Revised Remedial Action Work Plan

Cold Springs Terminals, NYSDEC Spill No. 89-04923

Southern Terminals Group

September 09, 2021, Revised: May 23, 2022

→ **The Power of Commitment**

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Certifications

I, Damian J. Vanetti, certify that I am currently a NYS registered professional engineer and that this Remedial Action Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

068011	May 23, 2022	
NYS Professional Engineer #	Date	Signature

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1. Introduction

The Cold Springs Terminal (CST) properties located along Hillside Road in the Town of Lysander, Onondaga County, New York are the subject of two Consent Orders executed by the New York State Department of Environmental Conservation (NYSDEC). A Consent Order to address light non-aqueous phase liquid (LNAPL) petroleum contamination was entered into by the Respondents, former operators of the Southern Terminals (ST) and collectively referred to as the Southern Terminals Group (STG), and executed on August 25, 2016 (Spill Number 8904923, DEC Case No. 12-1111-A-SBC, and Site No. S734146) (the “STG Consent Order”). A separate Consent Order to address dissolved phase groundwater and soil petroleum contamination and other matters, was entered into by Buckeye Pipe Line Company, L.P. and BP Products North America Inc. and executed by the NYSDEC on October 19, 2017 (DEC Case No. 12-1111-A-SBC-2017) (the “Northern Terminal [NT] Consent Order”).

The CST is comprised of three former Petroleum Bulk Storage (PBS) facilities occupying a total of approximately 6 acres of land. The NT is north of Hillside Road. The ST is south of Hillside Road and is subdivided into the southeastern terminal and the southwestern terminal, as shown in Figures 1 and 2.

Aboveground storage tanks (ASTs) and portions of their associated aboveground piping were previously removed from the ST by the property owners and/or their contractors in 2017. As a result, the ST currently consists of deteriorated asphalt pavement, dilapidated office buildings (one on the western end and two on the eastern end), and three petroleum transport truck loading racks along Hillside Road. South of these features and north of the Seneca River, the ST currently consists of two containment areas, the southeastern terminal, and the southwestern terminal, which are in disrepair, overgrown with vegetation, and contain wet/standing water areas. The entire ST is fenced and is located in an area with residences to the east and west, a cemetery and the NT adjoining to the north, and the Seneca River adjoining to the south.

During their operational histories, the facilities handled gasoline, Jet A fuel, kerosene, diesel, and fuel oil. NYSDEC-mandated environmental activities were initiated following a 1989 spill of an unknown volume of gasoline; however, other spills have been documented. Multiple investigations have occurred at the CST and historical remedial actions at the CST have included manual and automated LNAPL recovery and soil vapor extraction (SVE). These activities were performed adjacent to Hillside Road, beneath the southernmost portion of the NT and in northernmost portion of the ST. Reportedly, over an 18-year period between 1990 and 2008 (prior to the involvement of these Respondents in the remedial activities), an estimated 12,800 gallons of LNAPL was removed from the CST as liquid and soil vapor (GES, 2015).

In compliance with the NYSDEC-approved Supplemental Site Investigation Work Plan, approved under a previous consent order involving these and other respondents who are not part of the STG and who are not subject to the STG Consent Order, AECOM performed various investigations on the CST to determine viability of vacuum-enhanced groundwater extraction (VEGE) and multi-phase extraction (MPE) remedial alternatives to address mobile-phase LNAPL (AECOM, 2014). Based on the results of a pilot test, GES prepared a Remedial Action Work Plan (RAWP) for VEGE (GES, 2015) which was to utilize approximately 40 groundwater extraction points located on the CST to address LNAPL removal and dissolved phase groundwater contamination. When the STG separately settled with the State in 2016, this 2015 conceptual RAWP containing the VEGE model was appended to the STG Consent Order as Exhibit B. In its formal comments, dated October 24, 2016, approving Exhibit B, NYSDEC confirmed that under the STG Consent Order only LNAPL needed to be addressed, in accordance with Paragraph 9 (NYSDEC, 2016). As a result of NYSDEC’s formal acknowledgment that only LNAPL be addressed under the STG Consent Order, STG, with NYSDEC approval, revisited the proposed remedial action and completed further Site assessments, as follows.

– In June 2019 and pursuant to authorization from NYSDEC, GHD performed a limited Monitoring Well Assessment and LNAPL Gauging Event (GHD, 2019). The purpose of GHD's evaluation was to assess current monitoring well network conditions. Only 49 of the 84 anticipated monitoring wells were able to be located. Of those located, four monitoring wells could not be gauged as a result of damage and an additional nine wells were gauged but observed to be in poor condition. Overall, LNAPL was measured in apparent thicknesses varying from approximately 0.01 feet at S5 to 3.48 feet at A10. The apparent extent of LNAPL was generally consistent with historical observations; however, monitoring wells in several areas of historically-observed LNAPL could not be located and/or gauged.

– Subsequently, at the request of NYSDEC, GHD prepared and submitted a Supplemental Investigation Work Plan (SIWP, GHD, October 4, 2019), which outlined the approaches for monitoring well repair/replacement, additional data collection for remedial approach refinement and design, interim LNAPL recovery activities, and preparation of a revised RAWP. NYSDEC approved the SIWP via electronic correspondence on October 9, 2019, and GHD implemented the proposed tasks. A Supplemental Investigation Report (SIR, GHD, April 3, 2020) was prepared by GHD outlining the supplemental activities and the recommended remedial approach and submitted to NYSDEC for review and approval (Appendix A). NYSDEC subsequently approved the SIR on April 20, 2020.

The findings from the supplemental investigations undertaken in 2019 were used to develop a remedial approach limited to addressing LNAPL and fulfilling the STG Consent Order requirements for the CST properties. This revised RAWP outlines the proposed remedial approach.

1.1 Purpose of this Report

GHD has prepared this revised RAWP on behalf of the STG at the request of NYSDEC. The purpose of this revised RAWP is to provide an overview of the CST, a brief summary of historical investigations and findings, a brief summary of historical remedial actions, and a detailed description of the proposed remedial action to address LNAPL present in the subsurface to achieve the obligations of the STG under the STG Consent Order. Once approved by NYSDEC, this Revised RAWP will replace, in its entirety, the previous NYSDEC-approved RAWP (GES, 2015) and will provide for completion of a remedial approach that is consistent with the STG Consent Order, as requested by the NYSDEC.

1.2 Scope and Limitations

This report has been prepared by GHD for the Southern Terminals Group and may only be used and relied on by the Southern Terminals Group for the purpose agreed between GHD and the Southern Terminals Group, as set out in this report.

GHD otherwise disclaims responsibility to any person other than the Southern Terminals Group arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions, and recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions, and recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

The opinions, conclusions, and recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Conditions at other parts of the CST may be different from the conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by particular conditions, such as the location of buildings, services, and vegetation. As a result, not all relevant features and conditions may have been identified in this report.

Conditions (including the presence of hazardous substances and/or contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the CST conditions. GHD is also not responsible for updating this report if the CST conditions change.

GHD has prepared this report on the basis of information provided by the Southern Terminals Group and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

2. Existing Conditions and Previous Activities Summary

2.1 Geology

According to the Finger Lakes Sheet of the Surficial Geologic Map of New York (Muller and others, 1991), the CST is underlain by lacustrine silt and clay, generally characterized by laminated clay and silt, with upland soils north of Hillside Road identified as till. Soil descriptions collected to date from the CST indicate predominately fine-grained soil consisting of heterogeneous interbedded silt, silty sand, and sand with minor gravel lenses, primarily with depth and immediately above the till interface. The heterogeneous unit appears to fine upward from a dense underlying unit (till) with an increase in clay and clay horizons noted in the shallow soils from Hillside Road toward the Seneca River.

Geology is described as largely glacial in the upland area and alluvial in the floodplain of the Seneca River with floodplain sediments being more specifically described as very fine sand and silt grading to silt and clay. These sediments are underlain in the western portion of the CST by a fine sand with little silt. A fine to coarse sand and gravel, generally ranging in thickness from 1 to 4 feet, underlies all of the sediments in the river floodplain, immediately above the glacial till layer. The glacial till layer reportedly intersects the ground surface north of the NT, which is where the shallow glacial deposits ultimately pinch out. Geologic cross sections are included in Attachment 1 and depict findings that are consistent with previous and subsequent investigations conducted at the CST.

AECOM utilized cone penetrometer (CPT) investigation findings in their Pilot Test Summary Report (September 2014) to develop geologic cross sections for the ST, one crossing the approximate middle of the ST from north to south and one crossing the ST from west to east along the southern side of Hillside Road (Attachment 1). The north to south cross section depicts the increase in fine-grained soils with proximity to the Seneca River and the west to east cross section depicts the ST's characteristic fining upwards nature of fine sand to silt with heterogeneous lenses. AECOM's investigation collected 60 soil samples for grain size analysis, of which 49 were classified as silt, 10 were classified as fine sand, and one was classified as medium sand. It was reported that the sands were generally encountered in deeper soil samples and interbedded with silts. These depictions are consistent with findings of previous investigations and current understanding of CST geology.

2.2 Hydrogeology

The saturated alluvial deposits adjacent to the Seneca River comprise the shallow aquifer in the area and overlie the glacial till, which acts as a lower confining layer for the aquifer. This shallow aquifer is the unit of interest with respect to proposed remedial actions. Information obtained from previous investigations indicates that the shallow aquifer pinches out north of the NT, at the same point where the glacial till intersects the ground surface. Numerous groundwater contour and presumed flow direction figures have been presented in historical reports prepared for the CST. An overall summary of groundwater flow conditions (as presented in Figures 10 to 13 in Attachment 1), is as follows:

There is a steep slope on the groundwater north of the river floodplain, indicating flow towards the river. The groundwater gradient flattens as groundwater reaches the river floodplain. Such changes in the groundwater contour pattern indicates the influence of the river and the presence of deeper, high-hydraulic conductivity, sands and gravels.

When the flow gradient goes down in the floodplain (decrease in i), the hydraulic conductivity (K) must go up to maintain balance in the equation. The characteristics of the shallow soil in the floodplain reflect a low hydraulic conductivity and could not accommodate the flow, but the deeper fine to coarse sand and gravel just above the glacial till would have a high hydraulic conductivity and is therefore a viable conduit for transmitting the upland flow to the river. While the overlying shallow silts, fine sands, and clays are in hydraulic communication with the deeper sands and gravels, the vertical flux of constituents between units is limited.

Further, where LNAPL impacts have been detected in deeper, more coarse-grained materials, these overlying fine-grained materials confine the LNAPL and affect measured LNAPL thicknesses relative to groundwater elevation. In areas where the LNAPL is unconfined, LNAPL thickness is generally observed to decrease with increasing groundwater elevation while in semi-confined to confined areas, LNAPL thickness is stable to increasing with increasing groundwater elevations. This highlights the importance of understanding groundwater elevation when looking at the distribution of LNAPL (and thickness) with the changes in LNAPL thickness not indicating mobility but simply responses to water level fluctuations. Further, in the context of the semi-confined to confined LNAPL, some of this LNAPL is trapped within sand and gravel lenses which have poor connectivity limiting the potential for recovery and indicating that LNAPL storage (and associated volumes) are limited.

GHD completed a comprehensive depth to groundwater gauging event between December 2 and December 5, 2019 at a total of 96 groundwater monitoring wells, 55 on the ST and 41 on the NT. Groundwater elevations ranged from 363.19 feet above mean sea level (AMSL) at AMW5, located near the southern boundary of the ST adjacent to the Seneca River, to 394.57 feet AMSL at MW-207 near the center of the NT (Figure 3). Monitoring wells MW-206 and MW-209, located on the northern portion of the NT, exhibited artesian conditions at the time of the gauging event. The direction of inferred groundwater flow is generally to the south towards the Seneca River, which is consistent with historical observations. A steeper hydraulic gradient was generally observed at the NT as compared to the ST, which is also consistent with historical observations.

At the time of the December 2019 gauging event, 21 of the 96 wells gauged contained a measurable apparent thickness of LNAPL (i.e., 0.01 feet or greater). Based on observations to date, including geology, observations of slow LNAPL accumulation in monitoring wells, and declining LNAPL recovery rates in recovery wells, a portion of the LNAPL present appears to exist under confined conditions and has low transmissivity (refer to Table 6 in Appendix A).

2.3 Supplemental Investigation Summary

Based on the findings of supplemental investigation activities completed at the ST by GHD, which are discussed in detail in the August 3, 2020 SIR included as Appendix A, the following determinations were made:

1. The horizontal limits of LNAPL in the subsurface are generally well defined, with the greatest apparent LNAPL thicknesses underlying the ST containment areas (see Figure 4, which is taken from the SIR), where soils exhibit lower hydraulic conductivity than those located to the north. Some of the areas of greatest LNAPL thickness appear to be associated with areas of semi-confined to confined LNAPL with the greatest thicknesses observed during high groundwater elevations when LNAPL is pushed into the well screen and casing (this is a commonly recognized exaggeration phenomenon sometimes referred to as upfilling).
2. The LNAPL transmissivities (Tn) are generally low (averages of 0.06 to 1.95 ft^2/day in the four wells tested by GHD) and, with the exception of well S3 adjacent to Hillside Road along the northern boundary of the ST, were found to be below the Interstate Technology and Regulatory Council (ITRC) mobility thresholds at which long term LNAPL recovery is practicable (Tn between 0.1 and 0.8 ft^2/day). These wells are characterized by the fine-grained nature of soils within the saturated zone, which is a key control on LNAPL mobility/recoverability. Additional LNAPL transmissivity testing was performed by AECOM in 2014 at a total of 21 wells across the CST and found similar results, with the average (geometric mean) transmissivity reported as 0.016 ft^2/d. Three wells exceeded a value of 0.1 ft^2/d and none exceeded a value of 0.7 ft^2/d. Monitoring well S3 was also tested by AECOM and was similarly found to have the highest transmissivity of any tested well, with an average value of 0.31 ft^2/d and a maximum identified value of 0.7 ft^2/d.
3. Exceedances of Class GA Groundwater Standards, as presented in Technical and Operational Guidance Series (TOGS 1.1.1) for volatile organic compounds (VOCs), were detected in groundwater samples collected from wells located on the NT and ST. The extents of groundwater impacts were determined to be generally consistent with previous observations and do not indicate migration of the dissolved-phase plume beyond the CST. The detection

of elevated VOC concentrations in the underlying deep sand and gravel layer highlights a concern regarding the potential spreading of dissolved petroleum hydrocarbons if groundwater was to be reinjected in this zone in conjunction with the previously proposed remedial approach (i.e., VEGE). This concern established the need for an alternative LNAPL recovery approach.

4. The population of petroleum-degrading microbes in samples collected from ST wells is sufficient to support biodegradation of petroleum hydrocarbons. Further, concentrations of dissolved carbon dioxide and methane detected in samples from ST wells are indicative that the identified microbes are active and that natural source zone depletion (NSZD) is occurring.

As a result of these findings, GHD recommended the following:

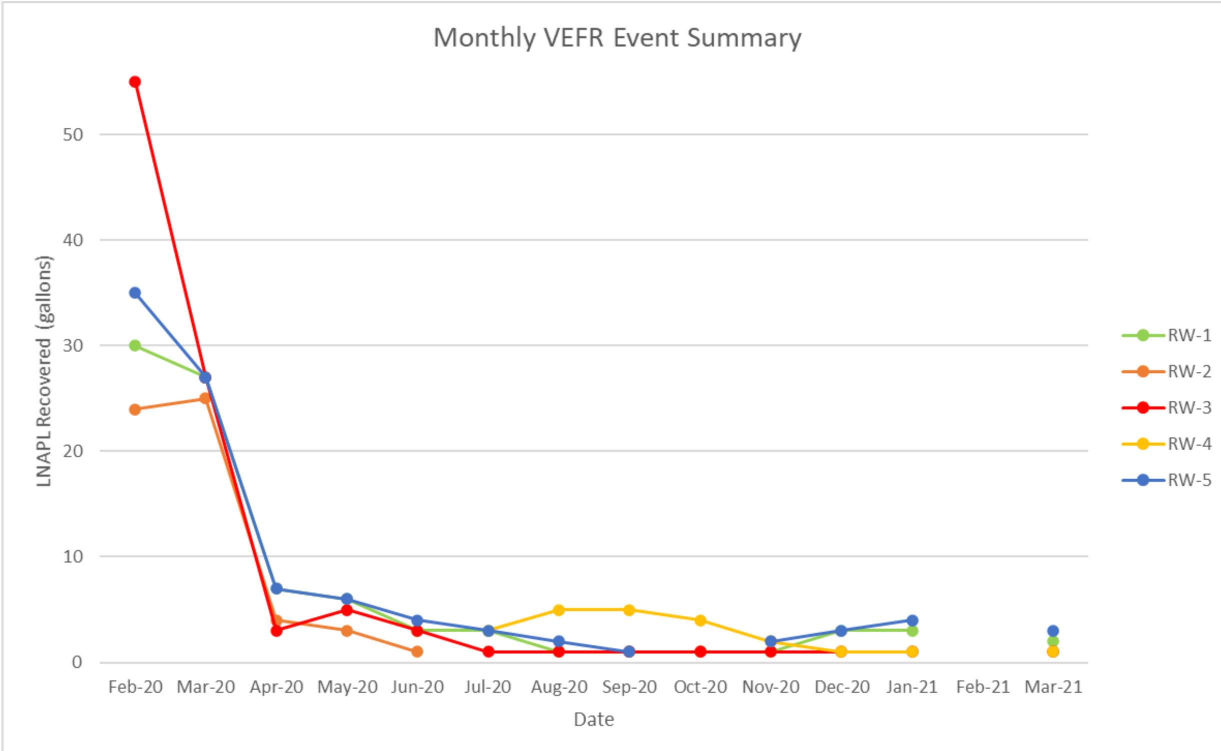
1. Continue vacuum-enhanced fluid recovery (VEFR) events until a permanent LNAPL recovery system was designed, installed, and operating.
2. Install additional wells in the western portion of the ST to define the western boundary of the LNAPL.
3. Re-install the MW-5 well cluster to eliminate potential for vertical hydraulic cross-communication.
4. Install the MW-8 cluster if conditions are more favorable for access at the time.
5. Develop a design to install and operate an automated LNAPL recovery system in appropriate wells to recover mobile-phase LNAPL to meet the requirements of the STG Consent Order.

2.4 LNAPL Recovery Summary

Historically, a significant volume of LNAPL, as discussed in Section 1 of this revised RAWP, has been recovered from the CST using various methods. More recently, between February 2020 and March 2021, VEFR events were performed periodically by GHD to continue LNAPL recovery. GHD utilized Sessler Environmental Services, LLC to perform the VEFR events at recovery wells RW-1 through RW-5 (Figure 2), on a weekly basis beginning the week of February 3, 2020. During each event, an initial LNAPL thickness was measured using standard LNAPL gauging techniques consisting of recording depth to the LNAPL surface (as applicable), depth to water, and total depth of the well using an oil-water interface probe. Down-well equipment was cleaned between each well location.

The four recovery wells with the thickest apparent LNAPL layer, as observed during initial gauging, were preferentially evacuated of LNAPL during each event. Initially, estimates of the LNAPL recovered were made by measuring liquid contained in the vacuum truck between wells. The quantity of LNAPL recovered during subsequent vacuum events was estimated by recording the apparent thickness of LNAPL present in each well between each vacuum cycle and calculating a volume. Recording information from the wells in this manner further supported previous observations of the low transmissivity of the formation, with respect to both LNAPL and groundwater, since minimal recovery was observed in the wells between vacuum cycles. Furthermore, a poor relationship was observed between apparent LNAPL thickness in a well and observed LNAPL recovery from the well, which supports the interpretation of LNAPL being present under confined conditions and the low LNAPL transmissivity nature of the formation.

Following the March 30, 2020 VEFR event, the frequency of recovery events was reduced to every other week based on declining LNAPL recovery rates. This recovery frequency continued through the May 26, 2020 event, after which the frequency was further reduced to monthly VEFR events based on LNAPL recovery rates remaining low (refer to Graph 1 and Appendix B). Reductions in VEFR event frequencies were approved by the NYSDEC. Between February 3, 2020 and March 29, 2021, an estimated total of approximately 366 gallons of LNAPL and 4,859 gallons of groundwater had been extracted (Table 1 and Appendix B). Groundwater and LNAPL recovered during VEFR events were transferred off-site for disposal (refer to the June 30, 2021 Summary of Vacuum-Enhanced Fluid Recovery Events letter report prepared by GHD for additional details).



Graph 1 ***Summary of LNAPL Recovered During Monthly VEFR Events***

Considering the volume of LNAPL estimated to have been recovered by others between 1990 and 2008 (prior to the involvement of these Respondents in the remedial activities) and the volume of LNAPL estimated to have been recovered by GHD between 2020 and 2021, an estimated total of 13,166 gallons of LNAPL (as liquid and soil vapor) has been removed for off-site disposal.

The high percentage of recovered groundwater versus LNAPL observed during VEFR events (Table 1), and the poor recharge of LNAPL and groundwater observed in the recovery wells, which is indicative of the low transmissivity formations present, indicate that the initially proposed VEGE approach would not be practicable.

3. Remedial Goals

3.1 STG Consent Order Remedial Action Objectives

The STG Consent Order and subsequent correspondence (NYSDEC, October 24, 2016) identified addressing LNAPL contamination as the remedial action objective (RAO) associated with the STG Consent Order. Recovery of the mobile-phase LNAPL to the extent practicable is protective of human health and the environment and does support reductions in the overall LNAPL volume. Natural mass losses (natural source zone depletion) are also contributing to LNAPL mass losses at the CST and will continue to support mass depletion after LNAPL recovery has been achieved to the extent practicable.

The primary objective of this revised RAWP is to describe the recommended remedial alternative to meet the STG Consent Order-specific RAO, based on the findings of the remedial investigations conducted in conformance with the STG Consent Order. This STG Consent Order-specific RAO was identified in accordance with the procedures described in 6 NYCRR Part 375 and the NYSDEC's DER-10 guidance document, last amended on May 3, 2010.

Based on the December 2019 gauging event performed by GHD at all accessible NT and ST wells, observable LNAPL is present in the subsurface within an approximately 29,000 square foot delineated area with apparent thicknesses ranging from 0.01 feet to a maximum observed apparent thickness of 3.59 feet in A14. The delineated LNAPL extents are primarily beneath the southwestern and southeastern terminals with apparently discrete areas of LNAPL present in other areas of the CST, two north of Hillside Road and one east of Hillside Road. Figure 4A depicts the measured apparent LNAPL thickness during the 2019 gauging event and the interpolated apparent LNAPL thickness across the CST at that time.

Based on observations from gauging events, the LNAPL mass can fluctuate based on groundwater elevation changes and LNAPL accumulation in certain wells occurs over extended time periods (i.e., LNAPL in MW-7S was not observed between the time the well was installed in November 2019 and August 24, 2020 and then slowly accumulated to a maximum observed apparent thickness of 6.84 feet on January 25, 2021). In addition, LNAPL recovery rates during VEFR events were observed to decrease over time. Based on these observations, it appears that LNAPL is present under confining conditions, and LNAPL transmissivity is low. These observations are consistent with the finding that clay and very fine sand and silt soils are present above and at the water table.

Due to the observed fluctuations in LNAPL, GHD performed another gauging event at all accessible NT and ST wells on March 10, 2022. The results of this gauging event indicated that the greatest apparent thicknesses of LNAPL are present in the subsurface within approximately the same general area as that identified during previous gauging events, with some changes in extent of the apparent LNAPL thicknesses noted. Figure 7A depicts the measured apparent LNAPL thickness during the March 2022 gauging event and the interpolated apparent LNAPL thickness across the CST at that time.

3.2 NT Consent Order CST-Wide RAOs

In addition to the STG Consent Order-specific RAO, there are other RAOs for the CST that are being addressed by NT parties under the separate NT Consent Order. These NT Consent Order-specific CST-wide RAOs, as outlined in the 2015 RAWP prepared by GES, include:

NT CST-SPECIFIC REMEDIAL ACTION OBJECTIVES SUMMARY		
Media	**Constituent(s) of Concern**	**Remedial Action Objectives**
Groundwater	Petroleum Hydrocarbons	<u>RAOs for Public Health Protection:</u> • Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards. • Prevent contact with, or inhalation of volatiles above applicable standards, from contaminated groundwater. <u>RAOs for Environmental Protection:</u> • Restore groundwater aquifer to pre-disposal/pre-release conditions, to the extent practicable. • Prevent the discharge of contaminants to surface water. • Remove the source of ground or surface water contamination through removal or treatment.
Soil	Petroleum Hydrocarbons	<u>RAOs for Public Health Protection:</u> • Prevent ingestion/direct contact with soil exhibiting concentrations above applicable standards. • Prevent inhalation of or exposure from contaminants volatilizing at concentrations above applicable standards from soil. <u>RAOs for Environmental Protection:</u> • Prevent migration of contaminants that would result in groundwater or surface water contamination. • Prevent impacts to biota from ingestion/direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain.
Surface Water	Petroleum Hydrocarbons	<u>RAOs for Public Health Protection:</u> • Prevent ingestion of water impacted by contaminants above applicable standards. • Prevent contact or inhalation of contaminants above applicable standards from impacted water bodies. • Prevent surface water contamination which may result in fish advisories. <u>RAOs for Environmental Protection:</u> • Surface water quality is to meet ambient water quality criteria for the contaminant of concern. • Prevent impacts to biota from ingestion/direct contact with surface water causing toxicity and impacts from bioaccumulation through the marine or aquatic food chain.
Sediment	Petroleum Hydrocarbons	<u>RAOs for Public Health Protection:</u> • Prevent direct contact with sediments contaminated at levels above applicable standards. • Prevent surface water contamination which may results in fish advisories. <u>RAOs for Environmental Protection:</u> • Prevent releases of contaminants from sediment that would results in surface water levels in excess of ambient water quality criteria.
Soil Vapor	Petroleum Hydrocarbons	<u>RAOs for Public Health Protection:</u> • Mitigate impacts to public health resulting from existing, or the potential for, soil vapor intrusion into buildings at the CST.

4. Proposed Remedial Action

Application of the VEFR methodology has demonstrated diminishing LNAPL recovery over time and also has generated significant volumes of impacted groundwater that required off-site transport and disposal. These observations are consistent with hydrogeologic findings, including limited LNAPL transmissivity and reduced recovery rates over time. The VEFR events were intended to be an interim measure until a final remedial system could be designed, installed, and operated. The proposed remedial approach to effectively recover mobile-phase LNAPL to the extent practicable is the installation of automated LNAPL skimmer systems in selected wells; gauging the CST wells on a periodic basis; manual recovery of LNAPL if identified during gauging; and continuing this approach until the recovery of the mobile-phase LNAPL is no longer practicable and NSZD continues to degrade LNAPL. This proposed remedy, as further described in this revised RAWP, is intended to meet the RAO identified in the STG Consent Order.

4.1 LNAPL Recovery System

The low LNAPL transmissivity and decreasing recovery rates observed supports the use of less energy intensive recovery methods than the originally proposed VEGE. Based on CST conditions and observations during past LNAPL recovery efforts, the recommended recovery method is to design and install an automated skimmer system targeted at wells with recoverable LNAPL present. The use of skimmers in similar applications is well documented and skimmer technology has been accepted by NYSDEC at other similar sites throughout New York state. The automated skimmer devices will:

- facilitate more effective LNAPL recovery in select wells
- be more sustainable with less energy consumption
- allow less frequent monitoring, once extraction rates are determined
- limit the amount of excess groundwater generated for treatment or disposal.

Automated skimmer systems are a remediation technology that involves the use of a multi-well control panel, either powered by a solar panel or the electrical grid, and downwell pumps equipped with a density float and oleophilic/hydrophobic intake filters that recover LNAPL. The recovered LNAPL is pumped through tubing leading from the well to holding tanks and is contained until sufficient volume is accumulated to warrant off-site disposal. The wells selected for skimmer installation will be determined based on location of greatest observed thicknesses of LNAPL and will be grouped such that a central control panel can be located within a reasonable distance of the wells.

Wells consist of 2-inch inside diameter (ID), 4-inch ID, and 6-inch ID polyvinyl chloride (PVC) or stainless-steel piping. Given the variability of well diameters and uncertainty of which wells will be selected for connection to the control panels, a standard 2-inch diameter skimmer will be utilized in all wells, which will allow for the greatest flexibility in system configuration. Various diameter wells can be accommodated with the standard 2-inch diameter skimmer because the skimmers are suspended in the wells from PVC well caps, which are sized for the specific well diameter. This approach will also allow for future adjustment of the systems and wells connected, as needed based on field observations.

4.2 Automated Skimmer System

4.2.1 Preparation

Stone access roadways will be constructed into the southwestern and southeastern terminals to facilitate access to install semi-permanent structures to house skimmer control panels and recovered LNAPL storage drums, as well as, to prevent unauthorized tampering and unnecessary exposure of equipment to the elements. A total of three, 10-foot by 12-foot wooden sheds will be placed as near as possible to wells that are anticipated to be connected to the skimmer system. For planning purposes and based on observations to date, two sheds will be placed in the southwestern terminal, one near RW-2 and one near A14, and one shed will be placed in the southeastern terminal near the MW-5R well cluster. The existing fence that surrounds the ST will be maintained and locked and the sheds will be fitted with locks to secure the remedial systems.

4.2.2 System Installation

On-going LNAPL gauging data will be reviewed and wells with the greatest apparent thicknesses of LNAPL will be selected for connection to the skimmer systems. Three control panels, each of which can be connected to, and simultaneously operate, up to five skimmers installed in five wells, are proposed to be utilized. Based on current data and CST conditions, skimmers are anticipated to be installed in monitoring wells A10, A13, A14, AMW5, MW-1S, MW-2S, MW-5SR, MW-7S, RW-1, RW-3, RW-4, and RW-5 (Figure 5). However, the skimmer assemblies are fully mobile and can readily be relocated to other wells by simply swapping out well caps and lengths of tubing, if observations warrant. This anticipated setup will also allow for future expansion of each system to include one additional well if observations warrant.

Skimmer installation will begin by reviewing historical data to determine the minimum and maximum depths of the oil/water interface in each well where a skimmer will be installed. This will provide a range of expected oil/water interface fluctuations to assist with accurate placement of the skimmers within their possible range of travel (higher placement if oil/water interface is typically lower than currently observed and lower placement if the oil/water interface is typically higher than currently observed). A depth to the oil/water interface within the selected well at the time of installation will then be measured and recorded. Rubber product discharge tubing, with a 3/8-inch ID and 5/8-inch outside diameter (OD), and polyethylene air supply tubing, with a 0.17-inch ID and 1/4-inch OD, will be advanced through fittings in the PVC well cap and attached to the top of the skimmer assembly. The depth to the skimmer intake will be measured from the PVC well cap and adjusted such that the intake screen is suspended at the observed oil/water interface. The skimmer assembly will then be lowered into the well and the rubber and polyethylene tubing will be extended from the well to the control panel within the nearest shed. This process will be repeated for each well connected to the control panels.

When the rubber and polyethylene tubing enter the shed, the rubber tubing will be directed towards a steel 55-gallon drum dedicated to each well and appropriately labeled and the polyethylene tubing will be connected to the control panel. The 55-gallon drums will be placed in secondary containment structures to prevent accidental releases, and each will have a tank full shutoff switch installed, which will be connected to the control panel, as an extra safety measure. The drums will be grounded and each drum vented to the outside of the sheds.

The control panel will be mounted on the wall of the shed. The air line from each well will be connected to one well port of the control panel and the tank full switch installed in the 55-gallon drum for that corresponding well will also be connected to the corresponding tank full switch port on the control panel. Two desiccant air dryer assemblies will be installed in series prior to the compressor air inlet. The final connection to the control panel will be power from a battery inside the shed, which will be charged by a solar panel that will be mounted to the roof of the shed. A typical schematic of the skimmer system and down-well components is included as Figure 6.

4.2.3 System Startup

Once all the skimmers are installed and all the connections to the control panel are made, the control panel can be setup to run the skimmers. Each well will be able to be adjusted and controlled independently based on length of tubing runs, observed LNAPL thicknesses, and expected recovery rates. Control panel set points for each well include duration of vacuum cycle (to draw LNAPL into the skimmer assembly), duration of pressure cycle (to discharge accumulated LNAPL from the skimmer assembly into the 55-gallon drum), and the delay period between cycles. The systems will need to be monitored and adjusted for a period of time until a balance between LNAPL withdrawal rates and LNAPL recovery rates is achieved.

4.2.4 Pilot Test

It was proposed to implement the pilot test as the initial startup of the system from April 2021 through August 2021 (prior to submittal of this revised RAWP for review) to verify that system components work properly under CST-specific conditions and to confirm the effectiveness of recovering LNAPL via skimming. The initial system setup and operation was implemented with the NYSDEC's concurrence. During this initial period, weekly system checks were performed and the skimmer control parameters were routinely adjusted in an effort to optimize system operation. Monitoring wells were also routinely gauged and skimmers were adjusted accordingly as needed.

During implementation of the pilot test, it was discovered that skimmer assemblies could not be placed into proposed monitoring wells A13 and A14 as a result of damage to their risers, which prevented the assemblies from passing freely. As a result, skimmers were not installed in these two wells and LNAPL was instead recovered manually approximately once a month.

Skimmers were able to be installed in proposed wells A10, AMW5, MW-1S, and RW-1 (Unit 1); MW-2S and RW-3 (Unit 2); and MW-5SR, MW-7S, RW-4, and RW-5 (Unit 3), as depicted on Figure 5. System adjustments and modifications were completed for a period of time after skimmer installation to improve the system performance. These requirements decreased as the skimmers were in operation longer. Based on measurements taken for each well, it is estimated that the following quantities of LNAPL were recovered by the skimmer systems between installation and the end of the pilot test (August 2021):

Table 2 Estimated Pilot Test LNAPL Recoveries

Well ID	Skimmer Unit	LNAPL Recovered (gallons)
A10	1	1.5
AMW5	1	2.0
RW-1	1	12.2
MW-1S	1	0.25
RW-3	2	4.2
MW-2S	2	3.7
RW-4	3	1.0
MW-5SR	3	6.55
RW-5	3	7.25
MW-7S	3	6.75
TOTAL		45.4

The information gathered through the pilot test indicated that skimmers are a feasible alternative to meet the RAO of the STG Consent Order and the lessons learned will be carried forward to optimize the efficient and effective operation of the remediation system. Following completion of the pilot test, the skimmer systems remained in operation at the CST with the NYSDEC's concurrence. Figure 7 depicts the apparent LNAPL thickness measured during August 2021, following completion of the pilot test.

4.3 Automated Skimmer System Operation, Maintenance, and Reporting

Once the skimmer systems are operational and tuned to well specific conditions, on-going operation and maintenance field activities may be reduced. An operation and maintenance (O&M) manual has been developed to cover the necessary activities and is included as Attachment 2 to this Revised RAWP. In general, O&M activities for system components include periodic checks of:

- quantity accumulated in the drums
- system set points
- tubing run conditions
- desiccant life
- solar panels
- skimmer intake screen conditions
- drum vent discharge conditions.

Other O&M tasks reasonably expected to be required could include:

- periodic LNAPL gauging events (minimum monthly) at accessible CST monitoring wells that currently have, or historically have had, measurable LNAPL, including wells with skimmers installed at the time (Figure 8 depicts the wells proposed to be gauged on a monthly basis, based on available information at the time this Revised RAWP was prepared. The specific wells included in each gauging event are subject to change based on future gauging observations and concurrence from the NYSDEC)
- periodic LNAPL gauging events (minimum quarterly) at all accessible CST monitoring wells, including wells with skimmers installed at the time
- periodic adjustment of skimmer intake screen placement
- periodic relocation of skimmer assemblies into wells with observed LNAPL (or alternatively, periodic manual recovery of LNAPL from those wells)
- replacement of tubing or skimmers due to observed malfunction.

Petroleum/water mixture from the LNAPL collection drums will be periodically vacuumed out and transported to CES of Oriskany, New York. The petroleum fraction will be stripped and processed for recycling, and groundwater will be treated and then discharged to the local POTW in accordance with the operating permit of the facility. These disposal events will occur on an as-needed basis, which will be determined by monitoring the level of fluids accumulated in the drums. In general, the drums will be vacuumed out prior to reaching 80% capacity of the drum.

Since each well with a skimmer installed will discharge to a dedicated 55-gallon drum, a more representative determination of how much LNAPL and how much water is being recovered from each individual well will be possible. This will also allow for a better determination of recovery effectiveness and an indication of when the skimmer may need to be adjusted (i.e., when more water is accumulating in drum than LNAPL). The amount of LNAPL recovered from each well will be tracked to evaluate LNAPL transmissivity and determine when recovery effectiveness decreases and/or is no longer practicable. Changes to pumping rates, skimmer intake installation depths, and wells in which skimmers are installed will also be tracked and recorded for future reference and documentation.

LNAPL gauging of all accessible CST wells will periodically (monthly or quarterly depending on well) occur to track observed LNAPL thicknesses and apparent LNAPL extents, and to assess general LNAPL transmissivity within the area of recovery. The gauging data will be used to determine at which wells manual LNAPL recovery will be performed as part of these periodic gauging events. In addition, skimmer locations will be reviewed with respect to the periodic gauging data and skimmers relocated as needed to focus on wells with the greatest apparent thickness of LNAPL. In general, if a well is observed to consistently have an apparent LNAPL thickness of 0.5-feet or more for three consecutive periodic gauging and manual recovery events, then an assessment will be performed to determine if it would be effective to relocate an existing skimmer assembly or install a new skimmer assembly and connect to the nearest control panel.

Quarterly reports summarizing system operation, LNAPL recovery results, and gauging data will be prepared and submitted to NYSDEC. Semi-annually, the practicability of on-going LNAPL recovery will be evaluated as described in Section 4.5 and a summary report with recommendations for modifications to the systems, if any, will be prepared and submitted to NYSDEC.

During implementation of the skimmer systems, the NYSDEC will be notified, and its approval will be obtained, as follows:

- at least 48-hours prior to any temporary shutdown of the remedial systems for maintenance or other planned activities
- prior to any seasonal or final shutdowns of the remedial systems
- prior to decommissioning of any CST wells
- within 24-hours following any unplanned system shutdowns, with the notification including the reason for the shutdown and the anticipated shutdown timeframe.

4.4 Temporary Seasonal Shutdown

The skimmer systems are planned to be temporarily shutdown each year during winter conditions, generally from mid-December to early-April, due to freezing temperatures and anticipated limited access to the CST.

The temporary system shutdown will include the following activities:

- Conducting a final monitoring event of the LNAPL recovered in the collection drums
- Disconnecting the skimmer systems
- Draining lines into the collection drums
- Pulling the skimmer assembly and tubing from the wells
- Labeling each of the skimmer assemblies and storing in the corresponding shed
- Gauging depth to LNAPL and depth to water and calculating a LNAPL thickness in each well, as appropriate, and recording
- Replacing the cap on the wells
- Emptying the drums of liquids and disposing of liquids off-site (i.e., vacuum truck)
- Coiling tubing at wells and covering ends to prevent entry of unwanted debris
- Disconnecting solar panels from batteries and shutting down control panels (batteries will be stored in GHD office for the winter to protect from freezing)
- Locking the sheds.

The specific date of temporary shutdown will be established each year and communicated to NYSDEC for approval prior to completing temporary shutdown activities.

Notification will be provided to NYSDEC in the spring of each year when access and temperatures are amenable to reinstalling and restarting the skimmer systems (tentatively early-April). From the time of shutdown to restarting of the system, monthly groundwater elevation/LNAPL thickness gauging events and manual recovery of identified LNAPL will occur at the CST wells identified for monthly gauging. Recovered LNAPL will be placed in drums within the system sheds and disposed of off-site (i.e., vacuum truck) once access is possible in the spring. Drums will only be filled to 80 percent capacity and new drums brought in if needed.

4.5 Automated Skimmer System Shutdown Evaluation

Performance metrics will be used to quantify the practicability of continuing LNAPL recovery in order to establish endpoints for LNAPL recovery and the automated skimmer system operation. Figures 9, 9A, and 9B summarize the decision making process for the practicability of LNAPL recovery. It is not possible to establish with certainty the timeframe to reach a point where LNAPL recovery is no longer practicable. In order to assess the practicability of the LNAPL recovery, performance metrics will initially be evaluated every 6-months. Performance metrics evaluations may include the following:

- LNAPL transmissivity maintained below the ITRC mobility thresholds at which long term LNAPL recovery is practicable (Tn between 0.1 and 0.8 ft2/day)
- declining LNAPL recovery rates
- asymptotic conditions of LNAPL recovery versus time curves
- evaluation of LNAPL versus water recovery ratio
- gauging apparent thickness of LNAPL in wells supports stability of LNAPL
- evaluation of NSZD performance indicates comparable or greater reduction in LNAPL mass than the skimmers are recovering (see Attachment 3 – NSZD Work Plan for additional details)

Once baseline conditions have been established, the frequency of these performance metrics evaluations will be adjusted as appropriate, and as agreed to in advance by NYSDEC.

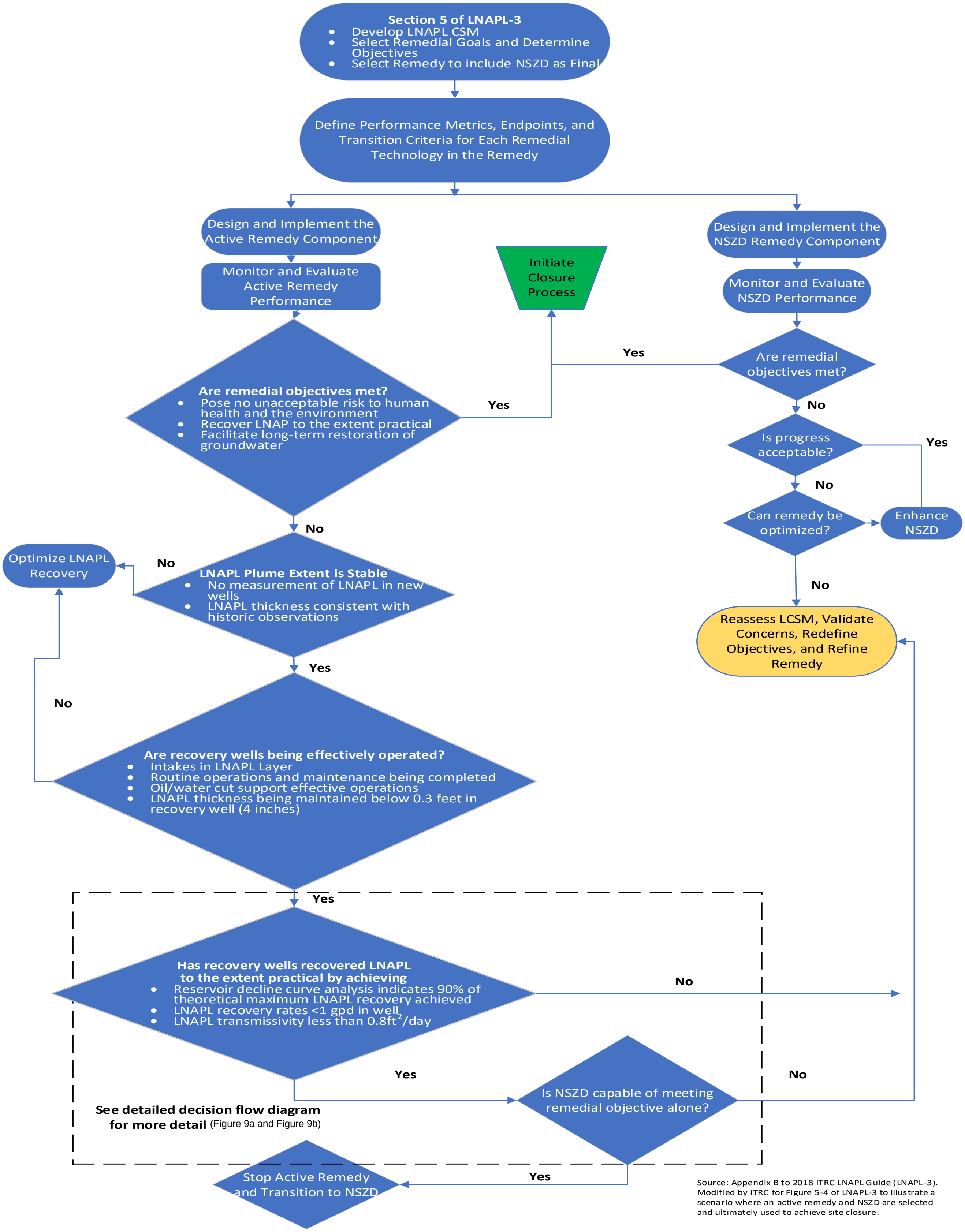


Figure 9 *Decision Logic Diagram for Combined Active LNAPL Recovery and NSZD Remedy*

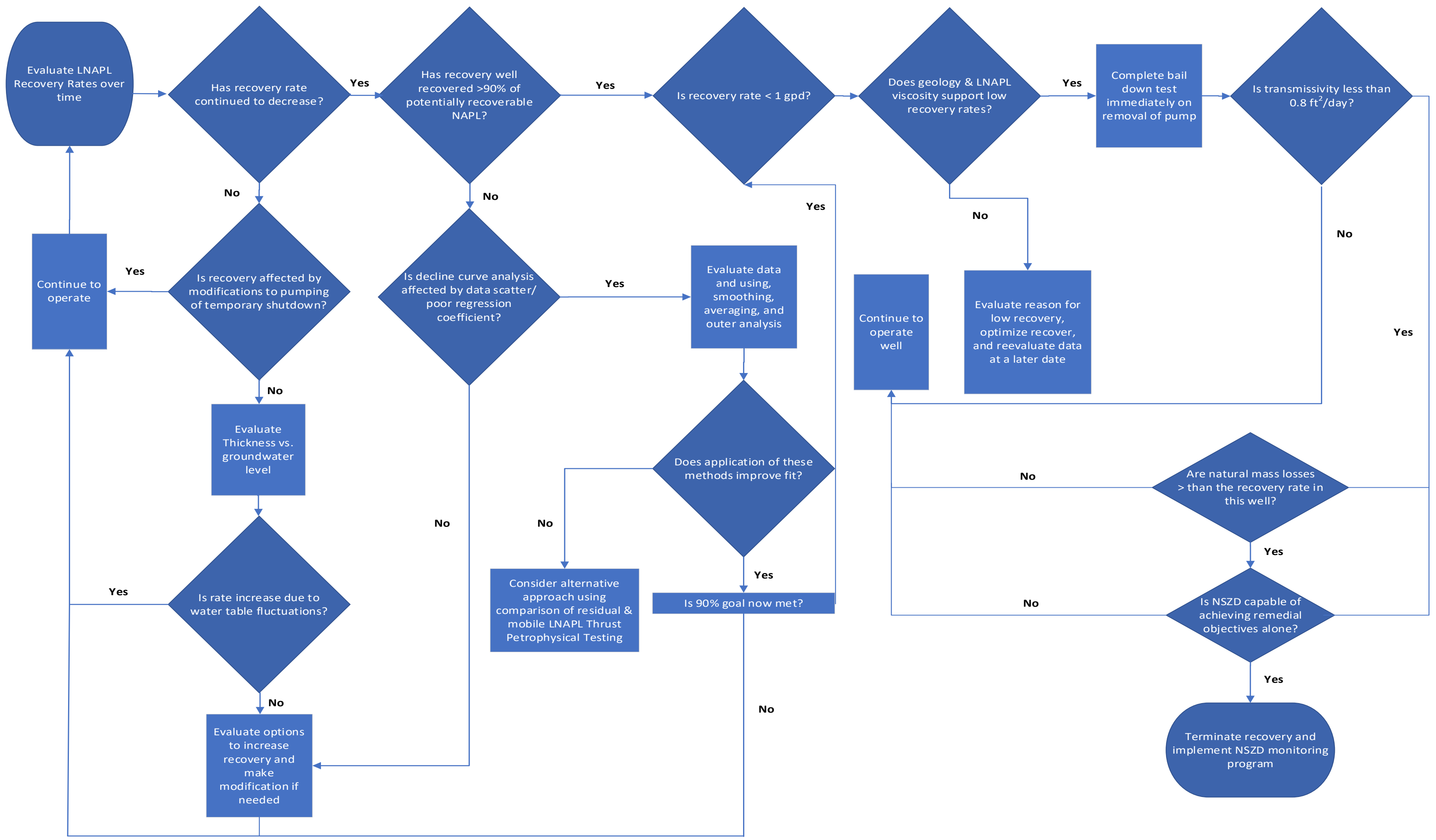


Figure 9A *LNAPL Decision Logic Diagram for LNAPL Recovery Wells*

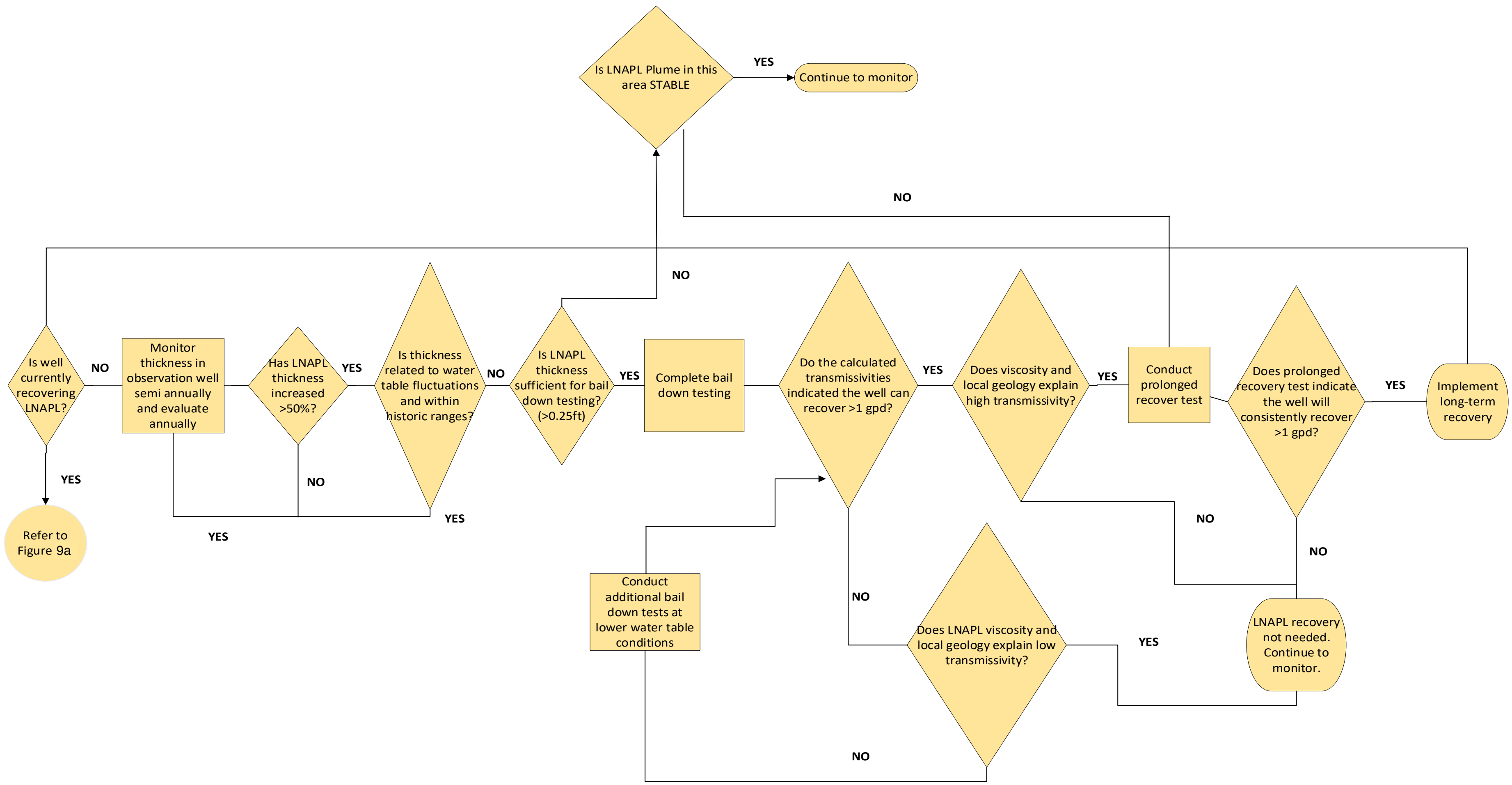


Figure 9B ***LNAPL Decision Logic Diagram for Monitoring Wells with LNAPL (Wells Where Active Recovery is not Occurring)***

Following achievement of favorable performance metrics, with advance approval from NYSDEC, the skimmer systems will be temporarily shut down, wells will be gauged, and LNAPL transmissivity testing will be performed for three consecutive months. Concurrently, NSZD performance will be evaluated in accordance with the procedures outlined in the NSZD Work Plan (Attachment 3). If well gauging continues to indicate minimal LNAPL is present in the target wells, LNAPL transmissivity continues to indicate that recovery is not practicable, and NSZD assessment indicates on-going mass degradation, then approval will be requested and, once received from NYSDEC, the skimmer systems will be permanently shutdown. NSZD will continue to be evaluated on a periodic basis (anticipated to be semi-annually initially) and periodic gauging and manual recovery of LNAPL using pumps, bailers, and/or skimmer socks will continue. Based on CST gauging observations and NSZD evaluation data, and following concurrence from the NYSDEC, the LNAPL recovery skimmer systems will be decommissioned, and on-going LNAPL gauging and manual recovery will be discontinued, allowing ongoing mass degradation (NSZD) to continue in order to achieve the STG Consent Order RAO.

