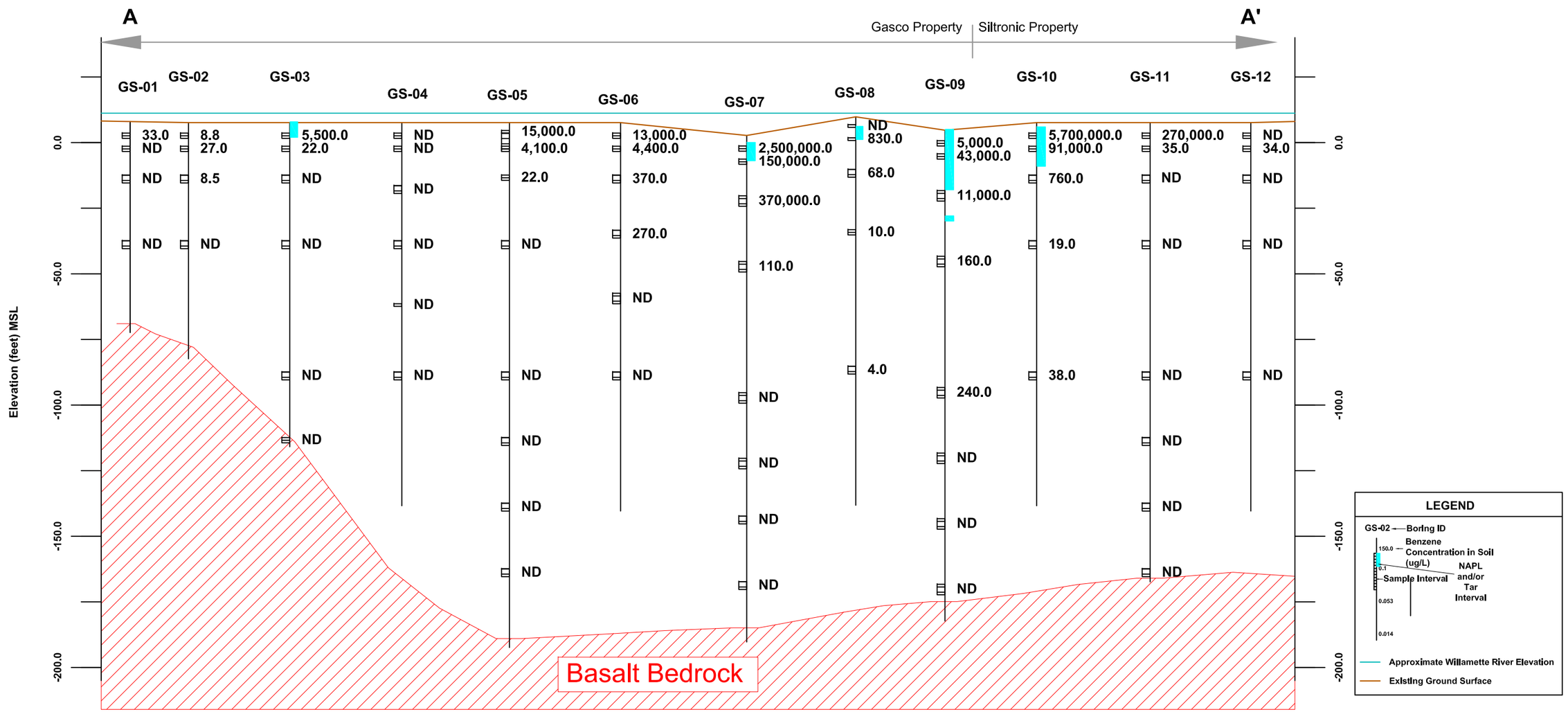
0 200
Scale in Feet

5X Vertical Exaggeration

Apr 30, 2007 10:41am jpelc C:\Documents and Settings\jpelc\My Documents\Gasco\CADstuff\ForReport\XSA.dwg Benzene_Soil

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 8
Sediment Benzene Concentrations
Cross Section A-A'
NW Natural, Portland, Oregon



Notes:
1. Vertical Datum: City of Portland
2. Horizontal Datum: Oregon State Plane NAD(83)
3. See Boring Logs for Sample Details

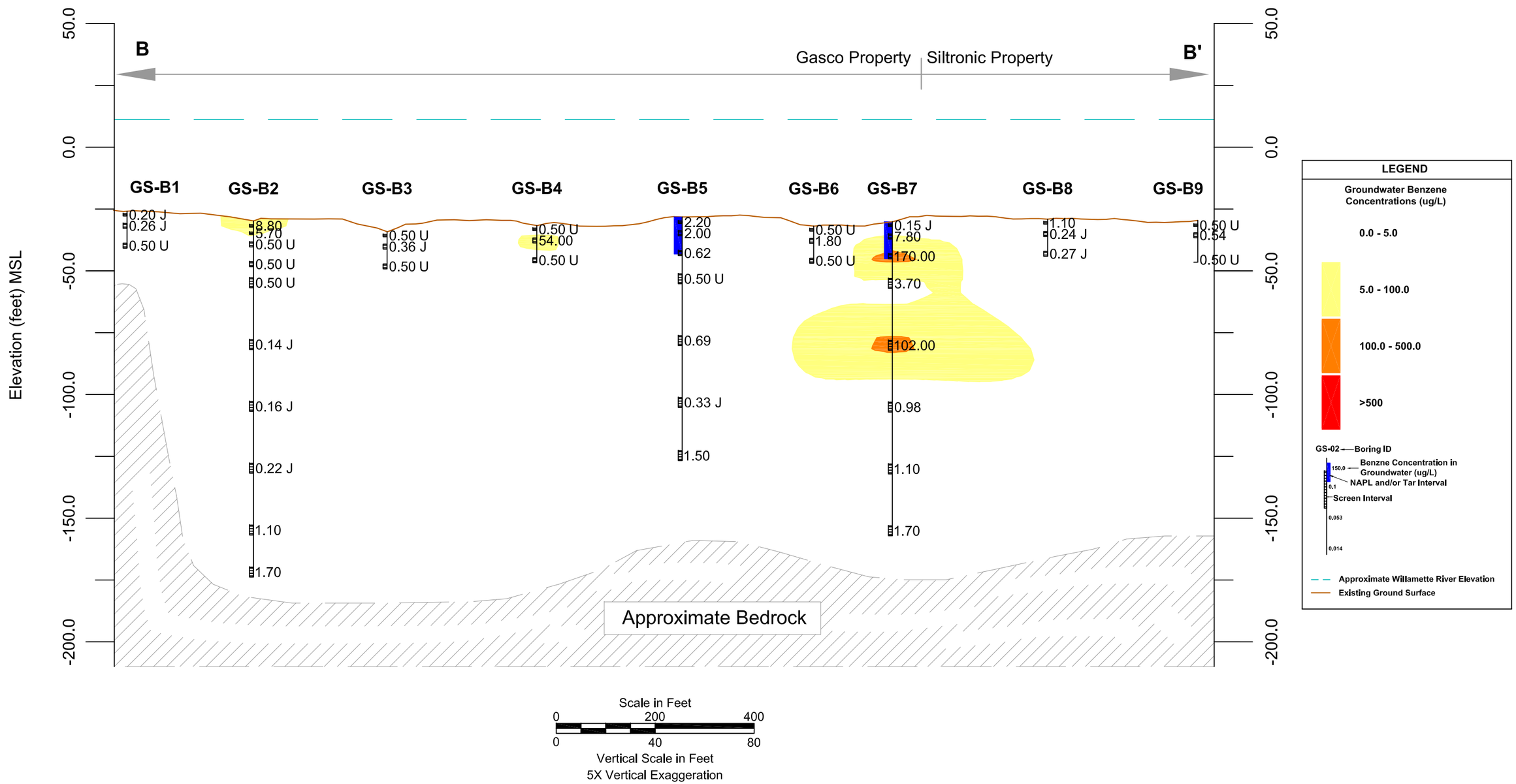
0 200
Scale in Feet

5X Vertical Exaggeration

Apr 30, 2007 10:41am jpelc C:\Documents and Settings\jpelc\My Documents\Gasco\CADstuff\ForReport\XSA.dwg Napthalene_Soil

