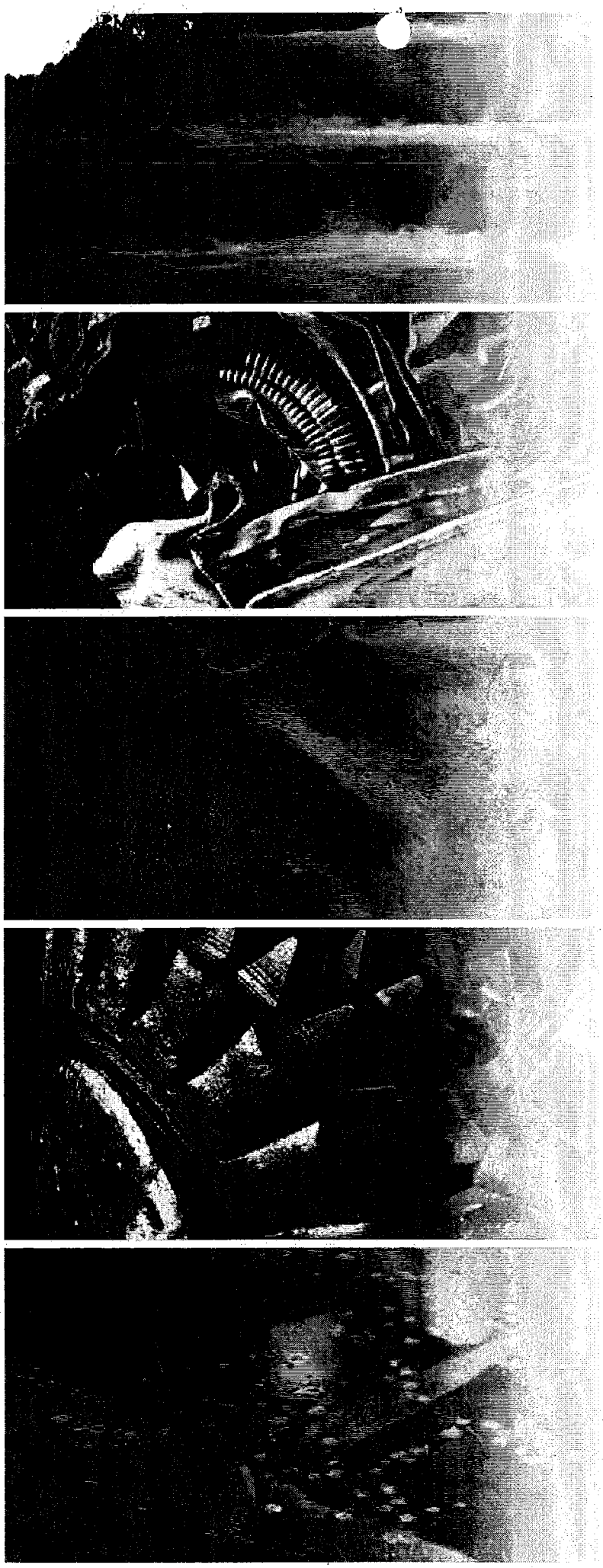


Summary Report for Petroleum Plume Investigation You & I Market Pacific Beach, Washington

Prepared for Washington State Department of Ecology

May 25, 2011
17330-34

HARTCROWSER

This page is intentionally left blank
for double-sided printing.

Summary Report for Petroleum Plume Investigation You & I Market Pacific Beach, Washington

Prepared for
Washington State
Department of Ecology

May 25, 2011
17330-34

Prepared by
Hart Crowser, Inc.

Christopher R. Poulsen, PE
Senior Associate

Ross Stainsby, LHG
Senior Associate

1700 Westlake Avenue North, Suite 200
Seattle, Washington 98109-6212
Fax 206.328.5581
Tel 206.324.9530

This page is intentionally left blank
for double-sided printing.

CONTENTS

TABLES

CONTENTS (Continued)

Page

FIGURES

APPENDIX A
FIELD EXPLORATION METHODS AND ANALYSIS WITH BORING AND MONITORING WELL LOGS

SUMMARY REPORT FOR
PETROLEUM PLUME INVESTIGATION
YOU & I MARKET
PACIFIC BEACH, WASHINGTON

INTRODUCTION

This summary report has been prepared as part of Hart Crowser's environmental support services to aid in delineating the nature and extent of petroleum contamination associated with the You & I Market site. The work described herein was completed in general accordance with the Work Plan dated June 8, 2010, and the Sampling and Analysis Plan (SAP) dated February 17, 2011. The purpose of our activities were to:

- Further define/delineate the nature and extent of the petroleum hydrocarbon plume at the site;
- Assess the potential risks to human health and the environment; and
- Provide a preliminary assessment of potential cleanup options.

SITE DESCRIPTION

The You & I Market (Site), formerly known as Joe's Market, is located at 51 Main Street in the town of Pacific Beach, Washington (Figure 1). The Site is located on the southwest corner of the Main Street and Second Street intersection in an area of mixed residential and commercial use (Figure 2). The total area of the lot is 12,480 square feet. The Land Use Code is 55-Retail Trade-Automotive, Marine Craft, Aircraft, & Accessories-Gas Stations, which is the current as well as the planned future use.

The Site is paved, with a gravel alley located along the southern border of the property. The property slopes gently to the southeast and is less than one-half mile east of the Pacific Ocean. The market is served by the city municipal water system with an underground line located in the center of the alley. An underground drainage line is located beneath the edge of the street along the south and east sides of the Site.

The Site has been identified by the Washington State Department of Ecology's (Ecology) Toxics Cleanup Program as an active Leaking Underground Storage Tank (LUST) site. The Site name is listed as "You and I Market" with Ecology ID No. 434203 and Underground Storage Tank (UST) No. 2514. Its status was listed as "Awaiting Cleanup" on July 17, 1995.

SITE BACKGROUND AND HISTORY

The Site is currently used as a gasoline station/convenience mart. We understand that in 1995, three underground storage tanks (USTs) were removed. This included the removal of one 8,000-gallon UST, one 6,000-gallon UST, and one 4,000-gallon UST which formerly contained leaded and unleaded gasoline and diesel fuel, respectively. The UST removal was documented in the "UST Removal Report" submitted to Ecology by Anderson Petroleum Services, Inc. At the time of the UST removal, two new USTs consisting of a 10,000-gallon unleaded regular gasoline tank and a 6,000-gallon premium unleaded/4,000-gallon diesel fuel split tank were installed.

In 1997, during excavation of a utility vault, workers with Century Tel Company noted strong petroleum odors in the soil. This excavation was located approximately 100 feet southeast of the site, across Second Street. In January 1998, AA Enviro Assessment Inc. (AEA) conducted a site investigation. A second investigation was conducted in November 2000 by Northwest Testing Company (NWT). Both reports documented weathered gasoline and diesel contamination exceeding MTCA Method A soil cleanup levels beneath and around the pump islands. The petroleum plume was observed to extend over 100 feet southeast of the pump island, passing beneath Second Street to the telephone vault. Most of the soil contamination was observed between 4 to 9 feet below ground surface (bgs). Petroleum contamination was also encountered south of the USTs. The lateral extent of the petroleum plume off the Site was not defined by these studies.

In July 2009, the current owner of the property, Mr. David Koh, contracted with Environmental Services Network (ESN) to advance six soil borings at the site and to analyze soil and groundwater collected from these borings. We understand that there was no official report, but the analytical results from the laboratory confirmed the presence of gasoline-range hydrocarbons that exceeded MTCA Method A cleanup levels in soil and groundwater southeast of the pump island.

In January 2010, during a heavy rainfall event, Ecology received a report of fuel "bubbling up" from the ground on the east side of the pump island concrete pad. The fuel was observed flowing south down Second Street into a storm drain located a few hundred yards away. This storm drain empties into nearby Joe Creek, which flows into the Pacific Ocean.

PETROLEUM PLUME INVESTIGATION

In February and March 2011, in general accordance with the Work Plan dated June 8, 2010, and the SAP dated February 17, 2011, Hart Crowser conducted a soil and groundwater investigation to delineate the nature and extent of the petroleum plume at the Site. The work was divided into two phases. Phase 1 consisted of a push-probe investigation to delineate the nature and extent of the petroleum plume in soil and groundwater, and Phase 2 consisted of installing and sampling up to six (6) monitoring wells at locations based on the results of Phase 1.

Detailed description of field activities including any departures from the proposed Work Plan/SAP are presented in Appendix A.

Phase 1 Push-Probe Investigation

Push-Probe Soil Borings and Sample Collection

We completed thirteen push-probe borings on February 28 and March 1, 2011, to depths of 8 to 10 feet below ground surface (bgs) as shown on Figure 2, Site and Exploration Plan. In accordance with our SAP, the borings were continuously sampled at four-foot intervals. Selected soil samples were field-screened using headspace and water sheen tests to determine the appropriate interval for collecting discrete samples. Based on the field indications, a single discrete soil sample was collected from each boring and analyzed on site by ESN Northwest's mobile laboratory. If there was no field indication of contamination, the soil at the groundwater interface was selected for chemical analysis. Boring Logs are presented in Appendix A.

Soil Vapor Sampling

As outlined in our Work Plan, up to six soil vapor samples were to be collected to evaluate potential vapor intrusion risks at the Site. However, because of the shallow groundwater table (1 to 3 feet bgs) no soil vapor samples were collected.

Groundwater Sampling

Water samples were collected from push probes PP-1, PP-3, PP-4, PP-7, PP-8, PP-11, PP-12, and PP-13. Grab groundwater samples were analyzed on-site by ESN Northwest's mobile laboratory.

Phase 2 Groundwater Monitoring

Monitoring Well Installation and Sampling

Based on the results of soil and water samples collected during Phase 1, six (6) monitoring wells, MW-1 through MW-6, were installed on March 29 and 30, 2011, at locations shown on Figure 2. Well Construction Logs are presented in Appendix A.

Each well was developed by surging and pumping a minimum volume of 10 well casings of groundwater before collecting a groundwater sample. One groundwater sample was collected from each well on March 30, 2011, and sent to Apex Laboratories in Tigard, Oregon, for analysis.

SITE GEOLOGY AND HYDROGEOLOGY

The geology encountered during push-probe investigation varied across the site. The Fill unit consisted of silty, sandy gravel to gravelly, sandy silt and varied in thickness from 0.5 to 4 feet. The soil under the Fill consists of clayey Silt, sandy Silt, and silty Sand units. The northern and western push-probe explorations under the pump island and UST areas (PP-4, PP-5, PP-6, PP-12, and PP-13) consist of the Fill unit over the clayey Silt unit over the silty Sand unit. The push-probe locations east of Second Street (PP-1, PP-2, PP-3, and PP-11) consist of the Fill unit over the sandy Silt, Sand, or Silt units. The southern and eastern push-probe explorations (PP-7, PP-8, PP-9, and PP-10) consist of the Fill unit over the clayey Silt unit over an organic Silt unit. The thickness of each unit varies across the site.

Groundwater was encountered at depths ranging from 1 to 6 feet bgs during the push-probe explorations. This shallow groundwater appears to be perched water. Groundwater levels were measured in the monitoring wells and range from 9.6 to 10.1 feet bgs. Figure 3 illustrates relative groundwater elevations and shows that groundwater is flowing southeast toward Joe Creek, which is consistent with site topography and the orientation of the petroleum hydrocarbon plume.

INVESTIGATION RESULTS/NATURE AND EXTENT OF PETROLEUM HYDROCARBON PLUME

Soil Characterization

Thirteen push-probe borings were completed at You & I Market on February 28 and March 1, 2011. One soil sample from each boring was analyzed on site for total petroleum hydrocarbons (TPH – diesel, oil, and gasoline range) and benzene, toluene, ethylbenzene, and xylenes (BTEX) analysis in accordance with methods NWTPH-Dx Extended, NWTPH-Gx, and EPA 8260. Soil sample analytical results are summarized in Table 1. Analytical results by location are shown on Figures 4 and 5 and summarized as follows:

- All diesel-range petroleum hydrocarbons were below detection limits with the exception of soil sample PP-1 at concentrations of 63 mg/kg. The diesel concentration in PP-1 was well below the Model Toxic Control Act (MTCA) Method A cleanup level of 2,000 mg/kg.

- Gasoline-range hydrocarbons were detected at concentrations exceeding the MTCA Method A unrestricted cleanup level of 30 mg/kg in three samples, PP-2, PP-4, and PP-11 at concentrations of 39, 100, and 140 mg/kg, respectively. Gasoline-range hydrocarbons were also detected in duplicate sample PP-11 at 130 mg/kg. All other gasoline-range soil sample analytical results were below detection limits.

- Oil-range hydrocarbons were not detected.

- Benzene was detected in one sample, PP-2-7, at 0.06 mg/kg, which is above the MTCA Method A unrestricted cleanup level of 0.03 mg/kg. All other soil sample results were below method detection limits.

- All toluene, ethylbenzene, and xylenes concentrations were either below method detection limits or below their respective MTCA Method A cleanup levels.

Groundwater Characterization

Groundwater samples were collected during Phase I (push-probe grab samples) and Phase II (groundwater monitoring wells) and analyzed for gasoline- and diesel-range TPH and BTEX. Groundwater analytical results are presented in Table 2 and on Figures 6 and 7.

Push-Probe Groundwater Samples

Thirteen groundwater samples were collected during the Phase I investigation. Groundwater samples were analyzed for TPH and BTEX, as previously discussed.

- Diesel- and oil-range petroleum hydrocarbons were not detected in any samples.
- Gasoline-range hydrocarbons were detected in two samples above the MTCA Method A cleanup level (800 µg/L), PP-4 and PP-11, at concentrations of 1,900 and 1,800 µg/L, respectively. Additionally, gasoline-range hydrocarbons were detected in duplicate sample PP-11 at 3,800 µg/L.
- All benzene, toluene, ethylbenzene, and xylenes concentrations were below their respective Method A cleanup levels or below method detection limits.

Monitoring Well Samples

Six monitoring wells were installed as part of the Phase II investigation on March 30 and 31, 2011. Each well was sampled and analyzed for TPH and BTEX.

- Diesel-range petroleum hydrocarbons were detected in two samples at concentrations above the MTCA Method A cleanup level (500 µg/L), MW-1 and MW-2, at 6,840 and 1,910 µg/L, respectively. Diesel-range petroleum hydrocarbons were also detected in duplicate sample MW-1 at 6,850 µg/L.
- Gasoline-range hydrocarbons were detected in two samples (MW-1 and MW-2) at concentrations above the MTCA Method A cleanup level, at concentrations of 47,200 and 8,360, respectively. Additionally, gasoline-range hydrocarbons were detected in duplicate sample MW-1 at 42,000 µg/L.
- Oil-range hydrocarbons were not detected.
- Benzene was detected in two samples at concentrations above it's MTCA Method A cleanup level (5 µg/L), MW-1 and MW-2, at 32.6 and 137 µg/L, respectively, as well as MW-1(duplicate) at 32.3 µg/L.
- Ethylbenzene was detected in well MW-1 at a concentration (1,400 µg/L) above it's MTCA Method A cleanup level of 700 µg/L, as well as MW-1(duplicate) at 1,430 µg/L.

- Xylenes were detected in well MW-1 at a concentrartion (5,220 µg/L) above the MTCA Method A cleanup level of 1,000 µg/L, as well as MW-1(duplicate) at 5,040 µg/L.

CONCLUSIONS AND POTENTIAL REMEDIATION OPTIONS

Soil and groundwater immediately adjacent to the pump island and extending approximately 120 feet to the southeast (see Figures 3 through 7) are impacted with TPH and BTEX in excess of MTCA Method A cleanup levels. Remedial alternatives should be evaluated and implemented to protect potential receptors from these impacts.

Given the nature of contamination at the Site, to determine the approximate remediation costs we briefly evaluated two remediation technologies: 1) Excavation with Off-site Disposal; and 2) *In Situ* Chemical and Bioremediation. Following are the likely cleanup options and planning-level costs:

Excavation with Off-Site Disposal

You & I Market Property

We estimate that the petroleum hydrocarbon-impacted soil within the You & I Market property is approximately 40 feet by 80 feet and up to 6 feet below the ground surface. Based on these dimensions, there is approximately 700 cubic yards of petroleum hydrocarbon-contaminated soil located within the You and I property boundaries.

The majority of the impacts appear to be located directly southeast of the pump island and adjacent to the USTs. Direct excavation and disposal of the shallow source area soil (above the historical low groundwater level) should be considered as a readily implementable, permanent, cost-effective, and protective remedial approach for addressing the source area soil. Additionally, removing impacted source-area soil and backfilling with clean material protects groundwater from future contamination.

Once the source area soil has been removed, *in situ* treatment (biological or chemical amendments) and/or monitored natural attenuation may be implemented to treat remaining chemicals of concern in groundwater. In the event that impacted soil cannot be removed and continues to serve as a source to groundwater, air sparging and/or soil gas vapor extraction and treatment have been effective at treating and removing gasoline-related constituents and may be evaluated.

The estimated cost to excavate and dispose of petroleum-contaminated soil and backfill with imported material typically is between $150 and $220 per ton. The estimated cost to excavate and backfill this area is approximately $105,000 to $154,000. Repaving the removed asphalt would result in an additional cost of approximately $18,000.

Public Right-of-Way

Much of the delineated petroleum hydrocarbon plume extends to the southeast under Second Street. It is assumed that excavation of impacted soil in this area would not be a cost-effective and/or readily implementable remedial alternative. Given the relatively low downgradient concentrations and the relatively low risk and lack of potential receptors in this area, monitored natural attenuation or *in situ* chemical/biological options should be evaluated to treat this area. Wells MW-2, MW-4, and MW-3 are within this immediate area. Periodic monitoring of these wells would reveal any changes in the subsurface that may require a more active remedial approach.