4.6 Automated Skimmer System Decommissioning

Once concurrence and approval are received from NYSDEC, the LNAPL recovery skimmer systems will be decommissioned. Decommissioning will consist of:

- removing the skimmer assemblies from the wells
- replacing the PVC well caps with J-plugs and re-securing the wells
- removing all discharge and air supply tubing from the wells to the sheds
- disconnecting and removing the solar panels and shutting down the control panels
- disposing/recycling of batteries, skimmer assemblies, tubing, and control panels off-site
- determining if sheds are removed or left
- decommissioning of all remedial system components
- decommissioning of unused groundwater monitoring wells and/or recovery wells in accordance with NYSDEC CP-43: Groundwater Monitoring Well Decommissioning Policy, if approved by NYSDEC.

Materials removed will either be appropriately characterized for off-site disposal or properly decontaminated if reused.

4.7 Post-Remedial Action Reporting

Following the successful completion of STG's remedial requirements under the STG Consent Order, a Construction Completion Report (CCR) and an Interim Site Management Plan (ISMP) will be prepared and submitted to the NYSDEC for review and approval.

The CCR will document remedial activities completed at the CST in accordance with this revised RAWP, will be prepared in accordance with the applicable requirements outlined in DER-10: Technical Guidance for Site Investigation and Remediation (NYSDEC, May 2010), and will generally follow the most current NYSDEC Final Engineering Report template. A draft of the CCR will be submitted to NYSDEC for review and comment and a final version will be submitted for approval following completion of requested revisions. All submittals will be in electronic format only.

Since contaminated groundwater, soil, and soil vapor will remain at the CST following completion of STG's remedial requirements, an ISMP will be prepared. The ISMP will be prepared in accordance with the requirements outlined in DER-10: Technical Guidance for Site Investigation and Remediation (NYSDEC, May 2010) and follow the most current NYSDEC template. A draft of the ISMP will be submitted to NYSDEC for review and comment and the final ISMP will be submitted to NYSDEC for approval following completion of requested revisions. All submittals will be in electronic format only.

Both the CCR and the ISMP will be included as attachments to the Final Engineering Report and final SMP, as appropriate, to be prepared for the CST by others following satisfaction of the NT Consent Order obligations by others.

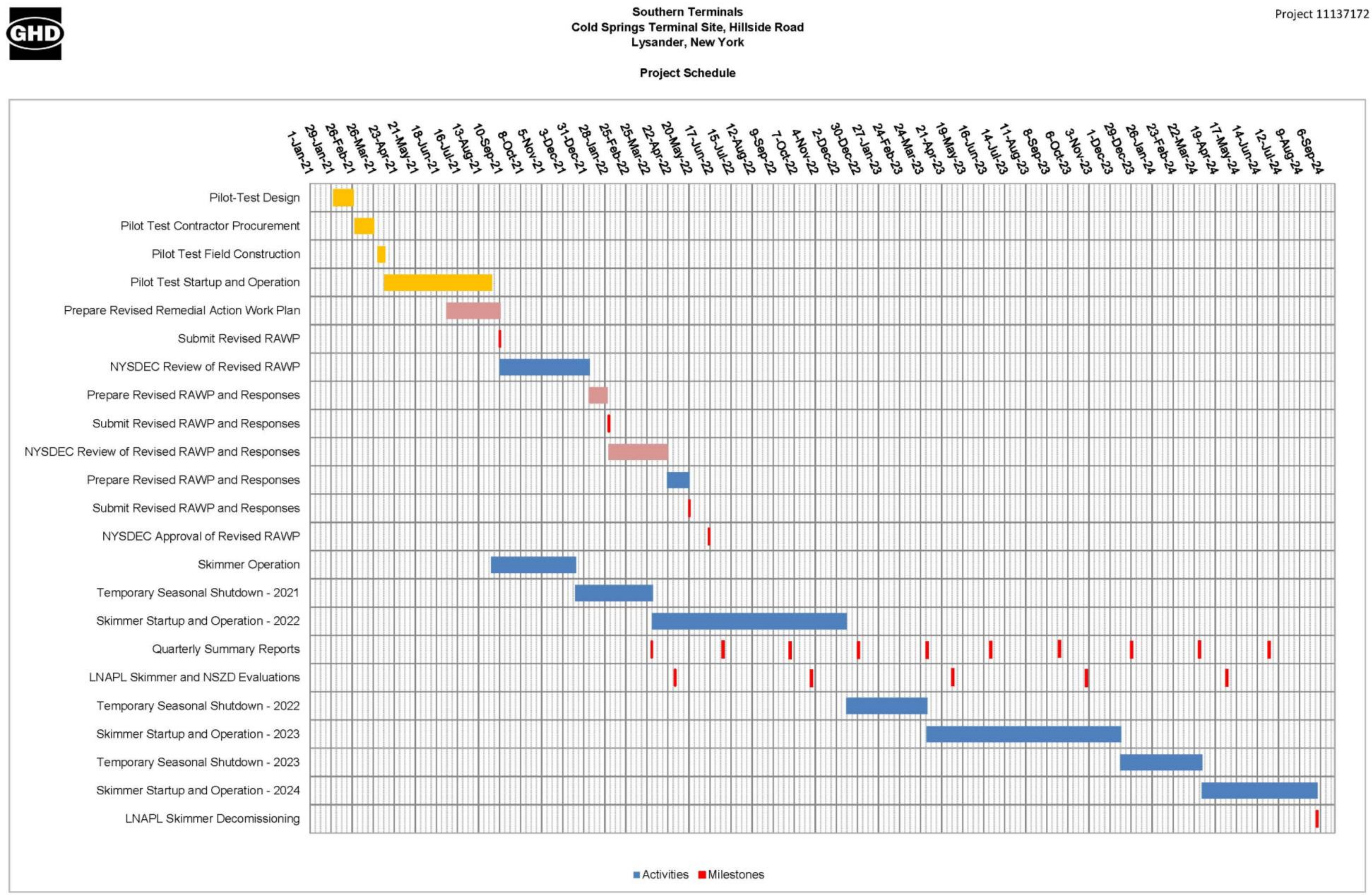
5. Health And Safety

The existing site-specific Health and Safety Plan (HASP) includes the activities proposed in this revised RAWP and activities that could occur in the future. The procedures outlined in the HASP apply to all personnel on the CST and will be provided and reviewed accordingly. Additionally, all GHD personnel on the CST will be OSHA 40-hour HAZWOPPER trained.

6. Project Schedule

The proposed project schedule to implement the remedial approach associated with the STG Consent Order is included as Figure 10 below. The results of the semi-annual performance assessments will further define the schedule and the timeframe for continued LNAPL recovery and operation of the skimmer systems.

Figure 10 *Project Schedule*



7. References

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6. GHD, June 30, 2021. Summary of Vacuum-Enhanced Fluid Recovery Events
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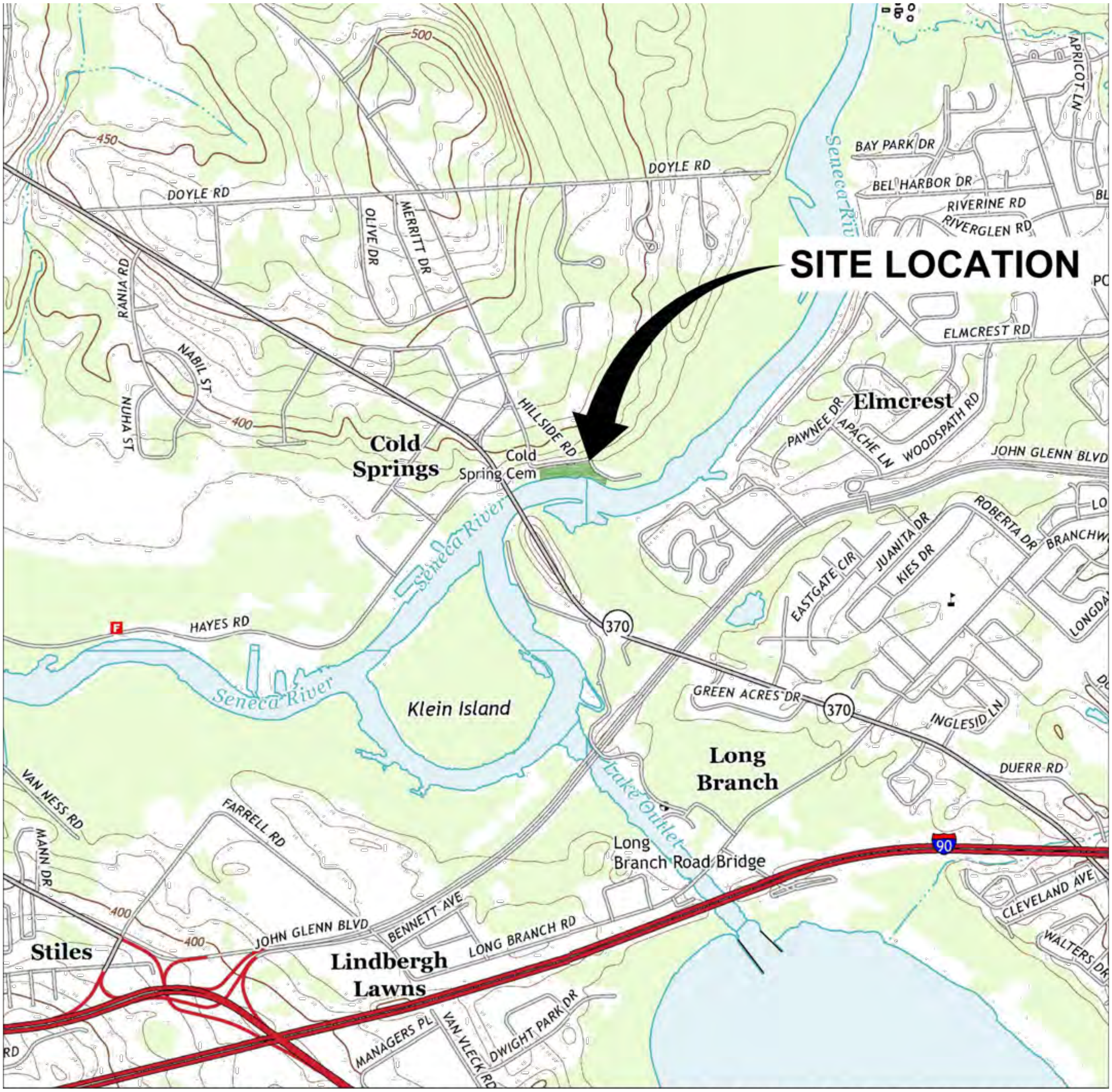
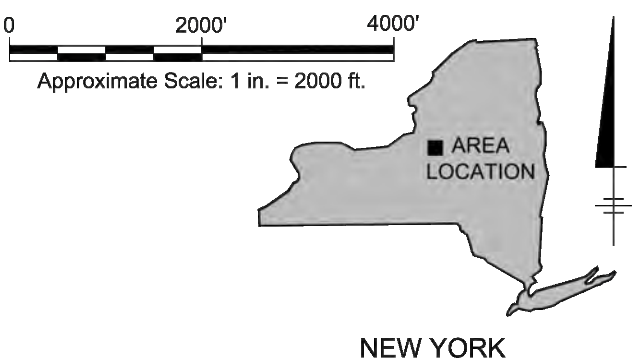
Figures



REFERENCE: BASE MAP USGS 7.5. MIN. TOPO. QUAD., BALDWINSVILLE, BREWERTON, CAMILLUS & SYRACUSE WEST, NY, 2013.



2019Q1-Title Block

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

SITE LOCATION MAP

Project No. **111-37172**
Report No. **007**
Date **JUN 21**

FIGURE 1

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Plot Date: 25 June 2021 - 9:43 AM

LEGEND

- PRE-EXISTING SOUTHERN TERMINALS MONITORING WELL LOCATION
- NESTED SOUTHERN TERMINALS MONITORING WELL LOCATION (INSTALLED NOVEMBER 2019)
- SOUTHERN TERMINALS LNAPL RECOVERY WELL LOCATION (INSTALLED NOVEMBER 2019)
- ADDITIONAL SOUTHERN TERMINALS MONITORING WELL LOCATION (INSTALLED MAY 2020)
- PRE-EXISTING NORTHERN TERMINALS MONITORING WELL
- SIGNIFICANTLY DAMAGED MONITORING WELL - CANNOT BE GAUGED
- DECOMMISSIONED MONITORING WELL (MARCH 2020)

N

0 100'

GHD

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

SITE MAP

Project No. 111-37172
Report No. 007
Date JUN 21

FIGURE 2

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Plot Date: 18 January 2022 - 12:28 PM

LEGEND

- PRE-EXISTING SOUTHERN TERMINALS MONITORING WELL LOCATION
- NESTED SOUTHERN TERMINALS MONITORING WELL LOCATION (INSTALLED NOVEMBER 2019)
- SOUTHERN TERMINALS LNAPL RECOVERY WELL LOCATION (INSTALLED NOVEMBER 2019)
- ADDITIONAL SOUTHERN TERMINALS MONITORING WELL LOCATION (INSTALLED MAY 2020)
- PRE-EXISTING NORTHERN TERMINALS MONITORING WELL
- MONITORING WELL NOT GAUGED (DECEMBER 2019)
- DECOMMISSIONED MONITORING WELL (MARCH 2020)
- 364.42 GROUNDWATER ELEVATION
- 390 MAJOR GROUNDWATER CONTOUR
- 392 MINOR GROUNDWATER CONTOUR

NOTES:

1. WELLS WITHOUT A GROUNDWATER ELEVATION WERE NOT ABLE TO BE LOCATED OR ACCESSED, OR WERE NOT INSTALLED AT THE TIME, AND WERE NOT GAUGED.
2. MONITORING WELLS MW-5SR, MW-5DR, MW-8S, MW-8D, MW-11S, MW-11SR, MW-11D, MW-12S, MW-12D, MW-13S, MW-13D, MW-14, AND MW-15 WERE NOT INSTALLED AT THE TIME OF THE DECEMBER 2019 GAUGING EVENT.

NOTES

1. GROUNDWATER ELEVATIONS CORRECTED FOR LNAPL PRESENCE ON TOP OF THE GROUNDWATER TABLE :
   CORRECTED GROUNDWATER ELEVATION = ELEVATION + (LNAPL DENSITY [0.79] X LNAPL THICKNESS)
2. GROUNDWATER ELEVATIONS FROM DEEP WELLS NOT SHOWN OR INCLUDED IN CONTOURING

N

0 100'

GHD

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

GROUNDWATER CONTOURS AND INFERRED FLOW DIRECTION (DECEMBER 2019)

Project No. 111-37172
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Date JUN 21

FIGURE 3

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NOTE:

TWO A6 SHOWN ON FIGURE

APPARENT LNAPL THICKNESS IN FEET

0-1	3-4
1-2	4-5
2-3	5+

N

0 100'

GHD

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

GREATEST APPARENT
LNAPL THICKNESS
DECEMBER 2019 - MARCH 2020

Project No. 111-37172
Report No. 007
Date AUG 21

FIGURE 4

Filename: \\ghdnet\ghd\US\Niagara Falls\Legacy\PROJ\11130000\11137172 - Cold Springs Terminal PRP Group\Revised RAWP\Figures\11137172 - Figure 4.dwg
Plot Date: 18 August 2021 - 9:22 PM

LEGEND

- PRE-EXISTING SOUTHERN TERMINALS MONITORING WELL LOCATION
- NESTED SOUTHERN TERMINALS MONITORING WELL LOCATION (INSTALLED NOVEMBER 2019)
- SOUTHERN TERMINALS LNAPL RECOVERY WELL LOCATION (INSTALLED NOVEMBER 2019)
- ADDITIONAL SOUTHERN TERMINALS MONITORING WELL LOCATION (INSTALLED MAY 2020)
- PRE-EXISTING NORTHERN TERMINALS MONITORING WELL
- MONITORING WELL NOT GAUGED DURING DECEMBER 2019 EVENT
- DECOMMISSIONED MONITORING WELL (MARCH 2020)
- 1.09 APPARENT LNAPL THICKNESS (DECEMBER 2019)
- NML NO MEASURABLE APPARENT LNAPL THICKNESS (DECEMBER 2019)

NOTES:

1. WELLS WITHOUT AN APPARENT LNAPL THICKNESS OR "NML" DESIGNATION WERE NOT ABLE TO BE LOCATED OR ACCESSED, OR WERE NOT INSTALLED AT THE TIME, AND WERE NOT GAUGED.
2. MONITORING WELLS MW-5SR, MW-5DR, MW-8S, MW-8D, MW-11S, MW-11SR, MW-11D, MW-12S, MW-12D, MW-13S, MW-13D, MW-14, AND MW-15 WERE NOT INSTALLED AT THE TIME OF THE DECEMBER 2019 GAUGING EVENT.

APPARENT LNAPL THICKNESS IN FEET

0-1	3-4
1-2	4-5
2-3	5+

N

0 100'

GHD

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

APPARENT LNAPL THICKNESS
DECEMBER 2019

Project No. 11137172
Report No. -
Date JAN 2022

FIGURE 4A

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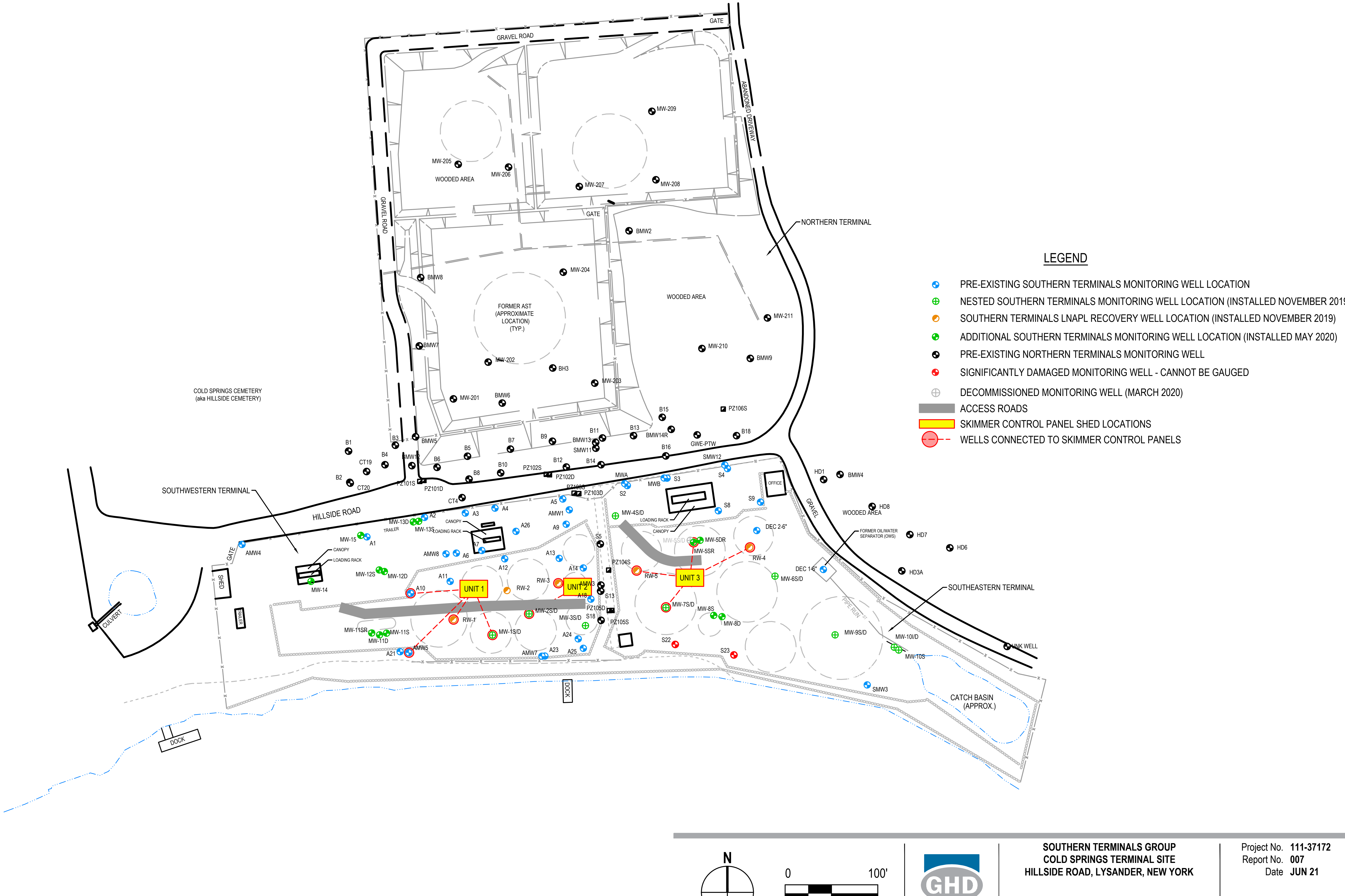


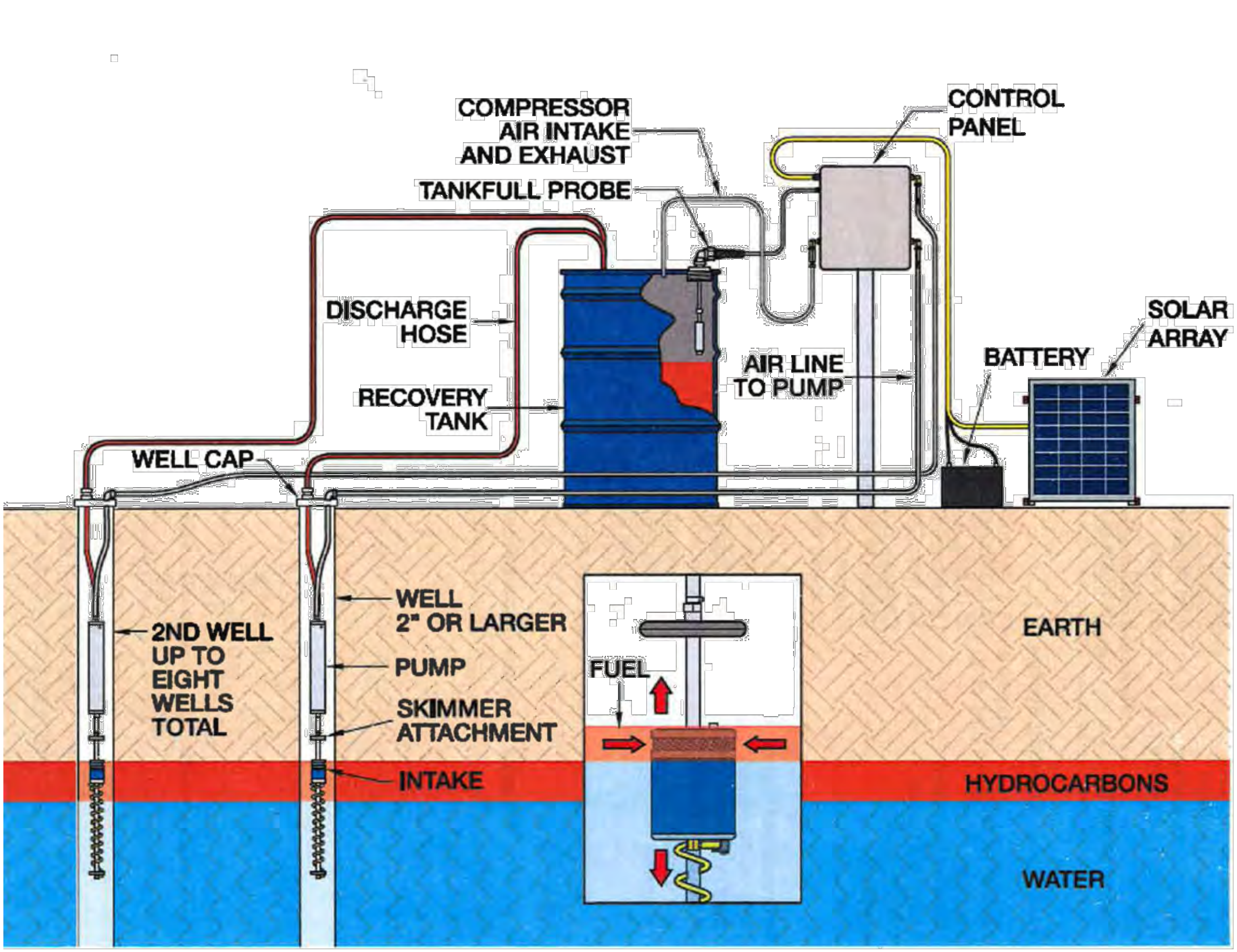
SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

PILOT TEST SKIMMER LOCATIONS

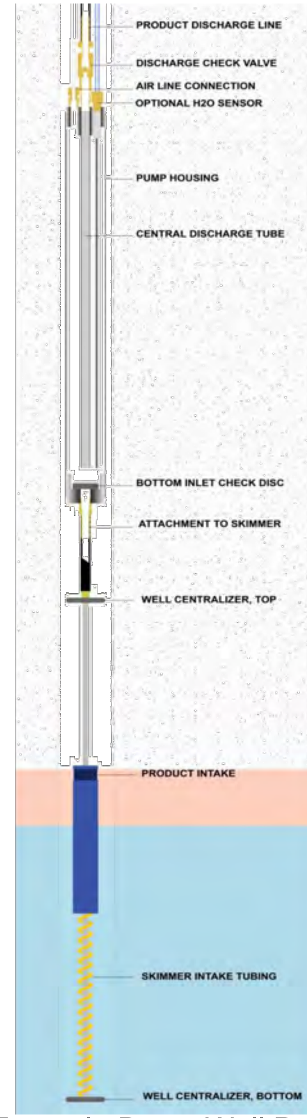
Project No. 111-37172
Report No. 007
Date JUN 21

FIGURE 5

Filename: G:\Projects\564\11137172\Tech\RAWP\Figures\11137172 - Figure 5.dwg
Plot Date: 12 May 2022 - 11:48 AM



Generic Solar Sipper Schematic



Example Down Well Pump and Skimmer Assembly

NOTES:

1. Schematics provided by Geotech and are representative of typical equipment setup.

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

SKIMMER SCHEMATICS

Project No. 11137172
Report No. 007
Date JUN 21

FIGURE 6

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SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

Project No. 11137172
Report No. -
Date JAN 2022

GHD

APPARENT LNAPL THICKNESS
AUGUST 2021

FIGURE 7

Filename: G:\Projects\564\11137172\Tech\RAWP\Figures\11137172 - Figure 7 Apparent LNAPL Thickness - August 2021.dwg
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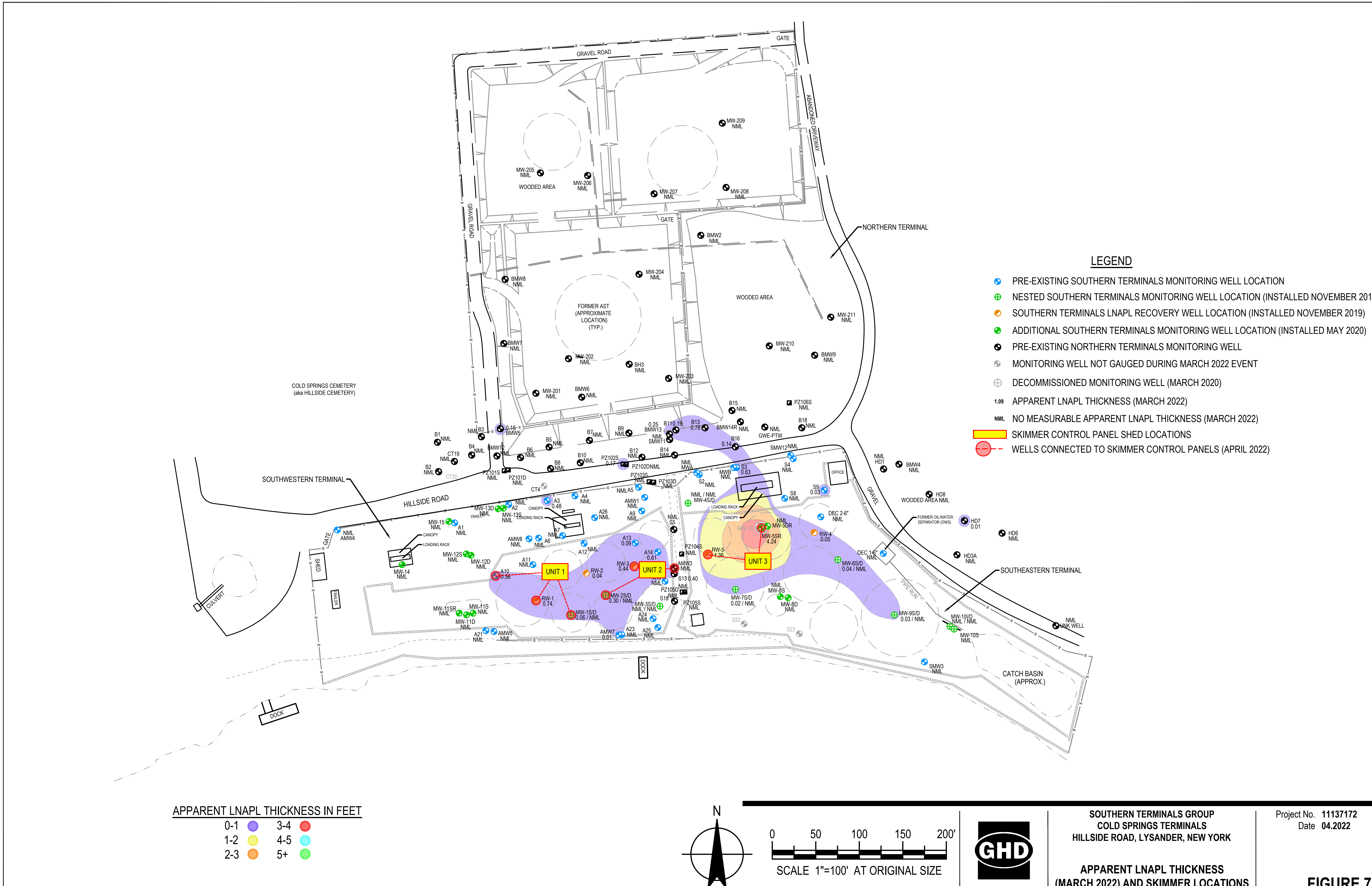

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LEGEND

- PRE-EXISTING SOUTHERN TERMINALS MONITORING WELL LOCATION
- NESTED SOUTHERN TERMINALS MONITORING WELL LOCATION (INSTALLED NOVEMBER 2019)
- SOUTHERN TERMINALS LNAPL RECOVERY WELL LOCATION (INSTALLED NOVEMBER 2019)
- ADDITIONAL SOUTHERN TERMINALS MONITORING WELL LOCATION (INSTALLED MAY 2020)
- PRE-EXISTING NORTHERN TERMINALS MONITORING WELL
- MONITORING WELL NOT ABLE TO BE GAUGED (DAMAGED)
- DECOMMISSIONED MONITORING WELL (MARCH 2020)
- WELLS TO BE GAUGED MONTHLY

NOTES:
ALL ACCESSIBLE WELLS WILL BE GAUGED ON A QUARTERLY BASIS TO IDENTIFY LNAPL VARIATIONS
WELLS WITH IDENTIFIED LNAPL WILL BE ADDED TO MONTHLY GAUGING EVENTS

0 50 100 150 200'
SCALE 1"=100' AT ORIGINAL SIZE

GHD

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINALS
HILLSIDE ROAD, LYSANDER, NEW YORK

WELLS PROPOSED TO BE PERIODICALLY GAUGED

Project No. 11137172
Date 04.2022

FIGURE 8

Filename: G:\Projects\564\11137172\Digital_Design\ACAD\Figures\11137172-FIG08-Wells to be Gagued Monthly.dwg
Plot Date: 12 May 2022 11:55 AM

Tables

Table 1 - Monthly Summary of VEFR Event Recoveries

Well ID	Month	Number of VEFR Events	Total LNAPL Recovered[1] (gallons)	Total Water Removed (gallons)	Total Removed (gallons)
RW-1	Feb-20 [1]	3	30	125	155
	Mar-20 [1]	5	27	289	316
	Apr-20	2	7	104	111
	May-20	2	6	151	157
	Jun-20	1	3	52	55
	Jul-20	1	3	65	68
	Aug-20	1	1	43	44
	Sep-20	1	1	31	32
	Oct-20	1	1	55	56
	Nov-20	1	1	40	41
	Dec-20	1	3	38	41
	Jan-21	1	3	47	50
	Feb-21	0	-	-	-
	Mar-21	1	2	50	52
RW-1 Totals		**21**	**88**	**1,090**	**1,178**
RW-2	Feb-20	2	24	95	119
	Mar-20	5	25	436	461
	Apr-20	2	4	121	125
	May-20	2	3	126	129
	Jun-20	1	1	54	55
	Jul-20	0	-	-	-
	Aug-20	0	-	-	-
	Sep-20	0	-	-	-
	Oct-20	1	1	53	54
	Nov-20	0	-	-	-
	Dec-20	0	-	-	-
	Jan-21	0	-	-	-
	Feb-21	0	-	-	-
	Mar-21	0	-	-	-
RW-2 Totals		**13**	**58**	**885**	**943**
RW-3	Feb-20	3	55	168	223
	Mar-20	5	27	372	399
	Apr-20	2	3	110	113
	May-20	2	5	134	139
	Jun-20	1	3	79	82
	Jul-20	1	1	29	30
	Aug-20	1	1	50	51
	Sep-20	1	1	42	43
	Oct-20	1	1	30	31
	Nov-20	1	1	74	75
	Dec-20	1	1	46	47
	Jan-21	1	1	45	46
	Feb-21	1	-	-	-
	Mar-21	1	1	39	40
RW-3 Totals		**22**	**101**	**1,218**	**1,319**

Table 1 - Monthly Summary of VEFR Event Recoveries

Well ID	Month	Number of VEFR Events	Total LNAPL Recovered[(1)] (gallons)	Total Water Removed (gallons)	Total Removed (gallons)
RW-4	Feb-20	0	-	-	-
	Mar-20	0	-	-	-
	Apr-20	0	-	-	-
	May-20	0	-	-	-
	Jun-20	0	-	-	-
	Jul-20	1	3	62	65
	Aug-20	1	5	43	48
	Sep-20	1	5	73	78
	Oct-20	1	4	47	51
	Nov-20	1	2	38	40
	Dec-20	1	1	50	51
	Jan-21	1	1	39	40
	Feb-21	-	-	-	-
	Mar-21	1	1	47	48
RW-4 Totals		**8**	**22**	**399**	**421**
RW-5	Feb-20	3	35	89	124
	Mar-20	5	27	456	483
	Apr-20	2	7	182	189
	May-20	2	6	156	162
	Jun-20	1	4	71	75
	Jul-20	1	3	40	43
	Aug-20	1	2	60	62
	Sep-20	1	1	40	41
	Oct-20	0	-	-	-
	Nov-20	1	2	39	41
	Dec-20	1	3	54	57
	Jan-21	1	4	30	34
	Feb-21	-	-	-	-
	Mar-21	1	3	50	53
RW-5 Totals		**20**	**97**	**1,267**	**1,364**
VEFR Events Totals		**84**	**366**	**4,859**	**5,225**

Notes:

(1) Approximate volumes based on measurements of water and LNAPL thickness in vac truck following completion of recovery at each well

(2) Approximate volumes based on measurements of water and LNAPL thickness in recovery well between each vacuum cycle

VEFR - Vacuum enhanced fluid recovery

- = LNAPL recovery not performed at recovery well during specific recovery event

Appendices

Appendix A

Supplemental Investigation Summary – Southern Terminals, GHD, April 3, 2020

April 3, 2020 Reference No. 11137172

Mr. Michael Belveg
Assistant Engineer (Environmental)
New York State Department of Environmental Conservation
615 Erie Boulevard West
Division of Environmental Remediation
Syracuse, NY 13204

Dear Mr. Belveg:

Re: Supplemental Investigation Summary - Southern Terminals
Cold Springs Terminal Site, Hillside Road, Lysander, New York
NYSDEC Spill No. 89-04923

1. Introduction

On behalf of the Respondents to the Southern Terminals Consent Order executed by the New York State Department of Environmental Conservation (NYSDEC) on August 25, 2016, GHD has prepared this Supplemental Investigation (SI) Summary for the Cold Springs Terminal Site, located along Hillside Road in Lysander, New York (Site). Refer to Figure 1 for a Site Location Map. The purpose of the SI was to collect and evaluate data to refine the remedial strategy for the Site (see GHD letter and enclosures dated October 4, 2019 to Mr. Michael Belveg, which is incorporated in its entirety in Attachment A). The Work Plan also included replacement of several wells damaged/destroyed during previous aboveground storage tank (AST) removal activities conducted by the Site Owners and/or their contractors and agents on the Southern Terminals (ST) portion of the Site.

Activities performed as part of the SI included:

- Repair/replacement and installation of monitoring wells
- Additional data collection activities required to refine the remedial approach and finalize remedial system design, including groundwater analytical data, hydraulic conductivity, and LNAPL transmissivity
- Light non-aqueous phase liquid (LNAPL) recovery activities

Pursuant to GHD's March 11, 2020 telephone discussion, we will address next steps and prepare a final Remedial Action Work Plan for the activities required under the Southern Terminals Consent Order.

2. Supplemental Investigation

The following sections summarize work performed as part of the October 2019 Supplemental Investigation Work Plan (SIWP). Implementation of the SIWP began on November 4, 2019 and is ongoing. The following sections summarize field activities associated with implementation of the SIWP. All activities were conducted in accordance with NYSDEC DER-10/Technical Guidance for Site Investigation and Remediation (DER-10).

2.1 Stage I

2.1.1 Monitoring Well Repair and Replacement

GHD retained New York State (NYS) Licensed drilling contractor Nothnagle Drilling, Inc. (Nothnagle) to complete soil boring, monitoring and recovery well installation, and well development activities between November 4 and 25, 2019.

2.1.1.1 Monitoring Well Repair

GHD personnel repaired three monitoring well locations (A11, A12, and A13) prior to the Site survey. Each location was repaired by addition of a flexible rubber coupling and a section of polyvinyl chloride (PVC) pipe to bring the monitoring well up to, or above, grade. J-plugs were reused or replaced as necessary. Monitoring well A3 was previously identified as requiring repair, however, upon further inspection, the monitoring well was not repaired due to its location in a paved area and potential for additional damage. The well is located in an uncovered manhole (a lockable J-plug is present) in an area of heavy traffic during Site activities. Monitoring well A14 was damaged beyond immediate repair, with the well casing lifted and slightly bent at ground surface. This well will still be used for LNAPL thickness measurements but not for groundwater elevation measurements or potential future groundwater sampling. Given the close proximity of A13 and newly installed RW-3, A14 is not necessary for groundwater elevation measurements. Monitoring well SMW3, which is bent at the surface, will also be used to determine the presence or absence of LNAPL not for groundwater elevation measurements.

2.1.1.2 Monitoring and Recovery Well Installation

A total of nine nested monitoring well locations (MW-1 through MW-7, MW-9, and MW-10) and five recovery wells (RW-1 through RW-5) were installed and developed between November 4 and 25, 2019. MW-8 could not be installed due to Site conditions at the time of the SI. There was approximately 1 foot of standing water at the location of MW-8 and the area immediately surrounding it, preventing safe access by the drill rig and field personnel. Monitoring and recovery well locations are presented on Figure 2. Soil boring and well construction logs are included as Attachment B.

Utility Mark-out

To prevent damage to existing utilities in the vicinity of the Site, a NYS One-Call was completed prior to initiation of field activities. Consistent with standard operating procedure, boring locations which were accessible for the applicable equipment, were cleared by Ground Penetrating Radar Systems, LLC (GPRS) utilizing electromagnetic and/or ground penetrating radar (GPR) methods. The MW-10 nested well, originally intended to replace HD-4A, was moved inside the containment structure due to the presence of a gas line running the length of the gravel road immediately outside the fenced portion of the Site.

Soil Boring/Monitoring Well Installation

Prior to drilling, boring locations were hand cleared to a depth of 5 feet below ground surface (bgs) utilizing a hand auger. Soil borings were then advanced utilizing hollow stem augers (HSA). Each boring was continuously sampled in 4-foot increments via driven Macro Core® sampler equipped with disposable acetate sleeves for logging and screening purposes. Soil samples were screened for the presence of volatile organic vapors using a photoionization detector (PID) calibrated to 100 parts per million (ppm) by volume of isobutylene. Nested monitoring well locations were drilled using a 6.25-inch internal diameter (ID) auger; recovery well locations were drilled with a 4.25-inch ID auger, then over-drilled utilizing 8.25-inch ID augers. The Macro Core® and augers were decontaminated between boring locations, utilizing a pressure washer and/or Alconox® and potable water rinse on a temporary decontamination pad.

Borings for monitoring wells were advanced to top of glacial till, between approximately 23 feet bgs at MW-5 to approximately 35.5 feet bgs at MW-10 based on lithology or refusal. No soil samples were collected for analysis during soil boring or monitoring well installation activities.

Monitoring wells were installed as nested pairs of shallow and deep wells in the same borehole with screened intervals straddling the water table and deep gravel layer, respectively. Shallow wells were constructed of 10 feet of 2-inch diameter, 0.010-inch continuous-slot, Schedule 40 PVC screen and riser to approximately 2 to 3 feet above ground surface. Deep wells were constructed with screened intervals within the gravel layer identified at each location. All deep monitoring wells were advanced to the top of the glacial till with the exception of MW-6D, where refusal was encountered at approximately 26.5 feet bgs. The annular space in screened intervals was backfilled with #00N sand followed by bentonite chip seals between shallow and deep wells and above shallow wells to within approximately 1 to 1.5 feet of ground surface. Nested wells were completed at the surface with a 6-inch protective steel casing set in concrete and locking hinged cover.

Subsurface conditions observed at MW-10 resulted in the installation of monitoring wells screened across three different intervals. During drilling activities, little to no indication of impacts were observed in shallow soils straddling the water table. Elevated PIDs were detected beginning at approximately 24 feet bgs. An additional intermediate well (MW-10I) was installed between the shallow and deep intervals to capture potential impacts otherwise not identified in shallow soils and groundwater. MW-10I and MW-10D were installed as a nested pair; MW-10S was installed in a separate boring and completed at the surface with a 4-inch protective steel casing set in concrete and locking hinged cover.

Recovery wells were constructed of 10 feet of 6-inch diameter, 0.010-inch continuous-slot, Schedule 40 PVC screen and riser to approximately 2 to 3 feet above ground surface. Recovery wells were screened straddling the water table, from approximately 5 to 15 feet bgs. Annular space in screened intervals was backfilled with #00N sand followed by a bentonite seal to within approximately 1.5 feet of ground surface. Recovery wells were completed at the surface with an 8-inch protective steel casing set in concrete and locking Royer cover.

Monitoring and recovery well locations are presented on Figure 2. Soil boring and well construction logs are included as Attachment B.

Monitoring and Recovery Well Development

A total of nine newly-installed monitoring well clusters, five newly-installed recovery wells, and six existing monitoring wells determined to be potential monitoring network wells were developed between November 21 and 25, 2019. Wells were purged of approximately five well volumes or to dryness five times utilizing a submersible pump set at a rate of approximately 2 to 3 gallons per minute (GPM). Development water was transferred to 275-gallon totes located on Site and stored for later off-Site disposal.

Soil Gas Probe Installation

Several inches of standing water was encountered within containment areas on both the southwestern and southeastern portions of the ST at the time of the SI. As a result, soil gas probe installation was not completed during the initial field mobilization. GHD will continue to evaluate Site conditions and will complete soil gas probe installation when conditions permit.

2.1.2 Monitoring Well Survey

Following monitoring well repair and replacement, GHD retained Bryant Associates, PC, a NYS Licensed Surveyor, to complete a survey of all monitoring wells located on both the Northern Terminal (NT) and ST properties. A total of 122 wells which were located and identified as usable during 2019 monitoring well assessment activities were surveyed for northing and easting on the New York State Plane Coordinate System – Central System, North American Datum of 1983 (NAD83), and measuring point elevation (northern point of monitoring well riser) on the North American Vertical Datum of 1988 (NAVD88). A map of monitoring and recovery well locations is included as Figure 2.

2.2 Stage II

2.2.1 Groundwater and LNAPL Gauging

Approximately 1 week following completion of monitoring and recovery well development, GHD personnel completed a comprehensive groundwater elevation and LNAPL gauging event across both the NT and ST portions of the Site. A total of 96 of 122 planned wells were located and gauged between December 2 and December 5, 2019. Weather conditions at the time of the event impeded location of, or safe access to, the remaining wells.

The gauging event consisted of recording depth to the LNAPL surface (as applicable), depth to water, and total depth of the well using an oil-water interface probe. Down-well equipment was decontaminated between each well location using an Alconox®-water solution and tap water rinse. Decontamination water was transferred to on-Site totes for characterization and off-Site disposal.

Groundwater elevations ranged from 363.19 feet above mean sea level (AMSL) at AMW5 on the ST to 394.57 feet AMSL at MW-207 on the NT. Monitoring wells MW-206 and MW-209, located on the northern portion of the NT, exhibited artesian conditions at the time of the gauging event. Observed apparent LNAPL thicknesses ranged from between 0.01 foot at A25, MW-2S, S13, S2, and B6 to 3.59 feet at A14.

Additional groundwater and LNAPL gauging events have been performed on selected wells in February and March 2020. Apparent LNAPL thicknesses for all gauging events completed as part of the SI are summarized in Table 1 and on Figure 3.

2.2.2 Groundwater Sample Collection

Groundwater sample collection occurred on December 3 and 4, 2019. Groundwater analytical data are summarized in Tables 2 and 3. NT wells SMW12 and PZ102S were redeveloped prior to sampling, as the wells are not routinely monitored and the condition of the wells was unknown. The wells were pumped of five well volumes, allowed to recover overnight, and were sampled the following day. With the exception of BMW5, groundwater monitoring and recovery wells were purged and sampled utilizing a peristaltic pump and in accordance with standard low flow methodology to minimize water table drawdown and potential for free product in samples. Due to the deep water table at the well location, BMW-5 was purged and sampled with poly tubing fitted with a stainless steel foot valve (inertial pumping).

Wells were purged until parameters of temperature, pH, conductivity, redox potential, and dissolved oxygen stabilized to within 10 percent of the previous reading for three consecutive readings as measured on a YSI. At well locations where LNAPL was present at the time of sampling, a 1-inch PVC pipe covered with zip-tied-in-place plastic was inserted into the well below the measured depth of LNAPL. The peristaltic tubing was then lowered through the 1-inch PVC to prevent collection of LNAPL-contaminated groundwater samples.

As requested by NYSDEC in comments to the SIWP on October 9, 2019, GHD provided NYSDEC with the list of wells to be sampled via email on November 26, 2019. The proposed monitoring list was approved by NYSDEC on November 27, 2019. Recovery well RW-1 was included in the original list of wells to be sampled; however, due to sediment issues, could not be sampled after multiple attempts. As such, nearby monitoring well A10 was substituted. Groundwater samples from the ST were analyzed for CP-51 list VOCs by United States Environmental Protection Agency (USEPA) Method 8260C, CP-51 list SVOCs by USEPA Method 8270D, iron by USEPA Method 6010, total organic carbon by Standard Method 5310C, nitrate and sulfate by USEPA Method 300, sulfide by Standard Method 4500, dissolved methane and carbon dioxide by method RSK-175, and petroleum degrader microbe count by Standard Method 9215B. In addition, groundwater samples were collected from MW-2S, MW-2D, MW-3S, MW-6S, MW-10I, RW-5, A10, and S4 on the ST portion of the Site to evaluate current conditions and natural source zone depletion (NSZD) parameters.

Groundwater samples were collected from NT monitoring wells BMW-5, BMW-12, BMW-13, BMW-14R, and piezometer PZ-102S for analysis of Commissioner Policy (CP)-51 list volatile organic compounds (VOCs) by USEPA Method 8260C, CP-51 list semi-volatile organic compounds (SVOCs) by USEPA Method 8270D, and lead via USEPA Method 6010D.

Groundwater samples for VOCs, SVOCs, lead, total organic carbon, sulfate, sulfide, nitrate, dissolved methane, and dissolved carbon dioxide were submitted to TestAmerica of Canton, Ohio, a New York State Department of Health (NYSDOH) Environmental Laboratory Accreditation Program (ELAP)-certified laboratory, for analysis under chain of custody procedures. Analysis of petroleum degrader microbe count was performed by GHD. Analytical laboratory reports will be provided in the Revised Remedial Action Work Plan (RAWP) or at the request of NYSDEC.