ANCHOR ENVIRONMENTAL, L.L.C.

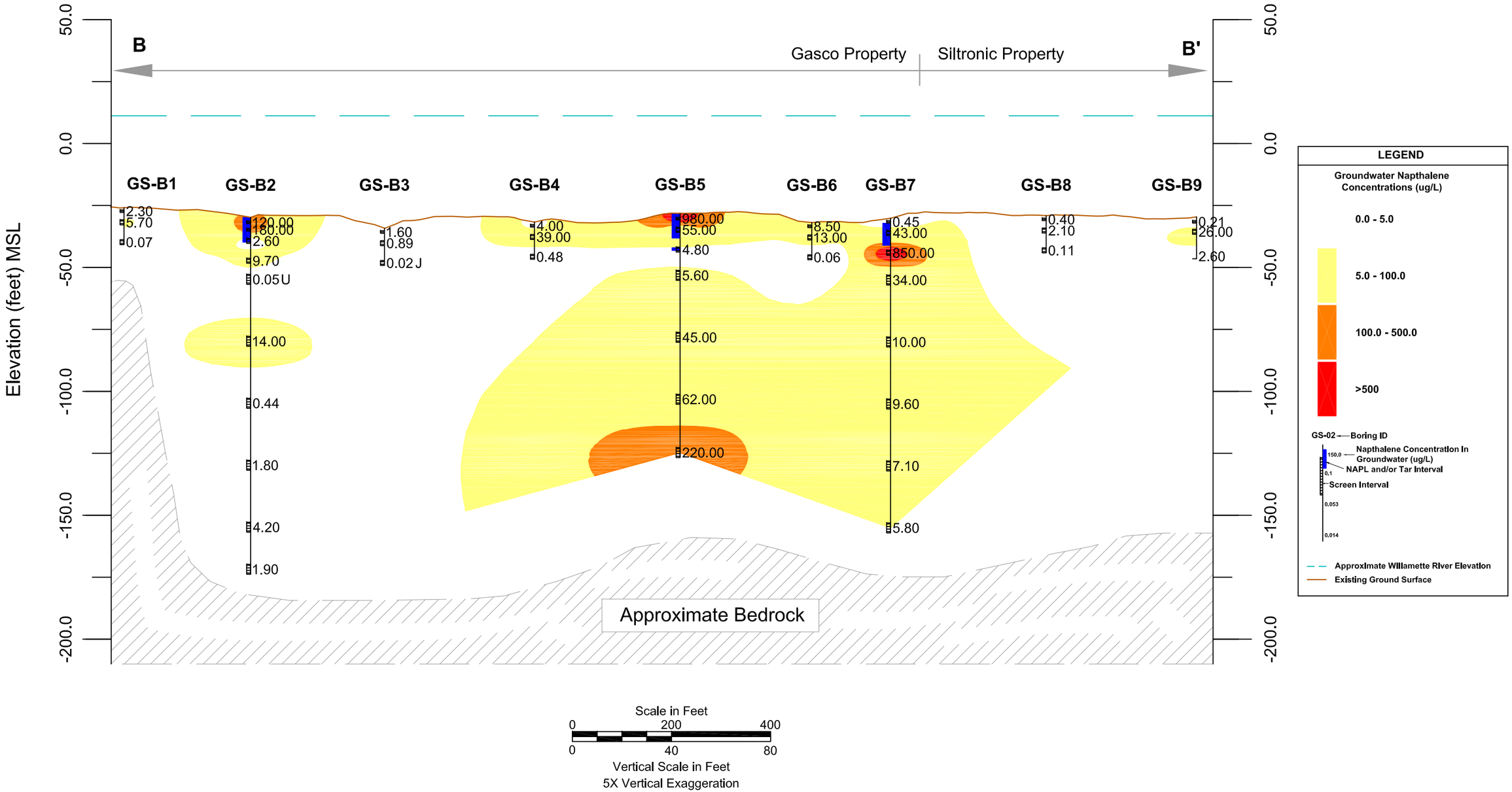
Figure 9
Sediment Napthalene Concentrations
Cross Section A-A'
NW Natural, Portland, Oregon



Jan 31, 2008 3:51pm jpelc C:\Documents and Settings\jpelc\Desktop\moveback\Gasco\Phase2\CAD\benzene.dwg B

ANCHOR ENVIRONMENTAL, L.L.C.