Adjacent Properties

The distal end of the plume extends approximately 120 feet southeast of the pump island, extending into the adjacent property as shown on Figures 4 through 7. Multiple utilities cross this general vicinity, and the area southeast of the telephone vault is inaccessible for intrusive remedial activities. Selective excavation of impacted shallow soil should be evaluated. In addition, *in situ* biological/chemical additions should be evaluated as an alternative to treat impacted soil and groundwater at the distal end of the plume.

In Situ Chemical and Bioremediation

The chemical and bioremediation approach consists of injecting a combination of chemical oxidants and biological oxidants and nutrients into the groundwater. Chemical oxidants are typically used in the vadose zone and source areas containing higher concentrations and have an effective treatment period of less than a week. The biological amendments are used to provide short-term and long-term treatment over larger areas within the saturated zone. These amendments are introduced into the subsurface using a water lance technique from the surface to the estimated base of contamination. For this site, amendments would likely be injected from the surface to a maximum depth of 8 feet.

Ten injection points will be spaced 6 feet apart along four rows perpendicular to groundwater flow, for an estimated total of 40 points for the chemical and

biological amendments. Additional targeted chemical oxidation points could also be installed in the source area to provide additional and immediate treatment.

The lance injections require dedicated work zones for personnel and a staging area for the pumps and mixers that can be set off to the side to minimize interruption to normal business access. A rotor hammer is used to cleanly penetrate the asphalt surface and coarse base material, creating a one-inch hole for the water lance. Once into the native soil material, the water lance is able to penetrate to the desired depth while injecting chemical and/or biological amendments.

The estimated costs include UIC permitting, injection crew, equipment, and product costs, confirmation sampling, and reporting will range from $80,000 to $120,000.

A brief beneficial water use survey would be necessary to determine if any downgradient residents or other receptors are using the shallow groundwater.

Groundwater Monitoring and Engineering Services

In addition to the remediation options outlined above, at least four quarters of groundwater monitoring and engineering support services would be required. Four quarters of groundwater monitoring and reporting would be approximately $30,000. Engineering support services to oversee the selected treatment and prepare the supporting documentation would cost approximately $32,000.

REFERENCES

Hart Crowser, 2010. Work Plan, June 8, 2010.

Hart Crowser, 2011. Sampling and Analysis Plan (SAP), February 17, 2011.

AA Enviro Assessment Inc. (AEA), January 1998. Site investigation.

Northwest Testing Company (NWT), November 2000. Site investigation.

J:\Jobs\1733034\Summary Report\You & I Market.doc

Table 1 - Analytical Results for Soil Samples

Sample ID	MTCA Method A Cleanup Level	PP-1-4	PP-2-7	PP-3-4.5	PP-4-6	PP-5-5	PP-6-3	PP-7-6	PP-8-3.5
Sampling Date		2/28/2011	2/28/2011	2/28/2011	2/28/2011	2/28/2011	3/1/2011	3/1/2011	3/1/2011
BTEX in mg/kg									
Benzene	0.03	0.02 U	0.06	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Ethylbenzene	6	0.05 U	0.36	0.05 U	0.66	0.05 U	0.05 U	0.05 U	0.05 U
Toluene	7	0.05 U	0.11	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Xylenes, total	9	0.15 U	1.5	0.15 U	2.3	0.15 U	0.15 U	0.15 U	0.15 U
TPH in mg/kg									
Diesel-Range Organics	2000	63	50 U	50 U	50 U	50 U	50 U	50 U	50 U
Oil-Range Organics	2000	100 U	100 U	100 U	100 U	100 U	100 U	100 U	100 U
Gasoline-Range Organics	30/100*	10 U	39	10 U	100	10 U	10 U	10 U	10 U

Sample ID	MTCA Method A Cleanup Level	PP-9-2.5	PP-10-6	PP-11-6	PP-11-6D	PP-12-3.5	PP-13-4.5
Sampling Date		3/1/2011	3/1/2011	3/1/2011	3/1/2011 Duplicate of PP-11-6	3/1/2011	3/1/2011
BTEX in mg/kg							
Benzene	0.03	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Ethylbenzene	6	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Toluene	7	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Xylenes, total	9	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
TPH in mg/kg							
Diesel-Range Organics	2000	50 U	50 U	50 U	50 U	50 U	50 U
Oil-Range Organics	2000	100 U	100 U	100 U	100 U	100 U	100 U
Gasoline-Range Organics	30/100*	10 U	10 U	140	130	10 U	10 U

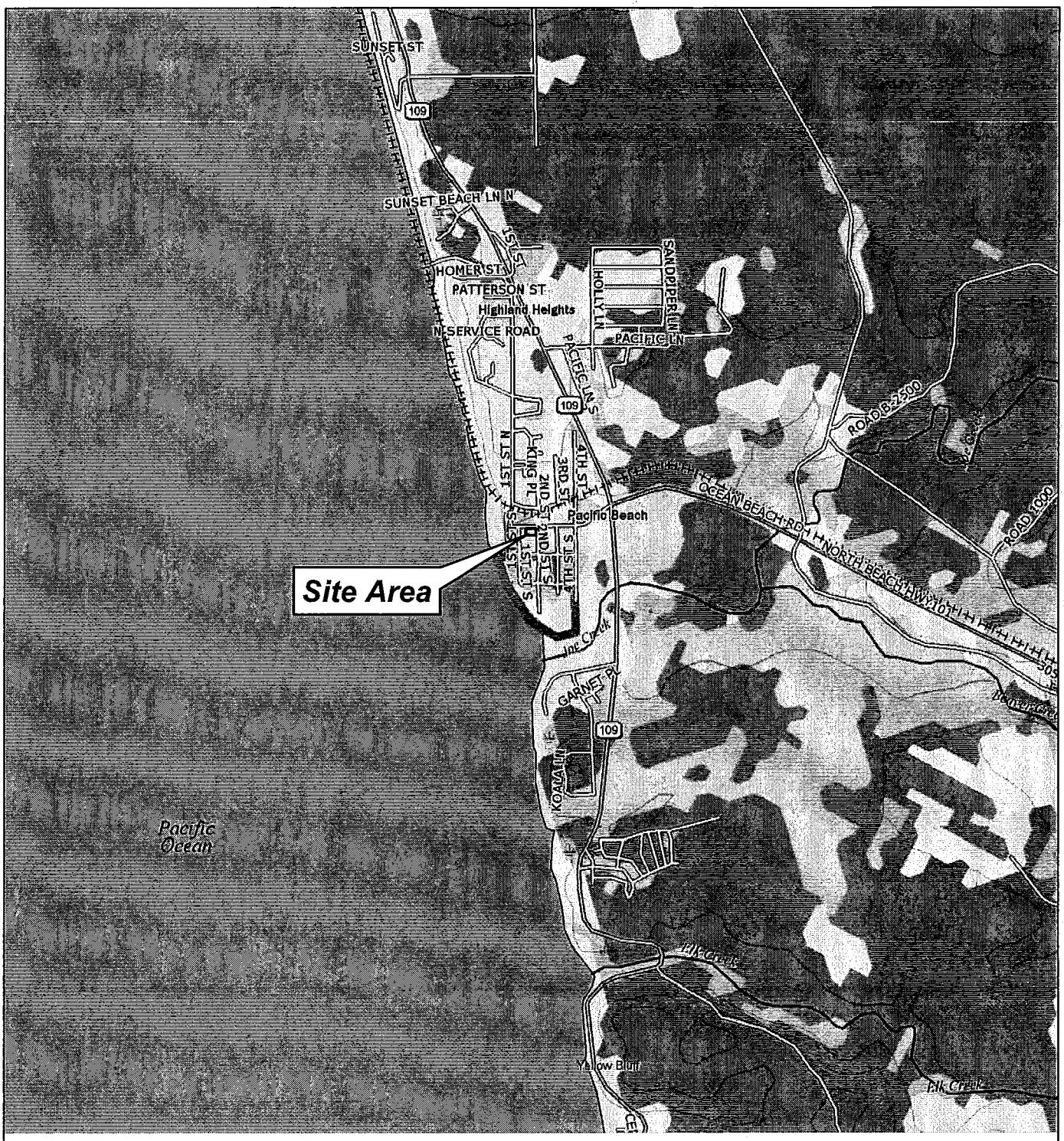
U = Not detected at the reporting limit indicated.
* 30 mg/kg when benzene is present, 100 mg/kg when benzene not present.

Table 2 - Analytical Results for Water Samples

Sample ID Sampling Date	MTCA Method A Cleanup Level	PP-1 2/28/2011	PP-3 2/28/2011	PP-4 2/28/2011	PP-7 3/1/2011	PP-8 3/1/2011	PP-11 3/1/2011	PP-11D 3/1/2011 Duplicate of PP-11	PP-12 3/1/2011
BTEX in ug/L									
Benzene	5	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.7	2.2	1.0 U
Ethylbenzene	700	1.0 U	1.1	25	1.0 U	1.0 U	1.1	2.2	1.0 U
Toluene	1000	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Xylenes, total	1000	3.0 U	3.6	90	3.0 U	3.0 U	3.0 U	3.0 U	3.0 U
TPH in ug/L									
Diesel-Range Organics	500	250 U	250 U	250 U	250 U	250 U	250 U	250 U	250 U
Oil-Range Organics	500	500 U	500 U	500 U	500 U	500 U	500 U	500 U	500 U
Gasoline-Range Organics	800/1000*	100 U	100 U	1900	100 U	100 U	1800 J	3800 J	100 U

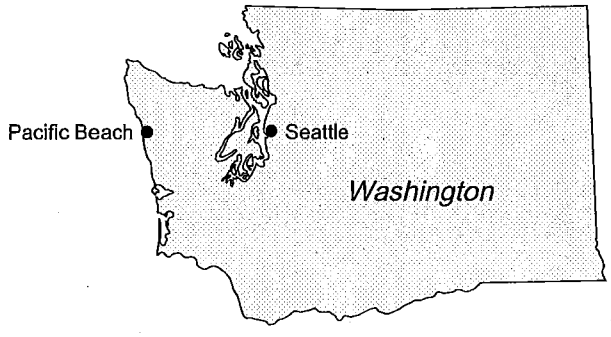
Sample ID Sampling Date	MTCA Method A Cleanup Level	PP-13 3/1/2011	MW-1 3/30/2011	MW-1 Dup 3/30/2011 Duplicate of MW-1	MW-2 3/30/2011	MW-3 3/31/2011	MW-4 3/30/2011	MW-5 3/31/2011	MW-6 3/30/2011
BTEX in ug/L									
Benzene	5	1.0 U	32.6	32.3	137	0.25 U	0.25 U	0.25 U	0.25 U
Ethylbenzene	700	1.0 U	1400	1430	256	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	1000	1.0 U	98	100	99.9	1 U	1 U	1 U	1 U
Xylenes, total	1000	3.0 U	5220	5040	803	1.5 U	1.5 U	1.5 U	1.5 U
TPH in ug/L									
Diesel-Range Organics	500	250 U	6840	6850	1910	236 U	236 U	245 U	236 U
Oil-Range Organics	500	500 U	485 U	472 U	472 U	472 U	472 U	490 U	472 U
Gasoline-Range Organics	800/1000*	100 U	47200	42000	8360	145	100 U	100 U	100 U

U = Not detected at the reporting limit indicated.
J = Estimated value.
* 800 ug/L when benzene is present, 1000 ug/L when benzene not present.



0 2,000 4,000

Scale in Feet



N

Source: DeLorme Topo USA®.

You & I Market
Pacific Beach, Washington

Vicinity Map

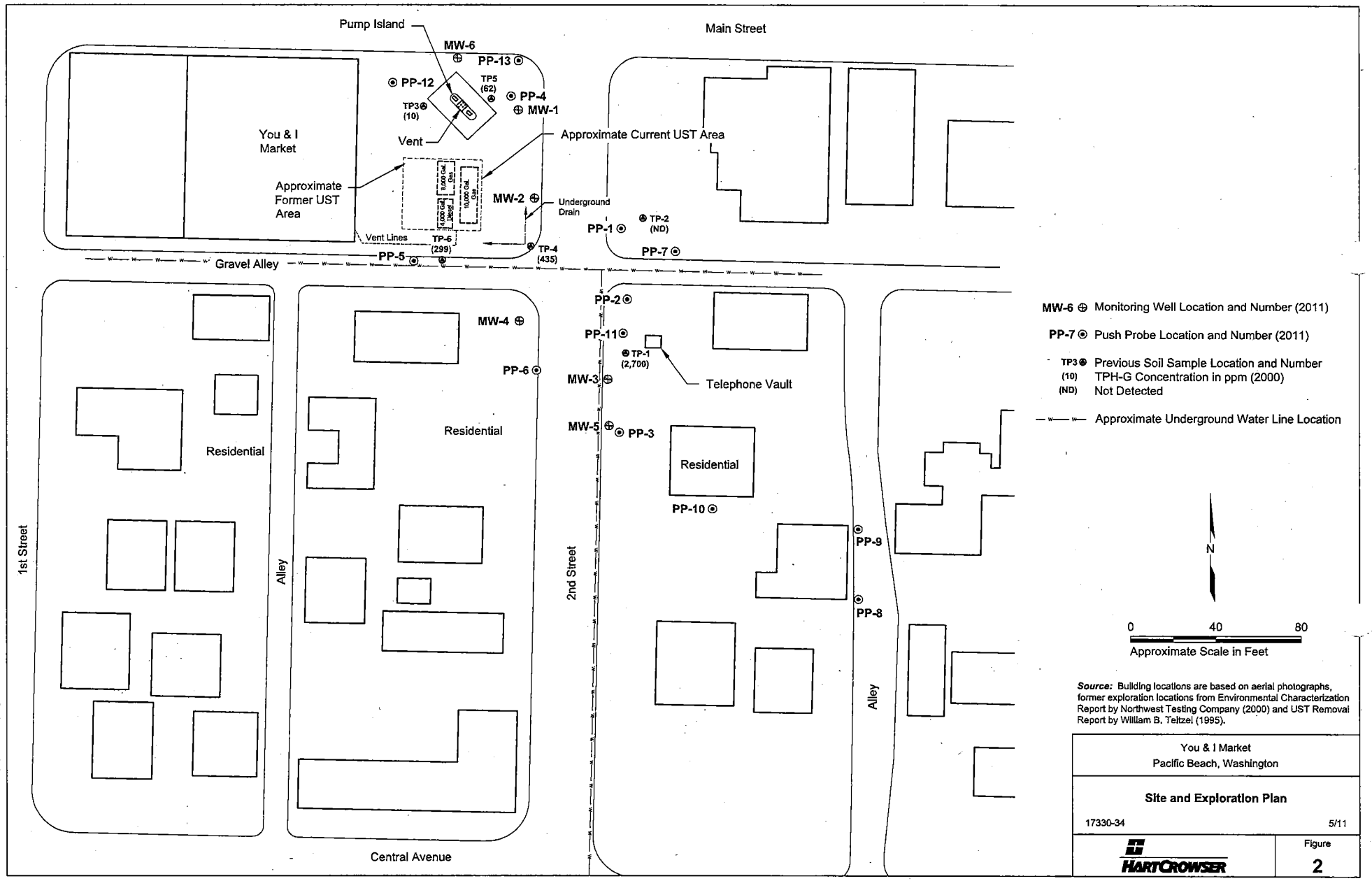
17330-34 5/11

HARTCROWSER

Figure 1

JAB 05/23/11 173303402-001 (Vicinity Map).dwg

This page is intentionally left blank
for double-sided printing.

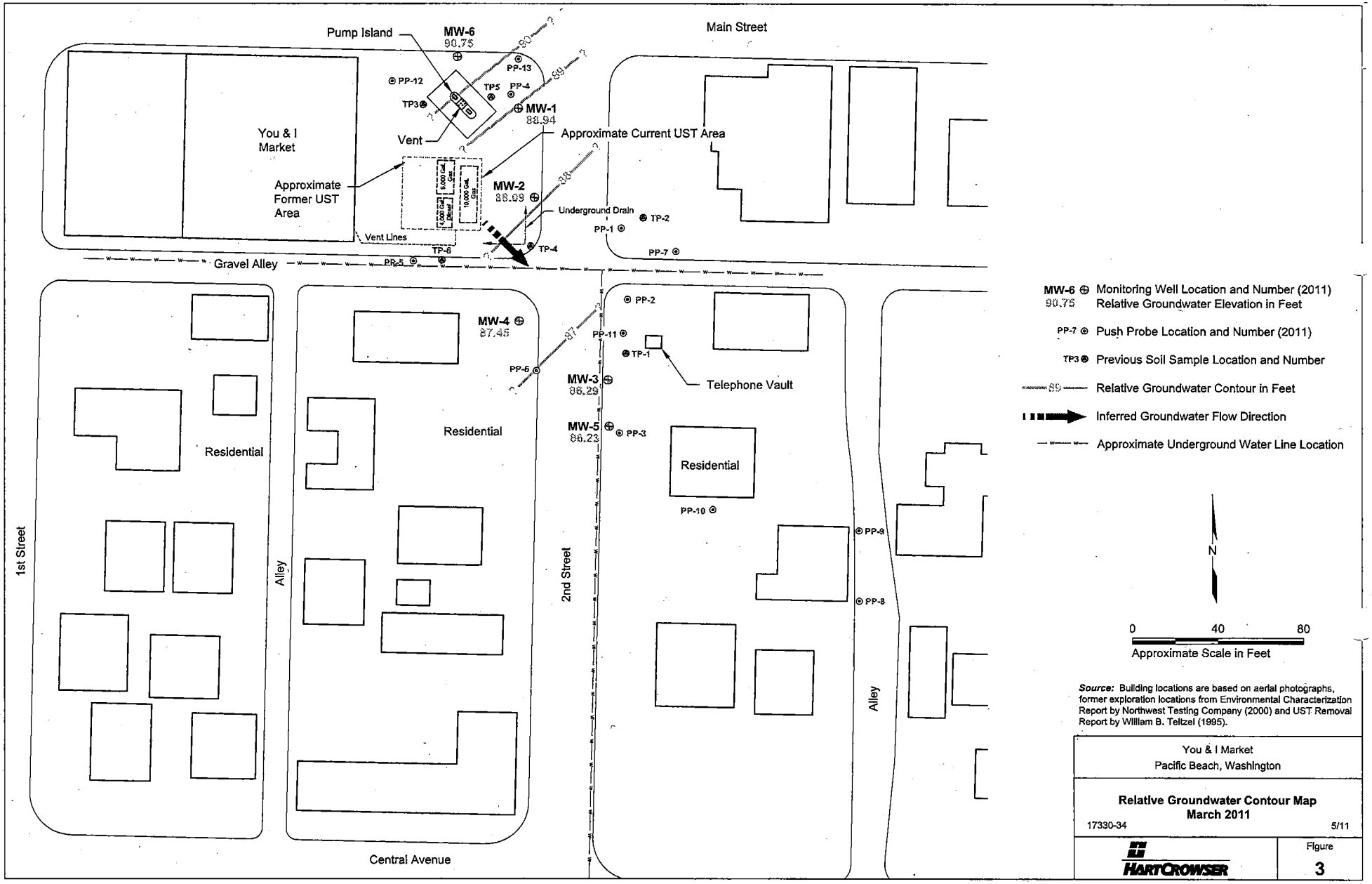


Source: Building locations are based on aerial photographs, former exploration locations from Environmental Characterization Report by Northwest Testing Company (2000) and UST Removal Report by William B. Teitzel (1995).

