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INTERIM REMEDIAL MEASURE WORK PLAN FOR PRODUCT RECOVERY IN OPERABLE UNIT 4 VIA CHEMICAL OXIDATION

ExxonMobil Former Buffalo Terminal
Buffalo, New York

Prepared for:

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1.0 INTRODUCTION

Roux Associates, Inc. (Roux Associates) and Remedial Engineering, P.C. (Remedial Engineering) have prepared this Interim Remedial Measure (IRM) Work Plan for Product Recovery in Operable Unit 4 (OU-4) via Chemical Oxidation (ChemOx), on behalf of ExxonMobil Oil Corporation (ExxonMobil). This IRM Work Plan describes the proposed IRM to address an area of separate-phase product at the Former ExxonMobil Buffalo Terminal considering the historic, current, and reasonably anticipated future use of OU-4 as industrial.

The former ExxonMobil Terminal and offsite areas formerly and currently owned by ExxonMobil, located at 625 Elk Street in Buffalo, New York, are shown on Figure 1. In order to address the environmental conditions, ExxonMobil entered into a Brownfield Site Cleanup Agreement with the New York State Department of Environmental Conservation (NYSDEC) on April 3, 2006. Under this agreement, the Site entered into New York State's Brownfield Cleanup Program (BCP). The "Site" is defined, for the purposes of the BCP, as the area within the limits of the five Operable Units (OU) as shown in Figure 2. In addition, the Site was previously divided into nine geographic areas for the purpose of assessing environmental conditions and reporting the results of area-specific activities (Figure 3). These geographic areas were designated according to the historical primary operations that occurred in each portion of the Site. The separate-phase product plume that is the subject of this IRM Work Plan is located in Operable Unit 4 (OU-4) within the area formerly designated as the Eastern Tank Yard Area (ETYA). Plate 1 shows a layout of the entire OU-4.

A portion of the Site south of Elk Street, including OU-4, is currently operating as a petroleum products storage and distribution facility owned and operated by Buckeye Terminals, LLC (Buckeye) with the surrounding non-operating area (formerly part of historic operations) owned by ExxonMobil.

The requirements and recommendations of the NYSDEC guidance document, Draft Brownfield Cleanup Program Guide (May 2004), were incorporated into this OU-4 IRM Work plan, in addition to the requirements and recommendations of the NYSDEC "Draft DER-10 Technical Guidance for Site Investigation and Remediation (DER-10)," dated December 25, 2002. This OU-4 IRM Work Plan has been prepared in accordance with the requirements of Section 5

DER-10 for a Remedial Action Work Plan since previous experience with the system during the pilot test and the site-specific knowledge of the contractors to be selected for the work do not warrant full design plans and specifications.

The process that was followed to field test, evaluate, and select ChemOx as the IRM for the OU-4 product plume area is presented in the document entitled "Remedial Action Selection Report (RAS) for the Interim Remedial Measure for Product Recovery in the ETYA", dated January 5, 2005.

As part of the remedial action selection process, field tests of four technologies were performed to evaluate potential remedial technologies for the OU-4 product plume. The field-testing included the following:

- Long-term separate-phase product-only recovery testing;
- Aquifer testing of groundwater recovery for containing and recovering groundwater, controlling the migration of separate-phase product, and enhancing separate-phase product recovery;
- Vacuum enhanced recovery (VER) pilot testing; and
- ChemOx pilot testing.

ChemOx was selected as the technology that best met the remedial goals and remedial action objectives (RAOs) for the OU-4 product plume area. The RAS included an evaluation of ChemOx against the criteria presented in Section 4.4 of the DER-10, as well as a conceptual design and operation, maintenance and monitoring (OM&M) program. This IRM Work Plan provides additional details required to implement the IRM in the OU-4 product plume area.

The remainder of this OU-4 IRM Work Plan is organized as follows:

- Section 2.0 provides a summary of the history of OU-4 (ETYA), including ownership, current and future land use, past and present operations (i.e., buildings, tanks, etc), and spills or releases;
- Section 3.0 provides a summary of environmental conditions based upon the results of previous investigations;
- Section 4.0 identifies remedial goals and remedial action objectives;

- Section 5.0 describes the IRM selection process;
- Section 6.0 describes the components of the ChemOx system;
- Section 7.0 describes health and safety procedures;
- Section 8.0 describes OM&M procedures and proposed system shutdown criteria;
- Section 9.0 describes the quality assurance/quality control procedures for the IRM;
- Section 10.0 describes reporting;
- Section 11.0 describes citizens participation;
- Section 12.0 describes institutional and engineering controls;
- Section 13.0 describes the project schedule; and
- Section 14.0 provides references.

Included with the IRM Work Plan are the following appendices:

A. Hydrographs

B. Separate Phase Product Analysis Results for OU-4 Wells

C. Quality Assurance Project Plan (QAPP) for the Chemical Oxidation IRM in Operable Unit 4

2.0 SITE SETTING AND HISTORY

The historical information presented in this Section was obtained from the document entitled "History of Operations at Buffalo Terminal" (Roux Associates, 2000). Historically, the major Site refinery and terminal operations occurred south of Elk Street in an area of approximately 89 acres. The petroleum refining operations at the Site began during 1880. The majority of the Site was purchased by Standard Oil Company of New York (SOCONY), ExxonMobil's predecessor, in 1892. In May 1981, the Site terminated all refinery operations. The Site continued as an ExxonMobil distribution terminal, receiving product via a pipeline and barge until May 2005. The active petroleum products storage and distribution terminal portion of the Site was sold on May 4, 2005 and is now owned and operated by Buckeye. The area of Buckeye's active terminal is approximately 35.8 acres. Throughout the Site's history, the areal extent of property owned by ExxonMobil changed as portions of property were acquired or sold for various reasons. The area within the current ExxonMobil property boundary is approximately 43.6 acres.

2.1 Eastern Tank Yard Area

OU-4 (Plate 1) is located between the eastern side of the Erie Lackawanna Railroad Company (formerly D.L.& W.R.R.) rail tracks and the bank of the Buffalo River. Prior to the straightening of the Buffalo River between 1914 and 1917, the river's course ran in a generally north to south direction through OU-4, parallel to the D.L. & W.R.R. tracks. The river was filled in, relocated to the east, and rerouted to continue in a west-southwesterly direction. A small parcel of land that existed prior to the rerouting between the D.L. & W.R.R. tracks and the original river was owned by SOCONY. This parcel of land was relinquished by SOCONY to the City of Buffalo on July 8, 1915. The City of Buffalo reportedly utilized the land between the D.L. & W.R.R. tracks and the rerouted river channel for disposal of municipal waste between the years 1921 and 1951. ExxonMobil purchased the parcel of land in 1951. OU-4 is part of the active terminal that is owned and operated by Buckeye and encompasses 15.3 acres.

2.1.1 Former and Current Structures

The City of Buffalo reportedly utilized the land between the D.L. & W.R.R. tracks and the rerouted river channel for disposal of municipal waste between the years 1921 and 1951. In 1953, two aboveground storage tanks (Tanks 175 and 176), each with 70,000-barrel capacities, were constructed in OU-4. The details concerning these storage tanks are provided in Table 1. To the southwest of the storage tanks, four propane tanks and a propane loading rack were constructed between 1958 and 1966. According to discussions with former and/or current ExxonMobil employees, the propane loading rack was never utilized. The propane tanks and loading rack were removed in 1988.

Three product pipelines are present within OU-4 (Plate 1). Two of the pipelines were formerly owned by ExxonMobil and are currently owned by Buckeye. One is abandoned in-place and the other is currently active. ExxonMobil's abandoned former pipeline enters OU-4 at the northeast boundary and crosses through the length of OU-4 in a south/southwesterly direction and continues into the STYA along the bulkhead immediately adjacent to the Buffalo River. According to a drawing of the pipeline, the depth of burial within OU-4 is approximately 4 feet. According to this drawing, the pipeline was purged of product and abandoned in-place.

The active portion of the former ExxonMobil pipeline enters the property in the northwest corner of OU-4 and follows the fence line in a southerly direction. The pipeline continues to follow the fence line until it crosses underneath the former Erie-Lackawanna Railroad and into OU-3 (the area formerly designated as the Southern Tank Yard Area [STYA]) at the location of the access road between OU-4 and OU-3.

Lakehead Pipeline Company, Inc. (Lakehead) owns the third product pipeline. The approximate location of this pipeline is shown on Plate 1. This pipeline enters OU-4 at a location near the former ExxonMobil pipeline and then generally runs in a west/southwesterly direction south of the containment berm for Tanks 175 and 176 to a point approximately 200 feet beyond the tanks, where it turns northwest and enters the STYA. Information provided to ExxonMobil by Lakehead indicates that the line was removed from active service in 1982 when the product was purged and the line was filled with nitrogen.

2.2 Waste Handling Areas

ExxonMobil also used OU-4 for disposal purposes. According to company records, the waste disposed in OU-4 included storage tank bottom material, spent cracking and reforming catalysts, oil/water separator material, slop oil solids, demolition debris, and asphalt-containing soil.

ExxonMobil reportedly used this area for disposal between the years 1952 and 1974. Plate 1 shows disposal locations of wastes disposed in OU-4 as reported in the company records. In addition, a review of available aerial photographs indicates that the area southwest of the tanks was a possible disposal location. Following several subsurface investigations, the disposal area within OU-4 was re-classified in 1988 by the NYSDEC from a New York State Registry of Inactive Hazardous Waste Disposal Sites Class 2a site (indicating that additional information is needed to accurately categorize the site) to a Class 3 site. This Class 3 classification indicates that the area does not pose a significant threat to the public or environment.

2.3 Spills/Releases

Two spills were documented to have occurred in this area (Table 2). The following releases have supporting documentation in the form of ExxonMobil records and NYSDEC Spill Report Forms.

- On August 28, 1989, approximately 6,500 gallons of unleaded gasoline were released. This incident was reported to the NYSDEC and assigned Spill No. 8905279. It was also reported to the City of Buffalo Fire Department. The incident occurred when Tank 176 was overfilled due to incorrect safe fill and high alarm settings being used. The area was barricaded and approximately 2,800 gallons of product were removed with a vacuum truck. In addition, the safe fill and high level alarm settings were corrected. Subsequently, monitoring wells were installed and monitored for the presence of product. The containment berm for this tank and Tank 175 were lined during the storage tank realignment project completed in 1991.

- On October 4, 2000, a sheen and seepage area was identified along the Buffalo River Bank adjacent to OU-4 (within OU-5) during the installation of MW-28. The NYSDEC was notified on that date and assigned Spill No. 0075417. In response, ExxonMobil installed a sorbent boom around two areas where impacts were observed (total length of approximately 300 feet). The booms were inspected and maintained daily until December 18, 2000 to prevent any adverse impacts to the Buffalo River from this area. The booms were destroyed on December 18, 2000 due to significant ice accumulation and movement in the river. Through March 2001, it was not possible to install permanent booms due to ice conditions in the river. Sorbent booms were installed along the riverbank around the seepage areas on March 16, 2001 and have been maintained since. Permanent slick-bar booms were installed around the areas of seepage in May 2001 (see Plate 1 for locations). The seepage areas have been inspected regularly since October 2000. These inspections include a description of the area of seepage, noting any differences in the appearance of the area (i.e., presence or absence of sheen and its location. if present). The inspections also noted the position of the boom and any adjustments required. The inspection results are presented in the site monitoring reports issued to the NYSDEC on a quarterly basis. The boomed area has been expanded based on additional sheen observed outside the boomed areas in June 2003, as discussed in

Section 2.4.2. Each winter, the booms are removed to prevent damage due to freezing conditions in the Buffalo River. The booms are reinstalled the following spring.

2.4 Environmental Remediation History in OU-4

The environmental remediation efforts on OU-4 include operation of the eastern leg of the well point system (WPS), treatment of extracted water, separate-phase product recovery (automated recovery and manual bailing), and the installation and maintenance of booms around the seepage area south of OU-4 (within OU-5).

2.4.1 Well Point System

Two groundwater extraction systems are currently operating at the Site: the well point system and the dual-phase recovery system. The groundwater recovered by these systems is treated by the Site's Water Treatment System, which has been operational since 1993. The Water Treatment system is installed in the Remediation Building in OU-3 within the area formerly designated as the Former Refinery Area (FRA). Treated water is discharged to the Buffalo Sewer Authority (BSA) municipal sewer system. The well point system extends into OU-4. The dual phase product recovery systems are not located in OU-4 and, therefore, they are not discussed.

Total fluids pulled from the WPS are pumped directly into the piping system and transmitted to the Site's Water Treatment System.

The Site's Water Treatment System was installed and operational by 1993. The Water Treatment System is located in the Remediation Building in OU-3 within the area formerly designated as the Former Refinery Area (FRA). The treatment system handles all extracted groundwater, as well as storm water not associated with the lined active tank farm drainage system, prior to discharge to the BSA sewer system.

Following treatment and flow monitoring by an ultrasonic flow meter, water is discharged to the BSA outfall. Recovered separate phase product is pumped to a storage tank and disposed of offsite.

2.4.2 Installation and Maintenance of the Booms Around the Seepage Areas Adjacent to OU-4 (within OU-5)

A sheen and seepage area along the Buffalo River bank adjacent to OU-4 (within OU-5) was first observed on October 4, 2000 during the installation of monitoring well MW-28. The NYSDEC was notified on that date and assigned Spill No. 0075417. In response, ExxonMobil installed a sorbent boom around two areas (shown on Plate 1) where impacts were observed. The booms were inspected and maintained daily until December 18, 2000 to prevent any adverse impacts to the Buffalo River from this area. The booms were destroyed on December 18, 2000 due to significant ice accumulation and movement in the river.

Through March 2001, it was not possible to install permanent booms due to ice conditions in the river. Sorbent booms were installed along the riverbank around the seepage areas on March 16, 2001 and have been maintained since. Permanent slick-bar booms were installed around the areas of seepage in May 2001 (see Plate 1 for locations).

On June 4, 2003, the shoreline of the Buffalo River was inspected by the NYSDEC. Areas of sheen were observed outside the currently boomed areas to the south and west of the southernmost boom. On June 6, 2003, approximately 120 feet of temporary absorbent booms were placed on the Buffalo River along the south end of the southern containment boom. On June 19 and 20, 2003, the absorbent booms were replaced with permanent booms and attached to the south end of the existing southern containment boom, therefore converting it into a single containment boom measuring 375 feet long. The northern containment boom remains intact. The permanent booms are removed during the winter months due to freezing conditions in the Buffalo River.

The seepage areas have been inspected regularly since October 2000. These inspections include a description of the area of seepage noting any differences in the appearance of the area (i.e., presence or absence of sheen and its location, if present). The inspections also note the position of the boom and any adjustments required.

2.4.3 Separate-Phase Product Recovery

Separate-phase product recovery is ongoing in OU-4. Product recovery efforts in OU-4 have included automated product recovery using a solar powered product only pumping system and manual bailing. Product recovery from selected wells has been conducted in order to provide additional data on the recoverability of product and evaluate the appropriateness of the technology for the OU-4 product plume area.

Between February 2000 and March 2006, a total of approximately 282 gallons of separate-phase product have been recovered from wells in OU-4 as follows:

- 169 gallons from the solar powered pumps (MW-28 and LF-6); and
- 113 gallons manually bailed from OU-4 wells (LF-1S, LF-3, LF-6, MW-28, P-15 and VERMW-3).

Of this total, approximately 81 gallons of product was recovered during the ChemOx pilot study (between April and June 2004) as follows:

- 32 gallons from the solar powered pump (MW-28); and
- 49 gallons manually bailed from OU-4 wells (LF-1S, LF-6 and VERMW-3).

3.0 SUMMARY OF ENVIRONMENTAL CONDITIONS

Data regarding environmental conditions at the Site, and particularly OU-4, were obtained from a review of the results of previous investigations and the ongoing monitoring program at the Site. The following sections include:

- a listing and brief description of previous investigations completed; and
- a summary of the environmental quality based on previous investigations, including soil quality, groundwater quality, separate-phase product occurrence, and sediment quality.

3.1 Previous Investigations

The following is a summary of the previous investigations conducted in OU-4:

- Phase I Investigation at OU-4 (former Disposal Area), conducted by Recra Research, Inc. in 1983 ((Recra Research, 1983);
- Phase II investigation at OU-4 (former Disposal Area), conducted by URS Company, Inc. in 1986 (URS, 1986) and follow-up sampling for the Phase II investigation in OU-4 conducted in the fall of 1986, spring of 1987, and March 1988;
- Installation of five monitoring wells (B-1MW, B-2MW, and B-4MW through B-6MW) in various areas of the Site and performance of water-level and product thickness measurements in these new wells, by Empire Soils Investigations, Inc. in July 1989 (ESI, 1989a);
- Installation of two monitoring wells (W-1 and W-2) in OU-4 and performance of water-level and product thickness measurements in these new wells, by Empire Soils Investigations, Inc. in October 1989 (ESI, 1989b);
- Installation of 25 monitoring piezometers (P-1 through P-25) in OU-4 and performance of water-level and product thickness measurements in these new piezometers, by Empire Soils Investigations, Inc. in April 1990 (ESI, 1990);
- Site Facility Investigation (SFI), conducted by Groundwater & Environmental Services, Inc. (GES) from June through August 1998 (Roux Associates, 1998);
- SFI Completion, conducted by GES and Roux Associates from July through October 1999 (Roux Associates, 1999);
- Field inspection of approximately 1,000 feet of shoreline along the Buffalo River by representatives of ExxonMobil, the NYSDEC, and Roux Associates on October 26, 2000;
- Installation of MW-28 in OU-4 on October 4, 2000 and installation of soil borings, collection of soil samples, installation of monitoring wells, and collection of sediment samples conducted by GES and Roux Associates between December 2000 and April 2001 summarized in the Separate-Phase Product Investigation Report for the Eastern Tank Yard Area (Roux Associates 2001);

- Site Investigation Completion, conducted by GES from August 2001 through February 2002 (Roux Associates, 2002); and

- Evaluation of Aquifer Characteristics conducted by GES and Roux Associates from June 2002 through August 2002 (Roux Associates, 2003a).

- Additional Sediment Sampling of the Buffalo River Shoreline Completion Letter Report, dated October 8, 2003 (Roux Associates 2003b)

3.2 Topography

The topography in OU-4 is generally flat, with a steeply sloped embankment to the Buffalo River. The ground surface elevation drops by approximately 22 to 25 feet in a horizontal span of approximately 25 to 30 feet from the top of the embankment to the river level. High water elevations in the Buffalo River prevent access to the shoreline.

3.3 Geology and Hydrogeology

In general, the geology of the entire OU-4 is influenced by the former disposal activities that were conducted in this area and re-routing of the Buffalo River. Four unconsolidated deposits exist in the area under consideration. The first is a fill layer that consists of black cinders, concrete, brick, glass, wood, silt, gravel, sand, and slag that is consistent with the historical disposal activities. This layer varies in thickness from 7 to 23 feet. The second unit consists of sands; silt (sandy silt to clayey silts); and silts and clays. The thickness of this layer is between 0 and 20 feet throughout the area of interest. The third layer is predominantly comprised of sand and gravel and ranges in thickness from 4 to 11 feet. Underlying the sand and gravel layer is a clay layer. Bedrock was not encountered in any of the wells installed in OU-4. Three generalized hydrogeologic cross-sections are presented on Figure 4. The cross section lines are shown on Plate 1.

Depth to groundwater across the entire OU-4 ranges from approximately 6 to 31 feet below grade. In the pilot test area, the depth to groundwater ranges from approximately 24 to 31 feet below grade. The influence of the eastern leg of the WPS can be seen in monitoring wells in the STYA and the southwest portion of OU-4. A groundwater divide, caused by the operation of the eastern leg of the WPS, exists in the southwestern portion of OU-4. The groundwater flow direction east of the divide is generally southeast toward the Buffalo River. The groundwater flow direction west of the divide, in the southwestern portion of OU-4, is generally west toward the WPS.

3.4 Environmental Quality

The following sections present a brief summary of the data generated during prior investigations regarding the occurrence of separate-phase product, soil, sediment, and groundwater quality in OU-4.

3.4.1 Separate-Phase Product

The historical and current extent of separate-phase product within monitoring wells is shown on Plate 1 south of Tank 176. The results of the long-term gauging program from June 2003 through March 2006 for wells in OU-4 are shown in Table 3. As noted, the data back to 2003 that was previously shown on Table 3 of the RAS is duplicated in Table 3 of this work plan since column headings were inadvertently omitted from the previous table. Hydrographs showing water-table elevation and thickness of product with time, as well as thickness of product and gallons of product bailed with time, for selected wells with separate-phase product in OU-4 (LF-1S, LF-3, LF-6, MW-28, VERMW-3, and VERMW-4) are presented in Appendix A. Separate-phase product has not been recorded in MW-3URS since July 1998; however, historical data indicates that product was present at this location. In addition to existing wells that currently have measurable separate-phase product present, separate-phase product (light golden colored product that could be squeezed out of the recovered soil) was noted at or near the water table interface during the completion of borings/wells SB-82 and SB-84 during December 2000. However, none of the wells installed in December 2000 have indicated the presence of measurable separate-phase product during ongoing water/product level gauging and/or groundwater sampling. In addition, no volatile organic compounds (VOCs) or semivolatile organic compounds (SVOCs) were detected in the groundwater samples collected from these wells in January 2001. Above the water table, heavier black product (still capable of being squeezed from the recovered soil) was observed at SB-82 (7 to 9 feet below land surface [ft bls]) and SB-84 (5 to 9 ft bls). Finally, thick black tar-like material, which was relatively solid, was observed above the water table at SB-79 (5 to 7 ft bls), SB-80 (7 to 9 ft bls), SB-81 (15-17 ft bls), SB-82 (11 to 11.5, 15 to 17, and 18.5 to 19 ft bls) and SB-85 (5 to 7 ft bls).

Samples of separate-phase product were collected and analyzed from four wells in this portion of OU-4 (P-15, MW-3URS, LF-1S and MW-28). Appendix B presents the results of the laboratory analyses performed on these samples. The results from MW-28 and LF-1S indicate that the separate-phase product at these locations is comprised entirely of severely biodegraded diesel fuels. The results from P-15 indicate that the product is comprised of 80 percent diesel range hydrocarbons and 20 percent gasoline range hydrocarbons. Finally, the results from MW-3URS, in which separate-phase product has not been observed since 1998, indicate that the product was comprised of 85 percent diesel range organics and 15 percent gasoline range organics.

Long-term product recovery since 2001 is described in Section 2.4.3.

3.4.2 Soil Quality

The summary of soil quality includes comparisons of the Site data collected to the NYSDEC soil quality criteria, described below.

Soil Quality Criteria

Soil quality data from previous investigations has been compared to the available NYSDEC soil quality criteria. The soil quality data generated during previous investigations have been evaluated against the criteria presented in the following NYSDEC documents:

- NYSDEC Recommended Soil Cleanup Objectives (RSCOs) presented in the "Division of Hazardous Waste Remediation. Division Technical and Administrative Guidance Memorandum (TAGM) 4046: Determination of Soil Cleanup Objectives and Cleanup Levels" (NYSDEC 1994) and NYSDEC revised soil cleanup criteria tables for TAGM 4046 for gasoline and fuel oil contaminated soil dated August 22, 2001 (NYSDEC 2001).

This type of comparison enables identification of areas that may pose a potential risk under a residential land use scenario, as well as those areas that may have potential to impact groundwater at concentrations exceeding drinking water standards.

However, it should be noted, that the BCP allows for consideration of the current and reasonably anticipated future use of the Site when selecting a remedy and provides for four potential cleanup "Tracks". ExxonMobil and Buckeye intend for land use of OU-4 remain as industrial for the foreseeable future. Based upon information from the City of Buffalo website, the current zoning of the portion of the site South of Elk Street is either M2-General Industrial District (OU-4) or M3-Heavy Industrial District (all other areas) with allowable industrial land use. Additional information regarding zoning and land use was provided by the City of Buffalo during the public comment period on ExxonMobil's BCP application. This information indicates that, per the City's Local Waterfront Revitalization Program (LWRP), the proposed zoning of the portion of the Site south of Elk Street is CM-Central Commercial District with a proposed land use of mixed-use commercial/light industrial.

Given the nature and extent of contamination in OU-4 and the current and reasonably anticipated future land use as industrial, ExxonMobil anticipates that the remediation for OU-4, including the IRM, will follow a Track 4 cleanup approach, which would entail development of site-specific cleanup criteria. The Track 4 approach recognizes that it may not be technically feasible or practicable to remove or treat all contamination at the Site. The NYSDEC has issued a second draft revised 6 NYCRR Part 375 dated June 14, 2006. This regulation will include the requirements to implement the BCP and will include the track-specific cleanup criteria tables. The schedule for finalizing the regulation has not been provided at this time.

Regarding the four Track cleanup approach, and the lack of currently promulgated regulations to implement the four Track approach, the draft BCP guide includes the following:

> "Until the Soil Cleanup Tables are developed as required by Title 14, the multi-track approach will not be available. Instead, the Department will continue to implement the approach used in the past under the VCP which most closely resembles Tracks 1 (unrestricted use) and 4 (site specific use based cleanup). Under this approach, the Department will continue to look at unrestricted remedies and site-by-site evaluations."

In general, the results of previous investigations indicate that soil quality in OU-4 has been impacted by historical activities. The samples collected during the previous investigations in OU-4 indicate that several VOCs, SVOCs, and metals exceeded NYSDEC RSCOs, though these will be reevaluated based upon site-specific criteria once developed.

Impacts due to diesel range constituents (SVOCs and total petroleum hydrocarbons-diesel range organics [TPH-DRO]) are more widespread with generally higher concentrations and concentrations of more compounds exceeding RSCOs than impacts due to gasoline constituents

(VOCs and TPH-gasoline range organics [TPH-GRO]). Limited impacts due to gasoline range constituents were observed within the product plume and in the west/southwest portion of OU-4.

3.4.3 Sediment Quality

Sediment quality data collected from the area adjacent to OU-4 (within OU-5) during previous investigations have indicated the presence of VOCs, SVOCs, and metals.

The results of a Phase II investigation of OU-4 (formerly referred to as the Buffalo Terminal Disposal Site) conducted in 1985 (URS, 1986) indicated that the sediment adjacent to OU-4 (within OU-5) was impacted by metals, VOCs, and SVOCs. The locations of the two sediment samples collected during the Phase II investigation are shown on Plate 1. The investigation concluded that the impact to sediment could, at least in part, be attributed to non-ExxonMobil source(s). As a result of the Phase II investigation and additional sampling, the NYSDEC concluded that the Buffalo Terminal Disposal Site does not present a significant threat to human health and the environment.

In addition, on a regional scale, historical sediment quality data was collected and evaluated by the United States Environmental Protection Agency (USEPA) during the period of 1981-1994 as part of several studies. This data indicates that the sediment both upstream and downstream from the Terminal is impacted by industrial activities. The impact upstream was demonstrated to be as great or greater than that found adjacent to the Terminal (USEPA 1984 and 1994).

The analytical results from sediment samples collected from the Buffalo River shoreline in April 2001 confirm field observations of petroleum-related impacts made during the October 2000 shoreline inspection and during the April 2001 sediment sampling program. Where odor, staining, sheen and/or separate-phase product were observed, the analytical results indicated the presence of petroleum-related constituents.

Laboratory results indicate that sediment quality in the 1,000-foot segment of Buffalo River shoreline inspected in October 2000 has been impacted by diesel range and gasoline range constituents. Impacts related to diesel fuel constituents (SVOCs and TPH-DRO) are more widespread with higher concentrations than impacts due to gasoline constituents (VOCs and

TPH-GRO). This information is consistent with the analytical results of product samples collected from OU-4 wells that indicate the product is primarily comprised of diesel fuel and diesel range hydrocarbons. The highest impacts from gasoline constituents were observed within the boomed areas at locations where product/iron staining and/or product seepage were observed during the October 2000 inspection of the shoreline and during the April 2001 sampling program.

The distribution of petroleum-related impacts along the shoreline is consistent with the possibility that impacts may be transported along the riverbank by the actions of currents and wind in either direction.

3.4.4 Groundwater Quality

The summary of groundwater quality includes comparisons of the Site data to the NYSDEC groundwater criteria, as described below.

Groundwater Criteria

In the discussions of previous investigations that follow, the groundwater data collected during these investigations is compared to the NYSDEC Ambient Water Quality Standards and Guidance values (AWQSGVs) for Class GA groundwater presented in the Division of Water Technical and Operational Guidance Series (TOGS 1.1.1) “Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations” (NYSDEC, 1998), as amended in April 2000.

Many wells in OU-4 have been sampled during the previous investigations and the quarterly groundwater sampling rounds conducted since January 2001. The results of the groundwater sampling confirmed the conclusions drawn from previous investigations, that concentrations of VOCs and SVOCs in groundwater are generally low in OU-4 and that NYSDEC AWQSGVs are exceeded only in localized areas (in the southwest portion of OU-4 and in the vicinity of the separate-phase product plume). Metal concentrations exceeding AWQSGVs were distributed throughout the area.

3.4.5 Field Observations Along the Buffalo River Bank Adjacent to OU-4 (within OU-5)

On October 26, 2000, representatives from ExxonMobil, the NYSDEC, and Roux Associates inspected the Buffalo River shoreline for evidence of sheen and product seepage. Approximately 1,000 feet of shoreline was inspected, as indicated on Plate 1 (the width of the shoreline area inspected is exaggerated for clarity). The following observations were made during the inspection. The locations of the items listed below are shown on Plate 1.

- The area where product seepage and the greatest product/iron staining was observed along the river bank is shown within the limits of the northeastern boomed area. The product seepage was observed just above the river level on October 26, 2000 (570.76 feet above mean sea level [amsl]) and the product/iron staining extended two to five feet into the river.

- Two areas where significant product/iron staining and sheen were observed and are shown within the southwestern boomed area. The product/iron staining extended several feet into the river.

- Two areas where product staining was observed within the embankment adjacent to the river are shown near the northeast boomed area. These areas were observed at an approximate elevation of 573 feet amsl to 574 feet amsl (approximately 2 to 3 feet above the river level on October 26, 2000).

- Three areas adjacent to the Buffalo River bank where an asphalt material was observed within the embankment are shown. The asphalt material was observed at an elevation of approximately 577 to 578 feet amsl (approximately 6 to 7 feet above the river level on October 26, 2000).

- An area where an asphalt/tar-like material was observed on the ground surface is shown to the northeast of monitoring well MW-4URS.

- An area where drum remnants were observed within the embankment is shown. The drum remnants were observed at an approximate elevation of 581 to 586 feet amsl (approximately 10 to 15 feet above the river level).

On June 4, 2003, the shoreline of the Buffalo River was inspected by the NYSDEC. Areas of sheen were observed outside the currently boomed areas to the south and west of the southernmost boom. Boom placement in these areas is discussed in Section 2.4.2.

- The shoreline continues to be inspected regularly. The results of the inspections are reported in the Site Monitoring Report that is issued on a quarterly basis.

4.0 REMEDIAL GOALS, SCGS AND REMEDIAL ACTION OBJECTIVES

This section describes the remedial goals and RAOs for the proposed remediation of the separate-phase product plume in OU-4, located south of Tank 176 as an IRM. Based upon the results of the previous site investigations and the current and potential future use of the property, the remedial goals and RAOs have been developed for the IRM. Also included is a description of Standards, Criteria and Guidance applicable to the IRM. This section was initially presented in the RAS document. However, since the Site had not yet entered the BCP at that time, this section has been revised, as applicable, to reflect changes due to the BCP.

4.1 Remedial Goals

As described in Section 4.1 of the Draft BCP Guide, "the goal of the remedy selection process in the BCP is to select a remedy for a site that is fully protective of public health and the environment, taking into account the current, intended, and reasonably anticipated future land use of the site". In addition, the draft BCP guide indicates that "Source removal should be the goal of all BCP remedies".

Consistent with the Draft BCP Guide, the proposed IRM for the OU-4 product plume, coupled with planned future remedial activities for the remainder of OU-4, will be fully protective of public health and the environment, taking into account the current, intended, and potential future land use. The proposed IRM removes, to the extent practicable, the source of contamination in the OU-4 product plume area. It also eliminates or mitigates significant threats to public health and the environment presented by the contaminants within the OU-4 product plume area.

4.2 Standards, Criteria and Guidance

SCGs are promulgated requirements ("standards" and "criteria") and non-promulgated guidance ("guidance") that govern activities that may affect the environment and are used by the DER at various stages in the investigation and remediation of a site. SCGs incorporate both the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by Superfund Amendments and Reauthorization Act of 1986 (CERCLA) concept of "applicable or relevant and appropriate requirements" (ARARs) and the USEPA's "to be considered" (TBCs) category of non-enforceable criteria or guidance. SCGs applicable to the OU-4 product plume area are presented below.

Citation	Title	Regulatory Agency
Soil		
TAGM-4046	Determination of Soil Cleanup Objectives and Cleanup Levels	NYSDEC
Draft BCP Guide	Site Specific Use Based Cleanup Criteria	NYSDEC
Draft Part 375	Proposed Track 4 Site-Specific Cleanup Criteria	NYSDEC
Ground Water/ Surface Water		
40 CFR Part 131	Water Quality Criteria	USEPA
40 CFR Part 141.11-16	Maximum Contaminant Levels	USEPA
40 CFR Part 141.50-52	Maximum Contaminant Level Goals	USEPA
6 New York Code of Rules and Regulations (NYCRR) Part 608	Use and Protection of Waters	NYSDEC
6 NYCRR Part 700-705	Surface Water and Ground Water Classification Standards	NYSDEC
Technical Operational Guidance Series (TOGS) 1.1.1	Ambient Water Quality Standards and Guidance Values	NYSDEC
Air		
40 CFR Part 50	National Ambient Air Quality Standards	USEPA
40 CFR Part 60	Standards for Performance of New Stationary Sources	USEPA
40 CFR Part 61	National Emissions Standards for Hazardous Air Pollutants	USEPA
Air Guide No. 1	Guideline for the Control of Toxic Ambient Air Contaminants	NYSDEC
6 NYCRR Part 212	General Process Emission Sources	NYSDEC
6 NYCRR Part 257	Air Quality Standards	NYSDEC

The prior Site investigations have identified the contaminants exceeding RSCOs and Class GA AWQSGVs and environmental media impacted by the contaminants. It is understood that the NYSDEC is in the process of finalizing the regulation (draft 6 NYCRR Part 375) to implement the BCP, which includes the Track 4 cleanup approach (i.e., restricted use with site-specific cleanup objectives) applicable to sites where the current and reasonably anticipated future land will be commercial or industrial. The Draft BCP Guide (which describes the cleanup approach to be used until the final regulations are promulgated) and the draft Part 375 (Track 4 approach) provide for the development of site-specific soil cleanup objectives. Therefore, given the current and anticipated land use at the Site, ExxonMobil will develop site-specific cleanup objectives for approval by the NYSDEC and re-evaluate the soil quality data based upon these values.

4.3 Remedial Action Objectives

The RAOs for the OU-4 separate-phase product plume area have been established for the protection of public health and the environment and are developed based on the SCGs, described above.

As specified in Draft DER-10, Section 4.1(c), RAOs are to be established by:

1. identifying all contaminants exceeding applicable SCGs and the environmental media impacted by the contaminants;
2. identifying applicable SCGs, taking into consideration the current and, where applicable, future land use for the Site;
3. identifying all actual or potential public health and/or environmental exposures resulting from contaminants in environmental media at, or impacted by, the Site; and
4. identifying any site-specific cleanup levels developed pursuant to Draft DER-10, Section 3.10.3(e).

As outlined in DER-10, Appendix 4B, the primary RAO for public health protection at the Site is to eliminate potential exposure pathways by preventing humans from contacting, ingesting, or inhaling contaminated environmental media. In addition, the following RAOs will be applicable to the OU-4 IRM for environmental protection:

- removal of the source of groundwater or surface water contamination, including free product and grossly contaminated soil, to the extent technically and practicably feasible;
- preventing migration of contamination that would result in groundwater, surface water, or sediment contamination; and
- preventing impacts to biota from ingestion/direct contact with surface water and sediments causing toxicity and impacts from bioaccumulation through the marine or aquatic food chain.

5.0 IRM SELECTION PROCESS

The RAS Report detailed the selection process that was followed for the IRM described in this work plan. However, since the Site had not yet entered the BCP at that time, the rationale for selection of the IRM has been revised, as applicable, to reflect changes due to the BCP.

As part of the IRM selection process, the following field tests were performed in the OU-4 in order to evaluate potential remedial technologies:

- Long-term separate-phase product-only recovery testing;
- Aquifer testing of groundwater recovery for containing and recovering groundwater, controlling the migration of separate-phase product, and enhancing separate-phase product recovery;
- VER pilot testing; and
- ChemOx pilot testing.

The results of the testing are described in detail in the RAS report and are summarized below. The rationale for selection of ChemOx is provided below and incorporates modifications to the original selection rationale presented in the RAS due to the Site entering the BCP.

5.1 Field Test Conclusions

Based upon the data presented above for the testing of the four technologies conducted in the separate-phase product plume in the OU-4, the following conclusions have been drawn regarding the potential applicability of these technologies to this area of the site.

5.1.1 Product-Only Recovery

The results of the long-term product only recovery testing has shown that product only pumping alone is not a viable option for achieving the RAOs for the OU-4 product plume area. Product only recovery through manual bailing and/or automated pumping does successfully remove the product that accumulates in the wells in the OU-4 product plume area; however, since it is a passive operation, the product must make its way into the well to be recovered and a single well influences only a small portion of the OU-4 product plume area. Multiple wells and pumping systems, as well as long operational periods, would be required to achieve large scale recovery across the OU-4 product plume area, which is impractical. Product-only recovery will continue to be employed to recover available product and increase recovery rates when used in combination with technologies that have been shown to increase product thicknesses in OU-4 product plume area wells (i.e., ChemOx).

5.1.2 Groundwater Recovery for Containment and Product Recovery Enhancement

Based upon the results of the aquifer testing, groundwater recovery for containment and product recovery enhancement is not a feasible technology for the OU-4 product plume area. Measurable water table drawdown was not observed in any of the surrounding monitoring wells during the pump testing at RW-8R, indicating a negligible zone of influence caused by the pumping well. Water level fluctuations were observed in all monitoring wells that were correlated directly to Buffalo River level changes. In addition, water table fluctuations corresponding to changes in Buffalo River levels were evident in the pumping well during the entire test period, indicating that even under pumping conditions, the influence of the river was not completely overcome. Though not calculated during the aquifer testing, a significant portion of the extracted groundwater volume was likely Buffalo River water. Due to the significant influence of the Buffalo River on the ability to extract groundwater and to effect drawdown in the area surrounding the pumping well, groundwater recovery is not a viable option to meet the RAOs for the OU-4 product plume area. The excessive volumes of groundwater/river water that would need to be recovered and treated in order to provide containment and product recovery enhancement would be cost prohibitive.

5.1.3 VER Pilot Test

The primary intent of the VER pilot test was to verify the effectiveness of VER at several different operating conditions based on the constraints of the site and equipment. The various tests were completed with all equipment operating within the expected ranges and without any test delays due to equipment or instrument malfunction. The test succeeded in acknowledging the limitations of the technology. The operation of the VER test showed the difficulties with utilizing the technology in an aquifer with a high permeability, a water table depth close to limitation of the technology and in close proximity to the Buffalo River.

Unfortunately, adjustments to the drop tube depth while operating at various recovery wells, the addition of a packer, and the installation of a pneumatic pump did not succeed in generating a higher vacuum on the well and, thus, extracting/entraining separate-phase product. The lithology of the OU-4 product plume area with a combination of fine to medium sands with some silt and clay, and the overlying fill with ash, glass, brick and concrete, allowed the applied vacuum to dissipate easily in the formation. The available equipment could not overcome the rate of vacuum dissipation.

The inability to maintain a high vacuum and observe significant influence at the wellhead or monitoring wells showed that the application of vacuum to entrain product would prove difficult without substantial expense. The only substantial hydrocarbon recovery was completed through the removal of vapor phase hydrocarbons.

Based upon these results, VER did not meet the RAOs for the remediation of the OU-4 product plume area and is not considered feasible for implementation in this area of the Site.

5.1.4 ChemOx Pilot Test

The ChemOx Pilot test was successful in reducing petroleum related contaminant concentrations in soil, groundwater, and separate phase product (the primary RAOs for the remediation). It also contributed to reducing product thicknesses in some wells within the pilot test area (either directly or through making additional product available for manual recovery) and in changing the physical properties and appearance of the product, indicating that breakdown of the product was occurring. Achieving a full understanding of the actual physical/chemical/biological processes responsible for these changes was beyond the scope of the pilot test.

ChemOx has been selected for implementation in the OU-4 separate-phase product plume area based upon the pilot test results. A description of the proposed full-scale remedy for the OU-4 product plume area is presented in Section 6.0. It was clear from the pilot test data that some modifications to the design of the pilot test injection points would be required to optimize system performance (i.e., deeper ozone and peroxide injection points and additional supplemental hydrogen peroxide-only injection points at the water table interface). These changes are discussed in Section 6.0, along with a conceptual layout of a full-scale ChemOx system for the OU-4 product plume area.

5.2 Rationale for Selection

This section includes a revised evaluation, as applicable, to reflect changes due to the BCP, of the selected IRM for the OU-4 product plume. ChemOx was selected as the recommended IRM for the OU-4 product plume based on the following eight evaluation criteria presented in Section 4.1 of the Draft DER-10 Technical Guidance and/or the Draft BCP Guide:

- Overall protection of public health and the environment;
- Compliance with SCGs;
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume with treatment;
- Short-term effectiveness;
- Implementability;
- Cost; and
- Compatibility with land use.

Each of the criteria is described below, along with an evaluation of the proposed recommended remedy against the criteria. In addition, DER-10 and the Draft BCP Guide require that the remedy be evaluated on the basis of Community Acceptance following public participation activities. However, per the Draft BCP Guide Section 3.14, since the proposed remedial action is being completed as an IRM that does not constitute the final remedy for OU-4, ExxonMobil contends that formal citizen participation activities are not required and the Community Acceptance criteria does not apply.

5.2.1 Overall Protection of Human Health and the Environment

Description of Criteria

From DER-10: "This criterion is an evaluation of the remedy's ability to protect public health and the environment, assessing how risks posed through each existing or potential pathway of exposure are eliminated, reduced, or controlled through removal, treatment, engineering controls, or institutional controls. The remedy's ability to achieve each of the RAOs is evaluated."

Evaluation of Proposed Remedy

The proposed ChemOx IRM system will be protective of human health and the environment by reducing the concentrations of petroleum-related hydrocarbons in groundwater, soil, and separate-phase product, as evidenced by the pilot test data for each of these media. In addition, operation of the ChemOx system will enhance separate-phase product recovery efforts by making more product available for manual and/or automated recovery efforts, as evidenced by the increase in product recovery during the pilot test. The potential for human and environmental exposure to the petroleum-related contaminants in the remediation OU-4 product plume will be reduced as the source of contamination (i.e., separate-phase product) is recovered and/or degraded and the concentrations of contaminants in groundwater discharging to the river are reduced.

5.2.2 Compliance with Standards, Criteria and Guidance (SCGs)

Description of Criteria

From DER-10: "Compliance with SCGs addresses whether or not a remedy will meet applicable environmental laws, regulations, standards, and guidance. All SCGs for the site will be listed along with a discussion of whether or not the remedy will achieve compliance. For those SCGs that will not be met, provide a discussion and evaluation of the impacts of each, and whether waivers are necessary."

Evaluation of Proposed Remedy

SCGs for the proposed remedy are presented in Section 4.0. As noted previously, it is understood that the NYSDEC is in the process of finalizing the regulation (draft 6 NYCRR Part 375) to implement the BCP, which includes the Track 4 cleanup approach (i.e., restricted use with site-specific cleanup objectives) applicable to sites where the current and reasonably anticipated future land will be commercial or industrial. The Draft BCP Guide (which describes the cleanup approach to be used until the final regulations are promulgated) and the draft Part 375 (Track 4 approach) provide for the development of site-specific soil cleanup objectives. Therefore, given the current and anticipated land use at the Site, ExxonMobil will develop site-specific cleanup objectives for approval by the NYSDEC and re-evaluate the soil quality data based upon these values. Even if SCGs are not met within a reasonable operating timeframe due to the practical limitations of the technology, significant reductions of contaminant concentrations and prevention of migration of contaminants to the Buffalo River are expected, which meet the RAOs for the site.

Though development of site-specific cleanup criteria is appropriate for the Site, it should be noted that pilot test data indicates that implementation of ChemOx in the pilot area has the potential to remediate concentrations of petroleum-related compounds in soil to NYSDEC RSCOs and groundwater to NYSDEC AWQSGVs. For example, concentrations of VOCs and SVOCs in groundwater at several monitoring wells within the pilot test area were reduced below applicable SCGs (NYSDEC AWQSGVs). Similarly, the soil sample from SB-194 indicated that concentrations were below NYSDEC RSCOs.

5.2.3 Long-term Effectiveness and Permanence

Description of Criteria

From DER-10: "This criteria evaluates the long-term effectiveness of the remedy after implementation. If wastes or treated residuals remain onsite after the selected remedy has been implemented, the following items are evaluated:

- The magnitude of the remaining risks (i.e., will there be any significant threats, exposure pathways, or risks to the community and environment from the remaining wastes or treated residuals);
- The adequacy of the engineering and institutional controls intended to limit the risk;
- The reliability of these controls; and
- The ability of the remedy to continue to meet RAOs in the future."

Evaluation of Proposed Remedy

The monitoring plan for the proposed remedy will evaluate the long-term effectiveness of the remediation with regard to the magnitude of remaining risk. The ChemOx process is expected to provide a long-term solution for the OU-4 product plume by treating petroleum-related contaminant concentrations in soil, groundwater, and separate-phase product through multiple physical, chemical, and biological processes and by enhancing recovery of separate-phase product. Therefore, if contamination does remain in the OU-4 product plume after implementation of the remedy, due to practical limitations of the technology, concentrations of contaminants will be significantly reduced from present conditions and migration of contaminants to the Buffalo River will be prevented.

Since ChemOx for the OU-4 product plume is an IRM, institutional controls (i.e., an environmental easement) are not required.

5.2.4 Reduction in Toxicity, Mobility or Volume through Treatment

Description of Criteria

From DER-10: "The remedy's ability to reduce the toxicity, mobility, or volume of site contamination is evaluated. Preference should be given to remedies that permanently and significantly reduce the toxicity, mobility, or volume of the wastes at the Site."

Evaluation of Proposed Remedy

As demonstrated during the pilot test, ChemOx was successful in reducing the concentrations of petroleum-related hydrocarbons in groundwater, soil, and separate-phase product. In addition, operation of the ChemOx system will enhance separate-phase product recovery efforts by making more product available for manual and/or automated recovery efforts, as evidenced by the increase in product recovery during the pilot test. The ChemOx process destroys contaminants in the various Site media (soil, groundwater, and separate-phase product) without producing significant byproducts (some carbon monoxide is produced). The process also enhances separate-phase product recovery through physical transformations and/or changes in water table elevations that make additional product available for manual and/or automated recovery. The byproduct of this recovery process is waste petroleum that is temporarily stored onsite and ultimately disposed offsite. It is expected that several hundred gallons of separate-phase product may be recovered during the remediation.

5.2.5 Short-term Effectiveness

Description of Criteria

From DER-10: "The potential short-term adverse impacts and risks of the remedy upon the community, the workers, and the environment during the construction and/or implementation are evaluated. A discussion of how the identified adverse impacts and health risks to the community or workers at the site will be controlled and the effectiveness of the controls should be presented.

Provide a discussion of engineering controls that will be used to mitigate short-term impacts (i.e., dust control measures). The length of time needed to achieve the remedial objectives is also estimated."