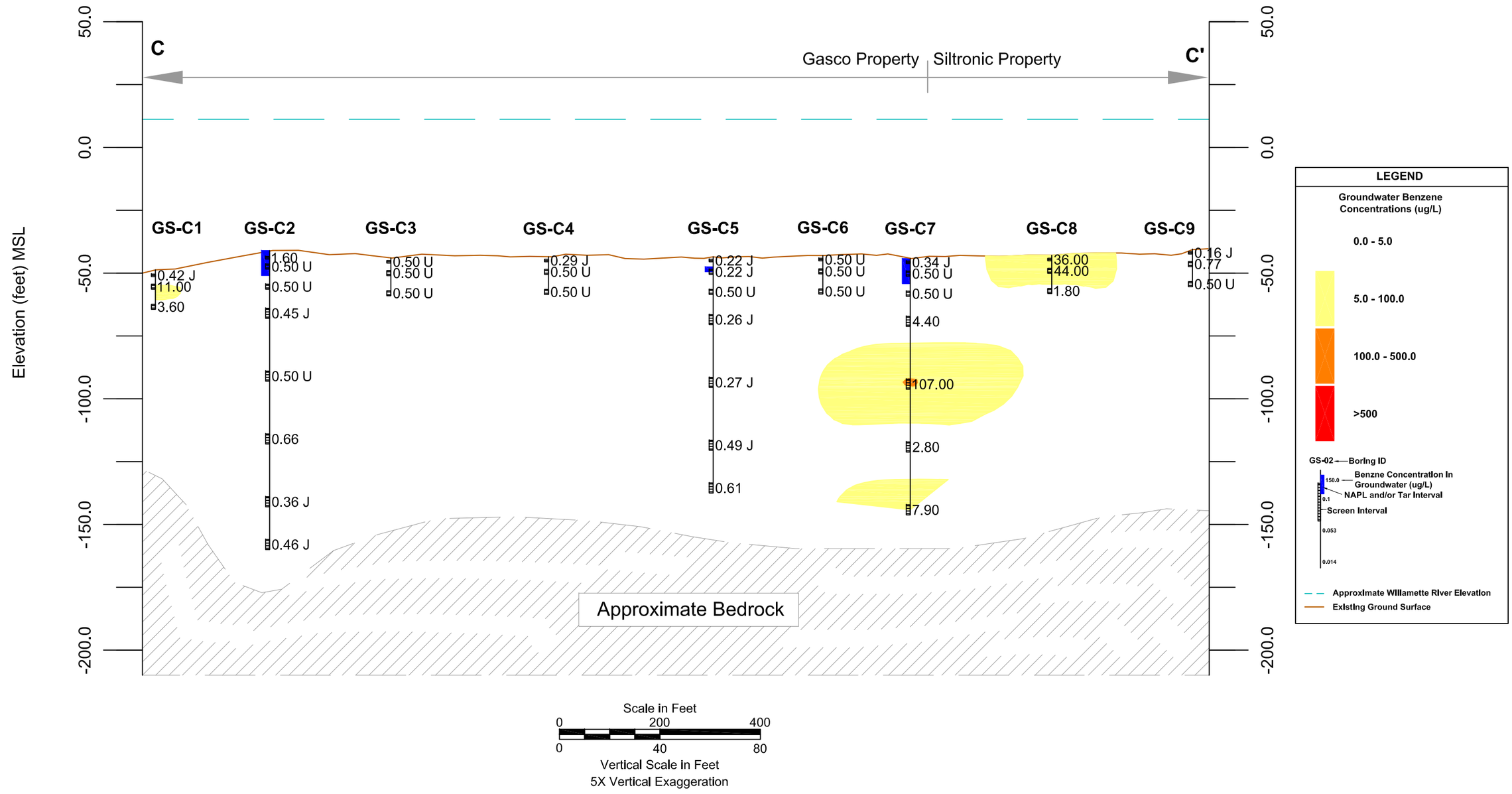
Figure 10
Subsurface Profile B-B'
Benzene Concentrations in Groundwater
Gasco, Portland, Oregon



Jan 31, 2008 3:58pm jpelc C:\Documents and Settings\jpelc\Desktop\moveback\Gasco\Phase2\CAD\napthalene.dwg XSB

ANCHOR ENVIRONMENTAL, L.L.C.

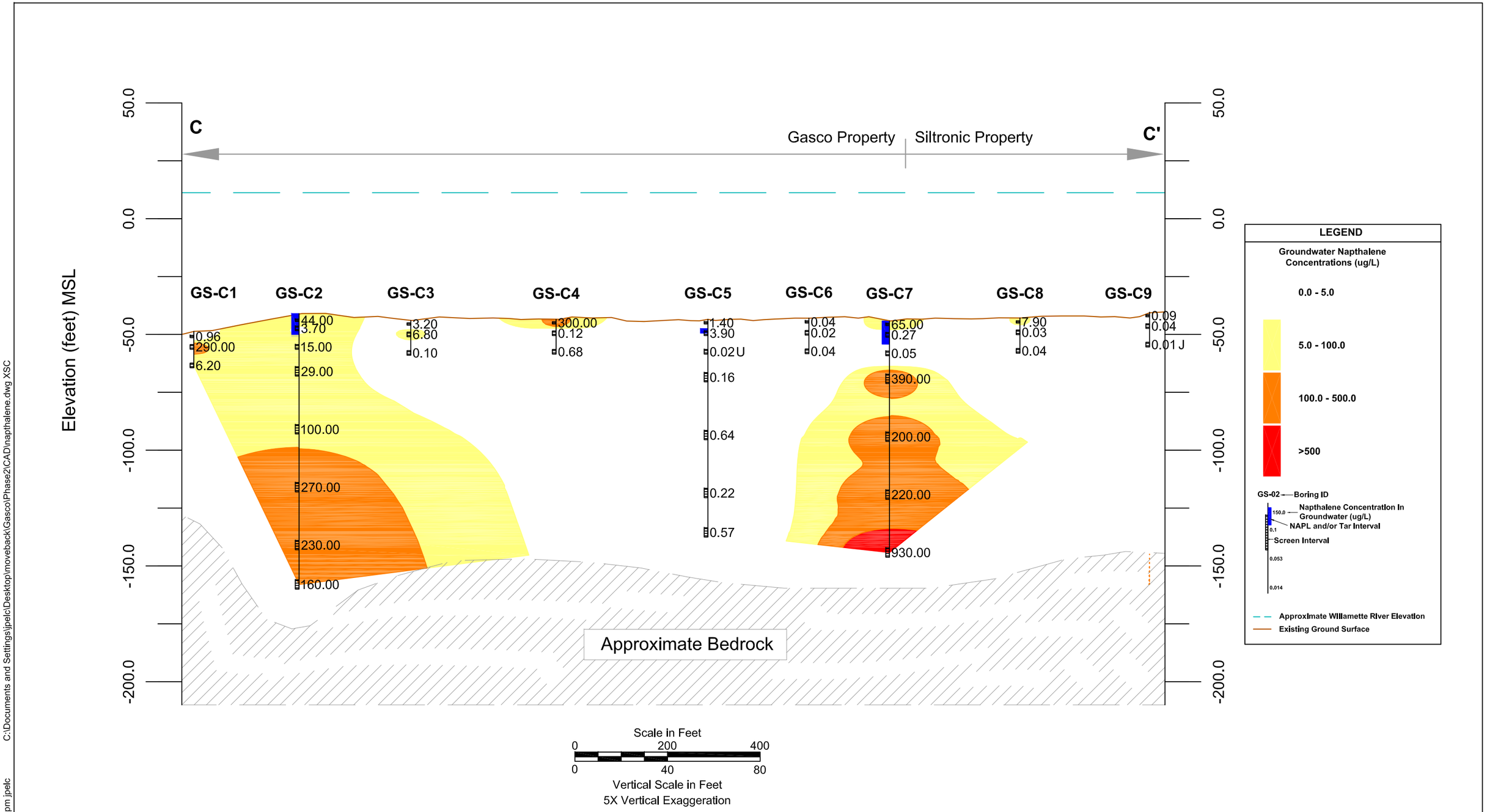
Figure 11
Subsurface Profile B-B'
Napthalene Concentrations in Groundwater
Gasco, Portland, Oregon



Jan 31, 2008 3:51pm jpelc C:\Documents and Settings\jpelc\Desktop\moveback\Gasco\Phase2\CAD\benzene.dwg C

ANCHOR ENVIRONMENTAL, L.L.C.