You & I Market Pacific Beach, Washington
Site and Exploration Plan
17330-34 5/11
HARTCROWSER Figure 2

JAB 05/25/11 17330340Z-008 (Exploration Plan).dwg

This page is intentionally left blank for double-sided printing.

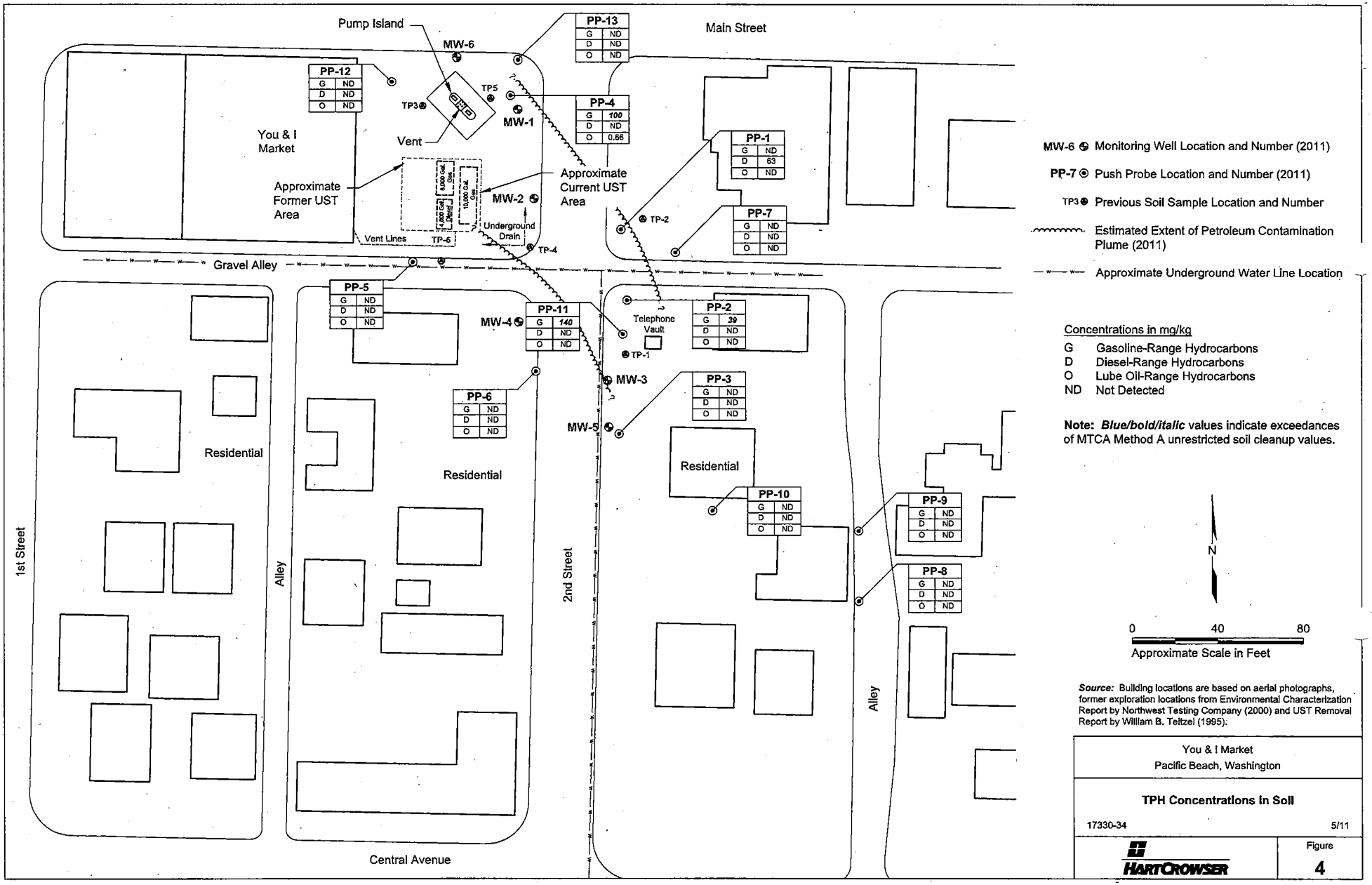


Source: Building locations are based on aerial photographs, former exploration locations from Environmental Characterization Report by Northwest Testing Company (2000) and UST Removal Report by William B. Teltzel (1995).

You & I Market Pacific Beach, Washington
Relative Groundwater Contour Map **March 2011** 17330-34 5/11
HARTCROWSER — Figure 3

JAB 05/25/11 17330340Z-009 (GW Contours - 3-11).dwg

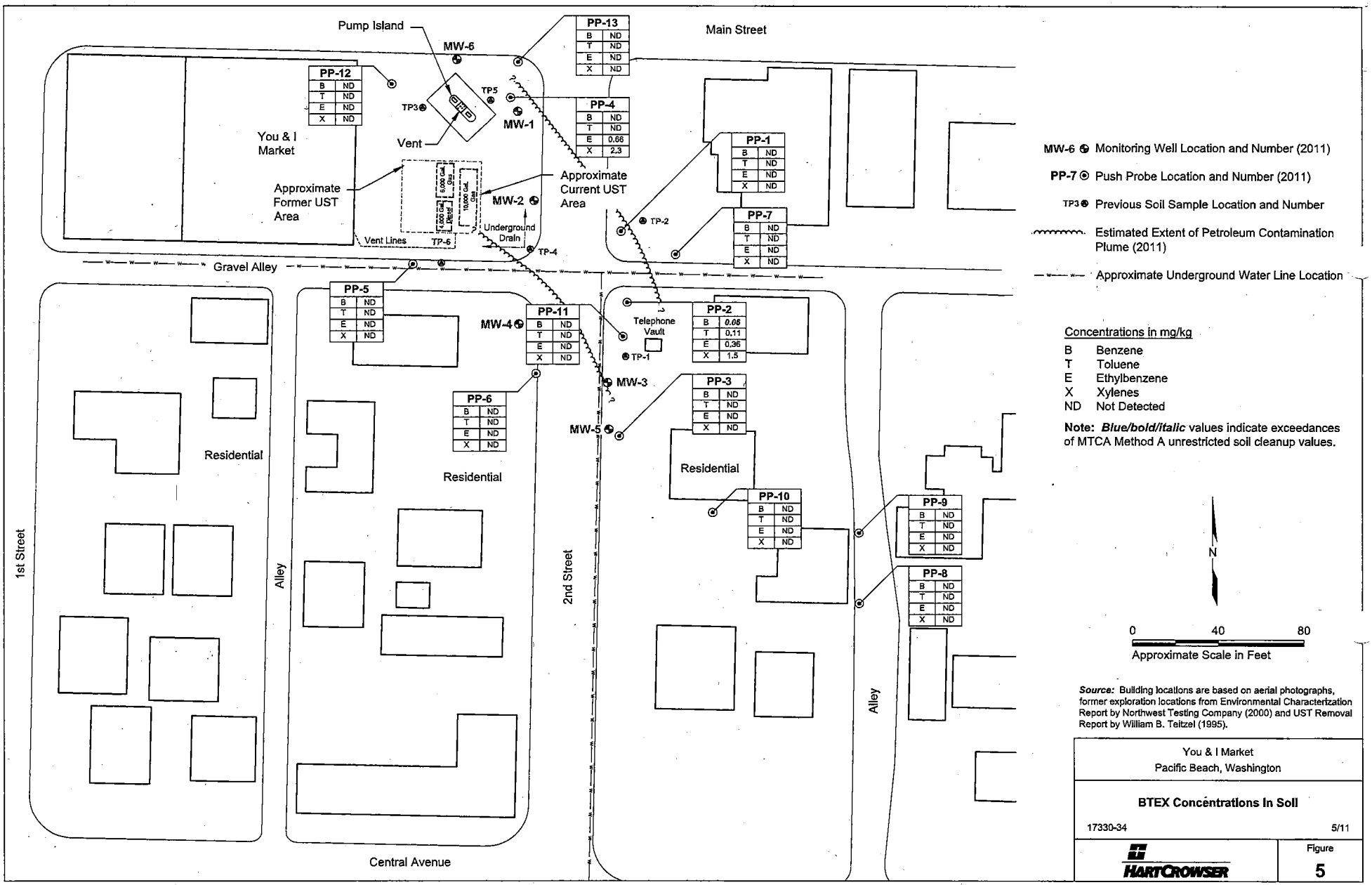
This page is intentionally left blank for double-sided printing.



You & I Market Pacific Beach, Washington
TPH Concentrations in Soil
17330-34 5/11
HARTCROWSER | Figure 4

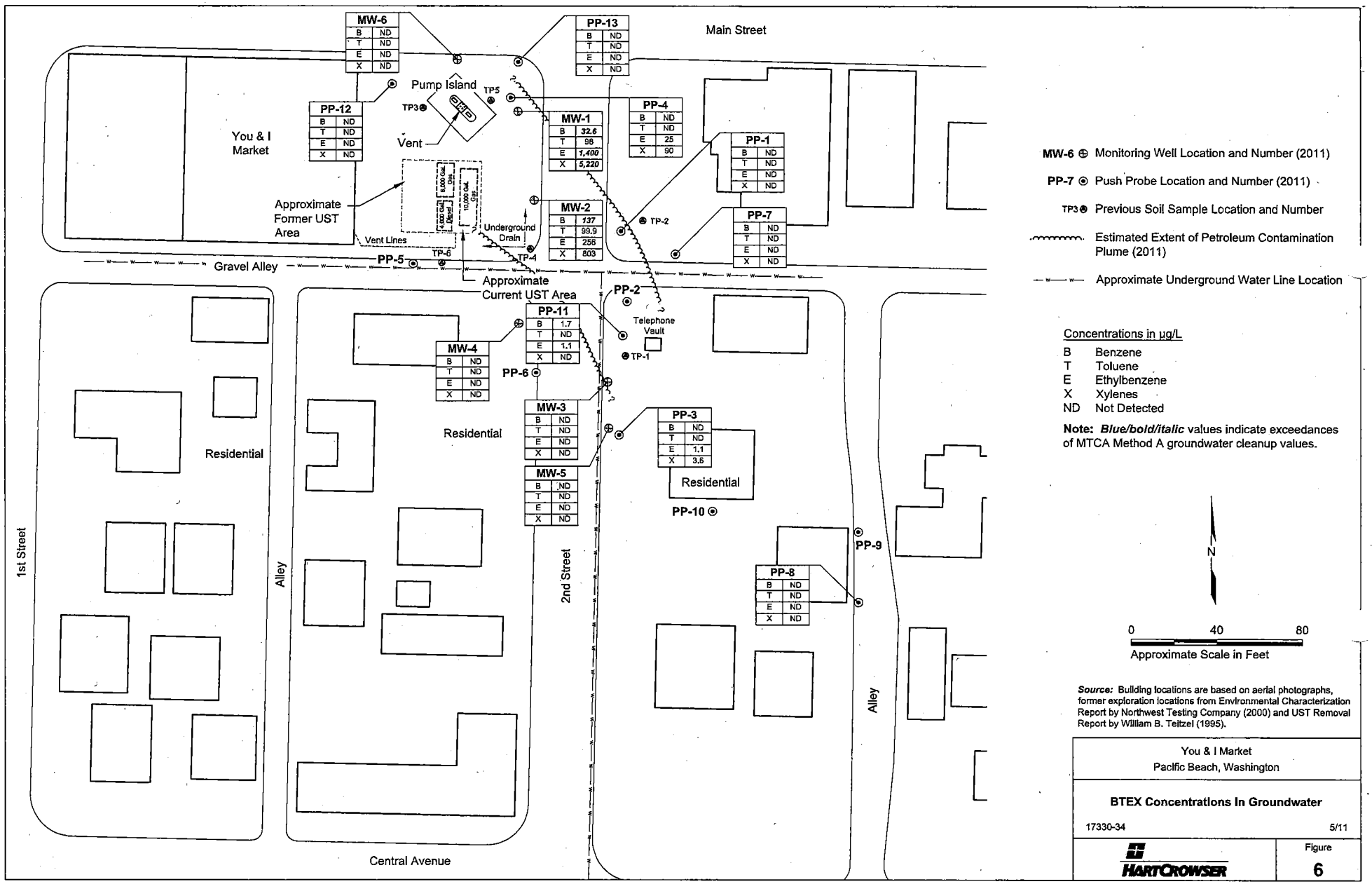
JAB 05/25/11 17330\GIS\17330-011 (TPH - Soil).dwg

This page is intentionally left blank for double-sided printing.



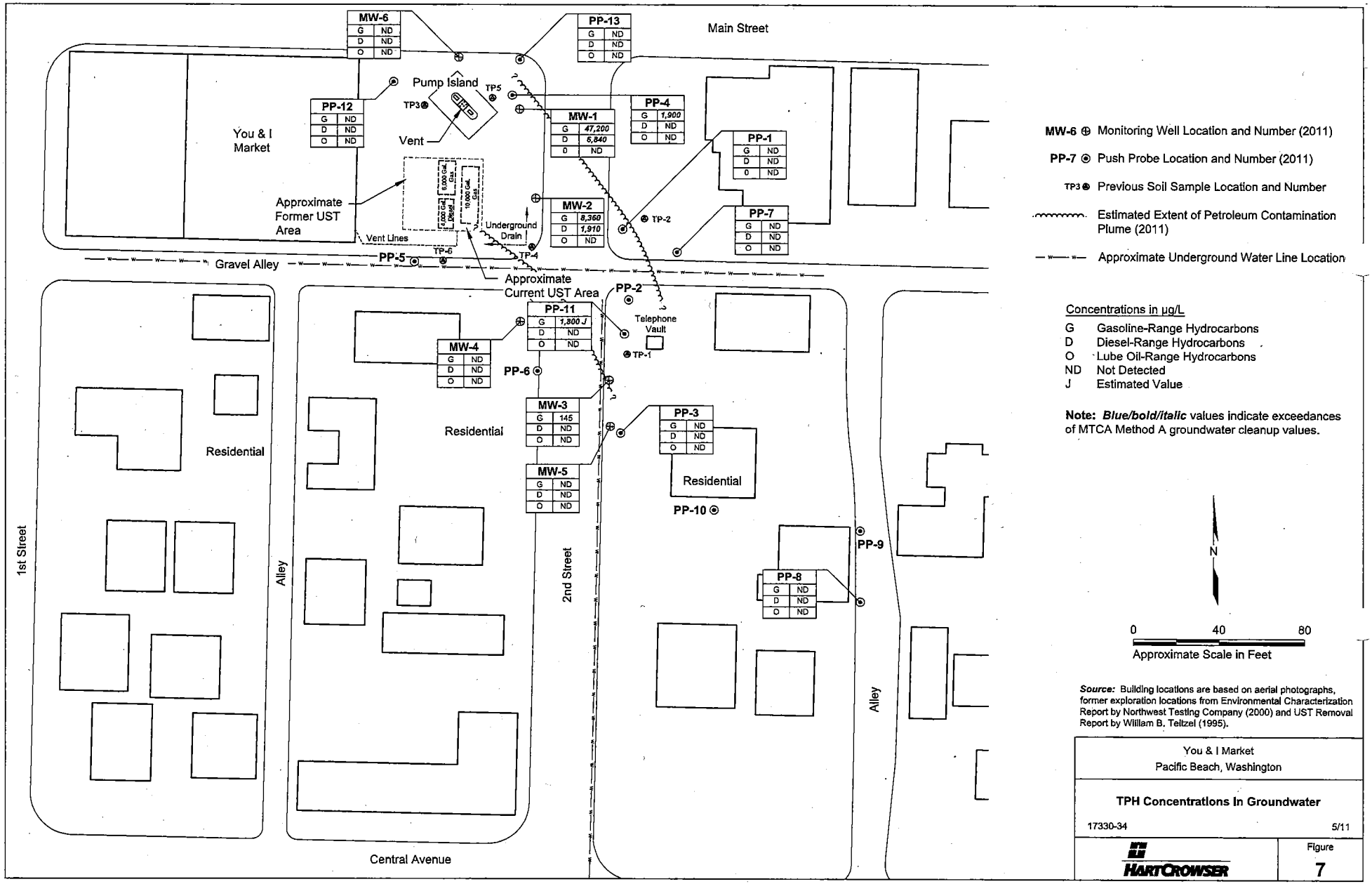
JAB 05/25/11 17330402-010 (BTEX - Soil).dwg

This page is intentionally left blank for double-sided printing.