Evaluation of Proposed Remedy

The health and environmental risks associated with implementation of ChemOx in the OU-4 product plume are minimal. The total remediation process is expected to take between one and two years of active operation (phased across the OU-4 product plume as described below), followed by two years of long-term monitoring. With the health and safety precautions and procedures developed during the pilot test operation, the system can be operated safely and without adverse impacts to human health and the environment. The ChemOx implementation area is located in an area of the Site where access is restricted by the steep slope to the Buffalo River and by a fence that surrounds much of OU-4. The ChemOx equipment trailer will be located within the fenced area of OU-4.

Although the ChemOx process produces an exothermic reaction in the subsurface, monitoring data collected during the pilot test indicated the process did not produce subsurface conditions that would pose a threat to human health (i.e., explosive conditions, harmful vapors, excessive temperatures, etc). Continued monitoring of conditions in the subsurface to assess for health and safety concerns will be conducted during full-scale operation.

5.2.6 Implementability

Description of Criteria

From DER-10: "The technical and administrative feasibility of implementing the remedy is evaluated. Technical feasibility includes the difficulties associated with the construction and the ability to monitor the effectiveness of the remedy. For administrative feasibility, the availability of the necessary personnel and material is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, etc."

Evaluation of Proposed Remedy

The materials, equipment, and personnel associated with the implementation of ChemOx are commercially available and have been proven effective and reliable for remediation of the media of concern at the Site under similar circumstances, as evidenced by the success of the pilot test in the OU-4 product plume. In general, the components of the remediation system can be constructed, maintained, and operated.

5.2.7 Cost

Description of Criteria

From DER-10: "Capital, operation, maintenance and monitoring costs are estimated for the remedy and presented on a present worth basis."

Evaluation of Proposed Remedy

The estimated construction and equipment costs and long-term operation, maintenance, and monitoring costs for two years (approximate annual cost of $270,000 per year) associated with the full-scale remedy are estimated as follows:

• Construction and Equipment Cost	$560,000
• O&M Cost	$540,000
Total Cost	$1,100,000

For cost estimating purposes, a two-year period of operation followed by a two year period of monitoring was assumed throughout this document.

5.2.8 Compatibility with Land Use

Description of Criteria

From the Draft BCP Guide: "Preliminary information regarding the land use factor was submitted as part of the application. The Department accepted this initial determination of use by approval of the application. This preliminary determination is confirmed and updated as necessary during the remedy selection process. Current, intended, or reasonably anticipated future land uses of the site and its surroundings must be considered in the selection of the remedy."

Evaluation of Proposed Remedy

Due to the fact that this is an IRM and not the final remedy for OU-4/OU-5, this criteria is not applicable.

6.0 CHEMOX SYSTEM COMPONENTS

The following is a detailed description of the components of the ChemOx system.

6.1 ChemOx System Layout

The proposed implementation of ChemOx as an IRM in the OU-4 product plume area will consist of installation of a network of 25 new nested ChemOx injection points in five ChemOx "Cells", eight existing or new supplemental peroxide-only injection points within ChemOx Cells 1 and 2 (additional points may be added in other cells based upon long-term data) and the operation of one mobile injection unit (similar to the pilot test injection unit). Operation of the ChemOx system will be in a phased approach within ChemOx Cells consisting of five nested injection points each (one ozone and one hydrogen peroxide point) plus up to four supplemental hydrogen peroxide injection points across the Site. It should be noted that the number of supplemental hydrogen peroxide points required per cell will be determined based upon long-term monitoring data from Cells 1 and 2. Construction of all equipment within the mobile injection units, as well as the aboveground piping, will be consistent with the pilot test configuration, except as noted below. Proposed full-scale ChemOx injection point construction and spacing is discussed further below.

Monitoring of the progress of the remediation will be conducted through a network of newly installed and existing groundwater monitoring wells and membrane interface probe (MIP) borings, with confirmatory soil borings collected at select locations. Construction of the proposed monitoring wells will be similar to the "VERMW" series wells installed for the pilot testing, except that they will be a 4-inch diameter. Operation, maintenance, and monitoring of the proposed ChemOx system is discussed below in Section 8. The proposed locations of ChemOx injection points, existing and proposed supplemental hydrogen peroxide points, existing and proposed monitoring wells, and MIP borings are presented on Plate 2. As evident in Plate 2, initially all ChemOx injection points and monitoring wells will be located outside the bermed area, downgradient of the Tank 176. This is to verify the long-term use of the technology prior to entrance into the ongoing active operations within the berm. Five MIP borings (Plate 2) will be installed initially within the bermed area to evaluate current conditions and to determine the appropriate need for ChemOx within the tank berm. During the monitoring phase of the ChemOx cells located outside the tank berm, the steps necessary to address impacts that may exist beneath the tank berm will be evaluated.

6.1.1 Proposed ChemOx Injection Point Spacing

Based upon the results of the pilot testing, a radius of influence of approximately 20 feet per injection point can reasonably be expected. Therefore, in order to provide overlapping coverage of the OU-4 product plume area, the proposed nested ChemOx injection points are spaced at approximately 30 feet apart, except nearest to the Buffalo River bank, which are spaced slightly closer (24 to 28 feet apart). This slightly closer spacing of nested injection points is intended to provide additional treatment of this critical area. Supplemental hydrogen peroxide points screened just below the water table, comprised of four proposed new points and four existing pilot test points (CO-2, CO-3, CO-4 and CO-5) within the first two cells, are staggered between the nested injection points. If, during long-term operation, particularly in the first two cells, it is determined that there are portions of the OU-4 product plume area that are not receiving adequate coverage, additional ChemOx nested injection points or supplemental hydrogen peroxide injection points will be installed in future cells. Conversely, if it is determined that certain portions of the area could be adequately covered by fewer nested or supplemental injection points, fewer points may be installed.

6.1.2 Proposed ChemOx Injection Point Construction

A cross section running generally west to east through the proposed ChemOx IRM area is presented as Figure 5. The cross section line is shown on Plate 2. The cross section shows the proposed configuration of the ChemOx injection points throughout this portion of the OU-4 product plume area. Based upon the results of the ChemOx pilot test MIP borings, the mass removal of hydrocarbons from the subsurface occurred at and above the elevation of the top/midpoint of the hydrogen peroxide injection point. It has been surmised that this is the zone at which the cone of influence created by the ozone rising from the ozone injection point meets the cone of influence created by the peroxide dispersed from the peroxide injection point. At all pilot test injection point locations, the peroxide injection screen was located within the second layer of unconsolidated deposits consisting of sands; silt (sandy silt to clayey silts); and silts and clays located directly below the first layer of unconsolidated deposits comprised of fill. At all locations except CO-1 (which was inoperable during the pilot test), the ozone injection point was located within the third layer of unconsolidated deposits comprised primarily of sand and gravel. The water table, separate-phase product and associated smear zone of residual product throughout the OU-4 product plume area are located within the two upper geologic layers. Therefore, they comprise the critical zone for treatment by the proposed ChemOx technology. The combination of nested ChemOx injection points (one deep ozone injection point and one hydrogen peroxide point) and supplemental hydrogen peroxide injection points screened just below the water table are intended to target this critical zone.

Nested Injection Point Configuration

Typical nested ChemOx injection point construction is provided on Figure 6. The proposed, nested ChemOx injection points will include two screens, as follows:

- One two-foot air/ozone injection point located just above the clay layer with the bottom of the screen ranging in depth from approximately 33 to 38 feet below grade (actual depths will vary throughout the site and will be determined based on encountering the clay layer) in a nested configuration;
- One two-foot hydrogen peroxide injection point located at the bottom of the second layer of unconsolidated deposits (sands; silt [sandy silt to clayey silts]; and silts and clays), (depths will vary throughout the OU-4 product plume area and will be determined based on the depth of the air/ozone injection point and geology encountered) in a nested configuration with the air/ozone injection point.

The proposed, nested ozone injection point configuration is deeper than that used during the pilot test and is, therefore, expected to provide a wider cone of influence of ozone. The proposed configuration of the nested hydrogen peroxide injection points is also a few feet deeper than the pilot test peroxide injection points. This configuration is intended to maximize the treatment provided in the vicinity of the water table/product table interface and smear zone, while still providing an additional treatment to a portion of the deeper contamination that was indicated by the pilot test MIP borings.

In order to ensure compatibility with the chemicals to be injected, the ozone injection wells will be constructed of stainless steel. Each “nested” location will include two injection wells constructed by installing two $^{1}/_{2}$–inch diameter stainless steel risers (one riser pipe for oxygen/ozone and one riser pipe for hydrogen peroxide) into a six-inch diameter borehole. Each borehole will be advanced to approximately 33 to 38 ft bls. All wells will be installed above the clay interval (denoting the base of the water table aquifer).

Each nested hydrogen peroxide and ozone injection well will be completed with a two foot long by ½ inch diameter section of stainless steel well screen (diffuser), installed at the end of a stainless steel casing into saturated soil. The ozone diffuser will be installed at the bottom of the nested injection well boring, approximately 33 to 38 ft bls depending upon the depth at which the clay layer is encountered. Sand pack will be placed surrounding the diffuser and to a depth of one foot above the top of the diffuser. A bentonite seal (minimum of one foot thick) will be placed above the sand pack surrounding the ozone diffuser to prevent short-circuiting. The two-foot hydrogen peroxide injection well screen will be installed at the bottom of the second layer of unconsolidated deposits (depths and screen interval will vary throughout the OU-4 product plume area and will be determined based on the geology encountered at each location). Sand pack will be placed surrounding the well screen and to a depth of two feet above the top of the screen. A bentonite seal (minimum of one foot thick) will be placed above the sand pack to prevent short-circuiting. Following the installation of the diffuser and the well casing, each borehole will be filled with concrete grout and completed with a stick-up protective casing.

Supplemental Injection Point Configuration

Supplemental hydrogen peroxide points that are staggered laterally from the ChemOx injection point will be existing or new wells screened just below the water table.

Each supplemental hydrogen peroxide point is or will be constructed such that the stainless steel diffuser is located just below the water table interface (approximately 26-28 ft bls). The actual depth will be based upon conditions encountered. Pilot test wells CO-2, CO-3, CO-4, and CO-5 will be utilized during the full-scale operation and there will be an additional four supplemental hydrogen peroxide only points installed within Cells 1 and 2. The construction will be of ½-inch stainless steel diffuser and riser in a 6-inch diameter borehole. The sand pack will be placed surrounding the diffuser and to a depth of two feet above the top of the diffuser. A bentonite seal (minimum of one foot thick) will be placed above the sand pack. The remainder of the well annulus will be filled with concrete grout and completed with a stick-up protective casing. Typical supplemental hydrogen peroxide injection point construction is provided on Figure 6.

The supplemental points may be added to the other cells based upon the field observations obtained from the operation within Cells 1 and 2.

6.1.3 Proposed Mobile ChemOx Injection Units

The proposed mobile ChemOx injection unit(s) will be similar to the equipment used during the pilot test. The use of one mobile injection unit that can operate within one or two ChemOx cells simultaneously is planned for the full-scale ChemOx system. The unit will be stationed in a centralized location in order to maximize the number of cells that can be treated without moving the unit, to the extent possible. The ChemOx system is housed in a 16-foot trailer. The trailer includes the air/ozone and hydrogen peroxide injection systems with individual controls for each well. A Process and Instrumentation Diagram depicting the oxidation system is included as Figure 7 and a Process and Instrumentation Diagram Legend is included as Figure 8.

The ozone components include an air compressor, pressure swing adsorption unit, and dual ozone generators. The air compressor and pressure swing adsorption unit are utilized to generate 90-95% pure oxygen and are commonly used with ozone generators. This approach was selected because it is regarded to be safer than the alternative method of storing oxygen tanks at the site. The air produced by the compressor is directed into a pressure swing adsorption unit that adsorbs the nitrogen naturally present in the air stream, resulting in an oxygen-rich air stream to feed the ozone generator. The nitrogen adsorption unit systematically exhausts small volumes of nitrogen back into the atmosphere. A flow indicator monitors the flow of the oxygen stream. A low flow and high/low pressure alarms will cause the air compressor to shut down to avoid a leak in the system or malfunctioning oxygen generation equipment. The flow is also transmitted to a flow controller, which operates a solenoid valve to ensure a constant flow is delivered to the ozone generator. Downstream of the flow indicator is a pressure indicator with a high pressure alarm and pressure relief valve.

As a safety precaution, the trailer is equipped with an ambient air ozone detector and an exhaust fan with a run light. If, at any time the ambient air ozone detector is activated, the system will shut down until manually reset. Additionally, the cabinet that houses the valves for the ozone is exhausted to the atmosphere through an ozone destruction media. If an ozone leak is detected (via inline ozone detector), the ozone detector would shut down the system and any ozone in the atmosphere would be destroyed prior to being vented from the trailer.

The hydrogen peroxide system within the trailer includes a holding tank and injection pump. The holding tank is double-walled and was used to store the solution of up to 35% hydrogen peroxide. An exterior hydrogen peroxide holding tank may be used during warm weather operation and will be equipped with a secondary containment. A high and low pressure alarm was in place on the hydrogen peroxide injection line in order to shut down the pump under high pressure or low pressure conditions.

6.1.4 Control Panel

The advanced oxidation system includes a programmable logic controller (PLC) to control the operation of the oxygen, ozone, air, and hydrogen peroxide injection system. The PLC will be used to manage the injection flow rates at each point and to pulse the operation of the system to cycle injection wells and flows.

6.1.5 Above Grade Piping

The injection wells will be connected to the remediation system trailer via an above grade piping network. Piping for the advanced oxidation system will include individual Teflon tubes to each oxygen/ozone injection well (Figure 7) and Polyvinyl chloride (PVC) lines for hydrogen peroxide delivery (1/2” diameter lines). The Teflon and PVC lines will be sleeved within high-density polyethylene tubing (HDPE) for physical protection.

Piping will be connected to the top of each injection well. Since the ozone lines are individually controlled from the equipment trailer, the Teflon tubing will be connected directly to the stainless steel injection point via a compression fitting. The individual hydrogen peroxide lines will be connected directly to the stainless steel injection points. A check valve will be installed at each hydrogen peroxide well.

6.1.6 Proposed Monitoring Network

The monitoring network for the full-scale ChemOx system will include existing and proposed ChemOx injection wells, existing and proposed monitoring wells, and MIP borings. This monitoring network will be used to assess the progress of the remediation, evaluate temporary shut downs of ChemOx cells, monitor for rebound after shutdown to determine if additional operation is required and to ultimately justify permanent shutdown of the system. Location of the proposed monitoring network is shown on Plate 2. Confirmatory soil borings will also be performed at select locations in the vicinity of MIP borings (locations will be selected based on monitoring data as described in Section 8.0 and are not shown on the Plate 2).

6.1.6.1 Existing and Proposed Monitoring Wells

In order to monitor water levels and separate-phase product thickness, groundwater quality and groundwater temperature, each ChemOx cell will have at least two monitoring wells (new and/or existing) located within or near the cell boundary. In addition, the hydrogen peroxide injection point at each nested ChemOx injection point and each supplemental hydrogen peroxide point will also be monitored for groundwater temperature. Parameters to be monitored and proposed monitoring schedules are described in Section 8.3. The proposed monitoring well network within or near each ChemOx cell is listed below and may be modified for ChemOx Cells 3, 4, and 5 based upon the results of long-term monitoring in ChemOx Cells 1 and 2. As a note, the numbering sequence of the ChemOx cells has been changed from that provided in the RAS in order to reflect the current anticipated operating sequence. The first two cells to be operated will be ChemOx Cells 1 and 2, followed by ChemOx Cells 3 and 4, and then ChemOx Cell 5.

<u>ChemOx Cell 1</u>

- Existing monitoring wells LF-3 and RW-8R;
- One proposed monitoring well located outside the cell boundary between ChemOx Cells 1 and 2; and
- Five hydrogen peroxide points of the proposed nested ChemOx injection points and four supplemental peroxide injection points (two existing hydrogen peroxide injections points [CO-3 and CO-5]) and two proposed points to be monitored for groundwater temperature only.

<u>ChemOx Cell 2</u>

- Existing monitoring wells VERMW-3, VERMW-4, MW-28, SB-75, and LF-6;
- One proposed monitoring well located outside the cell boundary between ChemOx Cells 1 and 2; and

- Five hydrogen peroxide points of the proposed nested ChemOx injection points and four supplemental peroxide injection points (two existing hydrogen peroxide injections points [CO-2 and CO-4]) and two proposed to be monitored for groundwater temperature only.

<u>ChemOx Cell 3</u>

- Existing monitoring wells RW-8R, LF-5, P-15, and LF-1S;
- No proposed monitoring wells; and
- Five proposed ChemOx nested hydrogen peroxide wells to be monitored for groundwater temperature only. The number of supplemental hydrogen peroxide injection points to be determined.

<u>ChemOx Cell 4</u>

- Existing monitoring wells MW-3URS, VERMW-1, VERMW-3, and LF-5;
- Two proposed monitoring wells; and
- Five proposed ChemOx nested hydrogen peroxide point wells to be monitored for groundwater temperature only. The number of supplemental hydrogen peroxide injection points to be determined.

<u>ChemOx Cell 5</u>

- Existing monitoring wells LF-4, B-6MW and LF-5;
- One proposed monitoring well; and
- Five proposed ChemOx nested hydrogen peroxide point wells to be monitored for groundwater temperature only. The number of supplemental hydrogen peroxide injection points to be determined.

6.1.6.2 Monitoring Well Construction

The proposed monitoring wells will be four-inch diameter wells and will be installed using a hollow stem auger rig. In accordance with ExxonMobil ground disturbance protocols, the 0 to 5 foot interval will be hand cleared using a hand auger and post hole digger. Soil samples will be collected for field documentation continuously from 15 feet below grade to the bottom of the boring, approximately 35 ft bls. The supervising technical staff will inspect soil samples and record applicable lithologic characteristics. In addition, all soil samples will be visually inspected for evidence of separate-phase product (i.e., separate-phase product sheen, odors, staining, etc.) and screened for organic vapors with a Photo-ionization Detector (PID).

Each well will be constructed of 20-slot screen extending from five feet above the water table to 15 feet below the water table. The annular space between the well and borehole will be filled with #1 sand to two feet above the top of the screen and a two-foot bentonite seal will be placed above the sand pack. The remainder of the annulus will be grouted within two feet of land surface and finished with a concrete cap. The concrete cap will be sloped to divert precipitation away from the well. Each monitoring well will be finished approximately two feet above grade and fitted with a five-foot steel casing.

The wells will be developed by surging and pumping until each monitoring well produces sediment-clear water, to the extent possible, and a good hydraulic connection is established between the well screen and the aquifer. Well development water will be transferred to the onsite water treatment system for treatment prior to discharge.

Each well will be surveyed for horizontal and vertical coordinates relative to the New York State Plane Coordinate System by a surveyor licensed in the State of New York after completion. Both ground surface and top of casing (i.e., measuring point) elevations will be determined for each well. Horizontal coordinates will be accurate to ±0.1 feet and vertical coordinates will be accurate to ±0.01 feet.

All of the monitoring wells will be fitted with a removable expansion plug to allow for water level and free product thickness measurements. A hand-held Magnehelic gauge will be configured for measuring pressure response from the monitoring well during ChemOx injections. A schematic of a typical monitoring well is shown in Figure 9.

6.1.6.3 Proposed MIP Boring Locations

In order to provide a qualitative assessment of total VOCs in the subsurface prior to, during, and after long-term operation of the ChemOx system, MIP borings will be completed within each ChemOx Cell. The locations of proposed MIP borings in the first two cells are shown on Plate 2. As shown, initially, three borings within Cells 1 and 2 will be installed. The number of MIP borings required for monitoring remedial progress in the other cells will be determined based on the performance of the first two cells. The MIP borings will be advanced to the approximate depth of the clay layer that forms the base of the aquifer in the OU-4 product plume area (approximately 33 to 38 feet below grade, which will vary slightly throughout the area).

In addition, during the baseline MIP round, five MIP borings will be completed within the Tank 176 tank berm, as shown on Plate 2. These borings will be used to evaluate current conditions and the potential need for ChemOx within the tank berm. During the monitoring phase of the ChemOx cells located outside the tank berm, steps necessary to address impacts that may exist beneath the tank berm will be evaluated.

The MIP is a percussion-tolerant VOC sensor that can continuously log volatile organics that diffuse through a semi-permeable membrane. Using a carrier gas, the VOCs are brought to the surface through tubing, which is connected to a laboratory grade PID, Flame Ionization Detector (FID), and Electron Capture Detector (ECD) for immediate screening. All three of these detectors are mounted in a Hewlett Packard 5890 Series II Gas Chromatograph cabinet.

As the operator advances the MIP sensor into the subsurface, a log is displayed onscreen by the field computer. This log provides information about VOCs in the subsurface using either the PID or FID or any combination of detectors. The real time log also provides a depth/speed graph, electrical log of the formation, and temperature log of the heated sensor onscreen. For this project, the FID and PID will be used.

The data provided is a scan of the subsurface, measured in micro-volts. The higher micro-volts equate to higher VOC concentrations. Generally, the micro-volts translate into a qualitative measurement of the VOCs present in the soil. Since there is no direct correlation between analytical data (measured in parts per million [ppm]) and the micro-voltage measurements at the boring locations, VOC distribution following full-scale implementation of ChemOx will be solely based on micro-voltage measurements before and after the completion ChemOx in each cell.

7.0 HEALTH AND SAFETY PROCEDURES

All remedial construction activities will be performed in a manner consistent with 29CFR 1910 and 1926. Each Consultant and Contractor onsite will be covered under a site-specific Health and Safety Plan (HASP) for the project. The HASP will be readily available during the Work. During all phases of site work, the Constultants/Contractor will monitor safety and health conditions and fully enforce the site-specific HASP. The Consultant/Contractor will be responsible for monitoring general site conditions and for safety hazards. Specifically, monitoring will be performed to verify that all requirements of the Occupational Safety and Health Administration as outlined on 29 CFR Part 1910 and 1926 are adhered to. A copy of the HASP, prepared by GES, has been submitted under separate cover.

8.0 OPERATION, MAINTENANCE AND MONITORING

A detailed description of the OM&M procedures that will be implemented during full-scale operation of the proposed ChemOx system are provided in the OM&M plan that has been prepared in accordance with the DER-10. This stand alone OM&M plan has been submitted under separate cover. A brief description of the operating sequence and OM&M procedures is provided below.

8.1 Proposed ChemOx System Phased Operation Sequence

Each ChemOx Cell covers an area of between 3,100 square feet (ChemOx Cell 5) and 3,800 square feet (ChemOx Cell 4). The proposed operation sequence will be to operate in ChemOx Cells 1 and 2 for approximately two months (plus approximately two weeks for receipt of groundwater quality data) and monitor conditions as described below. Once this initial operating period is completed and the monitoring data is evaluated, the injection will either be continued in these cells or will be initiated in Cells 3 and 4 for a two-month period (plus or minus) and followed by operation in ChemOx Cell 5. If it is determined that pulsing of the system to allow water levels in the area to return to normal conditions may be beneficial to separate-phase product recovery efforts (i.e., if continuous operation is believed to have submerged product), consideration will be given to altering operating parameters accordingly during operation in each cell. This determination will be made after evaluation of long-term water-level data during operation.

Due to the increased number and type of injection wells, the injection sequencing, air/ozone, and peroxide flow rates are expected to be different than those used during the long-term pilot test. Therefore, in order to confirm optimum injection rates and injection sequencing within each cell, an initial one-day startup and testing period will be performed. During that time, injection rates, cycles, intervals, and concentrations will be varied to maximize system effectiveness.

8.2 Operation and Maintenance

The ChemOx mobile system is a fully automated unit requiring minimal maintenance. Typical operational and preventative maintenance activities for the system are detailed in the OM&M plan.

8.3 Monitoring

The OM&M plan provides a detailed description of the proposed monitoring schedule for the full-scale ChemOx system. Monitoring will be conducted in the monitoring network described above for each operating ChemOx cells. At this time, operation of one or two cells at a time is proposed (Cells 1 and 2 operated together, Cells 3 and 4 operated together, and Cell 5 operated individually). The monitoring parameters and frequency described in the OM&M plan will be modified based upon information gathered during the full-scale system operation. The following is a brief description of the monitoring that will be conducted:

Injection System Monitoring

- Includes monitoring of system operating parameters throughout long-term operation on a daily basis.
- Modifications to operating parameters will be made, as necessary, based upon the data collected.
- Ambient air measurements in the IRM area for VOCs will also be conducted. Periodic measurements of ambient ozone, particularly during startup, will also be conducted.

System Performance Monitoring

Performance of the system and, ultimately, the criteria for system shutdown will be monitored based upon separate-phase product thickness, groundwater quality, MIP results, and soil quality. The OM&M plan provides a detailed description of the monitoring plan for the system, which includes the following activities:

- Baseline Groundwater Sampling within the OU-4 Product Plume and Each ChemOx Cell
- First Day – Startup and Testing
- Long-Term Operation - Weekly Monitoring
- Long-Term Operation - Monthly Monitoring
- Long-Term Operation - Membrane Interface Probe Borings
- Temporary Shutdown
- Monitoring for Rebound and Additional Operation
- Long-Term Monitoring for System Decommissioning

8.4 System decommissioning

Once this long-term monitoring has been completed in all cells indicating that RAOs have been met for the OU-4 product plume, the system will be decommissioned (i.e., piping will be removed and ChemOx injection wells and monitoring wells installed for the ChemOx system will be abandoned).

9.0 QUALITY ASSURANCE/QUALITY CONTROL

Groundwater and confirmatory soil samples will be submitted to TestAmerica, a NYSDOH ELAP certified laboratory. Category A laboratory data deliverables as defined in the analytical services protocol (ASP) will be requested for all sampling data.

Quality assurance and quality control for all laboratory sampling conducted as part of IRM implementation will be completed in accordance to the site-specific QAPP provided in Appendix C. This QAPP was prepared in accordance with the DER-10 Section 2.2.

10.0 REPORTING

IRM status reports will be prepared on a quarterly basis during the implementation of the IRM and included with the overall quarterly progress reports for the Site. The reports will include a summary of the progress of the IRM, including OM&M activities performed during the quarter, sampling results, water and product level gauging results, and MIP results, when appropriate. Any changes or modifications to the scope of the IRM during the quarter will be documented.

At the completion of all IRM activities, an Interim Remedial Action Report will be prepared in accordance with Section 5.7 of the Draft BCP Guide and Section 5.8 of the Draft DER-10. The Remedial Action Report will describe the work performed as part of the remediation and will include:

- Survey drawings and site maps of the final IRM components;
- Documentation of all gauging, sampling and MIP results;
- A certification by a New York professional engineer that all activities completed during the implementation of the IRM were performed in accordance with the specifications provided in this IRM work plan, as approved by the NYSDEC, and that the activities were personally witnessed by a person under the direct supervision of the professional engineer; and
- Any changes or modifications to the scope of the IRM.

11.0 CITIZEN PARTICIPATION PLAN

Per the Draft BCP Guide Section 3.14, since the proposed remedial action is being completed as an IRM that does not constitute the final remedy for OU-4, ExxonMobil contends that formal citizen participation activities are not required.

12.0 INSTITUTIONAL AND ENGINEERING CONTROLS

Since ChemOx is being completed as an IRM that is not the final remedy for OU-4, institutional controls are not required.

Engineering controls currently in place include a chain link fence that surrounds the majority of OU-4 and IRM implementation area. This fence is part of the main fence that surrounds the main portion of the Former Buffalo Terminal located south of Elk Street. Access to this main portion of the site, and the majority of the IRM implementation area, is through a locked security gate. The chain link fence and gate will be maintained throughout the implementation of the IRM.

13.0 SCHEDULE

Installation of ChemOx injection points, monitoring wells, MIP borings, and aboveground piping will be initiated following NYSDEC approval of this IRM work plan. This is anticipated to be initiated during the third quarter of 2006. Once all wells and equipment within ChemOx Cells 1 and 2 are completed, operation will begin within that cell. Based upon this proposed approach, startup of the first ChemOx cells is anticipated during the third quarter of 2006.

Respectfully submitted,

ROUX ASSOCIATES, INC.

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REMEDIAL ENGINEERING, P.C.

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Principal Engineer

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Table 1. Summary of Spills/Releases in OU-4, Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

Date of Incident	Quantity	Product	Cause/Source of Spill	Geographic Area	Media Affected	Agency Notified	Action Taken/Comments	Source	Date Spill Closed by NYSDEC
OPERABLE UNIT 4 (OU-4)									
8/28/1989	6500 gallons	Unleaded gasoline	Overfill from Mobil pipeline at Tank 176 due to incorrect safe fill and high alarm heights used.	ETYA	Soil	NYSDEC - #8905279 Albany & Buffalo Buffalo Fire Department	Area was barricaded; approximately 2800 gallons of product was removed with a vacuum truck; safe fill and alarm heights on tank were revised, monitoring wells installed. The containment berm for this tank and Tank 175 were lined during the storage tank r	Mobil Files/ NYSDEC Spills	6/11/1991
10/4/2000	Unknown	Unknown Petroleum Product	Sheen observed along the Buffalo River shoreline adjacent to the ETYA.	ETYA	Buffalo River	NRC NYSDEC - #0075417	Installed and maintained sorbent boom since 10/4/00. Spill report from notes that this spill was closed on 10/18/00 and would be incorporated into spill No. 8808982	Mobil Files/ NYSDEC Spills	10/18/2000
SPILLS FOR WHICH THE AREA OF OCCURRENCE COULD NOT BE DETERMINED FROM AVAILABLE INFORMATION (UNKNOWN)									
7/17/1987	1 gallon	Gasoline	Gasoline found in trench excavation. (No other information)	Unknown	Unknown	NYSDEC - #8703102	Recovered one gallon.	NYSDEC Spills	8/4/1987
9/7/1989	Unknown	#2 Fuel Oil	Underground tanks failed tightness test.	Unknown	Unknown	NYSDEC - #8905567	Unknown	NYSDEC Spills	11/20/1989
2/2/1990	<1 gallon	Gasoline	Product pipeline test failure	Unknown	Unknown	NYSDEC - #8910543	Product was removed from the pipeline; location of the leak was to be located. Follow-up action by NYSDEC to be made under spill # 8808982.	NYSDEC Spills	12/7/1990
5/18/1991	15-20 gallons	Caustic	Contractor cut 3-inch pipe in pipe rack with a shear with (believed to be) caustic remaining in the pipeline	Unknown	Unknown	NYSDEC - #9101954	Drained the pipe and cleaned area; NYSDEC Spill Report Form noted no further action required.	Mobil Files/ NYSDEC Spills	5/20/1991
7/12/1990	50 gallons	Diesel Fuel	Equipment failure in the diked area (No additional information)	Unknown	Soil	NYSDEC - #9004061	NYSDEC Spill Report Form indicates spill was cleaned up by Mobil.	NYSDEC Spills	7/12/1990
3/24/1992	25 gallons	#6 Fuel Oil	Pipeline severed during construction	Unknown	Soil	NYSDEC - #9113037	Impacted soil removed and placed in the biotreatment cell, no further action required.	NYSDEC Spills	4/3/1992
3/27/1992	50 gallons	Unknown Petroleum Product	Contractor cutting up old piping released residual oil trapped in piping	Unknown	Soil	NYSDEC - #9113176	Spill cleaned up and debris placed in biotreatment cell.	NYSDEC Spills	3/31/1992
7/31/1992	15 gallons	Mixed Product	Oil/water separator overflowed due to rain	Unknown	Soil	NYSDEC - #9205006	Impacted soil removed and placed in the biotreatment cell.	NYSDEC Spills	8/3/1992
9/20/1992	10 gallons	Gasoline	Pressure valve malfunction	Unknown	Soil	NYSDEC - #9207108	Spill cleaned up, no further action required.	NYSDEC Spills	9/21/1992
10/22/1992	5 gallons	Jet Fuel	During demolition, jet fuel leaked from an out of service line	Unknown	Soil	NYSDEC - #9208484	Pipe was blanked; absorbent pads placed; impacted soil removed and placed in the biotreatment cell. No further action required.	NYSDEC Spills	10/23/1992
3/1/1993	Unknown	Petroleum Product	4,000 cubic yards of contaminated soil (Source not specified)	Unknown	Soil	NYSDEC - #9314328	NYSDEC Spill Report Form noted no further action required.	NYSDEC Spills	3/8/1994
6/23/1993	20 gallons	Unknown Petroleum Product	Unknown	Unknown	Soil/Stone	NYSDEC - #9303750	Soil and stone were excavated and placed in biotreatment cell, no further action required.	NYSDEC Spills	7/23/1993
7/5/1993	40 gallons	Gasoline	Equipment failure	Unknown	Soil/Stone	NYSDEC - #9304257	Impacted soil removed and replaced with new stone; repairs were made, no further action required.	NYSDEC Spills	7/23/1993
1/17/1995	10 gallons	Petroleum Product	Sewer backup due to storm water and runoff	Unknown	Sewer	NYSDEC - #9413823	One cubic yard of soil removed and placed in biotreatment cell; auto dialer installed in the event of high alarm at storm sewer lift station.	Mobil Files/ NYSDEC Spills	5/15/1995
5/18/1999	30	Diesel Fuel	Product Spill from a tractor trailer onto the road and in the parking lot.	Unknown	Sewer	NYSDEC - #9901860	Speedy-dri applied; contractor cleaned up debris; disposal records provided to NYSDEC; no further action required.	Mobil Files/ NYSDEC Spills	6/7/1999

Table 2. Storage Tank History for OU-4, Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

Tank No	Size				Capacity (BBL)		Year Built	Removed	Duplicate Tank Designation Notes	Location	Product Stored	Roof Type	Shell
	Length	Width	Diameter (Feet)	Height (Feet)	Gross	Available							
Operable Unit 4 (OU-4)													
175			130	32	68,548	63,366	1953	Existing		ETYA (Former Disposal Area)	TCC Charge/ No. 6 Fuel Oil and Cutter, No.2 Fuel Oil	Cone	Welded
176			130	30	68,548	63,366	1953	Existing		ETYA (Former Disposal Area)	TCC Charge/ No. 6 Fuel Oil and Cutter, Unleaded Gasoline	Cone	Welded
F213	46	10					1977 map	1987 map		ETYA (Former Disposal Area)	Liquefied Petroleum Gas		
F214	46	10					1977 map	1987 map		ETYA (Former Disposal Area)	Liquefied Petroleum Gas		
F215	46	10					1977 map	1987 map		ETYA (Former Disposal Area)	Liquefied Petroleum Gas		
F216	46	10					1977 map	1987 map		ETYA (Former Disposal Area)	Liquefied Petroleum Gas		

Notes:

1. Where blanks entries exist, information from the existing documentation was not available.
2. For Construction dates, an entry referencing a map or aerial photo indicates the map/aerial photo that the tank first appeared.
3. For Removal Dates, an entry referencing a map or aerial photo indicates the first map/aerial photo that the tank does not appear on.
4. Not all 1917 tanks are listed.

Table 3. Summary of Water-Level, Product Thickness and Product Bailing Data in OU-4
Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

Well Designation	Date	Measuring Point Elevation (ft msl)	Depth to Product (ft)	Depth to Water (ft)	Product Thickness (ft)	Specific Gravity	Corrected Elevation (ft msl)	Product Bailed (gal)	Comments
B-6MW	06/25/03	596.35		24.64		0.8	571.71		
B-6MW	07/22/03	596.35		24.81		0.8	571.54		
B-6MW	07/23/03	596.35		24.81		0.8	571.54		
B-6MW	08/27/03	596.35		24.54		0.8	571.81		
B-6MW	09/30/03	596.35		24.35		0.8	572.00		
B-6MW	10/13/03	596.35		25.56		0.8	570.79		
B-6MW	11/25/03	596.35		25.12		0.8	571.23		
B-6MW	12/31/03	596.35		24.42		0.8	571.93		
B-6MW	01/19/04	596.35		24.83		0.8	571.52		
B-6MW	01/20/04	596.35		24.83		0.8	571.52		
B-6MW	02/27/04	596.35		25.87		0.8	570.48		
B-6MW	03/31/04	596.35		25.03		0.8	571.32		
B-6MW	04/07/04	596.35		24.68		0.8	571.67		
B-6MW	04/07/04	596.35		24.68		0.8	571.67		
B-6MW	05/28/04	596.35		23.87		0.8	572.48		
B-6MW	06/30/04	596.35		23.96		0.8	572.39		
B-6MW	07/12/04	596.35		24.31		0.8	572.04		
B-6MW	08/31/04	596.35		24.43		0.8	571.92		
B-6MW	09/15/04	596.35		24.36		0.8	571.99		
B-6MW	09/30/04	596.35		24.67		0.8	571.68		
B-6MW	10/11/04	596.35		25.29		0.8	571.06		
B-6MW	11/29/04	596.35		25.24		0.8	571.11		
B-6MW	12/28/04	596.35		24.77		0.8	571.58		
B-6MW	01/25/05	596.35		23.38		0.8	572.97		
B-6MW	02/28/05	596.35		24.55		0.8	571.80		
B-6MW	03/31/05	596.35		24.21		0.8	572.14		
B-6MW	04/06/05	596.35		23.74		0.8	572.61		
B-6MW	05/27/05	596.35		24.09		0.8	572.26		
B-6MW	07/18/05	596.35		24.55		0.8	571.80		
B-6MW	08/25/05	596.35		25.27		0.8	571.08		
B-6MW	09/30/05	596.35		24.77		0.8	571.58		
B-6MW	10/12/05	596.35		25.64		0.8	570.71		
B-6MW	11/30/05	596.35		25.32		0.8	571.03		
B-6MW	12/30/05	596.35		25.75		0.8	570.60		RIVER FROZEN
B-6MW	01/17/06	596.35		25.79		0.8	570.56		
B-6MW	01/20/06	596.35		25.79		0.8	570.56		
B-6MW	02/23/06	596.35		24.69		0.8	571.66		
B-6MW	03/29/06	596.35		24.87		0.8	571.48		
B-6MW	04/10/06	596.35		24.81		0.8	571.54		
B-6MW	06/30/06	596.35		24.14		0.8	572.21		
LF-1S	06/03/03	596.27	24.85	25.34	0.49	0.884	571.36	0.1	
LF-1S	06/11/03	596.27		24.38		0.884	571.89		
LF-1S	06/18/03	596.27	24.61	24.87	0.26	0.884	571.63	0.1	
LF-1S	06/25/03	596.27	24.54	24.94	0.4	0.884	571.68	0.1	
LF-1S	07/02/03	596.27	24.65	24.71	0.06	0.884	571.61		
LF-1S	07/10/03	596.27	24.75	24.76	0.01	0.884	571.52		
LF-1S	07/18/03	596.27		24.7		0.884	571.57		
LF-1S	07/23/03	596.27		24.73		0.884	571.54		
LF-1S	07/30/03	596.27		24.75		0.884	571.52		
LF-1S	08/08/03	596.27	24.65	24.65	0	0.884	571.62		
LF-1S	08/20/03	596.27	24.68	24.75	0.07	0.884	571.58	0.06	
LF-1S	09/04/03	596.27	25.08	25.76	0.68	0.884	571.11	0.1	
LF-1S	09/12/03	596.27	25.22	26.4	1.18	0.884	570.91	0.25	
LF-1S	09/18/03	596.27	25.25	26.66	1.41	0.884	570.86	0.25	
LF-1S	09/30/03	596.27		24.68		0.884	571.59		
LF-1S	10/10/03	596.27	25.3	26.34	1.04	0.884	570.85	0.25	
LF-1S	10/13/03	596.27	25.34	26.5	1.16	0.884	570.80		
LF-1S	10/17/03	596.27	25.25	25.67	0.42	0.884	570.97	0.125	
LF-1S	10/30/03	596.27				0.884		0.25	IP PROBE NOT WORKING PROPERLY
LF-1S	11/05/03	596.27	25.37	26.41	1.04	0.884	570.78	0.33	
LF-1S	11/12/03	596.27	25.52	26.7	1.18	0.884	570.61	0.125	
LF-1S	11/21/03	596.27	26.54	26.72	0.18	0.884	569.71		
LF-1S	12/05/03	596.27	25.5	25.55	0.05	0.884	570.76		
LF-1S	12/10/03	596.27				0.884			NOT GAUGED- ACCESS BLOCKED DUE TO TANK 176 CLEAN
LF-1S	12/19/03	596.27		25.06		0.884	571.21		
LF-1S	12/31/03	596.27	24.95	24.95	0	0.884	571.32		
LF-1S	01/08/04	596.27	24.76	24.76	0	0.884	571.51		
LF-1S	01/19/04	596.27		24.77		0.884	571.50		
LF-1S	02/13/04	596.27	25.34	25.35	0.01	0.884	570.93		
LF-1S	02/27/04	596.27	25.73	26.8	1.07	0.884	570.42	0.25	
LF-1S	03/05/04	596.27		24.45		0.884	571.82		
LF-1S	03/17/04	596.27		25.44		0.884	570.83		

Table 3. Summary of Water-Level, Product Thickness and Product Bailing Data in OU-4
Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

Well Designation	Date	Measuring Point Elevation (ft msl)	Depth to Product (ft)	Depth to Water (ft)	Product Thickness (ft)	Specific Gravity	Corrected Elevation (ft msl)	Product Bailed (gal)	Comments
LF-1S	03/29/04	596.27	25.17	25.5	0.33	0.884	571.06	0.04	
LF-1S	04/07/04	596.27		24.56		0.884	571.71		
LF-1S	04/13/04	596.27		24.56		0.884	571.71		
LF-1S	04/23/04	596.27				0.884			NOT GAUGED- CHEMOX TEST
LF-1S	05/19/04	596.27	24.63	24.83	0.2	0.884	571.62	0.25	
LF-1S	05/28/04	596.27				0.884			NOT GAUGED- CHEMOX TEST
LF-1S	06/04/04	596.27	25.21	23.91	-1.3	0.884	571.21	0.25	
LF-1S	06/30/04	596.27	23.79	25.3	1.51	0.884	572.30	0.5	
LF-1S	07/12/04	596.27	24.07	24.77	0.7	0.884	572.12		
LF-1S	07/16/04	596.27	24.07	24.77	0.7	0.884	572.12	0.25	
LF-1S	07/23/04	596.27	24.14	24.15	0.01	0.884	572.13		
LF-1S	07/30/04	596.27	24.27	24.29	0.02	0.884	572.00		
LF-1S	08/06/04	596.27	24	24.51	0.51	0.884	572.21	0.25	
LF-1S	08/17/04	596.27	24.28	25.46	1.18	0.884	571.85	0.5	
LF-1S	08/27/04	596.27	24.43	24.99	0.56	0.884	571.78		
LF-1S	09/07/04	596.27		24.38		0.884	571.89		
LF-1S	09/23/04	596.27	24.71	24.71	0	0.884	571.56		
LF-1S	10/11/04	596.27	25.25	25.25	0	0.884	571.02		
LF-1S	10/21/04	596.27		25.22		0.884	571.05		
LF-1S	11/03/04	596.27		25.25		0.884	571.02		
LF-1S	11/18/04	596.27		25.34		0.884	570.93		
LF-1S	11/30/04	596.27		24.47		0.884	571.80		
LF-1S	12/08/04	596.27		25.81		0.884	570.46		
LF-1S	12/14/04	596.27		24.8		0.884	571.47		
LF-1S	01/07/05	596.27		24.24		0.884	572.03		
LF-1S	01/14/05	596.27		23.5		0.884	572.77		
LF-1S	01/20/05	596.27		24.29		0.884	571.98		
LF-1S	01/25/05	596.27		23.27		0.884	573.00		
LF-1S	02/03/05	596.27		25.54		0.884	570.73		
LF-1S	02/15/05	596.27		23.95		0.884	572.32		
LF-1S	02/28/05	596.27		24.5		0.884	571.77		
LF-1S	03/14/05	596.27	24.29	24.47	0.18	0.884	571.96		
LF-1S	03/24/05	596.27		24.38		0.884	571.89		
LF-1S	03/30/05	596.27		24.29		0.884	571.98		
LF-1S	04/06/05	596.27		23.83		0.884	572.44		
LF-1S	04/15/05	596.27	25.09	26.1	1.01	0.884	571.06	0.25	
LF-1S	04/22/05	596.27	23.95	24.25	0.3	0.884	572.29		
LF-1S	05/06/05	596.27	23.94	25.2	1.26	0.884	572.18		
LF-1S	05/13/05	596.27	24.4	25.15	0.75	0.884	571.78	0.25	
LF-1S	05/18/05	596.27	24.05	25.01	0.96	0.884	572.11	1	
LF-1S	05/24/05	596.27	24.1	24.95	0.85	0.884	572.07		
LF-1S	06/03/05	596.27	24.15	24.19	0.04	0.884	572.12		
LF-1S	06/10/05	596.27	25.79	25.85	0.06	0.884	570.47		
LF-1S	06/17/05	596.27	24.11	25.1	0.99	0.884	572.05	0.25	
LF-1S	06/24/05	596.27	24.2	24.82	0.62	0.884	572.00		
LF-1S	07/06/05	596.27	24.75	25.1	0.35	0.884	571.48	0.12	
LF-1S	07/14/05	596.27	24.69	24.97	0.28	0.884	571.55		
LF-1S	07/18/05	596.27	24.43	24.67	0.24	0.884	571.81	0.12	PRODUCT BAILED ON 7/21
LF-1S	07/26/05	596.27	24.29	24.55	0.26	0.884	571.95	0.06	
LF-1S	08/05/05	596.27		24.86		0.884	571.41		
LF-1S	08/12/05	596.27		24.76		0.884	571.51		TRACE PRODUCT
LF-1S	08/18/05	596.27	24.92	25.1	0.18	0.884	571.33	0.03	
LF-1S	08/25/05	596.27	25.25	25.6	0.35	0.884	570.98	0.12	
LF-1S	09/15/05	596.27	25.15	26.1	0.95	0.884	571.01	0.12	
LF-1S	09/20/05	596.27	25.99	26.3	0.31	0.884	570.24	0.06	
LF-1S	09/30/05	596.27	25	25.03	0.03	0.884	571.27		
LF-1S	10/06/05	596.27	25.15	25.3	0.15	0.884	571.10	0.12	
LF-1S	10/12/05	596.27	25.5	26.74	1.24	0.884	570.63	0.12	PRODUCT BAILED ON 10/19
LF-1S	10/27/05	596.27	25.41	25.5	0.09	0.884	570.85		
LF-1S	11/10/05	596.27		24.94		0.884	571.33		
LF-1S	11/22/05	596.27	25.7	25.73	0.03	0.884	570.57		
LF-1S	12/08/05	596.27		25.4		0.884	570.87		RIVER FROZEN
LF-1S	12/15/05	596.27		25.85		0.884	570.42		RIVER FROZEN
LF-1S	12/27/05	596.27	25.77	25.79	0.02	0.884	570.50		RIVER FROZEN
LF-1S	01/10/06	596.27		25.3		0.884	570.97		TRACE PRODUCT
LF-1S	01/17/06	596.27	25.61	27.15	1.54	0.884	570.48	0.25	PRODUCT BAILED ON 1/24
LF-1S	01/31/06	596.27	25.1	25.15	0.05	0.884	571.16		
LF-1S	02/09/06	596.27		24.82		0.884	571.45		
LF-1S	02/16/06	596.27		24.87		0.884	571.40		
LF-1S	02/23/06	596.27		24.81		0.884	571.46		
LF-1S	03/02/06	596.27		25.3		0.884	570.97		
LF-1S	03/23/06	596.27		24.71		0.884	571.56		
LF-1S	03/30/06	596.27		25.02		0.884	571.25		
LF-1S	04/05/06	596.27		25.04		0.884	571.23		
LF-1S	04/10/06	596.27		24.76		0.884	571.51		