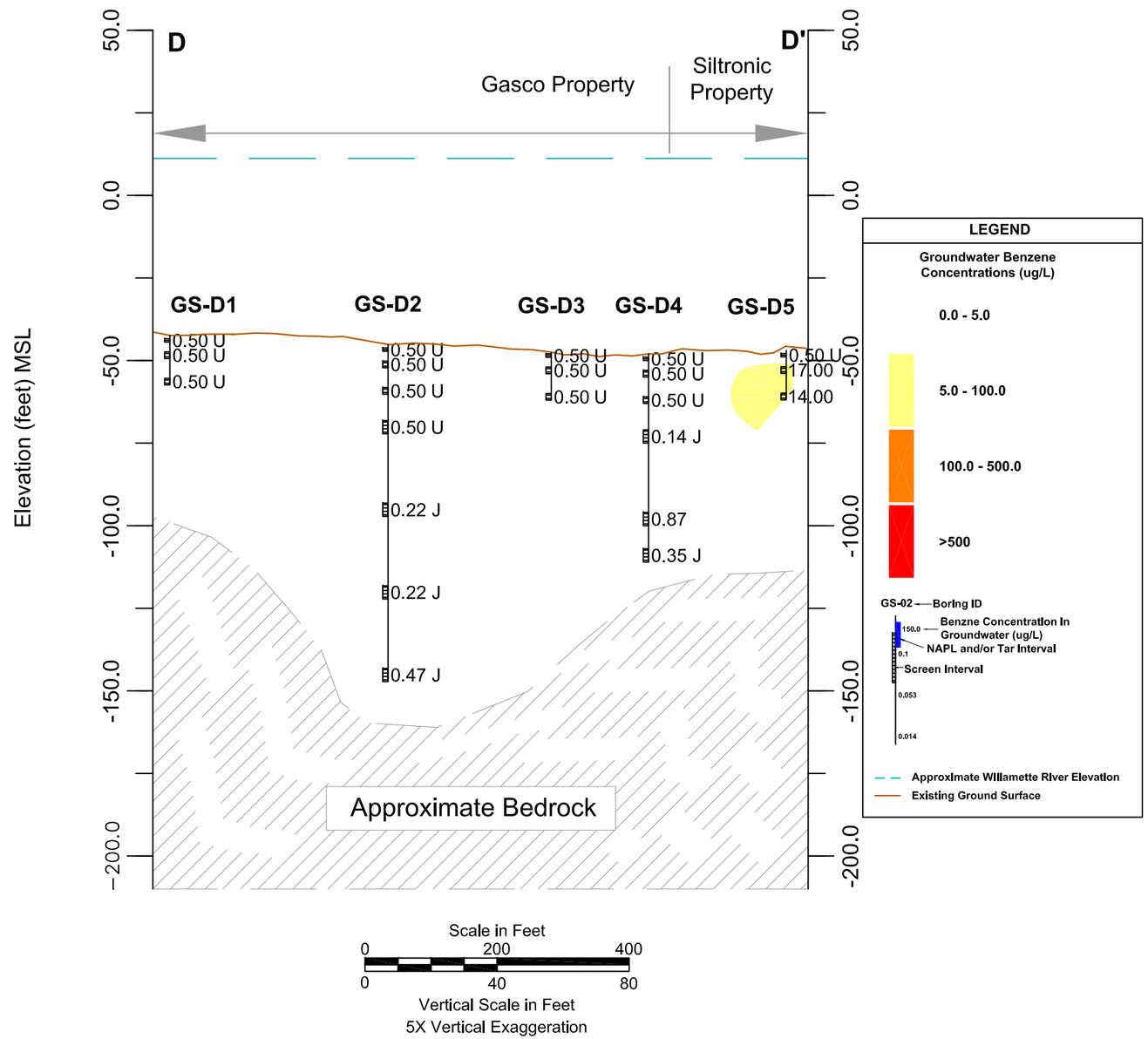
Figure 12
Subsurface Profile C-C'
Benzene Concentrations in Groundwater
Gasco, Portland, Oregon



Jan 31, 2008 3:58pm jpelc C:\Documents and Settings\jpelc\Desktop\moveback\Gasco\Phase2\CAD\napthalene.dwg XSC

ANCHOR ENVIRONMENTAL, L.L.C.

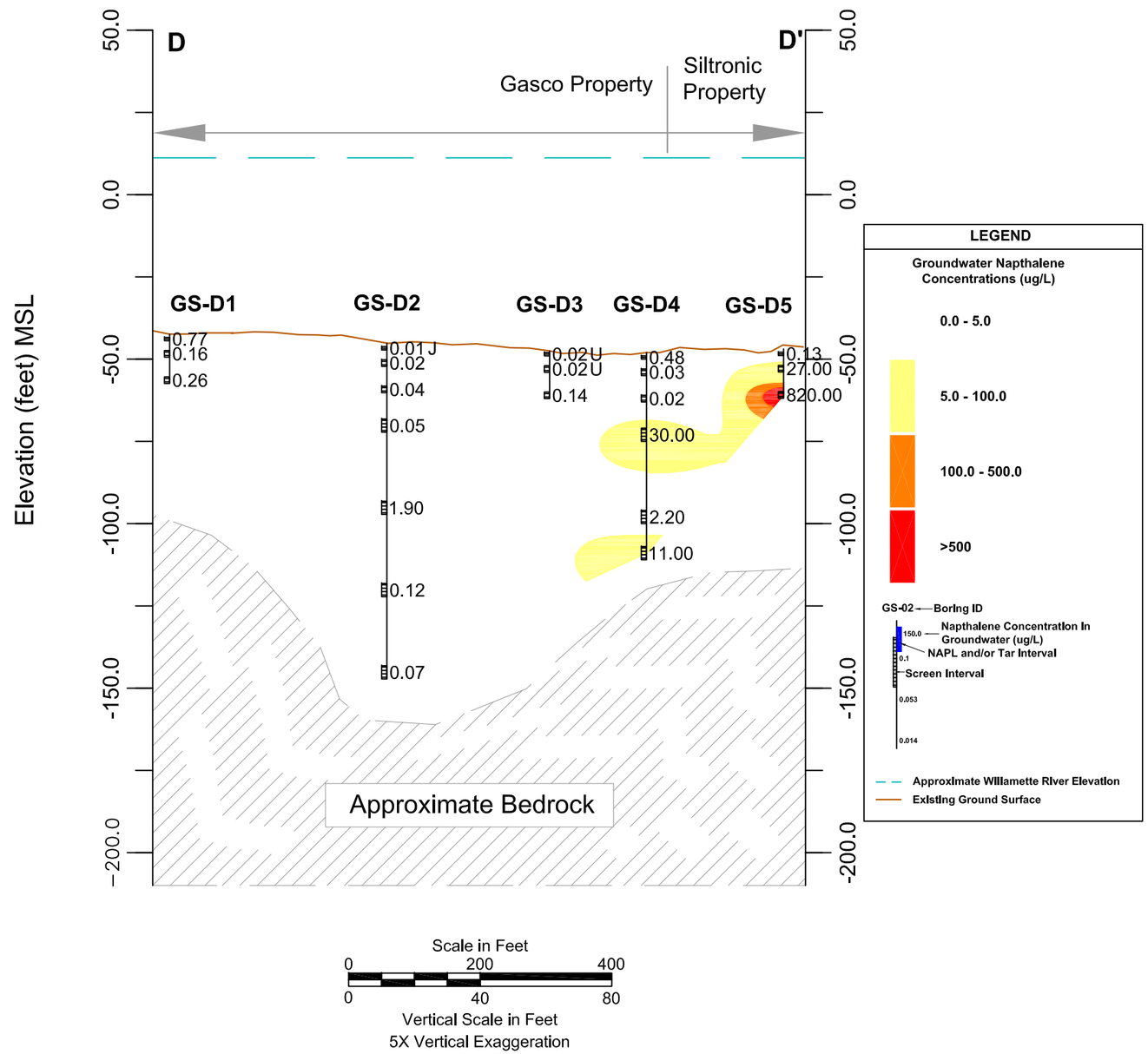
Figure 13
Subsurface Profile C-C'
Napthalene Concentrations in Groundwater
Gasco, Portland, Oregon



Jan 31, 2008 3:50pm jpelc C:\Documents and Settings\jpelc\Desktop\moveback\Gasco\Phase2\CAD\benzene.dwg D

ANCHOR ENVIRONMENTAL, L.L.C.