JAB 05/25/11 17330-002-012 (BTEX - GW).dwg

This page is intentionally left blank for double-sided printing.



JAB 05/25/11 17330402-013 (TPH - GW).dwg

This page is intentionally left blank for double-sided printing.

APPENDIX A
FIELD EXPLORATION METHODS AND ANALYSIS WITH BORING AND MONITORING WELL LOGS

APPENDIX A
FIELD EXPLORATION METHODS AND ANALYSIS WITH BORING AND MONITORING WELL LOGS

This appendix documents the processes Hart Crowser used to determine the nature (and quality) of the soil and groundwater underlying the project site addressed by this report. The discussion includes information on the following subjects:

- Explorations and Their Location;
- Hollow-Stem Auger Borings;
- Direct Push Probes;
- Soil Sampling Procedures;
- Soil Screening and Analysis;
- Grab Groundwater Sampling;
- Monitoring Well Installation;
- Well Development;
- Groundwater Level Measurements;
- Groundwater Sampling;
- Sample Handling and Laboratory Analysis; and
- Investigation-Derived Waste (IDW) Storage and Disposal.

Explorations and Their Location

Subsurface explorations for this project include push-probe soil borings and hollow stem auger borings completed as monitoring wells. The exploration logs in this appendix show our interpretation of the exploration sampling, and testing data. The logs indicate the depth where the soils change. Note that the change may be gradual. In the field, we classified the samples taken from the explorations according to the methods presented on Figure A-1 - Key to Exploration Logs. This figure also provides a legend explaining the symbols and abbreviations used in the logs.

Figure 2 shows the location of explorations, located by hand measuring or pacing from existing physical features.

Direct Push Probes

PP-1 through PP-13 were advanced to depths ranging from 6 to 10 feet bgs, from February 28 to March 1, 2011. ESN Northwest of Olympia, Washington completed the push probe explorations using a truck mounted 2-inch-diameter probe. A field geologist from Hart Crowser continuously observed the probing and collected the soil samples. Soil samples were collected using an acetate-

lined plastic sleeve sampler pushed by the push probe rig. Soil samples were generally collected in continuous 4.5-foot-depth intervals. Samples were classified in general accordance with ASTM D 2488 and were screened for potential soil contamination. The density/consistency of the soils (where presented parenthetically on the probe logs to indicate their having been estimated) is based on visual observation and probe reaction. Detailed logs were prepared of each probe. The probe logs are presented on Figures A-2 through A-14 at the end of this appendix.

Push-Probe Groundwater Sampling

Groundwater samples were collected at push probe locations (Figure 2). A temporary miniwell was installed by lowering a stainless steel screen section and tubing to a depth of 6 to 10 feet below ground surface. Samples were obtained using a peristaltic pump and low-flow groundwater sampling techniques. Grab groundwater samples were collected directly from the polyethylene tubing and placed in pre-cleaned, laboratory supplied, 500 mL amber jars and appropriately preserved 40 ml VOA bottles. Sufficient water was collected to overfill the sample jars. The jars were sealed and labeled. Filled sample jars were stored in a cooler containing bagged ice and submitted to the on-site chemistry laboratory under chain of custody protocols.

To avoid cross-contamination in the temporary miniwells, tubing was discarded after each use and the pump was refitted with new tubing at each miniwell location. Prior to sample collection, the temporary miniwell was purged until either conventional parameters (temperature, pH, and conductivity) varied by less than 10 percent or a maximum of three well volumes were purged, or the temporary well pumped dry. When free product or sheen was present in the groundwater, parameters were not read and the sample was collected after three casing volumes were purged.

Hollow-Stem Auger Borings

Hollow-stem auger borings, designated MW-1 through MW-6, were drilled from March 29 to March 30, 2011. All borings were completed to a depth of 10 feet bgs. The borings used a 4-inch inside diameter hollow-stem auger and were advanced with a truck-mounted drill rig subcontracted by Hart Crowser. The drilling was continuously observed by an engineering geologist from Hart Crowser. Detailed field logs were prepared of each boring. Using the Standard Penetration Test (SPT) and thin-walled Shelby tubes, we obtained samples at 2-1/2- to 5-foot-depth intervals.

The borings logs are on Figures A-15 through A-20 at the end of this appendix.

Soil Sampling Procedures

Soil samples were collected for chemical analysis directly from the split-spoon sampler/push probe, or sonic sleeve with a clean stainless steel spoon and/or clean disposable nitrile gloves and placed in pre-cleaned, laboratory supplied, 4-ounce glass sample jars and appropriately preserved 40-ml VOA bottles. Sufficient soil was removed to overfill the 4-once glass sample jars. Methanol preserved 40-ml VOA bottles were filled with a 5-gram soil plug, based on EPA Method 5035 procedures. The jars were sealed and labeled. Filled sample jars were stored in a cooler containing bagged ice and submitted to the chemistry laboratory under chain of custody protocols.

Soil Screening and Analysis

Field screening results were used as a general guideline to identify potential chemical constituents in soil samples. In addition, field screening results were used as a basis for selecting soil samples for chemical analysis.

Soil samples were field screened at 4.5-foot-depth intervals for evidence of petroleum- and/or volatile organic compounds (VOCs)-related impacts using (1) field observations, (2) sheen screening, and (3) headspace vapor screening using a MultiRAE photoionization detector (PID). The effectiveness of field screening varies with temperature, moisture content, organic content, soil type, and age of the constituents. Visual examination consists of inspecting the soil for stains. Visual screening is generally more effective when impacts are related to heavy petroleum hydrocarbons, such as motor or hydraulic oil, or when hydrocarbon concentrations are high.

We conducted water sheen testing by placing a small volume of soil in a pan of water and observing the water surface for signs of sheen. Sheens were classified as follows:

No Sheen (NS)	No visible sheen on water surface.
Trace Sheen (TS)	Small amounts of light colorless film, spotty; spread was very small, not rapid, large areas of no sheen remain, film dissipates rapidly.
Slight Sheen (SS)	Light colorless film, spotty to globular; spread was irregular, not rapid, areas of no sheen remain, film dissipates rapidly.

Moderate Sheen (MS)	Light to heavy film, may have some color or iridescence, globular to stringy, spread was irregular to flowing; few remaining areas of no sheen on water surface.
Heavy Sheen (HS)	Heavy colorful film with iridescence; stringy, spread was rapid; sheen flows off the sample; most of the water surface might be covered with sheen.

Headspace vapor screening was intended to indicate the presence of volatile organic vapors and involved placing a 3- to 6-ounce soil sample in a pint size plastic sample bag. The plastic bag was shaken for several minutes to expose and volatilize the soil sample to the air captured in the plastic bag headspace. The probe of the PID was inserted into the bag and the instrument measured the concentration of organic vapors in the soil sample bag headspace. The highest vapor reading was recorded for each sample. The PID measures concentrations in ppm and is calibrated to isobutylene. The PID is typically designed to quantify organic vapors concentrations in the range of 0 to 1,000 ppm. The presence or absence of a sheen or headspace vapors does not necessarily indicate the presence or absence of petroleum hydrocarbons.

Monitoring Well Installation

ESN Northwest installed six monitoring wells to allow for long-term groundwater level and quality monitoring. The monitoring wells were installed on March 29 and March 30, 2011.

Two-inch-diameter Schedule 40 PVC riser pipe and 2-inch-diameter 0.020-inch machine-slotted screen were used for the well casings and screens. The well screen and casing riser were lowered down through the hollow-stem auger/casing/open hole. As the auger/casing was withdrawn, No. 10/20 silica sand was placed in the annular space from the base of the boring to approximately 2 to 3 feet above the top of the well screen.

The monitoring wells were installed in accordance with Washington State Department of Ecology regulations.

Well seals were constructed by placing bentonite chips in the annular space on the top of the pre-packed screen to within one foot of ground surface. The remaining annular space was backfilled with concrete to complete the surface seal. The wells were completed with flush-mounted monuments, and equipped with locking well caps for security. The monitoring well construction details are illustrated on the boring logs on Figures A-15 through A-20.

Well Development

Monitoring wells MW-1 through MW-6 were developed on March 29 through March 30, 2011, using a peristaltic pump with disposable tubing. Hart Crowser provided oversight and documented field parameters during well development activities. A minimum of ten casing volumes was removed during development. Well development proceeded until the measured groundwater parameters of electrical conductivity, pH, and temperature were stable (within ±10 percent of the previous two readings) and until negligible turbidity was visible. Sediment thickness at the bottom of the well was measured and recorded before and after well development.

Groundwater Sampling

Groundwater samples were collected from six monitoring wells on March 30, 2011, for chemical analysis. One duplicate sample was collected for each analyte during the sampling event.

Sampling Equipment

Equipment used for the collection of groundwater samples included:

- pH, specific conductivity, and temperature meters;
- Solinst or equivalent water level indicator;
- Peristaltic pump with disposable polyethylene tubing;
- Laboratory-supplied pre-cleaned and preserved sample containers;
- Coolers with blue ice; and
- Hart Crowser Sample Custody Record and Groundwater Sampling Data forms.

Groundwater Sampling Procedures

Upon arrival at the wellhead, field personnel recorded conditions, depth to water, depth to product (if applicable), and depth to sediment in the wells using a Solinst or equivalent interface probe. If the well was pumped dry or product was present at a thickness greater than 0.05 foot, no purging or sampling was performed from that well. An alternate well in the vicinity was chosen for sampling based on site conditions and previous sampling experiences.

Prior to sampling, wells were purged and sampled using low-flow groundwater sampling techniques. Purging and sampling were conducted at a depth representing the middle of the screened interval of each well. Groundwater samples were collected once the field parameters of pH, specific conductivity,

and temperature were stabilized. The sample bottles were filled directly from the polyethylene tubing at relatively low-flow rates. To prevent cross-contamination of the wells, disposable polyethylene tubing was used for each groundwater sample and the interface probe was decontaminated between well locations using a non-phosphate-based cleaner and de-ionized water.

Sample Handling and Laboratory Analysis

Soil and groundwater samples collected during the February 28 through March 1, 2011 sampling event were analyzed on-site by ESN Northwest of Olympia, Washington, for chemical analysis.

Groundwater samples collected during the March 30, 2011 sampling event were shipped under chain-of-custody procedures to APEX Labs of Tigard, OR.

Duplicate samples collected and submitted to the laboratory(ies) to assess combined field and laboratory variability. The samples were assigned the same exploration label with two zeros at the end of the number.

Investigation-Derived Waste (IDW) Storage and Disposal

Soil Cuttings

Soil cuttings and purge water generated during exploration activities and groundwater sampling were placed into separate labeled drums, sampled, and left on site, pending analysis of drum contents. The property owner will manage disposal as part of the drill spoils and purge water disposal.

Water

The development water removed from the wells was drummed on site pending receipt of chemical analysis results from the analytical laboratory and determination of appropriate disposal procedures. Drum disposition forms were filled out to record the number, contents, and location of the drums generated.

J:\Jobs\1733034\Summary Report\You & I Market.doc

Key to Exploration Logs

Sample Description

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Density/Consistency

Soil density/consistency in borings is related primarily to the Standard Penetration Resistance. Soil density/consistency in test pits and probes is estimated based on visual observation and is presented parenthetically on the logs.

SAND or GRAVEL Density	Standard Penetration Resistance (N) in Blows/Foot	SILT or CLAY Consistency	Standard Penetration Resistance (N) in Blows/Foot	Approximate Shear Strength in TSF
Very loose	0 to 4	Very soft	0 to 2	<0.125
Loose	4 to 10	Soft	2 to 4	0.125 to 0.25
Medium dense	10 to 30	Medium stiff	4 to 8	0.25 to 0.5
Dense	30 to 50	Stiff	8 to 15	0.5 to 1.0
Very dense	>50	Very stiff	15 to 30	1.0 to 2.0
		Hard	>30	>2.0

Sampling Test Symbols

- Split Spoon
- Cuttings
- Core Run
- Push Probe
- Grab (Jar)

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture, likely below optimum
Moist	Likely near optimum moisture content
Wet	Much perceptible moisture, likely above optimum

Minor Constituents	Estimated Percentage
Trace	<5
Slightly (clayey, silty, etc.)	5 - 12
Clayey, silty, sandy, gravelly	12 - 30
Very (clayey, silty, etc.)	30 - 50

Test Symbols

NA	Not Available
NS	No Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen
PAHs	Polynuclear Aromatic Hydrocarbons
PCP	Pentachlorophenol
TOC	Total Organic Carbon
PID	Photoionization Detector Reading
ppm	Parts per Million
NWTPH	Northwest Total Petroleum Hydrocarbon
Dx	Gasoline Range
Gx	Diesel Range
HCID	Hydrocarbon Identification
VOCs	Volatile Organic Compounds

SOIL CLASSIFICATION CHART

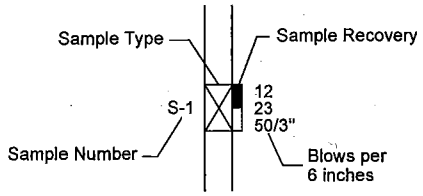
MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE)	GRAVEL AND GRAVELLY SOILS (MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE)	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS (MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE)	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS (MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE)	SILTS AND CLAYS (LIQUID LIMIT LESS THAN 50)			ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (LIQUID LIMIT GREATER THAN 50)			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

Groundwater Indicators

- Groundwater Level on Date or (ATD) At Time of Drilling
- Groundwater Seepage (Test Pits)

Sample Key



HARTCROWSER

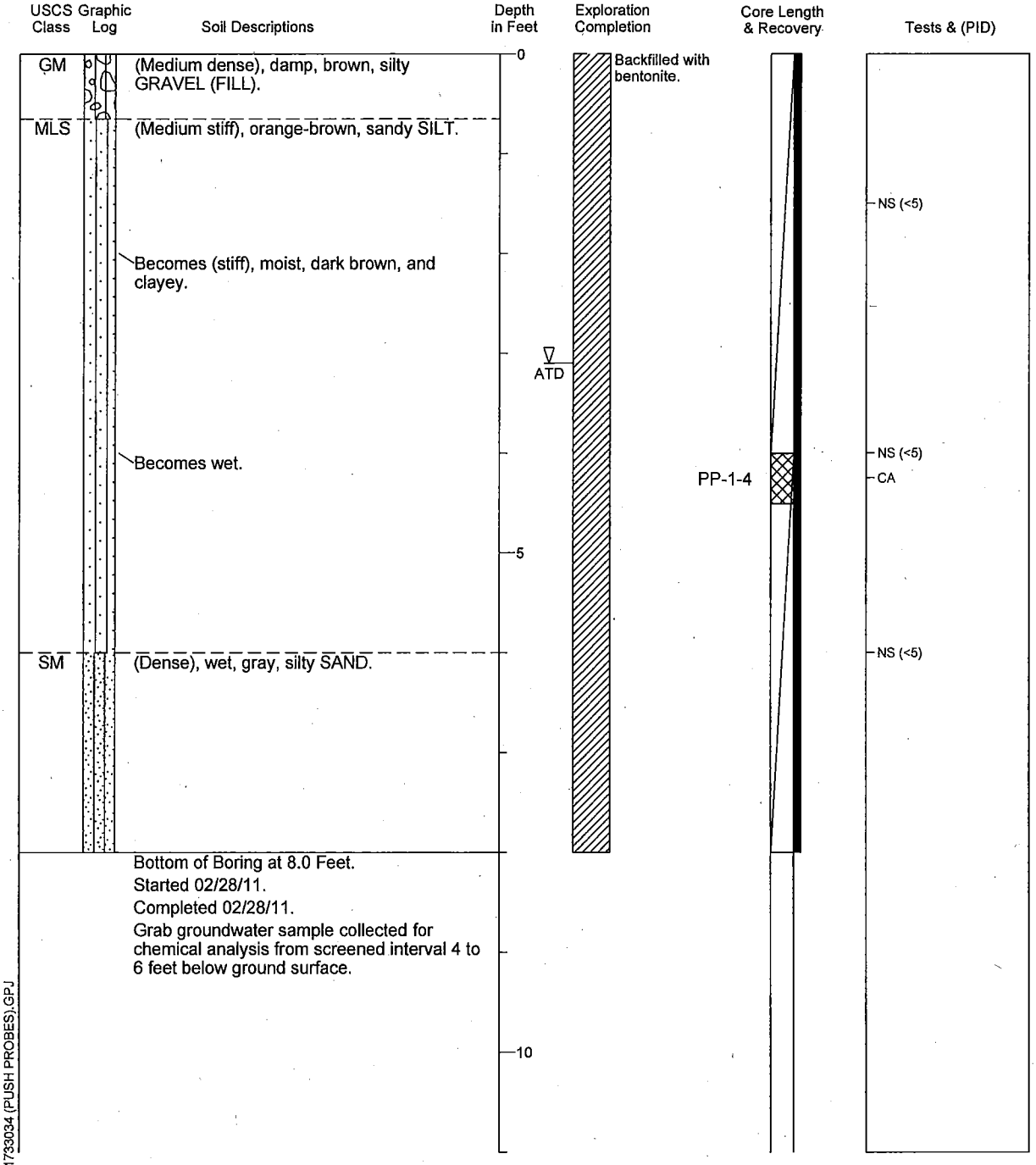
17330-34 *2/11*

Figure A-1

Push Probe Log for PP-1

Location: Pacific Beach, Washington
Logged By: Jason Miles
Reviewed By: Angie Godwin