Table 3. Summary of Water-Level, Product Thickness and Product Bailing Data in OU-4
Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

Well Designation	Date	Measuring Point Elevation (ft msl)	Depth to Product (ft)	Depth to Water (ft)	Product Thickness (ft)	Specific Gravity	Corrected Elevation (ft msl)	Product Bailed (gal)	Comments
LF-1S	04/28/06	596.27		24.94		0.884	571.33		
LF-1S	05/05/06	596.27		24.71		0.884	571.56		
LF-1S	05/18/06	596.27		24.6		0.884	571.67		
LF-1S	05/23/06	596.27		24.35		0.884	571.92		
LF-1S	06/15/06	596.27		24.39		0.884	571.88		
LF-1S	06/23/06	596.27		24.41		0.884	571.86		
LF-1S	06/30/06	596.27		24.06		0.884	572.21		
LF-2D	07/23/03	581.83		11.22		0.8	570.61		
LF-2D	10/13/03	581.83		11.64		0.8	570.19		
LF-2D	01/19/04	581.83		10.96		0.8	570.87		
LF-2D	04/07/04	581.83		10.15		0.8	571.68		
LF-2D	07/12/04	581.83		10.69		0.8	571.14		
LF-2D	09/15/04	581.83		11.22		0.8	570.61		
LF-2D	10/11/04	581.83		11.92		0.8	569.91		
LF-2D	01/25/05	581.83		11.41		0.8	570.42		
LF-2D	04/06/05	581.83		11.74		0.8	570.09		
LF-2D	07/18/05	581.83		11.79		0.8	570.04		
LF-2D	10/12/05	581.83		12.58		0.8	569.25		
LF-2D	01/17/06	581.83		11.91		0.8	569.92		
LF-2D	04/10/06	581.83		11.49		0.8	570.34		
LF-2S	07/23/03	581.77		9.49		0.8	572.28		
LF-2S	10/13/03	581.77		10.41		0.8	571.36		
LF-2S	01/19/04	581.77		7.49		0.8	574.28		
LF-2S	04/07/04	581.77		6.57		0.8	575.20		
LF-2S	07/12/04	581.77		8.89		0.8	572.88		
LF-2S	09/15/04	581.77		7.75		0.8	574.02		
LF-2S	10/11/04	581.77		9.59		0.8	572.18		
LF-2S	01/25/05	581.77		7.02		0.8	574.75		
LF-2S	04/06/05	581.77		6.29		0.8	575.48		
LF-2S	07/18/05	581.77		10.72		0.8	571.05		
LF-2S	10/12/05	581.77		11.18		0.8	570.59		
LF-2S	01/17/06	581.77		7.55		0.8	574.22		
LF-2S	04/10/06	581.77		8.29		0.8	573.48		
LF-3	07/23/03	596.17	24.62	24.63	0.01	0.883	571.55		
LF-3	10/13/03	596.17	25.39	25.48	0.09	0.883	570.77		
LF-3	01/19/04	596.17	24.92	24.97	0.05	0.883	571.24		
LF-3	04/07/04	596.17		24.3		0.883	571.87		SHEEN PRESENT
LF-3	07/12/04	596.17		23.68		0.883	572.49		
LF-3	10/11/04	596.17	25.13	25.17	0.04	0.883	571.04		
LF-3	01/25/05	596.17		23.08		0.883	573.09		Trace product
LF-3	04/06/05	596.17	23.65	23.71	0.06	0.883	572.51		
LF-3	07/18/05	596.17	24.31	24.47	0.16	0.883	571.84	0.25	PRODUCT BAILED ON 7/21
LF-3	10/06/05	596.17	25.37	25.39	0.02	0.883	570.80		
LF-3	10/12/05	596.17	25.45	25.68	0.23	0.883	570.69		
LF-3	10/27/05	596.17	25.27	25.4	0.13	0.883	570.88		
LF-3	11/10/05	596.17		24.7		0.883	571.47		
LF-3	11/22/05	596.17	25.57	25.66	0.09	0.883	570.59		
LF-3	12/08/05	596.17	25.62	25.65	0.03	0.883	570.55		RIVER FROZEN
LF-3	12/15/05	596.17	26.01	26.1	0.09	0.883	570.15		RIVER FROZEN
LF-3	12/27/05	596.17	25.71	25.72	0.01	0.883	570.46		RIVER FROZEN
LF-3	01/10/06	596.17	25.12	25.18	0.06	0.883	571.04		
LF-3	01/17/06	596.17	25.71	25.8	0.09	0.883	570.45		
LF-3	01/31/06	596.17	24.92	25.02	0.1	0.883	571.24		
LF-3	02/09/06	596.17	24.99	25.05	0.06	0.883	571.17		
LF-3	02/16/06	596.17	24.65	24.72	0.07	0.883	571.51		
LF-3	02/23/06	596.17	24.38	24.4	0.02	0.883	571.79		
LF-3	03/15/06	596.17				0.883			NOT GAUGED- ACCESS BLOCKED BY WATER
LF-3	03/23/06	596.17	24.45	24.51	0.06	0.883	571.71		
LF-3	03/30/06	596.17	24.79	24.85	0.06	0.883	571.37	0.1	
LF-3	04/05/06	596.17	24.8	24.85	0.05	0.883	571.36		
LF-3	04/10/06	596.17	24.52	24.59	0.07	0.883	571.64		
LF-3	04/28/06	596.17	24.81	24.86	0.05	0.883	571.35		
LF-3	05/05/06	596.17	24.58	24.7	0.12	0.883	571.58		
LF-3	05/11/06	596.17	24.58	24.6	0.02	0.883	571.59		
LF-3	05/18/06	596.17	24.45	24.48	0.03	0.883	571.72		
LF-3	05/23/06	596.17		24.2		0.883	571.97		TRACE PRODUCT
LF-3	06/15/06	596.17		24.2		0.883	571.97		TRACE PRODUCT
LF-3	06/23/06	596.17	24.25	24.26	0.01	0.883	571.92		
LF-3	06/30/06	596.17		23.92		0.883	572.25		
LF-4	07/23/03	594.87		22.16		0.8	572.71		
LF-4	10/13/03	594.87		22.92		0.8	571.95		
LF-4	01/19/04	594.87		22.22		0.8	572.65		
LF-4	04/07/04	594.87		22.02		0.8	572.85		
LF-4	07/12/04	594.87		21.62		0.8	573.25		

Table 3. Summary of Water-Level, Product Thickness and Product Bailing Data in OU-4
Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

Well Designation	Date	Measuring Point Elevation (ft msl)	Depth to Product (ft)	Depth to Water (ft)	Product Thickness (ft)	Specific Gravity	Corrected Elevation (ft msl)	Product Bailed (gal)	Comments
LF-4	10/11/04	594.87		22.63		0.8	572.24		
LF-4	01/25/05	594.87				0.8			Could not locate
LF-4	04/06/05	594.87		21.34		0.8	573.53		
LF-4	07/18/05	594.87		21.92		0.8	572.95		
LF-4	10/12/05	594.87		23		0.8	571.87		
LF-4	01/17/06	594.87		23.16		0.8	571.71		
LF-4	04/10/06	594.87		22.12		0.8	572.75		
LF-5	07/23/03	597.62		26.06		0.8	571.56		
LF-5	10/13/03	597.62		26.83		0.8	570.79		
LF-5	01/19/04	597.62		26.1		0.8	571.52		
LF-5	04/07/04	597.62		25.94		0.8	571.68		
LF-5	07/12/04	597.62		25.49		0.8	572.13		
LF-5	10/11/04	597.62		26.61		0.8	571.01		
LF-5	01/25/05	597.62		25.74		0.8	571.88		
LF-5	04/06/05	597.62		25.11		0.8	572.51		
LF-5	07/18/05	597.62		25.78		0.8	571.84		
LF-5	10/12/05	597.62		26.98		0.8	570.64		
LF-5	01/17/06	597.62		27.07		0.8	570.55		
LF-5	04/10/06	597.62		26.09		0.8	571.53		
LF-6	06/03/03	598.14	26.75	27.1	0.35	0.883	571.35	0.5	ADSORBENT SOCK PRESENT
LF-6	06/11/03	598.14	26.06	26.49	0.43	0.883	572.03	0.5	ADSORBENT SOCK PRESENT
LF-6	06/18/03	598.14	25.5	25.52	0.02	0.883	572.64	0.5	ADSORBENT SOCK PRESENT
LF-6	06/25/03	598.14	25.9	26.35	0.45	0.883	572.19	0.25	
LF-6	07/02/03	598.14	25.43	27.2	1.77	0.883	572.50	1.06	
LF-6	07/18/03	598.14	27.65	28.33	0.68	0.883	570.41	0.5	
LF-6	07/23/03	598.14	26.56	27.08	0.52	0.883	571.52		
LF-6	08/20/03	598.14	26.42	26.95	0.53	0.883	571.66	0.75	
LF-6	10/13/03	598.14	27.39	27.54	0.15	0.883	570.73		
LF-6	11/12/03	598.14	27.53	28.12	0.59	0.883	570.54	0.25	
LF-6	11/21/03	598.14	27.49	27.6	0.11	0.883	570.64		
LF-6	12/05/03	598.14	27.42	27.8	0.38	0.883	570.68	0.25	
LF-6	12/10/03	598.14				0.883			NOT GAUGED- ACCESS BLOCKED DUE TO TANK 176 CLEAN
LF-6	12/19/03	598.14	25.98	25.99	0.01	0.883	572.16		
LF-6	12/31/03	598.14	26.9	26.91	0.01	0.883	571.24		
LF-6	01/08/04	598.14	26.67	26.67	0	0.883	571.47		
LF-6	01/19/04	598.14		26.55		0.883	571.59		
LF-6	02/13/04	598.14	27.24	27.49	0.25	0.883	570.87		
LF-6	02/27/04	598.14	27.85	28.2	0.35	0.883	570.25		
LF-6	03/05/04	598.14		26.37		0.883	571.77		
LF-6	03/17/04	598.14		27.28		0.883	570.86		
LF-6	03/29/04	598.14	27.06	27.24	0.18	0.883	571.06	0.1	
LF-6	04/07/04	598.14	26.39	26.4	0.01	0.883	571.75		
LF-6	04/13/04	598.14	26.39	26.4	0.01	0.883	571.75		
LF-6	04/23/04	598.14				0.883			NOT GAUGED- CHEMOX TEST
LF-6	05/19/04	598.14	26.43	28.1	1.67	0.883	571.51	1.5	
LF-6	05/28/04	598.14				0.883			NOT GAUGED- CHEMOX TEST
LF-6	06/04/04	598.14	25.5	25.68	0.18	0.883	572.62	0.1	
LF-6	06/30/04	598.14	25.77	25.94	0.17	0.883	572.35		
LF-6	07/12/04	598.14	26	26.09	0.09	0.883	572.13		
LF-6	10/11/04	598.14	27.13	27.35	0.22	0.883	570.98	0.25	
LF-6	11/18/04	598.14		27.09		0.883	571.05		
LF-6	12/08/04	598.14		27.55		0.883	570.59		
LF-6	01/07/05	598.14		26.14		0.883	572.00		
LF-6	01/14/05	598.14		25.3		0.883	572.84		
LF-6	01/25/05	598.14		25.07		0.883	573.07		Trace product
LF-6	02/15/05	598.14		25.87		0.883	572.27		
LF-6	02/28/05	598.14		26.4		0.883	571.74		
LF-6	03/14/05	598.14		26.18		0.883	571.96		
LF-6	03/24/05	598.14		26.32		0.883	571.82		
LF-6	03/30/05	598.14		26.11		0.883	572.03		
LF-6	04/06/05	598.14		25.74		0.883	572.40		
LF-6	04/15/05	598.14		26.16		0.883	571.98		
LF-6	04/22/05	598.14		26.05		0.883	572.09		
LF-6	05/13/05	598.14		26.45		0.883	571.69		TRACE PRODUCT
LF-6	05/18/05	598.14	26.01	26.07	0.06	0.883	572.12		
LF-6	05/24/05	598.14	25.97	25.98	0.01	0.883	572.17		
LF-6	06/03/05	598.14	26.1	26.16	0.06	0.883	572.03		
LF-6	06/10/05	598.14		26.11		0.883	572.03		
LF-6	06/17/05	598.14		26.09		0.883	572.05		TRACE PRODUCT
LF-6	06/24/05	598.14	26.15	26.26	0.11	0.883	571.98		
LF-6	07/06/05	598.14	26.7	26.85	0.15	0.883	571.42		
LF-6	07/14/05	598.14	26.55	26.64	0.09	0.883	571.58		
LF-6	07/18/05	598.14	26.31	26.41	0.1	0.883	571.82		

Table 3. Summary of Water-Level, Product Thickness and Product Bailing Data in OU-4
Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

Well Designation	Date	Measuring Point Elevation (ft msl)	Depth to Product (ft)	Depth to Water (ft)	Product Thickness (ft)	Specific Gravity	Corrected Elevation (ft msl)	Product Bailed (gal)	Comments
LF-6	07/26/05	598.14	26.31	26.43	0.12	0.883	571.82		
LF-6	08/05/05	598.14	26.7	26.71	0.01	0.883	571.44		
LF-6	08/12/05	598.14		26.75		0.883	571.39		TRACE PRODUCT
LF-6	08/18/05	598.14	26.79	26.8	0.01	0.883	571.35		
LF-6	08/25/05	598.14	27.2	27.21	0.01	0.883	570.94		
LF-6	09/09/05	598.14	27.15	27.19	0.04	0.883	570.99		
LF-6	09/15/05	598.14	27.07	27.1	0.03	0.883	571.07		
LF-6	09/20/05	598.14		28.07		0.883	570.07		TRACE PRODUCT
LF-6	10/06/05	598.14	27.36	27.42	0.06	0.883	570.77		
LF-6	10/12/05	598.14	27.44	27.45	0.01	0.883	570.70		
LF-6	10/27/05	598.14	27.28	27.3	0.02	0.883	570.86		
LF-6	11/10/05	598.14		26.7		0.883	571.44		
LF-6	11/22/05	598.14		27.61		0.883	570.53		
LF-6	12/08/05	598.14		27.75		0.883	570.39		TRACE PRODUCT; RIVER FROZEN
LF-6	12/15/05	598.14		27.68		0.883	570.46		RIVER FROZEN
LF-6	12/27/05	598.14	27.61	27.69	0.08	0.883	570.52		RIVER FROZEN
LF-6	01/10/06	598.14	27.15	27.21	0.06	0.883	570.98		
LF-6	01/17/06	598.14	27.68	27.85	0.17	0.883	570.44		
LF-6	01/31/06	598.14		27.01		0.883	571.13		
LF-6	02/09/06	598.14		26.75		0.883	571.39		
LF-6	02/16/06	598.14		26.72		0.883	571.42		
LF-6	02/23/06	598.14		26.45		0.883	571.69		
LF-6	03/02/06	598.14		27.16		0.883	570.98		
LF-6	03/15/06	598.14				0.883			NOT GAUGED- ACCESS BLOCKED BY WATER
LF-6	03/23/06	598.14		26.6		0.883	571.54		
LF-6	03/30/06	598.14	26.86	26.92	0.06	0.883	571.27		
LF-6	04/05/06	598.14	26.87	26.9	0.03	0.883	571.27		
LF-6	04/10/06	598.14	26.65	26.74	0.09	0.883	571.48		
LF-6	04/28/06	598.14	26.8	27.13	0.33	0.883	571.30		
LF-6	05/05/06	598.14	25.52	25.86	0.34	0.883	572.58		
LF-6	05/11/06	598.14	25.42	25.7	0.28	0.883	572.69	0.5	
LF-6	05/18/06	598.14	26.38	26.5	0.12	0.883	571.75		
LF-6	05/23/06	598.14	26.2	26.31	0.11	0.883	571.93		
LF-6	06/15/06	598.14	26.23	26.29	0.06	0.883	571.90		
LF-6	06/23/06	598.14	26.24	26.37	0.13	0.883	571.88	0.25	
LF-6	06/30/06	598.14	25.85	25.94	0.09	0.883	572.28		
LF-7	07/23/03	598.28		26.72		0.8	571.56		
LF-7	10/13/03	598.28		27.61		0.8	570.67		
LF-7	01/19/04	598.28		27.04		0.8	571.24		
LF-7	04/07/04	598.28		26.53		0.8	571.75		
LF-7	07/12/04	598.28		26.37		0.8	571.91		
LF-7	10/11/04	598.28		27.39		0.8	570.89		
LF-7	01/25/05	598.28		25.28		0.8	573.00		
LF-7	04/06/05	598.28		25.96		0.8	572.32		
LF-7	07/18/05	598.28		26.57		0.8	571.71		
LF-7	10/12/05	598.28		27.77		0.8	570.51		
LF-7	01/17/06	598.28		27.97		0.8	570.31		
LF-7	04/10/06	598.28		26.75		0.8	571.53		
LF-8	07/23/03	596.99		21.72		0.8	575.27		
LF-8	10/13/03	596.99		21.98		0.8	575.01		
LF-8	01/19/04	596.99		21.06		0.8	575.93		
LF-8	04/07/04	596.99		20.25		0.8	576.74		
LF-8	07/12/04	596.99		21.33		0.8	575.66		
LF-8	10/11/04	596.99		21.61		0.8	575.38		
LF-8	01/25/05	596.99		20.34		0.8	576.65		
LF-8	04/06/05	596.99		19.73		0.8	577.26		
LF-8	07/18/05	596.99		21.68		0.8	575.31		
LF-8	10/12/05	596.99		11.81		0.8	585.18		
LF-8	01/17/06	596.99		21.57		0.8	575.42		
LF-8	04/10/06	596.99		22.37		0.8	574.62		
MW-1URS	06/25/03	594.82		13.38		0.8	581.44		
MW-1URS	07/22/03	594.82		13.73		0.8	581.09		
MW-1URS	07/23/03	594.82		13.73		0.8	581.09		
MW-1URS	08/27/03	594.82		13.75		0.8	581.07		
MW-1URS	09/30/03	594.82		16.35		0.8	578.47		WELL DAMAGED ON 9/22, NEW RISER INSTALLED, NOT YET SURVEYED
MW-1URS	10/13/03	594.82		15.17		0.8	579.65		
MW-1URS	11/25/03	594.82		14.93		0.8	579.89		
MW-1URS	12/31/03	594.82		14.39		0.8	580.43		
MW-1URS	01/19/04	594.82		14.46		0.8	580.36		
MW-1URS	01/20/04	594.82		14.46		0.8	580.36		
MW-1URS	02/27/04	594.82		14.91		0.8	579.91		

Table 3. Summary of Water-Level, Product Thickness and Product Bailing Data in OU-4
Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

Well Designation	Date	Measuring Point Elevation (ft msl)	Depth to Product (ft)	Depth to Water (ft)	Product Thickness (ft)	Specific Gravity	Corrected Elevation (ft msl)	Product Bailed (gal)	Comments
MW-1URS	03/31/04	594.82		14.27		0.8	580.55		
MW-1URS	04/07/04	594.82		9.66		0.8	585.16		
MW-1URS	04/07/04	594.82		9.66		0.8	585.16		
MW-1URS	05/28/04	594.82		13.99		0.8	580.83		
MW-1URS	06/30/04	594.82		14.56		0.8	580.26		
MW-1URS	07/12/04	594.82		14.52		0.8	580.30		
MW-1URS	08/31/04	594.82		14.6		0.8	580.22		
MW-1URS	09/30/04	594.82		14.54		0.8	580.28		
MW-1URS	10/11/04	594.82		14.69		0.8	580.13		
MW-1URS	11/29/04	594.82		14.53		0.8	580.29		
MW-1URS	12/28/04	594.82		13.68		0.8	581.14		
MW-1URS	01/25/05	594.82		13.55		0.8	581.27		
MW-1URS	02/28/05	594.82		14.17		0.8	580.65		
MW-1URS	03/31/05	594.82		13.99		0.8	580.83		
MW-1URS	04/06/05	594.82		13.52		0.8	581.30		
MW-1URS	05/27/05	594.82		14.09		0.8	580.73		
MW-1URS	07/18/05	594.82		14.55		0.8	580.27		
MW-1URS	08/25/05	594.82		14.88		0.8	579.94		
MW-1URS	09/30/05	594.82		14.39		0.8	580.43		
MW-1URS	10/12/05	594.82		14.5		0.8	580.32		
MW-1URS	11/30/05	594.82		14.19		0.8	580.63		
MW-1URS	12/30/05	594.82		14.59		0.8	580.23		RIVER FROZEN
MW-1URS	01/17/06	594.82		14.18		0.8	580.64		
MW-1URS	01/20/06	594.82		14.18		0.8	580.64		
MW-1URS	02/23/06	594.82		14.1		0.8	580.72		
MW-1URS	03/29/06	594.82		14.4		0.8	580.42		
MW-1URS	04/10/06	594.82		14.7		0.8	580.12		
MW-1URS	06/30/06	594.82		15.59		0.8	579.23		
MW-2URS	07/23/03	581.83		12.44		0.8	569.39		
MW-2URS	10/13/03	581.83		12.64		0.8	569.19		
MW-2URS	01/19/04	581.83		11.26		0.8	570.57		
MW-2URS	04/07/04	581.83		9.61		0.8	572.22		
MW-2URS	07/12/04	581.83		11.87		0.8	569.96		
MW-2URS	09/15/04	581.83		12.56		0.8	569.27		
MW-2URS	10/11/04	581.83		13.51		0.8	568.32		
MW-2URS	01/25/05	581.83		13.14		0.8	568.69		
MW-2URS	04/06/05	581.83		13.11		0.8	568.72		
MW-2URS	07/18/05	581.83		13.66		0.8	568.17		
MW-2URS	10/12/05	581.83		14.11		0.8	567.72		
MW-2URS	01/17/06	581.83		13.03		0.8	568.80		
MW-2URS	04/10/06	581.83		12.4		0.8	569.43		
MW-3URS	07/23/03	599.58		27.95		0.8822	571.63		
MW-3URS	10/13/03	599.58		28.66		0.8822	570.92		
MW-3URS	01/19/04	599.58		28.24		0.8822	571.34		
MW-3URS	04/07/04	599.58		27.73		0.8822	571.85		
MW-3URS	07/12/04	599.58		27.45		0.8822	572.13		
MW-3URS	09/15/04	599.58		27.52		0.8822	572.06		
MW-3URS	10/11/04	599.58		28.38		0.8822	571.20		
MW-3URS	01/25/05	599.58		26.56		0.8822	573.02		
MW-3URS	04/06/05	599.58		27.05		0.8822	572.53		
MW-3URS	07/18/05	599.58		27.66		0.8822	571.92		
MW-3URS	10/12/05	599.58		28.73		0.8822	570.85		
MW-3URS	01/17/06	599.58		29.15		0.8822	570.43		
MW-3URS	04/10/06	599.58		28.05		0.8822	571.53		
MW-4URS	06/25/03	594.59		23.08		0.8	571.51		
MW-4URS	07/22/03	594.59		23.07		0.8	571.52		
MW-4URS	07/23/03	594.59		23.07		0.8	571.52		
MW-4URS	08/27/03	594.59		22.97		0.8	571.62		
MW-4URS	09/30/03	594.59		22.86		0.8	571.73		
MW-4URS	10/13/03	594.59		24.02		0.8	570.57		
MW-4URS	11/25/03	594.59		23.5		0.8	571.09		
MW-4URS	12/31/03	594.59		22.93		0.8	571.66		
MW-4URS	01/19/04	594.59		23.36		0.8	571.23		
MW-4URS	01/20/04	594.59		23.36		0.8	571.23		
MW-4URS	02/27/04	594.59		24.39		0.8	570.20		
MW-4URS	03/31/04	594.59		23.46		0.8	571.13		
MW-4URS	04/07/04	594.59		23.2		0.8	571.39		
MW-4URS	04/07/04	594.59		23.2		0.8	571.39		
MW-4URS	05/28/04	594.59		22.35		0.8	572.24		
MW-4URS	06/30/04	594.59		22.47		0.8	572.12		
MW-4URS	07/12/04	594.59		22.79		0.8	571.80		
MW-4URS	08/31/04	594.59		22.84		0.8	571.75		
MW-4URS	09/15/04	594.59		22.85		0.8	571.74		
MW-4URS	09/30/04	594.59		23.15		0.8	571.44		
MW-4URS	10/11/04	594.59		23.74		0.8	570.85		

Table 3. Summary of Water-Level, Product Thickness and Product Bailing Data in OU-4
Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

Well Designation	Date	Measuring Point Elevation (ft msl)	Depth to Product (ft)	Depth to Water (ft)	Product Thickness (ft)	Specific Gravity	Corrected Elevation (ft msl)	Product Bailed (gal)	Comments
MW-4URS	11/29/04	594.59		23.59		0.8	571.00		
MW-4URS	12/28/04	594.59		22.97		0.8	571.62		
MW-4URS	01/25/05	594.59		21.86		0.8	572.73		
MW-4URS	02/28/05	594.59		22.98		0.8	571.61		
MW-4URS	03/31/05	594.59		22.62		0.8	571.97		
MW-4URS	04/06/05	594.59		22.13		0.8	572.46		
MW-4URS	05/27/05	594.59		22.54		0.8	572.05		
MW-4URS	07/18/05	594.59		22.93		0.8	571.66		
MW-4URS	08/25/05	594.59		23.69		0.8	570.90		
MW-4URS	09/30/05	594.59		23.22		0.8	571.37		
MW-4URS	10/12/05	594.59		24.09		0.8	570.50		
MW-4URS	11/30/05	594.59		23.79		0.8	570.80		
MW-4URS	12/30/05	594.59		24.68		0.8	569.91		RIVER FROZEN
MW-4URS	01/17/06	594.59		24.22		0.8	570.37		
MW-4URS	01/20/06	594.59		24.22		0.8	570.37		
MW-4URS	02/23/06	594.59		23.13		0.8	571.46		
MW-4URS	03/29/06	594.59		23.33		0.8	571.26		
MW-4URS	04/10/06	594.59		23.23		0.8	571.36		
MW-4URS	06/30/06	594.59		22.53		0.8	572.06		
MW-5URS	07/23/03	595.36		14.26		0.8	581.10		
MW-5URS	10/13/03	595.36		14.36		0.8	581.00		
MW-5URS	01/19/04	595.36				0.8			NOT GAUGED- WELL RISER BROKEN
MW-5URS	04/07/04	595.36		9.66		0.8	585.70		WELL CASING APPROX. 30" BROKEN OFF
MW-5URS	07/12/04	595.36		3.64		0.8	591.72		WELL CASING APPROX. 28" BROKEN OFF
MW-5URS	10/11/04	595.36		15.35		0.8	580.01		NEW RISER DTB 19.50 (TO BE SURVEYED)
MW-5URS	01/25/05	595.36		14.84		0.8	580.52		Well damaged, readings unreliable
MW-5URS	04/06/05	595.36		14.56		0.8	580.80		
MW-5URS	07/18/05	595.36		15.25		0.8	580.11		
MW-5URS	10/12/05	595.36		15.31		0.8	580.05		
MW-5URS	01/17/06	595.36		15.04		0.8	580.32		
MW-5URS	04/10/06	595.36		16.53		0.8	578.83		
MW-28	06/03/03	599.91	27.95	28.4	0.45	0.883	571.91		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 0
MW-28	06/11/03	599.91	27.57	27.7	0.13	0.883	572.32		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 0
MW-28	06/18/03	599.91	27.65	27.8	0.15	0.883	572.24		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.8
MW-28	06/25/03	599.91	27.48	27.74	0.26	0.883	572.40		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.8
MW-28	07/02/03	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.8
MW-28	07/10/03	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.8
MW-28	07/18/03	599.91	27.76	28.33	0.57	0.883	572.08	0.12	SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.8, DOWN DUE TO BAD REEL MOTOR
MW-28	07/23/03	599.91	27.62	28.71	1.09	0.883	572.16		
MW-28	07/30/03	599.91	27.64	28.92	1.28	0.883	572.12	0.5	SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.8, DOWN DUE TO BAD REEL MOTOR
MW-28	08/08/03	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.8
MW-28	08/20/03	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.67
MW-28	09/04/03	599.91	28.35	28.45	0.1	0.883	571.55		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02
MW-28	09/12/03	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.5

Table 3. Summary of Water-Level, Product Thickness and Product Bailing Data in OU-4
Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

Well Designation	Date	Measuring Point Elevation (ft msl)	Depth to Product (ft)	Depth to Water (ft)	Product Thickness (ft)	Specific Gravity	Corrected Elevation (ft msl)	Product Bailed (gal)	Comments
MW-28	09/18/03	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.46
MW-28	09/30/03	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.80; REMOVED DRUM AND TRANSFERRED TO 8,000 AST; 0.35 OF PRODUCT
MW-28	10/10/03	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.79
MW-28	10/13/03	599.91	28.49	28.51	0.02	0.883	571.42		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02
MW-28	10/17/03	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.78
MW-28	11/05/03	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.78
MW-28	11/12/03	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.76
MW-28	11/21/03	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.75
MW-28	12/05/03	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.74
MW-28	12/10/03	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.74
MW-28	12/19/03	599.91	28.13	28.15	0.02	0.883	571.78		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.74
MW-28	12/31/03	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.74
MW-28	01/08/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.74
MW-28	01/19/04	599.91	28.16	28.19	0.03	0.883	571.75		
MW-28	02/13/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.74
MW-28	02/27/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.75
MW-28	03/05/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.74
MW-28	03/17/04	599.91	28.41	28.42	0.01	0.883	571.50		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.7
MW-28	03/29/04	599.91	28.04	28.08	0.04	0.883	571.87		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.68
MW-28	04/07/04	599.91	27.56	27.6	0.04	0.883	572.35		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02
MW-28	04/13/04	599.91		3.67		0.883	596.24		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.64. SYSTEM DOWN FOR CHEMOX TEST
MW-28	04/23/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; SYSTEM DOWN FOR CHEMOX TEST
MW-28	05/19/04	599.91	27.55	27.57	0.02	0.883	572.36		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02;DTP 1.9
MW-28	05/28/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02;DTP 1.68
MW-28	06/04/04	599.91	27.09	27.16	0.07	0.883	572.81		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02;DTP 1.44

Table 3. Summary of Water-Level, Product Thickness and Product Bailing Data in OU-4
Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

Well Designation	Date	Measuring Point Elevation (ft msl)	Depth to Product (ft)	Depth to Water (ft)	Product Thickness (ft)	Specific Gravity	Corrected Elevation (ft msl)	Product Bailed (gal)	Comments
MW-28	06/28/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02;DTP 1.15
MW-28	06/30/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02;DTP 2.8- NEW DRUM CHANGED
MW-28	07/12/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02
MW-28	07/23/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.79
MW-28	07/30/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.78
MW-28	08/06/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.78
MW-28	08/17/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02;DTP 2.76
MW-28	08/27/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02;DTP 2.78
MW-28	09/07/04	599.91	27.57	27.59	0.02	0.883	572.34		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02;DTP 2.77
MW-28	09/23/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02;DTP 2.76
MW-28	10/11/04	599.91	28.38	28.94	0.56	0.883	571.46		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02
MW-28	10/21/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.79
MW-28	11/03/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.81
MW-28	11/18/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.80
MW-28	11/30/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.75
MW-28	12/08/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.76
MW-28	12/14/04	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.76
MW-28	01/07/05	599.91				0.883			Solar-powered product pump in well since 8/6/02;system down due to dead battery, 0.03 feet of product in well, DTP in drum =
MW-28	01/14/05	599.91				0.883			Solar-powered product pump in well since 8/6/02; DTP in drum 2.8 feet
MW-28	01/20/05	599.91				0.883			Solar-powered product pump in well since 8/6/02; DTP in drum 2.8 feet
MW-28	01/25/05	599.91		26.38		0.883	573.53		Solar-powered product pump in well since 8/6/02
MW-28	02/03/05	599.91				0.883			Solar-powered product pump in well since 8/6/02; DTP in drum 2.85 feet
MW-28	02/15/05	599.91				0.883			Solar-powered product pump in well since 8/6/02
MW-28	02/28/05	599.91				0.883			Solar-powered product pump in well since 8/6/02; DTP in drum 2.79 feet
MW-28	03/14/05	599.91	27.3	27.95	0.65	0.883	572.53		Solar-powered product pump in well since 8/6/02; DTP in drum 2.8 feet
MW-28	03/24/05	599.91		27.42		0.883	572.49		Solar-powered product pump in well since 8/6/02; DTP 2.78

Table 3. Summary of Water-Level, Product Thickness and Product Bailing Data in OU-4
Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

Well Designation	Date	Measuring Point Elevation (ft msl)	Depth to Product (ft)	Depth to Water (ft)	Product Thickness (ft)	Specific Gravity	Corrected Elevation (ft msl)	Product Bailed (gal)	Comments
MW-28	03/30/05	599.91				0.883			Solar-powered product pump in well since 8/6/02; DTP 2.78
MW-28	04/06/05	599.91		26.99		0.883	572.92		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02
MW-28	04/15/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.78
MW-28	04/22/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.78
MW-28	05/13/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.78
MW-28	05/18/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.78
MW-28	05/24/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.78
MW-28	06/03/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.76
MW-28	06/10/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.75
MW-28	06/17/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.75
MW-28	06/24/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.69
MW-28	07/06/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.62
MW-28	07/14/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.58
MW-28	07/18/05	599.91	27.53	27.6	0.07	0.883	572.37		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02;
MW-28	07/26/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.57
MW-28	08/05/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.45
MW-28	08/12/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.43
MW-28	08/18/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02;DTP 2.39
MW-28	08/25/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.36
MW-28	09/09/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.34
MW-28	09/15/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.31
MW-28	09/20/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.3
MW-28	09/30/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.28
MW-28	10/06/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.29
MW-28	10/12/05	599.91	28.44	29.32	0.88	0.883	571.37		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02
MW-28	10/27/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02
MW-28	11/10/05	599.91		28.15		0.883	571.76		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02;

Table 3. Summary of Water-Level, Product Thickness and Product Bailing Data in OU-4
Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

Well Designation	Date	Measuring Point Elevation (ft msl)	Depth to Product (ft)	Depth to Water (ft)	Product Thickness (ft)	Specific Gravity	Corrected Elevation (ft msl)	Product Bailed (gal)	Comments
MW-28	11/22/05	599.91	28.87	28.88	0.01	0.883	571.04		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.27
MW-28	12/08/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.27; RIVER FROZEN
MW-28	12/15/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.27; RIVER FROZEN
MW-28	12/27/05	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.27; RIVER FROZEN
MW-28	01/10/06	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.3
MW-28	01/17/06	599.91	29.06	29.08	0.02	0.883	570.85		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02
MW-28	01/31/06	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.3
MW-28	02/09/06	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.3
MW-28	02/16/06	599.91		27.9		0.883	572.01		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02
MW-28	02/23/06	599.91		27.63		0.883	572.28		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.3
MW-28	03/02/06	599.91		28.44		0.883	571.47		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.3
MW-28	03/15/06	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.3
MW-28	03/23/06	599.91		27.8		0.883	572.11		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.3
MW-28	03/30/06	599.91		28.09		0.883	571.82		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.3
MW-28	04/05/06	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.3
MW-28	04/10/06	599.91		27.95		0.883	571.96		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.3
MW-28	04/28/06	599.91	28.08	28.18	0.1	0.883	571.82		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.3
MW-28	05/05/06	599.91	27.83	27.86	0.03	0.883	572.08		SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.3
MW-28	05/18/06	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.3
MW-28	05/23/06	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.3
MW-28	06/23/06	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.3
MW-28	06/30/06	599.91				0.883			SOLAR-POWERED PRODUCT PUMP IN WELL SINCE 8/6/02; DTP 2.3
MW-39	07/23/03	596.21		19.47		0.8	576.74		
MW-39	10/13/03	596.21	21.58	21.59	0.01	0.8	574.63		
MW-39	01/19/04	596.21		23.96		0.8	572.25		
MW-39	04/07/04	596.21	21.35	21.36	0.01	0.8	574.86		
MW-39	07/12/04	596.21		18.8		0.8	577.41		
MW-39	10/11/04	596.21		24.17		0.8	572.04		
MW-39	01/25/05	596.21		18.89		0.8	577.32		
MW-39	04/06/05	596.21		18.67		0.8	577.54		
MW-39	07/18/05	596.21		20.5		0.8	575.71		
MW-39	10/12/05	596.21		22.29		0.8	573.92		
MW-39	01/17/06	596.21		22.81		0.8	573.40		

Table 3. Summary of Water-Level, Product Thickness and Product Bailing Data in OU-4
Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

Well Designation	Date	Measuring Point Elevation (ft msl)	Depth to Product (ft)	Depth to Water (ft)	Product Thickness (ft)	Specific Gravity	Corrected Elevation (ft msl)	Product Bailed (gal)	Comments
MW-39	04/10/06	596.21		22.53		0.8	573.68		
P-15	06/03/03	597.04	25.55	25.7	0.15	0.88	571.47		
P-15	06/11/03	597.04	25.31	25.54	0.23	0.88	571.70		
P-15	06/18/03	597.04	25.44	25.64	0.2	0.88	571.58		
P-15	06/25/03	597.04	25.35	25.6	0.25	0.88	571.66		
P-15	07/02/03	597.04	25.45	25.67	0.22	0.88	571.56		
P-15	07/10/03	597.04	25.5	25.85	0.35	0.88	571.50		
P-15	07/18/03	597.04	25.33	25.5	0.17	0.88	571.69		
P-15	07/23/03	597.04	25.48	25.78	0.3	0.88	571.52		
P-15	07/30/03	597.04	25.42	25.73	0.31	0.88	571.58		
P-15	08/08/03	597.04	25.4	25.72	0.32	0.88	571.60		
P-15	08/20/03	597.04	25.43	25.83	0.4	0.88	571.56	0.06	
P-15	09/04/03	597.04	25.8	26.09	0.29	0.88	571.21	0.1	
P-15	09/12/03	597.04	26.03	26.3	0.27	0.88	570.98	0.125	
P-15	09/18/03	597.04	26.03	26.46	0.43	0.88	570.96	0.125	
P-15	09/30/03	597.04	25.54	25.71	0.17	0.88	571.48	0.06	
P-15	10/10/03	597.04	26.15	26.35	0.2	0.88	570.87		
P-15	10/13/03	597.04	26.18	26.53	0.35	0.88	570.82		
P-15	10/17/03	597.04	25.96	26.32	0.36	0.88	571.04	0.008	
P-15	11/05/03	597.04	26.36	26.5	0.14	0.88	570.66	0.012	
P-15	11/12/03	597.04	26.38	26.6	0.22	0.88	570.63		
P-15	11/21/03	597.04	26.2	26.23	0.03	0.88	570.84		
P-15	12/05/03	597.04	26.4	26.65	0.25	0.88	570.61		
P-15	12/10/03	597.04				0.88			NOT GAUGED- ACCESS BLOCKED DUE TO TANK 176 CLEAN
P-15	12/19/03	597.04	25.85	25.96	0.11	0.88	571.18	0.1	
P-15	12/31/03	597.04	25.66	25.72	0.06	0.88	571.37		
P-15	01/08/04	597.04	26.36	26.42	0.06	0.88	570.67		
P-15	01/19/04	597.04	25.66	25.72	0.06	0.88	571.37		
P-15	02/13/04	597.04	26.34	26.45	0.11	0.88	570.69		
P-15	02/27/04	597.04	25.6	25.9	0.3	0.88	571.40		
P-15	03/05/04	597.04	25.37	25.41	0.04	0.88	571.67		
P-15	03/17/04	597.04	25.45	25.65	0.2	0.88	571.57	0.05	
P-15	03/29/04	597.04	25.95	26.15	0.2	0.88	571.07	0.04	
P-15	04/07/04	597.04	25.44	25.54	0.1	0.88	571.59		
P-15	04/13/04	597.04	25.44	25.54	0.1	0.88	571.59	0.05	
P-15	04/23/04	597.04				0.88			NOT GAUGED- CHEMOX TEST
P-15	05/19/04	597.04	25.39	25.73	0.34	0.88	571.61	0.1	
P-15	05/28/04	597.04	24.61	25.1	0.49	0.88	572.37	0.25	
P-15	06/04/04	597.04	24.72	25.33	0.61	0.88	572.25	0.1	
P-15	06/18/04	597.04	24.6	25.28	0.68	0.88	572.36	0.1	
P-15	06/30/04	597.04	24.7	25.5	0.8	0.88	572.24	0.25	
P-15	07/12/04	597.04	24.93	25.65	0.72	0.88	572.02		
P-15	07/16/04	597.04	24.93	25.65	0.72	0.88	572.02	0.25	
P-15	07/23/04	597.04	24.95	25.47	0.52	0.88	572.03	0.1	
P-15	07/30/04	597.04	25.03	25.29	0.26	0.88	571.98		
P-15	08/06/04	597.04	24.8	25.38	0.58	0.88	572.17	0.25	
P-15	08/17/04	597.04	25.1	25.76	0.66	0.88	571.86	0.25	
P-15	08/27/04	597.04	25.15	25.74	0.59	0.88	571.82		
P-15	09/07/04	597.04	25.07	25.7	0.63	0.88	571.89	0.1	
P-15	09/23/04	597.04	25.44	25.6	0.16	0.88	571.58		
P-15	10/11/04	597.04	25.89	26.31	0.42	0.88	571.10	0.25	
P-15	10/21/04	597.04	25.95	25.97	0.02	0.88	571.09		
P-15	11/03/04	597.04	25.99	26.13	0.14	0.88	571.03		
P-15	11/18/04	597.04	26.09	26.31	0.22	0.88	570.92		
P-15	11/30/04	597.04	25.55	25.56	0.01	0.88	571.49		
P-15	12/08/04	597.04	26.22	26.45	0.23	0.88	570.79	0.1	
P-15	12/14/04	597.04	26.58	26.61	0.03	0.88	570.46		
P-15	12/22/04	597.04	25.68	25.71	0.03	0.88	571.36		
P-15	01/07/05	597.04		25.1		0.88	571.94		
P-15	01/14/05	597.04		24.51		0.88	572.53		
P-15	01/20/05	597.04		25.01		0.88	572.03		
P-15	01/25/05	597.04		24.31		0.88	572.73		Trace product
P-15	02/03/05	597.04	25.37	25.4	0.03	0.88	571.67		
P-15	02/15/05	597.04	24.8	24.92	0.12	0.88	572.23		
P-15	02/28/05	597.04	25.23	25.47	0.24	0.88	571.78		
P-15	03/14/05	597.04	25.1	25.39	0.29	0.88	571.91		
P-15	03/24/05	597.04	25.39	25.6	0.21	0.88	571.62		
P-15	03/30/05	597.04	25.17	25.39	0.22	0.88	571.84		
P-15	04/06/05	597.04	24.54	24.72	0.18	0.88	572.48		
P-15	04/15/05	597.04	25.05	25.27	0.22	0.88	571.96		
P-15	05/06/05	597.04	24.79	25.22	0.43	0.88	572.20		
P-15	05/13/05	597.04	25.25	25.69	0.44	0.88	571.74	0.25	
P-15	05/18/05	597.04	24.81	25.42	0.61	0.88	572.16		

Table 3. Summary of Water-Level, Product Thickness and Product Bailing Data in OU-4
Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

Well Designation	Date	Measuring Point Elevation (ft msl)	Depth to Product (ft)	Depth to Water (ft)	Product Thickness (ft)	Specific Gravity	Corrected Elevation (ft msl)	Product Bailed (gal)	Comments
P-15	05/24/05	597.04	25.01	25.59	0.58	0.88	571.96		
P-15	06/03/05	597.04	25.02	25.55	0.53	0.88	571.96		
P-15	06/10/05	597.04	25.3	25.39	0.09	0.88	571.73		
P-15	06/17/05	597.04	24.99	25.5	0.51	0.88	571.99	0.25	
P-15	06/24/05	597.04	25.02	25.51	0.49	0.88	571.96		
P-15	07/06/05	597.04	25.45	25.73	0.28	0.88	571.56	0.12	
P-15	07/14/05	597.04	25.5	25.8	0.3	0.88	571.50		
P-15	07/18/05	597.04	25.27	25.52	0.25	0.88	571.74	0.12	PRODUCT BAILED ON 7/21
P-15	07/26/05	597.04	24.96	25.31	0.35	0.88	572.04	0.12	
P-15	08/05/05	597.04	25.49	25.62	0.13	0.88	571.53	0.06	
P-15	08/12/05	597.04	25.57	25.98	0.41	0.88	571.42	0.12	
P-15	08/18/05	597.04	25.77	26.14	0.37	0.88	571.23	0.06	
P-15	08/25/05	597.04	25.95	26.37	0.42	0.88	571.04	0.06	
P-15	09/09/05	597.04	26	26.44	0.44	0.88	570.99	0.12	
P-15	09/15/05	597.04	26.05	26.5	0.45	0.88	570.94	0.12	
P-15	09/20/05	597.04	26.5	26.6	0.1	0.88	570.53		
P-15	09/30/05	597.04	25.55	25.7	0.15	0.88	571.47	0.06	
P-15	10/06/05	597.04	26.15	26.2	0.05	0.88	570.88		
P-15	10/12/05	597.04	26.28	26.59	0.31	0.88	570.72	0.12	PRODUCT BAILED ON 10/19
P-15	10/27/05	597.04	26.25	26.4	0.15	0.88	570.77		
P-15	11/10/05	597.04		25.47		0.88	571.57		
P-15	11/22/05	597.04	26.11	26.25	0.14	0.88	570.91		
P-15	12/08/05	597.04	26.2	26.5	0.3	0.88	570.80	0.12	RIVER FROZEN
P-15	12/15/05	597.04	26.55	26.66	0.11	0.88	570.48		RIVER FROZEN
P-15	12/27/05	597.04	26.45	26.55	0.1	0.88	570.58		RIVER FROZEN
P-15	01/10/06	597.04	26.08	26.2	0.12	0.88	570.95	0.1	
P-15	01/17/06	597.04	26.45	26.5	0.05	0.88	570.58		
P-15	01/31/06	597.04	25.75	25.76	0.01	0.88	571.29		
P-15	02/09/06	597.04		25.7		0.88	571.34		TRACE PRODUCT
P-15	02/16/06	597.04		25.71		0.88	571.33		
P-15	02/23/06	597.04		25.49		0.88	571.55		
P-15	03/02/06	597.04	25.96	25.97	0.01	0.88	571.08		
P-15	03/15/06	597.04				0.88			NOT GAUGED- ACCESS BLOCKED BY WATER
P-15	03/23/06	597.04	25.48	25.49	0.01	0.88	571.56		
P-15	03/30/06	597.04	25.68	25.71	0.03	0.88	571.36		
P-15	04/05/06	597.04	25.69	25.74	0.05	0.88	571.34		
P-15	04/10/06	597.04	25.6	25.61	0.01	0.88	571.44		
P-15	04/28/06	597.04	25.68	25.71	0.03	0.88	571.36		
P-15	05/05/06	597.04	25.65	25.66	0.01	0.88	571.39		
P-15	05/11/06	597.04	25.45	25.51	0.06	0.88	571.58		
P-15	05/18/06	597.04	25.31	25.35	0.04	0.88	571.73		
P-15	05/23/06	597.04	25.11	25.13	0.02	0.88	571.93		
P-15	06/15/06	597.04	25.19	25.3	0.11	0.88	571.84	0.25	
P-15	06/23/06	597.04	25.25	25.27	0.02	0.88	571.79		
P-15	06/30/06	597.04	24.95	25.01	0.06	0.88	572.08		
RW-8R	07/23/03	593.4		21.62		0.8	571.78		
RW-8R	10/13/03	593.4		22.53		0.8	570.87		
RW-8R	01/19/04	593.4		21.67		0.8	571.73		
RW-8R	04/07/04	593.4		21.33		0.8	572.07		
RW-8R	07/12/04	593.4		20.72		0.8	572.68		
RW-8R	10/11/04	593.4		22.26		0.8	571.14		
RW-8R	01/25/05	593.4		20.01		0.8	573.39		
RW-8R	04/06/05	593.4		20.41		0.8	572.99		
RW-8R	07/18/05	593.4		21.48		0.8	571.92		TRACE PRODUCT
RW-8R	10/12/05	593.4		22.47		0.8	570.93		
RW-8R	01/17/06	593.4		22.79		0.8	570.61		
RW-8R	04/10/06	593.4		21.75		0.8	571.65		
SB-74	07/23/03	599.1		27.64		0.8	571.46		
SB-74	10/13/03	599.1		28.39		0.8	570.71		
SB-74	01/19/04	599.1		28.01		0.8	571.09		
SB-74	04/07/04	599.1		27.46		0.8	571.64		
SB-74	07/12/04	599.1				0.8			NOT GAUGED - ACCESS BLOCKED BY DENSE VEGETATION
SB-74	09/15/04	599.1		27.16		0.8	571.94		
SB-74	10/11/04	599.1		28.09		0.8	571.01		
SB-74	01/25/05	599.1		26.27		0.8	572.83		
SB-74	04/06/05	599.1		26.73		0.8	572.37		
SB-74	07/18/05	599.1		27.38		0.8	571.72		
SB-74	10/12/05	599.1		28.48		0.8	570.62		
SB-74	01/17/06	599.1		28.78		0.8	570.32		
SB-74	04/10/06	599.1		27.75		0.8	571.35		
SB-75	07/23/03	599.86		28.31		0.8	571.55		
SB-75	10/13/03	599.86		29.04		0.8	570.82		