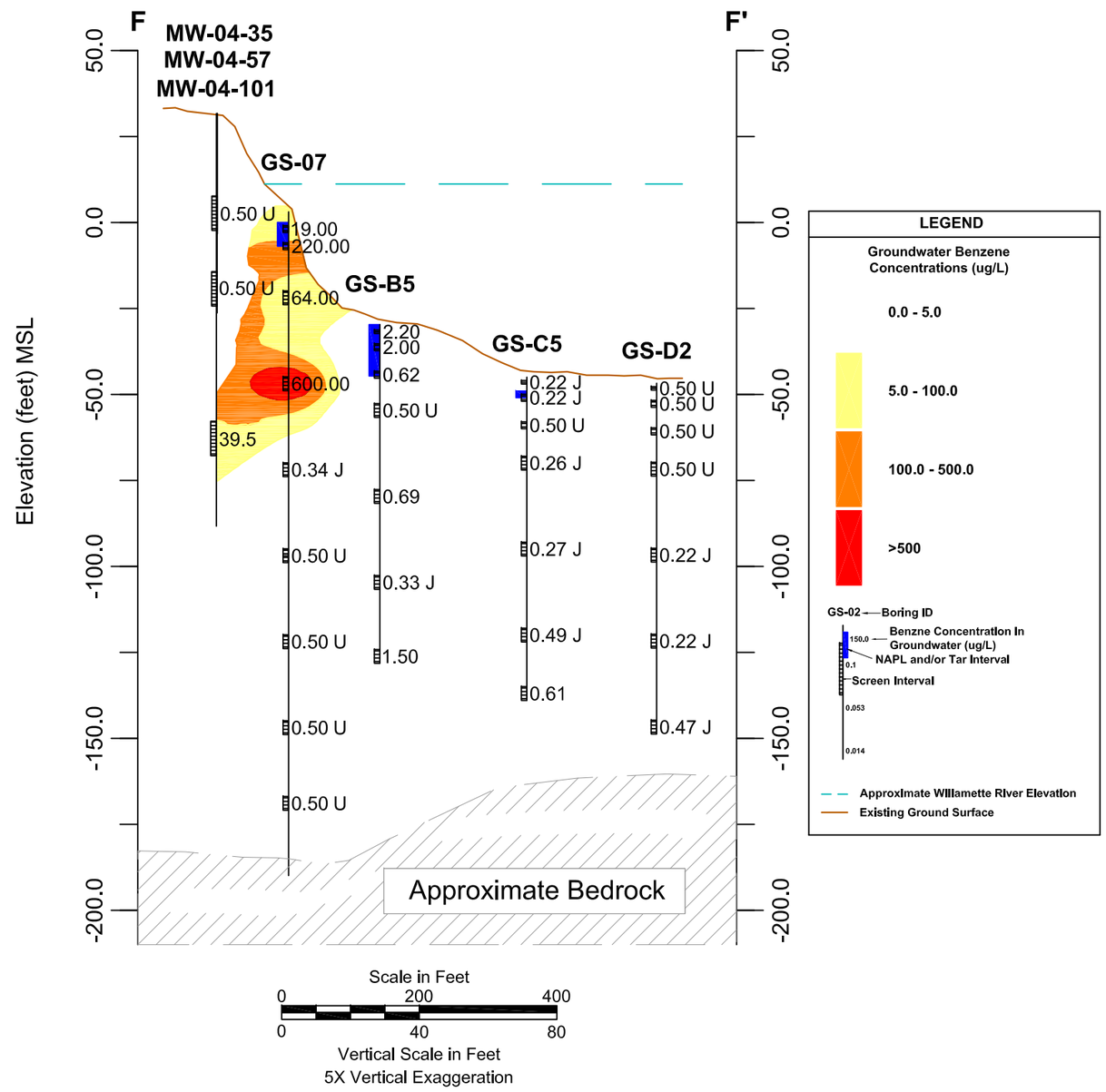
Figure 14
Subsurface Profile D-D'
Benzene Concentrations in Groundwater
Gasco, Portland, Oregon



Jan 31, 2008 3:58pm jpelc C:\Documents and Settings\jpelc\Desktop\moveback\Gasco\Phase2\CAD\napthalene.dwg XSD

ANCHOR ENVIRONMENTAL, L.L.C.

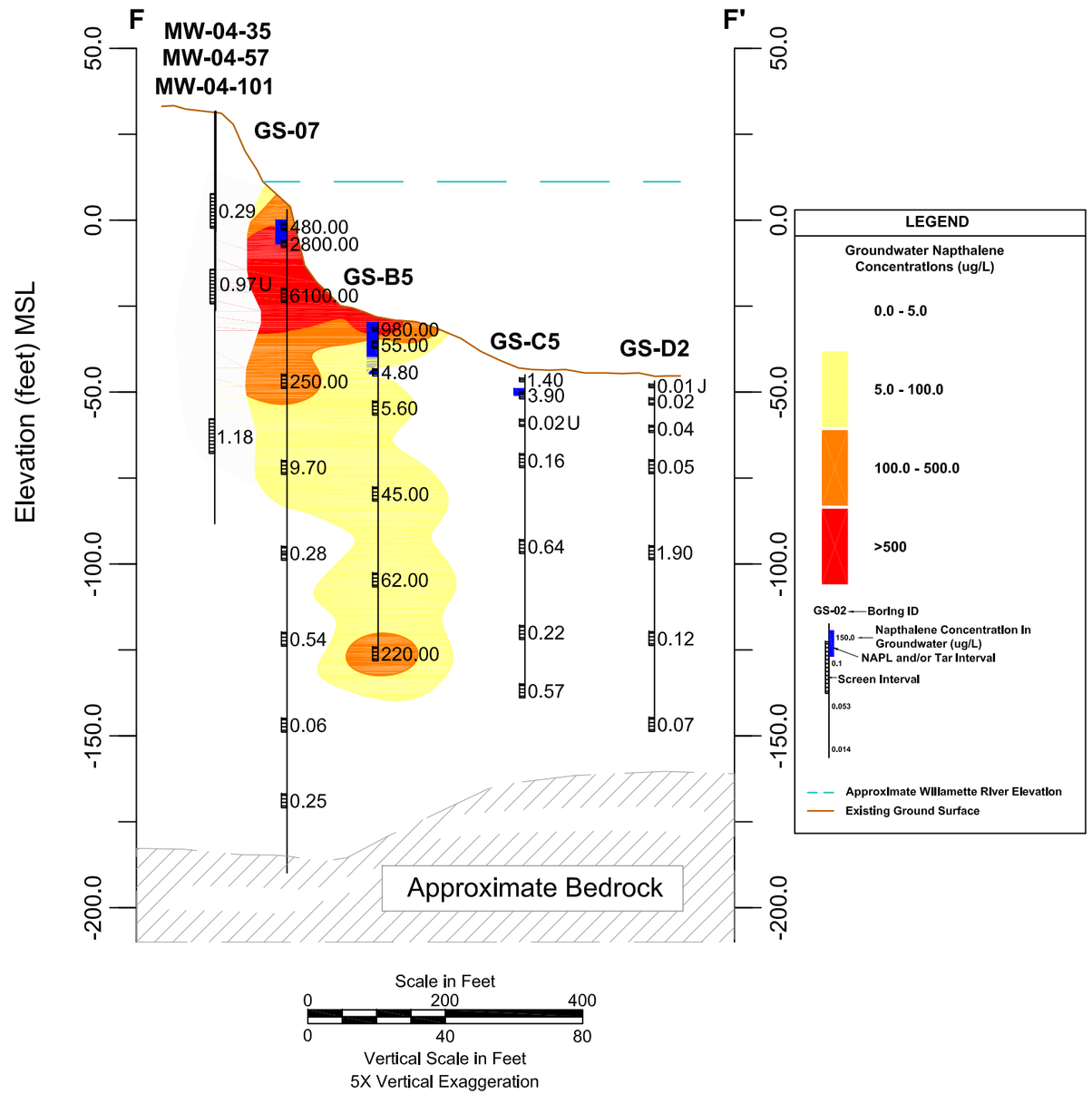
Figure 15
Subsurface Profile D-D'
Napthalene Concentrations in Groundwater
Gasco, Portland, Oregon