Drilling Type: Push Probe
Soil Sampler: 4-Foot Core
Hole Diameter: 2"



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. Drilled By: ESN

HARTCROWSER

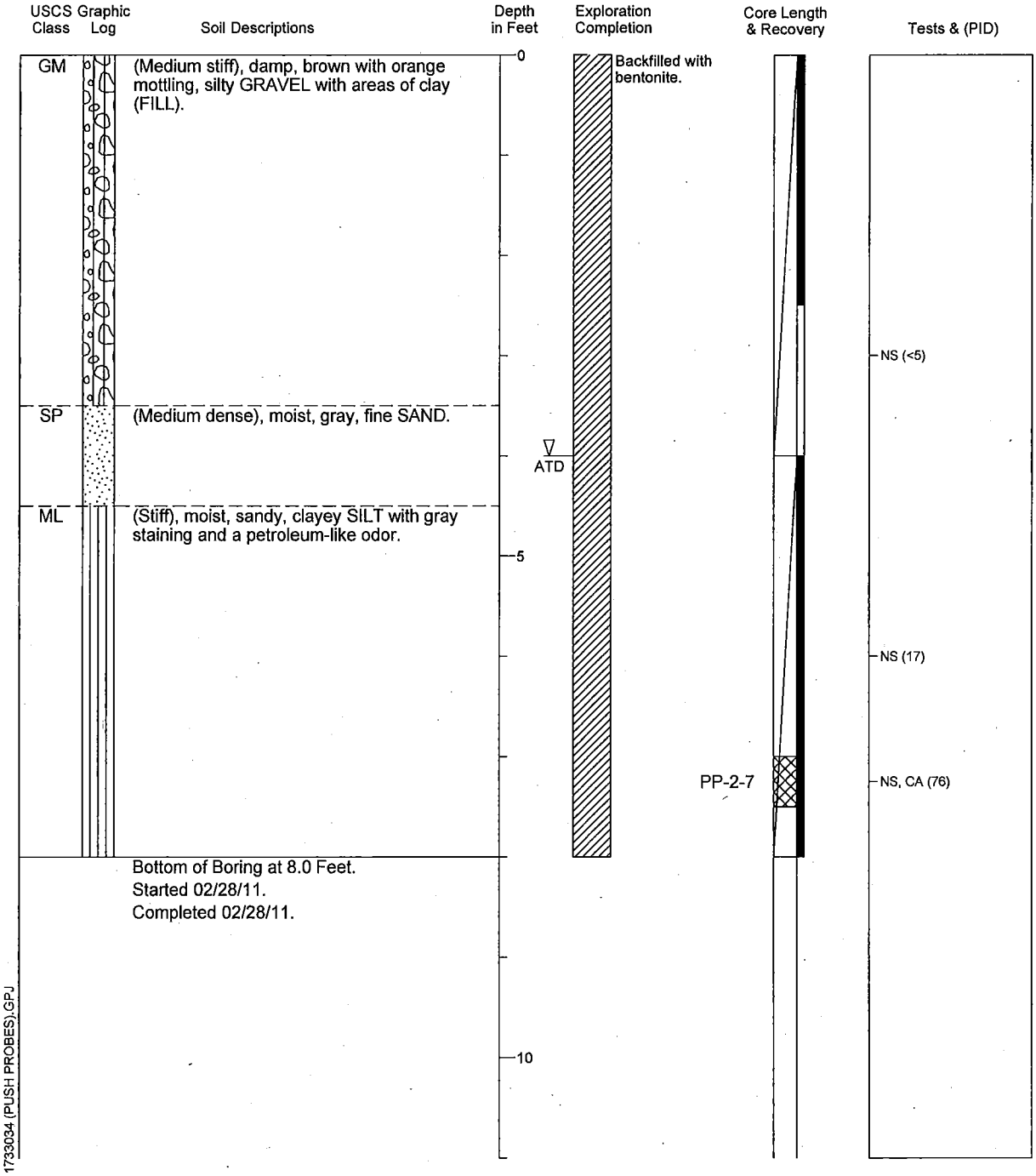
17330-34 2/11

Figure A-2

Push Probe Log for PP-2

Location: Pacific Beach, Washington
Logged By: Jason Miles
Reviewed By: Angie Godwin

Drilling Type: Push Probe
Soil Sampler: 4-Foot Core
Hole Diameter: 2"



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. Drilled By: ESN

HARTCROWSER

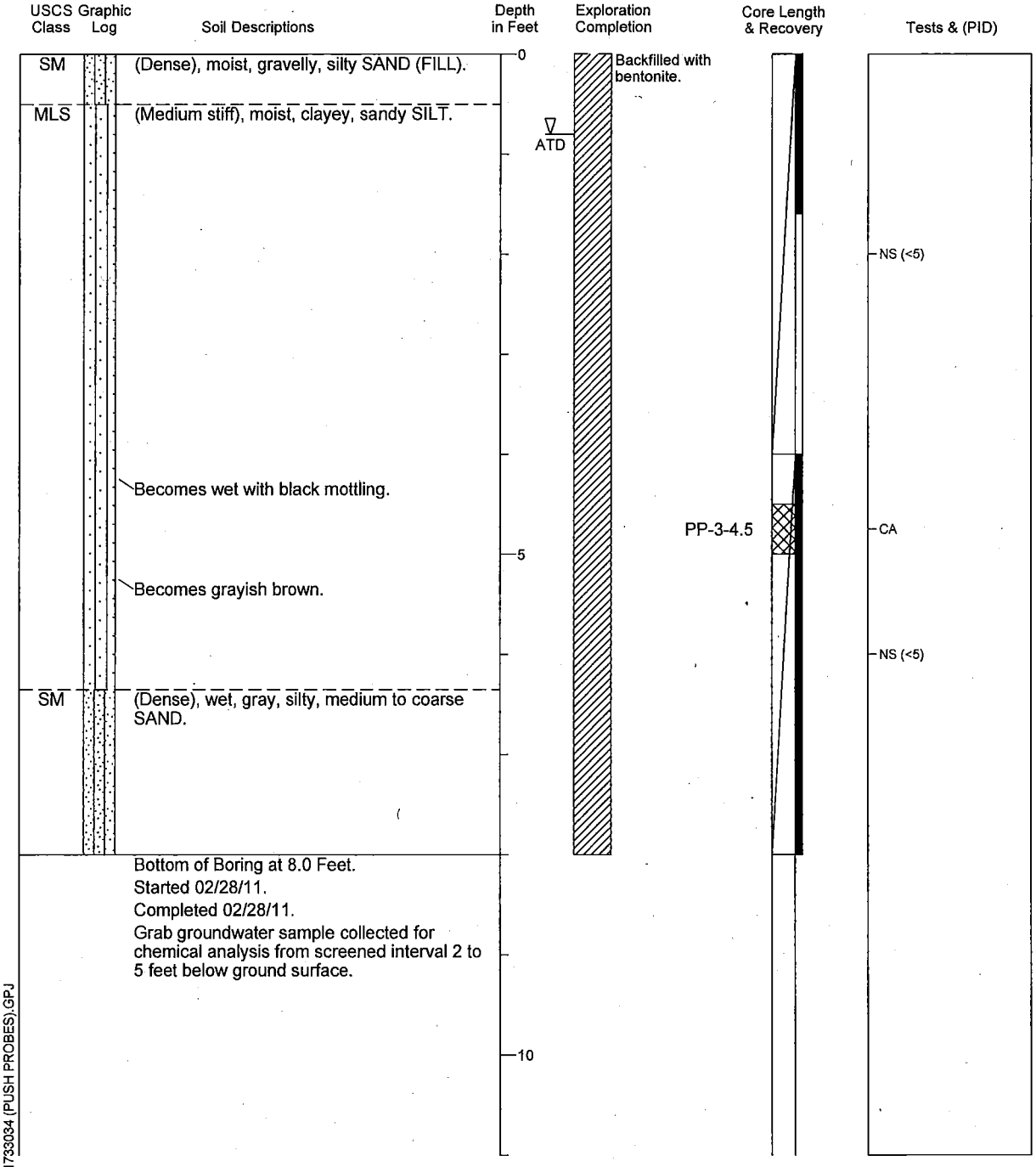
17330-34 2/11

Figure A-3

Push Probe Log for PP-3

Location: Pacific Beach, Washington
Logged By: Jason Miles
Reviewed By: Angie Godwin

Drilling Type: Push Probe
Soil Sampler: 4-Foot Core
Hole Diameter: 2"



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. Drilled By: ESN

HARTCROWSER

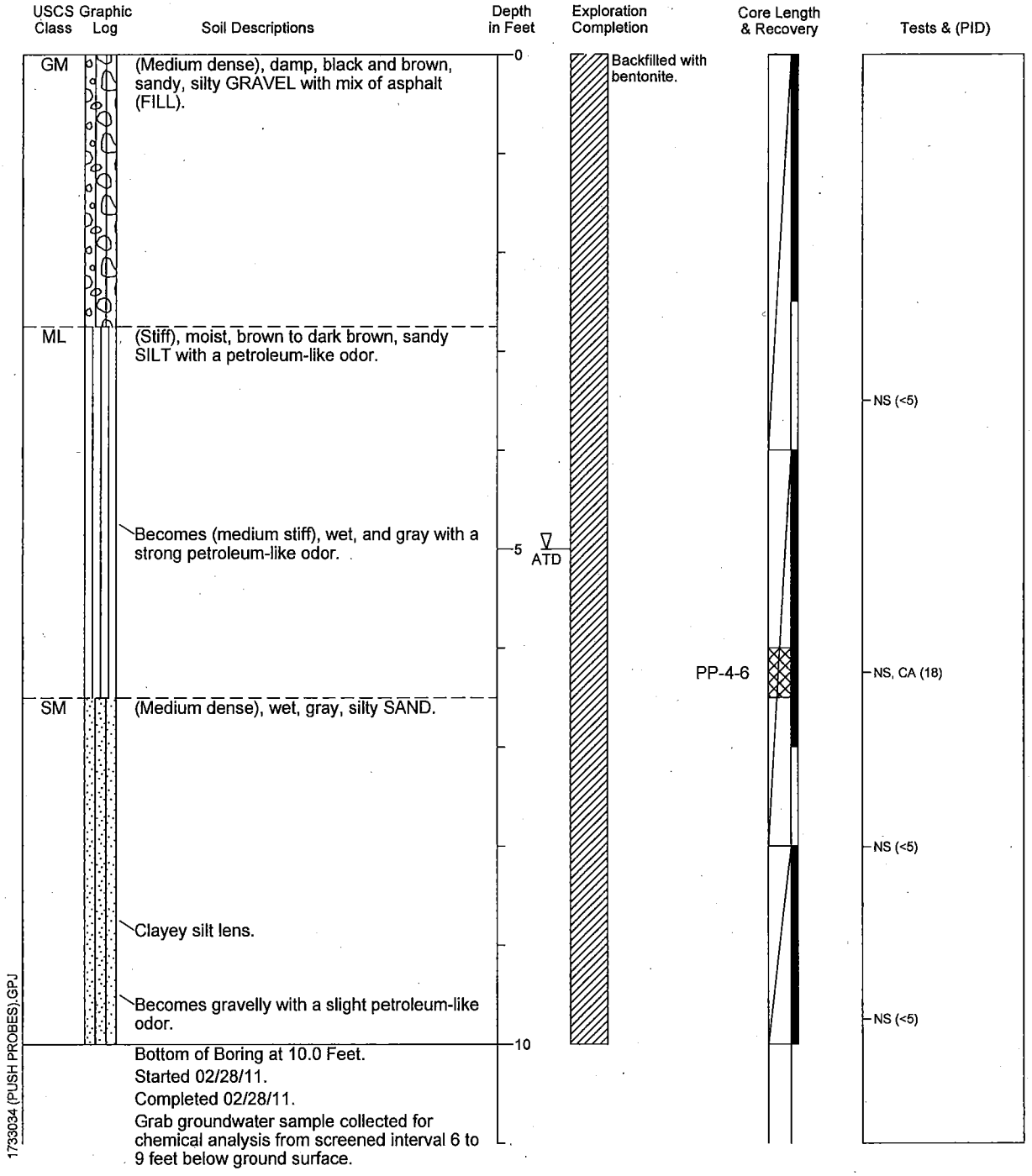
17330-34 2/11

Figure A-4

Push Probe Log for PP-4

Location: Pacific Beach, Washington
Logged By: Jason Miles
Reviewed By: Angie Godwin

Drilling Type: Push Probe
Soil Sampler: 4-Foot Core
Hole Diameter: 2"



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. Drilled By: ESN

HARTCROWSER

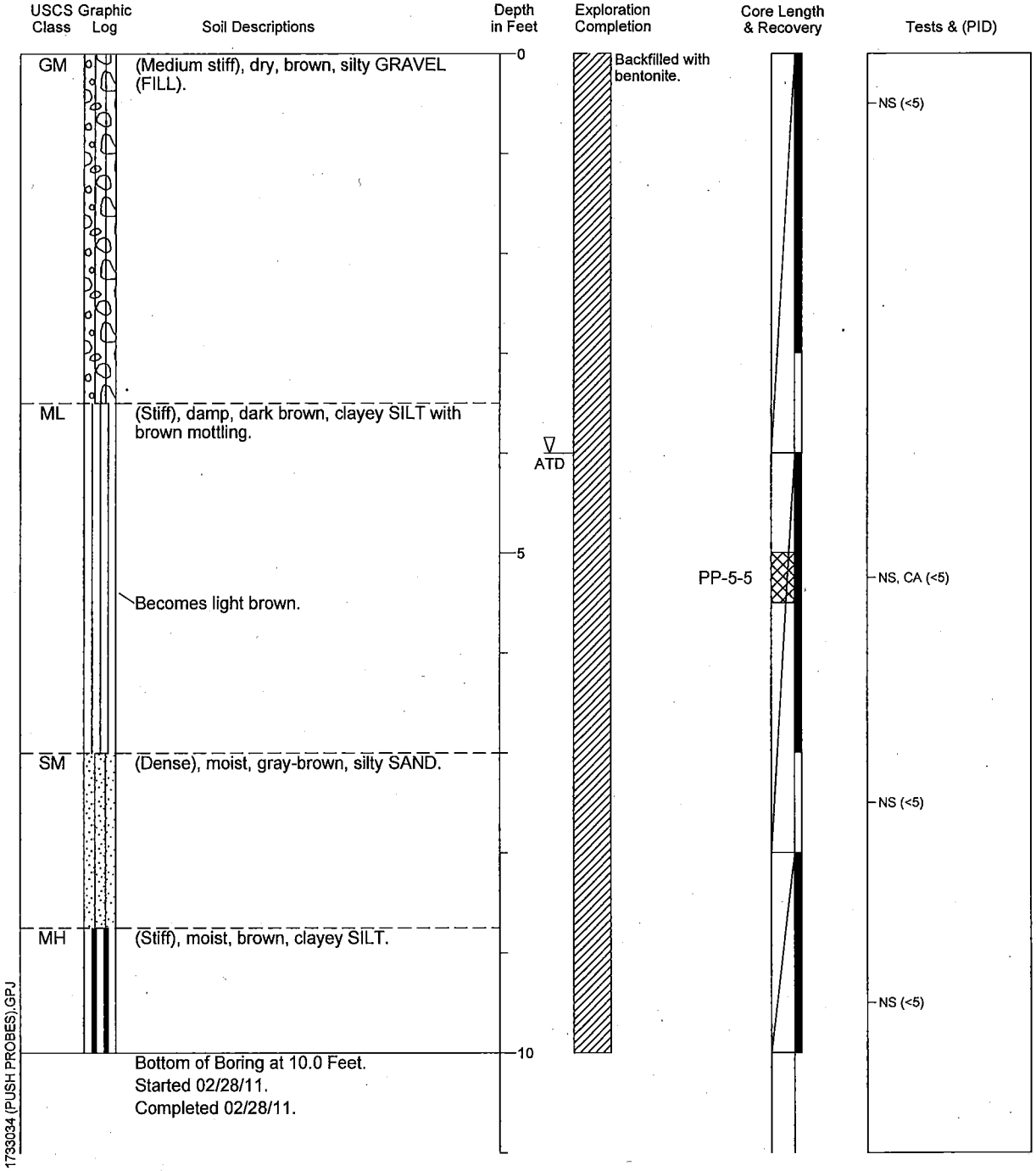
17330-34 2/11

Figure A-5

Push Probe Log for PP-5

Location: Pacific Beach, Washington
Logged By: Jason Miles
Reviewed By: Angie Godwin

Drilling Type: Push Probe
Soil Sampler: 4-Foot Core
Hole Diameter: 2"