Purge and development water was transferred to on-Site totes for temporary storage prior to off-Site disposal.

LNAPL Sample Collection

On December 12, 2019, GHD notified NYSDEC via email that LNAPL samples, not originally outlined in the SIWP, would be collected. Samples were collected from monitoring wells MWA, A10, A14, and MW-5S for analysis of CP-51 list VOCs by USEPA Method 8260C, fractionated volatile petroleum hydrocarbons (VPH) by Massachusetts Department of Environmental Protection (MADEP) Method VPH-18-2.1, and fractionated extractable petroleum hydrocarbons (EPH) by MADEP Method EPH-04-1. An LNAPL analytical summary is included as Table 4. Analytical laboratory reports will be provided in the Revised RAWP or at the request of NYSDEC.

2.2.3 Hydraulic Conductivity Testing

Single-well hydraulic conductivity estimates were obtained for NT wells BMW-12, BMW-13, and BMW-14R and at newly-installed deep nested monitoring wells (gravel zone) MW-1D, MW-4D, and MW-9D on the ST. Hydraulic conductivity estimates were collected via rising and falling head slug tests in which a known volume of water was displaced in the well by inserting a PVC slug. The water level change was measured using a down-hole pressure transducer and oil-water interface probe. Following equilibration, the slug was removed and the water level rise in the well was monitored. Multiple slug tests were conducted to support analysis of data. Testing data were imported into Aqtesolv®, which incorporates the monitoring well construction data and the recovery time into an unconfined solution to estimate hydraulic conductivity. Complete testing data will be provided in the Revised RAWP. Backup data can be provided at the request of NYSDEC.

On the NT, hydraulic conductivity ranged from $5.39x10^{-4}$ centimeters per second (cm/s) at BMW-12 to $2.30x10^{-3}$ cm/s at BMW-14R. Hydraulic conductivity values for the deep wells on the ST ranged from $1.86x10^{-4}$ cm/s at MW-1D to $1.63x10^{-3}$ cm/s at MW-4D. A summary of hydraulic conductivity values is presented in Table 5.

2.2.4 LNAPL Baildown Tests

To support the assessment of LNAPL mobility and recoverability at the Site, LNAPL baildown tests were conducted to determine LNAPL transmissivities in wells in the LNAPL zone. Monitoring wells A13 and S3 and recovery wells RW-1 and RW-5 were chosen based on overall location and the presence of greater than 6 inches of LNAPL at the time of testing, pursuant to best practices in ASTM E2856-13: *Standard Guide for Evaluation of LNAPL Transmissivity* (May 2013) . Baildown tests were performed at wells A13, S3, and RW-5 between December 11 and 13, 2019; the test at RW-1 was completed on January 31, 2020.

Analysis of the LNAPL baildown results was performed following American Society for Testing and Materials (ASTM) guidance E2856-13, and LNAPL transmissivity was estimated using the American Petroleum Institute's (API's) *LNAPL Transmissivity Workbook: Calculation of LNAPL Transmissivity from Baildown Test Data* (API Workbook, September 2012). As summarized in Table 6, LNAPL transmissivity (T_n) values for the wells were less than the Interstate Technology and Regulatory Council (ITRC) *de minimis* criterion of 0.8 square foot per day (ft^2/day). Transmissivity values between 0.1 to 0.8 ft^2/day are typically indicative of less mobile, lower recoverability LNAPL present at residual saturations. These LNAPL transmissivity results provide a line of evidence that the bulk of the LNAPL in the area of the tested wells is present as unrecoverable residual. This is consistent with the fine grained nature of the soils in this area. Complete testing data will be provided in the Revised RAWP. Backup data can be provided at the request of NYSDEC.

2.2.5 Grain Size Sample Collection and Analysis

On January 28, 2020, GHD informed NYSDEC via email that sediment samples would be collected from up to ten monitoring wells for grain size analysis. Sedimentation appeared to be an issue in newly-installed monitoring and recovery wells following development, and the samples were collected to assist in determining potential sediment load in system design. Sediment in new wells was agitated within the water column of each well and pumped into 5-gallon buckets and was allowed to settle out. The buckets were allowed to settle for 72 hours before the water was decanted and sediment was collected for analysis. Sediment samples to be analyzed for grain size distribution were shipped to Integrated Geosciences Laboratories, Inc. of Houston, Texas under chain of custody procedure. Grain size data is summarized in Table 7. Analysis and analytical reports will be provided in the Revised RAWP or can be provided at the request of NYSDEC.

Additional monitoring well development in conjunction with LNAPL recovery events have reduced sedimentation rates to a point where it appears that it is no longer an issue. GHD will continue to monitor potential sedimentation during future recovery and skimming events, however, at this time no further activities specifically focused on addressing sedimentation infiltration are planned.

2.3 Phase III

LNAPL Recovery

As part of the SI and at the request of NYSDEC, GHD is conducting LNAPL recovery activities at the Site. GHD is utilizing Sessler Environmental Services, LLC (Sessler) to perform vacuum-enhanced fluid recovery (VEFR) events at newly-installed recovery wells. Weekly events have occurred on February 3, 17, and 24, and March 3, 11, 23, and 30, 2020. A weekly event was not performed February 10, 2020, as weather conditions prohibited truck access to the Site. Recovery wells included in weekly events include RW-1 through RW-3 and RW-5. At this time, RW-4 contains insufficient LNAPL for VEFR. A summary of VEFR events and recovered LNAPL volumes is included as Table 8. A total of approximately 250 gallons of LNAPL and 2,030 gallons of groundwater have been extracted to date. Groundwater and LNAPL recovered during VEFR events are transferred off Site for disposal as discussed in Section 2.4.

The decline in LNAPL recovery over time is consistent with the low LNAPL transmissivity in the formation and suggests that LNAPL recharge to the well is controlled by the low LNAPL transmissivity of the predominantly finer grained materials. As discussed further below, this supports the use of less energy intensive methods (e.g. skimming) which, if operated continuously, are more compatible with these low LNAPL transmissivities (recovery of LNAPL at rates consistent with the later parts of the recovery cycle observed during the VEFR events).

2.4 Investigation Derived Waste

Soil generated during soil boring installation was transferred to a 30-cubic yard (CY) roll-off container for characterization and off-Site disposal. Soil will be transported to Covanta Environmental Solutions LLC (CES) of Oriskany, New York for incineration and landfill or to Niagara Falls, New York for energy-from-waste then landfill pending profile approval. Sediment generated during monitoring well development is located in 55-gallon drums on Site and will be transported to CES pending approved profile.

Groundwater and LNAPL generated during monitoring well development and sampling was transferred to on-Site 275-gallon totes for off-Site disposal. Groundwater and LNAPL were removed from totes via vacuum-truck during a regularly-scheduled LNAPL recovery event. Petroleum/water mixture is transported to CES of Oriskany, New York. The petroleum fraction is stripped and processed for recycling, and groundwater is treated then discharged to the local publicly-owned treatment works (POTW). Groundwater manifests to date are located in Attachment C.

2.5 Monitoring Well Abandonment

On February 17, 2020, GHD personnel identified approximately 4.8 feet of LNAPL in newly-installed MW-5D. Prior to that time, no indications of LNAPL, such as elevated PID readings or sheens on purge water had been identified in the deeper-screened zone at the MW-5 cluster, indicating that the presence of LNAPL in the deep well is not indicative of current Site conditions. GHD personnel purged all LNAPL from MW-5D. MW-5D contained approximately 0.6 foot of LNAPL on February 24; 5.1 feet on March 2; and 0.05 on March 11, 2020. LNAPL was purged from the well each time it was observed. A total of approximately 3 gallons has been removed from the deep well. The shallow well within the nested pair, MW-5S, regularly contains 4 to 5 feet of LNAPL.

Due to well construction (i.e., shallow and deep well completed in the same borehole) and Site conditions encountered at the time of well installation (i.e., running sands), it is possible that some bridging of the bentonite seal between the two nested well screened intervals has occurred. As such, GHD abandoned the MW-5S/D pair on March 19, 2020. Nothnagle was on Site to perform well abandonment. The protective casing was removed, and the well was over-drilled to the bottom of the shallow well screen (approximately 15.5 feet bgs). The shallow well PVC screen and riser were removed from the boring. The well was then over-drilled to the bottom of the deep well screen, approximately 21 feet bgs. The PVC screen and riser were removed. The boring was then backfilled with cement grout, applied in 5-foot lifts via tremie. A monitoring well abandonment log is included in Attachment B. Monitoring wells MW-5S and MW-5D will be replaced at a later date as wells in separate borings.

3. Conclusions and Recommendations

Based on field observations and data collected during implementation of the SIWP, the spatial distribution of LNAPL is illustrated on Figure 3. LNAPL is observed: 1) beneath Hillside Drive; 2) beneath the southern boundary of the Northern Terminal; and 3) beneath the ST property. The greatest thicknesses of LNAPL are observed in the former ST tank farm areas, but impacts in these areas are primarily contained within lower conductivity (relative to the wells in Hillside Drive) soils. Overall, the boundaries of the plume exhibit less than 1 foot of LNAPL thickness with the exception of an area beneath the NT at BMW-5 and a narrow core running east-west between monitoring wells AMW5 and S9 through the center of the plume, south of Hillside Road. The western extent of the LNAPL plume (as illustrated on Figure 3) is currently undefined by the available monitoring well array. The direction of groundwater flow (generally to the south) is consistent with historic data, with a steeper hydraulic gradient generally observed beneath the NT as compared to the ST.

Exceedances of Class GA Groundwater Standards, as presented in Technical and Operational Guidance Series (TOGS 1.1.1) for VOCs, were detected in wells located on the NT and ST. The detection of elevated VOC concentrations in the deep gravel layer highlight a concern regarding the potential spreading of dissolved petroleum hydrocarbons if groundwater is reinjected in this zone in conjunction with the previously proposed remedial approach (i.e., vacuum-enhanced groundwater extraction).

The population of petroleum degrading microbes in samples collected from ST wells is sufficient to support biodegradation of petroleum hydrocarbons. Concentrations of dissolved carbon dioxide and methane are indicative that the microbes are active and NSZD is occurring. This is likely to be due to a combination of aerobic degradation and methanogenesis in areas of negative redox conditions.

Recommendations

Based on data collected to date, GHD recommends the following activities at the Site going forward.

- *Continued VEFR Events at the Site* – As discussed with NSYDEC on March 11, 2020, GHD will discontinue weekly VEFR events. Going forward, events will occur on a biweekly basis, and are currently scheduled for April 13 and 27 and May 11 and 26, 2020. At this time, and consistent with low LNAPL transmissivities observed in monitoring and recovery wells on Site, vacuum events extract on average approximately 10 gallons of LNAPL and 65 gallons of water per recovery well per event (refer to Table 8). More recent extraction events have resulted in lower LNAPL recoveries, on the order of approximately 2 to 3 gallons per well. .
- *Installation of Delineation Wells* – Installation of delineation wells to confirm the western extent of the LNAPL plume. Three well clusters will be installed as shown on Figure 4 (two contingent well cluster locations are depicted on Figure 4 pending the data obtained from the initial three well pairs). Reinstallation of MW-5S and MW-5D will occur at this time, and GHD will evaluate if Site conditions have improved sufficiently for installation of the MW-8 cluster. Each cluster will contain a shallow well to monitor LNAPL conditions as well as a deep well, screened in the gravel zone.
- *Installation and Operation of Automated LNAPL Skimmers* – Low LNAPL recoveries during VEFR events indicate that the wells would be suitable for more passive methods of LNAPL removal, such as skimmers. Automated LNAPL skimmers should be installed at approximately ten wells in various locations on Site that consistently exhibit a LNAPL thickness greater than 1 foot. The automated devices will: 1) facilitate more effective LNAPL recovery (to the extent practicable); 2) allow less frequent monitoring, once extraction rates are determined; 3) limit the amount of excess groundwater generated for disposal; and 4) if appropriate, can be incorporated into an alternative remedial strategy. Installation and operation of LNAPL skimmers would result in cessation of VEFR events.

An updated project schedule is included as Attachment D.

4. References

AECOM, 2014. Pilot Test Summary Report, Cold Springs Terminals, Lysander, New York, NYSDEC Spill # 89-04923

American Petroleum Institute (API), 2016. API LNAPL Transmissivity Workbook: A Tool for Baildown Test Analysis

ASTM International, 2013. Standard Guide for Estimation of LNAPL Transmissivity, E2856-13

GHD, 2019. Monitoring Well Assessment and LNAPL Gauging Event Letter Report, Southern Terminals, Cold Springs Terminal Site, Hillside Road, Lysander, New York

GHD, 2019. Supplement Investigation Work Plan, Cold Springs Terminal Site, Hillside Road, Lysander, New York, NYSDEC Spill No. 89-04923

Groundwater & Environmental Services, Inc. (GES), 2015. Remedial Action Work Plan, Cold Springs Terminal, Lysander, New York, NYSDEC Spills Incident #89-04923

Please do not hesitate to contact us with questions or if additional information is needed.

Sincerely,

GHD

Alyssa Cruikshank

AC/adh-eew/3
*Encl.

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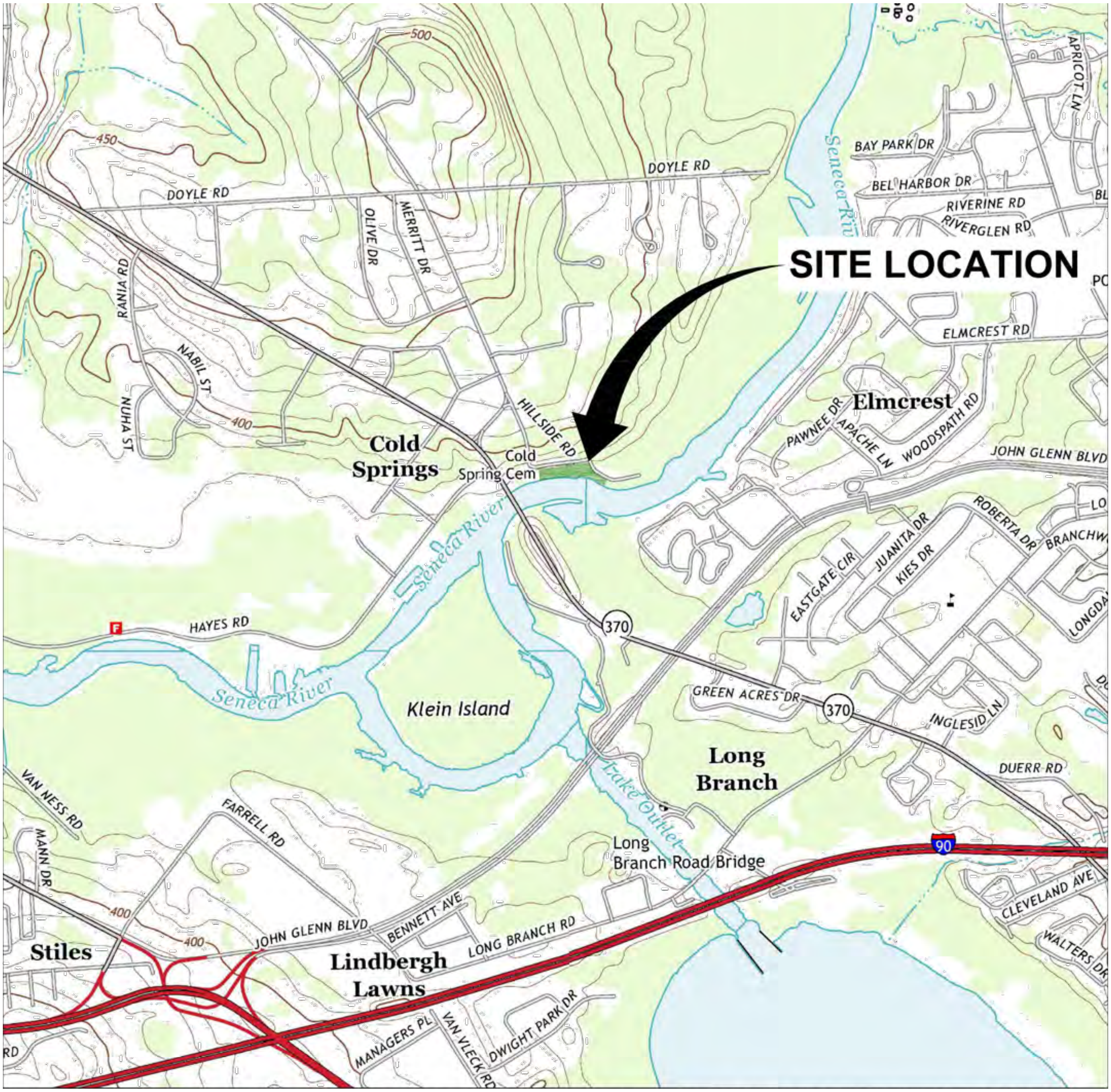
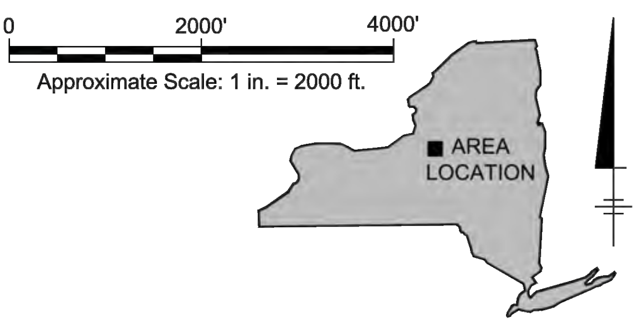
*List of Enclosures:

Figure 1 - Site Location Map
Figure 2 - Site Map
Figure 3 - Apparent LNAPL Thickness - December 2-5, 2019
Figure 4 - Proposed Monitoring Well Locations
Table 1 - LNAPL Thicknesses
Table 2 - Groundwater Analytical Summary
Table 3 - Petroleum Degrader Count Summary
Table 4 - LNAPL Analytical Summary
Table 5 - Hydraulic Conductivity Summary
Table 6 - LNAPL Transmissivity Summary
Table 7 - Grain Size Analysis Summary
Table 8 - LNAPL Recovery
Attachment A - Supplemental Investigation Work Plan
Attachment B - Boring and Well Construction Logs
Attachment C - Groundwater Disposal Manifests
Attachment D - Project Schedule



REFERENCE: BASE MAP USGS 7.5. MIN. TOPO. QUAD., BALDWINSVILLE, BREWERTON, CAMILLUS & SYRACUSE WEST, NY, 2013.



NEW YORK

2019Q1-Title Block

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

SITE LOCATION MAP

Project No. **111-37172**
Report No. **001**
Date **JUL 19**

FIGURE 1

Filename: P:\Drawings\10000000s\11137172 - Cold Springs\Report 1\CADD\Drawings\Figures\Report Figures\11137172 - Figures.dwg
Plot Date: 2 August 2019 - 1:36 PM

LEGEND

BMW2	MONITORING WELL
MW-5S/D	WELL ABANDONED
MW-1S/D	NESTED MONITORING WELL LOCATION
RW-4	RECOVERY WELL LOCATION
MW-8S/D	WELL NOT INSTALLED

NOTE:

TWO A6 SHOWN ON FIGURE

N

0 100'

GHD

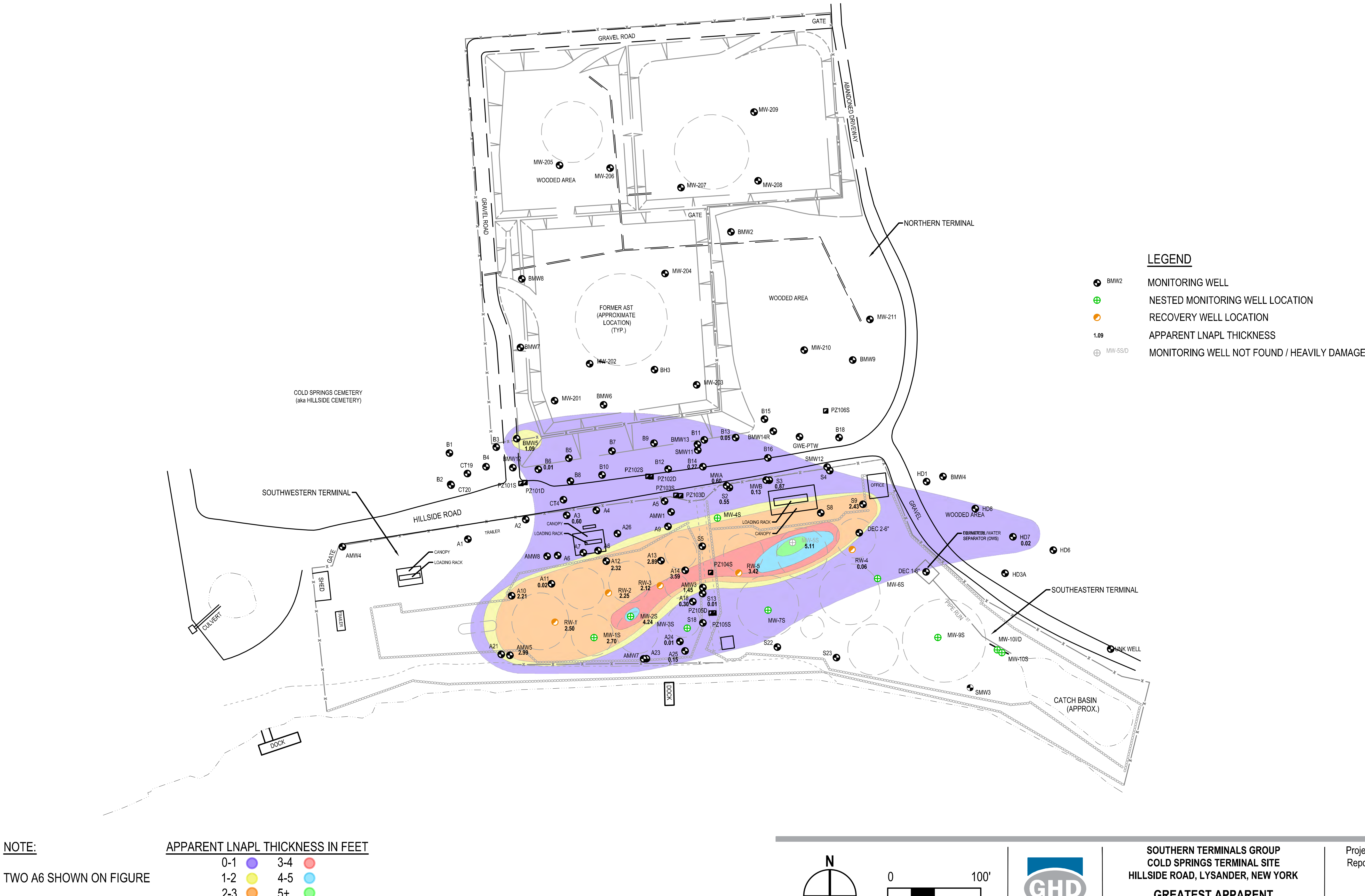
SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

SITE MAP

Project No. **111-37172**
Report No. **003**
Date **MAR 20**

FIGURE 2

Filename: N:\US\Buffalo\Legacy\Drawings-NIA\Drawings\10000000s\11137172 - Cold Springs\Report 3\CADD\Drawings\Figures\Report Figures\11137172 - Figure2.dwg
Plot Date: 13 March 2020 - 1:14 PM



SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

GREATEST APPARENT LNAPL THICKNESSES DECEMBER 2019-MARCH 2020

Project No. 111-37172
Report No. 003
Date MAR 20

FIGURE 3

Filename: C:\US\Buffalo\Legacy\Drawings-NIA\Drawings\10000000s\11137172 - Cold Springs\Report 3\CADD\Drawings\Figures\Report Figures\11137172 - Figure3(3-25-20).dwg
Plot Date: 27 March 2020 - 5:22 PM

NOTE:

TWO A6 SHOWN ON FIGURE

N

0 100'

GHD

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

PROPOSED MONITORING WELL LOCATIONS

Project No. 111-37172
Report No. 003
Date MAR 20

FIGURE 4

Filename: C:\US\Buffalo\Legacy\Drawings-NIA\Drawings\10000000s\11137172 - Cold Springs\Report 3\CADD\Drawings\Figures\Report Figures\11137172 - Figure4.dwg
Plot Date: 25 March 2020 - 7:58 PM

Table 1

LNAPL Thicknesses
Southern Terminal
Lysander, New York

Monitoring Well ID	Date	Measuring Point Elevation (feet AMSL)	Depth to Product (feet BMP)	Depth to Water (feet BMP)	Well Total Depth (feet BMP)	Apparent LNAPL Thickness (feet)	Groundwater Elevation (feet AMSL)	Corrected Groundwater Elevation(1) (feet AMSL)
Southern Terminals								
A1	12/2/2019(2)	377.43	-	-	-	-	-	-
	3/11/2020		-	6.76	-	-	370.67	-
	3/16/2020		-	8.15	-	-	369.28	-
	3/23/2020		-	9.35	-	-	368.08	-
A2	12/2/2019(2)	379.22	-	-	-	-	-	-
	3/11/2020		-	9.78	-	-	369.44	-
	3/16/2020		-	10.68	-	-	368.54	-
	3/23/2020		-	11.04	-	-	368.18	-
	3/30/2020		-	7.68	11.95	-	371.54	-
A3	12/2/2019(2)	379.45	-	-	-	-	-	-
	3/11/2020		13.99	14.45	-	0.46	365.00	365.36
	3/16/2020		14.10	14.61	-	0.51	364.84	365.24
	3/23/2020		14.50	15.10	-	0.60	364.35	364.82
	3/30/2020		14.48	15.08	-	0.60	364.37	364.84
A4	12/2/2019(2)	378.91	-	-	-	-	-	-
	3/11/2020		DRY		10.58	-	-	-
	3/16/2020		DRY		10.60	-	-	-
	3/23/2020		DRY		10.58	-	-	-
	3/30/2020		DRY		10.59	-	-	-
A5	12/2/2019	378.37	-	14.58	19.17	-	363.79	-
	3/11/2020		-	12.76	-	-	365.61	-
	3/16/2020		-	13.06	-	-	365.31	-
	3/23/2020		-	13.58	-	-	364.79	-
	3/30/2020		-	12.99	19.12	-	365.38	-
A6-West(3)	12/2/2019	378.16	-	12.05	12.17	-	366.11	-
	3/11/2020		-	11.95	-	-	366.21	-
	3/16/2020		-	11.97	-	-	366.19	-
	3/23/2020		-	11.99	12.12	-	366.17	-
A6-East(3)	12/2/2019	-	-	-	-	-	-	-
A7	12/2/2019	377.99	-	11.63	11.80	-	366.36	-
	3/11/2020		-	11.58	-	-	366.41	-
	3/16/2020		-	11.58	-	-	366.41	-
	3/23/2020		-	11.60	-	-	366.39	-
	3/30/2020		-	11.59	11.75	-	366.40	-
A9	12/2/2019	376.67	-	12.81	17.30	-	363.86	-
	3/11/2020		-	11.15	-	-	365.52	-
	3/16/2020		-	11.32	-	-	365.35	-
	3/23/2020		-	11.85	-	-	364.82	-
	3/30/2020		-	11.27	17.30	-	365.40	-
A10	12/2/2019	373.17	9.32	10.48	14.38	1.16	362.69	363.61
	2/17/2020		8.35	10.44	-	2.09	362.73	364.38
	2/24/2010		8.31	10.35	-	2.04	362.82	364.43
	3/2/2020		7.94	10.10	-	2.16	363.07	364.78
	3/11/2020		7.78	9.99	-	2.21	363.18	364.93
	3/16/2020		8.00	10.14	-	2.14	363.03	364.72
	3/23/2020		8.57	10.55	-	1.98	362.62	364.18
	3/30/2020		8.36	10.30	14.37	1.94	362.87	364.40

Table 1

LNAPL Thicknesses
Southern Terminal
Lysander, New York

Monitoring Well ID	Date	Measuring Point Elevation (feet AMSL)	Depth to Product (feet BMP)	Depth to Water (feet BMP)	Well Total Depth (feet BMP)	Apparent LNAPL Thickness (feet)	Groundwater Elevation (feet AMSL)	Corrected Groundwater Elevation(1) (feet AMSL)
Southern Terminals								
A11	12/2/2019	374.01	-	10.36	16.47	-	363.65	-
	2/17/2020		-	9.47	-	-	364.54	-
	2/24/2020		-	9.45	-	-	364.56	-
	3/2/2020		9.11	9.13	-	0.02	364.88	364.90
	3/11/2020		-	8.94	-	-	365.07	-
	3/16/2020		-	9.12	-	-	364.89	-
	3/23/2020		-	9.65	-	-	364.36	-
	3/30/2020		-	9.48	16.44		364.53	-
A12	12/2/2019(2)	373.63	-	-	-	-	-	-
	2/17/2020		8.68	11.00	-	2.32	362.63	364.46
	2/24/2020		8.73	10.96	-	2.23	362.67	364.43
	3/2/2020		8.30	10.45	-	2.15	363.18	364.88
	3/11/2020		8.08	9.93	-	1.85	363.70	365.16
	3/16/2020		8.30	9.36	-	1.06	364.27	365.11
	3/23/1930		8.95	10.73	-	1.78	362.90	364.31
	3/30/2020		8.80	10.59	15.99	1.79	363.04	364.45
A13	12/2/2019	375.07	10.99	13.88	21.55	2.89	361.19	363.47
	2/17/2020		10.37	11.45	-	1.08	363.62	364.47
	2/24/2020		10.38	11.50	-	1.12	363.57	364.45
	3/2/2020		10.07	11.20	-	1.13	363.87	364.76
	3/11/2020		9.84	10.97	-	1.13	364.10	364.99
	3/16/2020		10.00	11.14	-	1.14	363.93	364.83
	3/23/2020		10.55	11.67	-	1.12	363.40	364.28
	3/30/2020		10.40	11.51	21.35	1.11	363.56	364.44
A14(4)	12/2/2019	374.00	9.79	13.38	21.69	3.59	360.62	363.46
	2/17/2020		9.21	11.52	-	2.31	362.48	364.30
	2/24/2020		9.13	11.43	-	2.30	362.57	364.39
	3/2/2020		8.85	11.20	-	2.35	362.80	364.66
	3/11/2020		8.67	10.88	-	2.21	363.12	364.87
	3/16/2020		8.93	10.73	-	1.80	363.27	364.69
	3/23/2020		9.64	11.20	-	1.56	362.80	364.03
	3/30/2020		9.35	11.20	-	1.85	362.80	364.26
A18	12/2/2019	373.80	10.21	10.51	19.21	0.30	363.29	363.53
	2/17/2020		9.45	9.73	-	0.28	364.07	364.29
	2/24/2020		9.40	9.68	-	0.28	364.12	364.34
	3/2/2020		9.10	9.35	-	0.25	364.45	364.65
	3/11/2020		8.92	9.15	-	0.23	364.65	364.83
	3/16/2020		9.12	9.40	-	0.28	364.40	364.62
	3/23/2020		9.71	9.97	-	0.26	363.83	364.04
	3/30/2020		9.48	9.75	-	0.27	364.05	364.26
A21	12/2/2019	372.99	-	9.58	15.33	-	363.41	-
	2/17/2020		-	8.90	-	-	364.09	-
	2/24/2020		-	8.90	-	-	364.09	-
	3/11/2020		-	8.38	-	-	364.61	-
	3/16/2020		-	8.78	-	-	364.21	-
	3/23/2020		-	9.29	-	-	363.70	-
	3/30/2020		-	7.90	15.18	-	365.09	-

Table 1

LNAPL Thicknesses
Southern Terminal
Lysander, New York

Monitoring Well ID	Date	Measuring Point Elevation (feet AMSL)	Depth to Product (feet BMP)	Depth to Water (feet BMP)	Well Total Depth (feet BMP)	Apparent LNAPL Thickness (feet)	Groundwater Elevation (feet AMSL)	Corrected Groundwater Elevation(1) (feet AMSL)
Southern Terminals								
A23	12/3/2019	375.81	-	10.77	15.27	-	365.04	-
	2/17/2020		-	9.65	-	-	366.16	-
	2/24/2020		-	9.91	-	-	365.90	-
	3/2/2020		-	9.62	-	-	366.19	-
	3/11/2020		-	9.33	-	-	366.48	-
	3/16/2020		-	9.84	-	-	365.97	-
	3/23/2020		-	10.58	-	-	365.23	-
	3/30/2020		-	10.07	15.23	-	365.74	-
A24	12/2/2019	373.43	-	8.84	13.27	-	364.59	-
	2/17/2020		7.51	7.52	-	0.01	365.91	365.92
	2/24/2020		-	7.54	-	-	365.89	-
	3/2/2020		-	7.05	-	-	366.38	-
	3/11/2020		-	7.10	-	-	366.33	-
	3/16/2020		-	7.45	-	-	365.98	
	3/23/2020		-	8.01	-	-	365.42	-
	3/30/2020		-	7.52	13.28	-	365.91	-
A25	12/2/2019	373.66	9.58	9.59	15.08	0.01	364.07	364.08
	2/17/2020		7.95	8.09	-	0.14	365.57	365.68
	2/24/2020		8.02	8.16	-	0.14	365.50	365.61
	3/2/2020		7.30	7.37	-	0.07	366.29	366.35
	3/11/2020		7.40	7.48	-	0.08	366.18	366.24
	3/16/2020		7.75	7.90	-	0.15	365.76	365.88
	3/23/2020		8.44	8.55	-	0.11	365.11	365.20
	3/30/2020		-	7.94	15.05	-	365.72	-
A26	12/2/2019	378.28	-	6.64	6.68	-	371.64	-
	3/11/2020		-	6.63	-	-	371.65	-
	3/16/2020		-	6.63	-	-	371.65	-
	3/23/2020		-	6.64	-	-	371.64	-
	3/30/2020		-	6.64	6.67	-	371.64	-
AMW1	12/2/2019	377.30	-	13.44	15.40	-	363.86	-
	3/11/2020		-	11.71	-	-	365.59	-
	3/16/2020		-	11.87	-	-	365.43	-
	3/23/2020		-	12.40	-	-	364.90	-
	3/30/2020		-	11.32	-	-	365.98	-
AMW3	12/5/2019	373.44	9.80	11.25	15.27	1.45	362.19	363.34
AMW4	12/2/2019(2)	378.43	-	-	-	-	-	-
	3/11/2020		-	10.48	-	-	367.95	-
	3/16/2020		-	10.77	-	-	367.66	-
	3/23/2020		-	11.20	-	-	367.23	-
	3/30/2020		-	10.65	13.85	-	367.78	-
AMW5	12/2/2019	375.65	11.84	14.77	18.19	2.93	360.88	363.19
	2/17/2020		11.27	14.18	-	2.91	361.47	363.77
	2/24/2020		11.30	14.29	-	2.99	361.36	363.72
	3/2/2020		10.95	13.68	-	2.73	361.97	364.13
	3/11/2020		10.83	13.65	-	2.82	362.00	364.23
	3/16/2020		11.15	13.93	-	2.78	361.72	363.92
	3/23/2020		11.68	14.53	-	2.85	361.12	363.37
	3/30/2020		11.19	14.20	-	3.01	361.45	363.83

Table 1

LNAPL Thicknesses
Southern Terminal
Lysander, New York

Monitoring Well ID	Date	Measuring Point Elevation (feet AMSL)	Depth to Product (feet BMP)	Depth to Water (feet BMP)	Well Total Depth (feet BMP)	Apparent LNAPL Thickness (feet)	Groundwater Elevation (feet AMSL)	Corrected Groundwater Elevation[(1)] (feet AMSL)
Southern Terminals								
AMW7	12/3/2019	375.31	-	11.62	16.64	-	363.69	-
	2/17/2020		-	10.65	-	-	364.66	-
	2/24/2020		-	10.60	-	-	364.71	-
	3/2/2020		-	10.23	-	-	365.08	-
	3/11/2020		-	10.10	-	-	365.21	-
	3/16/2020		-	10.42	-	-	364.89	-
	3/23/2020		-	11.23	-	-	364.08	-
	3/30/2020		-	10.84	16.60	-	364.47	-
AMW8	12/2/2019	378.52	-	14.70	17.06	-	363.82	-
	3/11/2020		-	11.22	-	-	367.30	-
	3/16/2020		-	11.99	-	-	366.53	-
	3/23/2020		-	13.27	-	-	365.25	-
	3/30/2020		-	11.87	17.06	-	366.65	-
DEC 1-6"	12/2/2019	373.97	-	8.91	13.68	-	365.06	-
	2/17/2020		-	5.30	-	-	368.67	-
	2/24/2020		-	5.43	-	-	368.54	-
	3/2/2020		-	FROZEN AT 4.90'		-	-	-
	3/11/2020		-	5.08	-	-	368.89	-
	3/16/2020		-	5.46	-	-	368.51	-
	3/23/2020		-	5.80	-	-	368.17	-
	3/30/2020		-	4.73	13.65	-	369.24	-
DEC 2-6"	12/2/2019	372.01	-	7.27	12.04	-	364.74	-
	2/17/2020		-	FROZEN AT 3.22'		-	-	-
	2/24/2020		-	FROZEN AT 3.10'		-	-	-
	3/2/2020		-	FROZEN AT 3.10'		-	-	-
	3/11/2020		-	3.24	-	-	368.77	-
	3/16/2020		-	3.81	-	-	368.20	-
	3/23/2020		-	3.85	-	-	368.16	-
	3/30/2020		-	3.02	12.00	-	368.99	-
MWA	12/2/2019	376.57	12.62	13.22	14.44	0.60	363.35	363.82
	3/11/2020		11.11	11.19	-	0.08	365.38	365.44
	3/16/2020		11.27	11.36	-	0.09	365.21	365.28
	3/23/2020		11.71	11.98	-	0.27	364.59	364.80
	3/30/2020		-	10.96	14.40	-	365.61	-
MWB	12/2/2019	374.74	-	9.88	13.13	-	364.86	-
	3/11/2020		-	8.03	-	-	366.71	-
	3/16/2020		9.42	9.55	-	0.13	365.19	365.29
	3/23/2020		-	9.98	-	-	364.76	-
	3/30/2020		-	8.24	13.05	-	366.50	-
MW-1S	12/2/2019	373.50	-	10.11	16.93	-	363.39	-
	2/17/2020		8.92	11.42	16.95	2.50	362.08	364.06
	2/24/2020		8.94	11.60	16.95	2.66	361.90	364.00
	3/2/2020		8.69	10.93	-	2.24	362.57	364.34
	3/11/2020		8.58	10.42	16.92	1.84	363.08	364.53
	3/16/2020		8.80	10.89	16.92	2.09	362.61	364.26
	3/23/2020		9.25	11.95	-	2.70	361.55	363.68
	3/30/2020		9.13	11.77	16.92	2.64	361.73	363.82

Table 1

LNAPL Thicknesses
Southern Terminal
Lysander, New York

Monitoring Well ID	Date	Measuring Point Elevation (feet AMSL)	Depth to Product (feet BMP)	Depth to Water (feet BMP)	Well Total Depth (feet BMP)	Apparent LNAPL Thickness (feet)	Groundwater Elevation (feet AMSL)	Corrected Groundwater Elevation(1) (feet AMSL)
Southern Terminals								
MW-1D	12/2/2019	373.44	-	10.11	29.67	-	363.33	-
	2/17/2020		-	9.42	-	-	364.02	-
	2/24/2020		-	9.42	-	-	364.02	-
	3/2/2020		-	9.10	-	-	364.34	-
	3/11/2020		-	8.92	29.68	-	364.52	-
	3/16/2020		-	9.14	29.61	-	364.30	-
	3/23/2020		-	9.75	-	-	363.69	-
	3/30/2020		-	9.58	29.84	-	363.86	-
MW-2S	12/2/2019	374.22	10.65	10.66	16.57	0.01	363.56	363.57
	2/17/2020		9.32	12.36	18.13	3.04	361.86	364.26
	2/24/2020		9.32	12.48	18.05	3.16	361.74	364.24
	3/2/2020		9.15	11.55	-	2.40	362.67	364.57
	3/11/2020		8.94	11.25	18.15	2.31	362.97	364.79
	3/16/2020		9.05	12.00	18.13	2.95	362.22	364.55
	3/23/2020		9.36	13.60	-	4.24	360.62	363.97
	3/30/2020		9.34	12.85	18.12	3.51	361.37	364.14
MW-2D	12/2/2019	374.38	-	10.91	29.39	-	363.47	-
	2/17/2020		-	10.17	-	-	364.21	-
	2/24/2020		-	10.18	-	-	364.20	-
	3/2/2020		-	9.83	-	-	364.55	-
	3/11/2020		-	9.61	29.40	-	364.77	-
	3/16/2020		-	9.83	29.38	-	364.55	-
	3/23/2020		-	10.42	-	-	363.96	-
	3/30/2020		-	10.25	29.38	-	364.13	-
MW-3S	12/2/2019	373.76	-	10.04	18.32	-	363.72	-
	2/17/2020		-	9.15	18.33	-	364.61	-
	2/24/2020		-	9.12	18.30	-	364.64	-
	3/2/2020		-	8.79	-	-	364.97	-
	3/11/2020		-	8.69	18.35	-	365.07	-
	3/16/2020		-	8.95	18.32	-	364.81	-
	3/23/2020		-	9.53	-	-	364.23	-
	3/30/2020		-	9.20	18.32	-	364.56	-
MW-3D	12/2/2019	373.73	-	10.30	31.82	-	363.43	-
	2/17/2020		-	9.58	-	-	364.15	-
	2/24/2020		-	9.56	-	-	364.17	-
	3/2/2020		-	9.24	-	-	364.49	-
	3/11/2020		-	9.04	31.87	-	364.69	-
	3/16/2020		-	9.25	31.85	-	364.48	-
	3/23/2020		-	9.86	-	-	363.87	-
	3/30/2020		-	9.67	31.88	-	364.06	-

Table 1

LNAPL Thicknesses
Southern Terminal
Lysander, New York

Monitoring Well ID	Date	Measuring Point Elevation (feet AMSL)	Depth to Product (feet BMP)	Depth to Water (feet BMP)	Well Total Depth (feet BMP)	Apparent LNAPL Thickness (feet)	Groundwater Elevation (feet AMSL)	Corrected Groundwater Elevation(1) (feet AMSL)
Southern Terminals								
MW-4S	12/2/2019	378.32	-	14.45	19.48	-	363.87	-
	2/17/2020		-	13.28	19.72	-	365.04	-
	2/24/2020		-	13.17	19.71	-	365.15	-
	3/2/2020		-	12.85	-	-	365.47	-
	3/11/2020		-	12.66	19.73	-	365.66	-
	3/16/2020		-	12.93	19.72	-	365.39	-
	3/23/2020		-	13.45	-	-	364.87	-
	3/30/2020		-	13.04	19.71	-	365.28	-
MW-4D	12/2/2019	378.32	-	14.58	27.59	-	363.74	-
	2/17/2020		-	13.63	-	-	364.69	-
	2/24/2020		-	13.60	-	-	364.72	-
	3/2/2020		-	13.29	-	-	365.03	-
	3/11/2020		-	13.03	27.45	-	365.29	-
	3/16/2020		-	13.21	27.45	-	365.11	-
	3/23/2020		-	13.78	-	-	364.54	-
	3/30/2020		-	13.63	27.45	-	364.69	-
MW-5S	12/2/2019	373.16	8.72	11.21	18.24	2.49	361.95	363.92
	2/17/2020		7.55	11.73	18.20	4.18	361.43	364.73
	2/24/2020		7.31	12.25	18.27	4.94	360.91	364.81
	3/2/2020		6.94	12.05	-	5.11	361.11	365.15
	3/11/2020		7.12	10.66	18.27	3.54	362.50	365.30
	3/16/2020		7.59	9.98	18.20	2.39	363.18	365.07
MW-5D	12/2/2019	373.18	-	9.41	24.18	-	363.77	-
	2/17/2020		7.49	12.30	-	4.81	360.88	364.68
	2/24/2020		8.40	9.04	-	0.64	364.14	364.65
	3/2/2020		7.08	12.15	-	5.07	361.03	365.04
	3/11/2020		8.02	8.07	24.05	0.05	365.11	365.15
	3/16/2020		-	8.22	24.00	-	364.96	-
MW-6S	12/2/2019	372.00	-	8.22	17.34	-	363.78	-
	2/17/2020		-	7.48	17.33	-	364.52	-
	2/24/2020		-	7.46	17.33	-	364.54	-
	3/2/2020		-	7.14	-	-	364.86	-
	3/11/2020		-	6.98	17.33	-	365.02	-
	3/16/2020		-	7.17	17.32	-	364.83	-
	3/23/2020		-	7.73	-	-	364.27	-
	3/30/2020		-	7.55	17.35	-	364.45	-
MW-6D	12/2/2019	372.07	-	8.38	30.02	-	363.69	-
	2/17/2020		-	7.67	-	-	364.40	-
	2/24/2020		-	7.66	-	-	364.41	-
	3/2/2020		-	7.34	-	-	364.73	-
	3/11/2020		-	7.17	30.01	-	364.90	-
	3/16/2020		-	7.36	30.02	-	364.71	-
	3/23/2020		-	7.95	-	-	364.12	-
	3/30/2020		-	7.75	30.02	-	364.32	-

Table 1

LNAPL Thicknesses
Southern Terminal
Lysander, New York

Monitoring Well ID	Date	Measuring Point Elevation (feet AMSL)	Depth to Product (feet BMP)	Depth to Water (feet BMP)	Well Total Depth (feet BMP)	Apparent LNAPL Thickness (feet)	Groundwater Elevation (feet AMSL)	Corrected Groundwater Elevation(1) (feet AMSL)
Southern Terminals								
MW-7S	12/2/2019	371.93	-	8.29	18.22	-	363.64	-
	2/17/2020		-	7.54	-	-	364.39	-
	2/24/2020		-	7.50	18.99	-	364.43	-
	3/2/2020		-	7.20	-	-	364.73	-
	3/11/2020		-	7.01	19.02	-	364.92	-
	3/16/2020		-	7.26	19.00	-	364.67	-
	3/23/2020		-	7.84	-	-	364.09	-
	3/30/2020		-	7.66	19.00	-	364.27	-
MW-7D	12/2/2019	371.97	-	8.48	31.94	-	363.49	-
	2/17/2020		-	7.78	-	-	364.19	-
	2/24/2020		-	7.76	-	-	364.21	-
	3/2/2020		-	7.45	-	-	364.52	-
	3/11/2020		-	7.26	31.95	-	364.71	-
	3/16/2020		-	7.45	31.95	-	364.52	-
	3/23/2020		-	8.07	-	-	363.90	-
	3/30/2020		-	7.89	31.94	-	364.08	-
MW-9S	12/2/2019	371.90	-	8.18	17.53	-	363.72	-
	2/17/2020		-	7.50	17.53	-	364.40	-
	2/24/2020		-	7.44	17.50	-	364.46	-
	3/2/2020		-	7.13	-	-	364.77	-
	3/11/2020		-	7.02	17.50	-	364.88	-
	3/16/2020		-	7.23	17.52	-	364.67	-
	3/23/2020		-	7.77	-	-	364.13	-
	3/30/2020		-	7.55	17.50	-	364.35	-
MW-9D	12/2/2019	371.88	-	8.28	36.07	-	363.60	-
	2/17/2020		-	7.66	-	-	364.22	-
	2/24/2020		-	7.64	-	-	364.24	-
	3/2/2020		-	7.33	-	-	364.55	-
	3/11/2020		-	7.18	36.07	-	364.70	-
	3/16/2020		-	7.38	36.05	-	364.50	-
	3/23/2020		-	7.98	-	-	363.90	-
	3/30/2020		-	7.79	36.08	-	364.09	-
MW-10S	12/2/2019	371.67	-	7.67	16.84	-	364.00	-
	2/17/2020		-	7.07	16.77	-	364.60	-
	2/24/2020		-	7.05	16.77	-	364.62	-
	3/2/2020		-	6.77	-	-	364.90	-
	3/11/2020		-	6.67	16.85	-	365.00	-
	3/16/2020		-	6.87	16.85	-	364.80	-
	3/23/2020		-	7.37	-	-	364.30	-
	3/30/2020		-	7.13	16.83	-	364.54	-
MW-10I	12/2/2019	370.91	-	7.31	30.32	-	363.60	-
	2/17/2020		-	6.73	-	-	364.18	-
	2/24/2020		-	6.72	-	-	364.19	-
	3/2/2020		-	6.41	-	-	364.50	-
	3/11/2020		-	6.26	30.25	-	364.65	-
	3/16/2020		-	6.57	30.28	-	364.34	-
	3/23/2020		-	7.06	-	-	363.85	-
	3/30/2020		-	6.86	30.25	-	364.05	-

Table 1

LNAPL Thicknesses
Southern Terminal
Lysander, New York

Monitoring Well ID	Date	Measuring Point Elevation (feet AMSL)	Depth to Product (feet BMP)	Depth to Water (feet BMP)	Well Total Depth (feet BMP)	Apparent LNAPL Thickness (feet)	Groundwater Elevation (feet AMSL)	Corrected Groundwater Elevation(1) (feet AMSL)
Southern Terminals								
MW-10D	12/2/2019	370.97	-	7.33	37.16	-	363.64	-
	2/17/2020		-	6.66	-	-	364.31	-
	2/24/2020		-	6.76	-	-	364.21	-
	3/2/2020		-	6.45	-	-	364.52	-
	3/11/2020		-	6.30	37.12	-	364.67	-
	3/16/2020		-	6.52	37.13	-	364.45	-
	3/23/2020		-	7.03	-	-	363.94	-
	3/30/2020		-	6.90	37.14	-	364.07	-
PZ103S	12/2/2019(2)	377.79	-	-	-	-	-	-
PZ103D	12/2/2019(2)	377.76	-	-	-	-	-	-
PZ104S	12/2/2019(2)	-	-	-	-	-	-	-
PZ105S	12/5/2019	373.57	-	9.41	20.02	-	364.16	-
PZ105D	12/5/2019	373.53	-	10.31	26.78	-	363.22	-
RW-1	12/2/2019	373.37	9.43	11.93	16.81	2.50	361.44	363.42
	2/17/2020		8.87	11.02	17.17	2.15	362.35	364.05
	2/24/2020		9.00	10.43	16.98	1.43	362.94	364.07
	3/2/2020		8.71	10.40	-	1.69	362.97	364.31
	3/11/2020		8.55	9.57	17.23	1.02	363.80	364.61
	3/16/2020		8.83	9.68	17.27	0.85	363.69	364.36
	3/23/2020		9.37	10.38	-	1.01	362.99	363.79
	3/30/2020		9.16	10.11	17.23	0.95	363.26	364.01
RW-2	12/2/2019	372.78	-	9.18	15.05	-	363.60	-
	2/17/2020		7.96	10.21	17.10	2.25	362.57	364.35
	2/24/2020		8.20	9.22	17.18	1.02	363.56	364.37
	3/2/2020		7.98	8.68	-	0.70	364.10	364.65
	3/11/2020		7.77	8.18	17.29	0.41	364.60	364.92
	3/16/2020		7.95	8.40	17.32	0.45	364.38	364.74
	3/23/2020		8.46	9.30	-	0.84	363.48	364.14
	3/30/2020		8.34	8.91	17.31	0.57	363.87	364.32
RW-3	12/2/2019	373.32	9.51	10.58	17.17	1.07	362.74	363.59
	2/17/2020		8.52	10.64	17.11	2.12	362.68	364.35
	2/24/2020		8.62	10.11	17.15	1.49	363.21	364.39
	3/2/2020		8.38	9.50	-	1.12	363.82	364.70
	3/11/2020		8.21	9.11	17.18	0.90	364.21	364.92
	3/16/2020		8.42	9.23	17.24	0.81	364.09	364.73
	3/23/2020		8.91	10.02	-	1.11	363.30	364.18
	3/30/2020		8.74	9.88	17.25	1.14	363.44	364.34
RW-4	12/2/2019	372.54	-	8.63	16.68	-	363.91	-
	2/17/2020		7.61	7.66	16.50	0.05	364.88	364.92
	2/24/2020		7.56	7.61	-	0.05	364.93	364.97
	3/2/2020		7.24	7.30	-	0.06	365.24	365.29
	3/11/2020		7.06	7.10	16.42	0.04	365.44	365.47
	3/16/2020		7.30	7.36	16.40	0.06	365.18	365.23
	3/23/2020		7.78	7.83	-	0.05	364.71	364.75
	3/30/2020		7.48	7.55	16.40	0.07	364.99	365.05