Table 3. Summary of Water-Level, Product Thickness and Product Bailing Data in OU-4
Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

Well Designation	Date	Measuring Point Elevation (ft msl)	Depth to Product (ft)	Depth to Water (ft)	Product Thickness (ft)	Specific Gravity	Corrected Elevation (ft msl)	Product Bailed (gal)	Comments
SB-75	01/19/04	599.86		28.77		0.8	571.09		
SB-75	04/07/04	599.86		28.13		0.8	571.73		
SB-75	07/12/04	599.86		27.37		0.8	572.49		
SB-75	09/15/04	599.86		27.81		0.8	572.05		
SB-75	10/11/04	599.86		28.72		0.8	571.14		
SB-75	01/25/05	599.86		26.46		0.8	573.40		
SB-75	04/06/05	599.86		27.08		0.8	572.78		
SB-75	07/18/05	599.86		28.07		0.8	571.79		
SB-75	10/12/05	599.86		28.98		0.8	570.88		
SB-75	01/17/06	599.86		29.65		0.8	570.21		
SB-75	04/10/06	599.86		28.58		0.8	571.28		
SB-76	07/23/03	600.96		26.24		0.8	574.72		
SB-76	10/13/03	600.96		26.24		0.8	574.72		
SB-76	01/19/04	600.96		26.38		0.8	574.58		
SB-76	04/07/04	600.96		26		0.8	574.96		
SB-76	07/12/04	600.96		25.91		0.8	575.05		
SB-76	09/15/04	600.96		25.8		0.8	575.16		
SB-76	10/11/04	600.96		26.22		0.8	574.74		
SB-76	01/25/05	600.96		25.5		0.8	575.46		
SB-76	04/06/05	600.96		25.69		0.8	575.27		
SB-76	07/18/05	600.96		26.49		0.8	574.47		
SB-76	10/12/05	600.96		25.98		0.8	574.98		
SB-76	01/17/06	600.96		26.24		0.8	574.72		
SB-76	04/10/06	600.96		26.81		0.8	574.15		
SB-78	06/25/03	598.97		22.32		0.8	576.65		
SB-78	07/22/03	598.97		22.3		0.8	576.67		
SB-78	07/23/03	598.97		22.3		0.8	576.67		
SB-78	08/27/03	598.97		22.53		0.8	576.44		
SB-78	09/30/03	598.97		22.66		0.8	576.31		
SB-78	10/13/03	598.97		22.43		0.8	576.54		
SB-78	11/25/03	598.97		22.37		0.8	576.60		
SB-78	12/31/03	598.97		22.31		0.8	576.66		
SB-78	01/19/04	598.97		22.41		0.8	576.56		
SB-78	01/20/04	598.97		22.41		0.8	576.56		
SB-78	02/27/04	598.97		22.74		0.8	576.23		
SB-78	03/31/04	598.97		22.16		0.8	576.81		
SB-78	04/07/04	598.97		21.99		0.8	576.98		
SB-78	04/07/04	598.97		21.99		0.8	576.98		
SB-78	05/28/04	598.97		21.35		0.8	577.62		
SB-78	06/30/04	598.97		22.25		0.8	576.72		
SB-78	07/12/04	598.97		22.3		0.8	576.67		
SB-78	08/31/04	598.97		22.43		0.8	576.54		
SB-78	09/15/04	598.97		22.09		0.8	576.88		
SB-78	09/30/04	598.97		22.34		0.8	576.63		
SB-78	10/11/04	598.97		21.31		0.8	577.66		
SB-78	11/29/04	598.97		22.26		0.8	576.71		
SB-78	01/25/05	598.97		21.84		0.8	577.13		
SB-78	02/28/05	598.97		22.13		0.8	576.84		
SB-78	03/31/05	598.97		22.1		0.8	576.87		
SB-78	04/06/05	598.97		21.54		0.8	577.43		
SB-78	05/27/05	598.97		22.08		0.8	576.89		
SB-78	07/18/05	598.97		22.3		0.8	576.67		
SB-78	08/25/05	598.97		22.49		0.8	576.48		
SB-78	09/30/05	598.97		21.82		0.8	577.15		
SB-78	10/12/05	598.97		22.08		0.8	576.89		
SB-78	11/30/05	598.97		27		0.8	571.97		
SB-78	12/30/05	598.97		22.28		0.8	576.69		RIVER FROZEN
SB-78	01/17/06	598.97		22.13		0.8	576.84		
SB-78	01/20/06	598.97		22.13		0.8	576.84		
SB-78	02/23/06	598.97		22.02		0.8	576.95		
SB-78	03/29/06	598.97		22.49		0.8	576.48		
SB-78	04/10/06	598.97		23.14		0.8	575.83		
SB-78	06/30/06	598.97		26.17		0.8	572.80		
SB-79	06/26/03	599.26		26.81		0.8	572.45		VISUAL INSPECTION WELL- RUST
SB-79	07/23/03	599.26		26.83		0.8	572.43		
SB-79	10/13/03	599.26		27.11		0.8	572.15		
SB-79	01/19/04	599.26		26.72		0.8	572.54		
SB-79	04/07/04	599.26		25.6		0.8	573.66		
SB-79	07/12/04	599.26		26.16		0.8	573.10		
SB-79	09/15/04	599.26		24.87		0.8	574.39		
SB-79	10/11/04	599.26		24.76		0.8	574.50		
SB-79	01/25/05	599.26		25.15		0.8	574.11		
SB-79	04/06/05	599.26		25.28		0.8	573.98		
SB-79	07/18/05	599.26		25.34		0.8	573.92		DRY

Table 3. Summary of Water-Level, Product Thickness and Product Bailing Data in OU-4
Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

Well Designation	Date	Measuring Point Elevation (ft msl)	Depth to Product (ft)	Depth to Water (ft)	Product Thickness (ft)	Specific Gravity	Corrected Elevation (ft msl)	Product Bailed (gal)	Comments
SB-79	10/12/05	599.26				0.8			DRY
SB-79	01/17/06	599.26		25.4		0.8	573.86		
SB-79	04/10/06	599.26				0.8			WELL DRY
SB-80	06/26/03	599.11		25.93		0.8	573.18		VISUAL INSPECTION WELL- CLEAR
SB-80	07/23/03	599.11		26.22		0.8	572.89		
SB-80	10/13/03	599.11		26.55		0.8	572.56		
SB-80	01/19/04	599.11		25.74		0.8	573.37		SHEEN PRESENT
SB-80	04/07/04	599.11		25.11		0.8	574.00		
SB-80	07/12/04	599.11		26.61		0.8	572.50		
SB-80	09/15/04	599.11		22.88		0.8	576.23		
SB-80	10/11/04	599.11		25.9		0.8	573.21		
SB-80	01/25/05	599.11		24.63		0.8	574.48		
SB-80	04/06/05	599.11		24.29		0.8	574.82		
SB-80	07/18/05	599.11		25.87		0.8	573.24		
SB-80	10/12/05	599.11		25.97		0.8	573.14		
SB-80	01/17/06	599.11		26.14		0.8	572.97		
SB-80	04/10/06	599.11		27.51		0.8	571.60		
SB-81	06/26/03	597.81		24.88		0.8	572.93		VISUAL INSPECTION WELL- RUST
SB-81	07/23/03	597.81		25.28		0.8	572.53		
SB-81	10/13/03	597.81		26.45		0.8	571.36		
SB-81	01/19/04	597.81		25.23		0.8	572.58		
SB-81	04/07/04	597.81		24.32		0.8	573.49		
SB-81	07/12/04	597.81		24.54		0.8	573.27		
SB-81	10/11/04	597.81		25.12		0.8	572.69		
SB-81	01/25/05	597.81		23.48		0.8	574.33		
SB-81	04/06/05	597.81		22.97		0.8	574.84		
SB-81	07/18/05	597.81		24.37		0.8	573.44		
SB-81	10/12/05	597.81		24.72		0.8	573.09		
SB-81	01/17/06	597.81		24.74		0.8	573.07		
SB-81	04/10/06	597.81		25.24		0.8	572.57		
SB-82	06/26/03	596.83		23.7		0.8	573.13		VISUAL INSPECTION WELL- CLEAR
SB-82	07/23/03	596.83		24.04		0.8	572.79		
SB-82	10/13/03	596.83		25.52		0.8	571.31		
SB-82	01/19/04	596.83		24.11		0.8	572.72		
SB-82	04/07/04	596.83		23.18		0.8	573.65		
SB-82	07/12/04	596.83		23.6		0.8	573.23		
SB-82	10/11/04	596.83		23.79		0.8	573.04		
SB-82	01/25/05	596.83		22.9		0.8	573.93		
SB-82	04/06/05	596.83		22.38		0.8	574.45		
SB-82	07/18/05	596.83		23.95		0.8	572.88		
SB-82	10/12/05	596.83		23.48		0.8	573.35		
SB-82	01/17/06	596.83		23.75		0.8	573.08		
SB-82	04/10/06	596.83		24.39		0.8	572.44		
SB-83	06/26/03	596.61		22.85		0.8	573.76		VISUAL INSPECTION WELL- CLEAR
SB-83	07/23/03	596.61		23.29		0.8	573.32		
SB-83	10/13/03	596.61		23.72		0.8	572.89		
SB-83	01/19/04	596.61		22.67		0.8	573.94		
SB-83	04/07/04	596.61		21.67		0.8	574.94		
SB-83	07/12/04	596.61		22.98		0.8	573.63		
SB-83	09/15/04	596.61		21.97		0.8	574.64		
SB-83	10/11/04	596.61		23.24		0.8	573.37		
SB-83	01/25/05	596.61		21.8		0.8	574.81		
SB-83	04/06/05	596.61		21.29		0.8	575.32		
SB-83	07/18/05	596.61		23.33		0.8	573.28		
SB-83	10/12/05	596.61		22.59		0.8	574.02		
SB-83	01/17/06	596.61		22.88		0.8	573.73		
SB-83	04/10/06	596.61		28.77		0.8	567.84		
SB-84	06/26/03	594.55		17.75		0.8	576.80		VISUAL INSPECTION WELL- CLEAR
SB-84	07/23/03	594.55		21.14		0.8	573.41		
SB-84	10/13/03	594.55		21.61		0.8	572.94		
SB-84	01/19/04	594.55		20.64		0.8	573.91		
SB-84	04/07/04	594.55		19.86		0.8	574.69		
SB-84	07/12/04	594.55		20.79		0.8	573.76		
SB-84	09/15/04	594.55		19.96		0.8	574.59		
SB-84	10/11/04	594.55		21.04		0.8	573.51		
SB-84	01/25/05	594.55		19.7		0.8	574.85		
SB-84	04/06/05	594.55		19.08		0.8	575.47		
SB-84	07/18/05	594.55		21.32		0.8	573.23		
SB-84	10/12/05	594.55		20.61		0.8	573.94		
SB-84	01/17/06	594.55		20.81		0.8	573.74		

Table 3. Summary of Water-Level, Product Thickness and Product Bailing Data in OU-4
Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

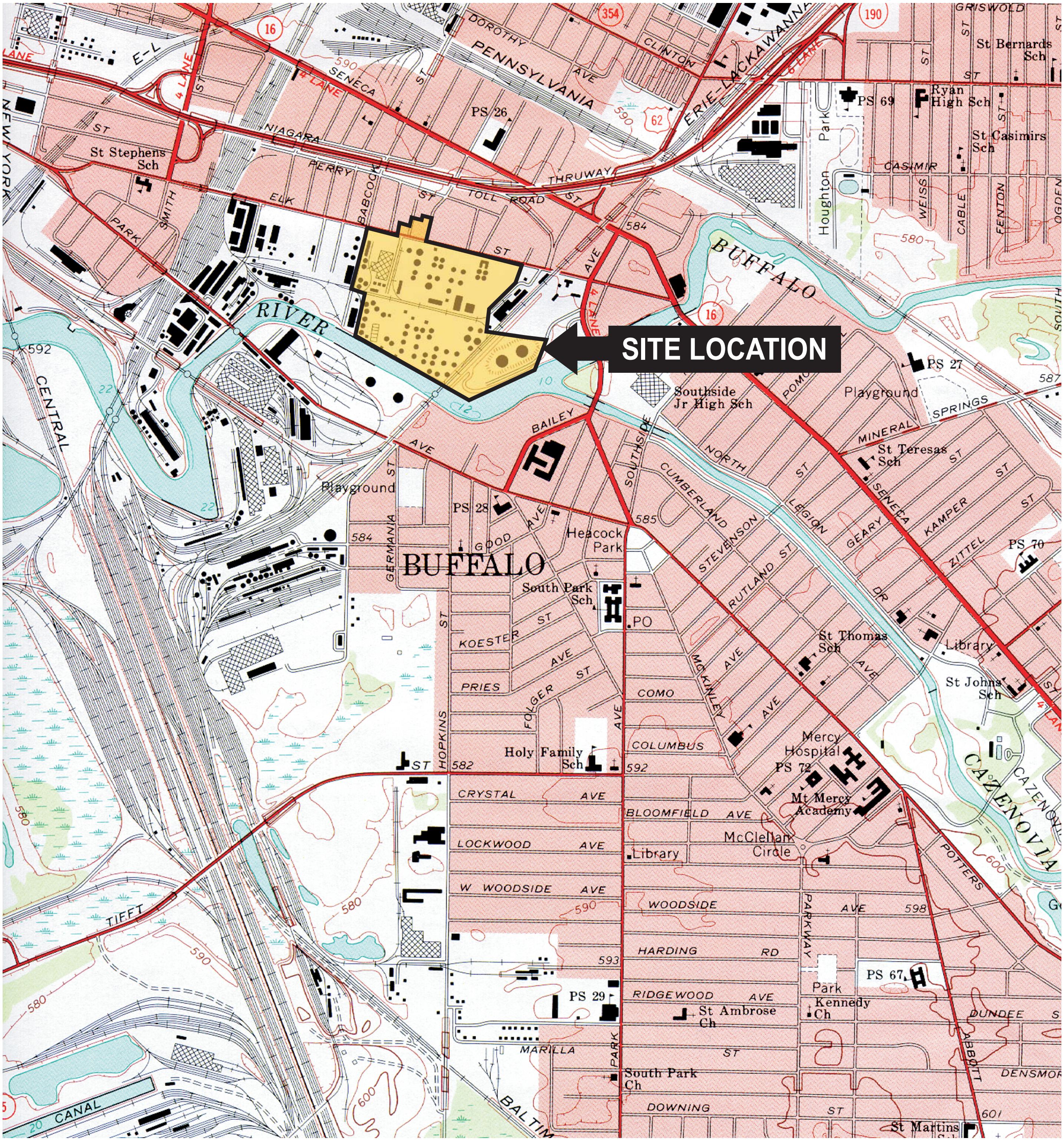
Well Designation	Date	Measuring Point Elevation (ft msl)	Depth to Product (ft)	Depth to Water (ft)	Product Thickness (ft)	Specific Gravity	Corrected Elevation (ft msl)	Product Bailed (gal)	Comments
SB-84	04/10/06	594.55		21.75		0.8	572.80		
SB-85	07/23/03	593.65		18.12		0.8	575.53		
SB-85	10/13/03	593.65		18.09		0.8	575.56		
SB-85	01/19/04	593.65		17.1		0.8	576.55		
SB-85	04/07/04	593.65		16.25		0.8	577.40		
SB-85	07/12/04	593.65		17.61		0.8	576.04		
SB-85	09/15/04	593.65		16.43		0.8	577.22		
SB-85	10/11/04	593.65		17.87		0.8	575.78		
SB-85	01/25/05	593.65		16.34		0.8	577.31		
SB-85	04/06/05	593.65		15.88		0.8	577.77		
SB-85	07/18/05	593.65		18.21		0.8	575.44		
SB-85	10/12/05	593.65		16.99		0.8	576.66		
SB-85	01/17/06	593.65		17.24		0.8	576.41		
SB-85	04/10/06	593.65		18.35		0.8	575.30		
SB-86	07/23/03	582.53		7.94		0.8	574.59		
SB-86	10/13/03	582.53		8.02		0.8	574.51		
SB-86	01/19/04	582.53		6.89		0.8	575.64		
SB-86	04/07/04	582.53		5.89		0.8	576.64		
SB-86	07/12/04	582.53		7.8		0.8	574.73		
SB-86	09/15/04	582.53		6.61		0.8	575.92		
SB-86	10/11/04	582.53		8.02		0.8	574.51		
SB-86	01/25/05	582.53		6.11		0.8	576.42		
SB-86	04/06/05	582.53		5.16		0.8	577.37		
SB-86	07/18/05	582.53		8.3		0.8	574.23		
SB-86	10/12/05	582.53		7.1		0.8	575.43		
SB-86	01/17/06	582.53		7.11		0.8	575.42		
SB-86	04/10/06	582.53				0.8			WELL DRY
VERMW-1	11/18/04	596.9367684		25.92		0.8	571.02		
VERMW-1	12/08/04	596.9367684		26.25		0.8	570.69		
VERMW-1	01/07/05	596.9367684		24.86		0.8	572.08		
VERMW-1	01/14/05	596.9367684		24.08		0.8	572.86		
VERMW-1	02/03/05	596.9367684		25.16		0.8	571.78		
VERMW-1	02/15/05	596.9367684		24.6		0.8	572.34		
VERMW-1	02/28/05	596.9367684		25.11		0.8	571.83		
VERMW-1	03/14/05	596.9367684		29.9		0.8	567.04		
VERMW-1	03/24/05	596.9367684		25.03		0.8	571.91		
VERMW-1	03/30/05	596.9367684		24.85		0.8	572.09		
VERMW-1	04/15/05	596.9367684		24.82		0.8	572.12		
VERMW-1	04/22/05	596.9367684		24.75		0.8	572.19		
VERMW-1	05/06/05	596.9367684		24.65		0.8	572.29		
VERMW-1	05/13/05	596.9367684		25.18		0.8	571.76		
VERMW-1	05/18/05	596.9367684		24.79		0.8	572.15		
VERMW-1	05/24/05	596.9367684		24.74		0.8	572.20		
VERMW-1	06/03/05	596.9367684		24.87		0.8	572.07		
VERMW-1	06/10/05	596.9367684		24.8		0.8	572.14		
VERMW-1	06/17/05	596.9367684		24.82		0.8	572.12		
VERMW-1	06/24/05	596.9367684		24.89		0.8	572.05		
VERMW-1	07/06/05	596.9367684		25.45		0.8	571.49		
VERMW-1	07/14/05	596.9367684		25.31		0.8	571.63		
VERMW-1	07/26/05	596.9367684		24.98		0.8	571.96		
VERMW-1	08/05/05	596.9367684		25.47		0.8	571.47		
VERMW-1	08/12/05	596.9367684		25.5		0.8	571.44		
VERMW-1	08/18/05	596.9367684		25.56		0.8	571.38		
VERMW-1	08/25/05	596.9367684		26.52		0.8	570.42		
VERMW-1	09/09/05	596.9367684		26.1		0.8	570.84		
VERMW-1	09/15/05	596.9367684		25.84		0.8	571.10		
VERMW-1	09/20/05	596.9367684		26.65		0.8	570.29		
VERMW-2	11/18/04	597.551381		26.5		0.8	571.05		
VERMW-2	12/08/04	597.551381		26.86		0.8	570.69		
VERMW-2	01/07/05	597.551381		25.46		0.8	572.09		
VERMW-2	01/14/05	597.551381		24.65		0.8	572.90		
VERMW-2	02/03/05	597.551381		25.85		0.8	571.70		
VERMW-2	02/15/05	597.551381		25.26		0.8	572.29		
VERMW-2	02/28/05	597.551381		25.75		0.8	571.80		
VERMW-2	03/14/05	597.551381		25.54		0.8	572.01		
VERMW-2	03/24/05	597.551381		25.68		0.8	571.87		
VERMW-2	03/30/05	597.551381		25.52		0.8	572.03		
VERMW-2	04/15/05	597.551381		25.42		0.8	572.13		
VERMW-2	04/22/05	597.551381		25.35		0.8	572.20		
VERMW-2	05/13/05	597.551381		25.8		0.8	571.75		
VERMW-2	05/18/05	597.551381		25.41		0.8	572.14		
VERMW-2	05/24/05	597.551381		25.39		0.8	572.16		
VERMW-2	06/03/05	597.551381		25.49		0.8	572.06		
VERMW-2	06/10/05	597.551381		25.37		0.8	572.18		
VERMW-2	06/17/05	597.551381		25.35		0.8	572.20		

Table 3. Summary of Water-Level, Product Thickness and Product Bailing Data in OU-4
Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

Well Designation	Date	Measuring Point Elevation (ft msl)	Depth to Product (ft)	Depth to Water (ft)	Product Thickness (ft)	Specific Gravity	Corrected Elevation (ft msl)	Product Bailed (gal)	Comments
VERMW-2	06/24/05	597.551381		25.52		0.8	572.03		
VERMW-2	07/06/05	597.551381		26.1		0.8	571.45		
VERMW-2	07/14/05	597.551381		25.94		0.8	571.61		
VERMW-2	07/26/05	597.551381		25.5		0.8	572.05		
VERMW-2	08/05/05	597.551381		26.08		0.8	571.47		
VERMW-2	08/12/05	597.551381		26.11		0.8	571.44		
VERMW-2	08/18/05	597.551381		26.15		0.8	571.40		
VERMW-2	08/25/05	597.551381		26.57		0.8	570.98		
VERMW-2	09/09/05	597.551381		26.41		0.8	571.14		
VERMW-2	09/15/05	597.551381		26.45		0.8	571.10		
VERMW-2	09/20/05	597.551381		27.38		0.8	570.17		
VERMW-3	08/06/04	598.7911349	26.35	27.75	1.4	0.8	572.16	0.5	
VERMW-3	08/17/04	598.7911349	26.71	28.93	2.22	0.8	571.64	0.25	
VERMW-3	09/23/04	598.7911349	27.14	27.85	0.71	0.8	571.51	0.25	
VERMW-3	10/11/04	598.7911349	27.75	28.57	0.82	0.8	570.88	0.25	
VERMW-3	11/03/04	598.7911349	27.66	27.85	0.19	0.8	571.09		
VERMW-3	11/18/04	598.7911349	27.65	27.8	0.15	0.8	571.11		
VERMW-3	12/08/04	598.7911349	28.15	28.16	0.01	0.8	570.64		
VERMW-3	01/07/05	598.7911349		26.78		0.8	572.01		
VERMW-3	01/14/05	598.7911349		25.34		0.8	573.45		
VERMW-3	02/03/05	598.7911349		27.07		0.8	571.72		
VERMW-3	02/15/05	598.7911349		26.45		0.8	572.34		
VERMW-3	02/28/05	598.7911349		26.98		0.8	571.81		
VERMW-3	03/14/05	598.7911349		26.74		0.8	572.05		
VERMW-3	03/24/05	598.7911349		26.82		0.8	571.97		
VERMW-3	03/30/05	598.7911349		26.73		0.8	572.06		
VERMW-3	04/15/05	598.7911349		26.5		0.8	572.29		
VERMW-3	04/22/05	598.7911349		26.7		0.8	572.09		
VERMW-3	05/13/05	598.7911349	27.04	27.05	0.01	0.8	571.75		
VERMW-3	05/18/05	598.7911349	26.59	26.66	0.07	0.8	572.19		
VERMW-3	05/24/05	598.7911349	26.53	26.56	0.03	0.8	572.26		
VERMW-3	06/03/05	598.7911349	26.7	26.91	0.21	0.8	572.05		
VERMW-3	06/10/05	598.7911349		26.29		0.8	572.50		
VERMW-3	06/17/05	598.7911349	26.6	26.7	0.1	0.8	572.17		
VERMW-3	06/24/05	598.7911349	26.75	27.1	0.35	0.8	571.97		
VERMW-3	07/06/05	598.7911349	27.22	27.28	0.06	0.8	571.56		
VERMW-3	07/14/05	598.7911349	27.11	27.43	0.32	0.8	571.62		
VERMW-3	07/26/05	598.7911349	26.69	26.74	0.05	0.8	572.09		
VERMW-3	08/05/05	598.7911349	27.27	27.48	0.21	0.8	571.48	0.06	
VERMW-3	08/12/05	598.7911349	27.25	27.32	0.07	0.8	571.53		
VERMW-3	08/18/05	598.7911349	27.32	27.51	0.19	0.8	571.43	0.03	
VERMW-3	08/25/05	598.7911349	27.76	28.04	0.28	0.8	570.98	0.06	
VERMW-3	09/09/05	598.7911349	27.5	27.6	0.1	0.8	571.27		
VERMW-3	09/15/05	598.7911349	27.63	27.72	0.09	0.8	571.14		
VERMW-3	09/20/05	598.7911349	28.6	28.65	0.05	0.8	570.18		
VERMW-3	10/06/05	598.7911349	27.65	27.68	0.03	0.8	571.14		
VERMW-3	10/27/05	598.7911349	27.89	27.91	0.02	0.8	570.90		
VERMW-3	11/10/05	598.7911349		27.45		0.8	571.34		
VERMW-3	11/22/05	598.7911349		28.28		0.8	570.51		
VERMW-3	12/08/05	598.7911349		28.35		0.8	570.44		RIVER FROZEN
VERMW-3	12/15/05	598.7911349		28.29		0.8	570.50		RIVER FROZEN
VERMW-3	12/27/05	598.7911349		28.35		0.8	570.44		RIVER FROZEN
VERMW-3	01/10/06	598.7911349		27.77		0.8	571.02		
VERMW-3	01/31/06	598.7911349		27.6		0.8	571.19		
VERMW-3	02/09/06	598.7911349		27.41		0.8	571.38		
VERMW-3	02/16/06	598.7911349		27.34		0.8	571.45		
VERMW-3	02/23/06	598.7911349		27.03		0.8	571.76		
VERMW-3	03/02/06	598.7911349		27.9		0.8	570.89		
VERMW-3	03/15/06	598.7911349				0.8			NOT GAUGED- ACCESS BLOCKED BY WATER
VERMW-3	03/23/06	598.7911349		27.2		0.8	571.59		
VERMW-3	03/30/06	598.7911349		27.46		0.8	571.33		
VERMW-3	04/05/06	598.7911349		27.48		0.8	571.31		
VERMW-3	04/28/06	598.7911349		27.47		0.8	571.32		
VERMW-3	05/05/06	598.7911349		27.2		0.8	571.59		
VERMW-3	05/11/06	598.7911349		27.01		0.8	571.78		
VERMW-3	05/18/06	598.7911349		26.9		0.8	571.89		
VERMW-3	05/23/06	598.7911349		26.82		0.8	571.97		
VERMW-3	06/15/06	598.7911349		27.77		0.8	571.02		
VERMW-3	06/23/06	598.7911349		27.8		0.8	570.99		
VERMW-3	06/30/06	598.7911349		26.42		0.8	572.37		
VERMW-4	11/18/04	597.5337037		26.52		0.8	571.01		
VERMW-4	12/08/04	597.5337037		26.84		0.8	570.69		
VERMW-4	01/07/05	597.5337037		25.45		0.8	572.08		
VERMW-4	01/14/05	597.5337037	24.58	24.59	0.01	0.8	572.95		

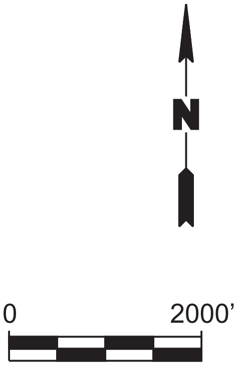
Table 3. Summary of Water-Level, Product Thickness and Product Bailing Data in OU-4
Former Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York

Well Designation	Date	Measuring Point Elevation (ft msl)	Depth to Product (ft)	Depth to Water (ft)	Product Thickness (ft)	Specific Gravity	Corrected Elevation (ft msl)	Product Bailed (gal)	Comments
VERMW-4	02/03/05	597.5337037	25.74	25.75	0.01	0.8	571.79		
VERMW-4	02/15/05	597.5337037		25.27		0.8	572.26		
VERMW-4	02/28/05	597.5337037		25.69		0.8	571.84		
VERMW-4	03/14/05	597.5337037		25.48		0.8	572.05		
VERMW-4	03/24/05	597.5337037		25.59		0.8	571.94		
VERMW-4	03/30/05	597.5337037	26.39	26.4	0.01	0.8	571.14		
VERMW-4	04/15/05	597.5337037	25	25.1	0.1	0.8	572.51		
VERMW-4	04/22/05	597.5337037	24.9	25.08	0.18	0.8	572.60		
VERMW-4	05/06/05	597.5337037	24.87	25.06	0.19	0.8	572.63		
VERMW-4	05/13/05	597.5337037	25.5	25.62	0.12	0.8	572.01		
VERMW-4	05/18/05	597.5337037	25.21	25.36	0.15	0.8	572.29		
VERMW-4	05/24/05	597.5337037	25.29	25.35	0.06	0.8	572.23		
VERMW-4	06/03/05	597.5337037	25.43	25.46	0.03	0.8	572.10		
VERMW-4	06/10/05	597.5337037	25.23	25.3	0.07	0.8	572.29		
VERMW-4	06/17/05	597.5337037	25.24	25.31	0.07	0.8	572.28		
VERMW-4	06/24/05	597.5337037	25.25	25.51	0.26	0.8	572.23		
VERMW-4	07/06/05	597.5337037	26.04	26.06	0.02	0.8	571.49		
VERMW-4	07/14/05	597.5337037	25.9	25.94	0.04	0.8	571.63		
VERMW-4	07/26/05	597.5337037	25.45	25.48	0.03	0.8	572.08		
VERMW-4	08/05/05	597.5337037	26.03	26.04	0.01	0.8	571.50		
VERMW-4	08/12/05	597.5337037	26.05	26.09	0.04	0.8	571.48		
VERMW-4	08/18/05	597.5337037	26.11	26.15	0.04	0.8	571.42		
VERMW-4	08/25/05	597.5337037	26.5	26.52	0.02	0.8	571.03		
VERMW-4	09/09/05	597.5337037	26.31	26.37	0.06	0.8	571.21		
VERMW-4	09/15/05	597.5337037	26.3	26.45	0.15	0.8	571.20		
VERMW-4	09/20/05	597.5337037		26.95		0.8	570.58		TRACE PRODUCT
VERMW-4	10/06/05	597.5337037	26.42	26.43	0.01	0.8	571.11		
VERMW-4	10/27/05	597.5337037		26.6		0.8	570.93		TRACE PRODUCT
VERMW-4	11/10/05	597.5337037		26.03		0.8	571.50		
VERMW-4	11/22/05	597.5337037	26.65	26.67	0.02	0.8	570.88		
VERMW-4	12/08/05	597.5337037		26.73		0.8	570.80		RIVER FROZEN
VERMW-4	12/15/05	597.5337037		27.01		0.8	570.52		RIVER FROZEN
VERMW-4	12/27/05	597.5337037		26.97		0.8	570.56		TRACE PRODUCT; RIVER FROZEN
VERMW-4	01/10/06	597.5337037		26.5		0.8	571.03		
VERMW-4	01/31/06	597.5337037		26.35		0.8	571.18		
VERMW-4	02/09/06	597.5337037		26.01		0.8	571.52		
VERMW-4	02/16/06	597.5337037		25.92		0.8	571.61		
VERMW-4	02/23/06	597.5337037		25.65		0.8	571.88		
VERMW-4	03/02/06	597.5337037		26.48		0.8	571.05		
VERMW-4	03/15/06	597.5337037				0.8			NOT GAUGED- ACCESS BLOCKED BY WATER
VERMW-4	03/23/06	597.5337037	25.75	25.77	0.02	0.8	571.78		
VERMW-4	03/30/06	597.5337037		26.16		0.8	571.37		
VERMW-4	04/05/06	597.5337037		26.15		0.8	571.38		
VERMW-4	04/28/06	597.5337037		26.15		0.8	571.38		
VERMW-4	05/05/06	597.5337037		25.91		0.8	571.62		
VERMW-4	05/11/06	597.5337037		25.89		0.8	571.64		
VERMW-4	05/18/06	597.5337037		25.65		0.8	571.88		
VERMW-4	05/23/06	597.5337037		25.52		0.8	572.01		
VERMW-4	06/15/06	597.5337037		26.55		0.8	570.98		
VERMW-4	06/23/06	597.5337037		26.59		0.8	570.94		
VERMW-4	06/30/06	597.5337037		25.25		0.8	572.28		
W-1	07/23/03	595.98		17.46		0.8	578.52		
W-1	10/13/03	595.98		17.55		0.8	578.43		
W-1	01/19/04	595.98		17.41		0.8	578.57		
W-1	04/07/04	595.98		16.96		0.8	579.02		
W-1	07/12/04	595.98		17.3		0.8	578.68		
W-1	10/11/04	595.98		17.48		0.8	578.50		
W-1	01/25/05	595.98		17.08		0.8	578.90		
W-1	04/06/05	595.98		16.73		0.8	579.25		
W-1	10/12/05	595.98		17.31		0.8	578.67		
W-1	01/17/06	595.98		17.35		0.8	578.63		
W-1	04/10/06	595.98		18.02		0.8	577.96		



QUADRANGLE LOCATION

SOURCE:
USGS; 1965, Buffalo SE, New York
7.5 Minute Topographic Quadrangle



Title:

SITE LOCATION MAP

FORMER BUFFALO TERMINAL

Prepared for:

EXXONMOBIL OIL CORPORATION

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: N.C.	Date: 26MAY06	FIGURE
Prepared by: R.K.	Scale: AS SHOWN	1
Project Mgr.: N.C.	Office: NY	
File No.: MC5230401.CDR	Project No.: 17252Y08	

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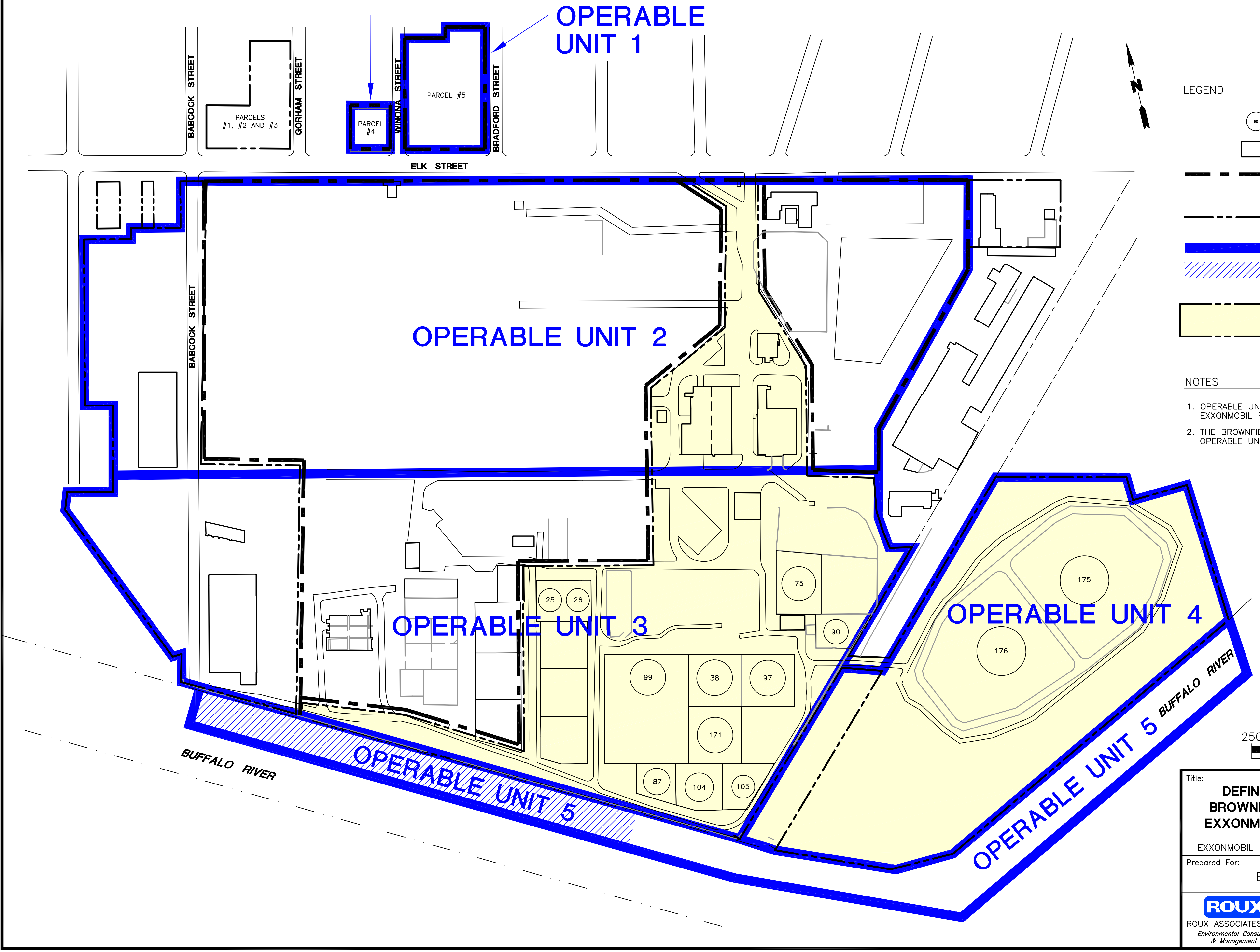

LEGEND

○ 90	EXISTING TANK
☐	EXISTING STRUCTURE
▬ ▬ ▬	PROPERTY CURRENTLY OWNED BY EXXONMOBIL (BASED ON DENLUCK–O'NEILL ENGINEERING AND SURVEYING, DEC. 15, 1988; AND NUSSBAUMER & CLARKE, INC. FEBRUARY 6, 1995)
— - - —	LIMITS OF PROPERTY FORMERLY OWNED BY EXXONMOBIL OIL CORPORATION
▬	OPERABLE UNIT BOUNDARY
▨	AREA WHERE EXXONMOBIL HAS PARTICIPATED IN DREDGING OPERATIONS TO MAINTAIN BARGE ACCESS TO THE SITE
▭	PROPERTY OWNED AND OPERATED BY BUCKEYE TERMINALS, LLC AS OF MAY 4, 2005

NOTES

1. OPERABLE UNIT 5 IS NOT PART OF THE CURRENT OR FORMER EXXONMOBIL PROPERTY.
2. THE BROWNFIELD SITE IS DEFINED AS ALL AREAS WITHIN THE OPERABLE UNIT BOUNDARIES.

250' 0 250'

Title:

DEFINITION OF OPERABLE UNITS AND BROWNFIELD SITE BOUNDARIES FOR THE EXXONMOBIL FORMER BUFFALO TERMINAL

EXXONMOBIL FORMER BUFFALO TERMINAL, BUFFALO, NEW YORK

Prepared For:

EXXONMOBIL OIL CORPORATION

ROUX

ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: N.C.	Date: 26MAY06	FIGURE
Prepared by: R.K.	Scale: AS SHOWN	2
Project Mgr: N.C.	Office: NY	
File No: MC5230402	Project: 17252Y08	

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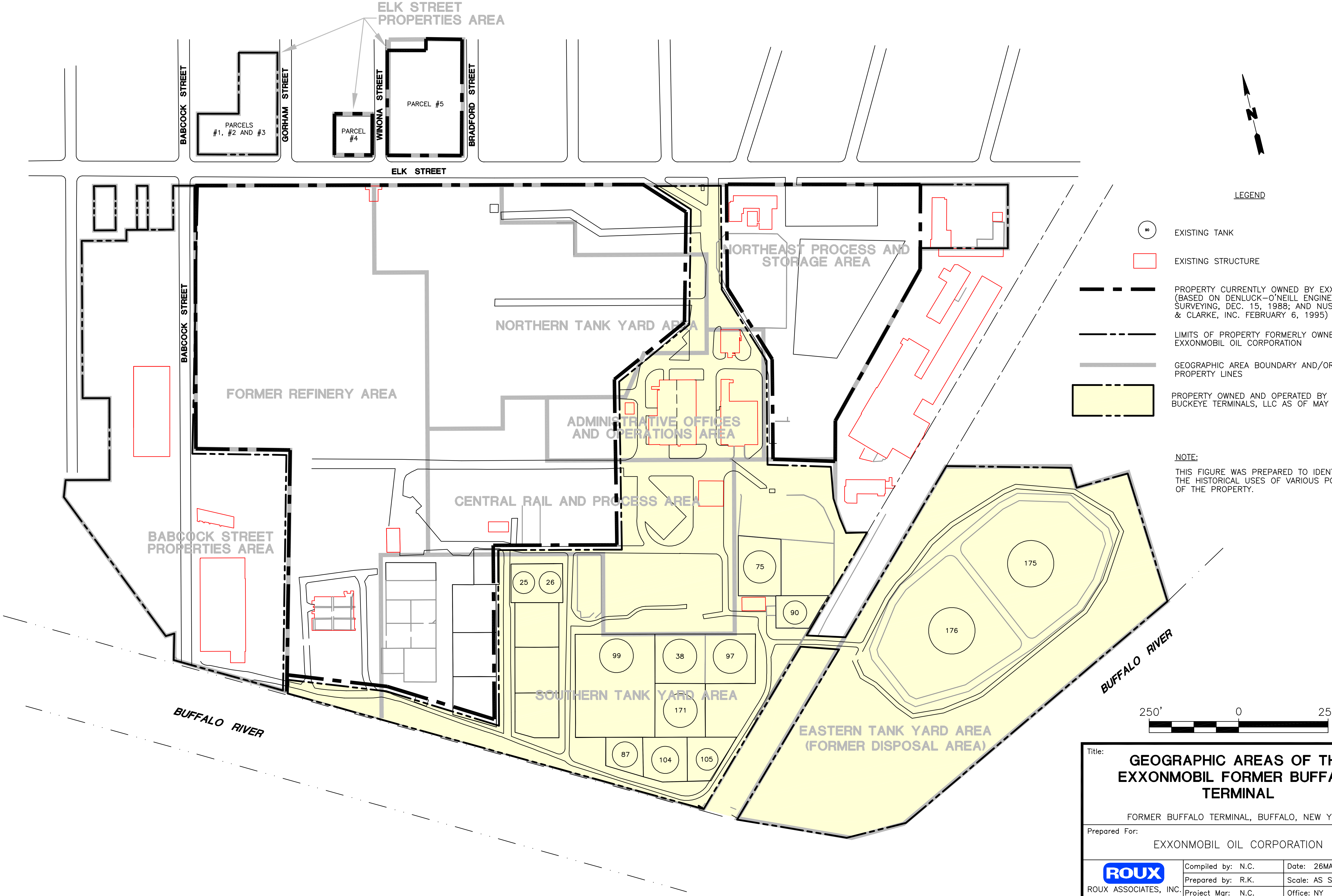

LEGEND

○	EXISTING TANK
🟥	EXISTING STRUCTURE
▬ ▪ ▬	PROPERTY CURRENTLY OWNED BY EXXONMOBIL (BASED ON DENLUCK–O'NEILL ENGINEERING AND SURVEYING, DEC. 15, 1988; AND NUSSBAUMER & CLARKE, INC. FEBRUARY 6, 1995)
— - - —	LIMITS OF PROPERTY FORMERLY OWNED BY EXXONMOBIL OIL CORPORATION
▬	GEOGRAPHIC AREA BOUNDARY AND/OR FORMER PROPERTY LINES
🟨	PROPERTY OWNED AND OPERATED BY BUCKEYE TERMINALS, LLC AS OF MAY 4, 2005

NOTE:

THIS FIGURE WAS PREPARED TO IDENTIFY THE HISTORICAL USES OF VARIOUS PORTIONS OF THE PROPERTY.