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. Drilled By: ESN

HARTCROWSER

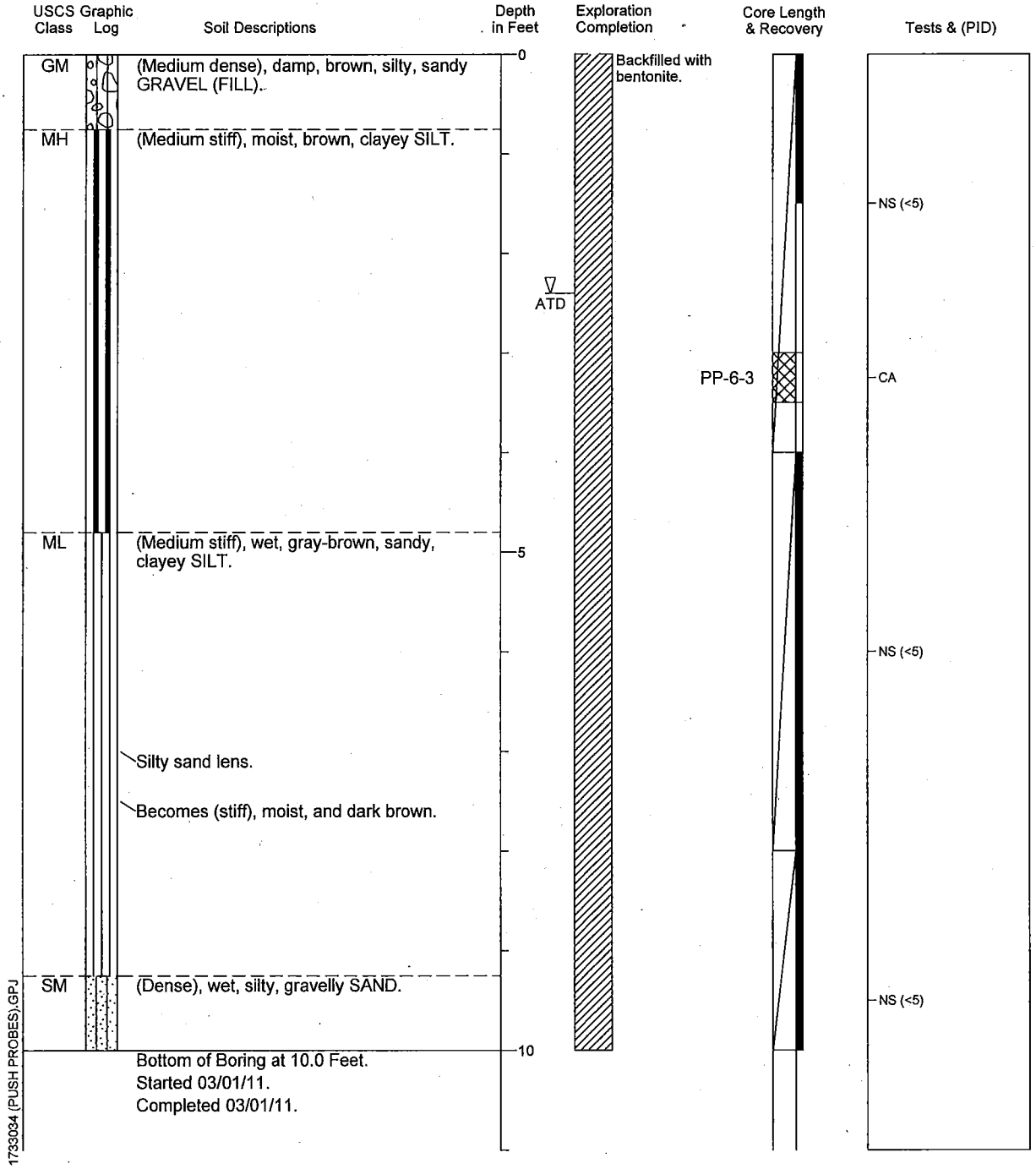
17330-34 *2/11*

Figure A-6

Push Probe Log for PP-6

Location: Pacific Beach, Washington
Logged By: Jason Miles
Reviewed By: Angie Godwin

Drilling Type: Push Probe
Soil Sampler: 4-Foot Core
Hole Diameter: 2"



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. Drilled By: ESN

HARTCROWSER

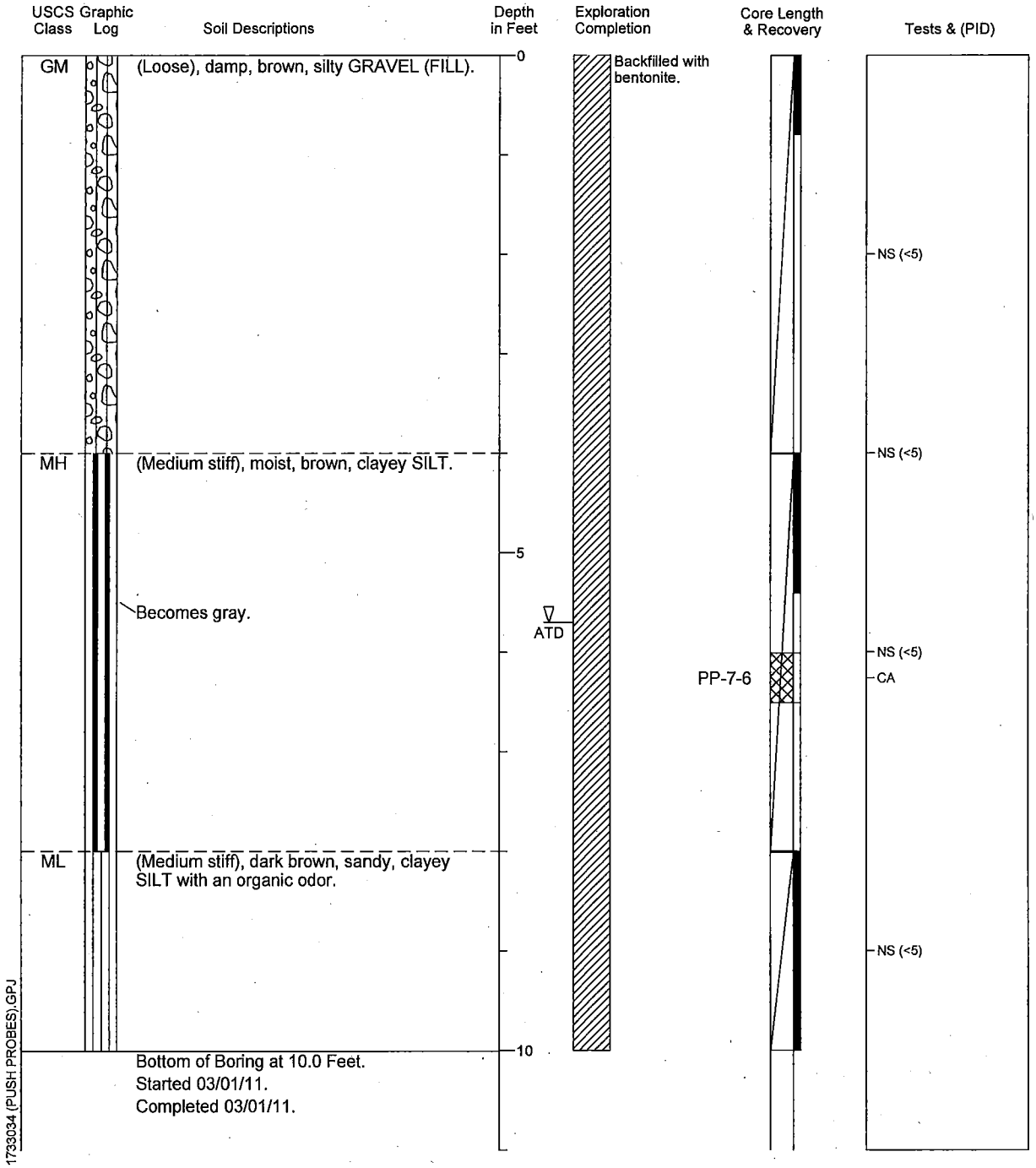
17330-34 2/11

Figure A-7

Push Probe Log for PP-7

Location: Pacific Beach, Washington
Logged By: Jason Miles
Reviewed By: Angie Godwin

Drilling Type: Push Probe
Soil Sampler: 4-Foot Core
Hole Diameter: 2"



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. Drilled By: ESN

HARTCROWSER

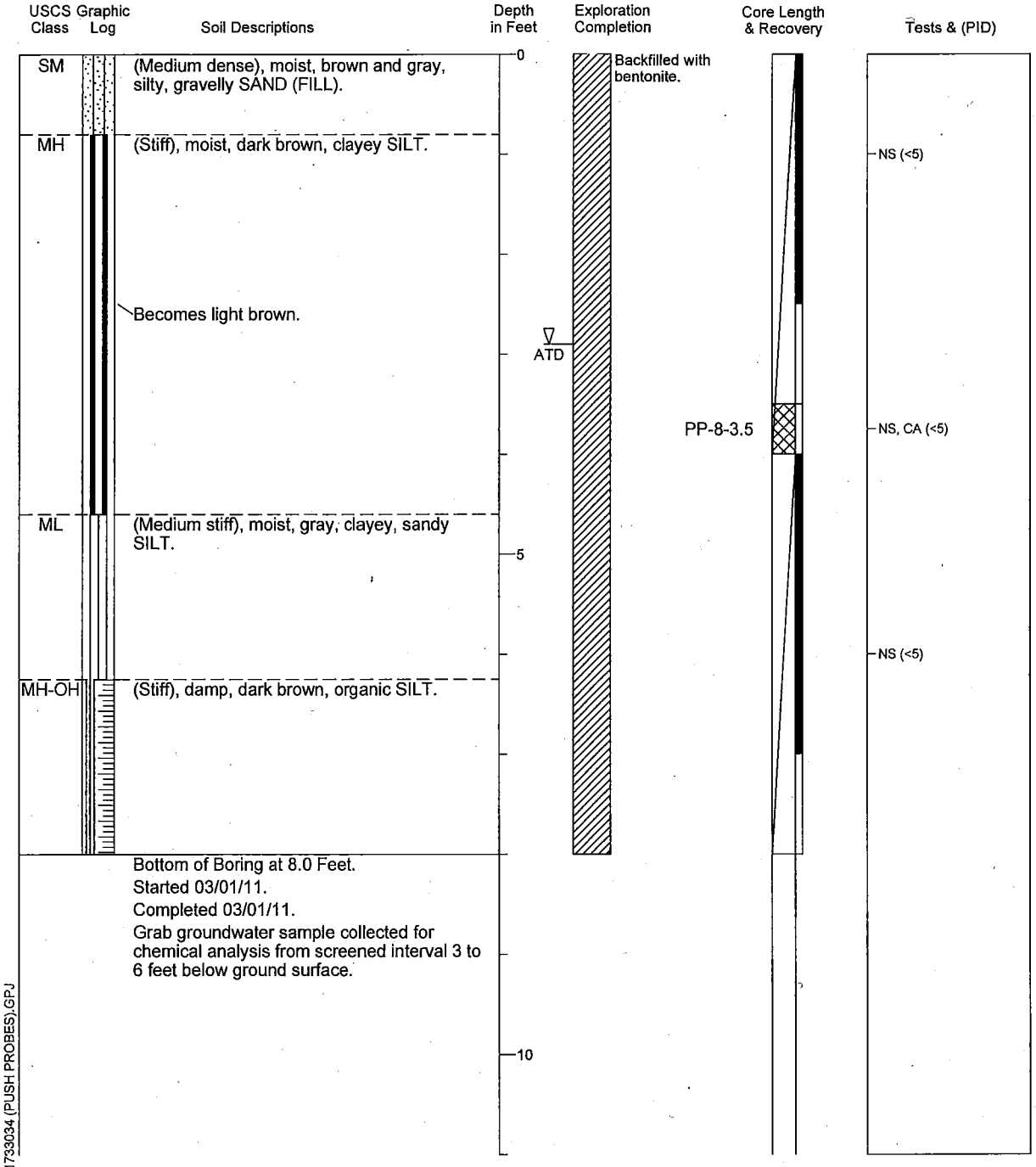
17330-34 2/11

Figure A-8

Push Probe Log for PP-8

Location: Pacific Beach, Washington
Logged By: Jason Miles
Reviewed By: Angie Godwin

Drilling Type: Push Probe
Soil Sampler: 4-Foot Core
Hole Diameter: 2"



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. Drilled By: ESN .

HARTCROWSER

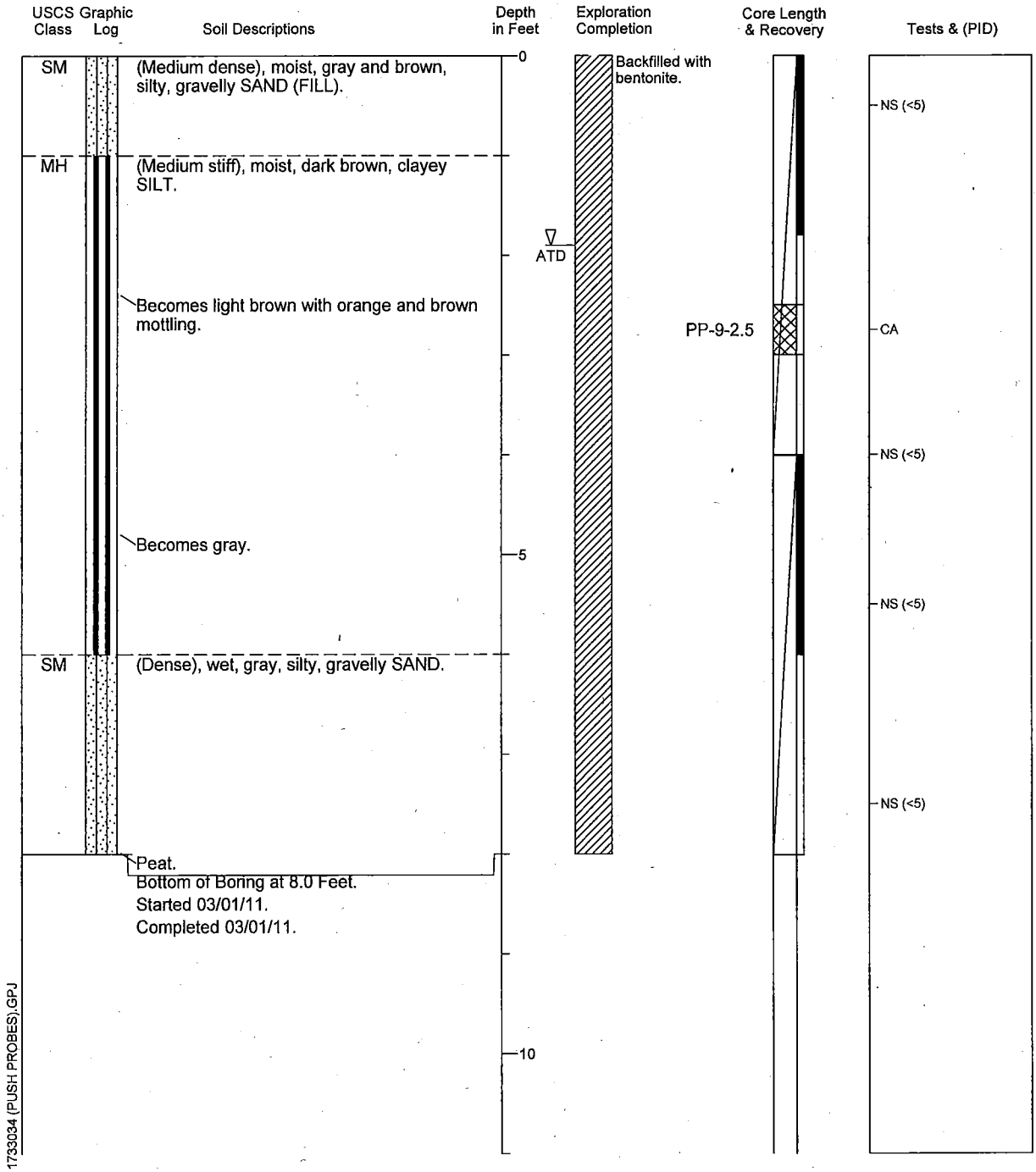
17330-34 2/11

Figure A-9

Push Probe Log for PP-9

Location: Pacific Beach, Washington
Logged By: Jason Miles
Reviewed By: Angie Godwin

Drilling Type: Push Probe
Soil Sampler: 4-Foot Core
Hole Diameter: 2"



1733034 (PUSH PROBES).GPJ

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. Drilled By: ESN

HARTCROWSER

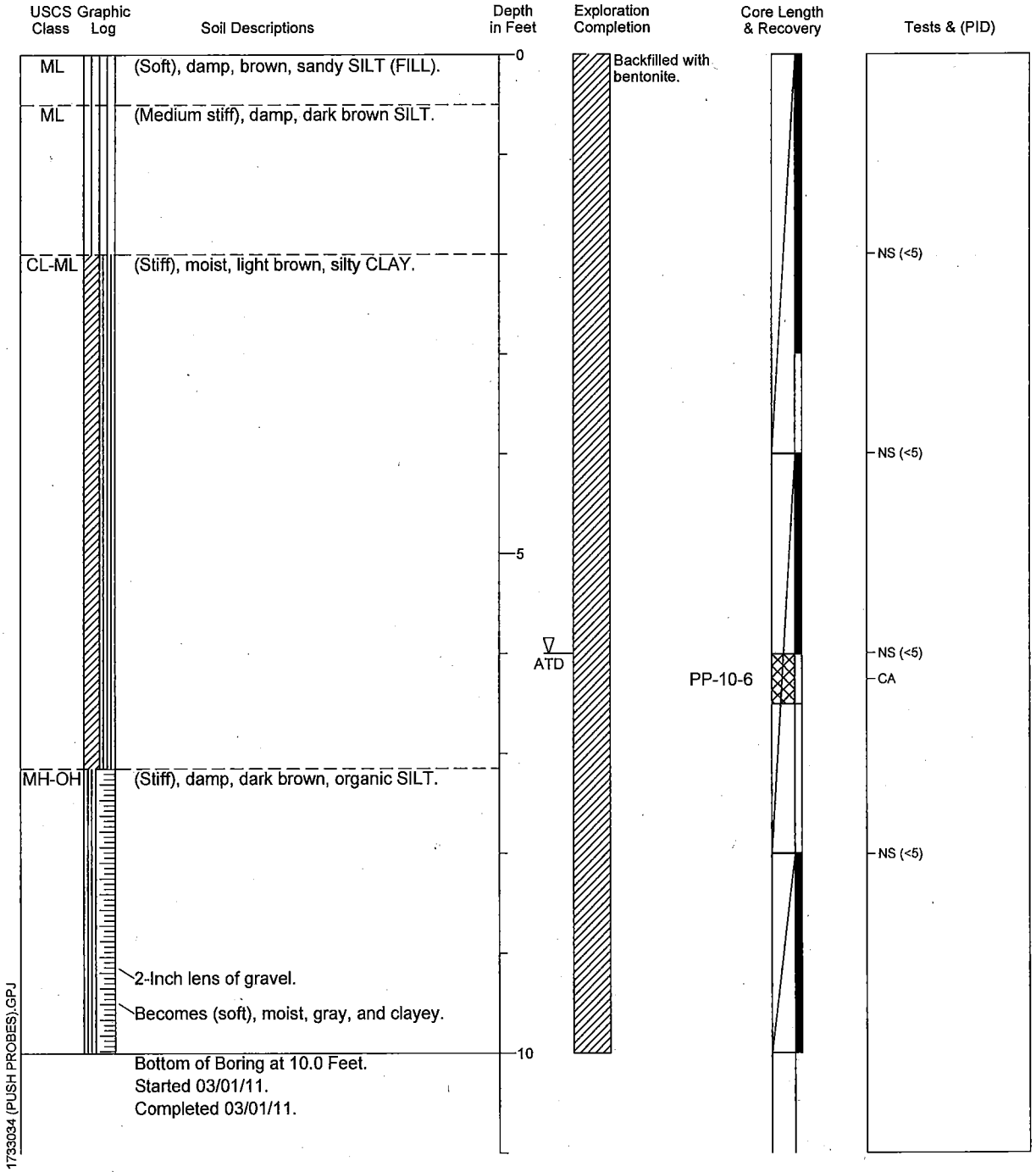
17330-34 2/11

Figure A-10

Push Probe Log for PP-10

Location: Pacific Beach, Washington
Logged By: Jason Miles
Reviewed By: Angie Godwin