Table 1

LNAPL Thicknesses
Southern Terminal
Lysander, New York

Monitoring Well ID	Date	Measuring Point Elevation (feet AMSL)	Depth to Product (feet BMP)	Depth to Water (feet BMP)	Well Total Depth (feet BMP)	Apparent LNAPL Thickness (feet)	Groundwater Elevation (feet AMSL)	Corrected Groundwater Elevation(1) (feet AMSL)
Southern Terminals								
RW-5	12/2/2019	372.49	7.29	10.71	17.30	3.42	361.78	364.48
	2/17/2020		7.55	9.57	17.14	2.02	362.92	364.52
	2/24/2020		7.60	8.98	-	1.38	363.51	364.60
	3/2/2020		7.30	8.77	-	1.47	363.72	364.88
	3/11/2020		7.14	8.44	17.28	1.30	364.05	365.08
	3/16/2020		7.48	8.19	17.42	0.71	364.30	364.86
	3/23/2020		8.00	8.85	-	0.85	363.64	364.31
	3/30/2020		7.68	8.68	17.45	1.00	363.81	364.60
S2	12/2/2019	376.83	12.96	12.97	20.28	0.01	363.86	363.87
	3/11/2020		11.27	11.82	-	0.55	365.01	365.44
	3/16/2020		11.45	11.98	-	0.53	364.85	365.27
	3/23/2020		11.98	12.52	-	0.54	364.31	364.74
	3/30/2020		-	11.64	20.22	-	365.19	-
S3	12/2/2019	375.19	11.28	11.81	17.90	0.53	363.38	363.80
	3/11/2020		-	9.58	-	-	365.61	-
	3/16/2020		9.79	10.66	-	0.87	364.53	365.22
	3/23/2020		10.35	11.12	-	0.77	364.07	364.68
	3/30/2020		10.19	10.90	-	0.71	364.29	364.85
S4	12/2/2019	374.22	-	10.13	17.48	-	364.09	-
	3/11/2020		CANNOT DETERMINE DUE TO BIOFOULING FILM				-	-
	3/16/2020		-	8.23	-	-	365.99	-
	3/23/2020		-	8.61	-	-	365.61	
	3/30/2020		-	5.74	17.42	-	368.48	-
S5	12/5/2019	375.535	-	11.72	16.67	-	363.82	-
S8	12/2/2019(2)	372.87	-	-	-	-	-	-
	3/11/2020		-	6.78	-	-	366.09	-
	3/16/2020		-	7.38	-	-	365.49	-
	3/23/2020		-	7.42	-	-	365.45	-
	3/30/2020		-	6.56	16.60	-	366.31	-
S9	12/2/2019(2)	372.18	-	-	-	-	-	-
	3/11/2020		5.90	8.33	-	2.43	363.85	365.77
	3/16/2020		6.28	8.60	-	2.32	363.58	365.41
	3/23/2020		6.85	9.12	-	2.27	363.06	364.85
	3/30/2020		6.00	8.45	-	2.45	363.73	365.67
S13	12/3/2019	372.72	9.34	9.35	15.89	0.01	363.37	363.38
S18	12/2/2019(2)	373.98	-	-	-	-	-	-
S22	12/2/2019(2)	-	-	-	-	-	-	-
S23	12/2/2019(5)	370.34	-	OBSTRUCTED AT 1.47'		-	-	-
SMW12	12/2/2019(2)	373.77	-	-	-	-	-	-
	3/23/2020		-	5.16	-	-	368.61	-
	3/30/2020		-	3.80	13.50	-	369.97	-
SMW3(4)	12/2/2019(2)	370.79	-	-	-	-	-	-
	3/11/2020		-	6.15	-	-	364.64	-
	3/16/2020		-	6.41	-	-	364.38	-
	3/23/2020		-	6.72	-	-	364.07	-
	3/30/2020		-	5.90	10.85	-	364.89	-

Table 1

LNAPL Thicknesses
Southern Terminal
Lysander, New York

Monitoring Well ID	Date	Measuring Point Elevation (feet AMSL)	Depth to Product (feet BMP)	Depth to Water (feet BMP)	Well Total Depth (feet BMP)	Apparent LNAPL Thickness (feet)	Groundwater Elevation (feet AMSL)	Corrected Groundwater Elevation(1) (feet AMSL)
Northern Terminal								
B3	12/2/2019(2)	378.10	-	-	-	-	0.00	-
B4	12/2/2019	382.47	-	17.61	23.51	-	364.86	-
B5	12/5/2019	385.41	-	21.57	26.70	-	363.84	-
B6	12/2/2019	381.50	17.36	17.37	23.79	0.01	364.13	364.14
B7	12/2/2019	385.36	-	21.54	22.90	-	363.82	-
B8	12/5/2019	377.50	-	13.82	19.79	-	363.68	-
B9	12/2/2019	385.40	-	21.57	21.63	-	363.83	-
B10	12/2/2019(2)	377.98	-	-	-	-	-	-
B11	12/2/2019	382.33	-	18.48	21.36	-	363.85	-
B12	12/2/2019(2)	377.21	-	-	-	-	-	-
B13	12/2/2019	381.91	16.04	16.09	21.44	0.05	365.82	365.86
B14	12/3/2019	376.02	12.25	12.52	23.23	0.27	363.50	363.71
B15	12/2/2019	382.09	-	17.17	18.66	-	364.92	-
B16	12/2/2019(2)	373.72	-	-	-	-	-	-
B18	12/2/2019(2)	373.03	-	-	-	-	-	-
BH3	12/2/2019	395.45	-	20.36	29.91	-	375.09	-
BMW2	12/2/2019	398.72	-	8.47	37.69	-	390.25	-
BMW4	12/2/2019	374.13	-	8.94	14.47	-	365.19	-
BMW5	12/2/2019	389.58	24.99	26.08	31.52	1.09	363.50	364.36
BMW6	12/2/2019	395.04	-	30.31	32.34	-	364.73	-
BMW7	12/2/2019	397.75	-	11.5	17.19	-	386.25	-
BMW8	12/2/2019	400.10	-	9.41	22.62	-	390.69	-
BMW9	12/2/2019	380.28	-	3.63	17.71	-	376.65	-
BMW12	12/2/2019	385.32	-	20.94	25.61	-	364.38	-
BMW13	12/2/2019	382.69	-	18.84	25.41	-	363.85	-
BMW14R	12/2/2019	379.96	-	15.93	19.83	-	364.03	-
CT4	12/2/2019(5)	379.55	-	DRY OR OBSTRUCTED AT 5.34'		-	-	-
CT19	12/2/2019(2)	381.96	-	-	-	-	-	-
CT20	12/2/2019(2)	381.53	-	-	-	-	-	-
GWE-PTW	12/2/2019(2)	374.06	-	-	-	-	-	-
HD1	12/2/2019	373.20	-	2.44	3.77	-	370.76	-
HD3A	12/2/2019	369.00	-	1.57	11.58	-	367.43	-
HD6	12/2/2019	368.62	-	4.03	6.13	-	364.59	-
HD7	12/2/2019	369.12	4.09	4.11	6.41	0.02	365.01	365.03
HD8	12/2/2019	371.97	-	4.38	6.39	-	367.59	-
MW-201	12/2/2019	395.38	-	26.43	26.70	-	368.95	-
MW-202	12/2/2019	395.42	-	15.28	18.30	-	380.14	-
MW-203	12/2/2019	394.38	-	DRY	20.41	-	-	-
MW-204	12/2/2019	395.02	-	4.98	21.77	-	390.04	-
MW-205	12/2/2019	398.05	-	5.26	22.65	-	392.79	-
MW-206	12/2/2019	397.87	-	1.86	22.81	-	396.01	-
MW-207	12/2/2019	398.65	-	4.08	22.62	-	394.57	-
MW-208	12/2/2019	397.23	-	4.63	22.07	-	392.60	-
MW-209	12/2/2019	399.74	-	3.09	24.80	-	396.65	-

Table 1

LNAPL Thicknesses
Southern Terminal
Lysander, New York

Monitoring Well ID	Date	Measuring Point Elevation (feet AMSL)	Depth to Product (feet BMP)	Depth to Water (feet BMP)	Well Total Depth (feet BMP)	Apparent LNAPL Thickness (feet)	Groundwater Elevation (feet AMSL)	Corrected Groundwater Elevation(1) (feet AMSL)
Northern Terminal								
MW-210	12/2/2019	386.72	-	9.64	20.06	-	377.08	-
MW-211	12/2/2019	387.40	-	7.48	17.27	-	379.92	-
PZ101S	12/2/2019(2)	379.47	-	-	-	-	-	-
PZ101D	12/2/2019(2)	379.52	-	-	-	-	-	-
PZ102D	12/3/2019	378.08	-	14.34	23.92	-	363.74	-
PZ102S	12/3/2019	378.24	-	14.51	17.85	-	363.73	-
PZ106S	12/2/2019(2)	374.15	-	-	-	-	-	-
SMW11	12/2/2019(2)	380.80	-	-	-	-	-	-
UNK WELL	12/2/2019	369.80	-	4.92	14.14	-	364.88	-

Notes

(1) Corrected groundwater elevation = Elevation + (LNAPL density [0.79] x NAPL thickness)
(2) Monitoring well could not be located due to snow accumulation
(3) Two A6 monitoring wells identified on historical maps
(4) Well used for monitoring LNAPL thicknesses only
(5) Monitoring well located but not gauged

Acronyms and Abbreviations

feet AMSL = Feet above mean sea level
feet BMP = Feet Below Measuring Point
- = No data available
DRY = Well dry at time of gauging
LNAPL = Light Non-aqueous Phase Liquids

Table 2

Groundwater Analytical Summary
Cold Springs Terminal
Lysander, New York

Sample Location: / Sample Date:	Units	TOGS 1.1.1 [1]	Southern Terminal MW-2S 12/4/2019	MW-2D 12/4/2019	MW-3S 12/4/2019	MW-6S 12/4/2019	MW-10I 12/3/2019	RW-5 12/4/2019	A10 12/4/2019	S4 12/3/2019	Northern Terminal BMW-5 12/13/2019	BMW-12 12/3/2019	BMW-13 12/3/2019	BMW-14R 12/3/2019	Northern Terminal PZ102S 12/4/2019
Field Parameters															
Conductivity	mS/cm	NA	0.776	1.037	0.783	0.765	1.607	0.736	0.743	0.312	-	0.828	1.114	1.026	0.77
Dissolved oxygen	mg/L	NA	7.49	6.5	1.15	3.05	NM	1.43	8.79	5.63	-	5.6	3.12	13.08	1.24
Oxidation reduction potential	millivolts	NA	-19.8	-60.3	50.9	57.4	-31.6	94.9	-37.9	14	-	-44.3	-44	-68.3	-46.2
pH	s.u.	NA	7.02	7.15	6.91	6.55	8.43	7.19	6.82	7.13	-	7.53	8.09	7.48	6.82
Temperature	Deg C	NA	9.66	11.21	9.88	9.32	9.36	10.26	10.1	11.33	-	9.72	6.0	6.6	10.31
Turbidity	NTU	NA	15.9	8.33	15.7	5.16	10.2	5.26	5.63	7.77	-	42.6	9.38	8.08	12.9
Volatile Organic Compounds															
1,2,4-Trimethylbenzene	µg/L	5	**920**	**2.4**	**94**	**250**	**370 / 390**	**970**	**1200**	**140**	**1500**	**540**	**1500**	**1500**	**760**
1,3,5-Trimethylbenzene	µg/L	5	**270**	**0.27 J**	**6.5**	**90**	**110 / 110**	**290**	**350**	**2.8 J**	**430**	**300**	**470**	**420**	**230**
sec-Butylbenzene	µg/L	5	<130	**0.78 J**	**5.5**	<40	<100 / <100	<200	<130	**0.58 J**	<100	<40	<400	**11 J**	<130
Benzene	µg/L	1	**5800**	**57**	**57**	**360**	**6500 / 6600**	**5200**	**17 J**	**140**	<100	**6.7 J**	**7500**	<50	**1800**
p-Isopropyltoluene (Cymene)	µg/L	5	<130	<2.0	**2.7**	<40	<100 / <100	<200	<130	<4.0	<100	<40	<400	**9.9 J**	<130
Ethylbenzene	µg/L	5	**1400**	**0.84 J**	**37**	**360**	**1700 / 1700**	**1500**	**1100**	**200**	**1000**	**180**	**1400**	**82**	**810**
Isopropyl benzene	µg/L	5	**57 J**	**6.1**	**29**	**29 J**	**44 J / 46 J**	**58 J**	**58 J**	**7.1**	**59 J**	**9.5 J**	**56 J**	**71**	**35 J**
Methyl tert butyl ether (MTBE)	µg/L	10	<130	<2.0	<2.0	<40	<100 / <100	<200	<130	<4.0	<100	<40	<400	<50	<130
Naphthalene	µg/L	10	**540**	**0.84 J**	**2.2**	**89**	**130 / 140**	**490**	**550**	**47**	**410**	**190**	**530**	**360**	**270**
N-Butylbenzene	µg/L	5	<130	**1.1 J**	**7.5**	<40	<100 / <100	<200	<130	**1.3 J**	<100	<40	<400	**34 J**	<130
N-Propylbenzene	µg/L	5	**120 J**	**7.2**	**29**	**51**	**43 J / 50 J**	**130 J**	**160**	**16**	**180**	**27 J**	**140 J**	**180**	**81 J**
Toluene	µg/L	5	**6900**	**2.6**	**4.0**	**1100**	**850 / 890**	**10,000**	**480**	**14**	**640**	**84**	**21,000**	<50	**3900**
Xylenes (total)	µg/L	5	**6700**	**5.7**	**13**	**1800**	**3500 / 3600**	**7800**	**5500**	**74**	**5000**	**1400**	**11,000**	**430**	**5300**
Semi-Volatile Organic Compounds															
Acenaphthene	µg/L	20	**1.2**	<0.19	**0.59**	**2.2**	<0.77 / <0.74	<1.9	<3.7	<0.19	<3.6	<1.2	<4.0	<1.9	<1.9
Anthracene	µg/L	50	<0.19	<0.19	<0.19	<0.19	<0.77 / <0.74	<1.9	<3.7	<0.19	<3.6	<1.2	<4.0	<1.9	<1.9
Benzo(a)anthracene	µg/L	0.002	<0.19	<0.19	<0.19	<0.19	<0.77 / <0.74	<1.9	<3.7	<0.19	<3.6	<1.2	<4.0	<1.9	<1.9
Benzo(a)pyrene	µg/L	ND	<0.19	<0.19	<0.19	<0.19	<0.77 / <0.74	<1.9	<3.7	<0.19	<3.6	<1.2	<4.0	<1.9	<1.9
Benzo(b)fluoranthene	µg/L	0.002	<0.19	<0.19	<0.19	<0.19	<0.77 / <0.74	<1.9	<3.7	<0.19	<3.6	<1.2	<4.0	<1.9	<1.9
Benzo(g,h,i)perylene	µg/L	NA	<0.19	<0.19	<0.19	<0.19	<0.77 / <0.74	<1.9	<3.7	<0.19	<3.6	<1.2	<4.0	<1.9	<1.9
Benzo(k)fluoranthene	µg/L	0.002	<0.19	<0.19	<0.19	<0.19	<0.77 / <0.74	<1.9	<3.7	<0.19	<3.6	<1.2	<4.0	<1.9	<1.9
Chrysene	µg/L	0.002	<0.19	<0.19	<0.19	<0.19	<0.77 / <0.74	<1.9	<3.7	<0.19	<3.6	<1.2	<4.0	<1.9	<1.9
Dibenz(a,h)anthracene	µg/L	NA	<0.19	<0.19	<0.19	<0.19	<0.77 / <0.74	<1.9	<3.7	<0.19	<3.6	<1.2	<4.0	<1.9	<1.9
Fluoranthene	µg/L	50	<0.19	<0.19	<0.19	<0.19	<0.77 / <0.74	<1.9	<3.7	<0.19	<3.6	<1.2	<4.0	<1.9	<1.9
Fluorene	µg/L	50	**1.8**	<0.19	**0.79**	**2.6**	<0.77 / <0.74	<1.9	<3.7	<0.19	<3.6	<1.2	<4.0	<1.9	<1.9
Indeno(1,2,3-cd)pyrene	µg/L	0.002	<0.19	<0.19	<0.19	<0.19	<0.77 / <0.74	<1.9	<3.7	<0.19	<3.6	<1.2	<4.0	<1.9	<1.9
Naphthalene	µg/L	10	**390**	**1.9**	**1.7**	**34**	**97 / 100**	**310**	**440**	**19**	**580**	**150**	**380**	**290**	**190**
Phenanthrene	µg/L	50	1.2	<0.19	<0.19	**0.95**	<0.77 / <0.74	<1.9	<3.7	<0.19	4.9	<1.2	<4.0	<1.9	<1.9
Pyrene	µg/L	50	<0.19	<0.19	<0.19	<0.19	<0.77 / <0.74	<1.9	<3.7	<0.19	<3.6	<1.2	<4.0	<1.9	<1.9
Gasses															
Carbon dioxide	µg/L	NA	**73,000**	**73,000**	**130,000**	**230,000**	**140,000 / 140,000**	**65,000**	**130,000**	**72,000**	-	-	-	-	-
Methane	µg/L	NA	**6600**	**3800**	**7500**	**5400**	**5500 / 5400**	**1600**	**4400**	**3300**	-	-	-	-	-
Metals															
Fe^{2+}	mg/L	NA	**1.05**	**2.29**	**1.00**	**1.26**	**2.12**	**0.02**	**1.59**	**0.93**	-	-	-	**2.52**	-
Lead	µg/L	25	-	-	-	-	-	-	-	-	**280**	**22**	**27**	**3.1 J**	**4.5 J**
Wet Chemistry															
Nitrate (as N)	mg/L	10	<0.10	<0.50	<0.10	<0.10	<0.10 / <0.10	<0.10	<0.10	<0.10	-	-	-	-	-
Sulfate	mg/L	250	**5.2**	**2.8 J**	**4.1**	**6.3**	**6.2 / 6.2**	**16**	**2.9 J**	**13**	-	-	-	-	-
Sulfide	mg/L	0.05	<1.0	<1.0	<1.0	<1.0	<1.5 / <1.0	**1.0**	<1.0	<1.9	-	-	-	-	-
Total organic carbon (TOC)	mg/L	NA	**13**	**4.4**	**10**	**11**	**18 / 17**	**16**	**11**	**4.6**	-	-	-	-	-

Notes

[1] Groundwater Standards and Guidance Values (SGVs) from New York State Department of Environmental Conservation (NYSDEC) Division of Water Technical and Operational Guidance Series (1.1.1), effective June 1998 (with addenda)
Bold values indicate a detection
Shading indicates value exceeds SGV
Two values in same cell indicate duplicate analysis

Data Qualifiers
J = The analyte was positively identified; however, the associated numerical value is an estimated concentration

Acronyms and Abbreviations
mS/cm = millisiemens per centimeter
s.u. = standard unit
Deg C = degrees Celsius
NTU = Nephelometric Turbidity unit
µg/L = micrograms per liter
mg/L = milligrams per liter
NA = not applicable
- = No data were collected

Table 3

Petroleum Degrader Count Summary
Cold Springs Terminal
Lysander, New York

Sample Location:	Units	A10	MW-2S	MW-2D	MW-3S	MW-6S	MW-10I	RW-5	S4
Sample Date:		12/4/2019	12/4/2019	12/4/2019	12/4/2019	12/4/2019	12/3/2019	12/4/2019	12/3/2019
Petroleum Degrader Microbe Count									
Petroleum Hydrocarbon Specific Microbial Population	CFU/mL	1.03E+04	2.17E+03	2.41E+03	2.18E+03	2.11E+04	1.30E+03	1.16E+04	7.22E+03

Notes:

Method 9215B Adapted from Standard Methods for the Examination of Water and Wastewater 17th ed.
Grown on gasoline and diesel vapor
Values are averages of duplicates

Acronyms and Abbreviations
CFU = Colony Forming Units
mL = milliliters

Table 4

LNAPL Analytical Summary
Cold Springs Terminal
Lysander, New York

Sample Location:		A10	A14	MW-5S	MWA
Sample Date:	Units	12/13/2019	12/13/2019	12/13/2019	12/13/2019
Hydrocarbon Fractionation					
C5-C8 Aliphatic	mg/kg	45,400	59,900	78,600	-
C5-C8 Aliphatic, adjusted (1)	mg/kg	44,800	47,700	52,900	-
C9-C10 Aromatic	mg/kg	122,000	87,400	131,000	-
C9-C12 Aliphatic	mg/kg	229,000	168,000	266,000	-
C9-C12 Aliphatic, adjusted (1)	mg/kg	87,000	57,000	103,000	-
C5-C8 Aliphatic	µg/L	-	-	-	909,000
C5-C8 Aliphatic, adjusted (1)	µg/L	-	-	-	790,000
C9-C10 Aromatic	µg/L	-	-	-	12,400,000
C9-C12 Aliphatic	µg/L	-	-	-	22,500,000
C9-C12 Aliphatic, adjusted (1)	µg/L	-	-	-	9,180,000
C9-C18 Aliphatic	mg/kg	346,000	542,000	409,000	332,000
C11-C22 Aromatic	mg/kg	52,800	102,000	58,500	45,000
C11-C22 Aromatic, adjusted (1)	mg/kg	48,000	95,300	52,700	38,900
C19-C36 Aliphatic	mg/kg	18,400	43,800	5720	11,300

Notes
(1) Adjusted results do not include target compounds measured during sample analysis but that are excluded from the carbon fraction based on molecular structure

Acronyms and Abbreviations
mg/kg = milligrams per kilogram
µg/L = micrograms per liter
- = No data were collected
LNAPL - Light non-aqeous phase liquids

Table 5

Hydraulic Conductivity Summary
Cold Springs Terminal
Lysander, New York

Well I.D.	Aquifer Condition	Stratigraphic Interval	Analytical Method [1]	Rising Head Test Hydraulic Conductivity [2] (cm/sec)	Rising Head Test Geometric Mean (cm/sec)	Falling Head Test Hydraulic Conductivity [2] (cm/sec)	Falling Head Test Geometric Mean (cm/sec)
Northern Terminal							
BMW-12	Unconfined	Shallow Overburden	Bouwer-Rice	5.10E-04	5.39E-04	-	-
				5.70E-04		-	
BMW-13	Unconfined	Shallow Overburden	Bouwer-Rice	1.40E-03	1.74E-03	-	-
				3.20E-03		-	
				1.60E-03		-	
				1.60E-03		-	
				1.40E-03		-	
				1.70E-03		-	
BMW-14R	Unconfined	Shallow Overburden	Bouwer-Rice	2.30E-03	2.30E-03	-	-
				2.30E-03		-	
Southern Terminal							
MW-1D	Unconfined	Deep Overburden (Gravel Layer)	Bouwer-Rice	2.00E-04	2.00E-04	1.60E-04	1.86E-04
				2.00E-04		1.90E-04	
				2.00E-04		2.10E-04	
MW-4D	Unconfined	Deep Overburden (Gravel Layer)	Bouwer-Rice	1.60E-03	1.35E-03	1.90E-03	1.63E-03
				1.20E-03		2.10E-03	
				1.10E-03		1.50E-03	
				1.50E-03		1.50E-03	
				1.40E-03		1.30E-03	
MW-9D	Unconfined	Deep Overburden (Gravel Layer)	Bouwer-Rice	9.30E-04	1.31E-03	1.40E-03	1.45E-03
				1.40E-03		8.00E-04	
				1.40E-03		1.70E-03	
				1.40E-03		1.60E-03	
				1.30E-03		1.60E-03	
				1.50E-03		1.90E-03	

Notes

[1] Bouwer, H., and R.C. Rice, 1976. A Slug Test Method for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells, Water Resources Research, vol. 12, no. 3, pp.423-428

[2] Falling head slug tests are considered invalid when the water level is within the screened interval. As a result, falling head test results are not shown for wells with water levels within the screened intervals

Table 6

LNAPL Transmissivity Summary
Cold Springs Terminal
Lysander, New York

Well ID	Date	Initial LNAPL Thickness	Final LNAPL Thickness	LNAPL Transmissivity			Average	Standard Deviation	Coefficient of Variation
				Bouwer- Rice*	Cooper- Jacob	Cooper- Bredehoeft-Papadopulos			
		ft		ft^2/d			ft^2/d		
A13	12/11/2019	2.66	0.19	0.40	0.42	0.42	0.41	0.01	0.02
RW-1	01/31/2020	3.28	0.44	0.39	0.45	0.65	0.49	0.14	0.28
RW-5	12/11/2019	2.99	0.41	0.05	0.02	0.09	0.06	0.03	0.63
S3	12/12/2019	0.53	0.26	0.01	0.83	5.01	1.95	2.68	1.38

Notes

* Bouwer-Rice model provides best fit of data

Acronyms and Abbreviations
ft = feet
ft^2/d = square feet per day

Table 7

Grain Size Analysis Summary
Cold Springs Terminal
Lysander, New York

Well ID[1]	Mean Grain Size Description	Median Grain Size	Particle Size Distribution [2]						Silt and Clay
				Sand Size					
		mm	Gravel	Coarse	Medium	Fine	Silt	Clay	
RW-1	Silt	0.055	0.00	0.00	0.00	25.89	70.76	3.35	74.11
RW-2	Silt	0.048	0.00	0.00	0.00	18.45	76.68	4.87	81.55
RW-4	Silt	0.040	0.00	0.00	0.00	7.15	87.13	5.72	92.85
RW-5	Silt	0.054	0.00	0.00	0.00	26.33	68.87	4.81	73.67
MW-2S	Silt	0.060	0.00	0.00	0.00	35.26	59.85	4.89	64.74
MW-4S	Silt	0.044	0.00	0.00	0.00	19.08	72.17	8.75	80.92
MW-5S	Silt	0.043	0.00	0.00	0.00	17.07	75.78	7.15	82.93
MW-7S	Silt	0.049	0.00	0.00	0.00	23.93	70.65	5.42	76.07

Notes

Samples analyzed via ASTM Method D433/D4464M Laser Analysis
[1] Samples collected from sediment accumulated within monitoring well
[2] Retained weight, percent

Acronyms and Abbreviations
mm = millimeters

Table 8

LNAPL Recovery
Cold Springs Terminal
Lysander, New York

	Units	Date	Recovery Well					Totals
			RW-1	RW-2	RW-3	RW-4	RW-5	
Initial LNAPL Thickness	Feet	02/03/2020	1.17	1.85	2.85	0.05	3.20	*NA*
LNAPL Recovered(1,2)	Gallons		23	-	30	-	23	*76*
Water Removed(1,2)	Gallons		45	-	27	-	44	*116*
Total Removed(1,2)	Gallons		68	-	57	-	67	*192*
Total Duration of Extraction	Minutes		120	-	120	-	120	*360*
Initial LNAPL Thickness	Feet	02/17/2020	2.15	2.25	2.12	0.05	2.02	*NA*
LNAPL Recovered(1,3)	Gallons		5	15	15	-	10	*45*
Water Removed(1,3)	Gallons		45	60	96	-	30	*231*
Gallons Removed(1,3)	Gallons		50	75	111	-	40	*276*
Total Duration of Extraction	Minutes		90	90	90	-	90	*360*
Initial LNAPL Thickness	Feet	02/24/2020	1.43	1.02	1.49	0.05	1.38	*NA*
LNAPL Recovered(1,3)	Gallons		2	9	10	-	2	*23*
Water Removed(1,3)	Gallons		35	35	45	-	15	*130*
Gallons Removed(1,3)	Gallons		37	44	55	-	17	*153*
Total Duration of Extraction	Minutes		90	90	90	-	90	*360*
Initial LNAPL Thickness	Feet	03/02/2020	1.33	0.70	1.12	0.06	1.47	*NA*
LNAPL Recovered(1,4)	Gallons		2	15	10	-	10	*37*
Water Removed(1,4)	Gallons		66	85	68	-	90	*309*
Total Removed(1,4)	Gallons		68	100	78	-	100	*346*
Total Duration of Extraction	Minutes		25	25	25	-	30	*105*
Initial LNAPL Thickness	Feet	03/11/2020	1.02	0.41	0.90	0.04	1.30	*NA*
LNAPL Recovered(1,4)	Gallons		12	3	10	-	8	*33*
Water Removed(1,4)	Gallons		56	97	100	-	82	*335*
Total Removed(1,4)	Gallons		68	100	110	-	90	*368*
Total Duration of Extraction	Minutes		30	25	30	-	30	*115*
Initial LNAPL Thickness	Feet	03/16/2020	0.85	0.45	0.81	0.06	0.71	*NA*
LNAPL Recovered(1,4)	Gallons		2	2	3	-	3	*10*
Water Removed(1,4)	Gallons		54	83	49	-	92	*278*
Total Removed(1,4)	Gallons		56	85	52	-	95	*288*
Total Duration of Extraction	Minutes		30	25	30	-	30	*115*
Initial LNAPL Thickness	Feet	03/23/2020	1.01	0.84	1.11	0.05	0.85	*NA*
LNAPL Recovered(1,4)	Gallons		6	2	2	-	3	*13*
Water Removed(1,4)	Gallons		50	67	65	-	92	*274*
Total Removed(1,4)	Gallons		56	69	67	-	95	*287*
Total Duration of Extraction	Minutes		30	25	30	-	30	*115*

Notes:

(1) Approximate volumes based on measurements of water and LNAPL thickness in vac truck following completion of recovery at each well
(2) LNAPL was recovered by vac truck extraction for a continuous 2-hour period at each well
(3) LNAPL was recovered by vac truck extraction for a continuous 1.5-hour period at each well
(4) LNAPL was recovered by vac truck extraction for multiple cycles of 5 minutes of extraction followed by 15 minutes of recovery

Acronyms and Abbreviations
\- = LNAPL recovery not performed at recovery well during specific recovery event
N/A = not applicable

Attachment A
Supplemental Investigation Work Plan

October 4, 2019 Reference No. 11137172

Mr. Michael Belveg
Assistant Engineer (Environmental)
Division of Environmental Remediation
New York State Department of Environmental Conservation
615 Erie Boulevard West
Syracuse, New York 13204

Dear Mr. Belveg:

Re: Supplemental Investigation Work Plan - Southern Terminals
Cold Springs Terminal Site, Hillside Road, Lysander, New York
NYSDEC Spill No. 89-04923

1. Introduction

On behalf of the Respondents to the Southern Terminals Consent Order executed by the New York State Department of Environmental Conservation (NYSDEC) on August 25, 2016, GHD has prepared this Supplemental Investigation Work Plan for the Cold Springs Terminal Site, located along Hillside Road in Lysander, New York (Site). The purpose of this Work Plan is to collect and evaluate data to refine the remedial strategy for the Site. The Work Plan also addresses the need to replace several wells damaged/destroyed, presumably by the Site Owners and/or their contractors and agents, during aboveground storage tank (AST) removal activities on the Southern Terminal (ST) portion of the Site.

Activities within this Work Plan include:

- Repair/replacement and installation monitoring infrastructure
- Additional data collection activities required to refine the remedial approach and finalize remedial system design
- Light non-aqueous phase liquid (LNAPL) recovery activities
- Submission of a Revised Remedial Action Work Plan (RAWP)

2. Background

The Cold Springs Terminal Site is comprised of three former Petroleum Bulk Storage (PBS) facilities on Hillside Road in the Town of Lysander, Onondaga County, New York. A Site Location Map is provided as Figure 1. A Site Map is included as Figure 2. The terminal occupies approximately 6 total acres, with the Northern Terminal (NT) consisting of 2.75 acres north of Hillside Road, and the Southwestern and Southeastern Terminals, collectively the ST, consisting of approximately 1.75 and 1.6 acres, respectively.

Throughout their operational histories, the facilities handled gasoline, Jet-A fuel, kerosene, diesel, and fuel oil. NYSDEC-mandated environmental activities were initiated following a 1989 spill of an unknown volume of gasoline; however, other spills have been documented. Multiple investigations have occurred during the Site's regulatory history. Historical remedial actions at the Site have included manual and automated LNAPL recovery as well as soil vapor extraction (SVE). These activities were performed adjacent to Hillside Road beneath the southernmost portion of the NT, and in northern portions of the ST properties. Reportedly, over an 18-year period between 1990 and 2008 (prior to the involvement of these Respondents in the response activities at the Site), an estimated 12,800 gallons of LNAPL was removed from Site as liquid and soil vapor (GES, 2015).

In compliance with the NYSDEC-approved Supplemental Site Investigation Work Plan (2012), AECOM performed various Site investigations on the ST properties to determine viability of vacuum-enhanced groundwater extraction (VEGE) and multi-phase extraction (MPE) remedial alternatives for residual LNAPL at the Site (2014). Based on the results of the pilot test, GES (2015) prepared a RAWP for VEGE at approximately 40 groundwater extraction points located on the ST and southern portion of the NT properties.

In June 2019 and pursuant to authorization from NYSDEC, GHD performed a limited Monitoring Well Assessment and LNAPL Gauging Event (GHD, 2019). The purpose of GHD's evaluation was to assess the Site and current monitoring well network conditions. While the majority of NT wells were located, only 49 of the 84 anticipated monitoring wells on the ST property were located. Of those, four monitoring wells could not be gauged as a result of damage and an additional nine wells were observed to be in poor condition. Overall, LNAPL was measured in thicknesses varying from approximately 0.01 feet at S5 to 3.48 feet at A10. The apparent extent of LNAPL is generally consistent with historical observations; however, monitoring wells in several areas of historically observed LNAPL could not be located and/or gauged. As such, GHD has identified a number of monitoring wells for replacement or repair. Summaries of monitoring well conditions and LNAPL measurements collected during the event are included as Tables 1 and 2 and are presented on Figures 3 and 4, respectively.

A follow-up conference call between NYSDEC, GHD, and ST was held on September 11, 2019. At that time, NYSDEC requested that LNAPL recovery begin during 2019. As such, GHD has proposed the installation of recovery wells and vacuum-enhanced fluid recovery (VEFR) events (Section 4.0).

3. Objectives

The objectives of this Supplemental Investigation Work Plan are to collect additional data sufficient to refine the engineering design for the NYSDEC-approved RAWP.

4. Scope of Work

The following sections summarize the Scope of Work for this Supplemental Investigation Work Plan. The investigation is broken into three phases based on field investigation/monitoring infrastructure installation, data collection, and additional remedial activities.

Section 4.1 includes information regarding repair/replacement and installation of monitoring infrastructure required at the Site. Section 4.2 summarizes preliminary additional data collection activities required to refine the remedial approach for the Site and finalize remedial system design. Section 4.3 summaries LNAPL recovery activities and submission of the Revised RAWP.

All activities will be conducted in accordance with NYSDEC *DER-10/Technical Guidance for Site Investigation and Remediation* (DER-10). NYSDEC will be provided with at least one week verbal and written notice of all field activities.

4.1 Phase I

4.1.1 Monitoring Well Repair and Replacement

GHD will repair three ST monitoring wells (A3, A12, A14) identified as damaged during 2019 monitoring well assessment activities. A total of ten nested monitoring well pair locations will be installed in central portions of the Southwestern and Southeastern terminals intended to replace remedial system performance wells (as identified in the NYSDEC-approved RAWP) and/or monitoring wells that historically contained greater than 1 foot of LNAPL that could not be located or were determined to be heavily damaged during the 2019 monitoring well assessment. These wells will also be used to fill in data gaps regarding LNAPL distribution. Five large-diameter wells will be installed for use in conjunction with LNAPL recovery activities.

Prior to initializing any subsurface intrusive activities, GHD or its drilling vendor will complete a New York State One-Call utility mark out to prevent accidental damage to underground utilities. GHD will retain a New York State Licensed drilling contractor to advance soil borings for monitoring and recovery well installation via hollow-stem auger (HSA). Borings will be continuously sampled via MacroCore and disposable acetate sleeves for geologic logging and screening purposes. Each sample will be screened for the presence of volatile organic compounds (VOCs) utilizing a photoionization detector (PID) equipped with a 10.6 eV lamp calibrated to 100 parts per million (ppm) by volume of isobutylene. Borings for monitoring well installation will be advanced to the top of the till layer that underlays the Site at a depth of approximately 20 feet; borings intended for installation of LNAPL recovery wells will be advanced to 12 to 15 feet bgs based on observations of LNAPL and the groundwater table at each location.

Upon completion of soil boring, each boring will be converted to a groundwater monitoring well or LNAPL recovery well. Newly installed monitoring well pairs will be constructed of 2-inch schedule 40 polyvinyl chloride (PVC). Deep wells in the pair will be screened across the gravel layer identified in historical reports as located immediately above the glacial till, e.g., 17 to 20 feet below ground surface (bgs). Shallow monitoring wells will be screened across the groundwater table observed at each boring location, e.g., 5 to 15 feet bgs. Screens will be 0.010-inch slotted (10-slot) well screen. Annular space will be backfilled with #00N sand, bentonite, and grout to the surface. Each well will be fitted with a locking J-plug and finished at the surface with flush-mount well boxes. Nested well pairs will allow the ST Group to evaluate flow patterns and groundwater conditions in different lithological zones as opposed to wells that are screened across multiple zones. Information from wells screened in the gravel zone will also be of assistance in determining if reinjection of extracted and treated groundwater is a viable option during operation of the VEGE system.

Recovery wells will be constructed of a minimum of 6-inch schedule 80 PVC with 10 feet of 10-slot screen spanning the water table and LNAPL zone. Annular space will be backfilled with #00N sand to the top of the well screen, followed by a minimum of one foot of bentonite, and grouted to the surface. Each recovery well will be finished at the surface with a flush-mount well box or manhole, dependent on well size.

Newly installed monitoring and recovery wells will be developed prior to use for sample collection no earlier than 24 hours following installation. A submersible pump will be used to purge each well until temperature, conductivity, pH, and turbidity of the purge water have stabilized as measured on a Yellow Spring Instrument (YSI) water quality meter or similar equipment. Existing wells which may be utilized as part of the monitoring network in the future will also be re-developed.

Investigation-derived waste (IDW) generated during monitoring/recovery well installation will be containerized for characterization and off-Site disposal. Consumable IDW will be disposed of as municipal waste.

A summary of proposed monitoring and recovery wells to be installed is included as Figure 5. Recovery wells on the Southeastern Terminal are contingent on field observations and determinations; however, 2-inch PVC monitoring wells will be installed, at a minimum.

4.1.2 Soil Gas Probe Installation

To facilitate an assessment of deep soil gas concentrations and to support quantification of natural mass losses via vapor losses (both hydrocarbons and biogenic gases) in the subsurface both shallow and deep soil gas probes will be installed on the Southern Terminal property.

A direct-push rig will be utilized to advance up to four soil borings to approximately 2 feet above the LNAPL layer for deep soil gas probe installation. Deep soil gas probes will be constructed utilizing a 6-inch stainless steel soil gas insert with poly tubing to surface. Up to a 1-foot sand pack will be placed around and above the screen, followed by at least 1 foot of bentonite and grout to surface. Up to four additional shallow soil probes will be installed to approximately 1 foot bgs utilizing a 6-inch stainless steel soil gas insert and poly tubing to surface. A 6-inch sand pack will be placed to the top of the screen, followed by bentonite to surface. Each soil gas probe will be finished at the surface with a flush-mount well box. Proposed soil gas probe locations are shown on Figure 6. Soil gas probes on the Southeastern Terminal are contingent on field observations and determinations.

4.1.3 Monitoring Well Survey

Following monitoring well repair and replacement, GHD will retain a New York State Licensed Surveyor to complete a survey of all monitoring wells located on both the NT and ST properties. GHD has reviewed several historical reports for survey data for existing monitoring wells, however conflicting information exists across multiple reports, and the recent demolition activities have changed topographic data such that a full survey is warranted. Survey data will be used to calculate groundwater elevation data for use in Site potentiometric surface contours.

4.2 Phase II

4.2.1 Groundwater and LNAPL Gauging

Approximately two weeks following completion of monitoring well replacement/repair to allow wells to reach equilibrium, a comprehensive groundwater elevation and LNAPL gauging event will be completed. All wells on both the NT and ST will be included in this event. The gauging event will consist of recording the depth to the LNAPL surface (as applicable), depth to the water surface, and total depth of the well using an interface probe. Down-well equipment will be decontaminated between each well location utilizing an Alconox-water solution and tap water rinse.

4.2.2 Groundwater Sample Collection

In order to design a remedial system that will perform most efficiently, more data is required to determine the current flux of constituents of concern (COCs) entering the ST. Groundwater samples will be collected from NT monitoring wells BMW-5, BMW-12, BMW-13, BMW-14R, and piezometer PZ-102S for VOCs by United States Environmental Protection Agency (USEPA) Method 8260, semi-volatile organic compounds (SVOCs) by USEPA Method 8270, and lead via USEPA Method 6010.

In addition, groundwater samples from four to eight groundwater monitoring wells will be collected to evaluate natural source zone depletion (NSZD) on the ST portion of the Site. The monitoring wells will be chosen in source, up- and down-gradient, and cross-gradient areas based on results of the gauging event. If monitoring/recovery wells to be sampled contain LNAPL at the time of the groundwater sample collection, the wells will be bailed of product and allowed to recover. Low-flow sample methodology will be utilized to minimize water table drawdown and potential for free product in samples. Wells will be purged until field parameters of temperature, pH, conductivity, redox potential, and dissolved oxygen stabilize to within 10 percent of the previous reading for three consecutive readings as measured on a YSI (or similar). Measurements will be recorded on a monitoring well sampling log. Samples collected for NSZD evaluation will be analyzed for VOCs by USEPA Method 8260, SVOCs by USEPA Method 8270, total organic carbon, Fe^{2+}, Fe^{3+}, sulfate, sulfide, nitrate, dissolved methane, dissolved carbon dioxide, and petroleum degrader microbe count.

All groundwater samples will be submitted to a New York State Department of Health (NYSDOH) Environmental Laboratory Accreditation Program (ELAP)-certified laboratory for analysis under

Chain-of-Custody procedures. IDW will be containerized for later off-Site disposal. Consumable IDW will be disposed of as municipal waste.

4.2.3 Hydraulic Conductivity Testing

Single-well hydraulic conductivity estimates will be obtained for NT wells BMW-12, BMW-13, and BMW-14R and at two to three newly installed deep nested monitoring wells (gravel zone) on the ST via slug tests. A known volume of water will be displaced in the well by inserting a PVC slug and the water level decline will be measured using a down-hole pressure transducer. Following equilibration, the slug will be removed and the water level rise in the well will be monitored. Multiple slug tests may be conducted in multiple wells to support analysis of data. Slug test displacement and recovery data will be analyzed using AQTESOLV (or similar) software to yield estimates of hydraulic conductivity in each well.

4.2.4 LNAPL Baildown Tests

To support the assessment of LNAPL mobility and recoverability at the site, LNAPL baildown tests will be conducted to determine LNAPL transmissivities in wells in the LNAPL zone. Wells to be tested will be determined following the comprehensive gauging event and will be focused in the area of future VEGE implementation. LNAPL baildown tests will be conducted in compliance with the American Petroleum Institute (API) LNAPL Transmissivity Workbook (2016). Data obtained during baildown tests will be utilized to calculate LNAPL transmissivities for use in system design.

4.2.5 Soil Gas Sample Collection

Soil gas samples will be collected from shallow and deep soil gas probes installed during Phase I of the Supplemental Investigation for NSZD evaluation. Soil gas probes will be purged of three volumes prior to sample collection. Samples will be collected over a one-hour period using individually certified-clean 6-liter Summa® canisters equipped with pre-calibrated flow controllers. The initial vacuum of each Summa® canister will be recorded immediately after opening; the final vacuum immediately prior to closure. Samples will be transported to a NYSDOH ELAP-certified laboratory for analysis of oxygen, carbon dioxide, methane, ethane, VOCs via USEPA Method TO-15, and total petroleum hydrocarbons (PHCs).

4.3 Phase III

4.3.1 LNAPL Recovery

As part of this Supplemental Investigation, ST Group will conduct LNAPL recovery activities at the Site. Based on results obtained during the comprehensive LNAPL and groundwater gauging event discussed in Section 4.2.1, the ST will utilize a subcontractor to perform a minimum of one VEFR event at each of the five newly installed recovery wells (to the extent they demonstrate a significant LNAPL thickness) utilizing a vac-truck. The necessity for additional VEFR events will be determined by weekly gauging at recovery wells within the source area.

LNAPL and water recovered will be transported off-Site for treatment and disposal or recycling.

4.3.2 Revised Remedial Action Work Plan

Upon completion of Phases I and II, a Revised RAWP for NYSDEC approval will be prepared. The Revised RAWP will be submitted to NYSDEC on or before January 17, 2020, based on contractor availability to complete tasks as proposed in this Supplemental Investigation Work Plan.

5. Implementation Schedule

A revised project schedule is included as Attachment A.

6. References

AECOM, 2014. *Pilot Test Summary Report, Cold Springs Terminals, Lysander, New York, NYSDEC Spill #: 89-04923.*

American Petroleum Institute (API), 2016. *API LNAPL Transmissivity Workbook: A Tool for Baildown Test Analysis*.

GHD, 2019. *Monitoring Well Assessment and LNAPL Gauging Event Letter Report, Southern Terminals, Cold Springs Terminal Site, Hillside Road, Lysander, New York.*

Groundwater & Environmental Services, Inc. (GES), 2015. *Remedial Action Work Plan, Cold Springs Terminal, Lysander, New York, NYSDEC Spills Incident #89-04923*.

Please do not hesitate to contact us with questions or if additional information is needed.

Sincerely,

GHD

Alyssa Cruikshank

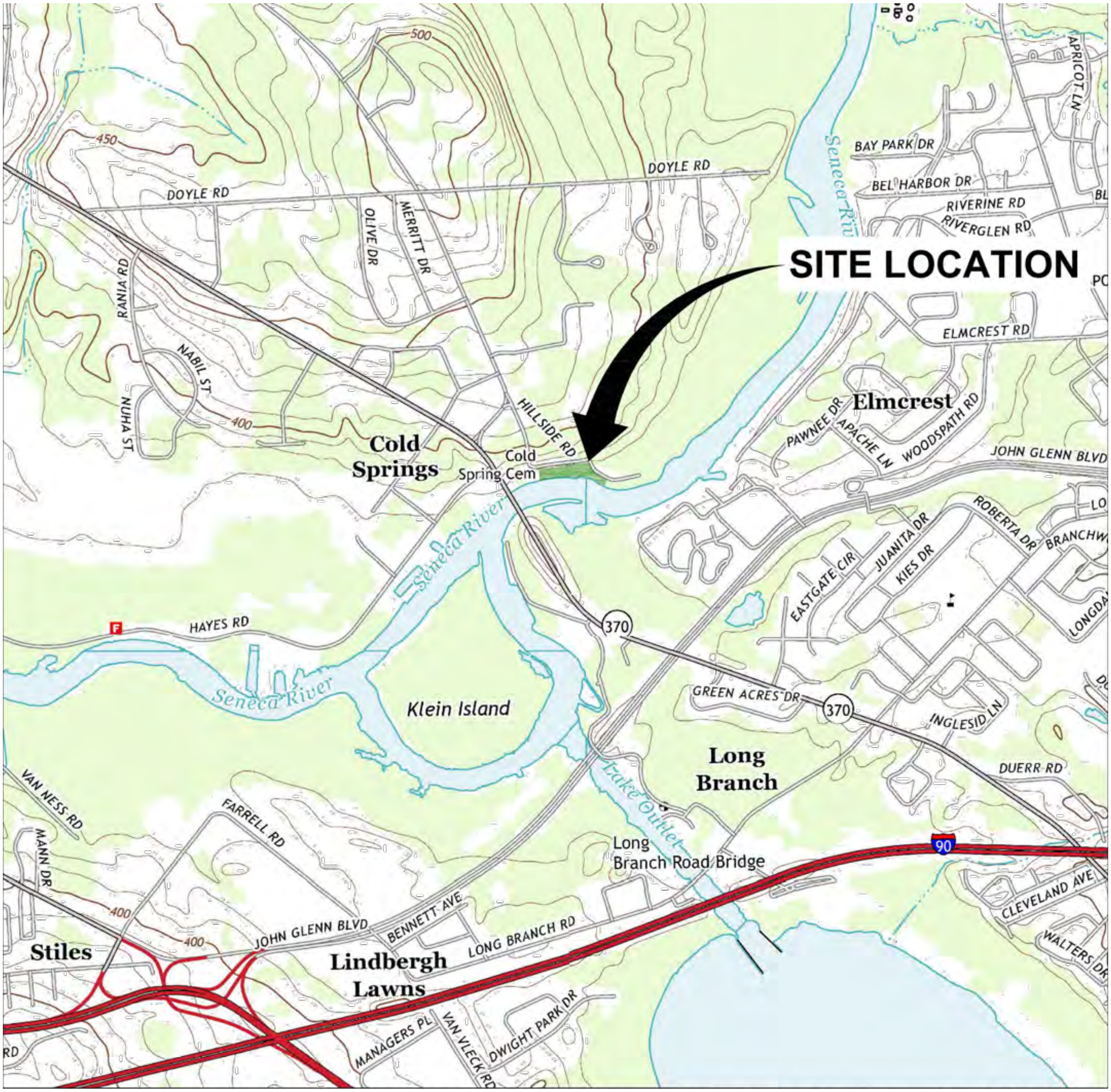
DJH/eew/2

Encl.