Title:

GEOGRAPHIC AREAS OF THE EXXONMOBIL FORMER BUFFALO TERMINAL

FORMER BUFFALO TERMINAL, BUFFALO, NEW YORK

Prepared For:

EXXONMOBIL OIL CORPORATION

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: N.C.	Date: 26MAY06	FIGURE
Prepared by: R.K.	Scale: AS SHOWN	3
Project Mgr: N.C.	Office: NY	
File No: MC5230403	Project: 17252Y08	

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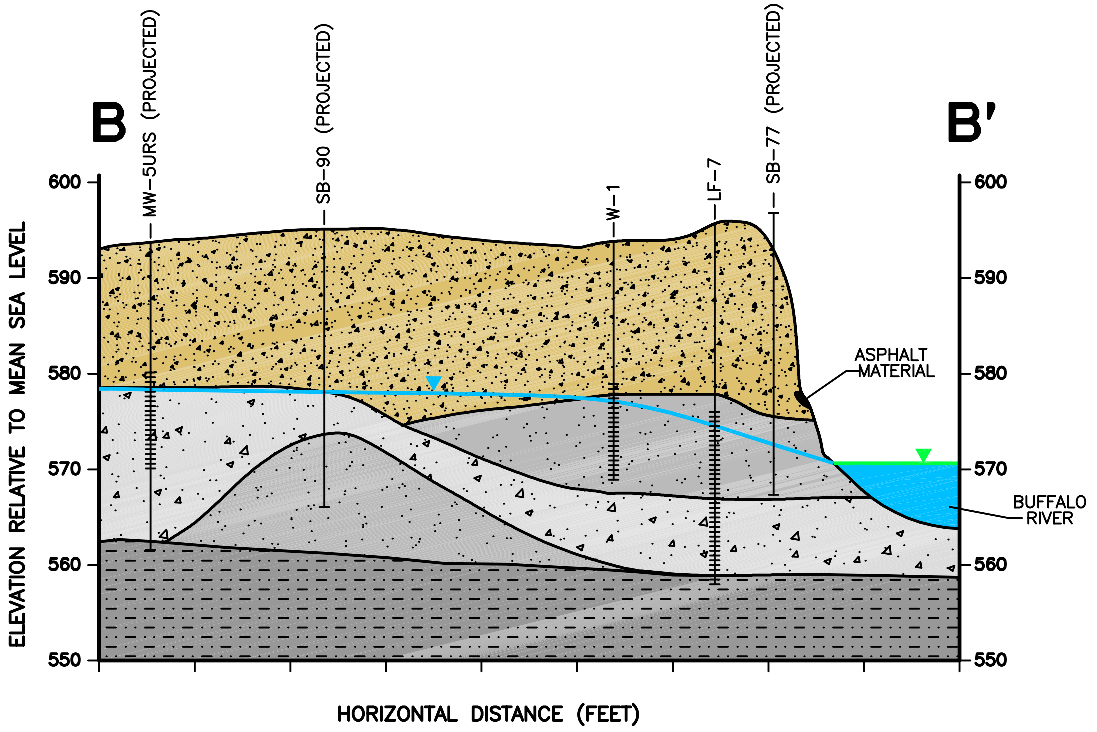
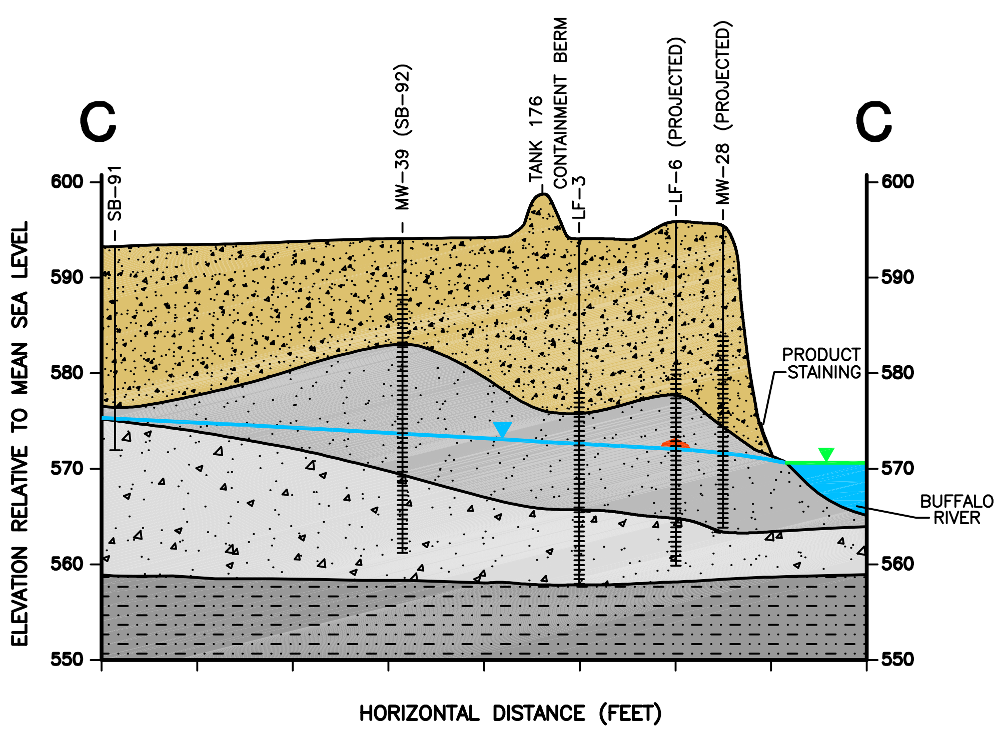
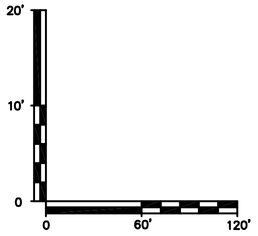
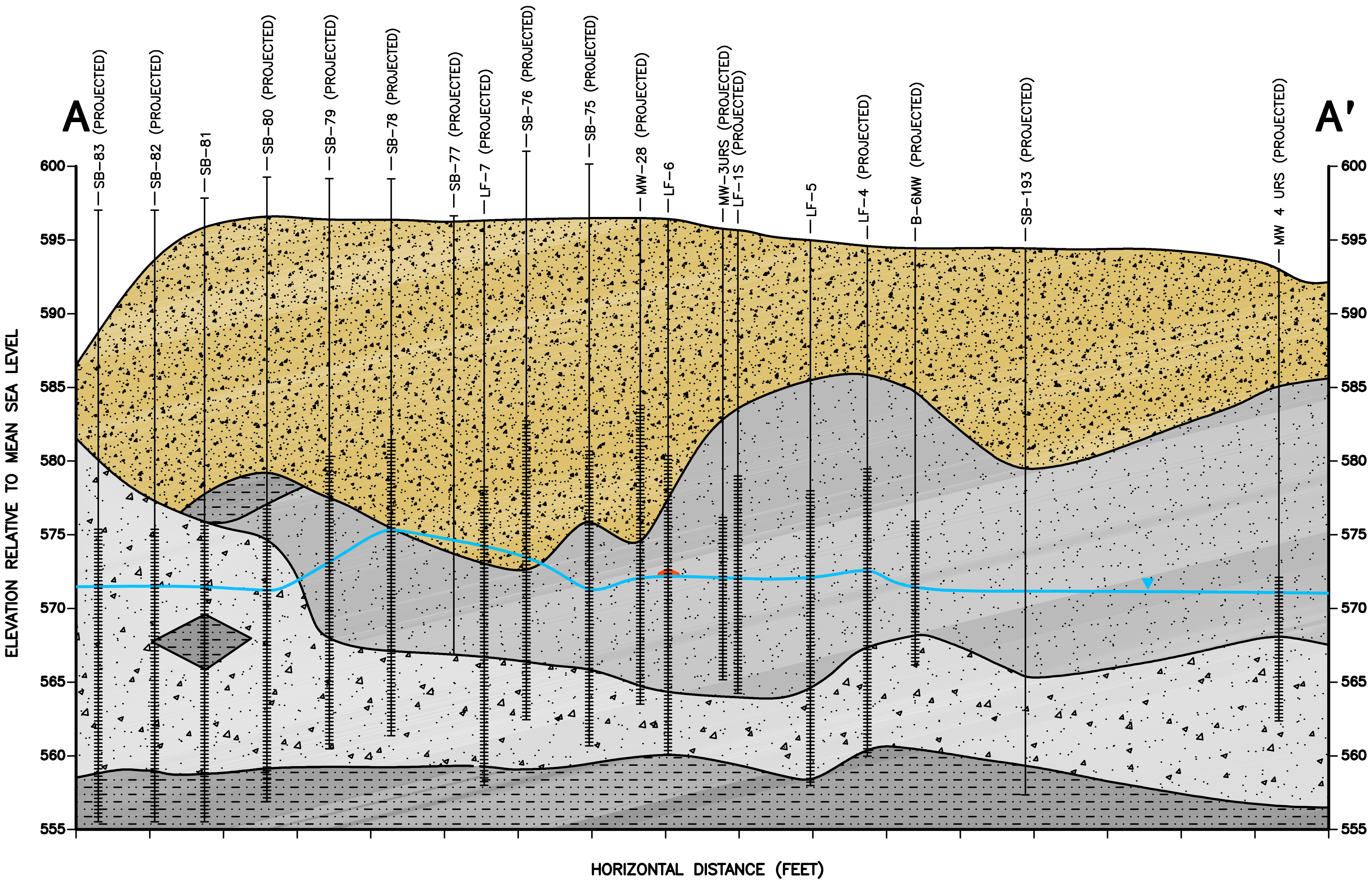






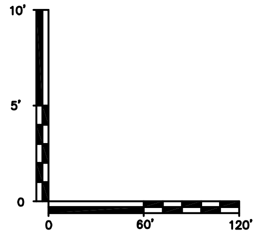


LEGEND

▼	BUFFALO RIVER ELEVATION IN FEET ABOVE MEAN SEA LEVEL (4/10/06)
▼	WATER-TABLE ELEVATION IN FEET ABOVE MEAN SEA LEVEL (4/10/06)
ǂ	INDICATES MONITORING WELL SCREENED INTERVAL
|	INDICATES SOIL BORING
▨	FILL MATERIAL CONSISTING OF BLACK CINDERS, CONCRETE, BRICK, GLASS, SLAG, WOOD, SILT, GRAVEL AND SAND
▨	ALLUVIAL DEPOSITS (SAND, SAND AND SILT, SAND AND GRAVEL, SILTY SAND, SILT)
▨	ALLUVIAL DEPOSITS (SAND AND GRAVEL)
▤	CLAY
🟥	SEPARATE-PHASE PRODUCT

NOTES:

1. FOR LOCATION OF SECTION LINES SEE PLATE 1.
2. LAND SURFACE SHOWN IS ALONG THE SECTION CUT LINE, NOT NECESSARILY AT THE WELL/BORING LOCATIONS IF WELL/BORING IS PROJECTED ONTO THE LINE.
3. MW-28 HAS A SOLAR POWERED PRODUCT RECOVERY PUMP INSTALLED SINCE APRIL 5, 2001.
4. LINES SEPARATING CLAY LAYER FROM SAND AND GRAVEL LAYER ARE SHOWN DASHED WHERE INFERRED.



Title:

GENERALIZED HYDROGEOLOGIC CROSS SECTIONS A-A' B-B' AND C-C'

BUFFALO TERMINAL, BUFFALO, NEW YORK

Prepared For:

EXXONMOBIL OIL CORPORATION

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: N.C.	Date: 21AUG04	FIGURE 4
Prepared by: R.K.	Scale: AS SHOWN	
Project Mgr: N.C.	Office: NY	
File No: MC5230407	Project: 17252Y06	

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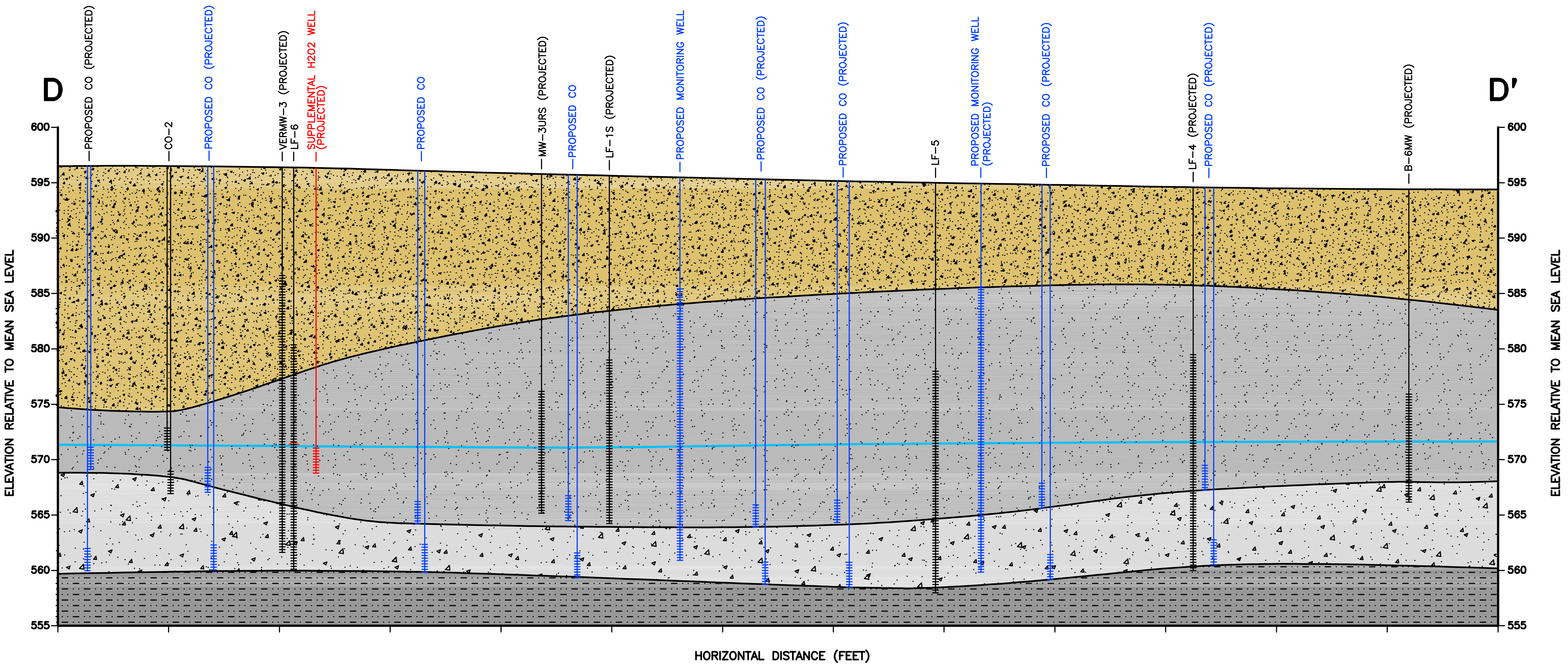

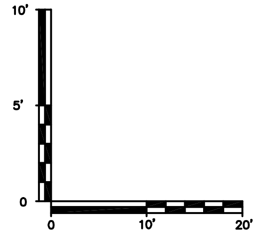

LEGEND

- BUFFALO RIVER ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- WATER-TABLE ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- INDICATES MONITORING WELL SCREENED INTERVAL
- INDICATES SOIL BORING
- INDICATES PROPOSED CHEMOX INJECTION WELL (CO) (2 NESTED WELLS PER LOCATION) AND PROPOSED MONITORING WELL
- INDICATES PROPOSED SUPPLEMENT HYDROGEN PEROXIDE (H2O2) INJECTION WELL

▨	FILL MATERIAL CONSISTING OF BLACK CINDERS, CONCRETE, BRICK, GLASS, SLAG, WOOD, SILT, GRAVEL AND SAND
▨	ALLUVIAL DEPOSITS (SAND, SAND AND SILT, SAND AND GRAVEL, SILTY SAND, SILT)
▨	ALLUVIAL DEPOSITS (SAND AND GRAVEL)
▤	CLAY
🟥	SEPARATE-PHASE PRODUCT

NOTES:

1. FOR LOCATION OF SECTION LINES SEE PLATE 1.
2. LAND SURFACE SHOWN IS ALONG THE SECTION CUT LINE, NOT NECESSARILY AT THE WELL/BORING LOCATIONS IF WELL/BORING IS PROJECTED ONTO THE LINE.
3. MW-28 HAS A SOLAR POWERED PRODUCT RECOVERY PUMP INSTALLED SINCE APRIL 5, 2001.
4. LINES SEPARATING CLAY LAYER FROM SAND AND GRAVEL LAYER ARE SHOWN DASHED WHERE INFERRED.

Title:

GENERALIZED HYDROGEOLOGIC CROSS SECTION D-D' THROUGH PROPOSED CHEMOX IRM AREA

FORMER BUFFALO TERMINAL, BUFFALO, NEW YORK

Prepared For:

EXXONMOBIL OIL CORPORATION

ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: N.C.	Date: 08AUG06	FIGURE
Prepared by: R.K.	Scale: AS SHOWN	5
Project Mgr: N.C.	Office: NY	
File No: MC5230408	Project: 17252Y06	

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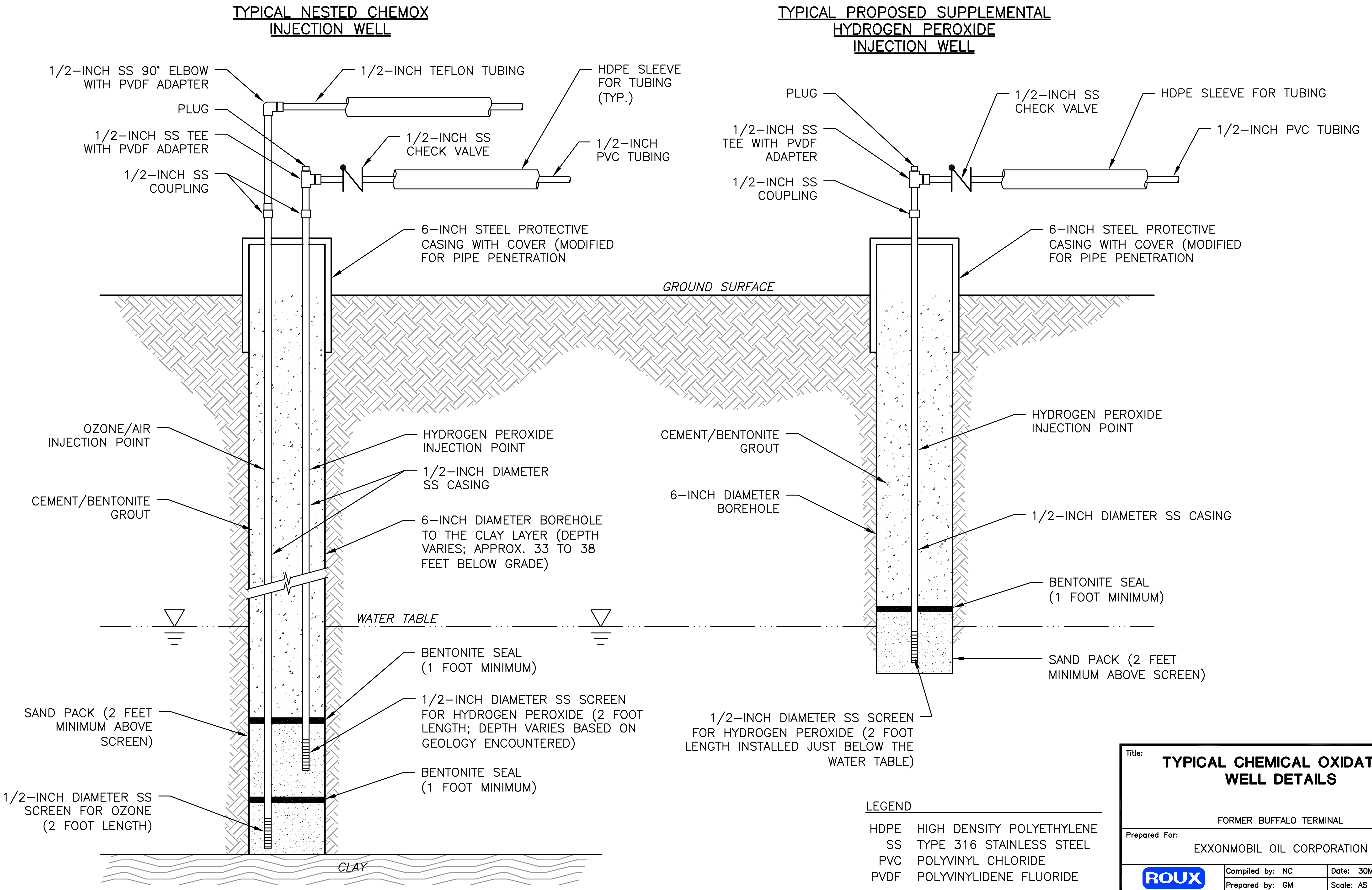

TYPICAL NESTED CHEMOX INJECTION WELL

TYPICAL PROPOSED SUPPLEMENTAL HYDROGEN PEROXIDE INJECTION WELL

LEGEND

HDPE	HIGH DENSITY POLYETHYLENE
SS	TYPE 316 STAINLESS STEEL
PVC	POLYVINYL CHLORIDE
PVDF	POLYVINYLIDENE FLUORIDE

Title:

TYPICAL CHEMICAL OXIDATION WELL DETAILS

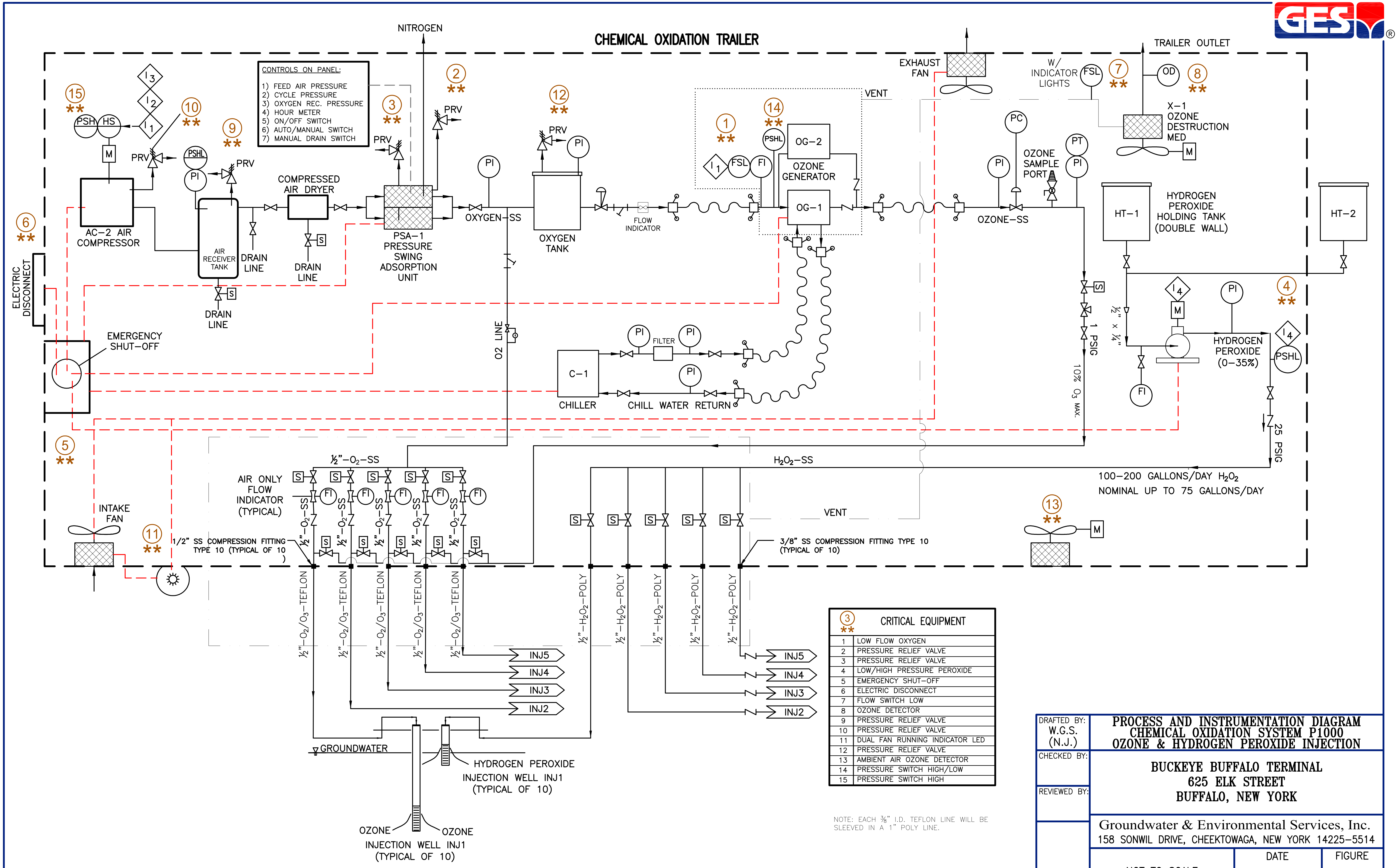
FORMER BUFFALO TERMINAL

Prepared For:

EXXONMOBIL OIL CORPORATION

ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: NC	Date: 30MAY06	FIGURE 6
Prepared by: GM	Scale: AS SHOWN	
Project Mgr: NC	Office: NY	
File No: MC5230406	Project: 17252Y08	



③ **	CRITICAL EQUIPMENT
1	LOW FLOW OXYGEN
2	PRESSURE RELIEF VALVE
3	PRESSURE RELIEF VALVE
4	LOW/HIGH PRESSURE PEROXIDE
5	EMERGENCY SHUT-OFF
6	ELECTRIC DISCONNECT
7	FLOW SWITCH LOW
8	OZONE DETECTOR
9	PRESSURE RELIEF VALVE
10	PRESSURE RELIEF VALVE
11	DUAL FAN RUNNING INDICATOR LED
12	PRESSURE RELIEF VALVE
13	AMBIENT AIR OZONE DETECTOR
14	PRESSURE SWITCH HIGH/LOW
15	PRESSURE SWITCH HIGH

NOTE: EACH ⅜" I.D. TEFLON LINE WILL BE SLEEVED IN A 1" POLY LINE.

DRAFTED BY:
W.G.S.
(N.J.)
CHECKED BY:
REVIEWED BY:

PROCESS AND INSTRUMENTATION DIAGRAM
CHEMICAL OXIDATION SYSTEM P1000
OZONE & HYDROGEN PEROXIDE INJECTION

BUCKEYE BUFFALO TERMINAL
625 ELK STREET
BUFFALO, NEW YORK

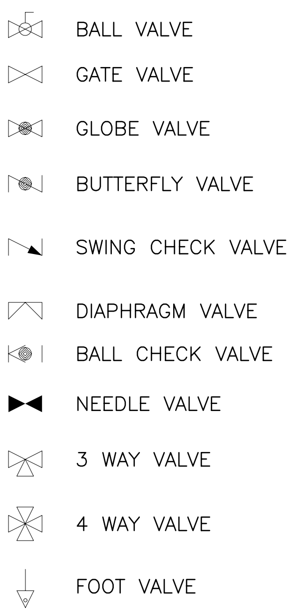
Groundwater & Environmental Services, Inc.
158 SONWIL DRIVE, CHEEKTOWAGA, NEW YORK 14225-5514

NOT TO SCALE

DATE
5-26-06

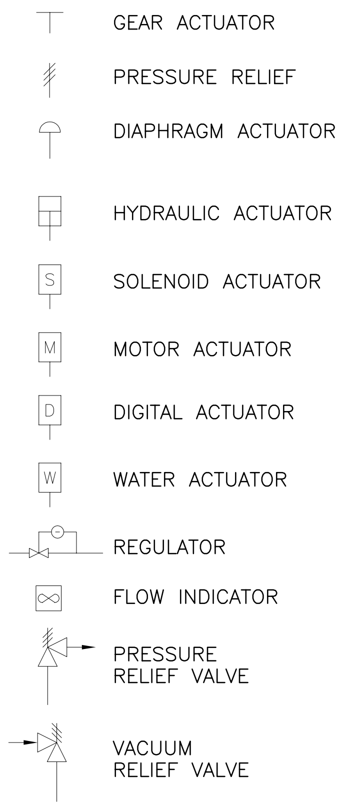
FIGURE
7

CONTROL VALVE BODIES



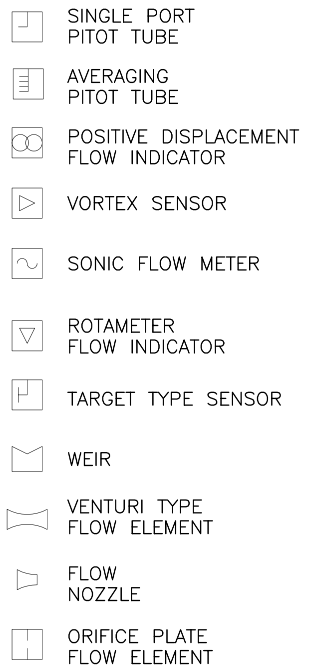
- BALL VALVE
- GATE VALVE
- GLOBE VALVE
- BUTTERFLY VALVE
- SWING CHECK VALVE
- DIAPHRAGM VALVE
- BALL CHECK VALVE
- NEEDLE VALVE
- 3 WAY VALVE
- 4 WAY VALVE
- FOOT VALVE

ACTUATORS/ REGULATORS



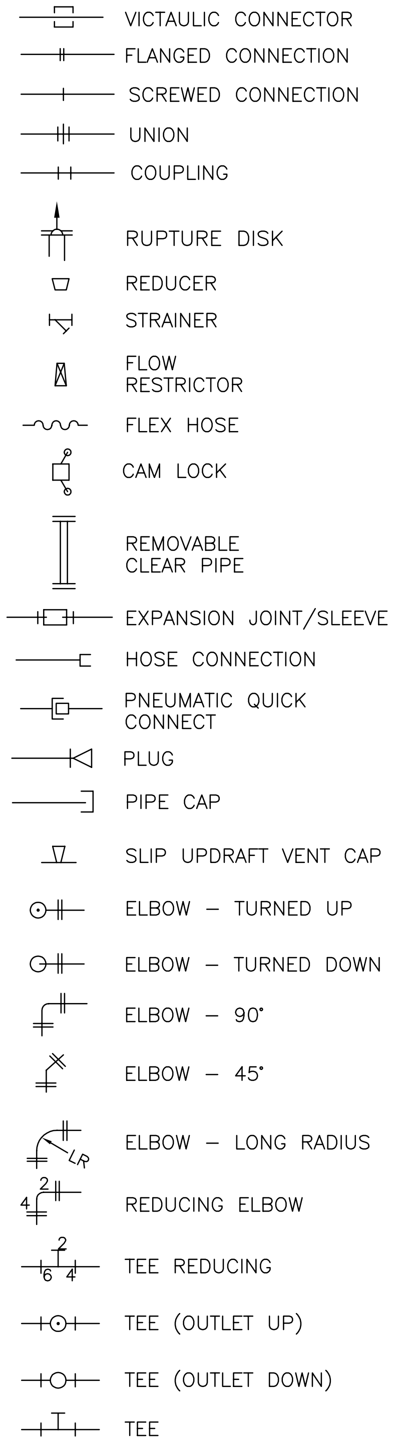
- GEAR ACTUATOR
- PRESSURE RELIEF
- DIAPHRAGM ACTUATOR
- HYDRAULIC ACTUATOR
- SOLENOID ACTUATOR
- MOTOR ACTUATOR
- DIGITAL ACTUATOR
- WATER ACTUATOR
- REGULATOR
- FLOW INDICATOR
- PRESSURE RELIEF VALVE
- VACUUM RELIEF VALVE

MEASURING DEVICE SYMBOLS:



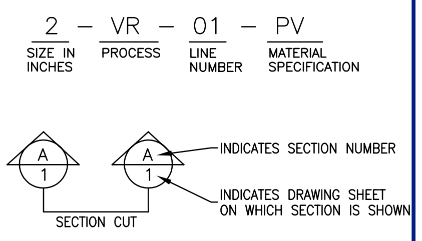
- SINGLE PORT PITOT TUBE
- AVERAGING PITOT TUBE
- POSITIVE DISPLACEMENT FLOW INDICATOR
- VORTEX SENSOR
- SONIC FLOW METER
- ROTAMETER FLOW INDICATOR
- TARGET TYPE SENSOR
- WEIR
- VENTURI TYPE FLOW ELEMENT
- FLOW NOZZLE
- ORIFICE PLATE FLOW ELEMENT

FITTINGS & PIPING

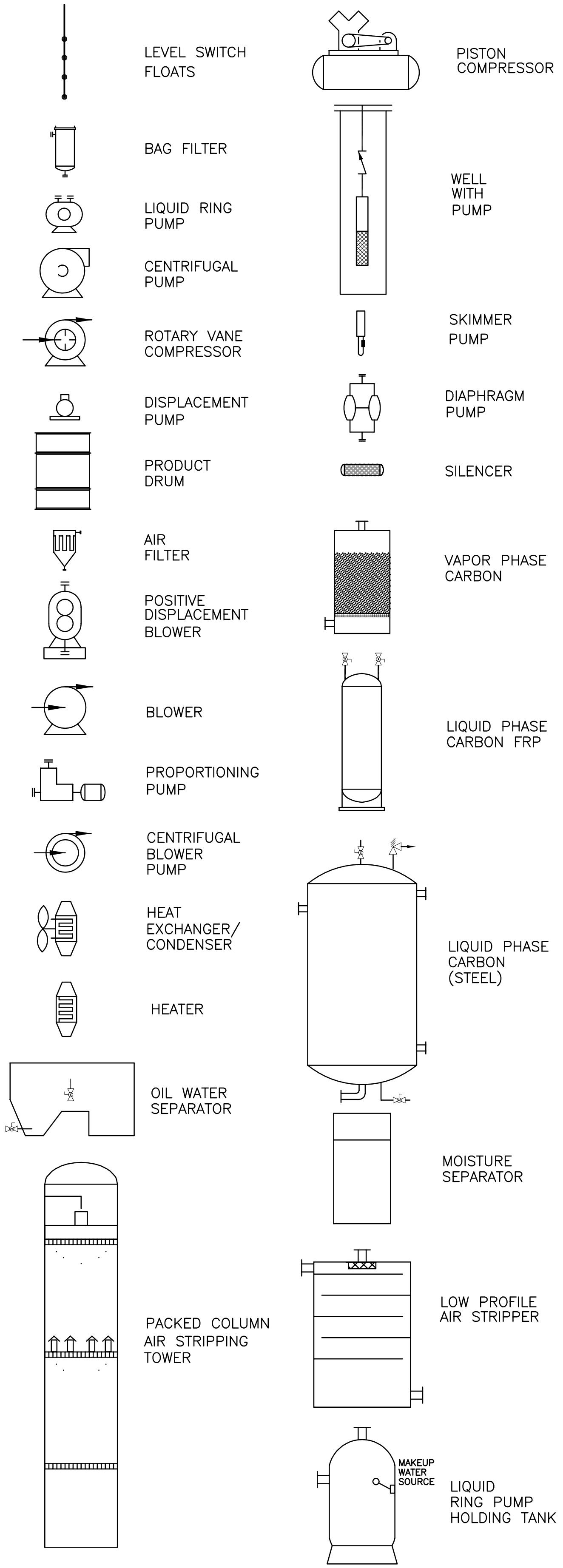


- VICTAULIC CONNECTOR
- FLANGED CONNECTION
- SCREWED CONNECTION
- UNION
- COUPLING
- RUPTURE DISK
- REDUCER
- STRAINER
- FLOW RESTRICTOR
- FLEX HOSE
- CAM LOCK
- REMOVABLE CLEAR PIPE
- EXPANSION JOINT/SLEEVE
- HOSE CONNECTION
- PNEUMATIC QUICK CONNECT
- PLUG
- PIPE CAP
- SLIP UPDRAFT VENT CAP
- ELBOW – TURNED UP
- ELBOW – TURNED DOWN
- ELBOW – 90°
- ELBOW – 45°
- ELBOW – LONG RADIUS
- REDUCING ELBOW
- TEE REDUCING
- TEE (OUTLET UP)
- TEE (OUTLET DOWN)
- TEE

LINE DESIGNATION:

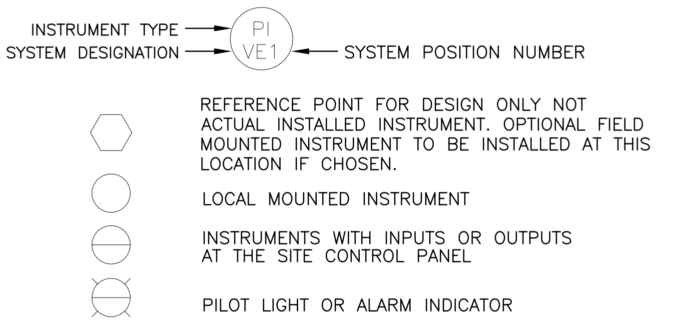


SYMBOL & LEGEND SHEET EQUIPMENT



- LEVEL SWITCH FLOATS
- BAG FILTER
- LIQUID RING PUMP
- CENTRIFUGAL PUMP
- ROTARY VANE COMPRESSOR
- DISPLACEMENT PUMP
- PRODUCT DRUM
- AIR FILTER
- POSITIVE DISPLACEMENT BLOWER
- BLOWER
- PROPORTIONING PUMP
- CENTRIFUGAL BLOWER PUMP
- HEAT EXCHANGER/ CONDENSER
- HEATER
- OIL WATER SEPARATOR
- PACKED COLUMN AIR STRIPPING TOWER
- PISTON COMPRESSOR
- WELL WITH PUMP
- SKIMMER PUMP
- DIAPHRAGM PUMP
- SILENCER
- VAPOR PHASE CARBON
- LIQUID PHASE CARBON FRP
- LIQUID PHASE CARBON (STEEL)
- MOISTURE SEPARATOR
- LOW PROFILE AIR STRIPPER
- LIQUID RING PUMP HOLDING TANK

INSTRUMENTATION:



- REFERENCE POINT FOR DESIGN ONLY NOT ACTUAL INSTALLED INSTRUMENT. OPTIONAL FIELD MOUNTED INSTRUMENT TO BE INSTALLED AT THIS LOCATION IF CHOSEN.
- LOCAL MOUNTED INSTRUMENT
- INSTRUMENTS WITH INPUTS OR OUTPUTS AT THE SITE CONTROL PANEL
- PILOT LIGHT OR ALARM INDICATOR

INSTRUMENT TYPE/DESIGNATION:

CP	CAPACITIVE SENSOR/PROBE
DPS	DIFFERENTIAL PRESSURE SWITCH
DPI	DIFFERENTIAL PRESSURE INDICATOR
FI	FLOW INDICATOR
FM	FLOW METER
FQI	FLOW METER (TOTALIZING)
FS	FLOW SWITCH
LAL	LEVEL ALARM LOW
LAH	LEVEL ALARM HIGH
LSLL	LEVEL SWITCH LOW LOW
LSL	LEVEL SWITCH LOW
LSM	LEVEL SWITCH MIDRANGE
LSH	LEVEL SWITCH HIGH
LSHH	LEVEL SWITCH HIGH HIGH
PAH	PRESSURE ALARM HIGH
PAL	PRESSURE ALARM LOW
PC	PRESSURE CONTROL
PI	PRESSURE INDICATOR
PS	PRESSURE SWITCH
PSH	PRESSURE SWITCH HIGH
PSL	PRESSURE SWITCH LOW
S	SAMPLE PORT
TAH	TEMPERATURE ALARM HIGH
TAL	TEMPERATURE ALARM LOW
TI	TEMPERATURE INDICATOR
TSH	TEMPERATURE SWITCH HIGH
TSL	TEMPERATURE SWITCH LOW
TT	TEMPERATURE TRANSDUCER

SYSTEM DESIGNATION:

ASB	AIR SPARGE POSITIVE DISPLACEMENT BLOWER
ASV	AIR SPARGE ROTARY VANE COMPRESSOR
ASW	AIR SPARGE WELL & MANIFOLD
DPB	DUAL PHASE POSITIVE DISPLACEMENT BLOWER
DPL	DUAL PHASE LIQUID RING PUMP
DPO	DUAL PHASE SEALED LIQUID RING PUMP
DPW	DUAL PHASE WELL & MANIFOLD
ERW	ELECTRIC RECOVERY WELL & PUMP
LC	LIQUID PHASE CARBON
OW	OIL– WATER SEPARATOR SYSTEM
PRW	PNEUMATIC RECOVERY WELL & PUMP
STL	AIR STRIPPER LOW PROFILE
VC	VAPOR PHASE CARBON
VEP	VAPOR EXTRACTION POSITIVE DISPLACEMENT
VER	VAPOR EXTRACTION REGENERATIVE BLOWER
VEW	VAPOR EXTRACTION WELL & MANIFOLD

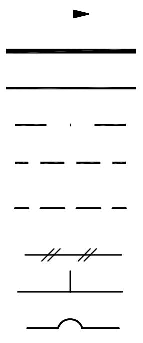
VALVE ABBREVIATIONS:

N.C. – NORMALLY CLOSED
N.O. – NORMALLY OPEN
MAN – MANUAL

MATERIAL SPECIFICATION:

PV – POLYVINYL CHLORIDE
GM – GALVANIZED
RC – RIGID COPPER
IR – IRON
ABS – ACRYLONITRILE BUTADIENE STYRENE
FL – FLEX

PROCESS LINE INDICATORS



- FLOW DIRECTION
- MAJOR PROCESS
- MINOR PROCESS
- WATER/AIR PIPING
- AIR PIPING
- INSTRUMENTATION CONTROLS
- PNEUMATIC LINE
- CONNECTING LINE
- CROSSOVER LINE

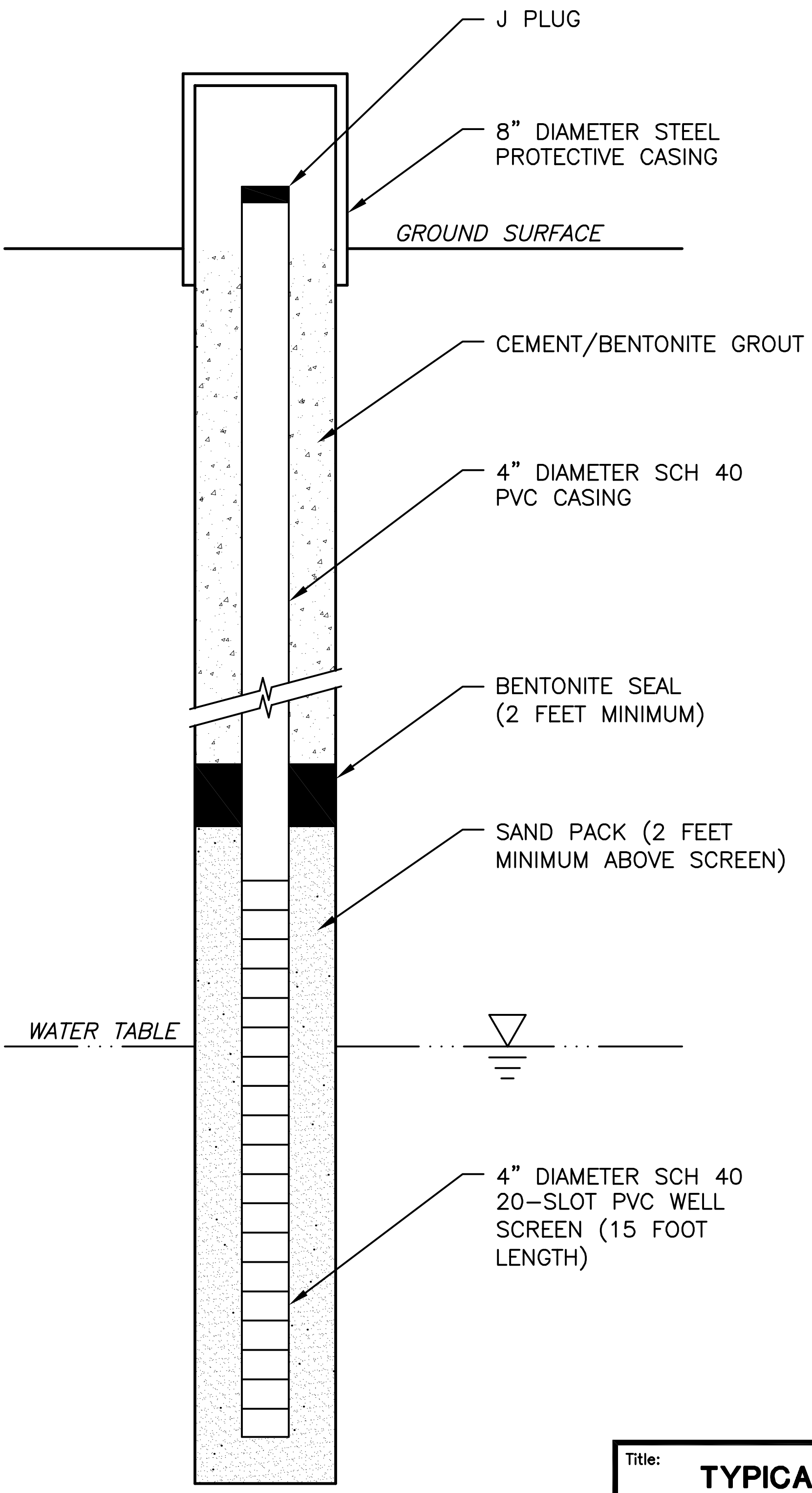
PROCESS LINE ABBREVIATIONS

ES – ELECTRIC SUPPLY
GS – GAS SUPPLY
HS – HYDRAULIC SUPPLY
NS – NITROGEN SUPPLY
SS – STEAM SUPPLY
W – WATER SUPPLY
V – VACUUM
VR – VAPOR REMOVAL
TF – TOTAL FLUIDS
AP – ACCESS PIPE / CONDUIT
SA – SPARGE AIR
PN – PNEUMATIC SUPPLY

DRAFTED BY: W.G.S. (N.J.)	**PROCESS & INSTRUMENTATION DIAGRAM LEGEND**
CHECKED BY:	**FORMER MOBIL BUFFALO TERMINAL #31010** **625 ELK STREET** **BUFFALO, NEW YORK**
REVIEWED BY:	Groundwater & Environmental Services, Inc. 158 SONWIL DRIVE, CHEEKTOWAGA, NEW YORK 14225–5514

NOT TO SCALE	DATE	FIGURE
	5–17–06	8

M:\Graphics\0900-Buffalo\Mobil\00Terminals\31010 Buffalo\31010 Buffalo Terminal P&ID Legend.dwg, 5/18/2006 7:53:55 AM, WShea



Title:

TYPICAL CHEMICAL OXIDATION MONITORING WELL DETAIL

FORMER BUFFALO TERMINAL, BUFFALO, NEW YORK

Prepared For:

EXXONMOBIL OIL CORPORATION

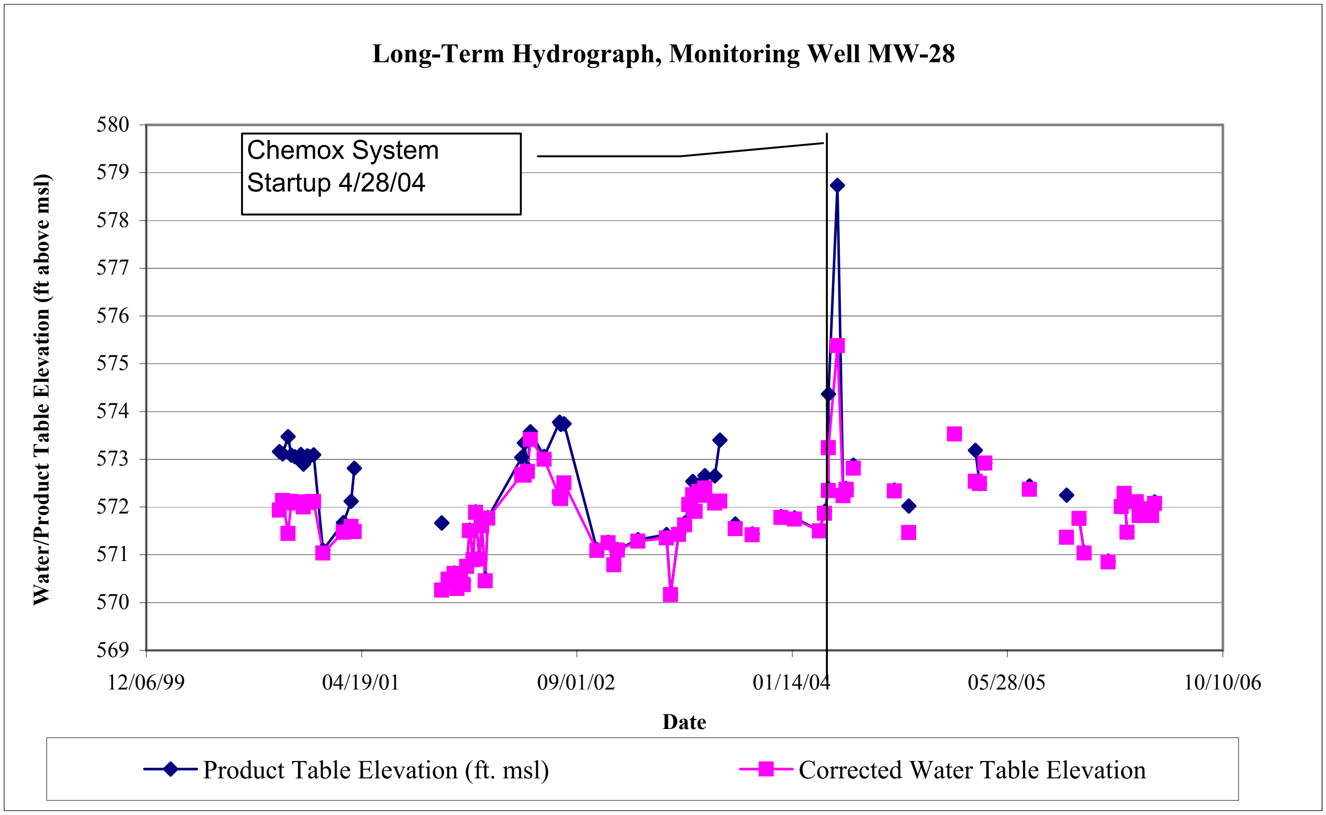
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: NC	Date: 30MAY06	FIGURE
Prepared by: GM	Scale: N.T.S.	9
Project Mgr: NC	Office: NY	
File No: MC5230406	Project: 17252Y08	