Drilling Type: Push Probe
Soil Sampler: 4-Foot Core
Hole Diameter: 2"



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. Drilled By: ESN

HARTCROWSER

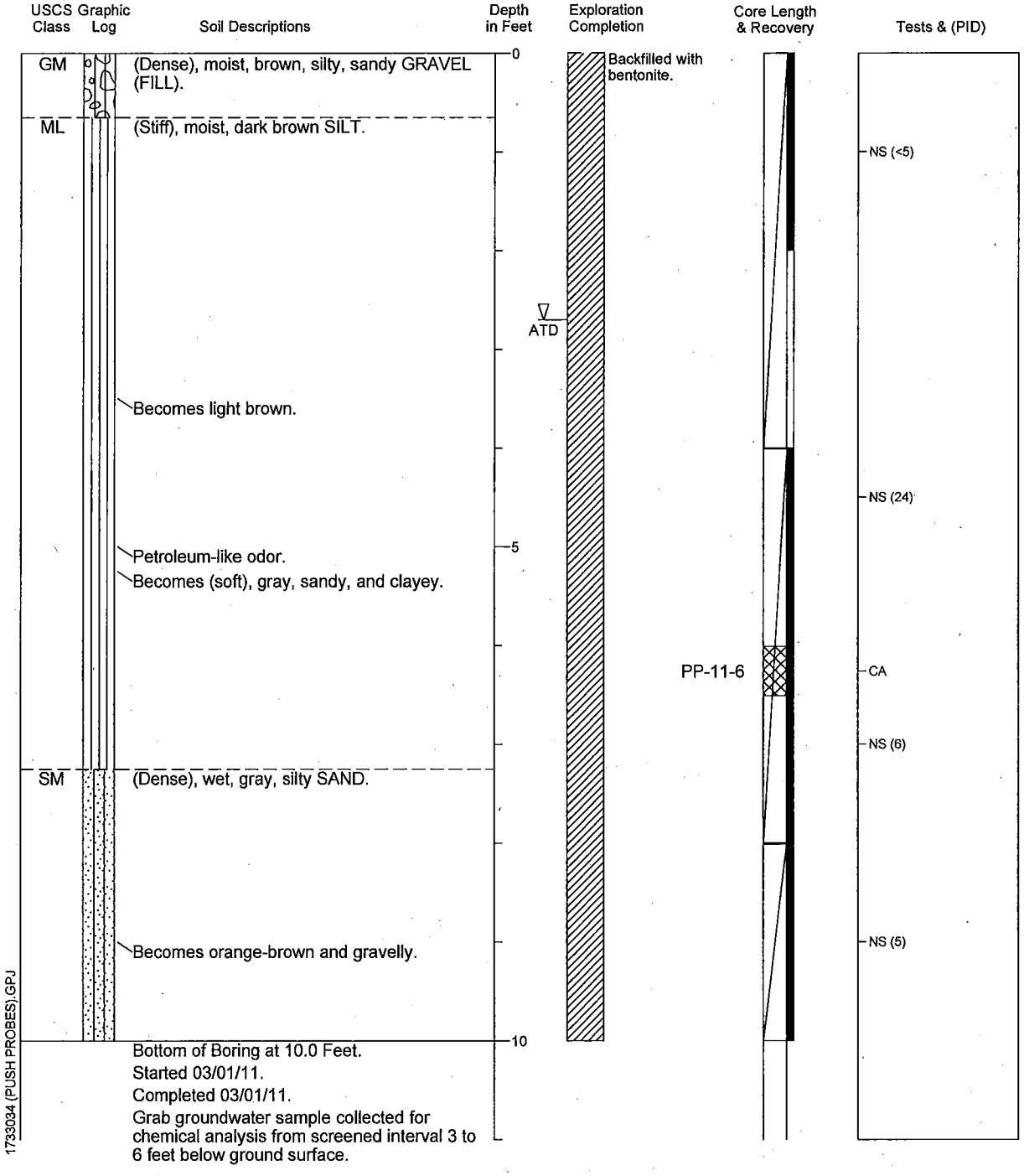
17330-34 2/11

Figure A-11

Push Probe Log for PP-11

Location: Pacific Beach, Washington
Logged By: Jason Miles
Reviewed By: Angie Godwin

Drilling Type: Push Probe
Soil Sampler: 4-Foot Core
Hole Diameter: 2"



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. Drilled By: ESN

HARTCROWSER

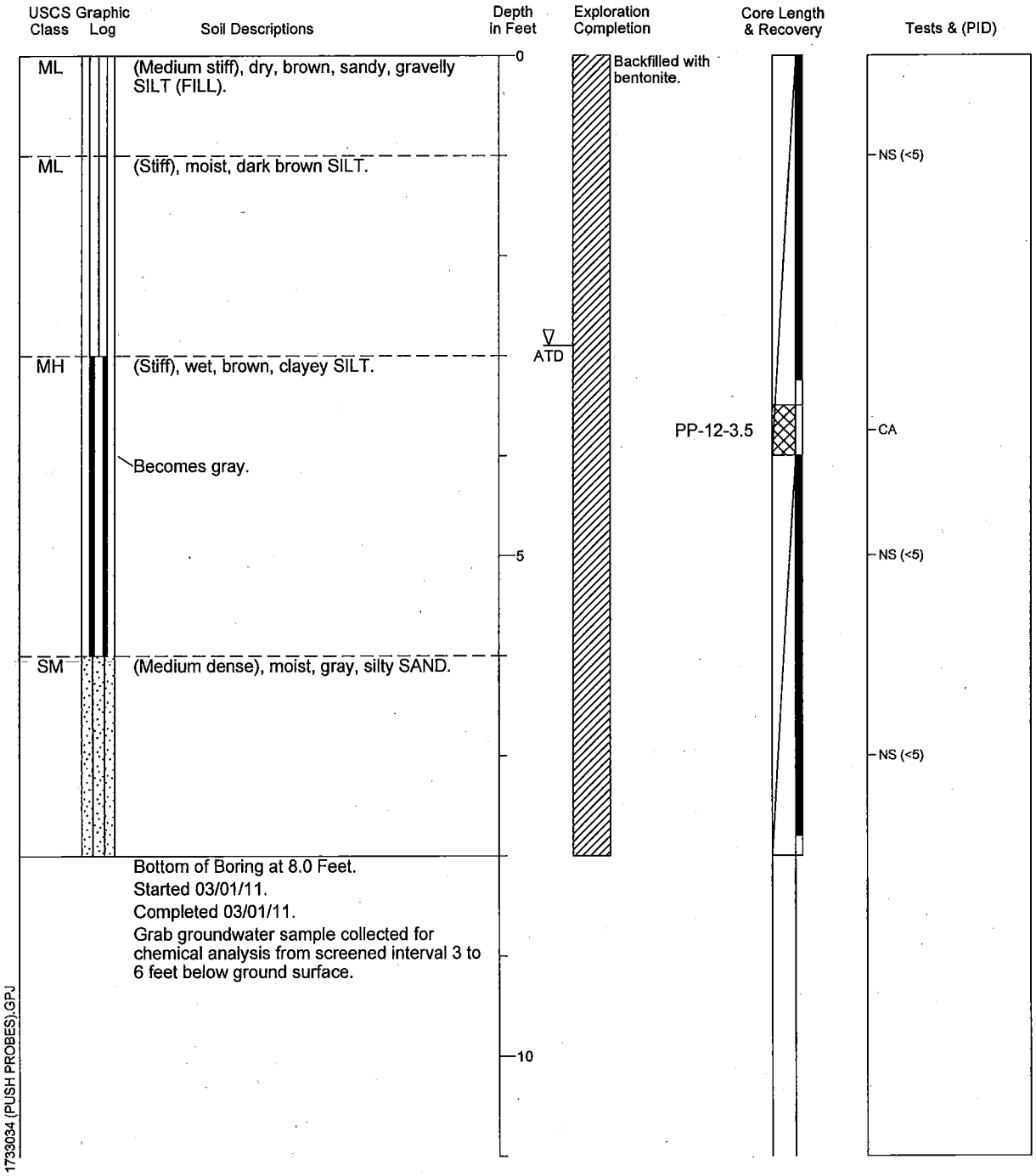
17330-34 2/11

Figure A-12

Push Probe Log for PP-12

Location: Pacific Beach, Washington
Logged By: Jason Miles
Reviewed By: Angie Godwin

Drilling Type: Push Probe
Soil Sampler: 4-Foot Core
Hole Diameter: 2"



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. Drilled By: ESN

HARTCROWSER

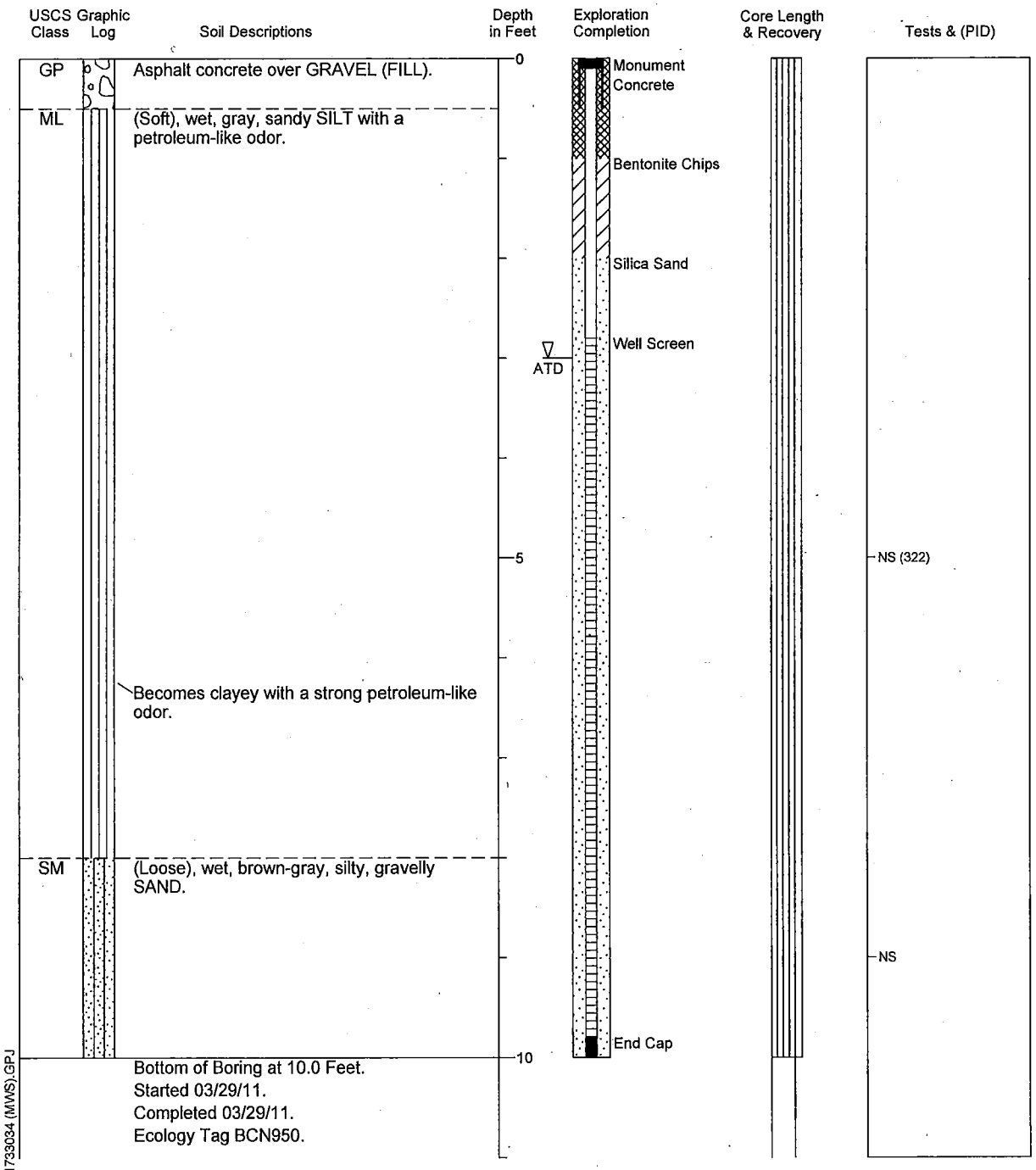
17330-34 2/11

Figure A-13

Monitoring Well Construction Data for MW-1

Location: Pacific Beach, Washington
Logged By: Jason Miles
Reviewed By: Angie Goodwin

Drilling Type: Hollow Stem Auger
Soil Sampler: NA
Hole Diameter: 9"
Inside Diameter of PVC Casing: 2"



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. Drilled By: ESN

HARTCROWSER

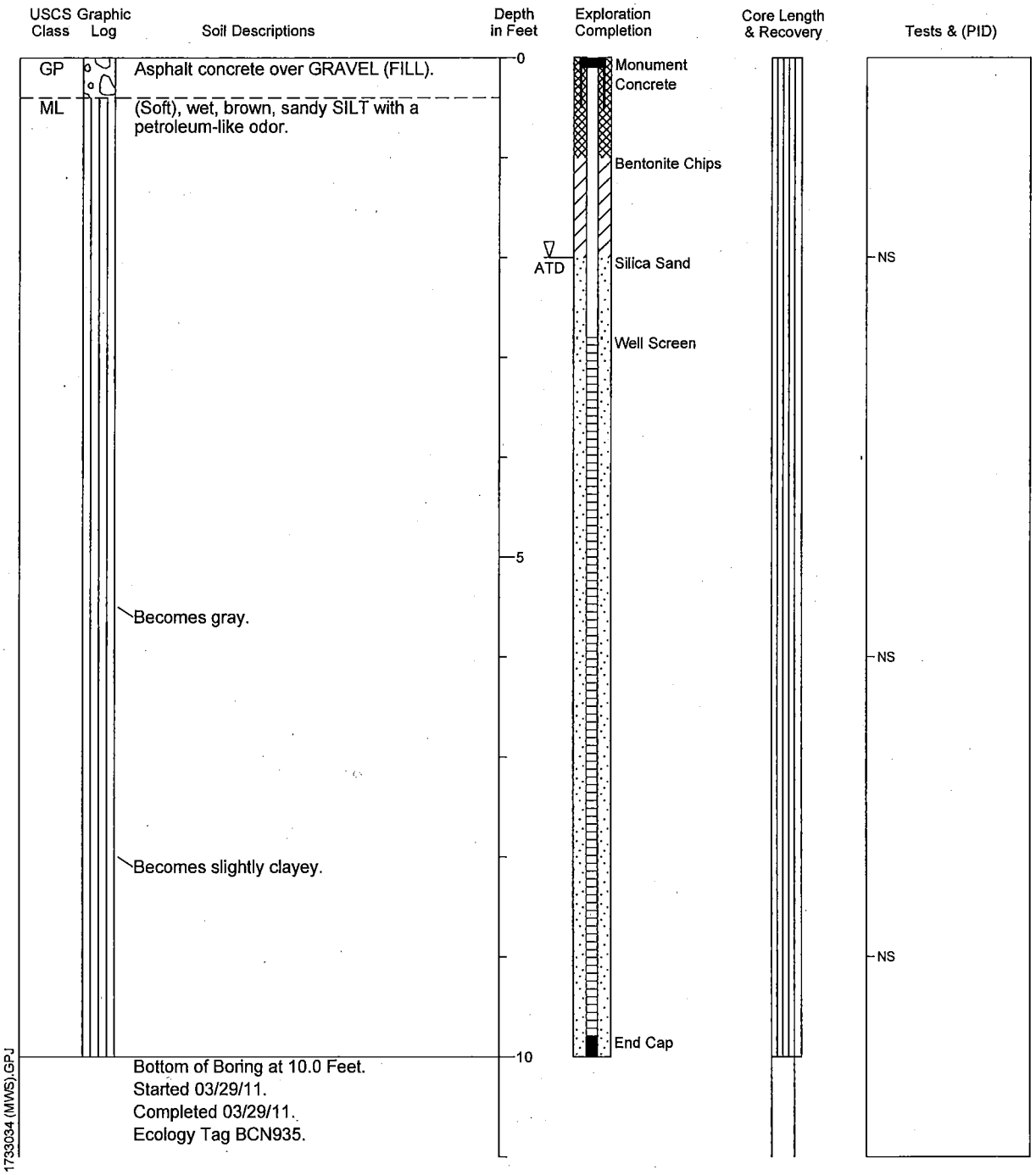
17330-34 3/11

Figure A-15

Monitoring Well Construction Data for MW-2

Location: Pacific Beach, Washington
Logged By: Jason Miles
Reviewed By: Angie Goodwin