Jan 31, 2008 3:49pm jpelc C:\Documents and Settings\jpelc\Desktop\moveback\Gasco\Phase2\CAD\benzene.dwg F

ANCHOR ENVIRONMENTAL, L.L.C.

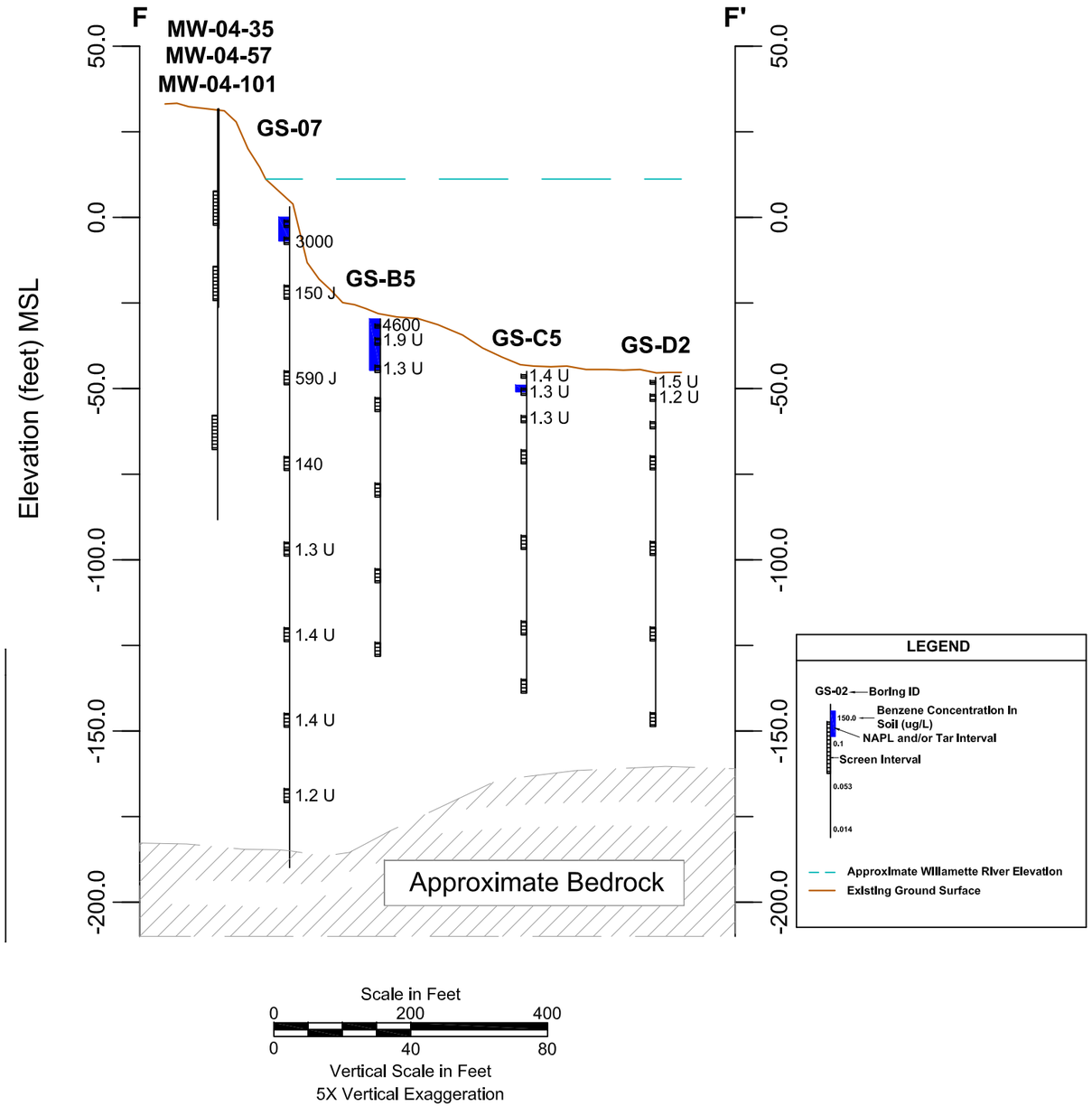
Figure 16
Subsurface Profile F-F'
Benzene Concentrations in Groundwater
Gasco, Portland, Oregon



Jan 31, 2008 3:57pm jpelc C:\Documents and Settings\jpelc\Desktop\moveback\Gasco\Phase2\CAD\napthalene.dwg XSF

ANCHOR ENVIRONMENTAL, L.L.C.