APPENDIX A

Hydrographs

Figure A-1. Long-Term Hydrographs for MW-28 (ETYA), Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York



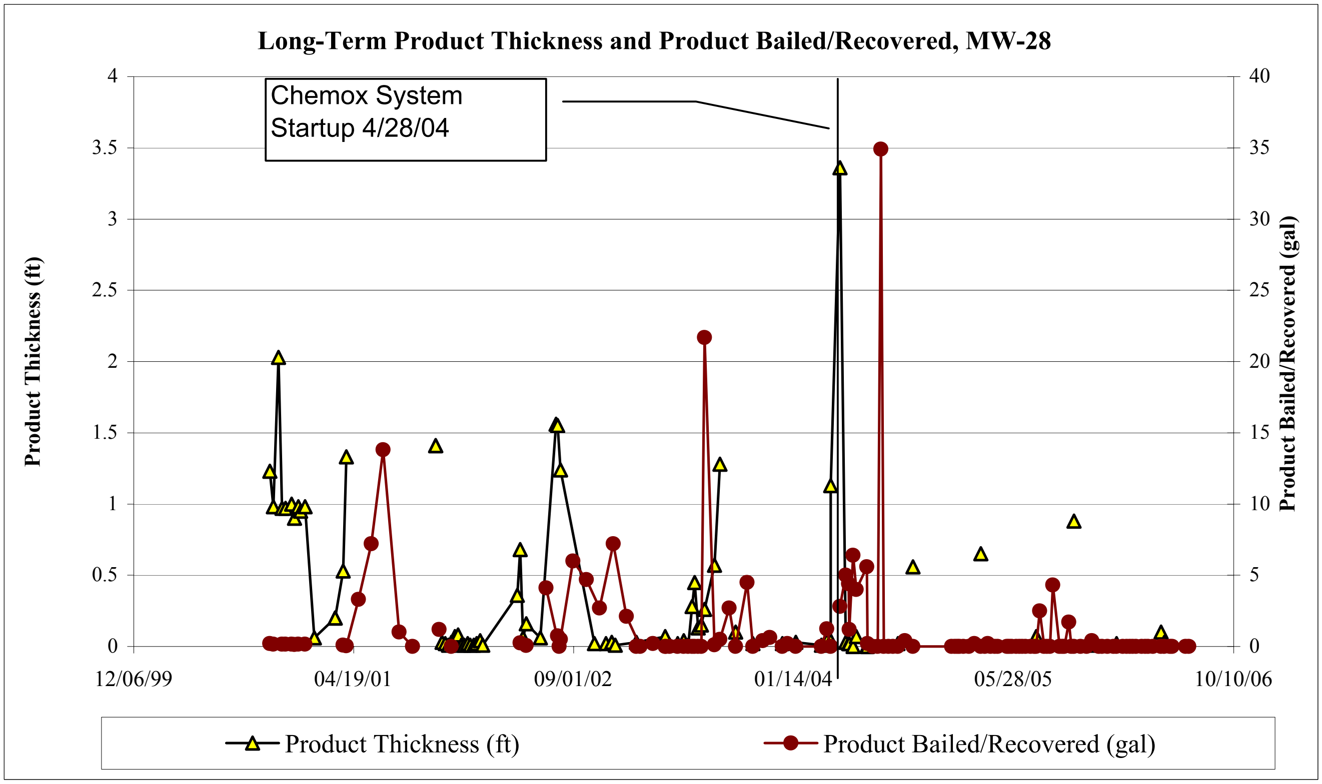
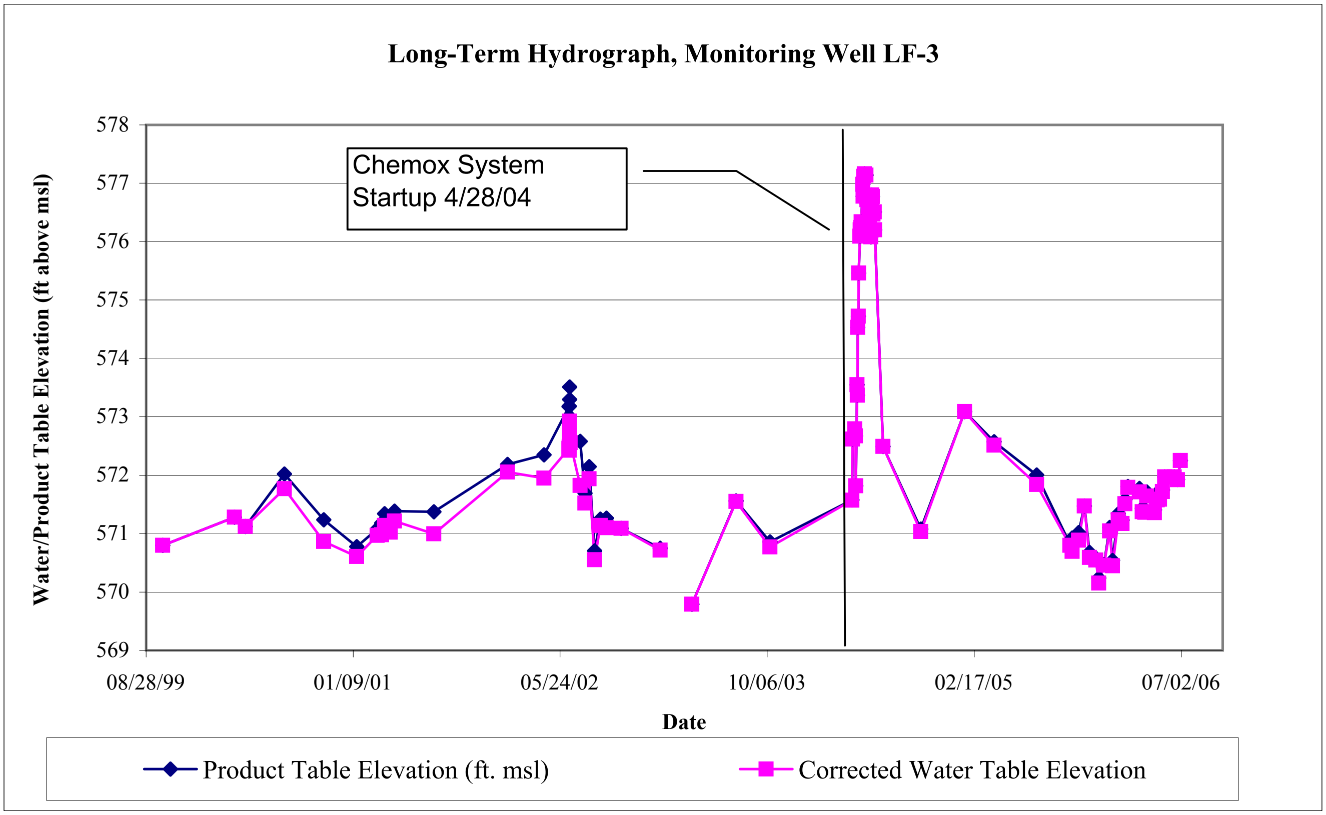


Figure A-2. Long-Term Hydrographs for LF-3 (ETYA), Buffalo Terminal, ExxonMobil Oil Corporation, Buffalo, New York



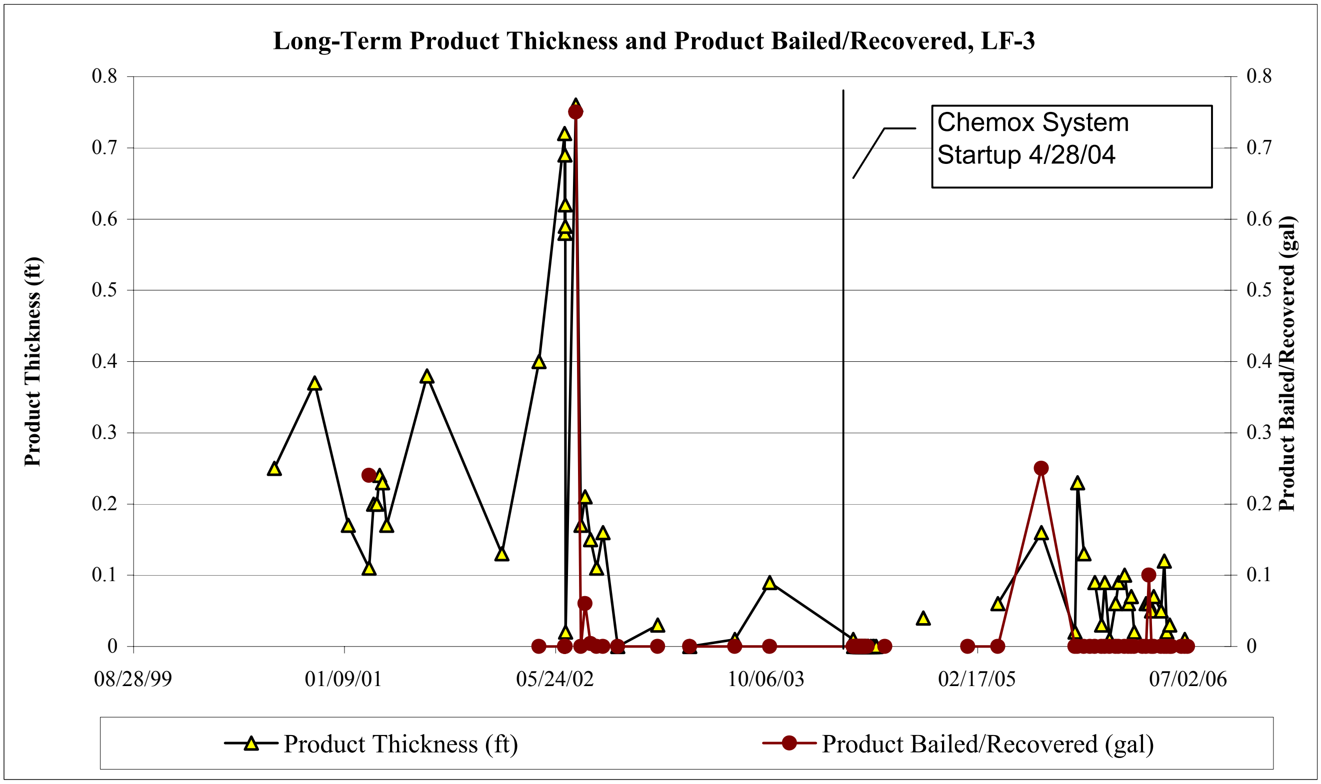
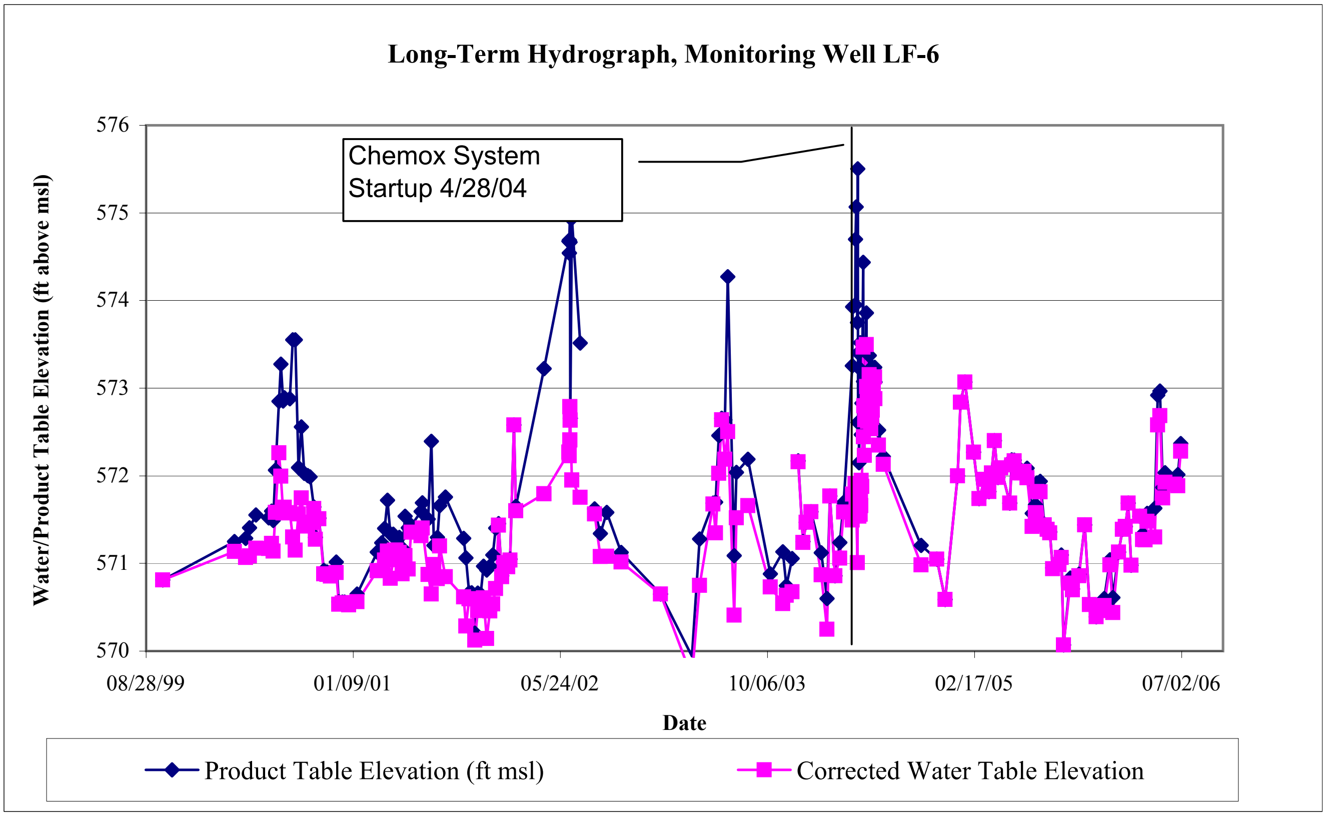


Figure A-3. Long-Term Hydrographs for LF-6 (ETYA) during ChemOx Pilot Test, Buffalo Terminal
ExxonMobil Oil Corporation, Buffalo, New York



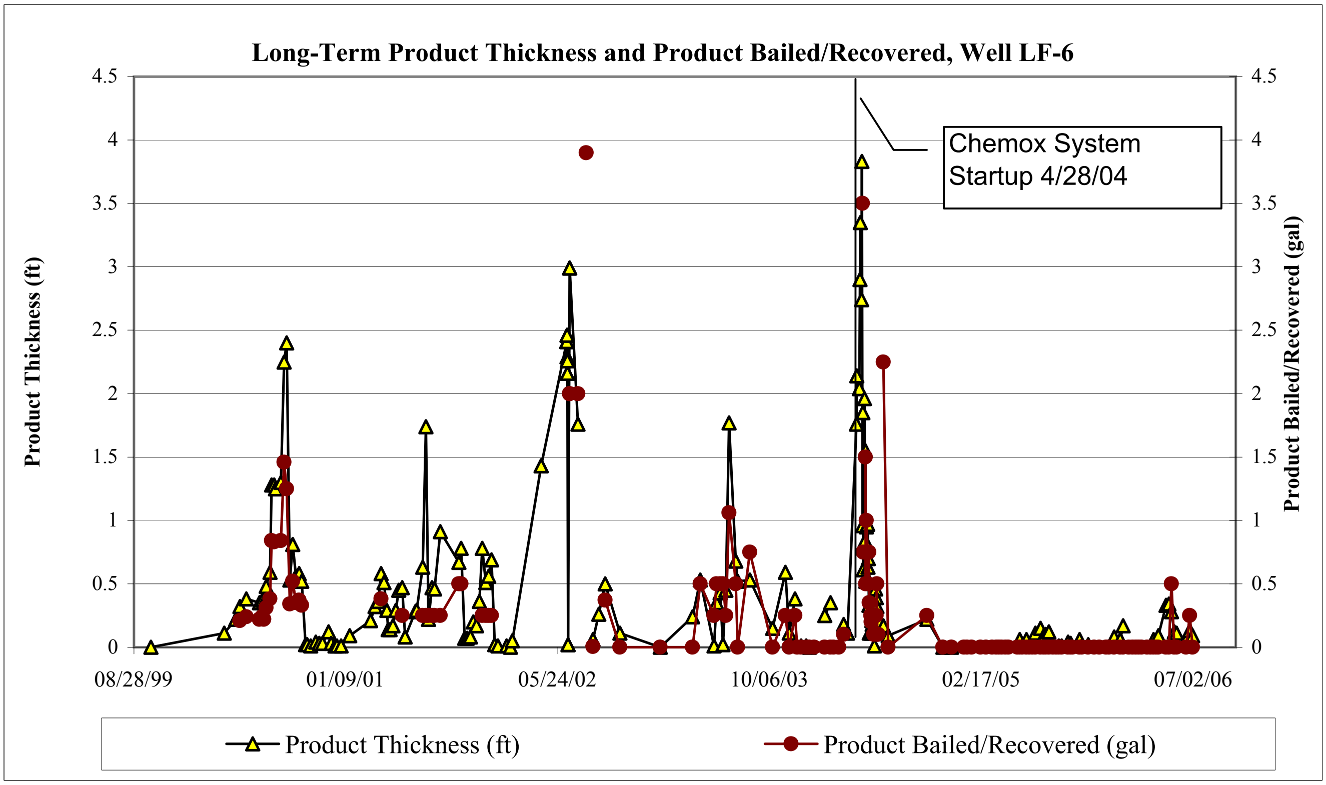
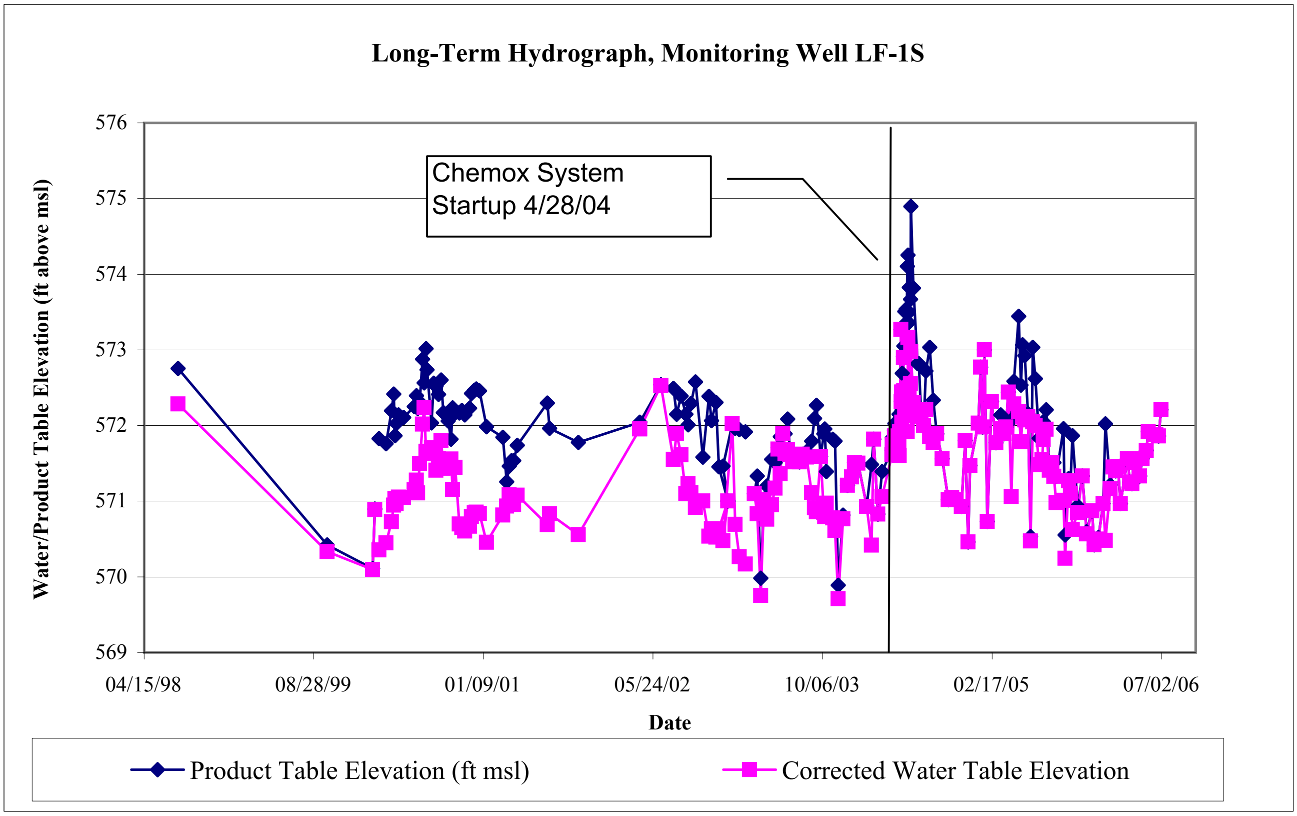
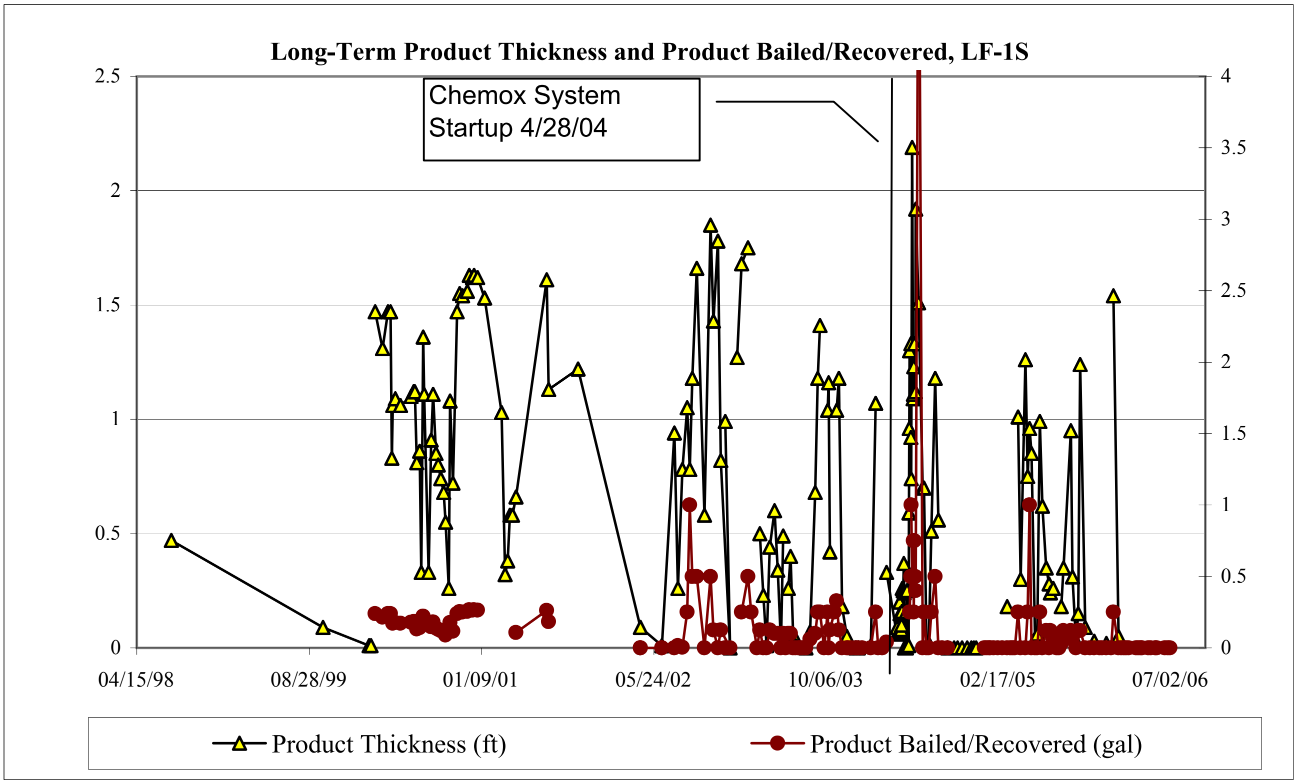


Figure A-4. Long-Term Hydrographs for LF-1S (ETYA) during ChemOx Pilot Test, Buffalo Terminal
ExxonMobil Oil Corporation, Buffalo, New York





APPENDIX B

Separate Phase Product Analysis Results for OU-4 Wells

TABLE 1

FREE PRODUCT INVESTIGATION
BUFFALO, NY
TERMINAL # 31-010

SAMPLE INFORMATION		
Sample Number:	00-6495	00-6497
Date of Sample:	11/3/00	11/3/00
Date Received:	11/6/00	11/6/00
Sample Description:	**MW-28**	**LF-1S**
Appearance:	Dark brown hydrocarbon in a pint bottle	Dark brown hydrocarbon in a pint bottle
ANALYTICAL DATA		
API Gravity @ 60 °F (TSL LP 78)	28.8	28.6
Lead Content, g/gal (ESL LP)	0.00	0.00
High Temperature Simulated Distillation (Mobil Method 1567)		
Initial Boiling Point, °F	250	256
2 % recovered, °F	307	309
5 % recovered, °F	336	336
10 % recovered, °F	370	370
20 % recovered, °F	417	417
30 % recovered, °F	444	444
40 % recovered, °F	475	475
50 % recovered, °F	495	495
60 % recovered, °F	518	520
70 % recovered, °F	543	545
80 % recovered, °F	576	576
90 % recovered, °F	613	613
95 % recovered, °F	648	648
98 % recovered, °F	685	685
Final Boiling Point, °F	752	751
Comparative Hydrocarbon Distribution by Gas Chromatography, GC Fingerprint (ESL LP 26)	The fingerprints of MW-28 and LF-1S show severely biodegraded diesel fuels and are identical to each other.	
Composition by GC/FID, High Temperature Simulated Distillated Distillation and Fingerprint		
% Gasoline	0	0
% Distillate	100	100
% Higher Boiling Material	0	0

ExxonMobil Research & Engineering, Paulsboro Technical Center, Paulsboro, NJ
AJ Malanowicz/DH Richman
November 17, 2000

APPENDIX C

Quality Assurance Project Plan

August 23, 2006

QUALITY ASSURANCE PROJECT PLAN FOR THE CHEMICAL OXIDATION IRM IN OPERABLE UNIT 4

ExxonMobil Former Buffalo Terminal
Buffalo, New York

Prepared for:

EXXONMOBIL OIL CORPORATION
1001 Wampanoag Trail
Riverside, Rhode Island 02915

Remedial Engineering, P.C.
Environmental Engineers

and ROUX ASSOCIATES, INC.
209 Shafter Street, Islandia, New York 11749 ♦ 631-232-2600

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APPENDICES

1.0 INTRODUCTION

Roux Associates, Inc. (Roux Associates) and Remedial Engineering, P.C. (Remedial Engineering) have developed this Quality Assurance Project Plan (QAPP) on behalf of ExxonMobil Oil Corporation (ExxonMobil) to describe in detail the field sampling and quality assurance/quality control methods to be used during implementation of Chemical Oxidation (ChemOx) Interim Remedial Measure (IRM) at the ExxonMobil Former Buffalo Terminal located south of Elk Street (Site). The Former Buffalo Terminal and offsite area currently or formerly owned by ExxonMobil are shown on Figure 1 of the ChemOx IRM Work Plan. The sampling activities to be conducted during implementation of the IRM are described in detail in the Operation, Maintenance and Monitoring (OM&M) Plan for the ChemOx System, dated August 23, 2006, which was submitted under separate cover.

In order to address the environmental conditions, ExxonMobil entered into a Brownfield Site Cleanup Agreement with the NYSDEC on April 3, 2006. Under this agreement, the Site entered into New York State's Brownfield Cleanup Program (BCP) The "Site" is defined, for the purposes of the BCP, as the area within the limits of the five Operable Units (OUs) as shown in Figure 2 of the ChemOx IRM Work Plan. In addition, the Site was divided into nine geographic areas for the purpose of assessing environmental conditions and reporting the results of area-specific activities (Figure 3 of the ChemOx IRM Work Plan). These areas were designated according to the historical primary operations that occurred in each portion of the Site. The area of separate-phase product to be addressed by the ChemOx IRM is located in Operable Unit 4, within the area previously designated as the Eastern Tank Yard Area (ETYA).

Consistent with the Draft BCP Guide, the proposed IRM for the OU-4 product plume, coupled with planned future remedial activities for the remainder of OU-4, will be fully protective of public health and the environment, taking into account the current, intended and potential future land use. The proposed IRM removes, to the extent practicable, the source of contamination in the OU-4 product plume area. It also eliminates or mitigates significant threats to public health and the environment presented by the contaminants within the OU-4 product plume area.

This QAPP was prepared in accordance with the NYSDEC's December 2002 Draft DER-10 Technical Guidance for Site Investigation and Remediation (DER-10) and provides guidelines and procedures to be followed by field personnel during implementation of the ChemOx IRM. Information contained in this QAPP relates to:

- Sampling objectives (Section 2);
- Project organization (Section 3);
- Sample media, sampling locations, analytical suites, sampling frequencies, and analytical laboratory (Section 4);
- Field sampling procedures (Section 5);
- Sample handling, sample analysis, and quality assurance/quality control (Section 6); and
- Site control procedures and decontamination (Section 7).

2.0 SAMPLING OBJECTIVES

The ChemOx IRM sampling program is designed to meet the data quality objectives (DQOs) set forth in the Draft DER-10. Specifically, analytical parameters selected for each sample, as described in Section 4, are comprehensive and are intended to meet the following objectives:

- Analyze groundwater samples for VOCs and SVOCs to determine baseline contaminant levels; and
- Analyze groundwater and soil samples for VOCs and SVOCs to monitor the ChemOx treatment system effectiveness and evaluate the progress of the remediation.

Sampling procedures are discussed in Section 5 of this QAPP. A discussion of the data quality objectives (DQOs) and quality assurance/quality control for the IRM is provided in Section 6.

3.0 PROJECT ORGANIZATION

The overall management structure and a general summary of the responsibilities of project team members are presented below.

ExxonMobil Project Manager

Joseph Abel is the ExxonMobil Project Manager. The ExxonMobil Project Manager is responsible for defining project objectives, and bears ultimate responsibility for the successful completion of the remedial action. This individual will provide overall management for the implementation of the scope of work and will coordinate all field activities with Remedial Engineering and GES. The ExxonMobil Project Manager is also responsible for all regulatory interaction and correspondence.

Project Manager

Noelle Clarke of Roux Associates/Remedial Engineering will serve as the Project Manager. The Project Manager is responsible for defining project objectives and bears responsibility for the successful completion of the investigation. This individual will provide overall management for the implementation of the scope of work and will coordinate all field activities. The Project Manager is also responsible for data review/interpretation and report preparation. Activities of the Project Manager are supported by the Project Quality Assurance Coordinator.

Field Team Leader

Andrew Janik of Groundwater & Environmental Services, Inc. (GES) will serve as the Field Team Leader. The Field Team Leader bears the responsibility for the successful execution of the field program, as scoped in the additional investigation letter work plan. The Field Team Leader will direct the activities of the technical staff in the field, as well all subcontractors. He will also assist in the interpretation of data. The Field Team Leader reports to the Project Manager.

Laboratory Project Manager

Gale Lage of TestAmerica, Inc. (TestAmerica) is responsible for sample container preparation, sample custody in the laboratory, and completion of the required analysis through oversight of the laboratory staff. The Laboratory Project Manager will ensure that quality assurance procedures are followed and that an acceptable laboratory report is prepared and submitted. The Laboratory Project Manager reports to the Field Team Leader.

4.0 SAMPLE MEDIA, LOCATIONS, ANALYTICAL SUITES, AND FREQUENCY

The media to be sampled during the implementation of the ChemOx IRM are groundwater and soil. Sampling locations, analytical suites, and frequency vary by the type of sample (i.e., baseline sample, monthly groundwater monitoring, etc). A discussion of the sampling for each type of groundwater and soil sample is provided below. Specifics regarding the collection of samples are provided in Section 5 of this QAPP.

4.1 Baseline Groundwater Sampling

A round of baseline groundwater samples will be collected from all monitoring wells in the target area (all five cells) prior to startup of the first cell. Samples will be analyzed for VOCs and SVOCs by USEPA methods 8260 and 8270, respectively (Table C-1). This round of sampling will serve as the baseline for the entire target area to assess the progress of the full scale remediation. If all wells throughout the target area are not yet installed at the time operation at the first cell is due to be initiated, all available wells will be sampled. QA/QC samples, including duplicates, field blanks and matrix spike/matrix spike duplicate (MS/MSD) will also be collected at the frequencies described in Table C-1.

In addition, prior to initiation of operation in each subsequent cell, the monitoring wells will be sampled for VOCs and SVOCs to evaluate if any reductions from the baseline occurred that could be attributed to operation of adjacent cells.

4.2 Monthly Groundwater Sampling

Groundwater quality for VOCs and SVOCs will be sampled at Chemical Oxidation injection wells and monitoring wells within each cell monthly during long-term operation. Samples will be analyzed for VOCs and SVOCs by USEPA methods 8260 and 8270, respectively (Table C-1). QA/QC samples, including duplicates, field blanks and matrix spike/matrix spike duplicate (MS/MSD) will also be collected at the frequencies described in Table C-1.

If the following criteria are met for a ChemOx Cell, it will be temporarily shut down:

- Groundwater quality data from the first two rounds of sampling indicate that significant reductions of VOCs and SVOCs have been achieved.
- VOC/SVOC removals in groundwater have reached asymptotic levels.

- MIP borings indicate total VOC removals.
- Separate-phase product has been reduced.

Operation in the next ChemOx Cell will then commence (following baseline groundwater sampling in that cell).

If the groundwater quality, MIP data and separate-phase product do not indicate significant remediation has occurred, operation in this ChemOx Cell will continue. Monitoring during any additional operation period will be the same as described above.

4.3 Groundwater Sampling for Rebound and System Decommissioning

If a ChemOx Cell met the criteria for temporary shutdown, groundwater quality within the monitoring wells in that cell will be sampled to assess if rebound of VOC and SVOC concentrations is occurring. The groundwater sampling will be performed during the next Site-wide quarterly sampling event, unless that event occurs within 30 days of the previous sampling round in the ChemOx cells, in which case the sampling for rebound will occur during the following quarterly event.

Groundwater quality samples will be collected after temporary shutdown, as described above. If concentrations of VOCs and/or SVOCs increase significantly or if separate phase product thickness increases, this cell will undergo an additional operating period. Monitoring during this additional operation period will be the same as described above.

If, after several consecutive operating periods, the concentrations of VOCs and SVOCs in groundwater continue to rebound, VOCs in the subsurface based on membrane interface probe (MIP) borings do not indicate significant reductions, and separate-phase product has not been remediated, it will be assumed that operation of the ChemOx system within this cell has met the practical limit of its remediation potential. At this time, if conditions within a particular cell still warrant additional remediation, modifications to the ChemOx system will be considered and/or alternative treatment methods will be evaluated.

For cells that meet the temporary shutdown criteria (following the initial or subsequent treatment periods), and that do not experience rebound (following the initial or subsequent treatment periods), monitoring wells will be sampled for VOCs and SVOCs by USEPA methods 8260 and 8270, respectively (Table C-1) during the next quarterly sampling round. The sampling frequency will depend upon field conditions encountered and the data will be used to determine if the system can be shut down in a particular cell. If conditions remain consistent with the temporary shutdown criteria, indicating that the remediation has been successful in meeting remedial action objectives, monitoring will be discontinued on a cell-by-cell basis. QA/QC samples, including duplicates, field blanks and matrix spike/matrix spike duplicate (MS/MSD) will also be collected at the frequencies described in Table C-1.

4.4 Soil Sampling for System Decommissioning

In addition to the groundwater sampling, for cells that meet the temporary shutdown criteria and do not experience rebound, soil samples will be collected at select locations in the vicinity of MIP borings, with analysis for VOCs and SVOCs by USEPA methods 8260 and 8270, respectively. QA/QC samples, including duplicates, field blanks and matrix spike/matrix spike duplicate (MS/MSD) will also be collected at the frequencies described in Table C-1.

4.5 Analytical Laboratory

Laboratory analyses will be performed by a NYSDOH ELAP certified laboratory, in accordance with the NYSDEC Analytical Services Protocol (ASP) using USEPA SW-846 Methods. The laboratory selected for this project is TestAmerica, located in Nashville, Tennessee.

5.0 FIELD SAMPLING PROCEDURES

This section provides a discussion of the field procedures to be used for sampling of soil and groundwater during implementation of the ChemOx IRM.

5.1 Groundwater Sampling

Groundwater sampling will be conducted throughout the monitoring phase of the IRM. After gauging for potential separate-phase product and purging of three well volumes of water, selected monitoring wells will be sampled for the parameters listed in Section 4.1, 4.2 and 4.3.

Additional details regarding groundwater-sampling protocols are described in Roux Associates' Standard Operating Procedures (SOP), which are provided in Appendix A.

5.2 Soil Sampling

All soil samples will be collected using Geoprobe™ sampling equipment. In accordance with ExxonMobil ground disturbance protocols, boring locations will be cleared from land surface to 5 feet below land surface (bls) using an ExxonMobil approved method (i.e., hand auger, air-knife, etc.). Soil samples will be collected for field documentation continuously from 15 feet below grade to the bottom of the boring (i.e., the top of the clay layer), approximately 35 ft bls. The supervising technical staff will inspect soil samples and record applicable lithologic characteristics. In addition, all soil samples will be visually inspected for evidence of separate-phase product (i.e., separate-phase product sheen, odors, staining, etc.) and screened for organic vapors with a Photo-ionization Detector (PID).

Soil borings with Geoprobe™ equipment will be conducted with van or truck mounted probing equipment, to the extent possible (i.e., in certain areas, hand-held Geoprobe™ tools may need to be used due to access constraints). The vehicle will be positioned over the selected boring location and a 2 feet or 4 feet long drive point sampler containing an acetate liner will be attached to steel rods and driven to the desired sample depth. The drive point sampler remains closed while it is being driven to the sampling depth. The sampler is opened by releasing the stop pin from the surface, and the sampler is driven 2 feet into the material to be sampled. Releasing the stop pin allows a piston to retract inside of the sampling tube while it is displaced by the soil core. The soil core is contained within the acetate liner in the sampler. The drive point sampler is removed from the ground by retracting the steel rods. The acetate liner, with the intact soil sample, is then removed from the drive point sampler. Management of any wastes generated during the implementation of this task is discussed in Section 7.

All Geoprobe^{TM} boring locations will be surveyed for horizontal and vertical coordinates relative to the New York State Plane Coordinate System by a surveyor licensed in the State of New York after completion. Horizontal coordinates will be accurate to ±0.1 feet and vertical coordinates will be accurate to ±0.01 feet.

The number and type of samples to be collected and parameters to be analyzed for will be determined following temporary shutdown of the system.

Additional details regarding soil sampling protocols are described in Roux Associates' SOP, which are provided in Appendix A.

6.0 SAMPLE HANDLING AND ANALYSIS

To ensure quality data acquisition and collection of representative samples, there are selective procedures to minimize sample degradation or contamination. These include procedures for preservation of the samples, as well as sample packaging, shipping procedures, and quality assurance/quality control.

6.1 Field Sample Handling

A detailed discussion of the proposed number and types of samples to be collected during each task, as well as the analyses to be performed can be found in Section 4.0 and in Table C-1 of this QAPP. The types of containers, volumes, holding times, and preservation techniques for the aforementioned testing parameters are presented in Table 2.

6.2 Sample Custody Documentation

The purpose of documenting sample custody is to ensure that the integrity and handling of the samples is not subject to question. Sample custody will be maintained from the point of sampling through the analysis (and return of unused sample portion, if applicable). Specific procedures regarding sample tracking from the field to the laboratory are described in Roux Associates' SOP for Sample Handling (Appendix A).

Each individual collecting the samples is personally responsible for the care and custody of the samples. All sample labels should be pre-printed or filled out using waterproof ink. The technical staff will review all field activities with the Field Team Leader to determine whether proper custody procedures were followed during the field work and to decide if additional samples are required.

All samples being shipped offsite for analysis must be accompanied by a properly completed TestAmerica chain of custody form (Appendix B). The sample numbers will be listed on the chain of custody form. When transferring the possession of samples, individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person and/or to/from a secure storage area and/or to the shipper, and/or to the laboratory.

Samples will be packaged for shipment and dispatched to the appropriate laboratory for analysis with a separate signed custody record enclosed in each sample box or cooler. Shipping containers will be locked and/or secured with strapping tape in at least two locations for shipment to the laboratory.

6.3 Sample Shipment

Sample packaging and shipping procedures are based upon USEPA specifications, as well as U.S. Department of Transportation (DOT) regulations. The procedures vary according to potential sample analytes, concentration, and matrix and are designed to provide optimum protection for the samples and the public. Sample packaging and shipment must be performed using the general outline described below. Additional information regarding sample handling is provided in Roux Associates' SOP for Sample Handling (Appendix A).

All samples will be shipped within 24 hours of collection and will be preserved appropriately from the time of sample collection.

A description of the sample packing and shipping procedures is presented below:

1. Prepare cooler(s) for shipment.
    - Tape drain(s) of cooler shut;
    - Affix "This Side Up" arrow labels and "Fragile" labels on each cooler; and
    - Place mailing label with laboratory address on top of cooler(s).
2. Arrange sample containers in groups by sample number.
3. Ensure that all bottle labels are completed correctly. Place clear tape over bottle labels to prevent moisture accumulation from causing the label to peel off.
4. Arrange containers in front of assigned coolers.
5. Place packaging material approximately at the bottom of the cooler to act as a cushion for the sample containers.
6. Arrange containers in the cooler so that they are not in contact with the cooler or other samples.
7. Fill remaining spaces with packaging material.

8. Ensure all containers are firmly packed in packaging material.
9. If ice is required to preserve the samples, ice cubes should be repackaged in Zip-lock™ bags and placed on top of the packaging material.
10. Sign chain of custody form (or obtain signature) and indicate the time and date it was relinquished to courier as appropriate.
11. Separate chain of custody forms. Seal proper copies within a large Zip-lock™ bag and tape to inside cover of cooler. Retain copies of all forms.
12. Close lid and latch.
13. Secure each cooler using custody seals.
14. Tape cooler shut on both ends.
15. Relinquish to overnight delivery service as appropriate. Retain air bill receipt for project records. (Note: All samples will be shipped for "NEXT A.M." delivery.)

6.4 Quality Assurance/Quality Control

The primary intended use for the samples that will be collected during implementation of the IRM are to document the effectiveness of the ChemOx treatment system and evaluate the progress of the remediation.

The primary DQO for the ChemOx IRM sampling is that data be accurate and precise and, hence, representative of the actual Site conditions. Accuracy refers to the ability of the laboratory to obtain a true value (i.e., compared to a standard) and is assessed through the use of laboratory quality control (QC) samples, including laboratory control samples and matrix spike samples, as well as through the use of surrogates, which are compounds not typically found in the environment that are injected into the samples prior to analysis. Precision refers to the ability to replicate a value and is assessed through both field and laboratory duplicate samples.

Sensitivity is also a critical issue in generating representative data. Laboratory equipment must be of sufficient sensitivity to detect target compounds and analytes at levels below NYSDEC standards and guidelines whenever possible. Equipment sensitivity can be decreased by field or laboratory contamination of samples and by sample matrix effects. Assessment of instrument sensitivity is performed through the analysis of reagent blanks, near-detection-limit standards, and response factors. Potential field and/or laboratory contamination is assessed through use of trip blanks, method blanks, and equipment rinse blanks (also called “field blanks”).

Table 1 lists the field and laboratory QC samples that will be analyzed to assess data accuracy and precision, as well as to determine if equipment sensitivity has been compromised. These tables also list the data acceptance criteria against which the data will be compared to verify that the project DQOs have been achieved.

All ChemOx IRM sample analyses will be performed in accordance with the NYSDEC using USEPA SW-846 methods. TestAmerica is the laboratory selected to analyze the field samples collected during implementation of the ChemOx IRM. TestAmerica maintains NYSDOH ELAP CLP certification for each of the analyses listed in Section 4.0.

ChemOx IRM laboratory data will to be reported in NYSDEC ASP Category A deliverables.

7.0 SITE CONTROL PROCEDURES

Site control procedures have been developed to minimize both the risk of exposure to contamination and the spread of contamination during field activities at the site. In order to accomplish this objective, the QAPP addresses three main considerations:

- The establishment of discrete work zones in the investigative area;
- The decontamination of field equipment; and
- The disposal of all investigation-derived waste.

All personnel who come into designated work areas, including contractors and observers, will be required to adhere strictly to the conditions imposed herein and to the provisions of the consultant's and/or contractor's Site-Specific Health and Safety Plan (HASP).

7.1 Field Work Zones

Field work zones will be limited to areas where soil and groundwater sampling is being conducted. Access to these areas will be limited in accordance with the HASP. Control of work zone access will be the responsibility of the individual(s) designated as a Site Health and Safety Manager. At the completion of each working day, all loose equipment (e.g., sampling equipment, coolers, etc.) will be secured. Heavy equipment, such as the drill rig, will remain onsite within an established, secured zone, or be moved to the main portion of the Site south of Elk Street.

7.2 Decontamination

In an attempt to avoid the spread of contamination, all drilling (i.e., augers) and sampling equipment (i.e., hand augers, sample trowels, etc.) must be decontaminated at a reasonable frequency. Temporary decontamination areas will be set up, as necessary. Detailed procedures for the decontamination of field and sampling equipment are included in the attached Roux Associates' SOPs (Appendix A). The location of the decontamination area(s) will be determined as necessary during the field work. The decontamination area will be constructed to ensure that any wash water generated during decontamination can be collected. Decontamination water (if any) will be transported to ExxonMobil's water treatment system, which is located in the main portion of the former terminal south of Elk Street or will be disposed offsite at an ExxonMobil-approved disposal facility.

7.3 Waste Handling and Disposal

Drill cuttings and all other investigation-derived waste will be transported and disposed of in accordance with all applicable federal, state, and local regulations at a facility selected by ExxonMobil. The remediation-derived waste that will be generated during the construction activities include:

- Drill Cuttings;
- Personal Protective Equipment (PPE);
- Purge water from monitoring well sampling; and
- Decontamination water, if any is generated.

PPE generated during the implementation of the ChemOx IRM will be consolidated and stored in appropriate bulk containers and temporarily staged at a waste storage area within the Site limits. Any full or partially filled containers will be appropriately labeled after the completion of the work. ExxonMobil will coordinate waste characterization and disposal.

Purge water and sampling equipment decontamination water will be collected and transported to ExxonMobil's water treatment system, which is located in the main portion of the former terminal south of Elk Street. The water will be treated through the system prior to discharge to the municipal sewer under the Site's existing discharge permit.

Decontamination water, if any, will be collected and transported to ExxonMobil's water treatment system, which is located in the main portion of the former terminal south of Elk Street or disposed of offsite at an ExxonMobil-approved disposal facility.

Drill cuttings generated during the implementation of the ChemOx IRM will be stored in drums and temporarily staged at a waste storage area within the site limits. Any fully or partially filled drums will be appropriately labeled after the completion of the work. ExxonMobil will coordinate waste characterization and disposal.