Figure 1 – Site Location Map
Figure 2 – Site Map
Figure 3 – 2019 Well Assessment Summary
Figure 4 – Apparent LNAPL Thickness – June 6-7, 2019
Figure 5 – Proposed Monitoring and Recovery Well Locations
Figure 6 – Proposed Soil Gas Probe Locations
Table 1 – Monitoring Well Assessment Status

Table 2 – Apparent LNAPL Thicknesses
Attachment A – Project Schedule

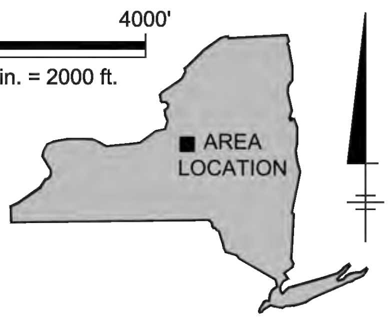
cc: Patrick Dworaczyk, Kinder Morgan
Harry Warner, NYSDEC
Ben Conlon, Esq., NYSDEC
Wendy Marsh, Esq., Hancock Estabrook, LLP
S. David Devaprasad, Esq., Devaprasad pllc
Dennis Hoyt, GHD



REFERENCE: BASE MAP USGS 7.5. MIN. TOPO. QUAD., BALDWINSVILLE, BREWERTON, CAMILLUS & SYRACUSE WEST, NY, 2013.

0 2000' 4000'

Approximate Scale: 1 in. = 2000 ft.



NEW YORK

2019Q1-Title Block

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

SITE LOCATION MAP

Project No. **111-37172**
Report No. **002**
Date **SEP 19**

FIGURE 1

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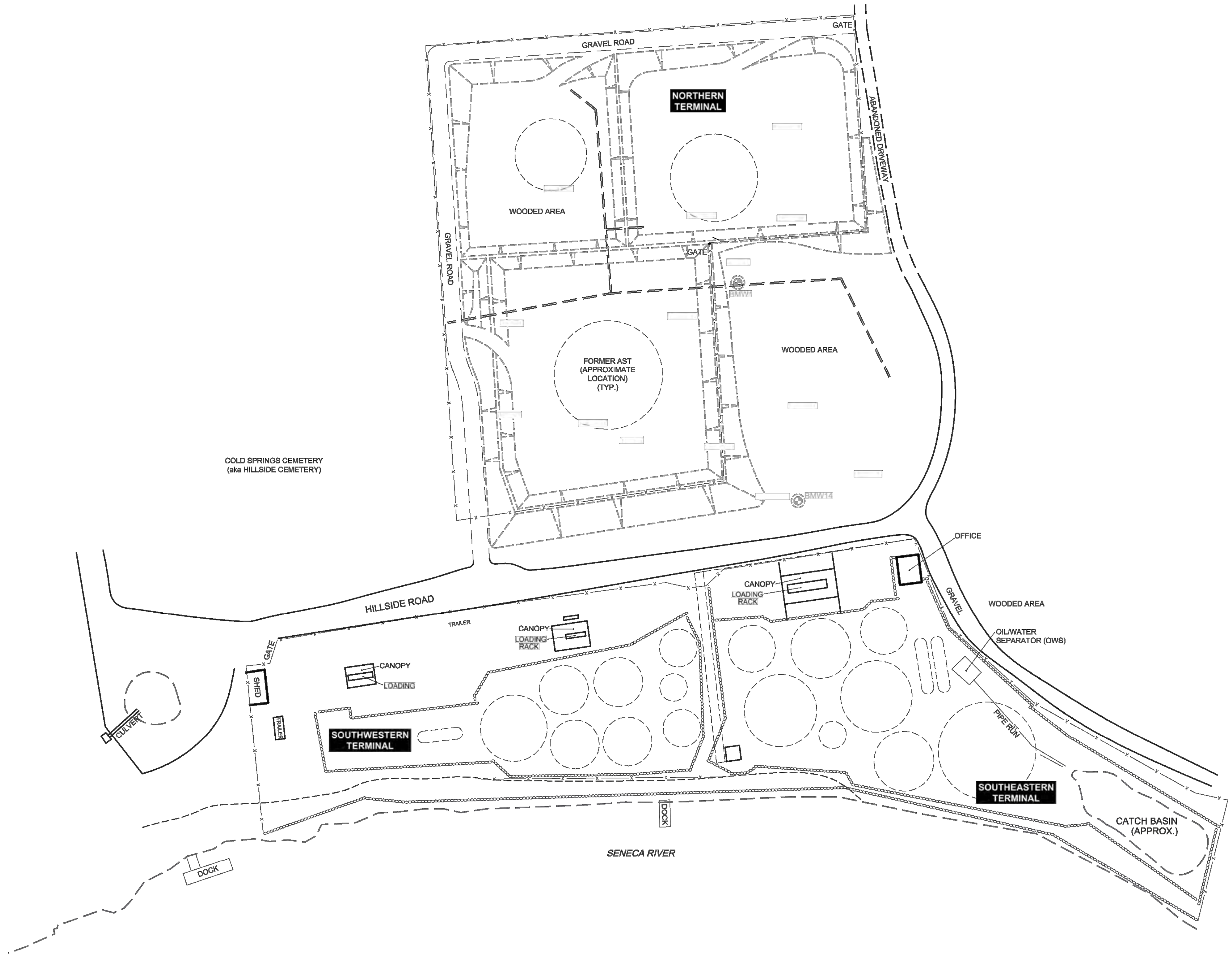
Plot Date: 30 September 2019 - 2:19 PM



GHD

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

SITE MAP

Project No. 111-37172
Report No. 002
Date SEP 19

FIGURE 2

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LEGEND

BMW2 — MONITORING WELL

WELL ASSESSMENT SUMMARY

- WELL FOUND, GOOD CONDITION, GAUGED
- WELL FOUND, GOOD CONDITION, NOT GAUGED
- WELL FOUND, POOR CONDITION, GAUGED
- WELL FOUND, DAMAGED, NOT GAUGED
- WELL NOT FOUND

NOTE:

1. THERE ARE TWO A6 SHOWN ON FIGURE

N

0 100'

GHD

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

WELL ASSESSMENT SUMMARY

Project No. 111-37172
Report No. 002
Date SEP 19

FIGURE 3

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Plot Date: 30 September 2019 - 2:20 PM

LNAPL THICKNESS IN FEET

- 0-1
- 1-2
- 2-3
- 3-4

NOTE:

1. THERE ARE TWO A6 SHOWN ON FIGURE

N

0 100'

GHD

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

APPARENT LNAPL THICKNESS
JUNE 6-7, 2019

Project No. 111-37172
Report No. 002
Date SEP 19

FIGURE 4

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SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

PROPOSED MONITORING WELL AND RECOVERY WELL LOCATIONS

Project No. 111-37172
Report No. 002
Date SEP 19

FIGURE 5

Filename: N:\US\Buffalo\Legacy\Drawings-NIA\Drawings\10000000s\11137172 - Cold Springs\Report 2\CADD\Drawings\Figures\Report Figures\11137172 - Figures.dwg
Plot Date: 30 September 2019 - 2:20 PM

N

0 100'

GHD

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

PROPOSED SOIL GAS PROBE LOCATIONS

Project No. **111-37172**
Report No. **002**
Date **SEP 19**

FIGURE 6

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Table 1

Monitoring Well Assessment Status
Southern Terminal
Lysander, New York
June 5 - 7, 2019

Monitoring Well ID	Southern Terminals Well Located Y	Southern Terminals Well Located N	Poor Condition/ Damaged	Monitoring Well ID	Northern Terminals Well Located Y	Northern Terminals Well Located N	Poor Condition/ Damaged
A1	X			B1	X		
A2	X			B2	X		
A3	X		Y	B3	X		
A4	X			B4	X		
A5	X		Y	B5	X		
A6	X			B6	X		
A6	X			B7	X		
A7	X			B8	X		
A8(1)		X		B9	X		
A9	X			B10	X		
A10	X			B11	X		
A11	X		Y	B12	X		
A12	X		Y	B13	X		
A13	X		Y	B14	X		
A14	X		Y	B15	X		
A15(1)		X		B16	X		
A16(1)		X		B18	X		
A17(1)		X		BH3	X		
A18	X			BMW1	X		
A19(1)		X		BMW2	X		
A20(1)		X		BMW4	X		
A21	X			BMW5	X		
A23	X			BMW6	X		
A24	X		Y	BMW7	X		
A25	X		Y	BMW8	X		
AMW1	X		Y	BMW9	X		
AMW2	X		Y	BMW12	X		
AMW3	X			BMW13	X		
AMW4	X			BMW14	X		
AMW5	X			CT19	X		
AMW6(1)		X		CT20	X		
AMW7	X			GWE-PTW	X		
AMW8	X		Y	HD1	X		
AMW9(1)		X		HD3A	X		
BMW6(1)		X		HD6	X		
BMW-15(1)		X		HD7	X		
CT4	X		Y	HD8	X		
HD4A(1)		X		MW-201	X		
HD5(1)		X		MW-202	X		
MWA	X			MW-203	X		
MWB	X			MW-204	X		
PZ102D	X			MW-205	X		
PZ102S	X			MW-206	X		
PZ103D	X			MW-207	X		
PZ103S	X			MW-208	X		
PZ104D(1)		X		MW-209	X		
PZ104S	X		Y	MW-210	X		

Table 1

Monitoring Well Assessment Status
Southern Terminal
Lysander, New York
June 5 - 7, 2019

Monitoring Well ID	Southern Terminals Well Located Y	N	Poor Condition/ Damaged
PZ105D	X		Y
PZ105S	X		
S1	X		Y
S2	X		
S3	X		Y
S4	X		
S5	X		
S6[1]		X	
S7[1]		X	
S8	X		
S9	X		
S10[1]		X	
S11[1]		X	
S12[1]		X	
S13	X		
S14[1]		X	
S15[1]		X	
S16[1]		X	
S17[1]		X	
S18	X		
S19[1]		X	
S20[1]		X	
S21[1]		X	
S22	X		Y
S23	X		Y
S24[1]		X	
S25[1]		X	
SMW1[1]		X	
SMW2[1]		X	
SMW3	X		Y
SMW4[1]		X	
SMW5[1]		X	
SMW7[1]		X	
SMW8[1]		X	
SMW9[1]		X	
SMW10[1]		X	
SMW12	X		
UNKNOWN 1	X		
UNKNOWN 2	X		
UNKNOWN 3	X		

Monitoring Well ID	Northern Terminals Well Located Y	N	Poor Condition/ Damaged
MW-211	X		
PZ101D	X		
PZ101S	X		
PZ106S	x		
SB2[1]		X	
SMW11	X		
Unknown	X		

Notes:

[1] - Monitoring well not located

Table 2

Monitoring Well Assessment Status
Southern Terminal
Lysander, New York
June 5 - 7, 2019

Monitoring Well ID	Depth to LNAPL (feet bmp)	Depth to Water (feet bmp)	LNAPL Thickness (feet)	Well Total Depth (feet bmp)
A1	-	9.21	-	11.02
A2	-	9.47	-	12.10
A3	12.69	13.55	0.86	13.81
A4	-	DRY	-	10.60
A5	-	11.98	-	17.99
A6	-	-	-	-
A6	-	11.96	-	12.09
A7	-	11.55	-	11.74
A8(1)	-	-	-	-
A9	-	11.42	-	17.24
A10	7.96	11.44	3.48	14.11
A11	-	6.75	-	14.83
A12	6.01	7.18	1.17	13.95
A13	7.52	10.03	2.51	18.85
A14	9.13	11.52	2.39	21.62
A15(1)	-	-	-	-
A16(1)	-	-	-	-
A17(1)	-	-	-	-
A18	9.49	9.83	0.34	19.18
A19(1)	-	-	-	-
A20(1)	-	-	-	-
A21	-	8.80	-	10.33
A23	-	9.28	-	14.84
A24	-	8.15	-	13.04
A25	8.88	8.95	0.07	14.98
AMW1	-	12.11	-	15.38
AMW2(2)	-	-	-	-
AMW3	8.35	11.04	2.69	15.04
AMW4	-	DRY	-	10.19
AMW5	11.44	14.77	3.33	18.15
AMW6(1)	-	-	-	-
AMW7	-	10.38	-	16.49
AMW8	-	12.22	-	16.17
AMW9(1)	-	-	-	-
BMW6(1)	-	-	-	-
BMW-15(1)	-	-	-	-
CT4	-	14.29	-	14.39
HD4A(1)	-	-	-	-
HD5(1)	-	-	-	-
MWA	11.13	11.19	0.06	14.41
MWB	9.55	9.96	0.41	13.05
PZ102D	-	12.88	-	23.88
PZ102S	-	12.93	-	17.81
PZ103D	-	12.65	-	23.87
PZ103S	-	12.43	-	18.75
PZ104D(1)	-	-	-	-

Table 2

Monitoring Well Assessment Status
Southern Terminal
Lysander, New York
June 5 - 7, 2019

Monitoring Well ID	Depth to LNAPL (feet bmp)	Depth to Water (feet bmp)	LNAPL Thickness (feet)	Well Total Depth (feet bmp)
PZ104S	-	8.07	-	18.83
PZ105D	-	9.35	-	26.73
PZ105S	-	8.27	-	19.71
S1(2)	-	-	-	-
S2	11.14	11.71	0.57	18.22
S3	-	7.26	-	15.00
S4	-	6.68	-	10.60
S5	5.55	5.56	0.01	14.40
S6(1)	-	-	-	-
S7(1)	-	-	-	-
S8	-	6.20	-	16.63
S9	7.57	9.13	1.56	20.03
S10(1)	-	-	-	-
S11(1)	-	-	-	-
S12(1)	-	-	-	-
S13	8.19	8.66	0.47	15.19
S14(1)	-	-	-	-
S15(1)	-	-	-	-
S16(1)	-	-	-	-
S17(1)	-	-	-	-
S18	-	8.02	-	15.45
S19(1)	-	-	-	-
S20(1)	-	-	-	-
S21(1)	-	-	-	-
S22(2)	-	-	-	-
S23(2)	-	-	-	-
S24(1)	-	-	-	-
S25(1)	-	-	-	-
SMW1(1)	-	-	-	-
SMW2(1)	-	-	-	-
SMW3	-	6.84	-	17.00
SMW4(1)	-	-	-	-
SMW5(1)	-	-	-	-
SMW7(1)	-	-	-	-
SMW8(1)	-	-	-	-
SMW9(1)	-	-	-	-
SMW10(1)	-	-	-	-
SMW12	-	4.84	-	13.55
UNKNOWN 1	-	5.02	-	13.65
UNKNOWN 2	-	3.1	-	12.09
UNKNOWN 3	-	6.56	-	6.63

Notes:

(1) - Monitoring well not located
(2) - Monitoring located but not gauged due to damage
LNAPL - Light non-aqueous phase liquid

Table 2

Monitoring Well Assessment Status
Southern Terminal
Lysander, New York
June 5 - 7, 2019

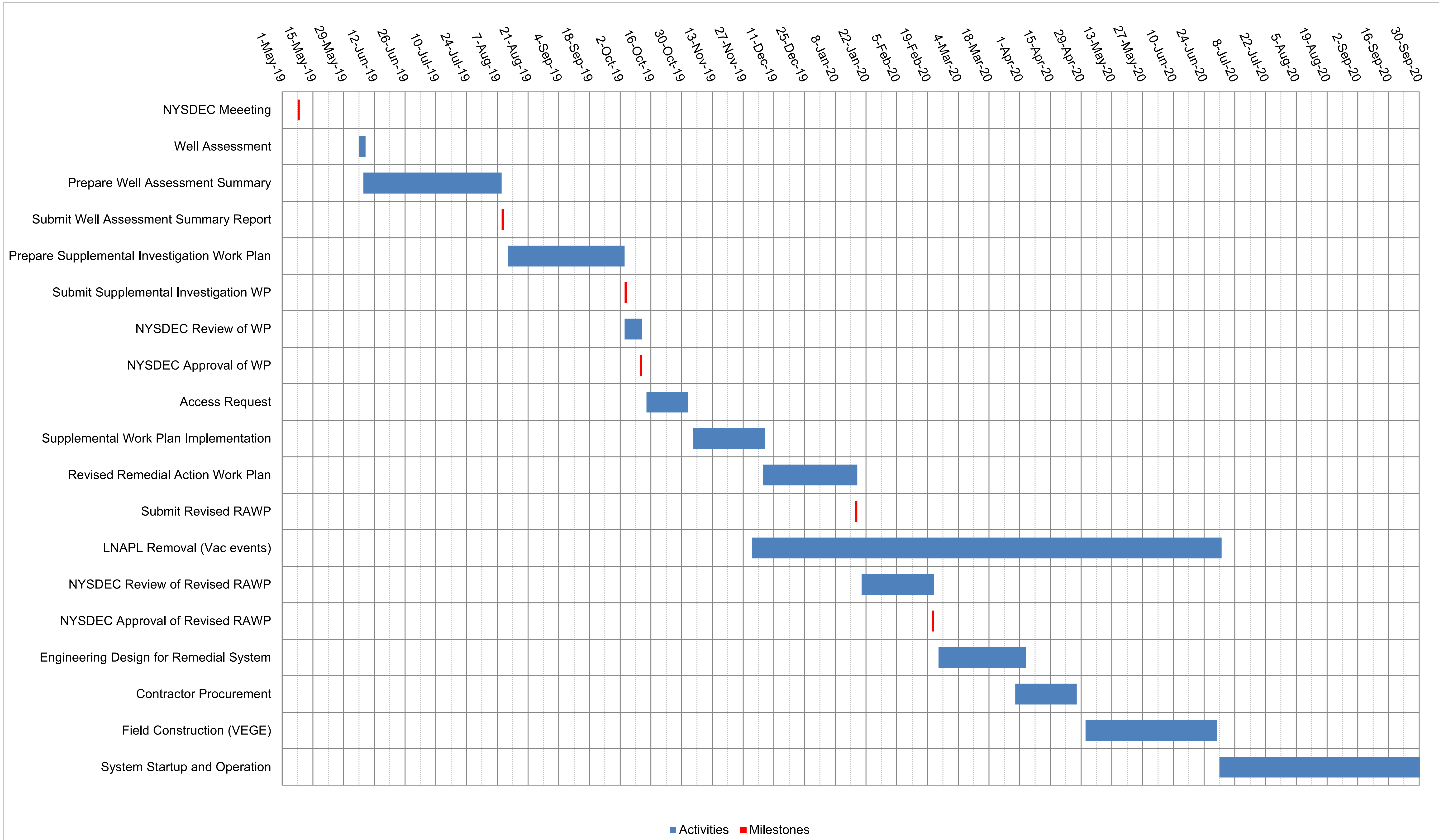
Monitoring Well ID	Depth to LNAPL (feet bmp)	Depth to Water (feet bmp)	LNAPL Thickness (feet)	Well Total Depth (feet bmp)

ft bmp	- Feet below measuring point
"-"	- No data available
DRY	- Monitoring well dry at time of gauging event

Attachment A
Project Schedule

Southern Terminals
Cold Springs Terminal Site, Hillside Road
Lysander, New York

Project Schedule



Attachment B
Boring and Well Construction Logs

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	MW-1 S/D
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-11-2019 1430
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	11-12-2019 1300
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**	**20F, Snow (11-12-2019)**	**Drilling method:**	Hollow Stem Auger (6.25")
		(P.M.):	**30F, Snow (11-11-2019)**	**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			**Sample Description**	**Sample Details**											**Chemical Analysis**	**Grain Size/ Other Analysis**
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content,			**Penetration Record Split Spoon Blows (Record N-Values & Recoveries)**										
From	**At**	**To**	**Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).**	**Sample Number**	**Sampling Method**	**6"**	**6"**	**6"**	**6"**	**N**	**R**	**Sample Interval**	**PID/FID (ppm)**			
0		5	Hand Auger	0 - 5	Hand Auger						60	0 - 1	3.4			
0		1	SM - Silty sand	5 - 9	Macrocore						36	1 - 2	10.2			
1		3.5	CL - Clay, Stiff, Brown, Wet, Gray and Orange Mottling, Increase silt and fine grained sand with depth	9 - 13	Macrocore						36	2 - 3	7.1			
3.5		5.5	SM - Silty sand, Brown, Moist	13 - 17	Macrocore						36	3 - 4	2.3			
5.5		26	SW - Very Fine and Fine Grained Sand, Compact, Dilatant, Gray-Brown with Isolated Dark Brown Staining, Odor, Sheen, Moist to Wet with Depth	17 - 20	Macrocore						36	4 - 5	3.5			
	6		Water Table	20 - 24	Macrocore						48	5 - 6	122.6			
	11		No Staining, Decreased Odors	24 - 27	Macrocore						36	6 - 7	416.7			
	20		No Sheen, Decreased Odors									7 - 8	64.5			
26		27	GW - Fine and Course Gravel, Compact, Black, Red, Brown, Wet									9 - 10	84.9			
27		27.2	GC - Clay and Silt with Fine and Course Gravel and Course Grained Sand, Hard, Red-Brown, Moist (Glacial Till)									10 - 11	54.8			
												11 - 12	66.5			
			Deep Well - Screen 25.8 - 27.3, Sand 25.0 - 27.3, Bentonite Chips (Holeplug) 15.5 - 25.0, Sand 15.0 - 15.5									13 - 14	104.7			
			Shallow Well - Screen 4.5 - 14.5, Sand 3.0 - 14.5, Bentonite Chips (Holeplug) 1.5 - 3.0, Concrete Surface Seal 0 - 1.5									14 - 15	100.0			
												15 - 16	41.1			

Notes and Comments

Depth of borehole caving ____________ Depth of first groundwater encounter ____________ Topsoil thickness ____________

Water level in open borehole on completion ____________ After ____________ Hours ____________

Notes: ____________

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	MW-1 S/D
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-11-2019 1430
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	11-12-2019 1300
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**	**20F, Snow (11-12-2019)**	**Drilling method:**	Hollow Stem Auger (6.25")
		(P.M.):	**30F, Snow (11-11-2019)**	**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			Sample Description	Sample Details											
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content, Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).			Penetration Record Split Spoon Blows (Record N-Values & Recoveries)									
From	At	To		Sample Number	Sampling Method	6"	6"	6"	6"	N	R	Sample Interval	PID/FID (ppm)	Chemical Analysis	Grain Size/ Other Analysis
												17 - 18	72.2		
												18 - 19	54.4		
												19 - 20	104.7		
												20 - 21	58.5		
												21 - 22	44.3		
												22 - 23	86.5		
												23 - 24	2.9		
												24 - 25	16.2		
												25 - 26	0.7		
												26 - 27	0.5		

Notes and Comments

Depth of borehole caving ____________ Depth of first groundwater encounter ____________ Topsoil thickness ____________
Water level in open borehole on completion ____________ After ____________ Hours ____________
Notes: ____________

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	MW-2 S/D
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-11-2019 0845
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	11-11-2019 1300
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**	**32F, Overcast**	**Drilling method:**	Hollow Stem Auger (6.25")
		(P.M.):	**32F, Overcast**	**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			**Sample Description**	**Sample Details**										**Chemical Analysis**	**Grain Size/ Other Analysis**
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content,			**Penetration Record Split Spoon Blows (Record N-Values & Recoveries)**									
From	**At**	**To**	**Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).**	**Sample Number**	**Sampling Method**	**6"**	**6"**	**6"**	**6"**	**N**	**R**	**Sample Interval**	**PID/FID (ppm)**		
0		5	Hand Auger	0 - 5	Hand Auger						60	0 - 1	0.2		
0		0.5	SW - Fine and Medium Grained Sand, Loose, Brown, Moist	5 - 9	Macrocore						36	1 - 2	170.8		
0.5		4	CL - Clay, Firm, Brown with Gray Mottling, Moist, Odors, Increase Silt with Depth	9 - 13	Macrocore						30	2 - 3	459.2		
4		5.5	SM - Silty Sand, Very Fine and Fine Grained Sand, Compact, Brown, Moist, Odors	13 - 17	Macrocore						36	3 - 4	743.4		
5.5		25	SW - Very Fine and Fine Grained Sand, Compact, Gray Brown, Wet, Odors, Trace Silt	17 - 21	Macrocore						48	4 - 5	717.8		
	6		Water Table	20 - 24	Macrocore						48	5 - 6	779.9		
	7		Brown, Dilatant	24 - 28	Macrocore						24	6 - 7	726.2		
	15		Dilatant, Loose when Shaken									7 - 8	729		
17		21	Weight of Rods/Hammer to Advance Sampler 4'									9 - 10	124.3		
25		26	GW - Fine and Coarse Gravel with Fine, Medium, and Coarse Grained Sand, Compact, Subrounded Gravel, Black/Brown/Red, Wet, Slight Odor									10 - 11	105.9		
26			Glacial Till - Hard, Reddish-Brown with Rusty Orange Mottling, Moist									11 - 11.5	173.9		
			Deep Well - Screen 24.9 - 26.4, Sand 24.0 - 26.4, Bentonite Chips (Holeplug) 15.5 - 24.0, Sand 15.0 - 15.5									13 - 14	62.1		
			Shallow Well - Screen 3.8 - 13.8, Sand 3.0 - 13.8, Bentonite Chips (Holeplug) 1.5 - 3.0, Concrete Surface Seal 0 - 1.5									14 - 15	122.7		
												15 - 16	87.9		

Notes and Comments

Depth of borehole caving ____________________ Depth of first groundwater encounter ____________________ Topsoil thickness ____________________
Water level in open borehole on completion ____________________ After ____________________ Hours ____________________
Notes: ____________________

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	MW-2 S/D
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-11-2019 0845
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	11-11-2019 1300
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**	**32F, Overcast**	**Drilling method:**	Hollow Stem Auger (6.25")
		(P.M.):	**32F, Overcast**	**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			Sample Description	Sample Details											
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content, Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).			Penetration Record Split Spoon Blows (Record N-Values & Recoveries)									
From	At	To		Sample Number	Sampling Method	6"	6"	6"	6"	N	R	Sample Interval	PID/FID (ppm)	Chemical Analysis	Grain Size/ Other Analysis
												17 - 18	84.3		
												18 - 19	131.2		
												19 - 20	237.4		
												20 - 21	255.5		
												21 - 22	230.7		
												22 - 23	152.5		
												23 - 24	27.2		
												24 - 25	11.4		
												25 - 26	6.4		

Notes and Comments

Depth of borehole caving ____________________ Depth of first groundwater encounter ____________________ Topsoil thickness ____________________

Water level in open borehole on completion ____________________ After ____________________ Hours ____________________

Notes: ____________________

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	MW-3 S/D
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-7-2019 0800
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	11-7-2019 1500
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**	**42F, Overcast**	**Drilling method:**	Hollow Stem Auger (6.25")
		(P.M.):	**38F, Showers**	**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			Sample Description	Sample Details										Chemical Analysis	Grain Size/ Other Analysis
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content,			Penetration Record Split Spoon Blows (Record N-Values & Recoveries)									
From	At	To	Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).	Sample Number	Sampling Method	6"	6"	6"	6"	N	R	Sample Interval	PID/FID (ppm)		
0		5	Hand Auger	0 - 5	Hand Auger						60	0 - 1	0.8		
0		0.67	CL - Silty Clay, Firm, Brown, Moist, Odors	5 - 9	Macrocore						48	1 - 2	1.5		
0.67		2.5	SM - Silty Sand, Fine Grained Sand, Compact, Brown, Moist, Odors, Trace Clay	9 - 13	Macrocore						24	2 - 3	57.5		
2.5		4.8	CL - Clay, Stiff, Brown, Moist, Slight Odor, Trace Silt, Fine Grained Sand, and Fine Gravel	13 - 17	Macrocore						36	3 - 4	134.3		
4.8		5.1	SW - Fine Grained Sand with Silt, Compact, Brown, Moist, Slight Odor, Trace Clay	17 -20	Macrocore						36	4 - 5	50.7		
5.1		8	CL - Clay, Firm, Gray Brown, Moist, Slight Odors, Trace Silt	20 - 24	Macrocore						48	5 - 6	117.2		
	7.5		Water Table	24 - 28	Macrocore						12	6 - 7	49.4		
8		9.4	CL - Silty Clay, Firm, Gray Brown, Wet, Odors	28 - 31	Macrocore						12	7 - 8	73.6		
9.4		13.5	SW - Very Fine and Fine Grained Sand, Some Silt, Compact, Brown, Wet, Dilatant, Slight Odor									8 - 9	165.4		
13.5		27	SW - Very Fine and Fine Grained Sand, Compact, Brown, Wet, Dilatant, Slight Odor, Trace Silt									9 - 10	16.8		
			24 - 27' - Weight of rods/hammer advanced sampler									10 - 11	11.9		
27		29	GW - Fine Gravel and Fine, Medium, and Coarse Grained Sand, Compact, Black/Brown/Red, Wet, Slight Odor, Trace Coarse Gravel									13 - 14	9.0		
			Deep Well - Screen 26.2 - 29.2, Sand 25.5 - 29.2, Bentonite Chips (Holeplug) 16.5 - 25.5, Sand 16.0 - 16.5									14 - 15	5.1		
			Shallow Well - Screen 5.7 - 15.7, Sand 4.0 - 15.7, Bentonite Chips (Holeplug) 1.5 - 4.0, Concrete Surface Seal 0 - 1.5									15 - 16	3.8		

Notes and Comments

Depth of borehole caving ____________________ Depth of first groundwater encounter ____________________ Topsoil thickness ____________________

Water level in open borehole on completion ____________________ After ____________________ Hours ____________________

Notes: ____________________

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	MW-3 S/D
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-7-2019 0800
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	11-7-2019 1500
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**	**42F, Overcast**	**Drilling method:**	Hollow Stem Auger (6.25")
		(P.M.):	**38F, Showers**	**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			Sample Description	Sample Details										Chemical Analysis	Grain Size/ Other Analysis
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content, Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).			Penetration Record Split Spoon Blows (Record N-Values & Recoveries)									
From	At	To		Sample Number	Sampling Method	6"	6"	6"	6"	N	R	Sample Interval	PID/FID (ppm)		
												17 - 18	5.2		
												18 - 19	4.8		
												19 - 20	16.0		
												20 - 21	6.2		
												21 - 22	30.2		
												22 - 23	14.8		
												23 - 24	28.3		
												24 - 25	20.2		
												28 - 29	16.0		

Notes and Comments

Depth of borehole caving ____________________ Depth of first groundwater encounter ____________________ Topsoil thickness ____________________

Water level in open borehole on completion ____________________ After ____________________ Hours ____________________

Notes: ____________________

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	MW-4 S/D
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11/5/2019
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	11/5/2019
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**		**Drilling method:**	Hollow Stem Auger (6.25")
		(P.M.):		**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			**Sample Description**	**Sample Details**										**Chemical Analysis**	**Grain Size/ Other Analysis**
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content, Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).			**Penetration Record Split Spoon Blows (Record N-Values & Recoveries)**									
From	**At**	**To**		**Sample Number**	**Sampling Method**	**6"**	**6"**	**6"**	**6"**	**N**	**R**	**Sample Interval**	**PID/FID (ppm)**		
0		5	Hand Auger	0 - 5	Hand Auger							2	2.3		
1		1.5	GW - Gravel, Asphalt, Asphalt Bedding, Slight Odor	5 - 9	Macrocore							2.5	2.7		
	1.5		ML - Sandy Silt, Fine and Medium Grained Sand, Predominently Fine Grained Sand, Low Plasticity (65, 35), Dark Brownish Gray, Petroleum Odor, Trace Coarse Grained Sand and Fine Gravel	9 - 13	Macrocore							3	20.7		
	4		As Above (75, 25), No Plasticity	13 - 17	Macrocore							3.5	5.4		
5		20	SM - Silty Sand, Fine Grained Sand, Compact, Gray Brown with Gray-Black Staining, Strong Odors and Slight Sheen, Moist to Wet with Depth	17 -20	Macrocore							4	11.5		
	9		Water Table, Dilatant Soils	20 - 24	Macrocore							4.5	7.6		
			Odors and Staining Decrease with Depth	24 - 27	Macrocore							5	49.0		
20		22.5	SP - Fine Grained Sand, Compact, Brown, Wet, Slight Odor, No Staining									5.5	40.1		
22.5		23.5	SM - Silty Sand, Fine and Medium Grained Sand, Compact, Brown, Wet, No Odor, Trace Fine Gravel with Depth									6 - 7	401.2		
23.5		25.5	GW - Fine and Coarse Gravel with Fine, Medium, and Coarse Grained Sand, Compact, Black/Brown/Rusty Orange, Coarsens Downward, Wet, Slight Odor									7 - 8	563.7		
25.5		26.5	Glacial Till - Hard, Rusty Orange/Brown, Fine Subrounded Gravel, Moist, No Odor, Transitions to Red 26 to 26.5', Very Hard, Moist									8 - 9	1048		
												9 - 10	580.1		
			Deep Well - Screen 23.2 - 25.2, Sand 22.7 - 25.2, Bentonite Chips (Holeplug) 17.2 - 22.7, Sand 17.0 - 17.2									10 - 11	34.1		
			Shallow Well - Screen 7.2 - 17.2, Sand 5.0 - 17.2, Bentonite Chips (Holeplug) 1.0 - 5.0, Concrete Surface Seal 0 - 1.0									13 - 14	146.2		

Notes and Comments

Depth of borehole caving ____________________ Depth of first groundwater encounter ____________________ Topsoil thickness ____________________
Water level in open borehole on completion ____________________ After ____________________ Hours ____________________
Notes: ____________________

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	MW-4 S/D
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11/5/2019
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	11/5/2019
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**		**Drilling method:**	Hollow Stem Auger (6.25")
		(P.M.):		**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			Sample Description	Sample Details										Chemical Analysis	Grain Size/ Other Analysis
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content, Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).	Sample Number	Sampling Method	Penetration Record Split Spoon Blows (Record N-Values & Recoveries)						Sample Interval	PID/FID (ppm)		
From	At	To				6"	6"	6"	6"	N	R				
												14 - 15	17.6		
												17 - 18	107.2		
												18 - 19	21.4		
												19 - 20	10.9		
												20 - 21	21.5		
												21 - 22	7.6		
												22 - 23	8.4		
												23 - 24	7.2		
												24 - 25	5.3		
												25 - 26	15.3		
												26.5	10.1		

Notes and Comments

Depth of borehole caving ____________ Depth of first groundwater encounter ____________ Topsoil thickness ____________
Water level in open borehole on completion ____________ After ____________ Hours ____________
Notes:

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	MW-5 S/D
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-18-2019 0930
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	11-18-2019 1430
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**	**32F, Mostly Cloudy**	**Drilling method:**	Hollow Stem Auger (6.25")
		(P.M.):	**32F, Mostly Cloudy**	**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			**Sample Description**	**Sample Details**										**Chemical Analysis**	**Grain Size/ Other Analysis**
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content, supplementary descriptors.			**Penetration Record Split Spoon Blows (Record N-Values & Recoveries)**									
From	**At**	**To**	**Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).**	**Sample Number**	**Sampling Method**	**6"**	**6"**	**6"**	**6"**	**N**	**R**	**Sample Interval**	**PID/FID (ppm)**		
0		5	Hand Auger	0 - 5	Hand Auger						60	0 - 1	1.4		
0		4.5	CL - Clay, Firm, Brown with Gray and Rusty Orange Mottling, Moist, Odors with Depth	5 - 9	Macrocore						36	1 - 2	409.7		
4.5		5.3	SM - Silty Sand, Firm, Gray Staining and Strong Odors, Moist, Trace Clay	9 - 13	Macrocore						36	2 - 3	985.0		
5.3		19.25	SW - Very Fine and Fine Grained Sand, Compact, Gray, Moist, Odors, Some Silt Decreases with Depth	13 - 17	Macrocore						36	3 - 4	534.2		
	7		Brown, Water Table and Sheen	17 - 20	Macrocore						36	4 - 5	387.2		
	9		Decrease Odors	22.5 - 23.5	Macrocore						12	5 - 6	576.4		
	11		Saturated, Loose if Shaken									6 - 7	633.4		
	14.5		Gray-Brown Zone from 14.5 - 16, Slight Odor									7 - 8	686.2		
	16		Brown from 16 - 19.25									9 - 10	162.6		
19.25		23	GW - Fine and Coarse Gravel with Fine, Medium, and Coarse Grained Sand, Compact, Black, Brown, Red, Wet, Subrounded Gravel, No Odor									10 - 11	61.3		
23		23.5	GC - Clay and Silt with Fine and Coarse Gravel and Medium and Coarse Grained Sand, Hard, Red-Brown with Rusty Orange Weathering top 2 inches, Moist (Glacial Till)									11 - 12	64.1		
			Running Sands and/or Natural Formation Collapse only allowed well to extend to 20.2 feet bgs after 3 attempts to set well at originally intended 23.5 foot depth									13 - 14	35.5		
			Deep Well - Screen 18.2 - 21.2, Sand 16.7 - 21.2, Bentonite Chips (Holeplug) 15.5 - 16.7, Sand 15.0 - 15.5									14 - 15	26.6		
			Shallow Well - Screen 5.5 - 15.5, Sand 3 - 15.5, Bentonite Chips (Holeplug) 1.5 - 3.0, Concrete Surface Seal 0 - 1.5									15 - 16	50.7		

Notes and Comments

Depth of borehole caving ____________ Depth of first groundwater encounter ____________ Topsoil thickness ____________

Water level in open borehole on completion ____________ After ____________ Hours ____________

Notes: ____________

Stratigraphy Log (Overburden)
(Form SP-14)

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	MW-5 S/D
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-18-2019 0930
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	11-18-2019 1430
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**	**32F, Mostly Cloudy**	**Drilling method:**	Hollow Stem Auger (6.25")
		(P.M.):	**32F, Mostly Cloudy**	**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			Sample Description	Sample Details										Chemical Analysis	Grain Size/ Other Analysis
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content, supplementary descriptors. Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).	Sample Number	Sampling Method	Penetration Record Split Spoon Blows (Record N-Values & Recoveries)						Sample Interval	PID/FID (ppm)		
From	At	To				6"	6"	6"	6"	N	R				
												17 - 18	28.1		
												18 - 19	38.8		
												19 - 20	32.7		
												22 - 23	12.7		

Notes and Comments

Depth of borehole caving ____________ Depth of first groundwater encounter ____________ Topsoil thickness ____________

Water level in open borehole on completion ____________ After ____________ Hours ____________

Notes: ____________

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	MW-6 S/D
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-18-2019 1530
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	11-19-2019 1200
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**	**40F, Overcast (11-19-2019)**	**Drilling method:**	Hollow Stem Auger (6.25")
		(P.M.):	**35F, Overcast (11-18-2019)**	**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			**Sample Description** Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content, supplementary descriptors. Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).	**Sample Details**										**Chemical Analysis**	**Grain Size/ Other Analysis**
						Penetration Record Split Spoon Blows (Record N-Values & Recoveries)									
From	**At**	**To**		**Sample Number**	**Sampling Method**	**6"**	**6"**	**6"**	**6"**	**N**	**R**	**Sample Interval**	**PID/FID (ppm)**		
0		5	Hand Auger	0 - 5	Hand Auger						60	0 - 1	6.4		
0		4.2	CL - Clay and Silt with Fine Gravel, Firm, Gray-Black, Moist, Odors	5 - 9	Macrocore						0	1 - 2	294.5		
4.2		4.8	CL - Clay and Silt, Firm, Brown with Gray Mottling, Moist, Odors, Trace Fine Gravel	9 - 13	Macrocore						0	2 - 3	470.3		
4.8		17	SM - Silty Sand, Very Fine and Fine Grained Sand, Compact, Brown, Moist, Odors, Trace Clay Decreases with Depth	13 - 17	Macrocore						0	3 - 4	482.2		
	11		Cuttings Brown Silt and Very Fine Sand, Soft, Wet, Odors, Dilatant	17 - 20	Macrocore						24	4 - 5	528.4		
17		24.5	SW - Very Fine and Fine Grained Sand, Little Medium Grained Sand, Compact until Shaken then Loose, Dilatant, Brown, Wet, Odors and Sheen	20 - 24	Macrocore						36	17 - 18	34.3		
	22		Coarsens Downward	24 - 28	Macrocore						24	18 - 19	21.1		
24.5		26.5	GW - Fine and Coarse Gravel with Fine, Medium, and Coarse Grained Sand, Compact, Subrounded, Black, Brown, Red, Wet									20 - 21	22.5		
	26.5		Sampler and Auger Refusal - Very Hard									21 - 22	39.1		
												22 - 23	192.4		
			Deep Well - Screen 25.3 - 27.3, Sand 24.0 - 27.3, Bentonite Chips (Holeplug) 15.5 - 24.0, Sand 15.0 - 15.5									24 - 25	112.9		
			Shallow Well - Screen 4.7 - 14.7, Sand 3.0 - 14.7, Bentonite Chips (Holeplug) 1.5 - 3.0, Concrete Surface Seal 0 - 1.5									25 - 26	53.9		

Notes and Comments

Depth of borehole caving ____________________ Depth of first groundwater encounter ____________________ Topsoil thickness ____________________
Water level in open borehole on completion ____________________ After ____________________ Hours ____________________
Notes: ____________________

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	MW-7 S/D
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-13-2019 1200
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	11-13-2019 1700
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**	**20F, Sunny**	**Drilling method:**	Hollow Stem Auger (6.25")
		(P.M.):	**20F, Sunny**	**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			**Sample Description**	**Sample Details**										**Chemical Analysis**	**Grain Size/ Other Analysis**
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content,			**Penetration Record Split Spoon Blows (Record N-Values & Recoveries)**									
From	**At**	**To**	**Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).**	**Sample Number**	**Sampling Method**	**6"**	**6"**	**6"**	**6"**	**N**	**R**	**Sample Interval**	**PID/FID (ppm)**		
0		5	Hand Auger	0 - 5	Hand Auger						60	0 - 1	12.6		
0		1	SM - Silty Sand, Loose, Dark Brown, Moist, Some Organics (Roots and Plant Debris)	5 - 9	Macrocore						36	1 - 2	120		
1		3	SW - Very Fine and Fine Grained Sand, Some Silt, Firm, Brown, Moist, Slight Odor	9 - 13	Macrocore						30	2 - 3	203.7		
3		4.5	CL - Clay, Stiff, Brown with Gray Mottling, Moist, Slight Odor	13 - 17	Macrocore						30	3 - 4	379.3		
4.5		5.2	SW - Very Fine and Fine Grained Sand, Firm, Gray-Brown, Moist, Strong Odor, Trace Silt	17 - 20	Macrocore						36	4 - 5	590.7		
5.2		9	CL - Clay, Stiff to Hard, Brown with Gray Mottling, Moist, Odors	20 - 24	Macrocore						12	5 - 6	235.2		
	7.5		Water Table	24 - 28	Macrocore						48	6 - 7	97.7		
9		27.25	SW - Very Fine and Fine Grained Sand, Compact, Dilatant and Loose when Shaken, Brown, Wet, Odors	28 - 29	Macrocore						12	7 - 8	60.2		
			20 - 24' - Macrocore sunk under weight of rods/hammer									9 - 10	39.7		
27.25		30	GW - Fine and Coarse Gravel and Fine, Medium, and Coarse Grained Sand, Compact, Black/Red/Brown, Subrounded Gravel, Wet, Slight Odor									10 - 11	60.2		
												11 - 12	108.6		
			Deep Well - Screen 26.2 - 29.2, Sand 25.7 - 29.2, Bentonite Chips (Holeplug) 16.5 - 25.7, Sand 16.0 - 16.5									13 - 14	65.8		
			Shallow Well - Screen 5.6 - 15.6, Sand 4.0 - 15.6, Bentonite Chips (Holeplug) 1.5 - 4.0, Concrete Surface Seal 0 - 1.5									14 - 15	108.0		
												15 - 16	53.5		

Notes and Comments

Depth of borehole caving ____________________ Depth of first groundwater encounter ____________________ Topsoil thickness ____________________
Water level in open borehole on completion ____________________ After ____________________ Hours ____________________
Notes: ____________________

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	MW-7 S/D
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-13-2019 1200
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	11-13-2019 1700
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**	**20F, Sunny**	**Drilling method:**	Hollow Stem Auger (6.25")
		(P.M.):	**20F, Sunny**	**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			Sample Description	Sample Details										Chemical Analysis	Grain Size/ Other Analysis
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content, Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).			Penetration Record Split Spoon Blows (Record N-Values & Recoveries)									
From	At	To		Sample Number	Sampling Method	6"	6"	6"	6"	N	R	Sample Interval	PID/FID (ppm)		
												17 - 18	30.3		
												18 - 19	145.7		
												19 - 20	112.9		
												20 - 21	61.3		
												24 - 25	17.4		
												25 - 26	40.3		
												26 - 27	44.3		
												27 - 28	5.4		
												28 - 29	5.9		

Notes and Comments

Depth of borehole caving ____________ Depth of first groundwater encounter ____________ Topsoil thickness ____________
Water level in open borehole on completion ____________ After ____________ Hours ____________
Notes: ____________

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	MW-9 S/I/D
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-20-2019 1515
Client:		**Surface elevation:**		**Date/Time completed:**	11-21-2019 1200
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**	**38F, Mostly Cloudy (11-21-2019)**	**Drilling method:**	Hollow Stem Auger (6.25")
		(P.M.):	**42F, Overcast (11-20-2019)**	**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			**Sample Description**	**Sample Details**										**Chemical Analysis**	**Grain Size/ Other Analysis**
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content, supplementary descriptors.			**Penetration Record Split Spoon Blows (Record N-Values & Recoveries)**									
From	**At**	**To**	**Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).**	**Sample Number**	**Sampling Method**	**6"**	**6"**	**6"**	**6"**	**N**	**R**	**Sample Interval**	**PID/FID (ppm)**		
0		5	Hand Auger	0 - 5	Hand Auger						60	0 - 1	0.0		
0		3.5	SW - Fine, Medium, and Coarse Grained Sand, Loose, Black, Dry	5 - 9	Macrocore						48	1 - 2	2.6		
3.5		7.5	CL - Clay, Firm to Hard, Brown with Gray Mottling, Moist, Odors	9 - 13	Macrocore						24	2 - 3	17.9		
	7.5		Water Table	13 - 17	Macrocore						36	3 - 4	269.0		
7.5		9	SM - Silty Sand, Very Fine and Fine Grained Sand, Compact, Dilatant, Gray-Brown to Brown with Depth, Wet, Odors, Sheen, Dark Brown Staining in Isolated Zones from 8 - 9' bgs	17 - 20	Macrocore						36	4 - 5	452.3		
9		31	SW - Very Fine and Fine Grained Sand, Compact, Dilatant and Loose when Shaken, Brown, Odors	20 - 24	Macrocore						48	5 - 6	580.1		
31		32.5	SW - Fine, Medium, and Coarse Grained Sand, Some Very Fine Grained Sand, Compact, Brown, Wet	24 - 28	Macrocore						48	6 - 7	424.4		
32.5		34	GW - Fine and Coarse Gravel with Fine, Medium, and Coarse Grained Sand, Compact, Black/Brown/Red, Wet, Slight Odor	29 - 33	Macrocore						48	7 - 8	648.7		
			Auger Refusal at 34' bgs, very hard gravelly drilling from 33 to 34'									8 - 9	187.8		
												9 - 10	54.8		
			Deep Well - Screen 31.6 - 33.6, Sand 29.5 - 33.6, Bentonite 16.5 - 29.5, Sand 16.0 - 16.5									10 - 11	39.9		
			Shallow Well - Screen 5.0 - 15.0, Sand 4.0 - 15.0, Bentonite 1.5 - 4.0, Concrete Surface Seal 0 - 1.5									13 - 14	40.9		
												14 - 15	46.7		
												15 - 16	65.3		

Notes and Comments

Depth of borehole caving ____________________ Depth of first groundwater encounter ____________________ Topsoil thickness ____________________

Water level in open borehole on completion ____________________ After ____________________ Hours ____________________

Notes: ____________________

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	MW-9 S/I/D
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-20-2019 1515
Client:		**Surface elevation:**		**Date/Time completed:**	11-21-2019 1200
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**	**38F, Mostly Cloudy (11-21-2019)**	**Drilling method:**	Hollow Stem Auger (6.25")
		(P.M.):	**42F, Overcast (11-20-2019)**	**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			Sample Description	Sample Details										Chemical Analysis	Grain Size/ Other Analysis
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content, supplementary descriptors. Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).	Sample Number	Sampling Method	Penetration Record Split Spoon Blows (Record N-Values & Recoveries)						Sample Interval	PID/FID (ppm)		
From	At	To				6"	6"	6"	6"	N	R				
												17 - 18	37.8		
												18 - 19	49		
												19 - 20	59.6		
												20 - 21	19.9		
												21 - 22	24.2		
												22 - 23	61.3		
												23 - 24	101.0		
												24 - 25	54.5		
												25 - 26	118.5		
												26 - 27	172.3		
												27 - 28	214.9		
												29 - 30	105.9		
												30 - 31	132.2		
												31 - 32	80.6		

Notes and Comments

Depth of borehole caving ____________ Depth of first groundwater encounter ____________ Topsoil thickness ____________
Water level in open borehole on completion ____________ After ____________ Hours ____________
Notes: ____________

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	MW-10 S/I/D
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-19-2019 1300
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	11-20-2019 1445
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**	**40F, Mostly Cloudy (11-20-2019)**	**Drilling method:**	Hollow Stem Auger (6.25")
		(P.M.):	**48F, Mostly Cloudy (11-19-2019)**	**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			**Sample Description**	**Sample Details**										**Chemical Analysis**	**Grain Size/ Other Analysis**
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content, supplementary descriptors.			**Penetration Record Split Spoon Blows (Record N-Values & Recoveries)**									
From	**At**	**To**	**Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).**	**Sample Number**	**Sampling Method**	**6"**	**6"**	**6"**	**6"**	**N**	**R**	**Sample Interval**	**PID/FID (ppm)**		
0		5	Hand Auger	0 - 5	Hand Auger						60	0 - 1	0.0		
0		3.5	SM - Silty Sand with Fine and Coarse Gravel, Compact, Dark Brown to Brown with Depth, Moist to Wet with Depth, No Odor	5 - 9	Macrocore						6	1 - 2	0.0		
3.5		5	SM - Silty Sand, Fine and Medium Grained Sand, Compact, Brown, Moist, Slight Odor	9 - 13	Macrocore						24	2 - 3	0.0		
5		9	ML - Silty Clay, Firm, Gray-Brown, Moist, Odors, Trace Fine Grained Sand	13 - 17	Macrocore						24	3 - 4	0.2		
9		28	SW - Very Fine and Fine Grained Sand, Compact, Dilatant and Loose when Shaken, Gray-Brown, Wet, Little Odor	17 - 20	Macrocore						36	4 - 5	7.4		
28			SW - Fine, Medium, and Coarse Grained Sand, Compact, Black/Brown/Red, Wet, Trace Sand Concretions	20 - 24	Macrocore						48	5 - 6	17.3		
			Attempted to auger to 32' bgs for next sample; however, had 10' of running sands in the augers. Had to abandon boring and start over the next day 5 feet to the west.	24 - 28	Macrocore						48	9 - 10	1.6		
			Based on running sands, new boring location was straight drill until gravel layer and glacial till were encountered and then install the wells, no sampling.	28 - 32	Macrocore						48	10 - 11	0.6		
												13 - 14	0.7		
			Augers grinding and jumping on gravel at 34' bgs									14 - 15	0.2		
			Auger refusal at 35.5' bgs									17 - 18	0.1		
												18 - 19	0.0		
												19 - 20	0.1		
												20 - 21	0.0		