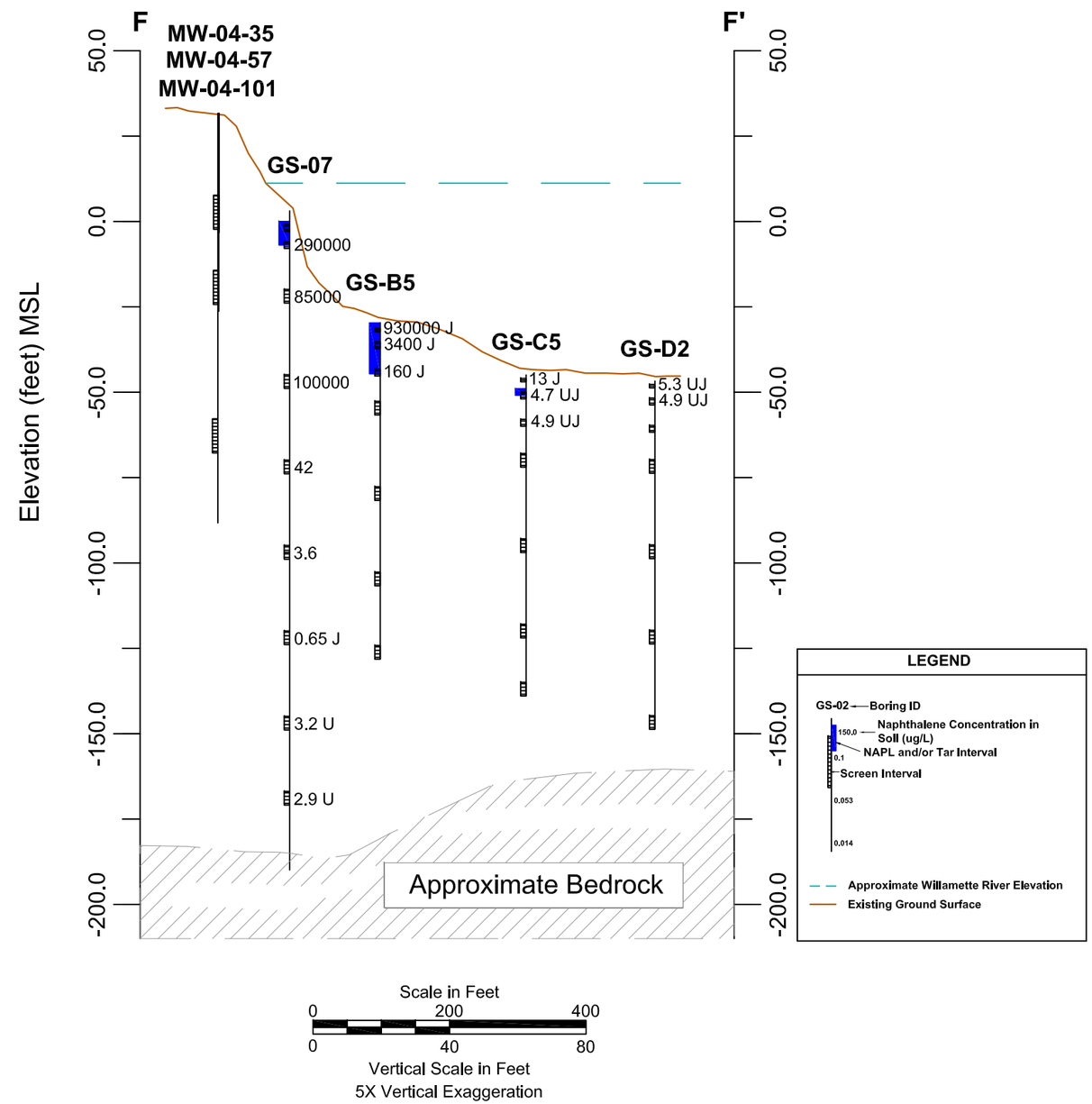
Figure 17
Subsurface Profile F-F'
Napthalene Concentrations in Groundwater
Gasco, Portland, Oregon



Jan 31, 2008 3:25pm jpelc C:\Documents and Settings\jpelc\Desktop\moveback\Gasco\Phase2\CAD\benzene.dwg SF

ANCHOR ENVIRONMENTAL, L.L.C.

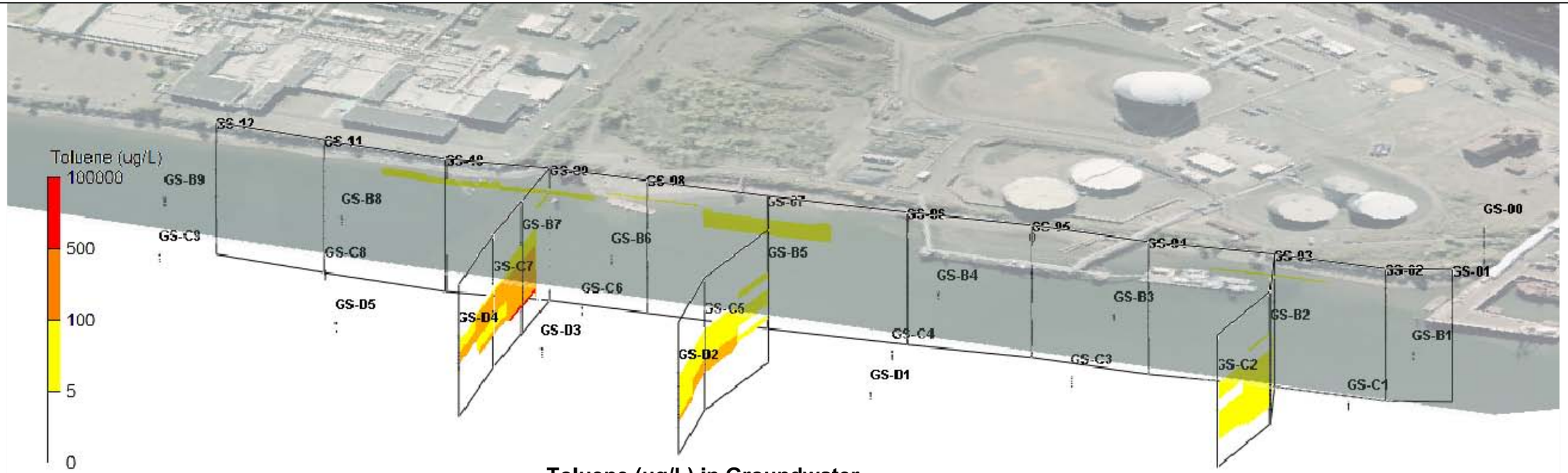
Figure 18
Subsurface Profile F-F'
Benzene Concentrations in Sediment
Gasco, Portland, Oregon