Table 1. OU-4 Chemical Oxidation IRM Field and Quality Control Sampling Summary

Sample Medium	Target Analytes	Field Samples[1]	Replicates[2]	Field Blanks[3]	Matrix Spikes[2]	Spike Duplicates[2]
Baseline, Monthly and System Decommissioning Groundwater Sampling	VOCs	TBD	1 per 20 samples or 1 per sample delivery group	1 per day	1 per 20 samples or 1 per sample delivery group	1 per 20 samples or 1 per sample delivery group
	SVOCs	TBD				
Soil Sampling for System Decommissioning	VOCs	TBD	1 per 20 samples or 1 per sample delivery group	1 per day	1 per 20 samples or 1 per sample delivery group	1 per 20 samples or 1 per sample delivery group
	SVOCs	TBD				

[1] - The number of field samples will vary during each sampling round.

[2] - Based on 1 per 20 samples or 1 per Sample Delivery Group (3 days max)

[3] - Based on 1 per day

VOCs - Volatile Organic Compounds

SVOCs - Semivolatile Organic Compounds

Table 2. OU-4 Chemical Oxidation IRM Sample Containers, Preservation and Holding Times

Analysis	Bottle Type	Preservation[a]	Holding Time[b]
Water Samples			
Volatile Organic Compounds (VOCs) SW-846 8260B	Three 40 mL VOA vials	Cool to 4°C	14 days
Semivolatile Organic Compounds (SVOCs) SW-846 8270C	1 liter glass w/teflon lined cap	Cool to 4°C	7 days to extract 40 days for analysis
Soil Samples			
Volatile Organic Compounds (VOCs) SW-846 8260B	2 oz. wide-mouth glass w/teflon lined cap	Cool to 4°C	14 days
Semivolatile Organic Compounds (SVOCs) SW-846 8270C	4 oz. wide-mouth glass w/teflon lined cap	Cool to 4°C	14 days to extract 40 days for analysis

(a) All samples to be preserved in ice during collection and transport

(b) Days from date of sample collection unless otherwise noted.

APPENDIX A

Roux Associates' Standard Operating Procedure

Date: May 5, 2000

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to explain the quality control (QC) measures taken to ensure the integrity of the samples collected and to establish the guidelines for the collection of QC samples. The objective of the QC program is to ensure that water-quality data of known and reliable quality are developed.

Because valid water-chemistry data are integral to a hydrogeologic investigation that characterizes water-quality conditions, the data will be confirmed by QC samples. Without checks on the sampling and analytical procedures, the potential exists for contradictory or incorrect results. The acceptance of water-quality data by regulatory agencies and in litigation-support investigations depends heavily on the proper QC program to justify the results presented. The QC sampling requirements must be determined by the project manager and be clearly defined in the work plan. If data validation (for in-house purposes or for compliance with the United States Environmental Protection Agency [USEPA] regulations) is stipulated as part of the hydrogeologic investigation, QC sampling must be conducted.

2.0 QUALITY CONTROL SAMPLES

2.1 Samples taken for analysis of compounds require the use of quality control samples to monitor sampling activities and laboratory performance. Types of quality control samples may include replicate and/or replicate split, trip blank, field equipment blank, matrix spike and matrix spike duplicate, and fortification. A discussion pertaining to each quality control sample follows:

a. Replicate and Replicate Split - Replicate sample analysis is done to check on the reproducibility of results either within a laboratory or between laboratories. A replicate sample is called a split sample when it is collected with or turned over to a second party (e.g., regulatory agency, consulting firm) for an independent analysis. Replicate samples are aliquots (equal portions) from a sample in a common container.

To collect a replicate sample, water from the bailer or pump will be distributed first to fill one container and then to fill the second container. Adequate water should be available to fill the bottles completely before they are capped. If the water is insufficient to fill all the bottles at once, then incrementally fill each bottle with water from two or more bailer volumes or pump cycles.

For some test substances, water may have to be accumulated in a common container and then decanted slowly into the sample bottles. The work plan should be checked for a description of how replicate samples are to be collected. Additionally, in the case of wells that recover slowly and produce insufficient water to fill all the replicate sample containers, the containers should be filled incrementally and kept on ice in the cooler in between filling periods.

b. Trip Blank - A trip blank sample is a sample bottle that is filled with "clean" (e.g., distilled/deionized) water in the laboratory, and travels unopened with the sample bottles. (The USEPA now uses the phrase "demonstrated analyte free water.") It is opened in the laboratory and analyzed along with the field samples for the constituent(s) of interest to detect if contamination has occurred during field handling, shipment, or in the laboratory. Trip blanks are primarily used to check for "artificial" contamination of the sample caused by airborne volatile organic compounds (VOCs) but may also be used to check for "artificial" contamination of the sample by a test substance or other analyte(s). One trip blank per cooler containing VOC samples, or test substance of other analyte(s) of interest would accompany each day's samples.

c. Field Equipment Blank - A field equipment blank (field blank) sample is collected to check on the sampling procedures implemented in the field. A field blank is made with "clean" (e.g., distilled/deionized/demonstrated analyte free) water by exposing it to sampling processes (i.e., the clean water must pass through the actual sampling equipment). For example, if samples are being collected with a bailer, the field blank would be made by pouring the clean water into a bailer which has been decontaminated and is ready for sampling, and then pouring from the bailer into the sample containers. If a metals equipment blank is to be made, and the water was filtered, then the sample must be filtered (i.e., exposed to the sampling process). One equipment blank would be incorporated into the sampling program for each day's collection of samples and analyzed for the identical suite of constituents as the sample. In some situations one equipment blank will be required for each type of sampling procedure (e.g., split-spoon, bailer, hand auger).

A special type of field blank may be needed where ambient air quality may be poor. This field blank sample would be taken to determine if airborne contaminants will interfere with constituent identification or quantification. This field blank sample is a sample bottle that is filled and sealed with "clean" (e.g., distilled/deionized/demonstrated analyte free) water in the analytical laboratory, and travels unopened with the sample bottles. It is opened in the field and exposed to the air at a location(s) to check for potential atmospheric interference(s). The field blank is resealed and shipped to the contract laboratory for analysis.

d. Matrix Spike and Matrix Spike Duplicate - Spikes of compounds (e.g., standard compound, test substance, etc.) may be added to samples in the laboratory to determine if the ground-water matrix is interfering with constituent identification or quantification, as well as a check for systematic errors and lack of sensitivity of analytical equipment. Samples for spikes are collected in the identical manner as for standard analysis, and shipped to the laboratory for spiking. Matrix spike duplicate sample collection, and laboratory spiking and analysis is done to check on the reproducibility of matrix spike results.

e. Fortification - A fortification, which is performed in the field, is used to check on the laboratory's ability to recover the test substance (analyte) added as well as its stability between fortification and analysis.

A field fortification (spike) is prepared by filling the container(s) with field or distilled/deionized/demonstrated analyte free water (as specified by the laboratory) to a predetermined volume (as specified by the laboratory) and adding the spike (supplied by the laboratory). The predetermined volume of water is measured with a clean (decontaminated) graduated cylinder. Field spikes will be prepared following the collection, labeling, and sealing of nonspiked samples in a separate cooler. The spike is kept at a safe distance from the sampling point (e.g., in the hotel room).

2.2 The work plan must be referred to for details regarding the type of QC samples to be collected and the QC sample collection method.

3.0 PROCEDURE

3.1 Implement QC sampling as outlined above, depending on the type of QC sample(s) specified in the work plan.

3.2 Ensure unbiased handling and analysis of replicate and blank QC samples by concealing their identity by means of coding so that the analytical laboratory cannot determine which samples are included for QC purposes. Attempt to use a code that will not cause confusion if additional samples are collected or additional monitoring wells are installed. For example, if there are three existing monitoring wells (MW-1, 2 and 3), do not label the QC blank MW-4. If an additional monitoring well were installed, confusion could result.

3.3 Label matrix spike and field fortification (spike) QC samples so that the analytical laboratory knows which samples are to be spiked in the laboratory and which samples were fortified (spiked) in the field, respectively. In certain situations, the field fortification will be "blind" or undisclosed to the laboratory to independently verify their analytical ability.

3.4 Verify that each sample is placed in an individual "zip-lock" bag, wrapped with "bubble wrap," and placed in its appropriate container (holder) in the cooler, and that the cooler has sufficient ice (wet ice or blue packs) to preserve the samples for transportation to the analytical laboratory. Consult the site work plan to determine if a particular ice is specified as the preservative for transportation (e.g., the USEPA prefers the use of wet ice because they claim that blue ice will not hold the samples at 4° Centigrade/Celsius).

3.5 Document the QC samples on the appropriate field form and in the field notebook. On the chain-of-custody form, replicate and blank QC samples will be labeled using the codes (Number 3.2, above), and matrix spike and field fortification QC samples will be identified as such (Number 3.3, above).

3.6 Follow standard shipping procedures for samples (i.e., retain one copy of the chain-of-custody form, secure the cooler with sufficient packing tape and a custody seal, forward the samples via overnight [express] mail or hand deliver to the designated analytical laboratory preferably within 24 hours but no later than 48 hours after sampling). However, check the site work plan for information on the analyte(s), as some have to be analyzed immediately (e.g., CN).

END OF PROCEDURE

STANDARD OPERATING PROCEDURE 3.2
FOR FIELD RECORD KEEPING AND QUALITY ASSURANCE/QUALITY CONTROL

Date: May 5, 2000

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide procedures and standards for record keeping and maintenance, for all field activities conducted by Roux Associates, Inc. (Roux Associates).

Strict quality assurance/quality control (QA/QC) is necessary to properly and accurately document and preserve all project-related information. Quality assurance is implemented to corroborate that quality control procedures are followed. Quality control provides a means to monitor investigation activities (e.g., sampling and laboratory performance) as a check on the quality of the data.

Valid data and information are integral to all aspects of Roux Associates' field activities. These aspects include, but are not necessarily limited to, activities that involve: drilling; sediment, sludge, and soil sampling (lithologic, and soil-quality and analysis); well construction and development; aquifer testing and analysis; water-quality sampling and analysis (surface water and ground water); free-product sampling and analysis; air-quality sampling and analysis; geophysical testing; demolition activities; waste removal operations; engineering installations; etc. The data will be confirmed by QA/QC methods established and set forth in the work plan/scope of work. Without checks on the field and analytical procedures, the potential exists for contradictory results, and associated incomplete or incorrect results from the interpretation of potentially questionable data.

Documentation will be entered in the field notebook and must be transcribed with extreme care, in a clear and concise manner, as the information recorded will become part of the permanent legal record. Because field notes are the legal record of site activities, they must be taken in a standard and consistent manner. If abbreviations are used, then they must first be spelled out for clarity (i.e., to avoid ambiguity and misunderstanding). All entries must be dated and initialed, and the time (military time) of the entry included. Field notebooks and forms must be assigned to an individual project and properly identified (i.e., client name, project number, location and name of site, individual recording information, dates, times, etc.). Change of possession of field notebooks or forms must be documented with the date and time, and initialed by both individuals. Following each day's entries, the field notebook or form must be photocopied in the event that the original documentation is lost or stolen. All field notebooks must have the company name and address legibly printed in indelible ink along with the message "If found, then please forward to Roux Associates, Inc. at the above address - REWARD OFFERED."

Information must be recorded while onsite because it may be difficult to recall details at a later date. Furthermore, information must be documented immediately as it provides unbiased information which will be used for writing the report when the field activities are completed. Project-related documentation is an irreplaceable, important record for other individuals who may become involved in the project, and provides the project manager with a complete history of project-related activities. Written information must be accompanied by maps, sketches, and photographs where appropriate, especially if these supplemental sources of information assist in the documentation process. A new page must be used in the field notebook for each new day's entries (i.e., unused portions of a previous page must have an "X" placed through it). The end of the day's records must be initialed and dated.

As part of record keeping and QA/QC activities, state and federal regulatory agencies should be contacted to check if special or different protocols are required and/or if particular or unconventional methods are required for the given field activity. Thus, the record keeping and QA/QC activities implemented by Roux Associates are based on technically sound standard practices and incorporate Roux Associates own, extensive experience in conducting hydrogeologic field activities.

2.0 MATERIALS

In order to track investigation activities, specific materials are required. These materials include the following:

a. A bound, waterproof field notebook.

b. Appropriate Roux Associates' forms (e.g., daily log, geologic log, monitoring well construction log, well sampling data form, location sketch, chain of custody, telephone conversation record, meeting notes, etc.).

c. Appropriate labels (e.g., sample, Roux Associates' Custody Seal, etc.)

d. Work plan/scope of work.

e. Health and safety plan (HASP).

f. Appropriate Roux Associates' SOPs.

g. Black pens, and indelible markers.

h. Camera and film.

3.0 DOCUMENTATION

3.1 Before the Roux Associates personnel leave the field, they must ensure that their field notes include comprehensive descriptions of the hydrogeologic conditions, and all investigation-related activities and results (onsite and offsite). This will safeguard against the inability to reconstruct and comprehend all aspects of the field investigation after its completion, and will serve to facilitate the writing of an accurate report. Properly documented information provides the QA/QC tracking (back-up) required for all Roux Associates' projects. General types of information that must be recorded (where pertinent to the investigation being conducted) include, but may not necessarily be limited to, the following:

a. List of Roux Associates personnel on site.

b. Name, date, and time of arrival on site by Roux Associates personnel, including temporary departures from, and returns to, the site during the work day.

c. Client and project number.

d. Name and location of study area.

e. Date and time of arrival on site by non-Roux Associates personnel (names and affiliation) and equipment (e.g., subcontractors and facility personnel, and drilling equipment, respectively, etc.), including temporary departures from, and returns to, the site during the work day, and departure at the end of the work day.

f. List of non-Roux Associates personnel on site.

g. Weather conditions at the beginning of the day as well as any changes in weather that occur during the working day.

h. Health and safety procedures including level of protection, monitoring of vital signs, frequency of air monitoring, and any change (i.e., downgrade or upgrade) in the level of protection for Roux Associates and other on-site personnel (e.g., subcontractors, facility personnel, etc.).

i. Health and safety procedures not in compliance with the HASP (for all on-site personnel).

j. Site reconnaissance information (e.g., topographic features, geologic features, surface-water bodies, seeps, areas of apparent contamination, facility/plant structures, etc.).

k. Air monitoring results (i.e., photoionization detector [PID], etc. measurements).

l. Task designation and work progress.

m. Work-related and site-related discussions with subcontractors, regulatory agency personnel, plant personnel, the general public, and Roux Associates personnel.

n. Delays, unusual situations, problems and accidents.

o. Field work not conducted in accordance with the work plan/scope of work, and rationale and justification for any change(s) in field procedures including discussions with personnel regarding the change(s) and who authorized the change(s).

p. QA/QC procedures not conducted in accordance with the QA/QC procedures established in the work plan/scope of work and rationale and justification for any change(s) in QA/QC procedures including discussions with personnel regarding the change(s) and who authorized the change(s).

q. Equipment and instrument problems.

r. Decontamination and calibration procedures.

s. Activities in and around the site and work area by any and all on-site personnel which may impact field activities.

t. Sketches, maps, and/or photographs (with dates and times) of the site, structures, equipment, etc. that would facilitate explanations of site conditions.

u. Contamination evidenced as a result of work-related activities (e.g., visible contaminants [sheen] in drilling fluids or on drilling equipment; sheen on, or staining of, sediments; color of, or separate [nonaqueous] phase on, water from borehole or well; vapors or odors emanating from a borehole or well; etc.); make all observations as objectively as possible (e.g., grey-blue, oil-like sheen; black and orange, rust-like stain; fuel-like odor; etc.) and avoid using nontechnical or negative-sounding terms (e.g., slimy, goopy, foul-smelling).

v. Date and time of final departure from the site of all personnel at the end of the work day.

3.2 In addition to the general types of information that must be recorded (as presented in Section 3.1), task-specific information must also be properly documented. Task-specific information which is required is provided in each respective task-oriented SOP, and the documentation procedures outlined in each SOP must be followed.

END OF PROCEDURE

Date: May 5, 2000

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish guidelines for sample handling which will allow consistent and accurate results. Valid chemistry data are integral to investigations that characterize media-quality conditions. Thus, this SOP is designed to ensure that once samples are collected, they are preserved, packed and delivered in a manner which will maintain sample integrity to as great an extent as possible. The procedures outlined are applicable to most sampling events and any required modifications must be clearly described in the work plan.

2.0 CONSIDERATIONS

Sample containers, sampling equipment decontamination, quality assurance/quality control (QA/QC), sample preservation, and sample handling are all components of this SOP.

2.1 Sample Containers

Prior to collection of a sample, considerations must be given to the type of container that will be used to store and transport the sample. The type and number of containers selected is usually based on factors such as sample matrix, potential contaminants to be encountered, analytical methods requested, and the laboratory's internal quality assurance requirements. In most cases, the overriding considerations will be the analytical methodology, or the state or federal regulatory requirements because these regulations generally encompass the other factors. The sample container selected is usually based on some combination of the following criteria:

a. Reactivity of Container Material with Sample

Choosing the proper composition of sample containers will help to ensure that the chemical and physical integrity of the sample is maintained. For sampling potentially hazardous material, glass is the recommended container type because it is chemically inert to most substances. Plastic containers are not recommended for most hazardous wastes because the potential exists for contaminants to adsorb to the surface of the plastic or for the plasticizer to leach into the sample.

In some instances, however, the sample characteristics or analytes of interest may dictate that plastic containers be used instead of glass. Because some metals species will adhere to the sides of the glass containers in an aqueous matrix, plastic bottles (e.g., nalgene) must be used for samples collected for metals analysis. A separate, plastic container should accompany glass containers if metals analysis is to be performed along with other analyses. Likewise, other sample characteristics may dictate that glass cannot be used. For example, in the case of a strong alkali waste or hydrofluoric solution, plastic containers may be more suitable because glass containers may be etched by these compounds and create adsorptive sites on the container's surface.

b. Volume of the Container

The volume of sample to be collected will be dictated by the analysis being performed and the sample matrix. The laboratory must supply bottles of sufficient volume to perform the required analysis. In most cases, the methodology dictates the volume of sample material required to complete the analysis. However, individual laboratories may provide larger volume containers for various analytes to ensure sufficient quantities for duplicates or other QC checks.

To facilitate transfer of the sample from the sampler into the container and to minimize spillage and sample disturbance, wide-mouth containers are recommended. Aqueous volatile organic samples must be placed into 40-milliliter (ml) glass vials with polytetrafluoroethylene (PTFE) (e.g., TeflonTM) septums. Non-aqueous volatile organic samples should be collected in the same type of vials or in 4-ounce (oz) wide-mouth jars provided by the laboratory. These jars should have PTFE-lined screw caps.

c. Color of Container

Whenever possible, amber glass containers should be used to prevent photodegradation of the sample, except when samples are being collected for metals analysis. If amber containers are not available, then containers holding samples should be protected from light (i.e., place in cooler with ice immediately after filling).

d. Container Closures

Container closures must screw on and off the containers and form a leak-proof seal. Container caps must not be removed until the container is ready to be filled with the sample, and the container cap must be replaced (securely) immediately after filling it. Closures should be constructed of a material which is inert with respect to the sampled material, such as PTFE (e.g., TeflonTM). Alternately, the closure may be separated from the sample by a closure liner that is inert to the sample material such as PTFE sheeting. If soil or sediment samples are being collected, the threads of the container must be wiped clean with a dedicated paper towel or cloth so the cap can be threaded properly.

e. Decontamination of Sample Containers

Sample containers must be laboratory cleaned by the laboratory performing the analysis. The cleaning procedure is dictated by the specific analysis to be performed on the sample. Sample containers must be carefully examined to ensure that all containers appear clean. Do not mistake the preservative as unwanted residue. The bottles should not be field cleaned. If there is any question regarding the integrity of the bottle, then the laboratory must be contacted immediately and the bottle(s) replaced.

f. Sample Bottle Storage and Transport

No matter where the sample bottles are, whether at the laboratory waiting to be packed for shipment or in the field waiting to be filled with sample, care must be taken to avoid contamination. Sample shuttles or coolers, and sample bottles must be stored and transported in clean environments. Sample bottles and clean sampling equipment must never be stored near solvents, gasoline, or other equipment that is a potential source of cross-contamination. When under chain of custody, sample bottles must be secured in locked vehicles, and custody sealed in shuttles or in the presence of authorized personnel. Information which documents that proper storage and transport procedures have been followed must be included in the field notebook and on appropriate field forms.

2.2 Decontamination of Sampling Equipment

Proper decontamination of all re-usable sampling equipment is critical for all sampling episodes. The SOP for Decontamination of Field Equipment and SOPs for method-specific or instrument-specific tasks must also be referred to for guidance for decontamination of various types of equipment.

2.3 Quality Assurance/Quality Control Samples

QA/QC samples are intended to provide control over the proper collection and tracking of environmental measurements, and subsequent review, interpretation and validation of generated analytical data. The SOPs for Collection of Quality Control Samples, for Evaluation and Validation of Data, and for Field Record Keeping and Quality Assurance/Quality Control must be referred to for detailed guidance regarding these respective procedures. SOPs for method-specific or instrument-specific tasks must also be referred to for guidance for QA/QC procedures.

2.4 Sample Preservation Requirements

Certain analytical methodologies for specific analytes require chemical additives in order to stabilize and maintain sample integrity. Generally, this is accomplished under the following two scenarios:

a. Sample bottles are preserved at the laboratory prior to shipment into the field.

b. Preservatives are added in the field immediately after the samples are collected.

Many laboratories provide pre-preserved bottles as a matter of convenience and to help ensure that samples will be preserved immediately upon collection. A problem associated with this method arises if not enough sample could be collected, resulting in too much preservative in the sample. More commonly encountered problems with this method include the possibility of insufficient preservative provided to achieve the desired pH level or the need for additional preservation due to chemical reactions caused by the addition of sample liquids to pre-preserved bottles. The use of pre-preserved bottles is acceptable; however, field sampling teams must always be prepared to add additional preservatives to samples if the aforementioned situations occur. Furthermore, care must be exercised not to overfill sample bottles containing preservatives to prevent the sample and preservative from spilling and therefore diluting the preservative (i.e., not having enough preservative for the volume of sample).

When samples are preserved after collection, special care must be taken. The transportation and handling of concentrated acids in the field requires additional preparation and adherence to appropriate preservation procedures. All preservation acids used in the field should be trace-metal or higher-grade.

2.5 Sample Handling

After the proper sample bottles have been received under chain-of-custody, properly decontaminated equipment has been used to collect the sample, and appropriate preservatives have been added to maintain sample integrity, the final step for the field personnel is checking the sample bottles prior to proper packing and delivery of the samples to the laboratory.

All samples should be organized and the labels checked for accuracy. The caps should be checked for tightness and any 40-ml volatile organic compound (VOC) bottles must be checked for bubbles. Each sample bottle must be placed in an individual "zip-lock" bag to protect the label, and placed on ice. The bottles must be carefully packed to prevent breakage during transport. When several bottles have been collected for an individual sample, they should not be placed adjacent to each other in the cooler to prevent possible breakage of all bottles for a given sample. If there are any samples which are known or suspected to be highly contaminated, these should be placed in an individual cooler under separate chain-of-custody to prevent possible cross contamination. Sufficient ice (wet or blue packs) should be placed in the cooler to maintain the temperature at 4 degrees Celsius (°C) until delivery at the laboratory. Consult the work plan to determine if a particular ice is specified as the preservation for transportation (e.g., the United States Environmental Protection Agency does not like the use of blue packs because they claim that the samples will not hold at 4°C). If additional coolers are required, then they should be purchased. The chain-of-custody form should be properly completed, placed in a "zip-lock" bag, and placed in the cooler. One copy must be maintained for the project files. The cooler should be sealed with packing tape and a custody seal. The custody seal number should be noted in the field book. Samples collected from Monday through Friday will be delivered to the laboratory within 24 hours of collection. If Saturday delivery is not available, samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if certain analytes require a shorter delivery time. If overnight mail is utilized, then the shipping bill must be maintained for the files and the laboratory must be called the following day to confirm receipt.

3.0 EQUIPMENT AND MATERIALS

3.1 General equipment and materials may include, but not necessarily be limited to, the following:

a. Sample bottles of proper size and type with labels.

b. Cooler with ice (wet or blue pack).

c. Field notebook, appropriate field form(s), chain-of-custody form(s), custody seals.

d. Black pen and indelible marker.

e. Packing tape, "bubble wrap", and "zip-lock" bags.

f. Overnight (express) mail forms and laboratory address.

g. Health and safety plan (HASP).

h. Work plan/scope of work.

i. Pertinent SOPs for specified tasks and their respective equipment and materials.

3.2 Preservatives for specific samples/analytes as specified by the laboratory. Preservatives must be stored in secure, spillproof glass containers with their content, concentration, and date of preparation and expiration clearly labeled.

3.3 Miscellaneous equipment and materials including, but not necessarily limited to, the following:

a. Graduated pipettes.

b. Pipette bulbs.

c. Litmus paper.

d. Glass stirring rods.

e. Protective goggles.

f. Disposable gloves.

g. Lab apron.

h. First aid kit.

i. Portable eye wash station.

j. Water supply for immediate flushing of spillage, if appropriate.

k. Shovel and container for immediate containerization of spillage-impacted soils, if appropriate.

4.0 PROCEDURE

4.1 Examine all bottles and verify that they are clean and of the proper type, number, and volume for the sampling to be conducted.

4.2 Label bottles carefully and clearly with project name and number, site location, sample identification, date, time, and the sampler's initials using an indelible marker.

4.3 Collect samples in the proper manner (refer to specific sampling SOPs).

4.4 Conduct preservation activities as required after each sample has been collected. Field preservation must be done immediately and must not be done later than 30 minutes after sample collection.

4.5 Conduct QC sampling, as required.

4.6 Seal each container carefully and place in an individual "zip lock" bag.

4.7 Organize and carefully pack all samples in the cooler immediately after collection (e.g., bubble wrap). Insulate samples so that breakage will not occur.

4.8 Complete and place the chain-of-custody form in the cooler after all samples have been collected. Maintain one copy for the project file. If the cooler is to be transferred several times prior to shipment or delivery to the laboratory, it may be easier to tape the chain-of-custody to the exterior of the sealed cooler. When exceptionally hazardous samples are known or suspected to be present, this should be identified on the chain-of-custody as a courtesy to the laboratory personnel.

4.9 Add additional ice as necessary to ensure that it will last until receipt by the laboratory.

4.10 Seal the cooler with packing tape and a custody seal. Record the number of the custody seal in the field notebook and on the field form. If there are any exceptionally hazardous samples, then shipping regulations should be examined to ensure that the sample containers and coolers are in compliance and properly labeled.

4.11 Samples collected from Monday through Friday will be delivered to the laboratory within 24 hours of collection. If Saturday delivery is not available, samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if certain analytes require a shorter delivery time.

4.12 Maintain the shipping bill for the project files if overnight mail is utilized and call the laboratory the following day to confirm receipt.

END OF PROCEDURE

STANDARD OPERATING PROCEDURE 4.2 FOR MEASURING WATER LEVELS USING AN ELECTRONIC SOUNDING DEVICE (M-SCOPE)

Date: May 5, 2000

1.0 PURPOSE

The purpose for this standard operating procedure (SOP) is to establish the guidelines for using m-scopes. A m-scope is an electronic sounding device used to measure the depth to ground water below an established (surveyed) measuring point (MP). Measuring the depth to water (DTW) below the surveyed MP provides information for calculating ground-water elevations needed to construct ground-water elevation maps and determine the direction of ground-water flow.

M-scopes can be less accurate than a steel tape because the wire can kink, measurement increment marks can shift, and the tip may have been cut off and replaced without proper documentation. Thus, it is mandatory that a m-scope be calibrated before use.

2.0 DECONTAMINATION

The m-scope must be pre-cleaned (decontaminated) using a non-phosphate, laboratory-grade solution and rinsed with copious amounts of distilled or deionized water. This process is repeated before each measurement and following the final measurement.

3.0 CALIBRATION

The m-scope must be calibrated before being used to measure water levels. Calibration is accomplished by measuring the water level with the m-scope followed by a measurement using a steel tape. This dual measurement procedure is continued until the individual is confident that measurements taken using both devices are similar and the m-scope is reliable. The calibration procedure is documented in the field notebook or on an appropriate field form, and initialed and dated.

4.0 PROCEDURE

4.1 If the well is not vented, then remove the cap and wait several minutes for the water level to equilibrate. Take several measurements to ensure that the water level measured is in equilibrium with the aquifer (i.e., not changing substantially).

4.2 The manufacturer's model must be noted because some have switches, lights, beepers, or a combination of the above.

4.3 The 1-foot or 5-foot marked intervals on the electrical line must be checked to ensure that they have not shifted, and the bottom of the probe has not been cut. Check on a periodic basis that the cord has not kinked.

4.4 The water-level measurement is taken by lowering the probe into the well until the instrument-specific detection method (e.g., light, beeper, or both) is activated by contacting the water.

4.5 The electrical line is held at the MP and, using a ruler (e.g., carpenter's folding ruler) or an engineer's scale, the distance from the "held" point to the nearest marked interval is measured. The distance measured is added to, or subtracted from, the marked interval reading. The result is the DTW.

4.6 Measurements will be taken accurately and to the nearest 0.01 foot.

4.7 After measuring all wells in an area, always re-measure at least one well, preferably the first well measured, to see if the static water level has changed (e.g., due to pumping in the area, tidal effects, etc.). If a significant change has occurred, it may be necessary to re-measure other wells.

4.8 If there are previous water-level measurements available for the wells, then have these data available to compare the measurements with those just taken. Use these data to see if water levels are similar or if they have changed. If water levels have changed, then check if the changes are consistent (i.e., all up or all down) and make sense.

4.9 Water-level elevations are calculated by subtracting the DTW from the MP and a water-elevation map is constructed (contoured) on a well location map. This also provides a check to evaluate if the water levels make sense (or anomalies are evidenced). Re-measure the well(s) where anomalies are found as a check on the initial measurement(s).

4.10 If anomalies persist or water-level trends are different from the historical database, then check to see if hydrogeologic conditions and/or stresses have changed (e.g., discharge areas, pumping and/or injection wells, etc.).

4.11 All pertinent data will be documented in the field notebook, and initialed and dated.

END OF PROCEDURE

Date: May 5, 2000

1.0 PURPOSE

The purpose for this standard operating procedure (SOP) is to establish the guidelines for purging a well prior to the collection of a ground-water sample. Purging (evacuating) a well involves the removal of the standing column of water in the well to allow "fresh" (representative) formation water to enter the well. Two conventionally used methods for well purging include: 1) discharge of a specified number of casing volumes of water (which is more commonly used); and 2) pumping until specific indicator parameters (e.g., specific conductance, pH, temperature) stabilize. Wells must be purged prior to sampling to ensure the collection of representative formation ground water for water-quality analysis.

For accepted, existing sampling and analysis programs, the same purging method will be used each time to maintain consistency. For new sampling and analysis programs, the basis for the purging technique(s) will be site-specific field conditions, client input, the experience of Roux Associates, Inc. and regulatory agency(ies) guidelines (e.g., some states permit purging a low-yield well to dryness while others insist that some water remains in the well).

2.0 EQUIPMENT AND MATERIALS

2.1 The following equipment may be needed to purge a monitoring well before sampling:

a. Bailers.

b. Centrifugal pumps.

c. Electrical submersible pumps.

d. Peristaltic pumps.

e. Positive gas-displacement devices.

f. Bladder pumps.

g. Hand-operated diaphragm or bilge pump(s).

h. Teflon™ tape, electrical tape.

i. Tape measure (stainless steel, steel, fiberglass) with 0.01-foot measurement increments and chalk (e.g., blue carpenter's) or m-scope.

j. Appropriate discharge hose and valves.

k. Appropriate discharge tubing (e.g., polypropylene) if using a peristaltic pump.

l. Appropriate compressed gas if using bladder-type or gas-displacement device.

m. Extension cord(s) or portable generator (and fuel) if using an electric submersible pump.

n. Non-absorbent cord (e.g., polypropylene, etc.), cotton (absorbent) cord.

o. Tripod(s).

p. Water Well Handbook.

q. Explosimeter.

r. Flow meter.

2.2 Bailers or centrifugal pumps are recommended for shallow, small diameter monitoring wells. For deep wells, or large diameter wells, a submersible pump is recommended.

3.0 DECONTAMINATION

Each piece of equipment that is used to evacuate wells (e.g., bailers, pumps, hoses) will be decontaminated thoroughly prior to the introduction of the equipment into the well and prior to leaving the site. Additionally, disposable items (e.g., cord, tubing) will be changed between each well purged and discarded in an appropriate manner.

4.0 PROCEDURE

4.1 The depth to water (DTW) is measured and subtracted from the sounded (total) depth of the well to calculate the length of the column of standing water in the well (in feet).

4.2 The volume of the standing water in the well is calculated by multiplying the length of standing water by a coefficient which equates the diameter of the well to gallons per linear foot. (Refer to the attached table from the Water Well Handbook for the coefficient or use the following equation [V=(7.48 gal/ft3)(r2h), where V is volume of water in gallons, r is the radius of the well casing in feet, and h is the height of the water column in the well in feet].)

4.3 If purging is performed by evacuating a specified number of casing volumes, then three to five volumes are purged (typical regulatory agency requirement).

4.4 If wells are screened in low permeability formations, then the well may go dry prior to removing the specified volume of water. If the recovery rate is fairly rapid and time allows, then remove more than one casing volume; otherwise, the evacuation of one casing volume may suffice. (Refer to the site sampling and analysis plan [SAP] for details of purging a low-yield well.)

4.5 Evacuation will occur from the top of the water column in the well to ensure that "fresh" formation water enters the bottom of the well through the screen, moves up as standing water is removed from the top, and all standing water is removed (i.e., only representative formation water is in the well).

4.6 The volume of water purged from the well must be measured and can be calculated directly by discharging into containers of known volume or can be calculated by multiplying rate of flow by time.

4.7 If a submersible or centrifugal pump is used, then the intake is set just below the dynamic (pumping) water level in the well. The rate of flow in gallons per minute (gpm) can be measured using a calibrated bucket (e.g., 5-gallon) if the rate is relatively low, or a 55-gallon drum if the rate is relatively high, and a watch capable of measuring time in second intervals. A precalibrated flow meter may also be used if available.

4.8 After the specified number of casing volumes have been evacuated from the well, the pump intake is lifted slowly until it breaks suction to confirm that any standing water above the intake has been purged.

4.9 If a bailer is used, then the bailer is lowered only deep enough to remove water from the top of the water column and a 5-gallon bucket is used to measure the volume of water evacuated.

4.10 If purging is not executed by evacuating a specified number of well volumes, then purging is performed by pumping or bailing the well until specific indicator parameters (e.g., specific conductance, pH, temperature) stabilize. The volume of water removed is documented on an appropriate field form or in the field notebook.

4.11 Water purged from the well will be disposed of in accordance with the appropriate method outlined in the site SAP.

4.12 If historic site data indicate that explosive gases could be present and accumulate in the well, then an explosimeter will be used to check vapor concentrations in wells at the site prior to beginning the purging procedure. Vapor concentrations in a well that exceed the 25 percent lower explosive limit (LEL) will require specific precautionary measures to allow purging the well without danger of explosion or fire (e.g., use of cotton cord for bailers or lowering pumping devices, non-electric powered pumps). These conditions will be addressed in the site health and safety plan (HASP) and/or SAP.

END OF PROCEDURE

STANDARD OPERATING PROCEDURE 4.4 FOR SAMPLING GROUND-WATER MONITORING WELLS FOR DISSOLVED CONSTITUENTS

Date: May 5, 2000

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish guidelines for the sampling of ground-water monitoring wells for dissolved constituents. As part of the SOP for the sampling of ground-water monitoring wells, sample collection equipment and devices must be considered, and equipment decontamination and pre-sampling procedures (e.g., measuring water levels, sounding wells, and purging wells) must be implemented. Sampling objectives must be firmly established in the work plan before considering the above.

Valid water-chemistry data are integral to a hydrogeologic investigation that characterizes ground-water quality conditions. Water-quality data are used to evaluate both current and historic aquifer chemistry conditions, as well as to estimate future conditions (e.g., trends, migration pathways). Water-quality data can be used to construct ground-water quality maps to illustrate chemical conditions within the flow system, to generate water-quality plots to depict conditions with time and trends, and to perform statistical analyses to quantify data variability, trends, and cleanup levels.

2.0 EQUIPMENT AND MATERIALS

2.1 In order to sample ground water from monitoring wells, specific equipment and materials are required. The equipment and materials list may include, but not necessarily be limited to, the following:

a. Bailers (Teflon™ or stainless steel).

b. Pumps (centrifugal, peristaltic, bladder, electric submersible, bilge, hand-operated diaphragm, etc.).

c. Gas-displacement device(s).

d. Air-lift device(s).

e. Teflon™ tape, electrical tape.

f. Appropriate discharge hose.

g. Appropriate discharge tubing (e.g., polypropylene, teflon, etc.) if using a peristaltic pump.

h. Appropriate compressed gas if using bladder-type or gas-displacement device.

i. Portable generator and gasoline or alternate power supply if using an electric submersible pump.

j. Non-absorbent cord (e.g., polypropylene, etc.).

k. Plastic sheeting.

l. Tape measure (stainless steel, steel, fiberglass) with 0.01-foot measurement increments and chalk (blue carpenter's).

m. Electronic water-level indicators (e.g., m-scope, etc.) or electric water-level/product level indicators.

n. Non-phosphate, laboratory-grade detergent.

o. Distilled/Deionized water.

p. Potable water.

q. Paper towels, clean rags.

r. Roux Associates' field forms (e.g., daily log, well inspection checklist, sampling, etc.) and field notebook.

s. Well location and site map.

t. Well keys.

u. Stop watch, digital watch with second increments, or watch with a second hand.

v. Water Well Handbook.

w. Calculator.

x. Black pen and water-proof marker.

y. Tools (e.g., pipe wrenches, screwdrivers, hammer, pliers, flashlight, pen knife, etc.).

z. Appropriate health and safety equipment, as specified in the site health and safety plan (HASP).

aa. pH meter(s) and buffers.

bb. Conductivity meter(s) and standards.

cc. Thermometer(s).

dd. Extra batteries (meters, thermometers, flashlight).

ee. Filtration apparatus, filters, pre-filters.

ff. Plasticware (e.g., premeasured buckets, beakers, flasks, funnels).

gg. Disposable gloves.

hh. Water jugs.

ii. Laboratory-supplied sample containers with labels.

jj. Cooler(s).

kk. Ice (wet, blue packs).

ll. Masking, duct, and packing tape.

mm. Chain-of-custody form(s) and custody seal(s).

nn. Site sampling and analysis plan (SAP).

oo. Site health and safety plan (HASP).

pp. Packing material (e.g., bubble wrap)

qq. "Zip-lock" plastic bags.

rr. Overnight (express) mail forms.

3.0 DECONTAMINATION

3.1 Make sure all equipment is decontaminated and cleaned before use (refer to the SOP for Decontamination of Field Equipment for detailed decontamination methods, summaries for bailers and pumps are provided below). Use new, clean materials when decontamination is not appropriate (e.g., non-absorbent cord, disposable gloves). Document, and initial and date the decontamination procedures on the appropriate field form and in the field notebook.

a. Decontaminate a bailer by: 1) wearing disposable gloves, 2) disassembling (if appropriate) and scrubbing in a non-phosphate, laboratory-grade detergent and distilled/deionized water solution, and 3) rinsing first with potable water and then distilled/deionized water.

b. Decontaminate a pump by: 1) wearing disposable gloves, 2) flushing the pump and discharge hose (if not disposable) first with a non-phosphate, laboratory-grade detergent and potable water solution in an appropriate container (clean bucket, garbage can, or 55-gallon drum) and then with distilled/deionized water or potable water, and 3) wiping pump-related equipment (e.g., electrical lines, cables, discharge hose) first with a clean cloth and detergent solution and then rinsing or wiping with a clean cloth and distilled/deionized water or potable water.

3.2 Note that the decontamination procedures for bailers and pumps are the minimum that must be performed. Check the work plan to determine if chemicals specified by individual state regulatory agencies must also be used for decontamination procedures (e.g., hexane, nitric acid, acetone, isopropanol, etc.).

4.0 CALIBRATION OF FIELD ANALYSIS EQUIPMENT

Calibrate field analysis equipment before use (e.g., thermometers, pH and conductivity meters, etc.). Refer to the specific SOP for field analysis for each respective piece of equipment. Document, and initial and date the calibration procedures on the appropriate field form, in the field notebook, and in the calibration log book.

5.0 PROCEDURE

5.1 Document, and initial and date well identification, pre-sampling information, and problems encountered on the appropriate field form and in the field notebook as needed.

5.2 Inspect the protective casing of the well and the well casing, and note any items of concern such as a missing lock, or bent or damaged casing(s).

5.3 Place plastic sheeting around the well to protect sampling equipment from potential cross contamination.

5.4 Remove the well cap or plug and, if necessary, clean the top of the well off with a clean rag. Place the cap or plug on the plastic sheeting. If the well is not vented, allow several minutes for the water level in the well to equilibrate. If fumes or gases are present, then diagnose these with the proper safety equipment. Never inhale the vapors.

5.5 Measure the depth to water (DTW) from the measuring point (MP) on the well using a steel tape and chalk or an electronic sounding device (m-scope). Refer to the specific SOPs for details regarding the use of a steel tape or a m-scope for measuring water levels. Calculate the water-level elevation. Document, and initial and date the information on the appropriate field form and in the field notebook.

5.6 Measuring the total depth of the well from the MP with a weighted steel tape. Calculate and record the volume of standing water in the well casing on the appropriate field form and in the field notebook.

5.7 Decontaminate the equipment used to measure the water level and sound the well with a non-phosphate, laboratory-grade detergent solution followed by a distilled/deionized water rinse.

5.8 Purge the well prior to sampling (refer to the SOP for Purging a Well). The well should be pumped or bailed to remove the volume of water specified in the work plan. Usually three to five casing volumes are removed if the recharge rate is adequate to accomplish this within a reasonable amount of time.

If the formation cannot produce enough water to sustain purging, then one of two options must be followed. These include: 1) pumping or bailing the well dry, or 2) pumping or bailing the well to "near-dry" conditions (i.e., leaving some water in the well). The option employed must be specified in the work plan and be in accordance with regulatory requirements.

If the well is purged dry, then all the standing water has been removed and upon recovery the well is ready for sampling. However, depending on the rate of recovery and the time needed to complete the sampling round, one of the following procedures may have to be implemented: 1) the well may have to be sampled over a period of more than one day; 2) the well may not yield enough water to collect a complete suite of samples and only select (most important) samples will be collected; or 3) the well may not recover which will preclude sampling. Regardless of the option that must be followed, the sampling procedure must be fully documented. When preparing to conduct a sampling round, review drilling, development and previous sampling information (if available) to identify low-yielding wells in order to purge them first, and potentially allow time for the well to recover for sampling.

5.9 Record the physical appearance of the water (i.e., color, turbidity, odor, etc.) on the appropriate field form and in the field notebook, as it is purged. Note any changes that occur during purging.

5.10 If a bailer is used to collect the sample, then:

a. Flush the decontaminated bailer three times with distilled/deionized water.

b. Tie the non-absorbent cord (polypropylene) to the bailer with a secure knot and then tie the free end of the bailer cord to the protective casing or, if possible, some nearby structure to prevent losing the bailer and cord down the well.

c. Lower the bailer slowly down the well and into the water column to minimize disturbance of the water surface. If a bottom-filling bailer is used, then do not submerge the top of the bailer; however, if a top-filling bailer is used, then submerge the bailer several feet below the water surface.

d. Remove and properly discard one bailer volume from the well to rinse the bailer with well water before sampling. Again, lower the bailer slowly down the well to the appropriate depth depending on the bailer type (as discussed above in 5.11 c). When removing the bailer from the well, do not allow the bailer cord to rest on the ground but coil it on the protective plastic sheeting placed around the well. Certain regulatory agencies require that the first bailer volume collected be utilized for the samples.

5.11 If a pump is used to collect the sample, then use the same pump used to purge the well and, if need be, reduce the discharge rate to facilitate filling sample containers and to avoid problems that can occur while filling sample containers (as listed in Number 5.14, below). Alternately, the purge pump may be removed and a thoroughly decontaminated bailer can be used to collect the sample.

5.12 Remove each appropriate container's cap only when ready to fill each with the water sample, and then replace and secure the cap immediately.

5.13 Fill each appropriate, pre-labeled sample container carefully and cautiously to prevent: 1) agitating or creating turbulence; 2) breaking the container; 3) entry of, or contact with, any other medium; and 4) spilling/splashing the sample and exposing the sampling team to contaminated water. Immediately place the filled sample container in a ice-filled (wet ice or blue pack) cooler for storage. If wet ice is used it is recommended that it be repackaged in zip-lock bags to help keep the cooler dry and the sample labels secure. Check the work plan as to whether wet ice or blue packs are specified for cooling the samples because certain regulatory agencies may specify the use of one and not the other.

5.14 "Top-off" containers for volatile organic compounds (VOCs) and tightly seal with Teflon™-lined septums held in place by open-top screw caps to prevent volatilization. Ensure that there are no bubbles by turning the container upside down and tapping it gently.

5.15 Filter water samples (Procedure 4.6) collected for dissolved metals analysis prior to preservation to remove the suspended sediment from the sample. If water samples are to be collected for total metals analysis, then collect a second set of samples without field filtering.

In the event that the regulatory agency(ies) want unfiltered samples for metals analysis, a second set of filtered samples should also be collected. Because unfiltered samples are indications of total metals (dissolved and suspended) they are not representative of aquifer conditions because ground water does not transport sediment (except in some rare cases). Thus, the results for dissolved metals in ground water should be based on filtered samples even if both filtered and unfiltered sets are presented in a report.

5.16 Add any necessary preservative(s) to the appropriate container(s) prior to, or after (preferred), the collection of the sample, unless the appropriate preservative(s) have already been added by the laboratory before shipment.

5.17 Collect quality control (QC) samples as required in the work plan to monitor sampling and laboratory performance. Refer to the SOP for Collection of Quality Control Samples.

5.18 Conduct field analyses after sample collection is complete by measuring and recording the temperature, conductivity, pH, etc. (as called for in the work plan). Note and record the "final" physical appearance of the water (after purging and sampling) on an appropriate field form and in the field notebook.

5.19 Wipe the well cap with a clean rag, replace the well cap and protective cover (if present). Lock the protective cover.

5.20 Verify that each sample is placed in an individual "zip-lock" bag, wrapped with "bubble wrap," placed in the cooler, and that the cooler has sufficient ice (wet ice or blue packs) to preserve the samples for transportation to the analytical laboratory.

5.21 Decontaminate bailers, hoses, and pumps as discussed in the decontamination SOP. Wrap decontaminated equipment with a suitable material (e.g., clean plastic bag or aluminum foil). Discard cords, rags, gloves, etc. in a manner consistent with site conditions.

5.22 Complete all necessary field forms, field notebook entries, and the chain-of-custody forms. Retain one copy of each chain-of-custody form. Secure the cooler with sufficient packing tape and a custody seal.

5.23 Samples collected from Monday through Friday will be delivered within 24 hours of collection. If Saturday delivery is not available, samples collected on Friday must be delivered by Monday morning. Consult the work plan to determine if any of the analytes require a shorter delivery time.

END OF PROCUDURE

STANDARD OPERATING PROCEDURE 4.6
FOR FILTRATION OF GROUNDWATER AND SURFACE-WATER SAMPLES FOR DISSOLVED METALS ANALYSIS

Date: May 5, 2000

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to establish guidelines for the field filtration of groundwater samples for dissolved metals analysis prior to sample preservation. Filtering is implemented when the water sample contains suspended fine-grained materials (fines) that cannot be prohibited from entering the water sample by well development or well design. However, as fines are not always distinctly visible in the water sample, all water samples to be analyzed for dissolved metals will undergo filtration. Groundwater samples from bedrock formations to be analyzed for dissolved metals must also be filtered.