Notes and Comments

Depth of borehole caving ____________ Depth of first groundwater encounter ____________ Topsoil thickness ____________

Water level in open borehole on completion ____________ After ____________ Hours ____________

Notes: ____________

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	MW-10 S/I/D
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-19-2019 1300
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	11-20-2019 1445
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**	**40F, Mostly Cloudy (11-20-2019)**	**Drilling method:**	Hollow Stem Auger (6.25")
		(P.M.):	**48F, Mostly Cloudy (11-19-2019)**	**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			**Sample Description**	**Sample Details**										**Chemical Analysis**	**Grain Size/ Other Analysis**
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content, supplementary descriptors. Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).			**Penetration Record Split Spoon Blows (Record N-Values & Recoveries)**									
From	**At**	**To**		**Sample Number**	**Sampling Method**	**6"**	**6"**	**6"**	**6"**	**N**	**R**	**Sample Interval**	**PID/FID (ppm)**		
			Deep Well - Screen 33.7 - 35.7, Sand 33.0 - 35.7, Bentonite 29.0 - 33.0, Sand 28.5 - 29.0									21 - 22	0.3		
			Intermediate Well - Screen 24.0 - 29.0, Sand 21.5 - 29.0, Bentonite 16.5 - 21.5, Bentonite/Cutting Mix 1.5 - 16.5, Concrete Surface Seal 0 - 1.5									22 - 23	1.6		
			Shallow Well - Installed in initial boring approximately 5' east of deep/intermediate well cluster									23 - 24	6.9		
			Shallow Well - Screen 4.5 - 14.5, Sand 3.0 - 14.5, Bentonite 1.5 - 3.0, Concrete Surface Seal 0 - 1.5									24 - 25	123.3		
												25 - 26	138.3		
												26 - 27	103.6		
												27 - 28	30.0		
												28 - 29	63.4		
												29 - 30	44.4		
												30 - 31	47.8		
												31 - 32	39.5		

Notes and Comments

Depth of borehole caving ____________________ Depth of first groundwater encounter ____________________ Topsoil thickness ____________________

Water level in open borehole on completion ____________________ After ____________________ Hours ____________________

Notes: ____________________

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	RW-1
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-4-2019 1200
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	11-4-2019 1700
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**		**Drilling method:**	Hollow Stem Auger (8.25")
		(P.M.):	**45F, Overcast**	**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			**Sample Description**	**Sample Details**											
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content,			**Penetration Record Split Spoon Blows (Record N-Values & Recoveries)**									
From	**At**	**To**	**Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).**	**Sample Number**	**Sampling Method**	**6"**	**6"**	**6"**	**6"**	**N**	**R**	**Sample Interval**	**PID/FID (ppm)**	**Chemical Analysis**	**Grain Size/ Other Analysis**
0		5	Hand Auger									0 - 1	2.0		
0		0.25	SW - Fine and Medium Grained Sand with Silt and Clay, Firm, Dark Brown, Trace Organics (Roots)									1.5	1.0		
0.25		4	CL - Clay, Stiff, Dark Brown with Gray and Brown Mottling, Moist, Odors, Hard with Depth									2	3.5		
4		9.5	SM - Silty Sand, Fine Grained Sand, Compact, Gray, Moist, Odors, Trace Clay									3	150.3		
	6		No Clay									3.5	33.2		
	7		Strong Odors and Black Staining from 7 - 9									4	28.5		
	8		Water Table									4.5	923.8		
9.5		15	SM - Silty Sand, Fine Grained Sand, Compact, Dilatant, Brown, Wet, Slight Odors Decrease with Depth									5	468.4		
												5 - 6	347.5		
												6 - 7	639.8		
			Screen 5.7 - 15.7, Sand 3.0 - 15.7, Bentonite Chips (Holeplug) 1.5 - 3.0, Concrete Surface Seal 0 - 1.5									7 - 8	804.3		
												8 - 9	1082		
												9 - 10	120.6		
												10 - 11	169.1		

Notes and Comments

Depth of borehole caving ____________ Depth of first groundwater encounter ____________ Topsoil thickness ____________
Water level in open borehole on completion ____________ After ____________ Hours ____________
Notes: ____________

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	RW-1
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-4-2019 1200
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	11-4-2019 1700
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**		**Drilling method:**	Hollow Stem Auger (8.25")
		(P.M.):	**45F, Overcast**	**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			Sample Description	Sample Details										Chemical Analysis	Grain Size/ Other Analysis
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content, Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).			Penetration Record Split Spoon Blows (Record N-Values & Recoveries)									
From	At	To		Sample Number	Sampling Method	6"	6"	6"	6"	N	R	Sample Interval	PID/FID (ppm)		
												11 - 12	64.2		
												12 - 13	91.9		
												13 - 14	47.5		
												14 - 15	38.3		

Notes and Comments

Depth of borehole caving ____________ Depth of first groundwater encounter ____________ Topsoil thickness ____________

Water level in open borehole on completion ____________ After ____________ Hours ____________

Notes: ____________

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	RW-2
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-6-2019 0730
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	11-6-2019 1200
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**		**Drilling method:**	Hollow Stem Auger (8.25")
		(P.M.):		**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			**Sample Description**	**Sample Details**											
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content,			**Penetration Record Split Spoon Blows (Record N-Values & Recoveries)**									
From	**At**	**To**	**Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).**	**Sample Number**	**Sampling Method**	**6"**	**6"**	**6"**	**6"**	**N**	**R**	**Sample Interval**	**PID/FID (ppm)**	**Chemical Analysis**	**Grain Size/ Other Analysis**
0		5	Hand Auger	0 - 5	Hand Auger						60	0 - 2	10.5		
0		2.5	CL - Clay, Firm, Brown, Wet, Some Organics (Roots and Plant Remains) 0 - 0.5 feet, Odors	5 - 9	Macrocore						30	2 - 3	N/A		
2.5		11.5	SM - Silty Sand, Fine Grained Sand, Firm, Brown, Wet, Odors and Slight Sheen, Trace Clay	9 - 13	Macrocore						36	3 - 4	N/A		
	4.5		No Clay, Dilatant	13 - 17	Macrocore						48	4 - 5	N/A		
	10		No Odors, Increase in Fine Grained Sand									5 - 6	1236		
11.5		17	SW - Fine Grained Sand with Silt, Compact, Dilatant, Brown, Wet, Very Slight Odors									6 - 7	1566		
												7 - 7.5	254.7		
			Overdrilled with 8.25" augers and set well at 15 feet									9 - 10	208.9		
			Screen 5.3 - 15.3, Sand 3.0 - 15.3, Bentonite Chips (Holeplug) 1.5 - 3.0, Concrete Surface Seal 0 - 1.5									10 - 11	102.8		
												11 - 12	173.3		
												13 - 14	283.2		
												14 - 15	102.1		
												15 - 16	59.6		
												16 - 17	223.2		

Notes and Comments

Depth of borehole caving ____________ Depth of first groundwater encounter ____________ Topsoil thickness ____________

Water level in open borehole on completion ____________ After ____________ Hours ____________

Notes: ____________

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	RW-3
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-6-2019 1230
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	11-6-2019 1700
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**		**Drilling method:**	Hollow Stem Auger (8.25")
		(P.M.):		**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			**Sample Description**	**Sample Details**											
			Order of descriptors: **Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content,**			**Penetration Record Split Spoon Blows (Record N-Values & Recoveries)**									
From	**At**	**To**	**Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).**	**Sample Number**	**Sampling Method**	**6"**	**6"**	**6"**	**6"**	**N**	**R**	**Sample Interval**	**PID/FID (ppm)**	**Chemical Analysis**	**Grain Size/ Other Analysis**
0		5	Hand Auger	0 - 5	Hand Auger						60	0 - 1	126.4		
0		0.8	CL - Clay, Firm, Brown, Moist, Odors, Trace Silt and Organics (Roots and Plant Remains)	5 - 9	Macrocore						36	1 - 2	1407		
0.8		4.5	SM - Silty Sand, Fine Grained Sand, Compact, Brown, Dilatant, Odors	9 - 13	Macrocore						36	2 - 3	1498		
4.5		10	SW - Fine and Medium Grained Sand, Some Silt, Compact, Brown, Strong Odors, Dilatant, Moist	13 - 15	Macrocore						12	3 - 4	1258		
	7		Water Table									4 - 5	1675		
10		14	SW - Fine and Medium Grained Sand and Silt, Compact, Brown, Wet, Dilatant and Loose when Shaken, Decreased Odors									5 - 6	1090		
												6 - 7	1442		
			Overdrilled with 8.25" augers and set well at 15 feet									7 - 8	1582		
			Screen 4.9 - 14.9, Sand 3.0 - 14.9, Bentonite Chips (Holeplug) 1.5 - 3.0, Concrete Surface Seal 0 - 1.5									9 - 10	1052		
												10 - 11	173.9		
												11 - 12	251.4		
												13 - 14	164.9		

Notes and Comments

Depth of borehole caving ____________________ Depth of first groundwater encounter ____________________ Topsoil thickness ____________________

Water level in open borehole on completion ____________________ After ____________________ Hours ____________________

Notes:

Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	RW-4
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-14-2019 0900
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**	**25F, Overcast**	**Drilling method:**	Hollow Stem Auger (8.25")
		(P.M.):		**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			Sample Description	Sample Details										Chemical Analysis	Grain Size/ Other Analysis
			Order of descriptors: **Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content,**			Penetration Record Split Spoon Blows (Record N-Values & Recoveries)									
From	At	To	**Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).**	Sample Number	Sampling Method	6"	6"	6"	6"	N	R	Sample Interval	PID/FID (ppm)		
			Could not hand auger first 5' of boring due to presence of compacted crushed stone and rip-rap	2.5 - 5	Macrocore						NR	2.5	437.7		
0		2.5	Crushed Stone / Rip-Rap, Gray, Compact, Dry	5 - 9	Macrocore						48	5 - 6	806.5		
2.5		7.5	CL - Clay, Stiff, Brown with Gray Mottling, Moist, Odors, Dark Gray Staining	9 - 13	Macrocore						36	6 - 7	836.1		
5		6	SM - Silty Sand, Very Fine and Fine Grained Sand layer	13 - 16	Macrocore						32	7 - 8	384.4		
	7.5		Water Table									8 - 9	627.7		
7.5		9.2	SM - Silty Sand, Some Very Fine Grained Sand, Compact, Dilatant, Brown with Gray Staining, Wet, Odors, Sheen									9 -10	355.1		
9.2		16	SW - Very Fine and Fine Grained Sand, Compact until Shaken then Loose, Dilatant, Brown, Wet									10 - 11	107.6		
	9.5		Staining									11 - 12	140.5		
	12		Staining and Sheen									13 - 14	92.7		
												14 - 15	47.4		
			Overdrilled with 8.25" augers, while drilling from 5 - 10' bgs, inner 4.25" augers sunk 5', fished out but all tooling was locked together so entire string needed to be pulled. Boring stayed open to 15' bgs long enough to get well materials in. Boring collapse backfilled bottom 5' of screened interval.									15 - 16	82.5		
			Screen 4.6 - 14.6, Natural Formation Collapse 10.0 - 14.6, Sand 3.0 - 10.0, Bentonite Chips (Holeplug) 1.5 - 3.0, Concrete Surface Seal 0 - 1.5												

Notes and Comments

Depth of borehole caving ____________________ Depth of first groundwater encounter ____________________ Topsoil thickness ____________________

Water level in open borehole on completion ____________________ After ____________________ Hours ____________________

Notes: ____________________

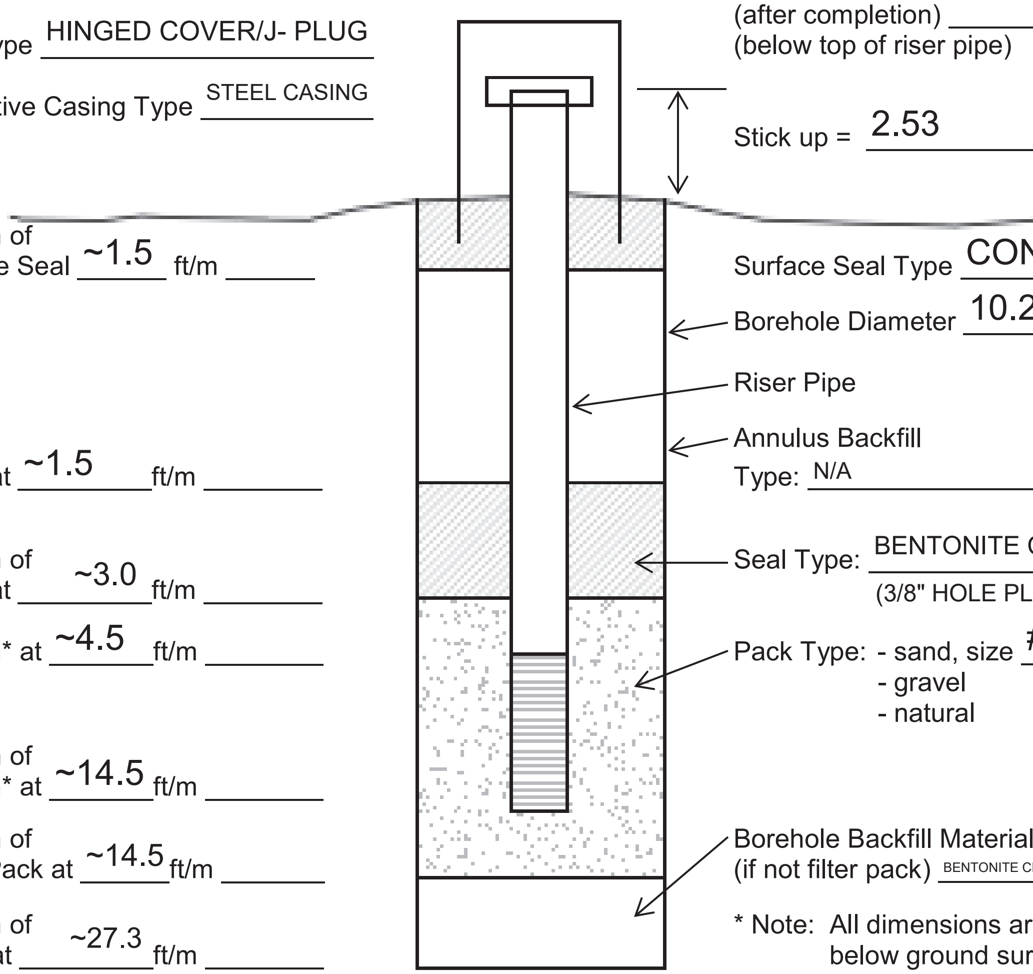
Project name:	Cold Springs - Southern Terminals	**Drilling contractor:**	**Nothnagle Drilling**	**Hole designation:**	RW-5
Project number:	11137172-15	**Driller:**	**Bryan Swartz**	**Date/Time started:**	11-12-2019 1415
Client:	Southern Terminals Group	**Surface elevation:**		**Date/Time completed:**	
Location:	Hillside Road, Lysander, NY	**Weather (A.M.):**		**Drilling method:**	Hollow Stem Auger (8.25")
		(P.M.):	**25F, Overcast**	**GHD supervisor:**	I. McNamara

Stratigraphic Intervals (Depths in ft BGS)			Sample Description	Sample Details										Chemical Analysis	Grain Size/ Other Analysis
			Order of descriptors: Soil type symbol(s) - primary component(s), (nature of deposit), secondary components, relative density/consistency, grain size/plasticity, gradation/structure, colour, moisture content,			Penetration Record Split Spoon Blows (Record N-Values & Recoveries)									
From	At	To	Note: Plasticity determination requires the addition of moisture if the sample is too dry to roll (indicate if moisture was added or not).	Sample Number	Sampling Method	6"	6"	6"	6"	N	R	Sample Interval	PID/FID (ppm)		
0		5	Hand Auger	0 - 5	Hand Auger						60	0 - 1	0.0		
0		2.5	CL - Clay, Stiff, Brown, Moist, No Odor, Organics (Roots) from 0 - 1.5 feet	5 - 9	Macrocore						24	1 - 2	0.3		
2.5		4.5	SM - Silty Sand, Very Fine and Fine Grained Sand, Compact, Gray-Brown, Odor, Moist, Trace Clay	9 - 13	Macrocore						36	2 - 3	721.4		
	4.5		Water Table	13 - 14	Macrocore						12	3 - 4	759.3		
4.5		14	SW - Very Fine and Fine Grained Sand, Compact, Dilatant, Brown, Odor, Wet, Some to Trace Silt with Depth									4 - 5	709.5		
	10		Decreased Odors									5 - 6	540.8		
	12.5		Saturated, Loose when Shaken									6 - 7	571.6		
												9 - 10	103.4		
			Screen 4.3 - 14.3, Sand 3.0 - 14.3, Bentonite Chips (Holeplug) 1.5 - 3.0, Concrete Surface Seal 0 - 1.5									10 - 11	96.5		
												11 - 12	92.0		
			Inner 4.25" augers sunk to 15 feet while overdrilling with 8.25" augers, set well at 15 feet as a result									13 - 14	163.4		

Notes and Comments

Depth of borehole caving ____________ Depth of first groundwater encounter ____________ Topsoil thickness ____________
Water level in open borehole on completion ____________ After ____________ Hours ____________
Notes: ____________

Project Name: COLD SPRINGS TERMINALS
Well Designation: MW-1S
Project Number: 11137172
Date Completed: 11/12/2019
Client: SOUTHERN TERMINALS GROUP
Drilling Method: HOLLOW STEM AUGER (6.25")
Location: LYSANDER, NY
GHD Supervisor: IAN McNAMARA



Cap Type: HINGED COVER/J- PLUG

Protective Casing Type: STEEL CASING

Measure bottom of well (after completion) (below top of riser pipe): 17.07 ft/m

Stick up = 2.53 ft/m

Bottom of Surface Seal: ~1.5 ft/m

Surface Seal Type: CONCRETE

Borehole Diameter: 10.25 in/cm

Riser Pipe

Annulus Backfill Type: N/A

Top of Seal* at: ~1.5 ft/m

Bottom of Seal* at: ~3.0 ft/m

Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)

Top of Screen* at: ~4.5 ft/m

Pack Type: - sand, size #00N
- gravel
- natural

Bottom of Screen* at: ~14.5 ft/m

Bottom of Filter Pack at: ~14.5 ft/m

Borehole Backfill Material (if not filter pack): BENTONITE CHIPS FROM DEEP WELL

Bottom of Hole* at: ~27.3 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other: ______

Screen Material: ☐ stainless steel ☒ pvc ☐ other: ______

Screen Length: 10 ft/m
Screen Diameter: 2 in/cm
Screen Slot Size: 0.010 in

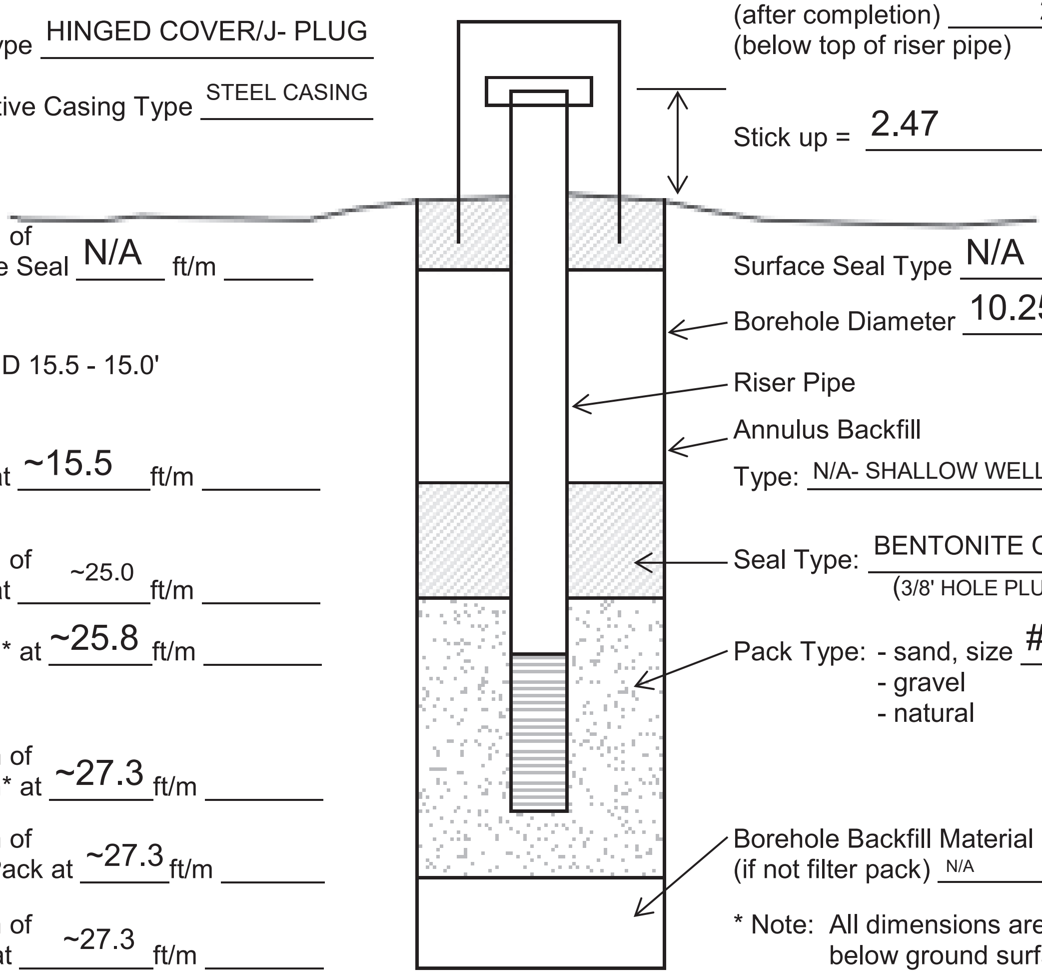
Riser Pipe Material: PVC SCH. 40
Riser Pipe Diameter: 2 in/cm

Surface Casing (Y/N): Y
Material: STEEL
Depth: 2 ft/m
Diameter: 6 in/cm
Sealant: CONCRETE

Development: Method: WHALE PUMP
Duration: 5x WELL VOLUME

Description of Purged Water: ______

Project Name: COLD SPRINGS TERMINALS
Well Designation: MW-1D
Project Number: 11137172
Date Completed: 11/12/2019
Client: SOUTHERN TERMINALS GROUP
Drilling Method: HOLLOW STEM AUGER (6.25")
Location: LYSANDER, NY
GHD Supervisor: IAN McNAMARA



Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:

Screen Material: ☐ stainless steel ☒ pvc ☐ other:

Screen Length: 1.5 ft/m Screen Diameter: 2 in/cm Screen Slot Size: 0.010 in

Riser Pipe Material: PVC SCH. 40 Riser Pipe Diameter: 2 in/cm

Surface Casing (Y/N) Y Material STEEL Depth 2 ft/m

Diameter 6 in/cm Sealant CONCRETE

Development: Method: WHALE PUMP Duration: 5x WELL VOLUME

Description of Purged Water:

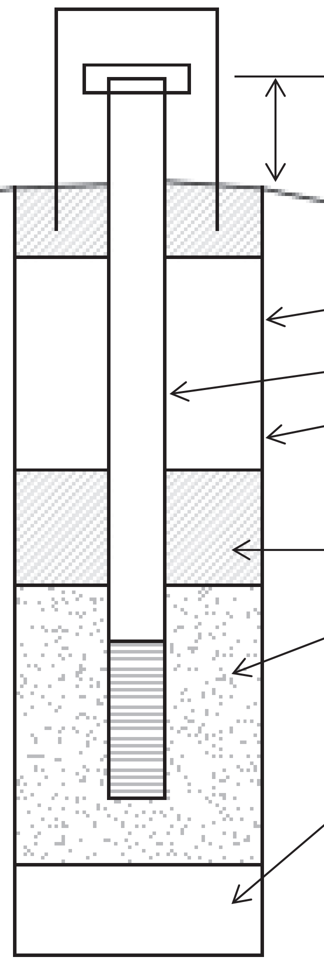
Project Name: COLD SPRINGS TERMINALS
Well Designation: MW-2S
Project Number: 11137172
Date Completed: 11/11/2019
Client: SOUTHERN TERMINALS GROUP
Drilling Method: HOLLOW STEM AUGER (6.25")
Location: LYSANDER, NY
GHD Supervisor: IAN McNAMARA

Cap Type: HINGED COVER/J- PLUG

Protective Casing Type: STEEL CASING

Measure bottom of well (after completion) 16.72 ft/m (below top of riser pipe)

Stick up = 2.91 ft/m



Bottom of Surface Seal ~1.5 ft/m

Surface Seal Type: CONCRETE

Borehole Diameter: 10.25 in/cm

Riser Pipe

Annulus Backfill Type: N/A

Top of Seal* at ~1.5 ft/m

Bottom of Seal* at ~3.0 ft/m

Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)

Top of Screen* at ~3.8 ft/m

Pack Type: - sand, size #00N
- gravel
- natural

Bottom of Screen* at ~13.8 ft/m

Bottom of Filter Pack at ~13.8 ft/m

Borehole Backfill Material (if not filter pack): BENTONITE CHIPS FROM DEEP WELL

Bottom of Hole* at ~26.4 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:

Screen Material: ☐ stainless steel ☒ pvc ☐ other:

Screen Length: 10 ft/m Screen Diameter: 2 in/cm Screen Slot Size: 0.010 in

Riser Pipe Material: PVC SCH. 40 Riser Pipe Diameter: 2 in/cm

Surface Casing (Y/N): Y Material: STEEL Depth: 2 ft/m

Diameter: 6 in/cm Sealant: CONCRETE

Development: Method: WHALE PUMP Duration: 5x WELL VOLUME

Description of Purged Water:

Project Name: COLD SPRINGS TERMINALS

Well Designation: MW-2D

Project Number: 11137172

Date Completed: 11/11/2019

Client: SOUTHERN TERMINALS GROUP

Drilling Method: HOLLOW STEM AUGER (6.25")

Location: LYSANDER, NY

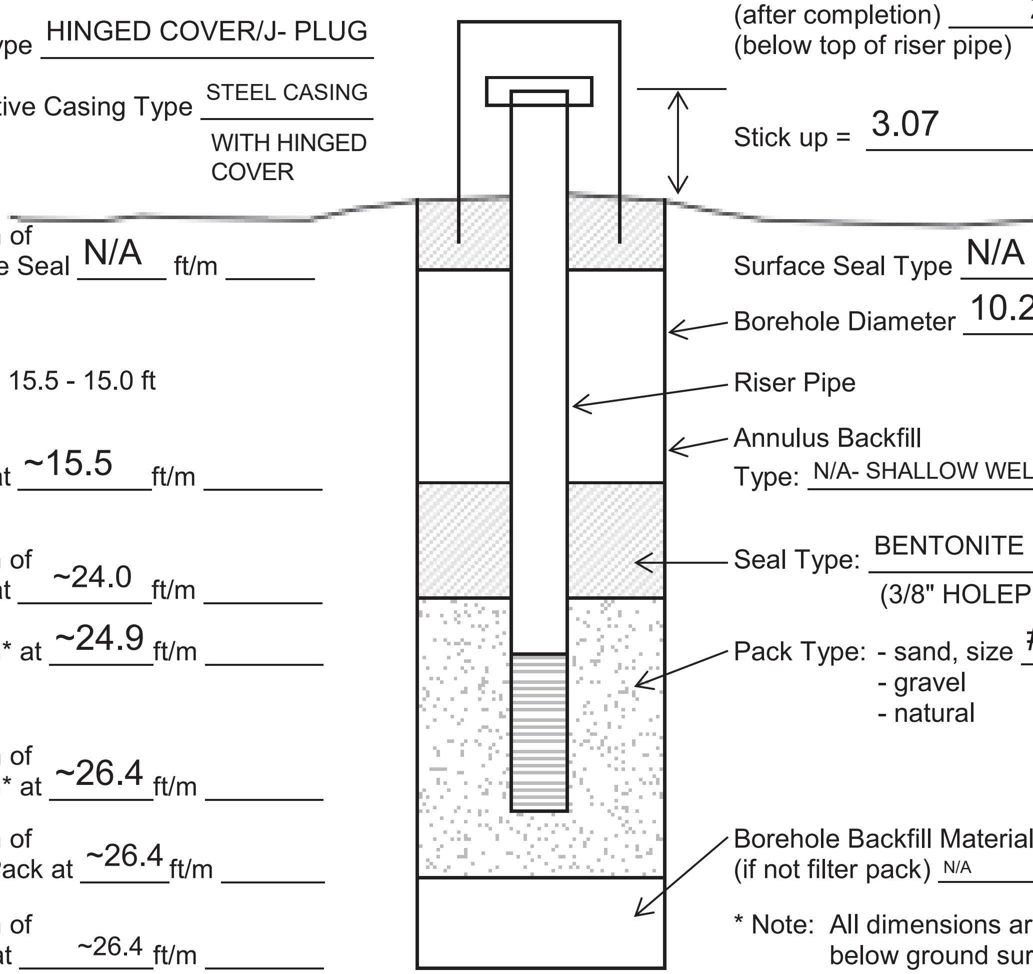
GHD Supervisor: IAN McNAMARA

Measure bottom of well (after completion) (below top of riser pipe) 29.46 ft/m

Cap Type HINGED COVER/J- PLUG

Protective Casing Type STEEL CASING WITH HINGED COVER

Stick up = 3.07 ft/m



Bottom of Surface Seal N/A ft/m

Surface Seal Type N/A

Borehole Diameter 10.25 in/cm

SAND 15.5 - 15.0 ft

Riser Pipe

Top of Seal* at ~15.5 ft/m

Annulus Backfill Type: N/A- SHALLOW WELL

Bottom of Seal* at ~24.0 ft/m

Seal Type: BENTONITE CHIPS (3/8" HOLEPLUG)

Top of Screen* at ~24.9 ft/m

Pack Type: - sand, size #00N
- gravel
- natural

Bottom of Screen* at ~26.4 ft/m

Bottom of Filter Pack at ~26.4 ft/m

Borehole Backfill Material (if not filter pack) N/A

Bottom of Hole* at ~26.4 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ■ continuous slot ☐ wire wrapped ☐ louvre ☐ other:

Screen Material: ☐ stainless steel ■ pvc ☐ other:

Screen Length: 1.5 ft/m Screen Diameter: 2 in/cm Screen Slot Size: 0.010 in

Riser Pipe Material: PVC SCH. 40 Riser Pipe Diameter: 2 in/cm

Surface Casing (Y/N) Y Material STEEL Depth 2 ft/m

Diameter 6 in/cm Sealant CONCRETE

Development: Method: WHALE PUMP Duration: 5x WELL VOLUME

Description of Purged Water:

Project Name: COLD SPRINGS TERMINALS

Project Number: 11137172

Client: SOUTHERN TERMINALS GROUP

Location: LYSANDER, NY

Well Designation: MW-3S

Date Completed: 11/07/2019

Drilling Method: HOLLOW STEM AUGER (6.25")

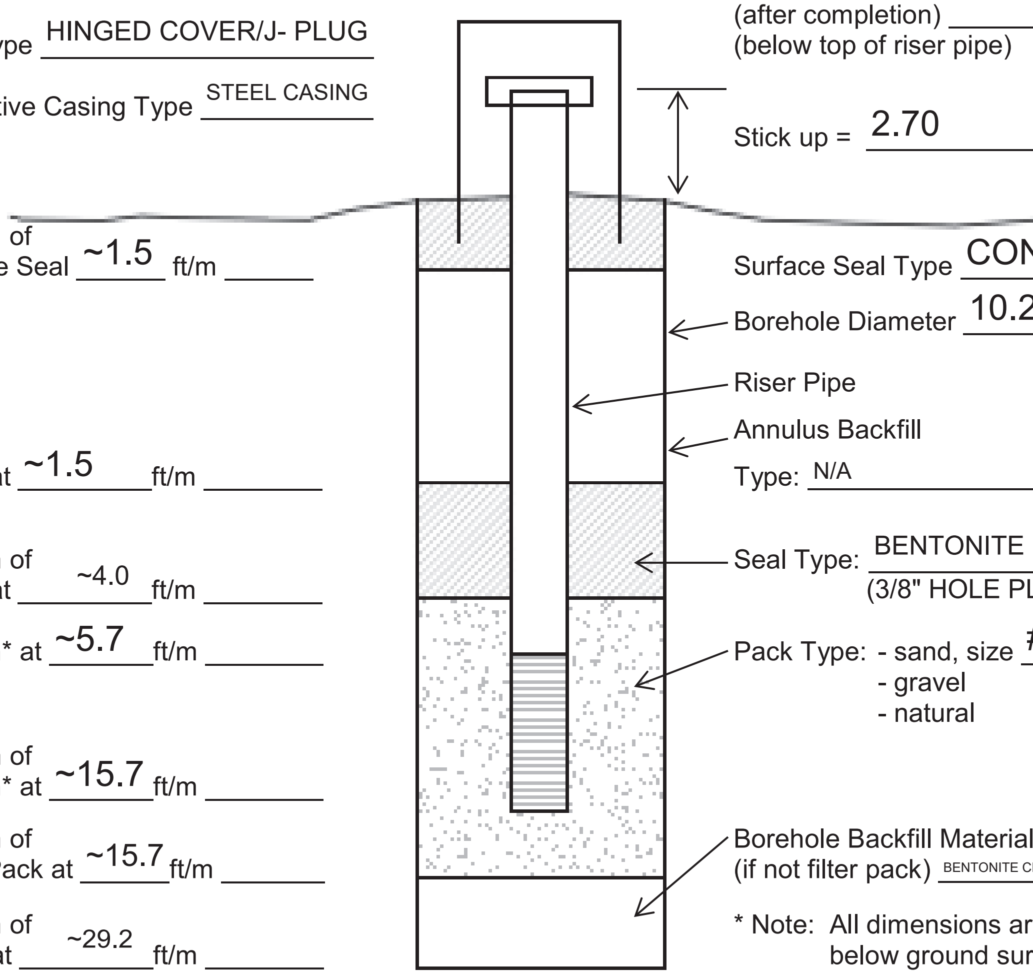
GHD Supervisor: IAN McNAMARA

Cap Type: HINGED COVER/J- PLUG

Protective Casing Type: STEEL CASING

Measure bottom of well (after completion) (below top of riser pipe): 18.39 ft/m

Stick up = 2.70 ft/m



Bottom of Surface Seal: ~1.5 ft/m

Surface Seal Type: CONCRETE

Borehole Diameter: 10.25 in/cm

Riser Pipe

Annulus Backfill Type: N/A

Top of Seal* at: ~1.5 ft/m

Bottom of Seal* at: ~4.0 ft/m

Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)

Top of Screen* at: ~5.7 ft/m

Pack Type: - sand, size #00N
- gravel
- natural

Bottom of Screen* at: ~15.7 ft/m

Bottom of Filter Pack at: ~15.7 ft/m

Borehole Backfill Material (if not filter pack): BENTONITE CHIPS FROM DEEP WELL

Bottom of Hole* at: ~29.2 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:

Screen Material: ☐ stainless steel ☒ pvc ☐ other:

Screen Length: 10 ft/m Screen Diameter: 2 in/cm Screen Slot Size: 0.010 in

Riser Pipe Material: PVC SCH. 40 Riser Pipe Diameter: 2 in/cm

Surface Casing (Y/N): Y Material: STEEL Depth: 2 ft/m

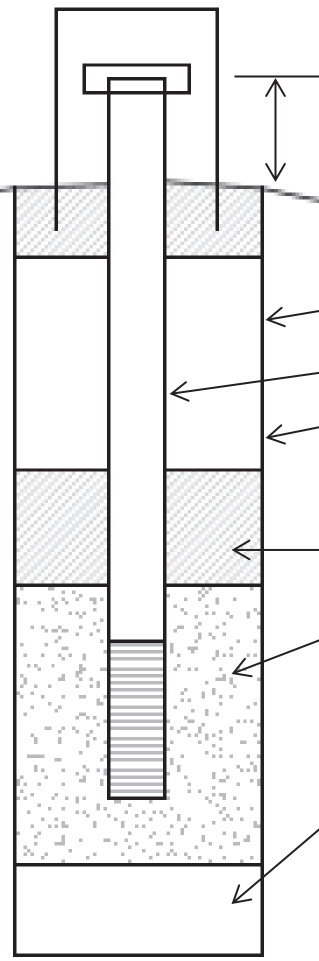
Diameter: 6 in/cm Sealant: CONCRETE

Development: Method: WHALE PUMP Duration: 5x WELL VOLUME

Description of Purged Water:

Well Instrumentation Log
(Form SP-15)

Project Name:	COLD SPRINGS TERMINALS	Well Designation:	MW-3D
Project Number:	11137172	Date Completed:	11/07/2019
Client:	SOUTHERN TERMINALS GROUP	Drilling Method:	HOLLOW STEM AUGER (6.25")
Location:	LYSANDER, NY	GHD Supervisor:	IAN McNAMARA



Cap Type: HINGED COVER/J- PLUG

Protective Casing Type: STEEL CASING

Measure bottom of well (after completion) (below top of riser pipe): 31.91 ft/m

Stick up = 2.67 ft/m

Bottom of Surface Seal: N/A ft/m

Surface Seal Type: N/A

Borehole Diameter: 10.25 in/cm

Riser Pipe

SAND 16.5- 16.0'

Annulus Backfill Type: N/A- SHALLOW WELL

Top of Seal* at: ~16.5 ft/m

Bottom of Seal* at: ~25.5 ft/m

Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)

Top of Screen* at: ~26.2 ft/m

Pack Type: - sand, size #00N
- gravel
- natural

Bottom of Screen* at: ~29.2 ft/m

Bottom of Filter Pack at: ~29.2 ft/m

Borehole Backfill Material (if not filter pack): N/A

Bottom of Hole* at: ~29.2 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:

Screen Material: ☐ stainless steel ☒ pvc ☐ other:

Screen Length: 3 ft/m Screen Diameter: 2 in/cm Screen Slot Size: 0.010 in

Riser Pipe Material: PVC SCH. 40 Riser Pipe Diameter: 2 in/cm

Surface Casing (Y/N): Y Material: STEEL Depth: 2 ft/m

Diameter: 6 in/cm Sealant: CONCRETE

Development: Method: WHALE PUMP Duration: 5x WELL VOLUME

Description of Purged Water:

Well Instrumentation Log
(Form SP-15)

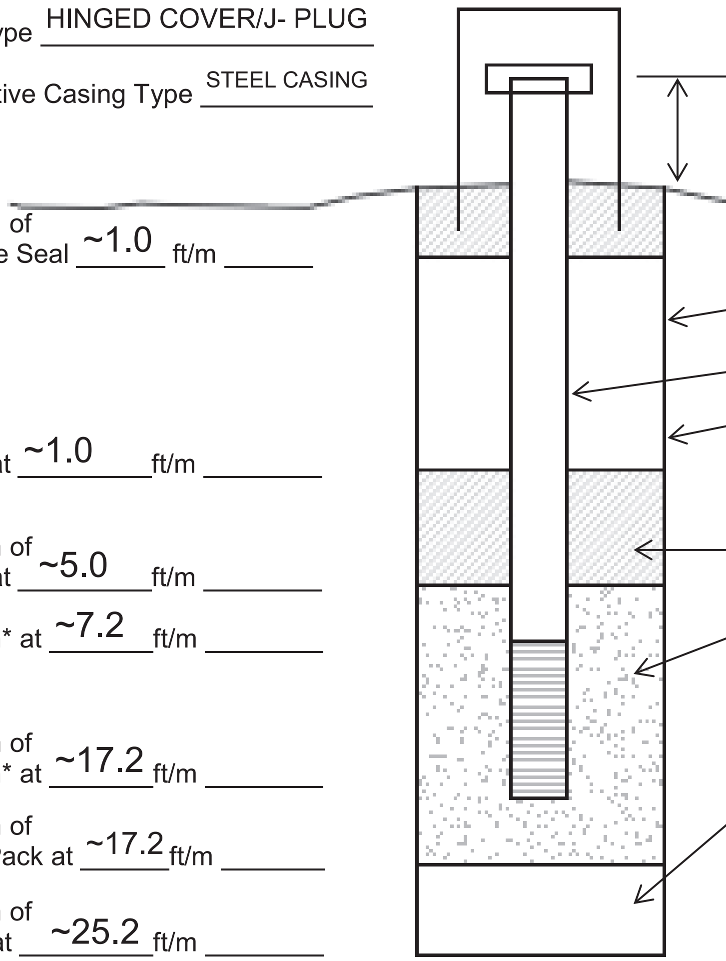
Project Name: COLD SPRINGS TERMINALS
Well Designation: MW-4S
Project Number: 11137172
Date Completed: 11/05/2019
Client: SOUTHERN TERMINALS GROUP
Drilling Method: HOLLOW STEM AUGER (6.25")
Location: LYSANDER, NY
GHD Supervisor: IAN McNAMARA

Cap Type: HINGED COVER/J- PLUG

Protective Casing Type: STEEL CASING

Measure bottom of well (after completion) (below top of riser pipe): 19.59 ft/m

Stick up = 2.47 ft/m



Bottom of Surface Seal: ~1.0 ft/m

Surface Seal Type: CONCRETE PAD

Borehole Diameter: 10.25 in/cm

Riser Pipe

Annulus Backfill Type: N/A

Top of Seal* at: ~1.0 ft/m

Bottom of Seal* at: ~5.0 ft/m

Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)

Top of Screen* at: ~7.2 ft/m

Pack Type:
- sand, size #00N
- gravel
- natural

Bottom of Screen* at: ~17.2 ft/m

Bottom of Filter Pack at: ~17.2 ft/m

Borehole Backfill Material (if not filter pack): BENTONITE FROM DEEP WELL

Bottom of Hole* at: ~25.2 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:

Screen Material: ☐ stainless steel ☒ pvc ☐ other:

Screen Length: 10 ft/m Screen Diameter: 2 in/cm Screen Slot Size: 0.010 in

Riser Pipe Material: PVC SCH. 40 Riser Pipe Diameter: 2 in/cm

Surface Casing (Y/N): Y Material: STEEL Depth: 2 ft/m

Diameter: 6 in/cm Sealant: CONCRETE

Development: Method: WHALE PUMP Duration: 5x WELL VOLUME

Description of Purged Water:

Well Instrumentation Log
(Form SP-15)

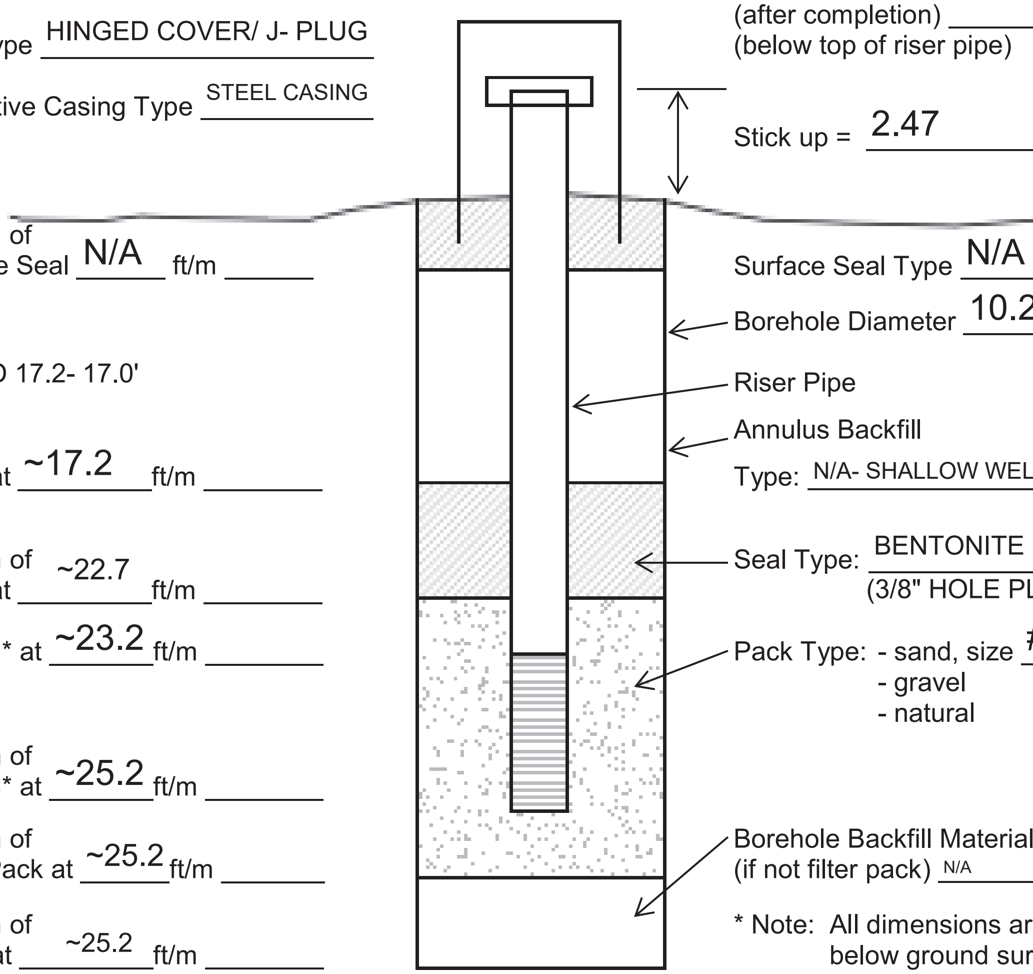
Project Name:	COLD SPRINGS TERMINALS	Well Designation:	MW-4D
Project Number:	11137172	Date Completed:	11/05/2019
Client:	SOUTHERN TERMINALS GROUP	Drilling Method:	HOLLOW STEM AUGER (6.25")
Location:	LYSANDER, NY	GHD Supervisor:	IAN McNAMARA

Measure bottom of well (after completion) (below top of riser pipe) 27.67 ft/m

Cap Type HINGED COVER/ J- PLUG

Protective Casing Type STEEL CASING

Stick up = 2.47 ft/m



Bottom of Surface Seal N/A ft/m

Surface Seal Type N/A

Borehole Diameter 10.25 in/cm

SAND 17.2- 17.0'

Riser Pipe

Annulus Backfill Type: N/A- SHALLOW WELL

Top of Seal* at ~17.2 ft/m

Bottom of Seal* at ~22.7 ft/m

Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)

Top of Screen* at ~23.2 ft/m

Pack Type: - sand, size #00N
- gravel
- natural

Bottom of Screen* at ~25.2 ft/m

Bottom of Filter Pack at ~25.2 ft/m

Borehole Backfill Material (if not filter pack) N/A

Bottom of Hole* at ~25.2 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ■ continuous slot ☐ wire wrapped ☐ louvre ☐ other:

Screen Material: ☐ stainless steel ■ pvc ☐ other:

Screen Length: 2 ft/m Screen Diameter: 2 in/cm Screen Slot Size: 0.010 in

Riser Pipe Material: PVC SCH. 40 Riser Pipe Diameter: 2 in/cm

Surface Casing (Y/N) Y Material STEEL Depth 2 ft/m

Diameter 6 in/cm Sealant CONCRETE

Development: Method: WHALE PUMP Duration: 5x WELL VOLUME

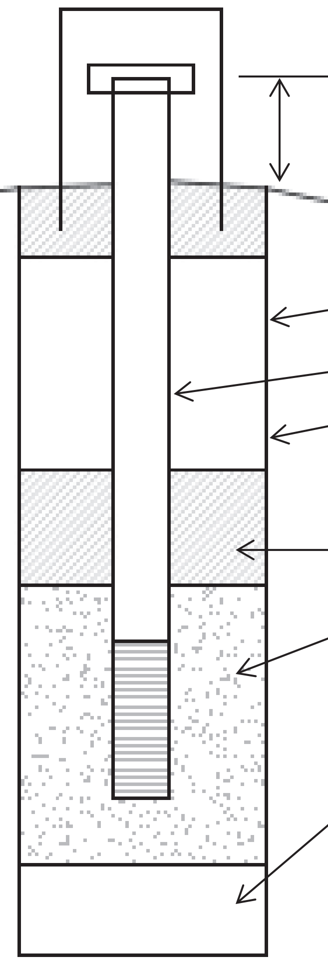
Description of Purged Water:

Project Name: COLD SPRINGS TERMINALS
Well Designation: MW-5S
Project Number: 11137172
Date Completed: 11/18/2019
Client: SOUTHERN TERMINALS GROUP
Drilling Method: HOLLOW STEM AUGER (6.25")
Location: LYSANDER, NY
GHD Supervisor: IAN McNAMARA

Cap Type: HINGED COVER/J- PLUG
Protective Casing Type: STEEL CASING

Measure bottom of well (after completion) (below top of riser pipe): 18.66 ft/m

Stick up = 3.17 ft/m



Bottom of Surface Seal: ~1.5 ft/m
Surface Seal Type: CONCRETE
Borehole Diameter: 10.25 in/cm
Riser Pipe
Annulus Backfill
Type: N/A

Top of Seal* at: ~1.5 ft/m
Bottom of Seal* at: ~3.0 ft/m
Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)

Top of Screen* at: ~5.5 ft/m
Pack Type: - sand, size #00N
- gravel
- natural

Bottom of Screen* at: ~15.5 ft/m
Bottom of Filter Pack at: ~15.5 ft/m
Borehole Backfill Material (if not filter pack): BENTONITE CHIPS FROM DEEP WELL
Bottom of Hole* at: ~21.2 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:
Screen Material: ☐ stainless steel ☒ pvc ☐ other:
Screen Length: 10 ft/m
Screen Diameter: 2 in/cm
Screen Slot Size: 0.010 in
Riser Pipe Material: PVC SCH. 40
Riser Pipe Diameter: 2 in/cm
Surface Casing (Y/N): Y
Material: STEEL
Depth: 2 ft/m
Diameter: 6 in/cm
Sealant: CONCRETE
Development: Method: WHALE PUMP
Duration: 5x WELL VOLUME
Description of Purged Water:

Well Instrumentation Log
(Form SP-15)