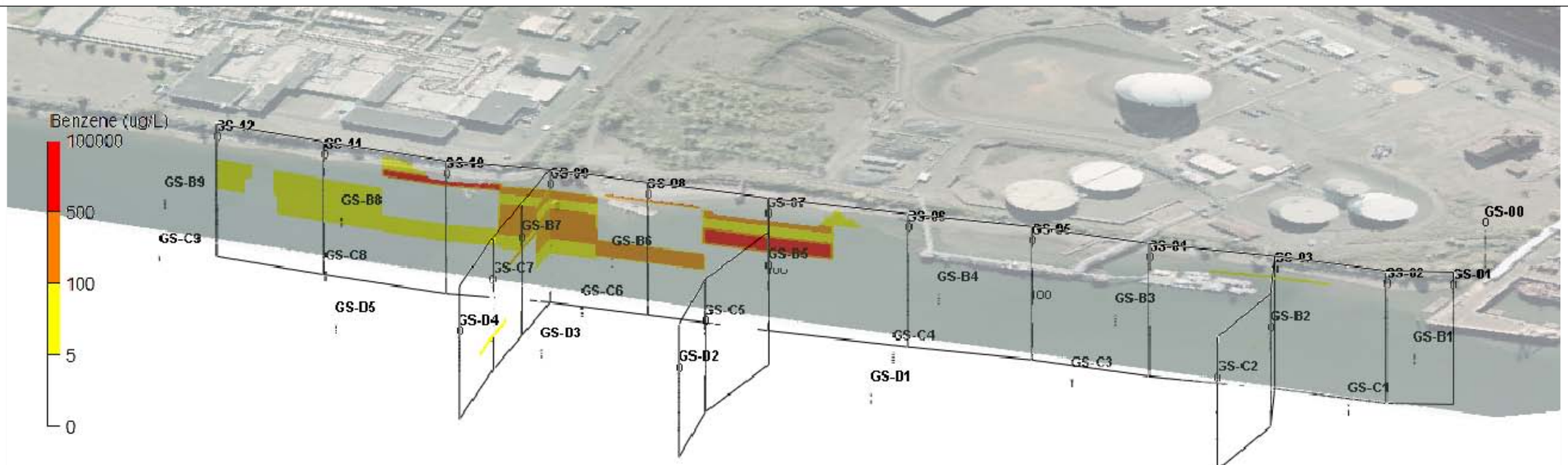
Jan 31, 2008 3:38pm jpelc C:\Documents and Settings\jpelc\Desktop\moveback\Gasco\Phase2\CAD\napthalene.dwg XS_SF

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 19
Subsurface Profile F-F'
Napthalene Concentrations in Sediment
Gasco, Portland, Oregon



Toluene (ug/L) in Groundwater



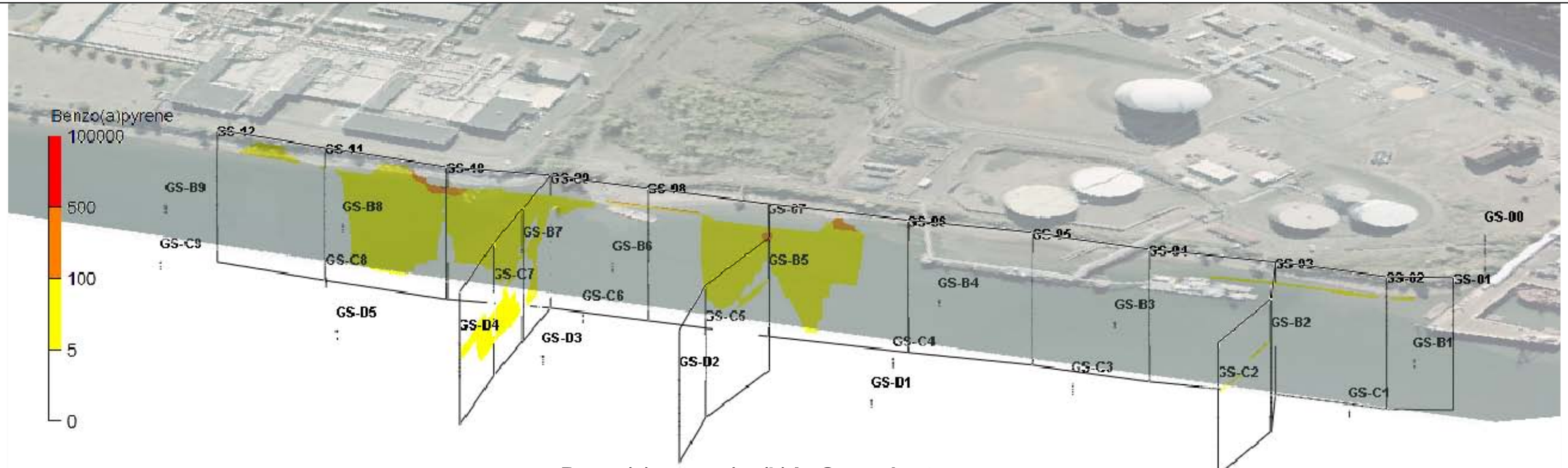
Benzene (ug/L) in Groundwater

Note: Locations are approximate and are for visualization purposes only.

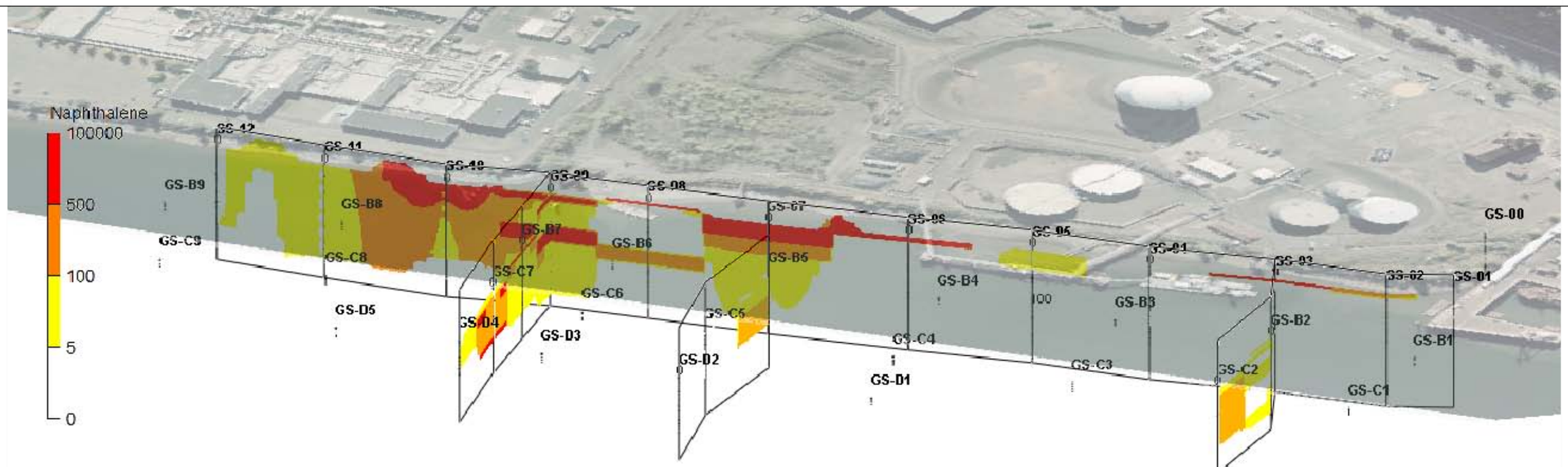
Feb 01, 2008 1:28pm jpelc C:\Documents and Settings\jpelc\Desktop\moveback\Gasco\Phase2\CAD\3DFence\benzene.dwg 1.18

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 20
Benzene and Toluene in Groundwater
3D Visualization Model
Gasco, Portland, Oregon



Benzo(a)pyrene (ug/L) in Groundwater



Naphthalene (ug/L) in Groundwater

Note: Locations are approximate and are for visualization purposes only.

Feb 01, 2008 1:27pm jpelc C:\Documents and Settings\jpelc\Desktop\moveback\Gasco\Phase2\CAD\3DFence\benzene.dwg 1.19

ANCHOR ENVIRONMENTAL, L.L.C.

Figure 21
Benzo(a)pyrene and Naphthalene in Groundwater
3D Visualization Model
Gasco, Portland, Oregon