It should be noted that filtration of groundwater for metals analysis has been a standard practice with the United States Geological Survey (USGS) for many years. However, it should also be noted that certain regulatory agencies insist that groundwater samples for metals analysis are not filtered. In this case, the analytical results are actually representative of total metals (i.e., dissolved and suspended). Nevertheless, in order to quantify the concentrations of dissolved metals in groundwater, filtration will be employed.

Within this framework, filtration refers to the filtering of water either directly or at the end of a filtration series through a 0.45 micrometer (micron) membrane filter. The presence of a large quantity of fines may require the prefiltering of the sample with a larger-size membrane filter prior to the 0.45 micron filter to avoid clogging the 0.45 micron filter and using an exorbitant amount of time to filter the sample.

Filtration must be done as soon as possible after a water sample is collected, preferably at the same time that the water is produced. If there is a delay between the time that the water sample is collected and the time that filtration occurs, then the time lag and reason for the delay must be documented. The filtering equipment and membrane must be suitable for the intended analysis. Where permitted by regulatory agencies, disposable in-line filters and disposable funnel-type filters may be used. Depending upon the sampling needs, sterile disposable filtering devices may be preferable since they eliminate the need for field decontamination. Materials known to adversely affect the analytical procedure must not be used. The site sampling and analysis plan (SAP) must be referred to for these and other site specific filtration conditions.

In the event that surface water is being analyzed for dissolved metals, the filtration process described below is also used.

2.0 MATERIALS AND EQUIPMENT

To field filter groundwater samples, specific equipment and materials are required. The equipment and materials listed below may be needed in addition to the materials and equipment listed in various sampling SOPs.

a. Non-phosphate, laboratory-grade detergent.

b. Distilled/Deionized water.

c. Potable water.

d. Field forms (e.g., daily log, sampling, etc.) and field notebook.

e. Filtration apparatus (e.g., disposable plastic filtering apparatus, disposable in-line filters, Gelman apparatus, Buchner funnel, etc.), filters, prefilters.

f. Plasticware (e.g., premeasured buckets, beakers, flasks, funnels).

g. Teflon™ tape.

h. Vacuum pump (e.g., hand-operated or electric).

i. Appropriate tubing and fittings.

j. Disposable gloves.

k. Sample jars with appropriate preservative (e.g., nitric acid) and labels.

3.0 DECONTAMINATION

3.1 Decontamination is not necessary if sterile, disposable plastic filtering equipment is utilized. If applicable, it may be useful to collect a distilled water field blank through a representative disposable filter to demonstrate proper "decontamination." If re-usable filtering equipment is being used, the following is the minimum decontamination procedure:

a. Wear disposable gloves while cleaning filtering equipment to avoid contamination and change gloves as needed.

b. Prepare a non-phosphate, laboratory-grade detergent solution and distilled or deionized water in a bucket.

c. Remove vacuum tubing from flask.

d. Remove filter membrane from funnel.

e. Disassemble filtering apparatus (flask and funnel) and scrub each piece of equipment with a brush and solution.

f. Rinse with potable water.

g. Rinse with copious amounts of distilled or deionized water.

h. Allow to dry and wrap equipment with a suitable material (e.g., clean plastic bag) in preparation for the next use.

3.2 The decontamination procedure must consider regulatory agency(ies) specifications which must be provided in the site SAP, and may include decontamination variations such as nitric acid rinses, acetone rinses, etc.

4.0 PROCEDURE

4.1. Ensure that the filtering equipment is disposable and dedicated or is properly decontaminated before each use.

4.2. Assemble the filtering apparatus (funnel and flask), and connect the vacuum pump in case it is needed to augment gravity filtration.

4.3. Place a clean (new) 0.45-micron pore-size filter in the funnel. Use larger, pore-size filters if prefiltering is required (i.e., if significant suspended sediment is present that would quickly clog the 0.45-micron filter and prevent continuous filtration or result in excessive time for filtration).

4.4. Obtain the water sample using an appropriate, decontaminated sample-collection device (e.g., bailer, pump).

4.5. Pass the unpreserved water sample through the 0.45 micron filter into the flask. If the sample contains significant sediment, then pass it through a prefilter before using the 0.45 micron filter. Apply a vacuum using the vacuum pump if needed to facilitate filtering.

4.6. Transfer the filtered water sample to the appropriate, prelabeled sample container containing the preservative (e.g., nitric acid) being careful not to overfill the container and dilute the preservative.

4.7. Follow standard operating procedures for sample documentation, shipping, and tracking (i.e., record keeping).

4.8. Decontaminate all reusable filtering (and sampling) equipment that came in contact with the water sample. Properly disposal of all non-reusable equipment in a manner appropriate with site conditions.

END OF PROCEDURE

STANDARD OPERATING PROCEDURE 5.1
FOR COLLECTION OF SOIL SAMPLES
FOR LABORATORY ANALYSIS

Date: May 5, 2000

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to establish guidelines for the collection of soil samples for laboratory analysis. This SOP is applicable to soil samples collected from split-spoon samplers during drilling, hand auger samples, grab samples from stockpiled soils, surface samples, test pit samples, etc.

2.0 CONSIDERATIONS

Soil samples may be collected in either a random or biased manner. Random samples can be based on a grid system or statistical methodology. Biased samples can be collected in areas of visible impact or suspected source areas. Soil samples can be collected at the surface, shallow subsurface, or at depth. When samples are collected at depth the water content should be noted, since generally "soil sampling" is restricted to the unsaturated zone. Equipment selection will be determined by the depth of the sample to be collected. A thorough description of the sampling locations and proposed methods of sample collection should be included in the work plan.

Commonly, surface sampling refers to the collection of samples at a 0 to 6 inch depth interval. Certain regulatory agencies may define the depth interval of a surface sample differently, and this must be defined in the work plan. Collection of surface soil samples is most efficiently accomplished with the use of a stainless steel trowel or scoop. For samples at greater depths a decontaminated bucket auger or power auger may be needed to advance the hole to the point of sample collection. Another clean bucket auger should then be used to collect the sample. To collect samples at depths of greater than approximately six feet the use of a drill rig and split spoon samples will usually be necessary. In some situations, sample locations are accessed with the use of a backhoe.

3.0 MATERIALS/EQUIPMENT

a. A work plan which outlines soil sampling requirements.

b. Field notebook, field form(s), maps, chain-of-custody forms, and custody seals.

c. Decontamination supplies (including: non-phosphate, laboratory grade detergent, buckets, brushes, potable water, distilled water, regulatory-required reagents, aluminum foil, plastic sheeting, etc.).

d. Sampling device (split-spoon sampler, stainless steel hand auger, stainless steel trowel, etc.).

e. Stainless steel spoons or spatulas.

f. Disposable sampling gloves.

g. Laboratory-supplied sample containers with labels.

h. Cooler with blue or wet ice.

i. Plastic sheeting.

j. Black pen and indelible marker.

k. Zip-lock bags and packing material.

l. Tape measure.

m. Paper towels or clean rags.

n. Masking and packing tape.

o. Overnight (express) mail forms.

4.0 DECONTAMINATION

All reusable sampling equipment will be thoroughly cleaned according to the decontamination SOP. Where possible, thoroughly pre-cleaned and wrapped sampling equipment should be used and dedicated to individual sampling locations. Disposable items such as sampling gloves, aluminum foil, and plastic sheeting will be changed after each use and discarded in an appropriate manner.

5.0 PROCEDURE

5.1 Prior to collecting soil samples, ensure that all sampling equipment has been thoroughly cleaned according to the decontamination SOP. If samples are to be collected at depth, then the boring must be advanced with thoroughly cleaned equipment to the desired sampling horizon and a different thoroughly cleaned sampler must be used to collect the sample.

5.2 Using disposable gloves and a pre-cleaned, stainless steel spatula or spoon, extract the soil sample from the sampler, measure the recovery, and separate the wash from the true sample. Where allowed by regulatory agency(ies), disposable plastic spoons may be used.

5.3 Place the sample in a laboratory-supplied, pre-cleaned sample container. This should be done as quickly as possible and this is especially important when sampling for volatile organic compounds (VOCs). Samples to be analyzed for VOCs must be collected prior to other constituents.

5.4 The sample container will be labeled with appropriate information such as, client name, site location, sample identification (location, depth, etc.), date and time of collection, and sampler's initials.

5.5 Using the remaining portion of soil from the sampler, log the sample in detail and record sediment characteristics (color, odor, moisture, texture, density, consistency, organic content, layering, grain size, etc.).

5.6 If soil samples are to be composited in the field, then equal portions from selected locations will be placed on a clean plastic sheet and homogenized. Alternately, several samples may be submitted to the laboratory for compositing by weight. The method used is dependent upon regulatory requirements. Specific compositing procedures shall be approved by the appropriate regulatory agency and described in the work plan. Samples to be analyzed for VOCs will not be composited unless required by a regulatory agency.

5.7 After the sample has been collected, labeled, and logged in detail, it is placed in a zip-lock bag and stored in a cooler at 4°C.

5.8 A chain-of-custody form is completed for all samples collected. One copy is retained and two are sent with the samples in a zip-lock bag to the laboratory. A custody seal is placed on the cooler prior to shipment.

5.9 Samples collected from Monday to Friday are to be delivered to the laboratory within 24 hours of collection. If Saturday delivery is unavailable, samples collected on Friday must be delivered by Monday morning. Check the work plan to determine if any analytes require a shorter delivery time.

5.10 The field notebook and appropriate forms should include, but not be limited to the following: client name, site location, sample location, sample depth, sample identification, date and time collected, sampler's name, method of sample collection, number and type of containers, geologic description of material, description of decontamination procedures, etc. A site map should be prepared with exact measurements to each sample location in case follow-up sampling is necessary.

5.11 All reusable sampling equipment must be thoroughly cleaned in accordance with the decontamination SOP. Following the final decontamination (after all samples are collected) the sampling equipment is wrapped in aluminum foil. Discard any gloves, foil, plastic, etc. in an appropriate manner that is consistent with site conditions.

END OF PROCEDURE

Date: May 5, 2000

1.0 PURPOSE

The purpose for this standard operating procedure (SOP) is to establish the guidelines for decontamination of all field equipment potentially exposed to contamination during drilling, and soil and water sampling. The objective of decontamination is to ensure that all drilling, and soil-sampling and water-sampling equipment is decontaminated (free of potential contaminants): 1) prior to being brought onsite to avoid the introduction of potential contaminants to the site; 2) between drilling and sampling events/activities onsite to eliminate the potential for cross-contamination between boreholes and/or wells; and 3) prior to the removal of equipment from the site to prevent the transportation of potentially contaminated equipment offsite.

In considering decontamination procedures, state and federal regulatory agency requirements must be considered because of potential variability between state and federal requirements and because of variability in the requirements of individual states. Decontamination procedures must be in compliance with state and/or federal protocols in order that regulatory agency(ies) scrutiny of the procedures and data collected do not result in non acceptance (invalidation) of the work undertaken and data collected.

2.0 PROCEDURE FOR DRILLING EQUIPMENT

The following is a minimum decontamination procedure for drilling equipment. Drilling equipment decontamination procedures, especially any variation from the method itemized below, will be documented on an appropriate field form or in the field notebook.

2.1 The rig and all associated equipment should be properly decontaminated by the contractor before arriving at the test site.

2.2 The augers, drilling casings, rods, samplers, tools, rig, and any piece of equipment that can come in contact (directly or indirectly) with the soil, will be steam cleaned onsite prior to set up for drilling to ensure proper decontamination.

2.3 The same steam cleaning procedures will be followed between boreholes (at a fixed on-site location[s], if appropriate) and before leaving the site at the end of the study.

2.4 All on-site steam cleaning (decontamination) activities will be monitored and documented by a member(s) of the staff of Roux Associates, Inc.

2.5 If drilling activities are conducted in the presence of thick, sticky oils (e.g., PCBs) which coat drilling equipment, then special decontamination procedures may have to be utilized before steam cleaning (e.g., hexane scrub and wash).

2.6 Containment of decontamination fluids may be necessary (e.g., rinseate from steam cleaning) or will be required (e.g., hexane), and disposal must be in accordance with state and/or federal procedures.

3.0 PROCEDURE FOR SOIL-SAMPLING EQUIPMENT

The following is a minimum decontamination procedure for soil-sampling equipment (e.g., split spoons, stainless-steel spatulas). Soil-sampling equipment decontamination procedures, especially any variation from the method itemized below, will be documented on an appropriate field form or in the field notebook.

3.1 Wear disposable gloves while cleaning equipment to avoid cross-contamination and change gloves as needed.

3.2 Steam clean the sampler or rinse with potable water. If soil-sampling activities are conducted in the presence of thick, sticky oils (e.g., PCBs) which coat sampling equipment, then special decontamination procedures may have to be utilized before steam cleaning and washing in detergent solution (e.g., hexane scrub and wash).

3.3 Prepare a non-phosphate, laboratory-grade detergent solution and distilled or potable water in a clean bucket.

3.4 Disassemble the sampler, as necessary and immerse all parts and other sampling equipment in the solution.

3.5 Scrub all equipment in the bucket with a brush to remove any adhering particles.

3.6 Rinse all equipment with copious amounts of potable water followed by distilled or deionized water.

3.7 Place clean equipment on a clean plastic sheet (e.g., polyethylene)

3.8 Reassemble the cleaned sampler, as necessary.

3.9 Transfer the sampler to the driller (or helper) making sure that this individual is also wearing clean gloves, or wrap the equipment with a suitable material (e.g., plastic bag, aluminum foil.

As part of the decontamination procedure for soil-sampling equipment, state and/or federal protocols must be considered. These may require procedures above those specified as minimum for Roux Associates, Inc., such as the use of nitric acid, acetone, etc. Furthermore, the containment and proper disposal of decontamination fluids must be considered with respect to regulatory agency(ies) requirements.

4.0 PROCEDURE FOR WATER-SAMPLING EQUIPMENT

The following is a decontamination procedure for water-sampling equipment (e.g., bailers, pumps). Water-sampling equipment decontamination procedures, especially any variation from the method itemized below, will be documented on an appropriate field form or in the field notebook.

4.1 Decontamination procedures for bailers follow:

a. Wear disposable gloves while cleaning bailer to avoid cross-contamination and change gloves as needed.

b. Prepare a non-phosphate, laboratory-grade detergent solution and potable water in a bucket.

c. Disassemble bailer (if applicable) and discard cord in an appropriate manner, and scrub each part of the bailer with a brush and solution.

d. Rinse with potable water and reassemble bailer.

e. Rinse with copious amounts of distilled or deionized water.

f. Air dry.

g. Wrap equipment with a suitable material (e.g., clean plastic bag, aluminum foil).

h. Rinse bailer at least three times with distilled or deionized water before use.

4.2 Decontamination procedures for pumps follow:

a. Wear disposable gloves while cleaning pump to avoid cross-contamination and change gloves as needed.

b. Prepare a non-phosphate, laboratory-grade detergent solution and potable water in a clean bucket, clean garbage can, or clean 55-gallon drum.

c. Flush the pump and discharge hose (if not disposable) with the detergent solution, and discard disposable tubing and/or cord in an appropriate manner.

d. Flush the pump and discharge hose (if not disposable) with potable water.

e. Place the pump on clear plastic sheeting.

f. Wipe any pump-related equipment (e.g., electrical lines, cables, discharge hose) that entered the well with a clean cloth and detergent solution, and rinse or wipe with a clean cloth and potable water.

g. Air dry.

h. Wrap equipment with a suitable material (e.g., clean plastic bag).

As part of the decontamination procedure for water-sampling equipment, state and/or federal protocols must be considered. These may require procedures above those specified as minimum for Roux Associates, Inc., such as the use of nitric acid, acetone, etc. Furthermore, the containment and proper disposal of decontamination fluids must be considered with respect to regulatory agency(ies) requirements.

STANDARD OPERATING PROCEDURE 10.3 FOR SOIL BORING AND/OR MONITORING OR OBSERVATION WELL DRILLING, FORMATION SAMPLING AND BOREHOLE ABANDONMENT IN UNCONSOLIDATED FORMATIONS

Date: May 5, 2000

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe the considerations and procedures, and to establish the guidelines for drilling (soil borings, wells, or piezometers) and formation sampling activities in unconsolidated formations. There are several drilling techniques available which include hollow-stem auger, cable tool, hydraulic rotary, cased-hole rotary, and air rotary. Formation (sediment/soil) sample collection include disturbed (drill cuttings), intact (split-spoon), and undisturbed (Shelby-tube or Denison-core). Borehole abandonment (closure) procedures will also be addressed in this SOP.

The objective of drilling is to collect accurate subsurface information and to prepare a borehole for potential completion as a well or piezometer. Consequently, the lithologic data is the all important, most essential information that can be collected. The lithologic data characterizes subsurface conditions, describes hydrogeologic coefficients qualitatively and/or quantitatively, and identifies optimum locations for screen zones if wells are constructed.

Data can be obtained through the physical examination and testing of formation samples, as well as knowledge regarding ground-water levels. Thus, drill fluid mix, fluid loss, rate of drilling, lengths of split-spoon and Shelby-tube/Denison-core recovery, etc. must be monitored by the on-site hydrogeologist or geologist.

2.0 DRILLING TECHNIQUE-SELECTION

Verify that the drilling technique is the one specified in the investigation work plan, and that the drilling equipment mobilized by the driller is in good condition and proper working order. Do not permit the driller to use a drilling rig that appears to be substandard, in disrepair, etc., and/or is questionable as to whether or not the rig has the capabilities to accomplish the goals of the drilling program. The drilling rig must be capable of:

a. Penetration of all anticipated subsurface materials and formations at a desired rate, and construction of a borehole of desired diameter (for the anticipated well, if applicable, including the placement of a gravel or sand pack through a tremie pipe and necessary formation sealing material such as bentonite or cement).

b. Identification of lithology for development of a geologic log of all unconsolidated formations and materials penetrated, including physical characteristics and visual description of color, grain sizes, sorting and mineralogy.

c. Collection of samples of aquifer fluids during the drilling process and prior to well construction, while at the same time minimizing potential for cross-contamination. The method used should prevent cross-contamination between surface soils and ground water or between different hydrogeologic units.

d. Collection of intact and/or undisturbed soil samples from the center line or sidewall of the borehole. This objective requires the drilling to be halted while soil samples are taken from the bottom or side of the incomplete borehole.

e. Completion of the borehole into a well (monitoring or observation) or piezometer during the initial construction process (i.e., constructing a well or piezometer as the borehole is drilled, or constructing a well or piezometer in the borehole immediately after the drilling tools are removed).

f. Implementation of borehole geophysical logging (when applicable and possible) to enable more accurate vertical and horizontal extrapolation of borehole data to the lithology of the hydrogeologic system.

g. Completion of a well or piezometer, if applicable, in the borehole following a time lapse for interpretation of geologic or geophysical data from the borehole.

3.0 DRILLING TECHNIQUE - DESCRIPTION

3.1 Hollow-Stem Auger - This drilling method is rapid and extremely effective in most cohesive sediments but less so in loose sandy material. Penetration may be up to 150 feet below land surface (bls) depending on the size of the rig, drilling conditions, and the diameter of the auger flight; however, depths up to 250 feet bls have been achieved under compatible conditions. A major advantage of this technique is that normally no fluids are introduced into the formation. If the auger flights can be removed and the integrity of the borehole maintained, then electrical and radiation (e.g., gamma, neutron, etc.) geophysical logs can be run. If the auger flights must remain in the borehole, then only radiation geophysical logs can be run. Casing, screen, and sampling devices can then be lowered through the hollow stem by removing the removable plug at the bottom of the auger flights, and gravel packing and cementing can be accomplished within the hollow stem. However, this can be difficult especially below the water table. Auger flight outside diameters (OD) range from 5 inches (in.) to 12 in. The diameter of a well that can be constructed inside the hollow stem is limited, however, to about 4 in.

3.2 Cable Tool (Percussion) - This drilling method is slow because the borehole is advanced by lifting and dropping a heavy string of drilling tools. Cuttings accumulate in the drill casing and are removed by a sand bailer. A steel casing is driven in as the hole is deepened. Cable-tool rigs can be used in unconsolidated sediment and bedrock to depths of hundreds or thousands of feet and often employ telescoping techniques for drilling deep boreholes. Electrical geophysical logs cannot be run through the steel cased borehole, but radiation logs (e.g., gamma, neutron, etc.) can be run. Well casing and screen can be installed within the cased hole after which the outer casing is pulled back (removed). Because the boring is cased as it is being drilled, cross-contamination between various depths is practically eliminated. The method provides an excellent means to collect good, representative formation samples.

3.3 Hydraulic Rotary - This drilling method uses a rotating bit to drill (advance) the borehole. Drill cuttings are removed using a recirculating drilling fluid (mud or water). Although setting up the drilling equipment is slow, the drilling process is reasonably fast. In the mud-rotary method, drilling mud forms a cake on the borehole wall which prevents excessive loss of fluid to the formation being drilled. The hydrostatic pressure combined with the weight and density of the mud slurry keeps the hole open. This allows the drill rods to be removed from the borehole and geophysical logs (electric and radiation) to be run in the open borehole.

In reverse hydraulic rotary drilling, the drilling fluid moves downward through annular space and then upward inside the drill pipe. If the drilling fluid does not contain mud, then sufficient water flow is required as make-up water because the borehole wall is not sealed; therefore, significant water loss can occur to the formation being drilled. The borehole is held open by hydrostatic pressure only. A serious obstacle to this drilling method occurs when the static water level is less than 15 feet below land surface because of insufficient hydrostatic head difference between the borehole and the water table. However, the problems of excessive water loss and shallow depths to water may be overcome by using mud as the drilling fluid.

In mud-rotary drilling, the drilling fluid (mud) moves downward through the drill pipe and then upward through the annular space. Therefore, the borehole is held open by hydrostatic pressure and the mud cake lining the wall of the borehole. The mud-rotary method can be used to construct moderate to deep wells in unconsolidated (and consolidated material), while the reverse rotary technique can be used to construct moderate to deep wells in unconsolidated materials. The principal disadvantage may be the difficulty in removing mud cake from the formation at the screened zone. Extensive well development may be required to remove the mud cake.

3.4 Cased-Hole Rotary - Several new rotary drilling techniques have been developed in which a steel casing is advanced with an air-rotary or mud-rotary drill. This technique is highly desirable for use in exploratory drilling at monitoring sites because water and soil samples may be collected under conditions which preclude contamination from shallower depths. Furthermore, this technique is extremely effective in boulder or cavernous zones which would inhibit or preclude drilling using other techniques. Drilling results are comparable to cable-tool drilling but with greatly enhanced speeds. In all the cased-hole techniques, the main benefit is that the only portion of the borehole which is open, is at the bottom of the drill casing; thus, no soil or water from shallower depths can move down and impact the depth drilled and/or sampled. Electrical geophysical logs cannot be run through the steel-cased borehole, however, radiation logs (e.g., gamma, neutron, etc.) can be run.

Presently, there are three cased-hole rotary techniques which include:

a. The drill-thru casing hammer technique in which the casing is advanced by percussion with a casing hammer or vibratory driver similar to the method used in a borehole drilled by the air-rotary method. The casing hammer can also pull out the casing (air drilling only).

b. The Odex™ Drilling System (European system) which "pulls" the casing using a fixture attached to an air-hammer type drill bit (air drilling only).

c. The Barber™ Drilling System in which drilling is done with a top-head drive and a rotary table that spins casing into the ground. Casing can be fitted with a carbide "shoe" to cut boulders and an air hammer can be used above the bit. Air or mud rotary can be used to lift cuttings.

Two potential problems may be encountered using the cased-hole rotary technique which include: 1) "sand heave" when drilling stops (which can be quickly drilled or bailed out) and 2) possible aeration of water in the cased borehole if volatiles are being tested (which can be overcome by pumping or bailing the standing water out before sampling). The minimum drill casing diameter is 6 inches and depth is limited to approximately 450 feet.

3.5 Air Rotary - This drilling method uses a rotating bit to drill, and high-velocity compressed air to remove cuttings from the borehole. A pneumatic down-hole hammer is often used to add percussion to the rotary drilling action. This drilling method is very fast and, although it is most suitable for penetrating hard bedrock, it can be used in unconsolidated formations. The borehole may be cased or uncased depending on geologic conditions. If an open borehole is drilled, then electrical and radiation (e.g., gamma, neutron, etc.) geophysical logs can be run. If a cased borehole is drilled, then only radiation geophysical logs can be run.

Four potential problems may be encountered when using the air-rotary technique:

a. When a prolific aquifer is tapped, the compressed air may not be able to lift the water to the surface.

b. Aeration of water in the borehole (and finished well) immediately prior to sampling can interfere with a number of inorganic and organic water-quality parameters.

c. Low yield water entry zones may not be identified because the air pressure prevents water from entering the borehole. Care should be taken to prevent overdrilling of the borehole.

d. Air rotary drilling can induce the migration of volatile organics to the surface or adjacent structures causing potential aesthetic or health and safety concerns.

If the air-rotary technique is used then the following special procedures will be implemented:

a. The type of air compressor and lubricating oil will be documented on an appropriate field form and in the field notebook and a 1-pint sample of the oil will be retained for characterization in the event organic compounds are detected in a well sample.

b. An air line oil filter will be required and changed per manufacturer's recommendations during operation with documentation of this maintenance on an appropriate field form and in the field notebook. More frequent oil filter changes will be made if oil is visibly detected in the filtered air.

c. The use of any additive will be prohibited, except approved water (e.g., potable water) for dust control and cuttings removal.

4.0 DECONTAMINATION

Drilling equipment decontamination procedures are outlined in the field equipment decontamination SOP. Proper decontamination in accordance with regulatory guidelines must be clearly documented in the field notebook.

5.0 PROCEDURE FOR DRILLING

5.1 Document all drilling-related activities (e.g., starting, stopping, footage, problems, decontamination, etc.) on the daily log form and in the field notebook. Record dates and times of activities, and names of Roux Associates personnel providing oversight.

5.2 Monitor and record drill fluid mix, speed of rotation, pressure on the drill fluid, rate of drilling, and length of drill rods or casing in the borehole.

5.3 Confirm that the drill rods and core barrel are straight, or discontinue drilling.

5.4 Pay particular attention to the advancement of the boring because differences in the rate of drilling may be indicative of differences in subsurface geologic conditions (e.g., sand and gravel versus clay).

5.5 Maintain a continuous dialogue with the driller to track and keep informed of all drilling activities (e.g., the speed of the drill and drilling pressure, difficult and easy drilling conditions, etc.).

5.6 Collect formation samples as described below in Section 6.0. Sample jars must be labeled appropriately (e.g., project number and name, site location, boring number, date, sample interval, blow counts, and initials of Roux Associates personnel collecting sample).

5.7 Record geologic information in the geologic log form and in the field notebook.

5.8 Handle and ship split-spoon sample jars carefully to avoid breakage and handle and ship tubes or cores carefully to prevent disturbance.

6.0 PROCEDURE FOR FORMATION SAMPLING

6.1 Intact formation sampling will be implemented using split-spoon samplers (which are driven), Shelby-tube samplers (which are pushed), or Denison-core samplers (which are rotated) depending on the drilling technique employed. Formation samples will be retained in suitable size (e.g., 1-pint or 0.5-pint) jars for physical descriptions and potential physical and chemical analysis. The appropriately labeled jars and tubes will be stored in a safe place to avoid breakage, agitation, and freezing. Intact formation samples will be collected as described in the work plan at specified intervals (e.g., at 5-foot increments below land surface) and at each major change in subsurface materials. Hydrogeologic information will be recorded on a geologic log form and in the field notebook. Detailed descriptions of the type(s) of intact sample(s) collected, sampling intervals and conditions, and objective(s) of the sample collection will be provided in the work plan.

6.2 Disturbed formation samples (drill cuttings) will be examined continuously throughout the entire depth of the borehole. If applicable to the study and/or stated in the work plan, borehole cuttings will be collected from the circulating auger flights which lift cuttings to land surface (hollow-stem auger technique), from the sand bailer (cable-tool technique), from the recirculating drilling fluid (mudflume) which transports cuttings to land surface (mud-rotary and related techniques), or from the compressed air used to carry cuttings to land surface (air-rotary and related techniques). Formation samples will be retained in appropriate size (e.g., 1-pint or 0.5-pint), properly labeled jars and stored in a safe place to avoid breakage, agitation, and freezing. Hydrogeologic data will be recorded on a geologic log form and in the field notebook.

6.3 The soil cores from the wells drilled at the site are used for lithologic identification. The first 18 inches of soil for each borehole will be collected intact using a split-spoon sample, Shelby-tube sampler, or Denison-core sampler. Split-spoon samples may be collected continuously from boreholes for cluster wells; single well and/or piezometer boreholes may be split-spooned throughout drilling or at specified intervals or changes in lithology. The conditions for sampling will be specified in the work plan.

6.4 Before collecting and retaining soil and/or sediments collected with the split-spoon sampler, the top several inches will be removed from the sampler and discarded to eliminate any sediment that may have caved into the bottom of the borehole.

6.5 Sediment sampling equipment such as split-spoon samplers, spatulas, etc. (but not including Shelby-tube or Denison-core samplers, which area not re-usable) will be decontaminated by steam cleaning and/or a non-phosphate, laboratory-grade and distilled/deionized wash followed by a distilled/deionized water rinse. (Refer to the SOP for Decontamination of Field Equipment for a detailed description of minimum and special decontamination procedures.) Decontamination of sediment sampling equipment will take place prior to the collection of the first sample and following the collection of each subsequent sample.

7.0 BOREHOLE ABANDONMENT OR CLOSURE

7.1 Upon the completion of the investigation, a determination will be made as whether to maintain the borehole (for a well or piezometer) or to close it (i.e., abandon and seal it). If the client and Roux Associates agree to abandon the borehole, then the state will be notified and a request will be presented for borehole abandonment. Upon state approval to seal the borehole, appropriate state borehole abandonment forms will be completed, if required. Following state approval, the abandonment of any borehole (or boring) will be in accordance with local, state and/or Federal regulations.

7.2 For each abandoned borehole, the procedure will be documented on an appropriate field form or in the study notebook. Documentation may include, where appropriate, the following:

a. Borehole designation.

b. Location with respect to the replacement borehole, if replaced (e.g., 30 ft north and 40 ft west of Borehole B-1). A location sketch should be prepared.

c. Open depth prior to grouting and any other relevant circumstances (e.g., formation collapse).

d. Drill casing left in the borehole by depth, size, and composition.

e. A copy of the geologic log.

f. A revised diagram of the abandoned borehole using a supplemental geologic log form.

g. Additional items left in hole by depth, description, and composition (e.g., lost tools, bailers, etc.).

h. A description and daily quantities of grout used to compensate for settlement.

i. The date of grouting.

j. The level of water or mud prior to grouting and the date and time measured.

k. Any other state or local well abandonment reporting requirements.

END OF PROCEDURE

APPENDIX B

TestAmerica Chain of Custody Form

TestAmerica
ANALYTICAL TESTING CORPORATION

CHAIN OF CUSTODY RECORD

☐ Nashville, TN ☐ Dayton, OH ☐ Indianapolis, IN
☐ Orlando, FL ☐ Watertown, WI
☐ Cedar Falls, IA ☐ Pontiac, MI

To assist us in using the proper analytical methods, is this work being conducted for regulatory purposes?

Compliance Monitoring? Yes No

Enforcement Action? Yes No

Client Name/Account #: ______

Address: ______

City/State/Zip: ______

Project Manager: ______

Telephone Number: ______ **Fax No.:** ______

Sampler Name: (Print) ______

Sampler Signature: ______

Report To: ______

Invoice To: ______

TA Quote #: ______

Project ID: ______

Project #: ______

							Preservative								Matrix						Analyze For:														
Sample ID / Description	Date Sampled	Time Sampled	No. of Containers Shipped	Grab	Composite	Field Filtered	Ice	HNO_3 (Red Label)	HCl (Blue Label)	NaOH (Orange Label)	H_2SO_4 Plastic (Yellow Label)	H_2SO_4 Glass(Yellow Label)	None (Black Label)	Other (Specify)	Groundwater	Wastewater	Drinking Water	Sludge	Soil	Other (specify):												**RUSH TAT (Pre-Schedule)**	Standard TAT	Fax Results	Send QC with report

Special Instructions:

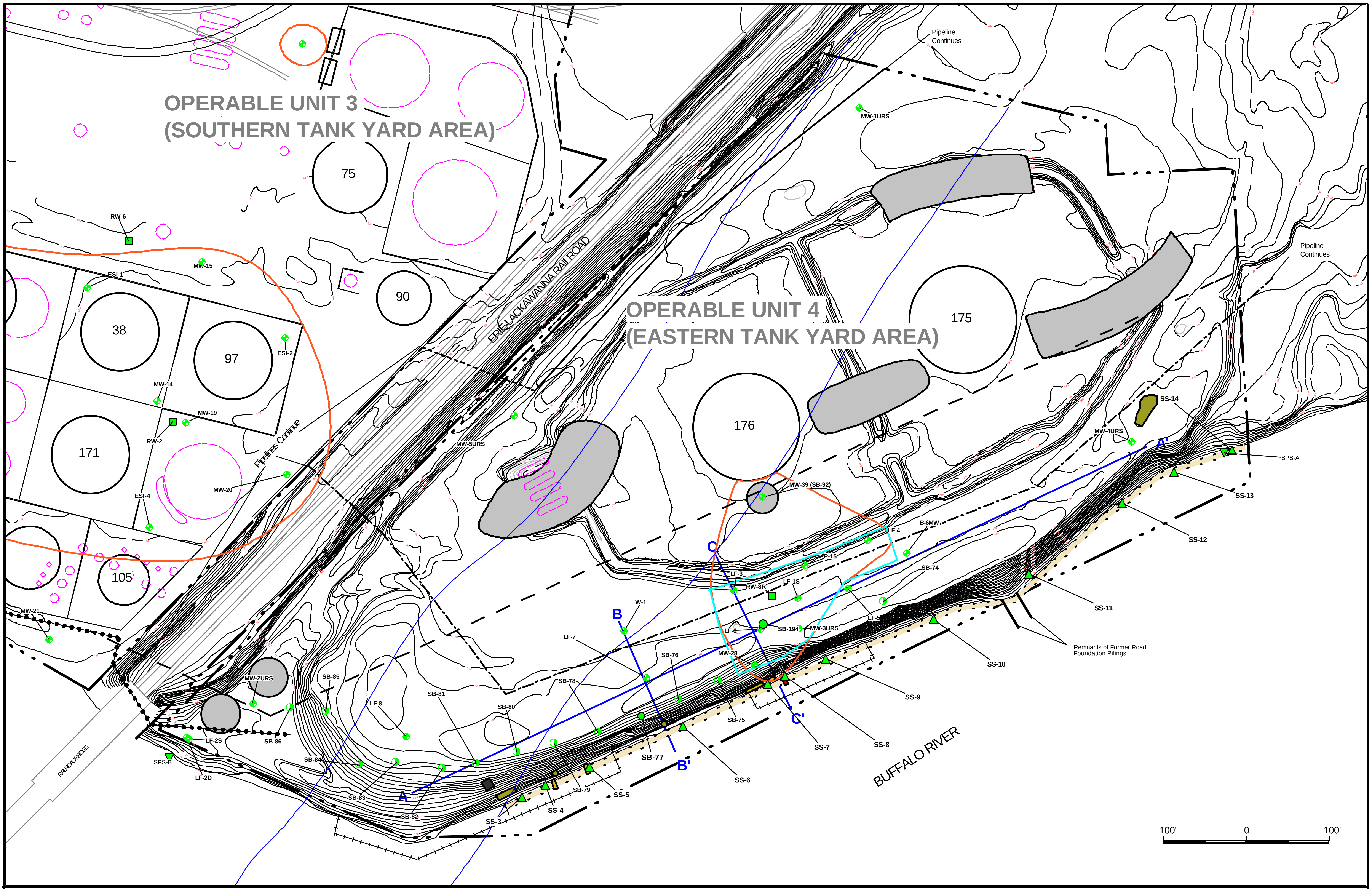
Method of Shipment: FEDEX

Relinquished by:	Date	Time	Received by:	Date	Time
Relinquished by:	Date	Time	Received by TestAmerica:	Date	Time

Laboratory Comments:

Temperature Upon Receipt:

VOCs Free of Headspace? Y N



LEGEND

◐	EXISTING SOIL BORING/ MONITORING WELL
●	EXISTING MONITORING WELL
🟩	EXISTING RECOVERY WELL
●	EXISTING SOIL BORING LOCATION
▽	PHASE II INVESTIGATION SEDIMENT SAMPLE LOCATION
▲	APRIL 2001 SEDIMENT SAMPLE LOCATION
☐	PROPOSED CHEMOX IRM IMPLEMENTATION AREA (SEE PLATE 2 FOR ADDITIONAL DETAIL)
A——A'	LOCATION OF HYDROGEOLOGIC CROSS SECTIONS A-A', B-B' AND C-C' (LOCATION OF D-D' IN THE CHEMOX IRM AREA IS SHOWN ON PLATE 2 FOR CLARITY)
••••••••	WELL POINT SYSTEM
🟨	AREAS OF PRODUCT/IRON STAINING (proportions exaggerated for clarity)
🟥	AREA OF PRODUCT SEEPAGE OBSERVED ON OCTOBER 26, 2000 (proportions exaggerated for clarity)
▨	LIMITS OF SHORELINE INSPECTED IN OCTOBER 2000 AND JUNE 2003 (width exaggerated for clarity)
——	LIMITS OF CURRENT/HISTORICAL SEPARATE-PHASE PRODUCT OBSERVED IN MONITORING WELLS
┼┼┼┼┼	LIMITS OF CONTAINMENT BOOM (proportions exaggerated for clarity)
●	HISTORICAL WASTE HANDLING AREAS
■	DRUM REMNANTS (proportions exaggerated for clarity)
■	ASPHALT MATERIAL (proportions exaggerated for clarity)
——	APPROXIMATE COURSE OF FORMER BUFFALO RIVER CHANNEL
— — — —	EXXONMOBIL OIL CORP.'S FORMER ABANDONED BURIED PRODUCT PIPELINE (CURRENTLY OWNED BY BUCKEYE TERMINALS LLC) (Line purged and abandoned in place)
- - - - - -	EXXON MOBIL OIL CORP.'S FORMER ACTIVE BURIED PRODUCT PIPELINE (CURRENTLY OWNED BY BUCKEYE TERMINALS LLC)
———	EXXONMOBIL OIL CORP.'S FORMER ACTIVE ABOVEGROUND PRODUCT PIPELINE (CURRENTLY OWNED BY BUCKEYE TERMINALS LLC)
—·—·—	LAKEHEAD PIPELINE CO.'S, BURIED PRODUCT PIPELINE (Line reportedly purged and filled with nitrogen in 1982)
——·· · ——	APPROXIMATE FORMER EXXONMOBIL (CURRENT BUCKEYE TERMINALS, LLC) PROPERTY LINE AND OU-4 BOUNDARY

NOTE:

THIS DRAWING ONLY SHOWS EXISTING MONITORING WELLS AND SOIL BORINGS. COMPONENTS OF THE CHEMOX PILOT TEST AND PROPOSED FULL SCALE CHEMOX IRM SYSTEM, INCLUDING INJECTION WELLS AND MONITORING WELLS, ARE SHOWN ON PLATE 2.

N

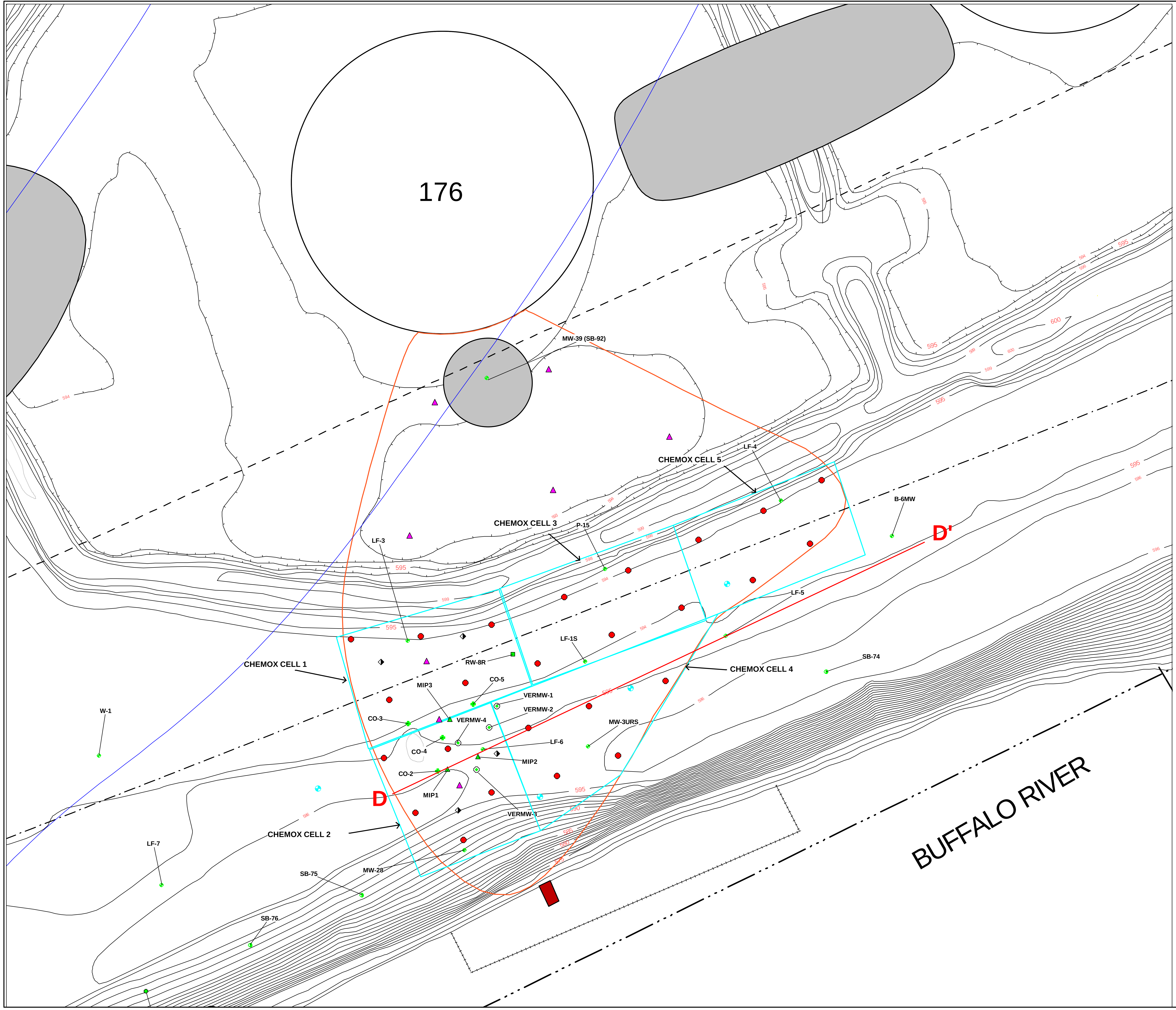
Title:

OU-4 SITE LOCATION PLAN

Prepared For:

EXXONMOBIL OIL CORPORATION

REMEDIAL ENGINEERING, P.C. 209 Shafter Street Islandia, New York 11479	Compiled by: NC	Date: 07/27/06	PLATE 1
	Prepared by: NC	Scale: AS SHOWN	
	Project Mgr: NC	Office: NY	
	File No: MC5230401.WOR	Project: 17252Y08	

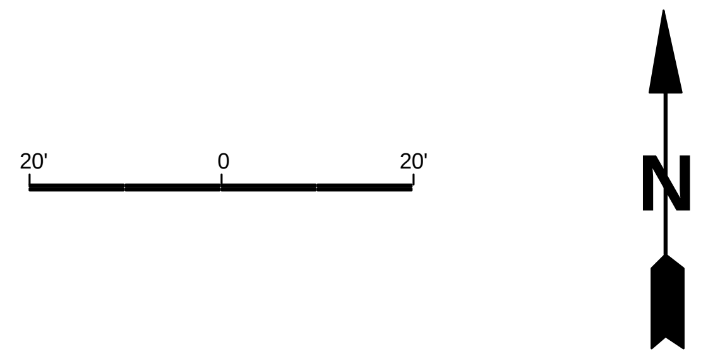


LEGEND

●	PROPSOED NESTED CHEMOX INJECTION WELL (ONE OZONE AND ONE HYDROGEN PEROXIDE POINT)
◆	PROPSOED SUPPLEMENTAL HYDROGEN PEROXIDE INJECTION WELL (ONE HYDROGEN PEROXIDE POINT JUST BELOW THE WATER TABLE)
▲	PROPOSED MEMBRANE INTERFACE PROBE LOCATION
⊕	PROPOSED CHEMOX GROUNDWATER OBSERVATION WELL
✚	EXISTING CHEMOX PILOT TEST NESTED INJECTION WELL (ONE OZONE AND ONE HYDROGEN PEROXIDE POINT). EXISTING PEROXIDE INJECTION POINTS CO-2, CO-3, CO-4 AND CO-5 TO BE USED DURING FULL SCALE OPERATION
▲	EXISTING MEMBRANE INTERFACE PROBE LOCATION
⊙	EXISTING PILOT TEST OBSERVATION WELL
■	EXISTING RECOVERY WELL
⊕	EXISTING MONITORING WELL
◐	EXISTING SOIL BORING/ MONITORING WELL
▭	PROPOSED CHEMOX CELL BOUNDARY
D —— D'	LOCATION OF HYDROGEOLOGIC CROSS SECTION D-D' THROUGH THE CHEMOX IRM TARGET AREA
●	HISTORICAL WASTE HANDLING AREAS
┼┼┼┼┼┼	LIMITS OF SORBENT BOOM (proportions exaggerated for clarity)
■	AREA OF PRODUCT SEEPAGE OBSERVED ON OCTOBER 26, 2000 (proportions exaggerated for clarity)
▭	LIMIT OF CURRENT AND HISTORICAL SEPARATE-PHASE PRODUCT OBSERVED IN MONITORING WELLS
——	APPROXIMATE COURSE OF FORMER BUFFALO RIVER CHANNEL
	CHEMOX = CHEMICAL OXIDATION
— — — —	EXXONMOBIL OIL CORP.'S FORMER ABANDONED BURIED PRODUCT PIPELINE (CURRENTLY OWNED BY BUCKEYE TERMINALS LLC) (Line purged and abandoned in place)
—·—·—·—	LAKEHEAD PIPELINE CO.'S, BURIED PRODUCT PIPELINE (Line reportedly purged and filled with nitrogen in 1982)
—— · · · —— · · · —	APPROXIMATE FORMER EXXONMOBIL (CURRENT BUCKEYE PIPELINE, LLC) PROPERTY LINE AND OU-4 BOUNDARY

NOTES:

1. PILOT TEST CHEMICAL OXIDATION WELL C0-1 HAD BEEN LOCATED IN CHEMOX CELL 2. DURING THE PILOT TEST, IT WAS DISCOVERED THAT THE WELL WAS INOPERABLE DUE TO A BLOCKAGE IN THE HYDROGEN PEROXIDE POINT. THIS WELL WILL NOT BE USED DURING FULL SCALE CHEMOX SYSTEM OPERATION AND IS NOT SHOWN FOR CLARITY.



Title:

PROPOSED IRM CHEMICAL OXIDATION SYSTEM AND MONITORING NETWORK LAYOUT

Prepared For:

EXXONMOBIL OIL CORPORATION

REMEDIAL ENGINEERING, P.C.
209 Shafter Street
Islandia, New York 11479

Compiled by: N.C.	Date: 7/27/06	PLATE
Prepared by: N.C.	Scale: AS SHOWN	2
Project Mgr: N.C.	Office: N.Y.	
File No: MC5230402.WOR	Project: 17252Y08	