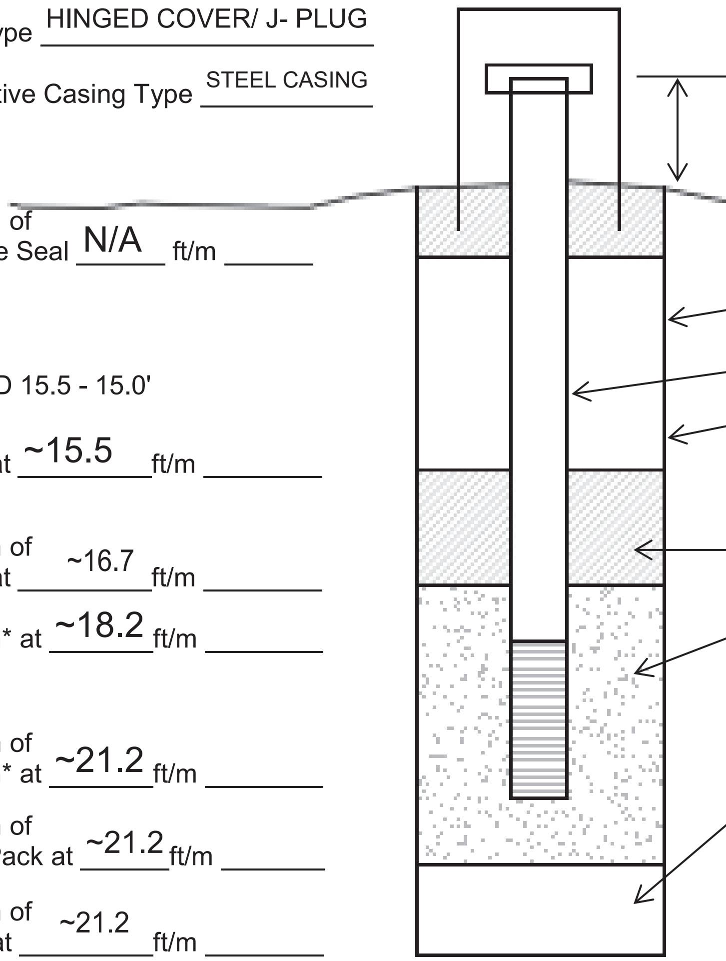
Project Name: COLD SPRINGS TERMINALS
Well Designation: MW-5D
Project Number: 11137172
Date Completed: 11/18/2019
Client: SOUTHERN TERMINALS GROUP
Drilling Method: HOLLOW STEM AUGER (6.25")
Location: LYSANDER, NY
GHD Supervisor: IAN McNAMARA

Measure bottom of well (after completion) 24.43 ft/m (below top of riser pipe)

Cap Type: HINGED COVER/ J- PLUG

Protective Casing Type: STEEL CASING

Stick up = 3.19 ft/m



Bottom of Surface Seal: N/A ft/m

Surface Seal Type: N/A

Borehole Diameter: 10.25 in/cm

Riser Pipe

SAND 15.5 - 15.0'

Annulus Backfill Type: N/A- SHALLOW WELL

Top of Seal* at ~15.5 ft/m

Bottom of Seal* at ~16.7 ft/m

Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)

Top of Screen* at ~18.2 ft/m

Pack Type:
- sand, size #00N
- gravel
- natural

Bottom of Screen* at ~21.2 ft/m

Bottom of Filter Pack at ~21.2 ft/m

Borehole Backfill Material (if not filter pack) N/A

Bottom of Hole* at ~21.2 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:

Screen Material: ☐ stainless steel ☒ pvc ☐ other:

Screen Length: 3 ft/m Screen Diameter: 2 in/cm Screen Slot Size: 0.010 in

Riser Pipe Material: PVC SCH. 40 Riser Pipe Diameter: 2 in/cm

Surface Casing (Y/N): Y Material: STEEL Depth: 2 ft/m

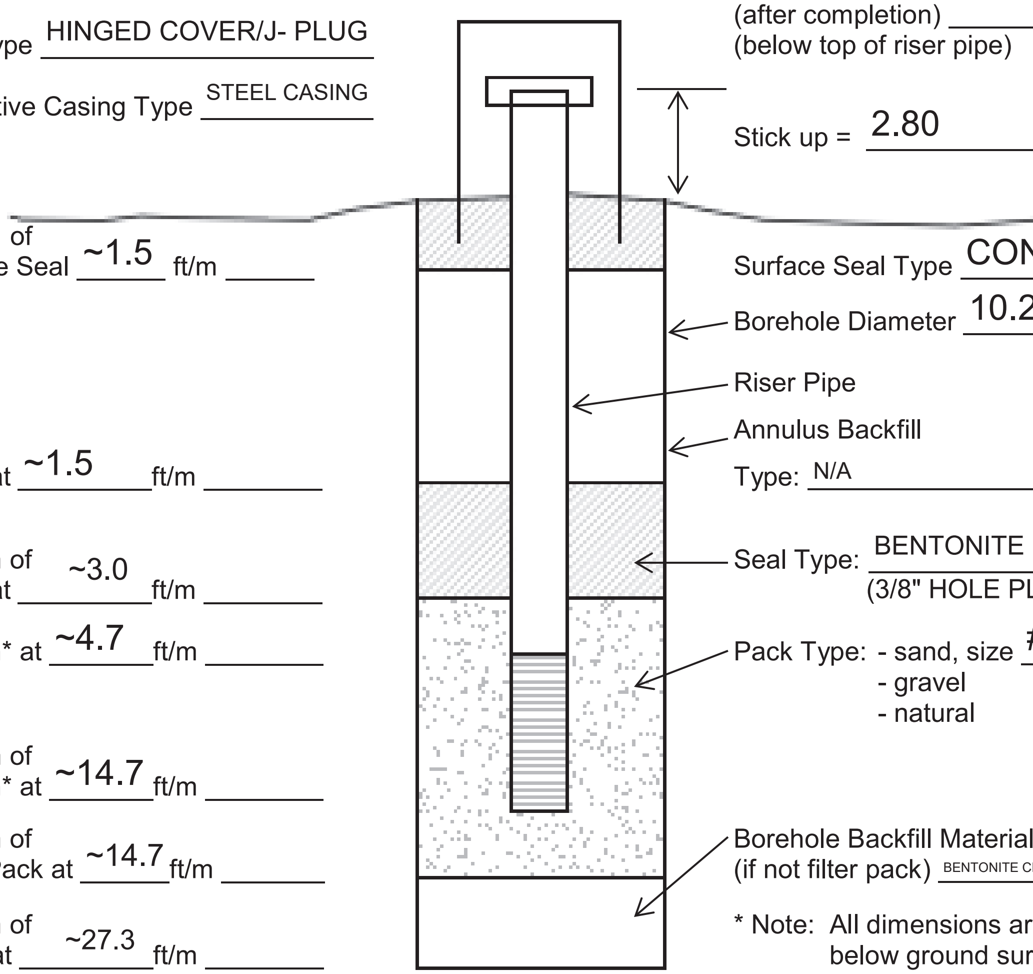
Diameter: 6 in/cm Sealant: CONCRETE

Development: Method: WHALE PUMP Duration: 5x WELL VOLUME

Description of Purged Water:

Well Instrumentation Log
(Form SP-15)

Project Name: COLD SPRINGS TERMINALS
Well Designation: MW-6S
Project Number: 11137172
Date Completed: 11/19/2019
Client: SOUTHERN TERMINALS GROUP
Drilling Method: HOLLOW STEM AUGER (6.25")
Location: LYSANDER, NY
GHD Supervisor: IAN McNAMARA



Cap Type: HINGED COVER/J- PLUG
Protective Casing Type: STEEL CASING
Measure bottom of well (after completion) (below top of riser pipe): 17.47 ft/m
Stick up = 2.80 ft/m
Bottom of Surface Seal: ~1.5 ft/m
Surface Seal Type: CONCRETE
Borehole Diameter: 10.25 in/cm
Riser Pipe
Annulus Backfill Type: N/A
Top of Seal* at: ~1.5 ft/m
Bottom of Seal* at: ~3.0 ft/m
Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)
Top of Screen* at: ~4.7 ft/m
Pack Type: - sand, size #00N
- gravel
- natural
Bottom of Screen* at: ~14.7 ft/m
Bottom of Filter Pack at: ~14.7 ft/m
Borehole Backfill Material (if not filter pack): BENTONITE CHIPS FROM DEEP WELL
Bottom of Hole* at: ~27.3 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:
Screen Material: ☐ stainless steel ☒ pvc ☐ other:
Screen Length: 10 ft/m Screen Diameter: 2 in/cm Screen Slot Size: 0.010 in
Riser Pipe Material: PVC SCH. 40 Riser Pipe Diameter: 2 in/cm
Surface Casing (Y/N): Y Material: STEEL Depth: 2 ft/m
Diameter: 6 in/cm Sealant: CONCRETE
Development: Method: WHALE PUMP Duration: 5x WELL VOLUME
Description of Purged Water:

Well Instrumentation Log
(Form SP-15)

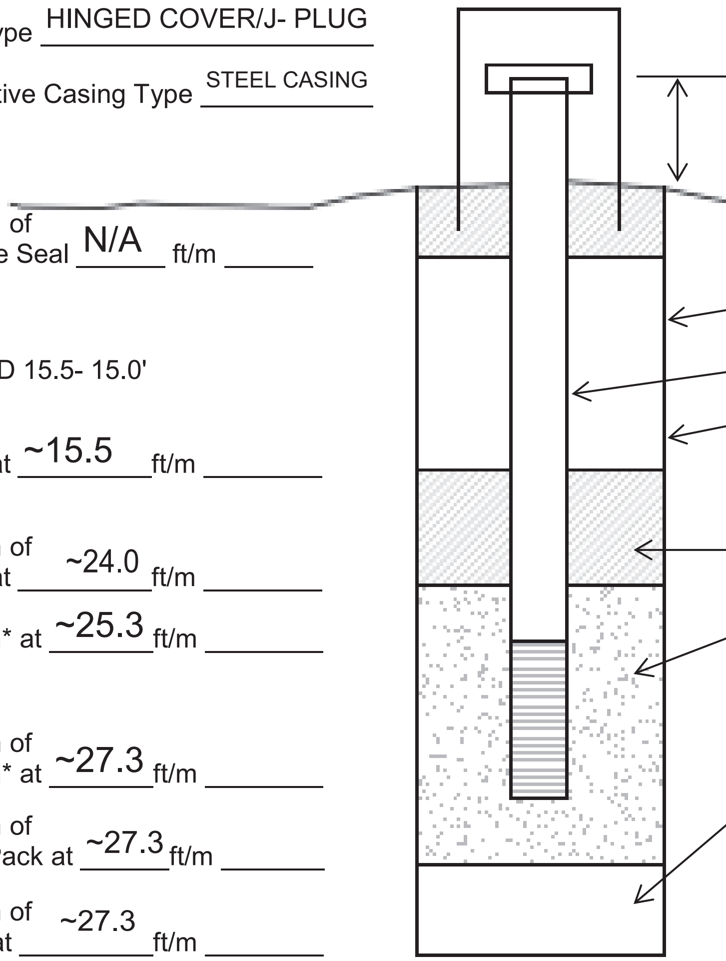
Project Name:	COLD SPRINGS TERMINALS	Well Designation:	MW-6D
Project Number:	11137172	Date Completed:	11/19/2019
Client:	SOUTHERN TERMINALS GROUP	Drilling Method:	HOLLOW STEM AUGER (6.25")
Location:	LYSANDER, NY	GHD Supervisor:	IAN McNAMARA

Measure bottom of well (after completion) (below top of riser pipe) 30.14 ft/m

Cap Type HINGED COVER/J- PLUG

Protective Casing Type STEEL CASING

Stick up = 2.87 ft/m



Bottom of Surface Seal N/A ft/m

Surface Seal Type N/A

Borehole Diameter 10.25 in/cm

SAND 15.5- 15.0'

Riser Pipe

Annulus Backfill Type: N/A- SHALLOW WELL

Top of Seal* at ~15.5 ft/m

Bottom of Seal* at ~24.0 ft/m

Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)

Top of Screen* at ~25.3 ft/m

Pack Type: - sand, size #00N
- gravel
- natural

Bottom of Screen* at ~27.3 ft/m

Bottom of Filter Pack at ~27.3 ft/m

Borehole Backfill Material (if not filter pack) N/A

Bottom of Hole* at ~27.3 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:

Screen Material: ☐ stainless steel ☒ pvc ☐ other:

Screen Length: 2 ft/m Screen Diameter: 2 in/cm Screen Slot Size: 0.010 in

Riser Pipe Material: PVC SCH. 40 Riser Pipe Diameter: 2 in/cm

Surface Casing (Y/N) Y Material STEEL Depth 2 ft/m

Diameter 6 in/cm Sealant CONCRETE

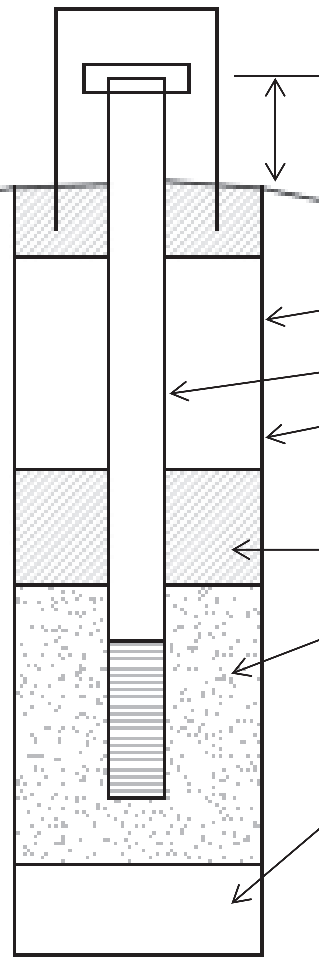
Development: Method: WHALE PUMP Duration: 5x WELL VOLUME

Description of Purged Water:

Project Name: COLD SPRINGS TERMINALS
Project Number: 11137172
Client: SOUTHERN TERMINALS GROUP
Location: LYSANDER, NY

Well Designation: MW-7S
Date Completed: 11/13/2019
Drilling Method: HOLLOW STEM AUGER (6.25")
GHD Supervisor: IAN McNAMARA

Cap Type: HINGED COVER/J- PLUG
Protective Casing Type: STEEL CASING



Measure bottom of well (after completion) (below top of riser pipe): 18.36 ft/m
Stick up = 2.81 ft/m

Bottom of Surface Seal: ~1.5 ft/m
Surface Seal Type: CONCRETE
Borehole Diameter: 10.25 in/cm
Riser Pipe
Annulus Backfill Type: N/A

Top of Seal* at: ~1.5 ft/m
Bottom of Seal* at: ~4.0 ft/m
Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)

Top of Screen* at: ~5.6 ft/m
Pack Type: - sand, size #00N
- gravel
- natural

Bottom of Screen* at: ~15.6 ft/m
Bottom of Filter Pack at: ~15.6 ft/m
Borehole Backfill Material (if not filter pack): BENTONITE CHIPS FROM DEEP WELL
Bottom of Hole* at: ~29.2 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:
Screen Material: ☐ stainless steel ☒ pvc ☐ other:
Screen Length: 10 ft/m Screen Diameter: 2 in/cm Screen Slot Size: 0.010 in
Riser Pipe Material: PVC SCH. 40 Riser Pipe Diameter: 2 in/cm
Surface Casing (Y/N): Y Material: STEEL Depth: 2 ft/m
Diameter: 6 in/cm Sealant: CONCRETE
Development: Method: WHALE PUMP Duration: 5x WELL VOLUME
Description of Purged Water:

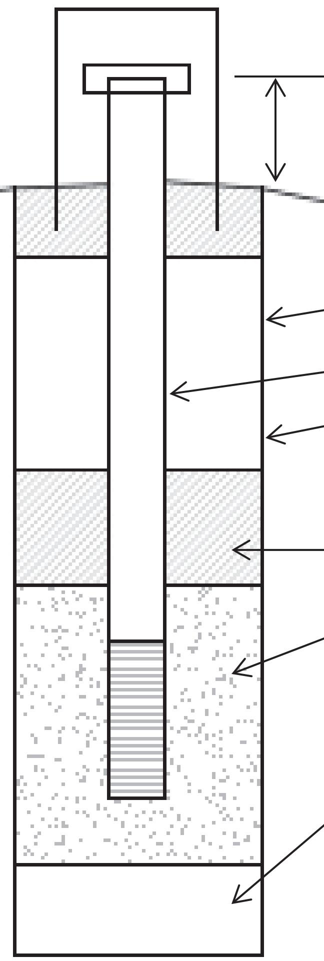
Well Instrumentation Log
(Form SP-15)

Project Name: COLD SPRINGS TERMINALS
Well Designation: MW-7D
Project Number: 11137172
Date Completed: 11/13/2019
Client: SOUTHERN TERMINALS GROUP
Drilling Method: HOLLOW STEM AUGER (6.25")
Location: LYSANDER, NY
GHD Supervisor: IAN McNAMARA

Cap Type: HINGED COVER/J- PLUG
Protective Casing Type: STEEL CASING

Measure bottom of well (after completion) (below top of riser pipe): 32.02 ft/m

Stick up = 2.85 ft/m



Bottom of Surface Seal: N/A ft/m
Surface Seal Type: N/A
Borehole Diameter: 10.25 in/cm
Riser Pipe
Annulus Backfill Type: N/A- SHALLOW WELL

SAND 16.5- 16.0'

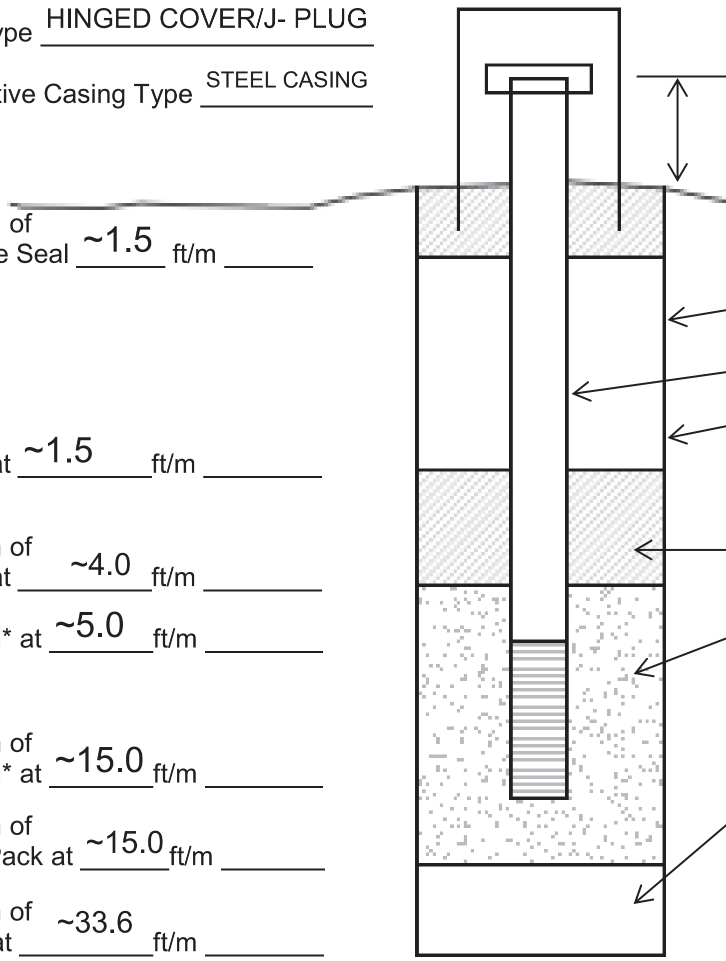
Top of Seal* at: ~16.5 ft/m
Bottom of Seal* at: ~25.7 ft/m
Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)
Top of Screen* at: ~26.2 ft/m
Pack Type: - sand, size #00N
- gravel
- natural
Bottom of Screen* at: ~29.2 ft/m
Bottom of Filter Pack at: ~29.2 ft/m
Borehole Backfill Material (if not filter pack): N/A
Bottom of Hole* at: ~29.2 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:
Screen Material: ☐ stainless steel ☒ pvc ☐ other:
Screen Length: 3 ft/m Screen Diameter: 2 in/cm Screen Slot Size: 0.010 in
Riser Pipe Material: PVC SCH. 40 Riser Pipe Diameter: 2 in/cm
Surface Casing (Y/N): Y Material: STEEL Depth: 2 ft/m
Diameter: 6 in/cm Sealant: CONCRETE
Development: Method: WHALE PUMP Duration: 5x WELL VOLUME
Description of Purged Water:

Well Instrumentation Log
(Form SP-15)

Project Name: COLD SPRINGS TERMINALS
Well Designation: MW-9S
Project Number: 11137172
Date Completed: 11/21/2019
Client: SOUTHERN TERMINALS GROUP
Drilling Method: HOLLOW STEM AUGER (6.25")
Location: LYSANDER, NY
GHD Supervisor: IAN McNAMARA



Cap Type: HINGED COVER/J- PLUG

Protective Casing Type: STEEL CASING

Measure bottom of well (after completion) (below top of riser pipe): 17.53 ft/m

Stick up = 2.56 ft/m

Bottom of Surface Seal: ~1.5 ft/m

Surface Seal Type: CONCRETE

Borehole Diameter: 10.25 in/cm

Riser Pipe

Annulus Backfill Type: N/A

Top of Seal* at: ~1.5 ft/m

Bottom of Seal* at: ~4.0 ft/m

Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)

Top of Screen* at: ~5.0 ft/m

Pack Type: - sand, size #00N
- gravel
- natural

Bottom of Screen* at: ~15.0 ft/m

Bottom of Filter Pack at: ~15.0 ft/m

Borehole Backfill Material (if not filter pack): BENTONITE CHIPS FROM DEEP WELL

Bottom of Hole* at: ~33.6 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:

Screen Material: ☐ stainless steel ☒ pvc ☐ other:

Screen Length: 10 ft/m Screen Diameter: 2 in/cm Screen Slot Size: 0.010 in

Riser Pipe Material: PVC SCH. 40 Riser Pipe Diameter: 2 in/cm

Surface Casing (Y/N): Y Material: STEEL Depth: 2 ft/m

Diameter: 6 in/cm Sealant: CONCRETE

Development: Method: WHALE PUMP Duration: 5x WELL VOLUME

Description of Purged Water:

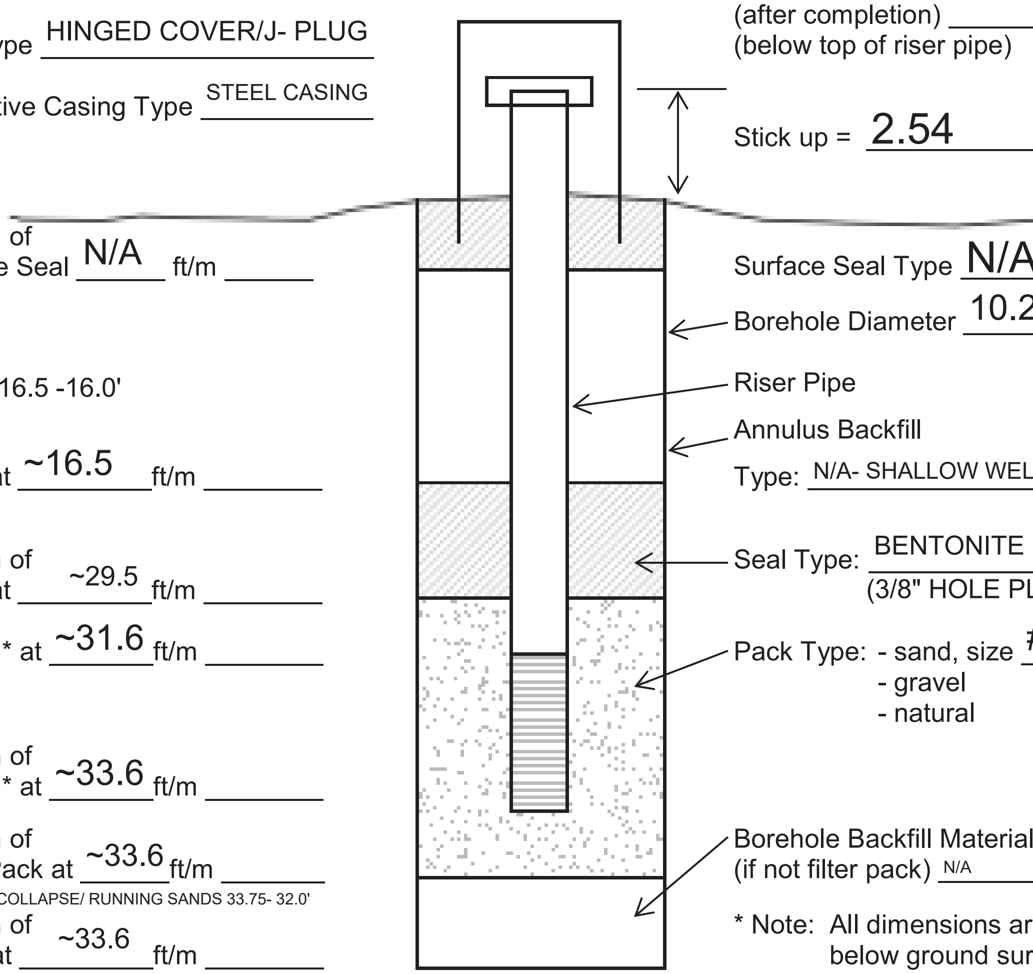
Project Name: COLD SPRINGS TERMINALS
Well Designation: MW-9D
Project Number: 11137172
Date Completed: 11/21/2019
Client: SOUTHERN TERMINALS GROUP
Drilling Method: HOLLOW STEM AUGER (6.25")
Location: LYSANDER, NY
GHD Supervisor: IAN McNAMARA

Measure bottom of well (after completion) (below top of riser pipe): 36.17 ft/m

Cap Type: HINGED COVER/J- PLUG

Protective Casing Type: STEEL CASING

Stick up = 2.54 ft/m



Bottom of Surface Seal: N/A ft/m

Surface Seal Type: N/A

Borehole Diameter: 10.25 in/cm

SAND 16.5 -16.0'

Riser Pipe

Annulus Backfill Type: N/A- SHALLOW WELL

Top of Seal* at: ~16.5 ft/m

Bottom of Seal* at: ~29.5 ft/m

Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)

Top of Screen* at: ~31.6 ft/m

Pack Type: - sand, size #00N
- gravel
- natural

Bottom of Screen* at: ~33.6 ft/m

Bottom of Filter Pack at: ~33.6 ft/m

NATURAL COLLAPSE/ RUNNING SANDS 33.75- 32.0'

Borehole Backfill Material (if not filter pack): N/A

Bottom of Hole* at: ~33.6 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:

Screen Material: ☐ stainless steel ☒ pvc ☐ other:

Screen Length: 2 ft/m Screen Diameter: 2 in/cm Screen Slot Size: 0.010 in

Riser Pipe Material: PVC SCH. 40 Riser Pipe Diameter: 2 in/cm

Surface Casing (Y/N): Y Material: STEEL Depth: 2 ft/m

Diameter: 6 in/cm Sealant: CONCRETE

Development: Method: WHALE PUMP Duration: 5x WELL VOLUME

Description of Purged Water:

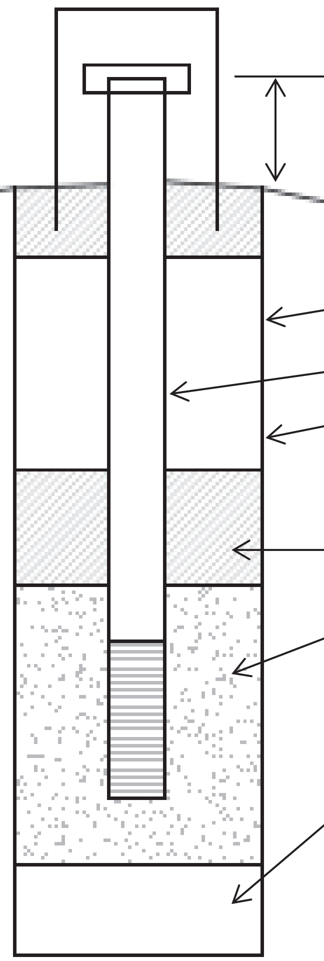
Project Name:	COLD SPRINGS TERMINALS	Well Designation:	MW-10S
Project Number:	11137172	Date Completed:	11/20/2019
Client:	SOUTHERN TERMINALS GROUP	Drilling Method:	HOLLOW STEM AUGER (6.25")
Location:	LYSANDER, NY	GHD Supervisor:	IAN McNAMARA

Cap Type: HINGED COVER/J- PLUG

Protective Casing Type: STEEL CASING

Measure bottom of well (after completion) (below top of riser pipe): 16.94 ft/m

Stick up = 2.46 ft/m



Bottom of Surface Seal: ~1.5 ft/m

Surface Seal Type: CONCRETE

Borehole Diameter: 10.25 in/cm

Riser Pipe

Annulus Backfill Type: N/A

Top of Seal* at: ~1.5 ft/m

Bottom of Seal* at: ~3.0 ft/m

Seal Type: BENTONITE CHIPS (3/8" HOLEPLUG)

Top of Screen* at: ~4.5 ft/m

Pack Type: - sand, size #00N
- gravel
- natural

Bottom of Screen* at: ~14.5 ft/m

Bottom of Filter Pack at: ~14.5 ft/m

Borehole Backfill Material (if not filter pack): NATURAL FORMATION COLLAPSE AND RUNNING SANDS

Bottom of Hole* at: ~32.0 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:

Screen Material: ☐ stainless steel ☒ pvc ☐ other:

Screen Length: 10 ft/m Screen Diameter: 2 in/cm Screen Slot Size: 0.010 in

Riser Pipe Material: PVC SCH. 40 Riser Pipe Diameter: 2 in/cm

Surface Casing (Y/N): Y Material: STEEL Depth: 2 ft/m

Diameter: 4 in/cm Sealant: CONCRETE

Development: Method: WHALE PUMP Duration: 5x WELL VOLUME

Description of Purged Water:

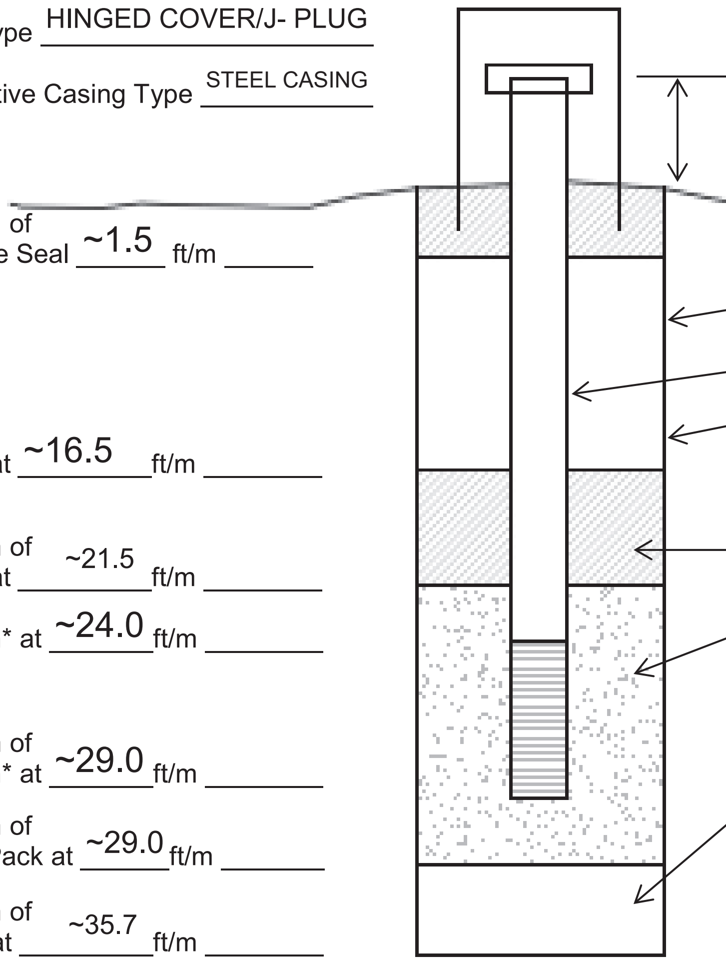
Project Name: COLD SPRINGS TERMINALS | Well Designation: MW-10I
Project Number: 11137172 | Date Completed: 11/20/2019
Client: SOUTHERN TERMINALS GROUP | Drilling Method: HOLLOW STEM AUGER (6.25")
Location: LYSANDER, NY | GHD Supervisor: IAN McNAMARA

Cap Type: HINGED COVER/J- PLUG

Protective Casing Type: STEEL CASING

Measure bottom of well (after completion) (below top of riser pipe): 30.39 ft/m

Stick up = 1.44 ft/m



Bottom of Surface Seal: ~1.5 ft/m

Surface Seal Type: CONCRETE

Borehole Diameter: 10.25 in/cm

Riser Pipe

Annulus Backfill Type: BENTONITE CHIPS AND SOIL CUTTING MIX

Top of Seal* at: ~16.5 ft/m

Bottom of Seal* at: ~21.5 ft/m

Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)

Top of Screen* at: ~24.0 ft/m

Pack Type: - sand, size #00N
- gravel
- natural

Bottom of Screen* at: ~29.0 ft/m

Bottom of Filter Pack at: ~29.0 ft/m

Borehole Backfill Material (if not filter pack): BENTONITE CHIPS FROM DEEP WELL

Bottom of Hole* at: ~35.7 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:

Screen Material: ☐ stainless steel ☒ pvc ☐ other:

Screen Length: 5 ft/m | Screen Diameter: 2 in/cm | Screen Slot Size: 0.010 in

Riser Pipe Material: PVC SCH. 40 | Riser Pipe Diameter: 2 in/cm

Surface Casing (Y/N): Y | Material: STEEL | Depth: 2 ft/m

Diameter: 6 in/cm | Sealant: CONCRETE

Development: Method: WHALE PUMP | Duration: 5x WELL VOLUME

Description of Purged Water:

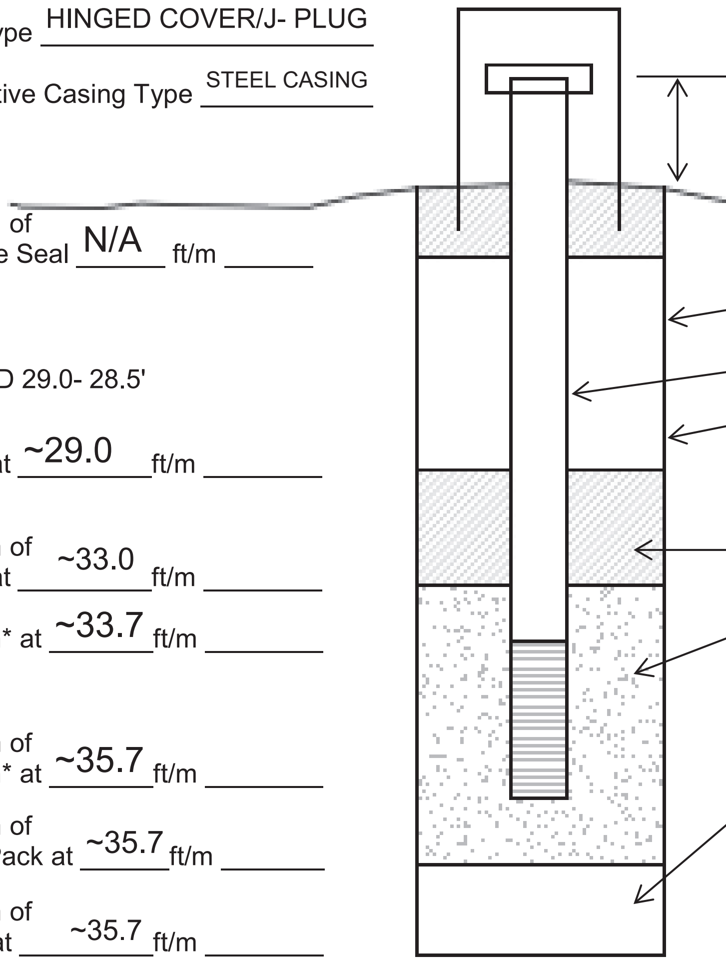
Project Name: COLD SPRINGS TERMINALS
Well Designation: MW-10D
Project Number: 11137172
Date Completed: 11/20/2019
Client: SOUTHERN TERMINALS GROUP
Drilling Method: HOLLOW STEM AUGER (6.25")
Location: LYSANDER, NY
GHD Supervisor: IAN McNAMARA

Cap Type: HINGED COVER/J- PLUG

Protective Casing Type: STEEL CASING

Measure bottom of well (after completion) (below top of riser pipe): 37.20 ft/m

Stick up = 1.50 ft/m



Bottom of Surface Seal: N/A ft/m

Surface Seal Type: N/A

Borehole Diameter: 10.25 in/cm

SAND 29.0- 28.5'

Riser Pipe

Annulus Backfill Type: N/A- INTERMEDIATE WELL

Top of Seal* at: ~29.0 ft/m

Bottom of Seal* at: ~33.0 ft/m

Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)

Top of Screen* at: ~33.7 ft/m

Pack Type:
- sand, size #00N
- gravel
- natural

Bottom of Screen* at: ~35.7 ft/m

Bottom of Filter Pack at: ~35.7 ft/m

Borehole Backfill Material (if not filter pack): N/A

Bottom of Hole* at: ~35.7 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:

Screen Material: ☐ stainless steel ☒ pvc ☐ other:

Screen Length: 2 ft/m
Screen Diameter: 2 in/cm
Screen Slot Size: 0.010 in

Riser Pipe Material: PVC SCH. 40
Riser Pipe Diameter: 2 in/cm

Surface Casing (Y/N): Y
Material: STEEL
Depth: 2 ft/m
Diameter: 6 in/cm
Sealant: CONCRETE

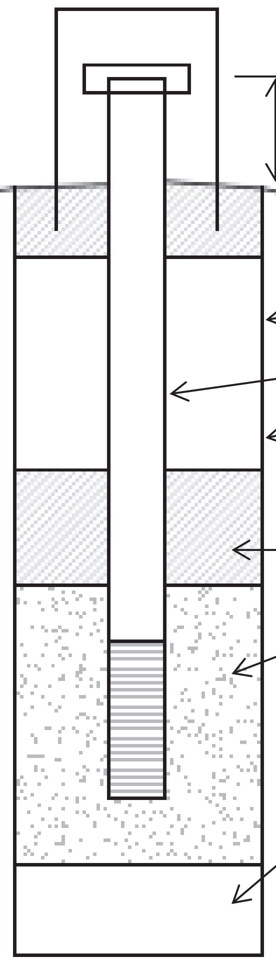
Development: Method: WHALE PUMP
Duration: 5x WELL VOLUME

Description of Purged Water:

Project Name: COLD SPRINGS TERMINALS
Project Number: 11137172
Client: SOUTHERN TERMINALS GROUP
Location: LYSANDER, NY

Well Designation: RW-1
Date Completed: 11/04/2019
Drilling Method: HOLLOW STEM AUGER (8.25")
GHD Supervisor: IAN McNAMARA

Cap Type: LOCKING ROYER/ J- PLUG
Protective Casing Type: STEEL STICK-UP



Measure bottom of well (after completion) (below top of riser pipe): 17.35 ft/m
Stick up = 1.68 ft/m

Bottom of Surface Seal: ~1.5 ft/m
Surface Seal Type: CONCRETE
Borehole Diameter: 12.25 in/cm
Riser Pipe
Annulus Backfill Type: N/A

Top of Seal* at: ~1.5 ft/m
Bottom of Seal* at: ~3.0 ft/m
Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)
Top of Screen* at: ~5.7 ft/m
Pack Type: - sand, size #00N
- gravel
- natural
Bottom of Screen* at: ~15.7 ft/m
Bottom of Filter Pack at: ~15.7 ft/m
Borehole Backfill Material (if not filter pack): N/A
Bottom of Hole* at: ~15.7 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:
Screen Material: ☐ stainless steel ☒ pvc ☐ other:
Screen Length: 10 ft/m Screen Diameter: 6 in/cm Screen Slot Size: 0.010 in
Riser Pipe Material: PVC SCH. 40 Riser Pipe Diameter: 6 in/cm
Surface Casing (Y/N): Y Material: STEEL Depth: 2 ft/m
Diameter: 8 in/cm Sealant: CONCRETE
Development: Method: WHALE PUMP Duration: 5x WELL VOLUME
Description of Purged Water:

Well Instrumentation Log
(Form SP-15)

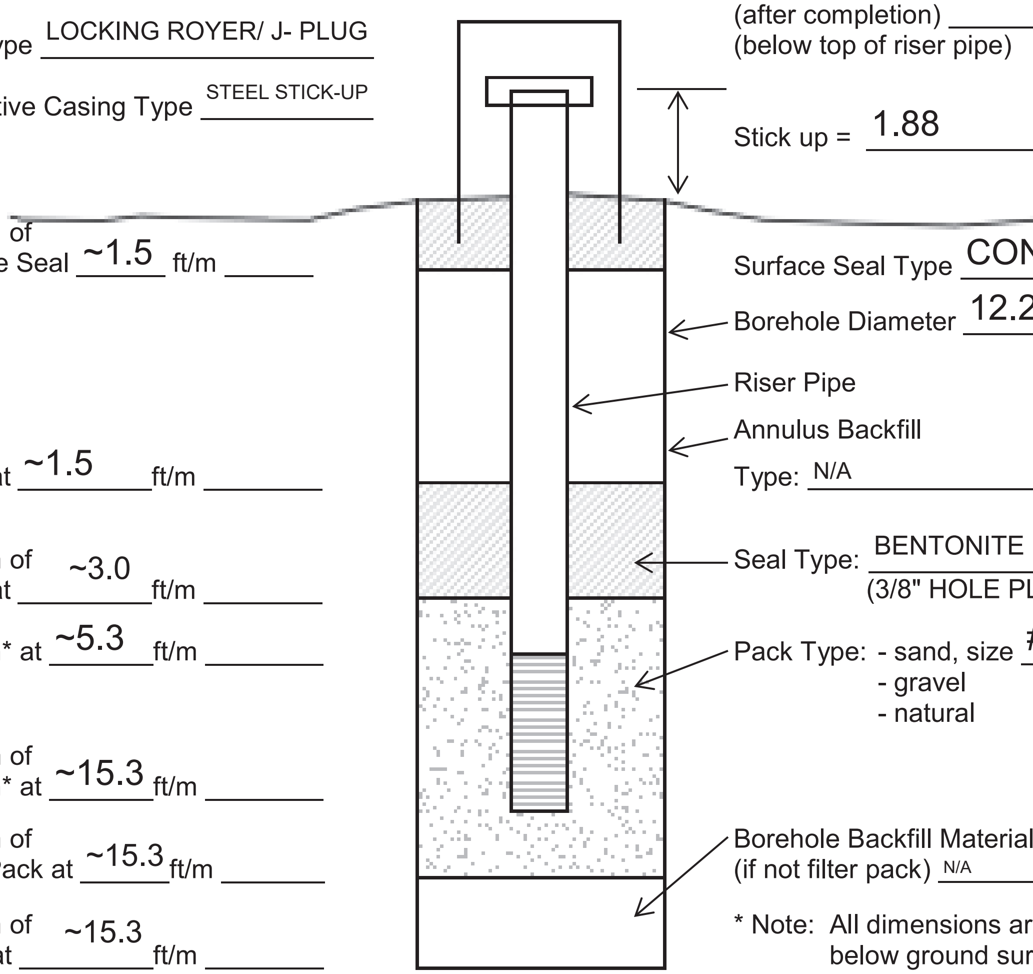
Project Name:	COLD SPRINGS TERMINALS	Well Designation:	RW-2
Project Number:	11137172	Date Completed:	11/06/2019
Client:	SOUTHERN TERMINALS GROUP	Drilling Method:	HOLLOW STEM AUGER (8.25")
Location:	LYSANDER, NY	GHD Supervisor:	IAN McNAMARA

Cap Type: LOCKING ROYER/ J- PLUG

Protective Casing Type: STEEL STICK-UP

Measure bottom of well (after completion) 17.16 ft/m (below top of riser pipe)

Stick up = 1.88 ft/m



Bottom of Surface Seal ~1.5 ft/m

Surface Seal Type: CONCRETE

Borehole Diameter: 12.25 in/cm

Riser Pipe

Annulus Backfill Type: N/A

Top of Seal* at ~1.5 ft/m

Bottom of Seal* at ~3.0 ft/m

Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)

Top of Screen* at ~5.3 ft/m

Pack Type: - sand, size #00N
- gravel
- natural

Bottom of Screen* at ~15.3 ft/m

Bottom of Filter Pack at ~15.3 ft/m

Borehole Backfill Material (if not filter pack) N/A

Bottom of Hole* at ~15.3 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ■ continuous slot ☐ wire wrapped ☐ louvre ☐ other:

Screen Material: ☐ stainless steel ■ pvc ☐ other:

Screen Length: 10 ft/m Screen Diameter: 6 in/cm Screen Slot Size: 0.010 in

Riser Pipe Material: PVC SCH. 40 Riser Pipe Diameter: 6 in/cm

Surface Casing (Y/N): Y Material: STEEL Depth: 2 ft/m

Diameter: 8 in/cm Sealant: CONCRETE

Development: Method: WHALE PUMP Duration: 5x WELL VOLUME

Description of Purged Water:

Well Instrumentation Log
(Form SP-15)

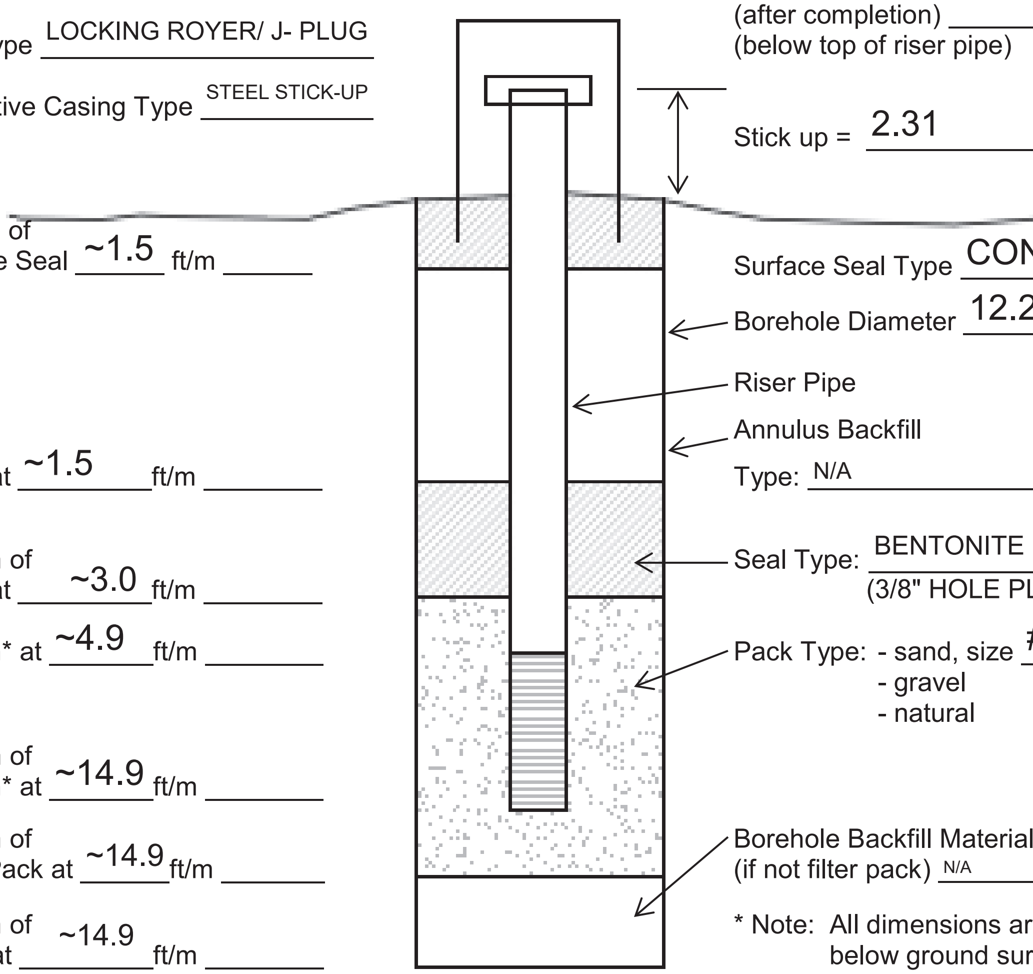
Project Name: COLD SPRINGS TERMINALS
Well Designation: RW-3
Project Number: 11137172
Date Completed: 11/06/2019
Client: SOUTHERN TERMINALS GROUP
Drilling Method: HOLLOW STEM AUGER (8.25")
Location: LYSANDER, NY
GHD Supervisor: IAN McNAMARA

Cap Type: LOCKING ROYER/ J- PLUG

Protective Casing Type: STEEL STICK-UP

Measure bottom of well (after completion) (below top of riser pipe): 17.22 ft/m

Stick up = 2.31 ft/m



Bottom of Surface Seal: ~1.5 ft/m

Surface Seal Type: CONCRETE

Borehole Diameter: 12.25 in/cm

Riser Pipe

Annulus Backfill Type: N/A

Top of Seal* at: ~1.5 ft/m

Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)

Bottom of Seal* at: ~3.0 ft/m

Top of Screen* at: ~4.9 ft/m

Pack Type: - sand, size #00N
- gravel
- natural

Bottom of Screen* at: ~14.9 ft/m

Bottom of Filter Pack at: ~14.9 ft/m

Borehole Backfill Material (if not filter pack): N/A

Bottom of Hole* at: ~14.9 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:

Screen Material: ☐ stainless steel ☒ pvc ☐ other:

Screen Length: 10 ft/m Screen Diameter: 6 in/cm Screen Slot Size: 0.010 in

Riser Pipe Material: PVC SCH. 40 Riser Pipe Diameter: 6 in/cm

Surface Casing (Y/N): Y Material: STEEL Depth: 2 ft/m

Diameter: 8 in/cm Sealant: CONCRETE

Development: Method: WHALE PUMP Duration: 5x WELL VOLUME

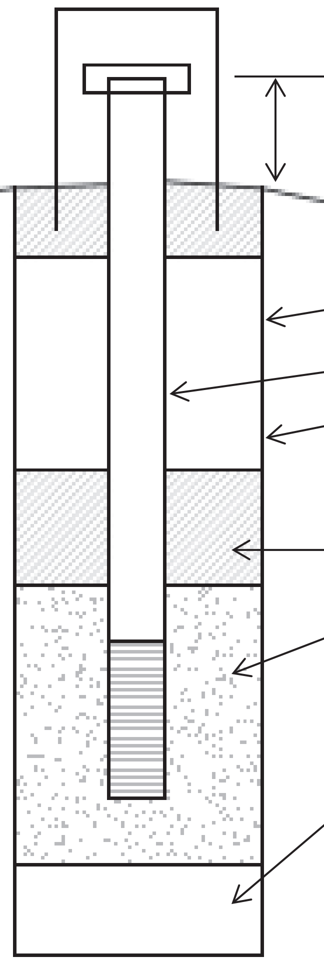
Description of Purged Water:

Project Name: COLD SPRINGS TERMINALS
Well Designation: RW-4
Project Number: 11137172
Date Completed: 11/14/2019
Client: SOUTHERN TERMINALS GROUP
Drilling Method: HOLLOW STEM AUGER (8.25")
Location: LYSANDER, NY
GHD Supervisor: IAN McNAMARA

Cap Type: LOCKING ROYER/ J- PLUG
Protective Casing Type: STEEL STICK-UP

Measure bottom of well (after completion) (below top of riser pipe): 16.97 ft/m

Stick up = 2.35 ft/m



Bottom of Surface Seal: ~1.5 ft/m
Surface Seal Type: CONCRETE
Borehole Diameter: 12.25 in/cm
Riser Pipe
Annulus Backfill Type: N/A
Top of Seal* at: ~1.5 ft/m
Bottom of Seal* at: ~3.0 ft/m
Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)
Top of Screen* at: ~4.6 ft/m
Pack Type: - sand, size #00N
- gravel
- natural COLLAPSE 15 - 10'
Bottom of Screen* at: ~14.6 ft/m
Bottom of Filter Pack at: ~14.6 ft/m
Borehole Backfill Material (if not filter pack): N/A
Bottom of Hole* at: ~14.6 ft/m

* Note: All dimensions are below ground surface (bgs)

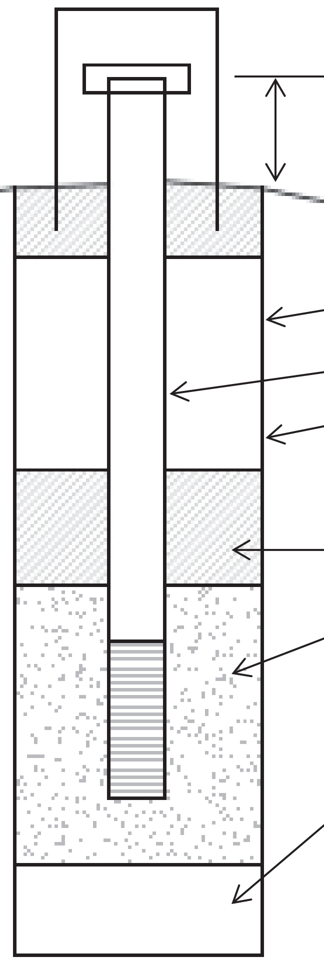
Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:
Screen Material: ☐ stainless steel ☒ pvc ☐ other:
Screen Length: 10 ft/m Screen Diameter: 6 in/cm Screen Slot Size: 0.010 in
Riser Pipe Material: PVC SCH. 40 Riser Pipe Diameter: 6 in/cm
Surface Casing (Y/N): Y Material: STEEL Depth: 2 ft/m
Diameter: 8 in/cm Sealant: CONCRETE
Development: Method: WHALE PUMP Duration: 5x WELL VOLUME
Description of Purged Water:

Project Name: COLD SPRINGS TERMINALS
Well Designation: RW-5
Project Number: 11137172
Date Completed: 11/12/2019
Client: SOUTHERN TERMINALS GROUP
Drilling Method: HOLLOW STEM AUGER (8.25")
Location: LYSANDER, NY
GHD Supervisor: IAN McNAMARA

Cap Type: LOCKING ROYER/ J- PLUG
Protective Casing Type: STEEL STICK-UP

Measure bottom of well (after completion) 17.57 ft/m (below top of riser pipe)

Stick up = 3.25 ft/m



Bottom of Surface Seal ~1.5 ft/m
Surface Seal Type: CONCRETE
Borehole Diameter: 12.25 in/cm
Riser Pipe
Annulus Backfill Type: N/A
Top of Seal* at ~1.5 ft/m
Bottom of Seal* at ~3.0 ft/m
Seal Type: BENTONITE CHIPS (3/8" HOLE PLUG)
Top of Screen* at ~4.3 ft/m
Pack Type: - sand, size #00N
- gravel
- natural
Bottom of Screen* at ~14.3 ft/m
Bottom of Filter Pack at ~14.3 ft/m
Borehole Backfill Material (if not filter pack) N/A
Bottom of Hole* at ~14.3 ft/m

* Note: All dimensions are below ground surface (bgs)

Screen Type: ☒ continuous slot ☐ wire wrapped ☐ louvre ☐ other:
Screen Material: ☐ stainless steel ☒ pvc ☐ other:
Screen Length: 10 ft/m
Screen Diameter: 6 in/cm
Screen Slot Size: 0.010 in
Riser Pipe Material: PVC SCH. 40
Riser Pipe Diameter: 6 in/cm
Surface Casing (Y/N): Y
Material: STEEL
Depth: 2 ft/m
Diameter: 8 in/cm
Sealant: CONCRETE
Development: Method: WHALE PUMP
Duration: 5x WELL VOLUME
Description of Purged Water:

WELL DECOMMISSIONING RECORD
NYSDEC NPL Sites

Site Name: COLD SPRINGS TERMINAL	Well I.D.: 5S, 5D
Site Location: LYSANDER, NY	Driller: B. SWARTZ
Drilling Co.: NOTHNAGLE DRILLING, INC.	Inspector:
	Date: 3-19-20

DECOMMISSIONING DATA
(Fill in all that apply)

OVERDRILLING

Interval Drilled	0'-22'
Drilling Method(s)	
Borehole Dia. (in.)	10"
Temporary Casing Installed? (y/n)	N
Depth temporary casing installed	
Casing type/dia. (in.)	
Method of installing	

CASING PULLING

Method employed	WINCH
Casing retrieved (feet)	15' + 21.5'
Casing type/dia. (in)	2" PVC

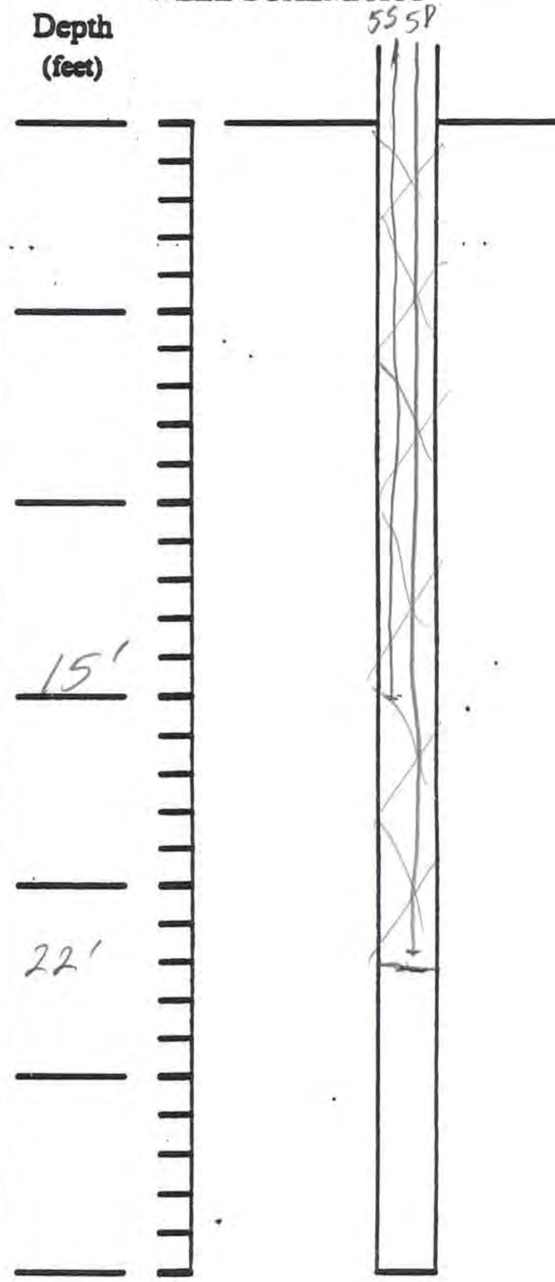
CASING PERFORATING

Equipment used	
Number of perforations/foot	
Size of perforations	
Interval perforated	

GROUTING

Interval grouted (FBLS)	0'-22'
# of batches prepared	2
For each batch record:	
Quantity of water used (gal.)	31.2
Quantity of cement used (lbs.)	376
Cement type	I
Quantity of bentonite used (lbs.)	15.6
Quantity of calcium chloride used (lbs.)	0
Volume of grout prepared (gal.)	45
Volume of grout used (gal.)	45

WELL SCHEMATIC*



COMMENTS: OVERDRILLED 2" PVC NESTED WELL 5S+5D WITH 6 1/4" H.S.A. PULLED TWO - 2" PVC WELLS + TREMIE GROUT ABANDONED

* Sketch in all relevant decommissioning data, including: interval overdrilled, interval grouted, casing left in hole, well stickup, etc.