Drilling Type: Hollow Stem Auger
Soil Sampler: NA
Hole Diameter: 9"
Inside Diameter of PVC Casing: 2"



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. Drilled By: ESN

HARTCROWSER

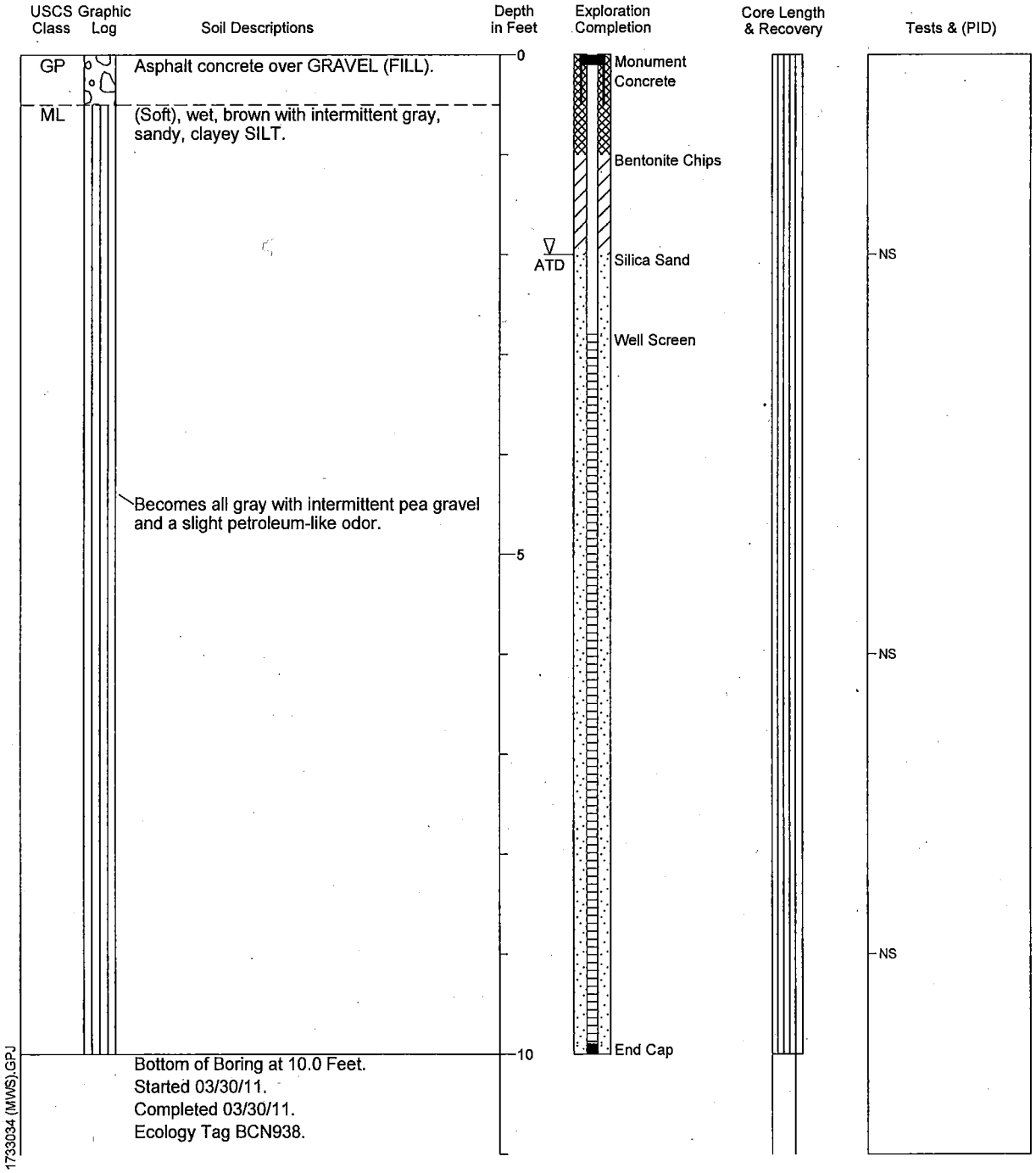
17330-34 3/11

Figure A-16

Monitoring Well Construction Data for MW-3

Location: Pacific Beach, Washington
Logged By: Jason Miles
Reviewed By: Angie Goodwin

Drilling Type: Hollow Stem Auger
Soil Sampler: NA
Hole Diameter: 9"
Inside Diameter of PVC Casing: 2"



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. Drilled By: ESN

HARTCROWSER

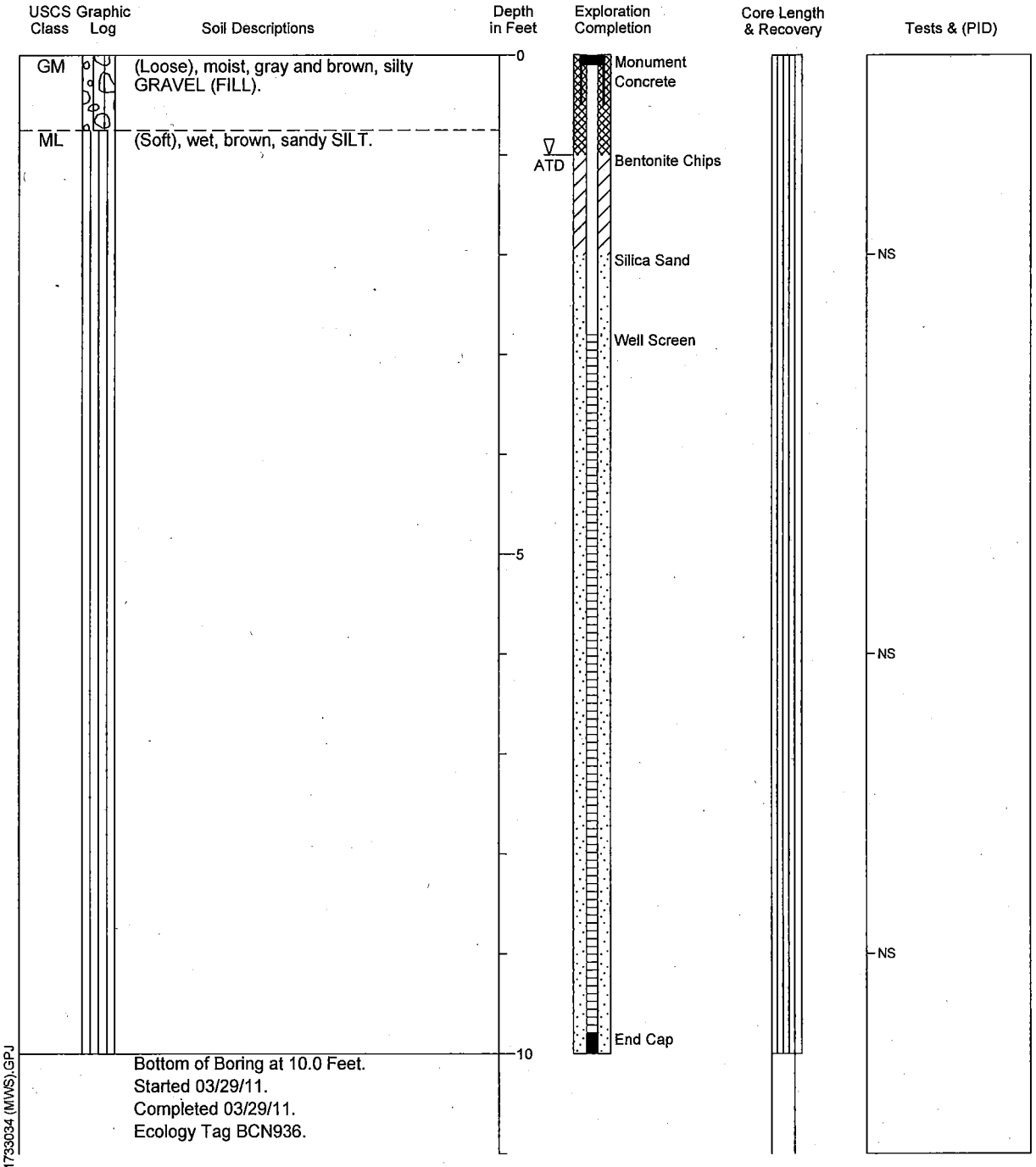
17330-34 3/11

Figure A-17

Monitoring Well Construction Data for MW-4

Location: Pacific Beach, Washington
Logged By: Jason Miles
Reviewed By: Angie Goodwin

Drilling Type: Hollow Stem Auger
Soil Sampler: NA
Hole Diameter: 9"
Inside Diameter of PVC Casing: 2"



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. Drilled By: ESN

HARTCROWSER

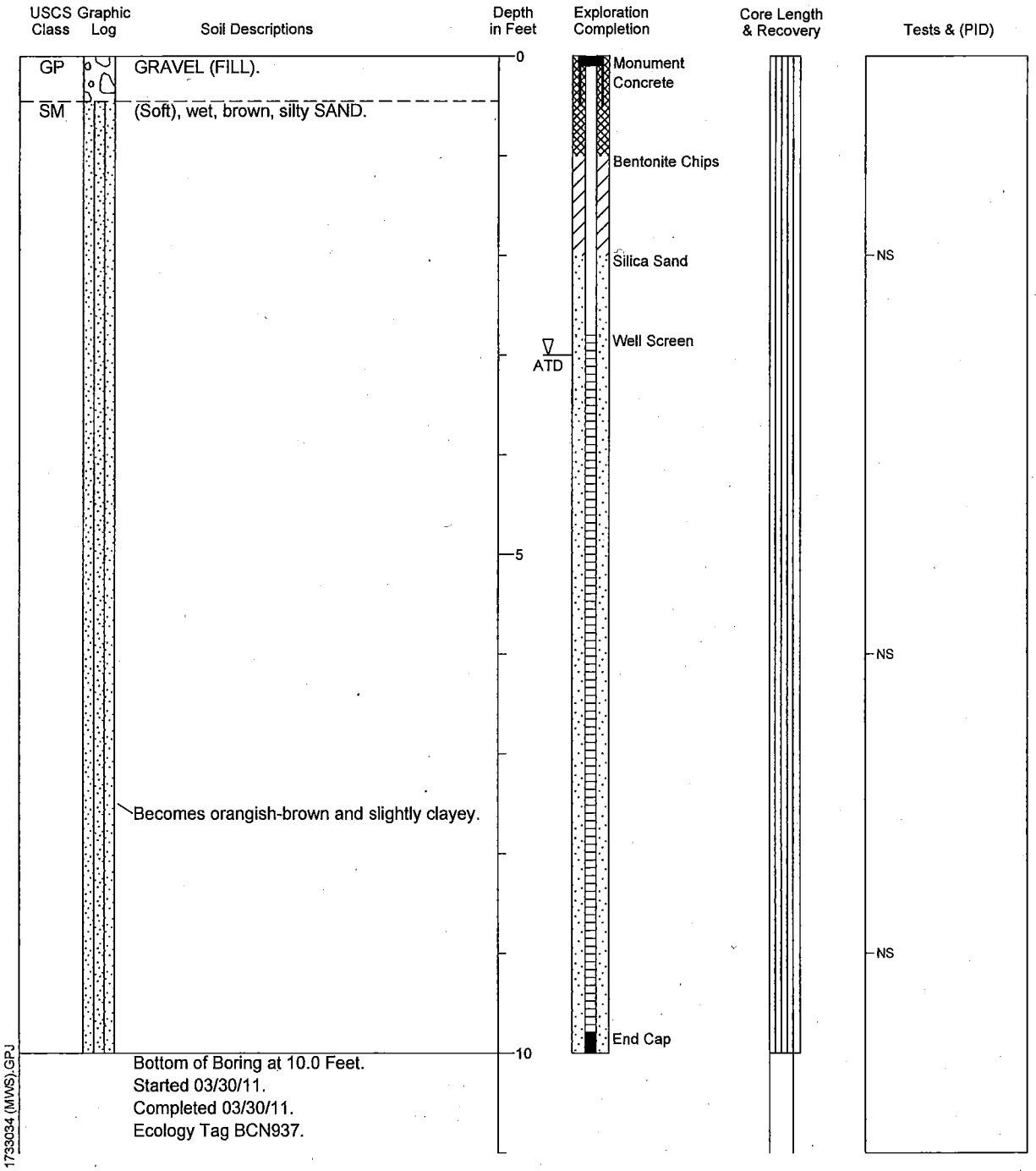
17330-34 3/11

Figure A-18

Monitoring Well Construction Data for MW-5

Location: Pacific Beach, Washington
Logged By: Jason Miles
Reviewed By: Angie Goodwin

Drilling Type: Hollow Stem Auger
Soil Sampler: NA
Hole Diameter: 9"
Inside Diameter of PVC Casing: 2"



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. Drilled By: ESN

HARTCROWSER

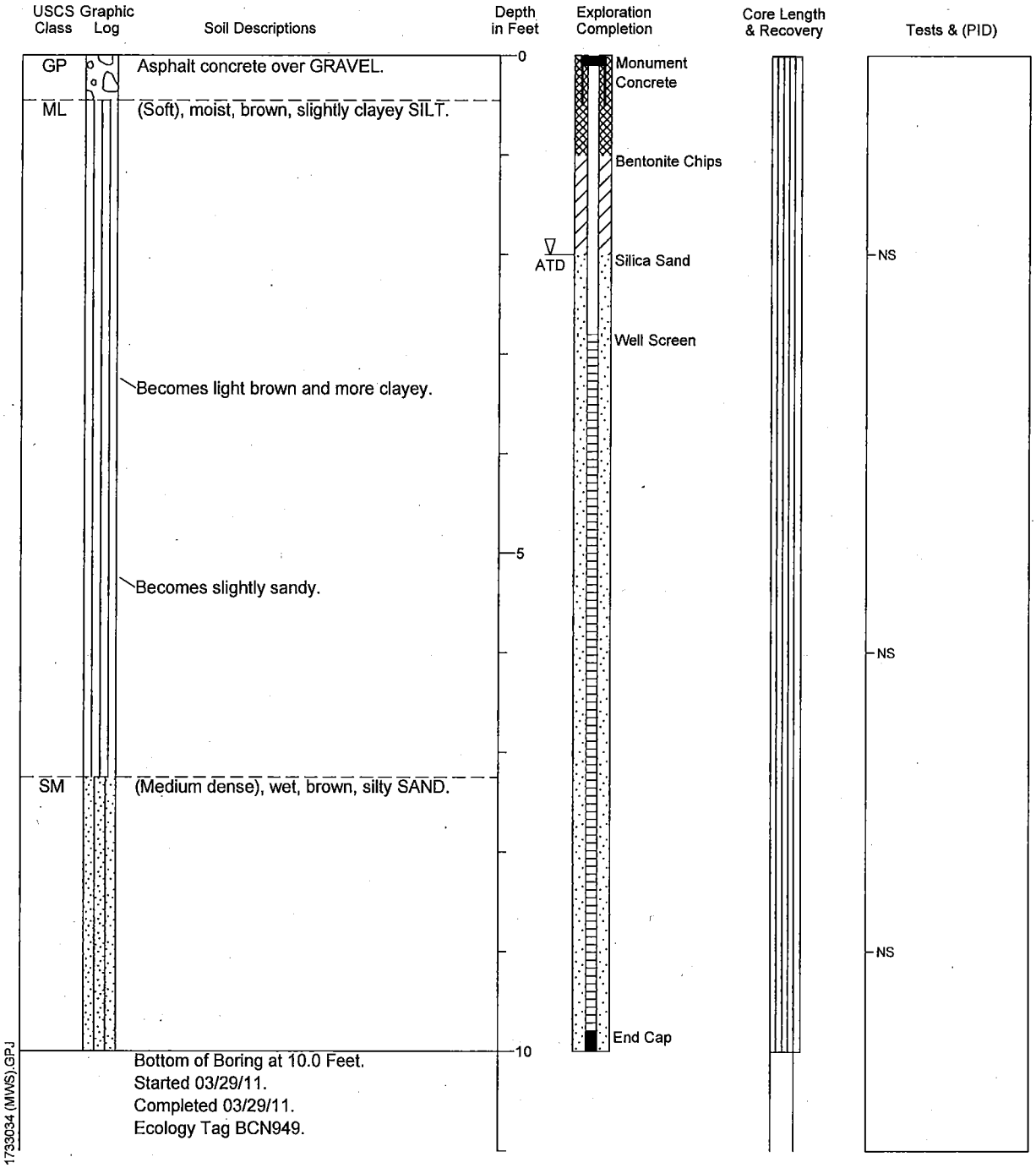
17330-34 *3/11*

Figure A-19

Monitoring Well Construction Data for MW-6

Location: Pacific Beach, Washington
Logged By: Jason Miles
Reviewed By: Angie Goodwin

Drilling Type: Push Probe and Hollow Stem Auger
Soil Sampler: Push Probe/Cuttings
Hole Diameter: 9"
Inside Diameter of PVC Casing: 2"



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. USCS designations are based on visual manual classification (ASTM D 2488) unless otherwise supported by laboratory testing (ASTM D 2487).
4. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.
5. Drilled By: ESN

HARTCROWSER

17330-34 *3/11*

Figure A-20