Stephen A. DiLaura

Attachment C
Groundwater Disposal Manifests

NON-HAZARDOUS WASTE MANIFEST

Please print or type. (Form designed for use on elite (12 pitch) typewriter)

NON-HAZARDOUS WASTE MANIFEST	1. Generator's US EPA ID No. VSQG		Manifest Document No. SUN 2289	2. Page 1 of 1
3. Generator's Name and Mailing Address [illegible] 7431 Hillside Road Lysander, NY 13027			SOH 103262	
4. Generator's Phone (716) 205-1881	Attn: Alyssa Cruikshank			
5. Transporter 1 Company Name Sun Environmental Corp.	6. US EPA ID Number NYR000176958		A. State Transporter's ID	7x-739 (315) 3[illegible]
			B. Transporter 1 Phone	
7. Transporter 2 Company Name	8. US EPA ID Number		C. State Transporter's ID	
			D. Transporter 2 Phone	
9. Designated Facility Name and Site Address [illegible] 120 Dry Road Oriskany NY 13424	10. US EPA ID Number NYR000009[illegible]		E. State Facility's ID	
			F. Facility's Phone	(315) 736-6080

11. WASTE DESCRIPTION	12. Containers No.	Type	13. Total Quantity	14. Unit Wt./Vol
a. NON-RCRA, NON-DOT REGULATED LIQUIDS (Fuel Impacted Water) Gasoline	1	TT	est 800	G
b.				
c.				
d.				

G. Additional Descriptions for Materials Listed Above

a. Approval # 1100043429/103262 DIRECT BILL TO GHD
JOB # SESS.0014

H. Handling Codes for Wastes Listed Above

a. R

15. Special Handling Instructions and Additional Information

Emergency Response (800) 807-7455
Sun Environmental Corp.

16. GENERATOR'S CERTIFICATION: I hereby certify that the contents of this shipment are fully and accurately described and are in all respects in proper condition for transport. The materials described on this manifest are not subject to federal hazardous waste regulations.

AS AGENT FOR GENERATOR

Printed/Typed Name	Signature	Month	Day	Year
IAN MCNAMARA	[signature]	2	3	20

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year
Jeremie Wolshiek	[signature]	2	3	20

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of the waste materials covered by this manifest except as noted in item 19.

Printed/Typed Name	Signature	Month	Day	Year
Dana Valenti	[signature] Valenti IOTSC	02	04	2020

GENERATOR — TRANSPORTER — FACILITY

NON-HAZARDOUS WASTE

SO 107531

NON-HAZARDOUS WASTE MANIFEST

Please print or type. (Form designed for use on elite (12 pitch) typewriter)

NON-HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. VSQG

Manifest Document No. SUN-3350

2. Page 1 of 1

3. Generator's Name and Mailing Address: Southern Terminal Group, 7431 Hillside Road, Lysander, NY 13027

4. Generator's Phone (716) 205-1881 — Attn: Alyssa Cruikshank

5. Transporter 1 Company Name: Sun Environmental Corp.

6. US EPA ID Number: NYR000176558

A. State Transporter's ID: 7A-702

B. Transporter 1 Phone: (315) 218-6595

7. Transporter 2 Company Name:

8. US EPA ID Number:

C. State Transporter's ID:

D. Transporter 2 Phone:

9. Designated Facility Name and Site Address: Industrial Oil, 120 Dry Road, Oriskany NY 13424

10. US EPA ID Number: NYR000005298

E. State Facility's ID:

F. Facility's Phone: (315) 736-6080

11. WASTE DESCRIPTION	12. Containers No.	Type	13. Total Quantity	14. Unit Wt./Vol.
a. NON-RCRA, NON-DOT REGULATED LIQUIDS (Fuel Impacted Water)		Gal	300	T
b.				
c.				
d.				

G. Additonal Descriptions for Materials Listed Above

a.Approval # 1100045429/103262 — DIRECT BILL TO GHD

JOB # SESS.0014

H. Handling Codes for Wastes Listed Above

a. R

15. Special Handling Instructions and Additional Information

Emergency Response (800) 807-7455

Sun Environmental Corp.

16. **GENERATOR'S CERTIFICATION:** I hereby certify that the contents of this shipment are fully and accurately described and are in all respects in proper condition for transport. The materials described on this manifest are not subject to federal hazardous waste regulations.

Printed/Typed Name: IAN MCNAMARA-GHD AS AGENT OF SOUTHERN TERMINAL GROUP — Signature: [signature] — Date: Month 2 Day 17 Year 20

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name: Cooper Lamb / Sun Environmental — Signature: [signature] — Date: Month 2 Day 17 Year 20

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name: — Signature: — Date: Month Day Year

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of the waste materials covered by this maifest, except as noted in Item 19.

Printed/Typed Name: Michael Williams — Signature: [signature] — Date: Month 02 Day 18 Year 20

NON-HAZARDOUS WASTE — GENERATOR — TRANSPORTER — FACILITY

NON-HAZARDOUS WASTE MANIFEST

#7109121

Please print or type. (Form designed for use on elite (12 pitch) typewriter)

NON-HAZARDOUS WASTE MANIFEST	1. Generator's US EPA ID No. VEQG	Manifest Document No. SUN 3291	2. Page 1 of 1

3. Generator's Name and Mailing Address: Southern Terminal Groups, 7431 Hillside Road, Lysander, NY 13027

4. Generator's Phone (716) 205-1891 — Attn: Alyssa Cruikshank

5. Transporter 1 Company Name	6. US EPA ID Number	A. State Transporter's ID	7A-702
Sun Environmental Corp.	NYR000176958	B. Transporter 1 Phone	(315) 218-0556
7. Transporter 2 Company Name	8. US EPA ID Number	C. State Transporter's ID	
		D. Transporter 2 Phone	
9. Designated Facility Name and Site Address	10. US EPA ID Number	E. State Facility's ID	
Industrial Oil, 120 Dry Road, Oriskany NY 13424	NYR000005298	F. Facility's Phone	(315) 736-6080

11. WASTE DESCRIPTION	12. Containers No.	Type	13. Total Quantity	14. Unit Wt./Vol
a. NON-RCRA, NON-DOT REGULATED LIQUIDS (Fuel Impacted Water)			est. 300 gallons	T
b.				
c.				
d.				

GENERATOR

G. Additional Descriptions for Materials Listed Above

a.Approval # 1100043429/103261 — DIRECT BILL TO GHD

JOB # SESS.0014

H. Handling Codes for Wastes Listed Above: a. R

15. Special Handling Instructions and Additional Information

Emergency Response (800) 807-7455
Sun Environmental Corp.

16. GENERATOR'S CERTIFICATION: I hereby certify that the contents of this shipment are fully and accurately described and are in all respects in proper condition for transport. The materials described on this manifest are not subject to federal hazardous waste regulations.

Printed/Typed Name: IAN MCNAMARA, GHD - AS AGENT FOR SOUTHERN TERMINALS GROUP — Signature: [signature] — Date: Month 2 Day 24 Year 20

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name: Cooper Lamb — Signature: Cooper Lamb — Date: Month 2 Day 24 Year 20

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name — Signature — Date: Month Day Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of the waste materials covered by this manifest, except as noted in item 19.

Printed/Typed Name: Mark Palisse — Signature: Mark Palisse — Date: Month 2 Day 25 Year 20

NON-HAZARDOUS WASTE

NON-HAZARDOUS WASTE MANIFEST

Please print or type (Form designed for use on elite (12 pitch) typewriter)

NON-HAZARDOUS WASTE MANIFEST	1. Generator's US EPA ID No. VSQG	Manifest Document No. SUN-3293	2. Page 1 of 1

3. Generator's Name and Mailing Address: Southern Terminal Groups, 7431 Hillside Road, Lysander, NY 13027

4. Generator's Phone: (720) 326-1861 — Attn: Alyssa Cruikshank

5. Transporter 1 Company Name	6. US EPA ID Number	A. State Transporter's ID	7A-709
Sun Environmental Corp.	NYR000176958	B. Transporter 1 Phone	(315) 212-0293
7. Transporter 2 Company Name	8. US EPA ID Number	C. State Transporter's ID	
		D. Transporter 2 Phone	
9. Designated Facility Name and Site Address	10. US EPA ID Number	E. State Facility's ID	
Industrial Oil, 120 Dry Road, Oriskany NY 13424	NYR000005298	F. Facility's Phone	(315) 736-6080

11. WASTE DESCRIPTION	12. Containers No.	Type	13. Total Quantity	14. Unit Wt./Vol.
a. NON-RCRA, NON-DOT REGULATED LIQUIDS (Fuel Impacted Water)			est 350	gal
b.				
c.				
d.				

G. Additional Descriptions for Materials Listed Above: a. Approval # 1100043429/103262 — JOB # SESS.0014 — DIRECT BILL TO GHD

H. Handling Codes for Wastes Listed Above: a. R

15. Special Handling Instructions and Additional Information

Emergency Response (800) 807-7455
Sun Environmental Corp.

16. **GENERATOR'S CERTIFICATION:** I hereby certify that the contents of this shipment are fully and accurately described and are in all respects in proper condition for transport. The materials described on this manifest are not subject to federal hazardous waste regulations.

Printed/Typed Name	Signature	Month	Day	Year
IAN McNAMARA - GHD, AS AGENT FOR SOUTHERN TERMINALS GROUP	[signature]	3	2	20

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year
Cooper Lamb	[signature]	3	2	20

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Month	Day	Year

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of the waste materials covered by this manifest, except as noted in item 19.

Printed/Typed Name	Signature	Month	Day	Year
MARK Bliss	[signature]	3	3	20

GENERATOR — TRANSPORTER — FACILITY

NON-HAZARDOUS WASTE

NON-HAZARDOUS WASTE MANIFEST

Please print or type (Form designed for use on elite (12 pitch) typewriter)

NON-HAZARDOUS WASTE MANIFEST

NON-HAZARDOUS WASTE — GENERATOR

1. Generator's US EPA ID No.: VSOG

Manifest Document No.: SUN 3294

2. Page 1 of 1

3. Generator's Name and Mailing Address:
Southern Terminal Groups
7431 Hillside Road
Lysander, NY 13027

4. Generator's Phone: (716) 205-1881 Attn: Alyssa Cruikshank

5. Transporter 1 Company Name: Sun Environmental Corp.

6. US EPA ID Number: NYR000176958

A. State Transorter's ID: 7A-709

B. Transporter 1 Phone: (315) 218-6995

7. Transporter 2 Company Name:

8. US EPA ID Number:

C. State Transporter's ID:

D. Transporter 2 Phone:

9. Designated Facility Name and Site Address:
Industrial Oil
120 Dry Road
Oriskany NY 13424

10. US EPA ID Number: NYR000005298

E. State Facility's ID:

F. Facility's Phone: (315) 736-6080

11. WASTE DESCRIPTION	12. Containers No.	12. Containers Type	13. Total Quantity	14. Unit Wt./Vol.
a. NON-RCRA, NON-DOT REGULATED LIQUIDS (Fuel Impacted Water)			est	T
b.				
c.				
d.				

G. Additonal Descriptions for Materials Listed Above:
a.Approval # 1100043429/103262 DIRECT BILL TO GHD
JOB # SESS.0014

H. Handling Codes for Wastes Listed Above: a. R

15. Special Handling Instructions and Additional Information:
Emergency Response (800) 807-7455
Sun Environmental Corp.

16. **GENERATOR'S CERTIFICATION:** I hereby certify that the contents of this shipment are fully and accurately described and are in all respects in proper condition for transport. The materials described on this manifest are not subject to federal hazardous waste regulations.

Printed/Typed Name	Signature	Date: Month	Day	Year

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Date: Month	Day	Year

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Date: Month	Day	Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator; Certification of receipt of the waste materials covered by this maifest, except as noted in item 19.

Printed/Typed Name	Signature	Date: Month	Day	Year

NON-HAZARDOUS WASTE MANIFEST

Please print or type (Form designed for use on elite (12 pitch) typewriter)

NON-HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. VSQG

Manifest Document No. SUN 3293

2. Page 1 of 1

3. Generator's Name and Mailing Address
Southern Terminal Group
7431 Hillside Road
Lysander, NY 13027

4. Generator's Phone ((716) 205-1881 Attn: Alyssa Cruikshank

5. Transporter 1 Company Name: Sun Environmental Corp.

6. US EPA ID Number: NYR000176958

A. State Transporter's ID: 7A-209

B. Transporter 1 Phone: (315) 218-6995

7. Transporter 2 Company Name

8. US EPA ID Number

C. State Transporter's ID

D. Transporter 2 Phone

9. Designated Facility Name and Site Address
Industrial Oil
120 Dry Road
Oriskany NY 13424

10. US EPA ID Number: NYR000085298

E. State Facility's ID

F. Facility's Phone: (315) 736-6850

11. WASTE DESCRIPTION	12. Containers No.	Type	13. Total Quantity	14. Unit Wt./Vol.
a. NON-RCRA, NON-DOT REGULATED LIQUIDS (Fuel Impacted Water)			est	T
b.				
c.				
d.				

G. Additonal Descriptions for Materials Listed Above

a.Approval # 1100043429/103262
JOB # SESS.0014

DIRECT BILL TO GHD

H. Handling Codes for Wastes Listed Above

a. R

15. Special Handling Instructions and Additional Information

Emergency Response (800) 807-7455
Sun Environmental Corp.

16. **GENERATOR'S CERTIFICATION:** I hereby certify that the contents of this shipment are fully and accurately described and are in all respects in proper condition for transport. The materials described on this manifest are not subject to federal hazardous waste regulations.

Printed/Typed Name [illegible] | Signature [signature] | Date Month Day Year

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name | Signature | Date Month Day Year

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name | Signature | Date Month Day Year

19. Discrepancy Indication Space

20. Facility Owner or Operator; Certification of receipt of the waste materials covered by this maifest, except as noted in item 19.

Printed/Typed Name | Signature | Date Month Day Year

GENERATOR

TRANSPORTER

FACILITY

NON-HAZARDOUS WASTE

NON-HAZARDOUS WASTE MANIFEST

Please print or type (Form designed for use on elite (12 pitch) typewriter)

NON-HAZARDOUS WASTE MANIFEST

1. Generator's US EPA ID No. VSQG

Manifest Document No.

2. Page 1 of 1

3. Generator's Name and Mailing Address: Southern Terminal Group, 7431 Hillside Road, Lysander NY 13027

4. Generator's Phone (716) 205-... Attn Alyssa C

5. Transporter 1 Company Name: Sun Environmental Corp

6. US EPA ID Number: NYR000176158

7. Transporter 2 Company Name:

8. US EPA ID Number:

A. State Transorter's ID: 7A-709

B. Transporter 1 Phone: 315-212-6957

C. State Transporter's ID

D. Transporter 2 Phone

9. Designated Facility Name and Site Address: Industrial Oil - CES, 120 Dry Rd, Oriskany NY 13424

10. US EPA ID Number: NYR000005298

E. State Facility's ID

F. Facility's Phone: 315-736-6080

11. WASTE DESCRIPTION	12. Containers No.	Type	13. Total Quantity	14. Unit Wt./Vol.
a. Non-RCRA Non-DOT Regulated Liquids (Fuel Impacted Water)	1	TT	est 370	G
b. Sun 3855				
c.				
d.				

G. Additonal Descriptions for Materials Listed Above

A) Approval #11C0043429/103762
Job# 5E55-0014 Direct Bill to GHD

H. Handling Codes for Wastes Listed Above

15. Special Handling Instructions and Additional Information

Emergency Response 800-807-7455
Sun Environmental Corp

GENERATOR

16. **GENERATOR'S CERTIFICATION:** I hereby certify that the contents of this shipment are fully and accurately described and are in all respects in proper condition for transport. The materials described on this manifest are not subject to federal hazardous waste regulations.

Printed/Typed Name: Ian McNamara, GHD As Agent For Southern Terminal Group

Signature: [signature]

Date: Month 3 Day 30 Year 20

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name: [illegible]

Signature: [signature]

Date: Month 3 Day 30 Year 20

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name

Signature

Date: Month Day Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator; Certification of receipt of the waste materials covered by this maifest, except as noted in item 19.

Printed/Typed Name

Signature

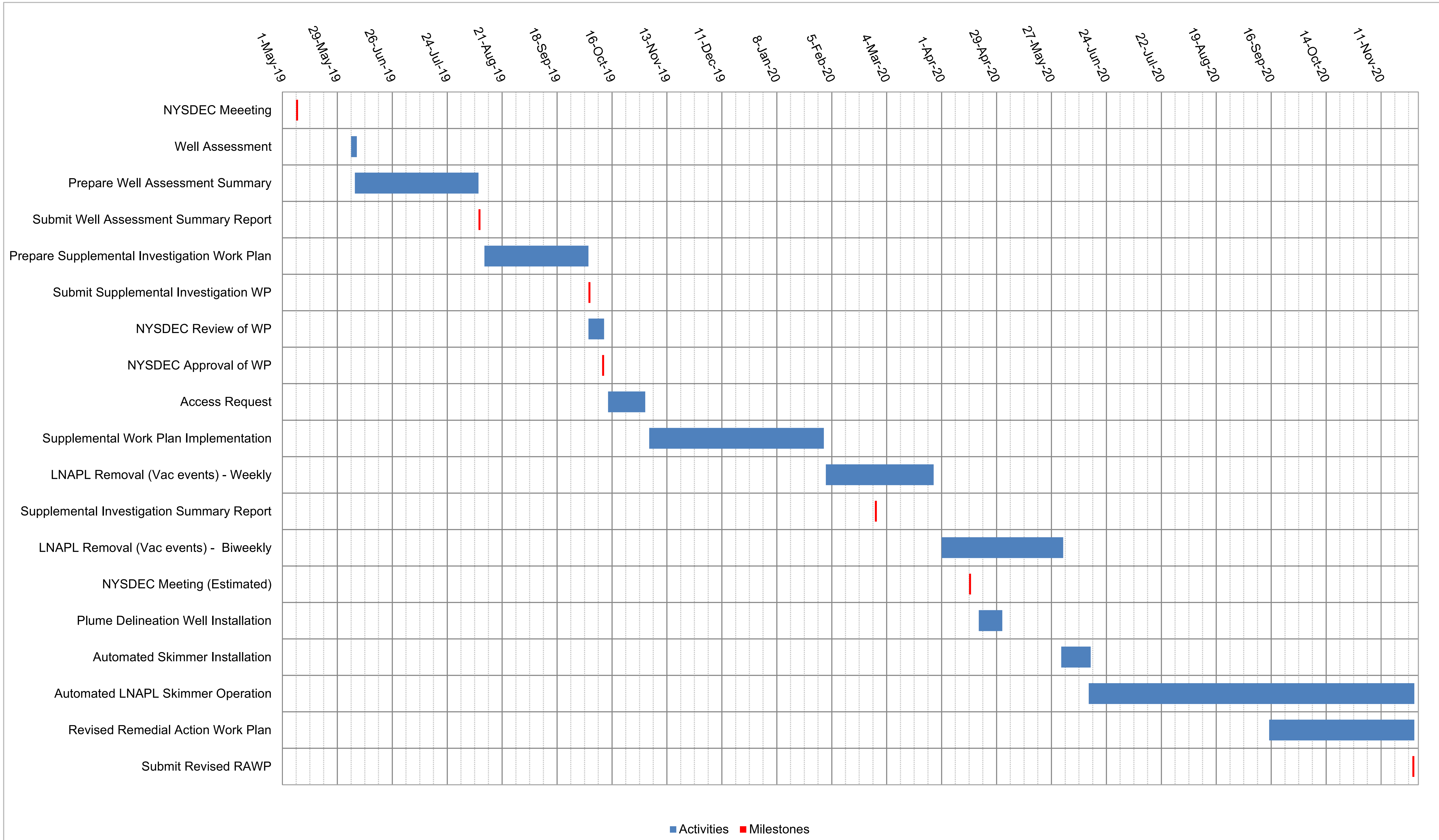
Date: Month Day Year

NON-HAZARDOUS WASTE

Attachment D
Project Schedule

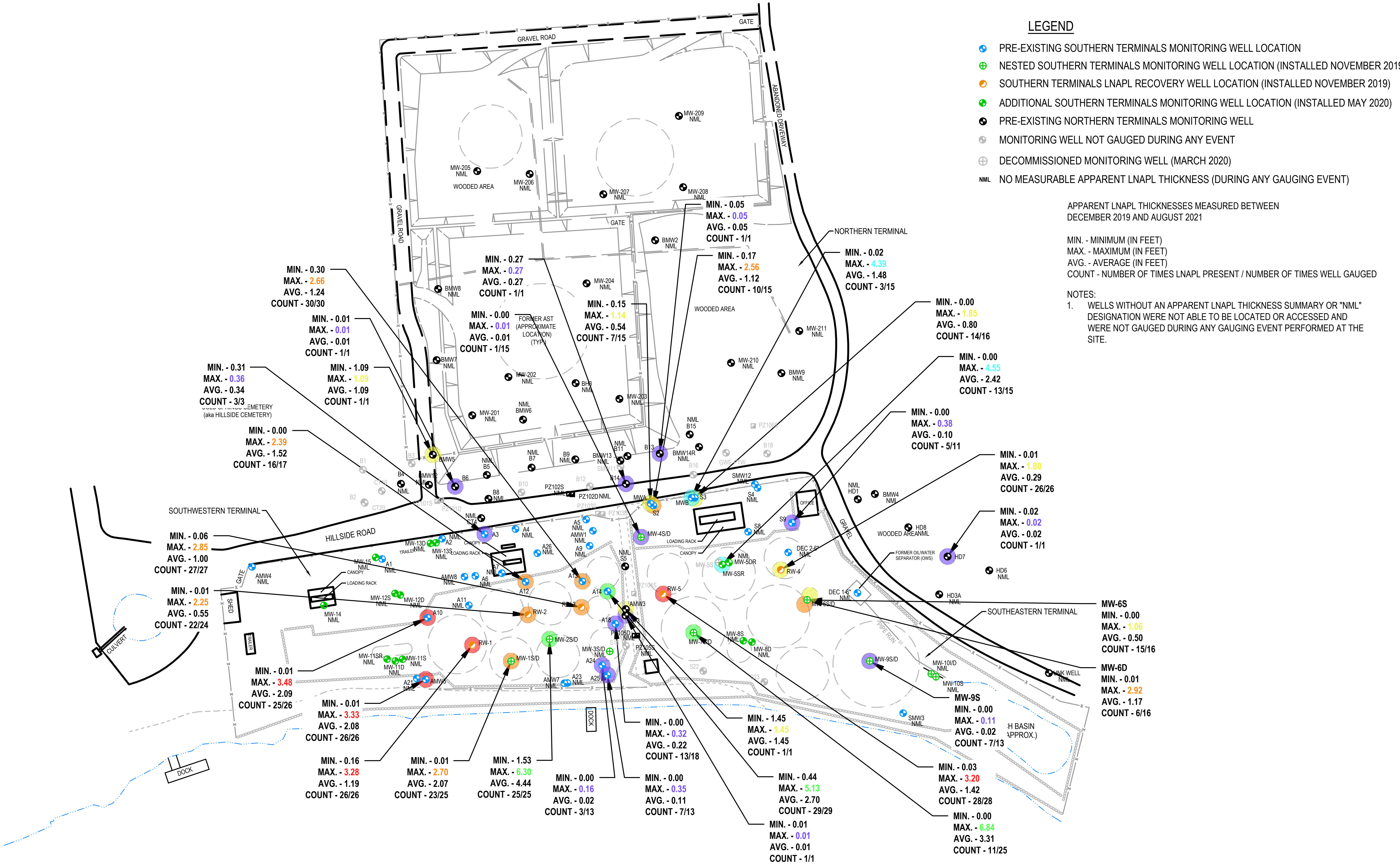
Southern Terminals
Cold Springs Terminal Site, Hillside Road
Lysander, New York

Project Schedule



Appendix B

Well Location and Apparent LNAPL Thickness Summary Figure and LNAPL Recovery Plots



APPARENT MAXIMUM LNAPL THICKNESS IN FEET

0-1	3-4
1-2	4-5
2-3	5+

N

0 100'

GHD

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

WELL LOCATION AND APPARENT LNAPL THICKNESS SUMMARY

Project No. 11137172
Report No. -
Date JAN 2022

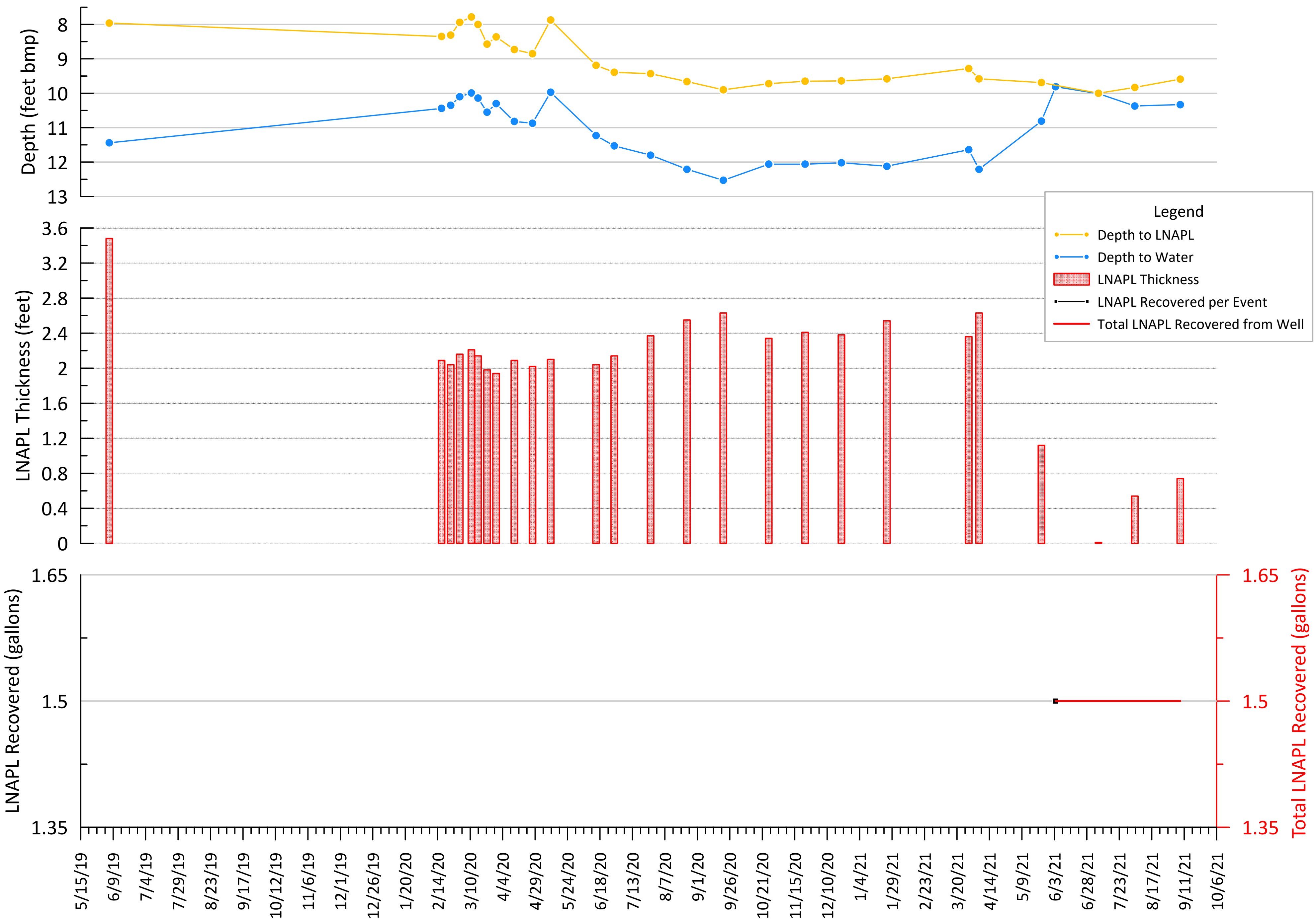
PLOT 1

Filename: G:\Projects\564\11137172\Tech\RAWP\Figures\11137172 - Plot 1 Apparent LNAPL Thickness - Overall MAX.dwg
Plot Date: 18 January 2022 - 10:52 AM

Cold Springs Site - Hillside Road, Lysander, NY
Southern Terminals Group
GHD Project Number 11137172

Skimmer Unit 1

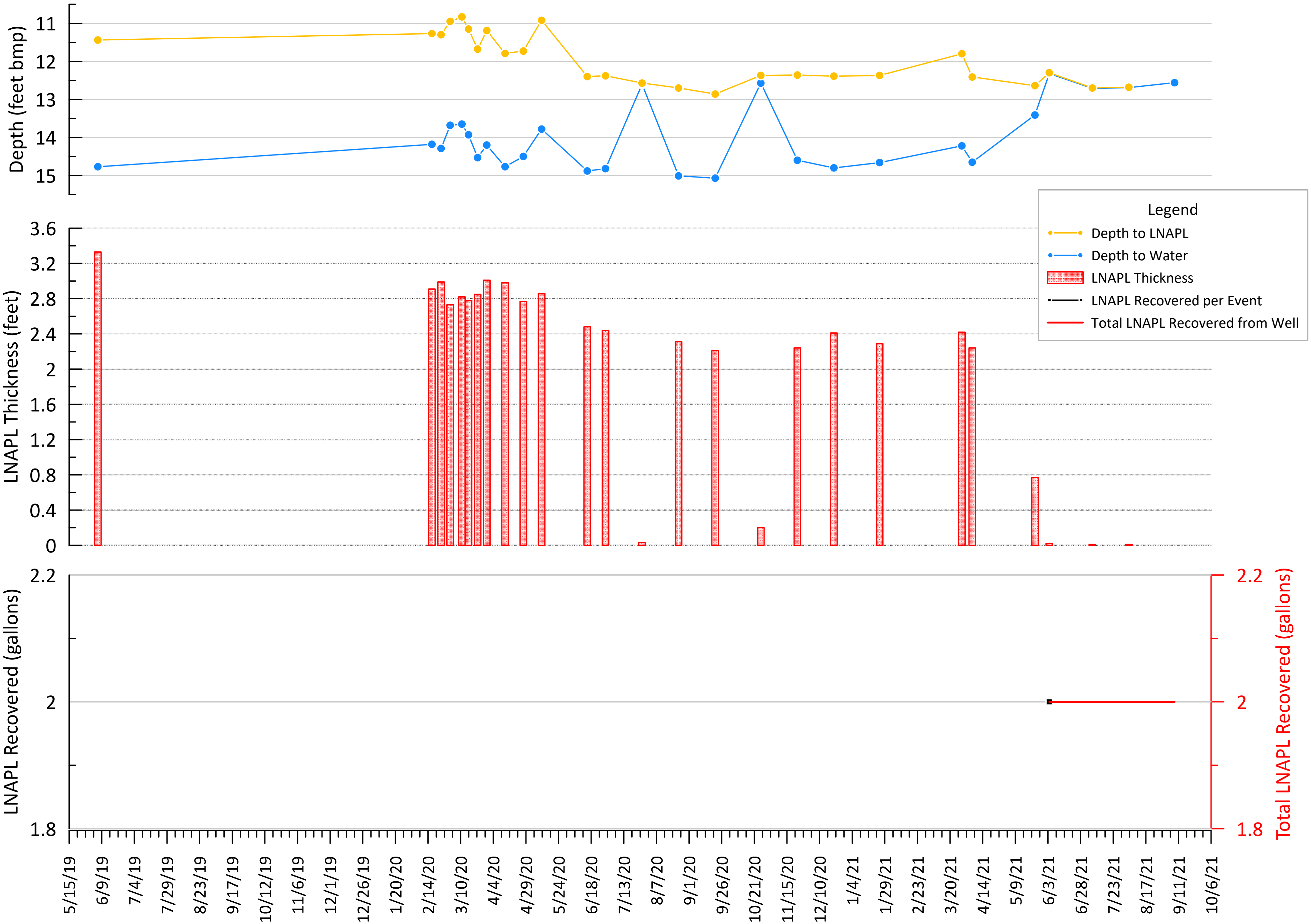
A10



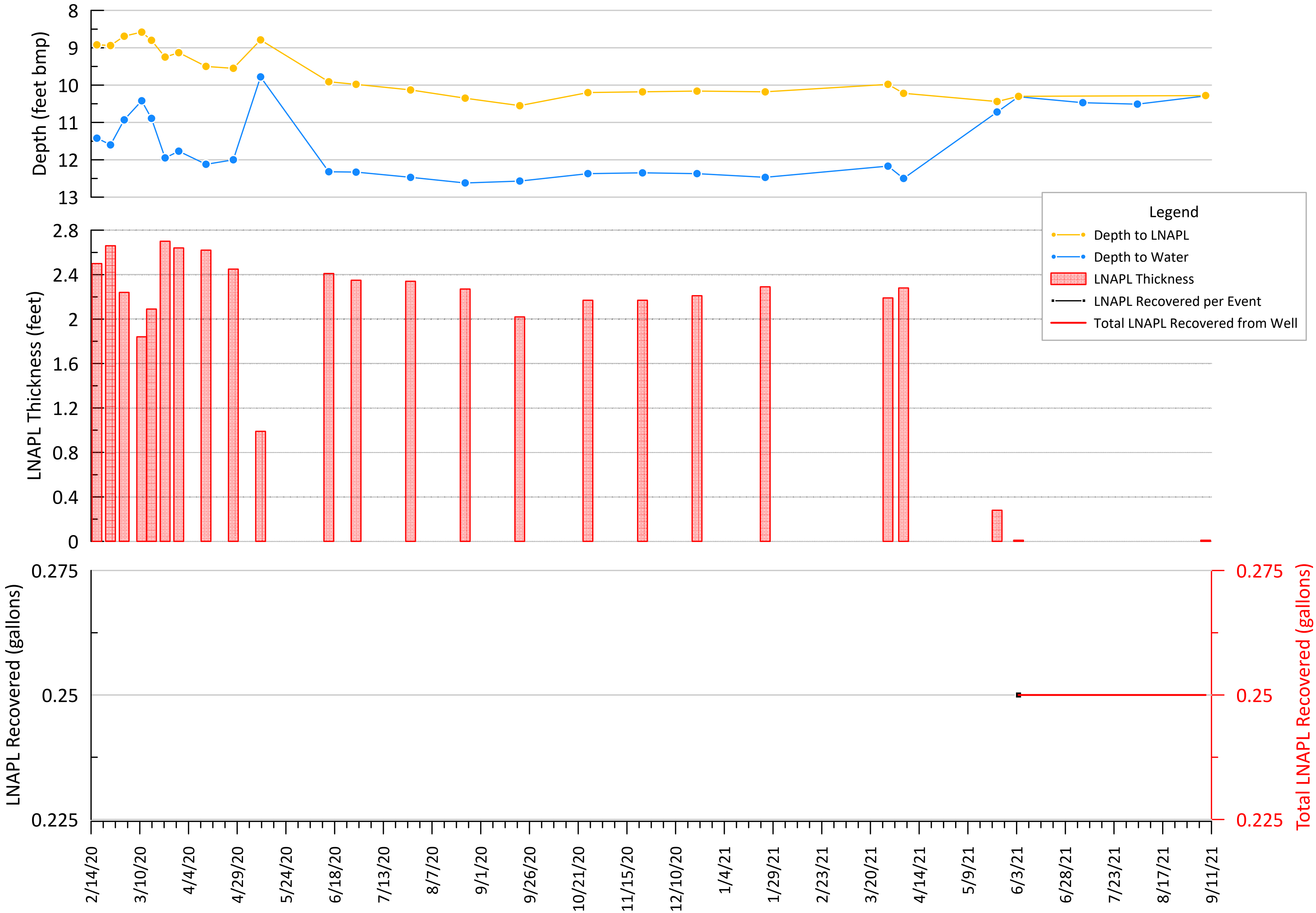
Skimmer Unit 1

AMW5

Cold Springs Site - Hillside Road, Lysander, NY
Southern Terminals Group
GHD Project Number 11137172

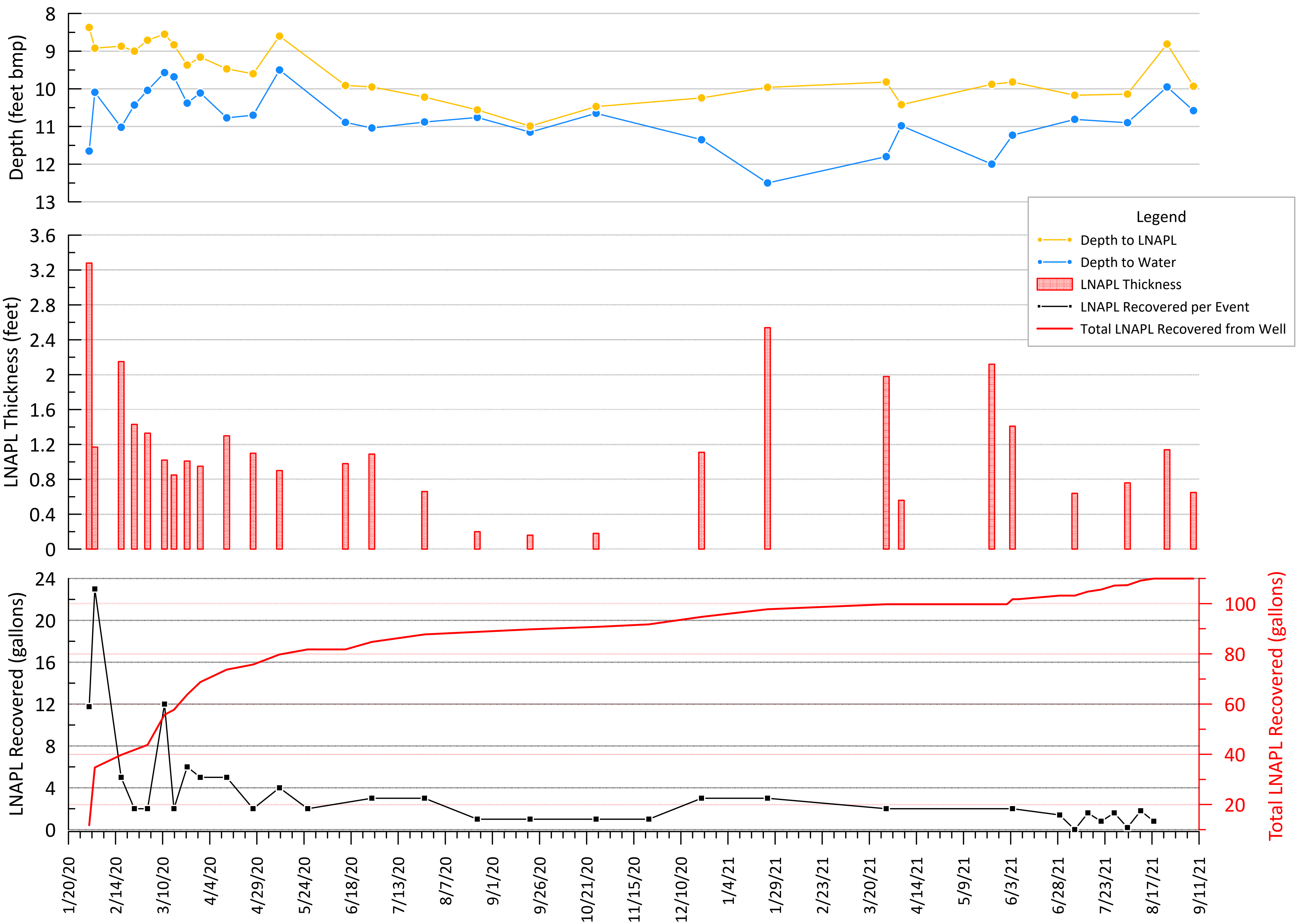


Skimmer Unit 1
MW-1S



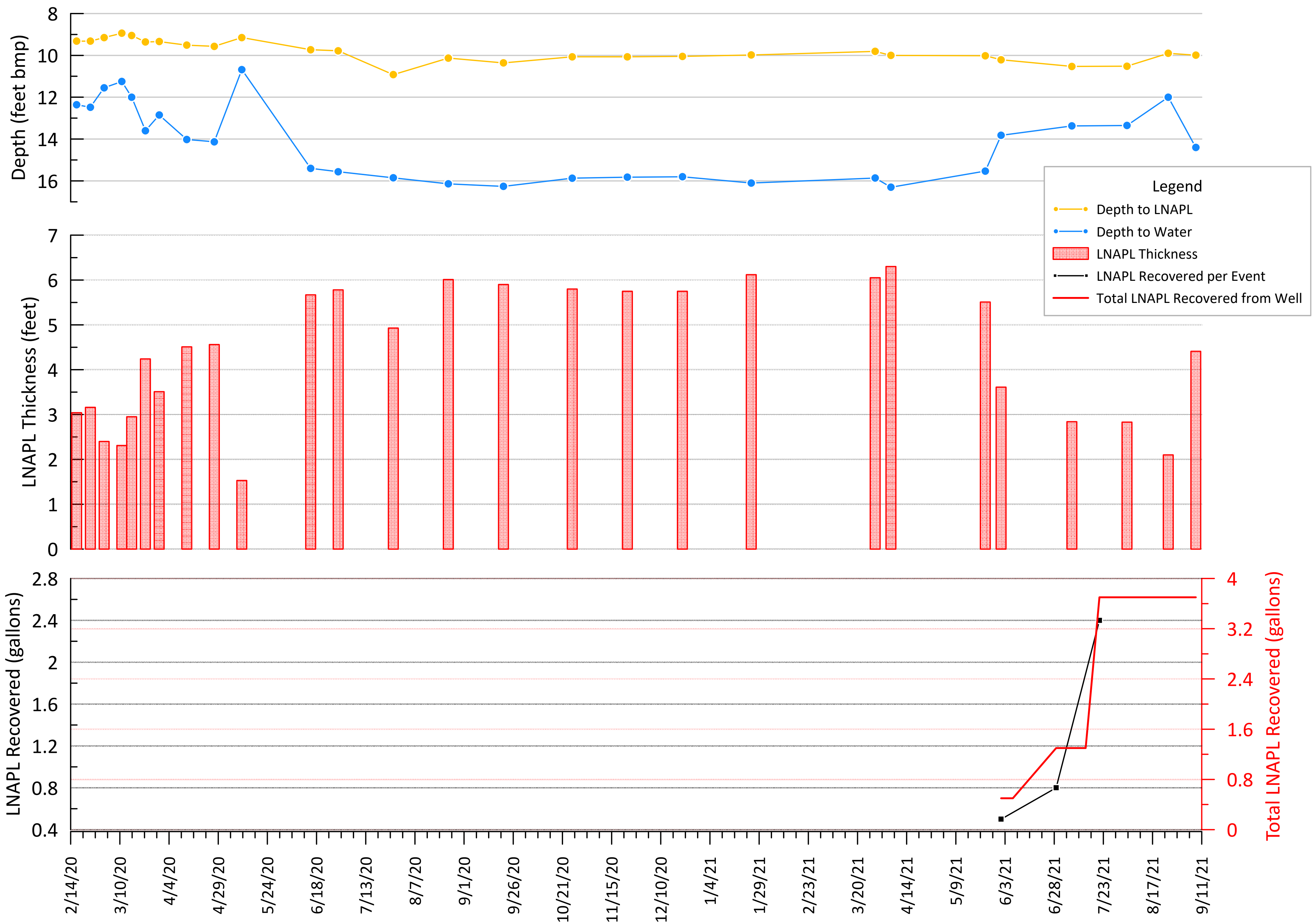
Cold Springs Site - Hillside Road, Lysander, NY
Southern Terminals Group
GHD Project Number 11137172

Skimmer Unit 1
RW-1



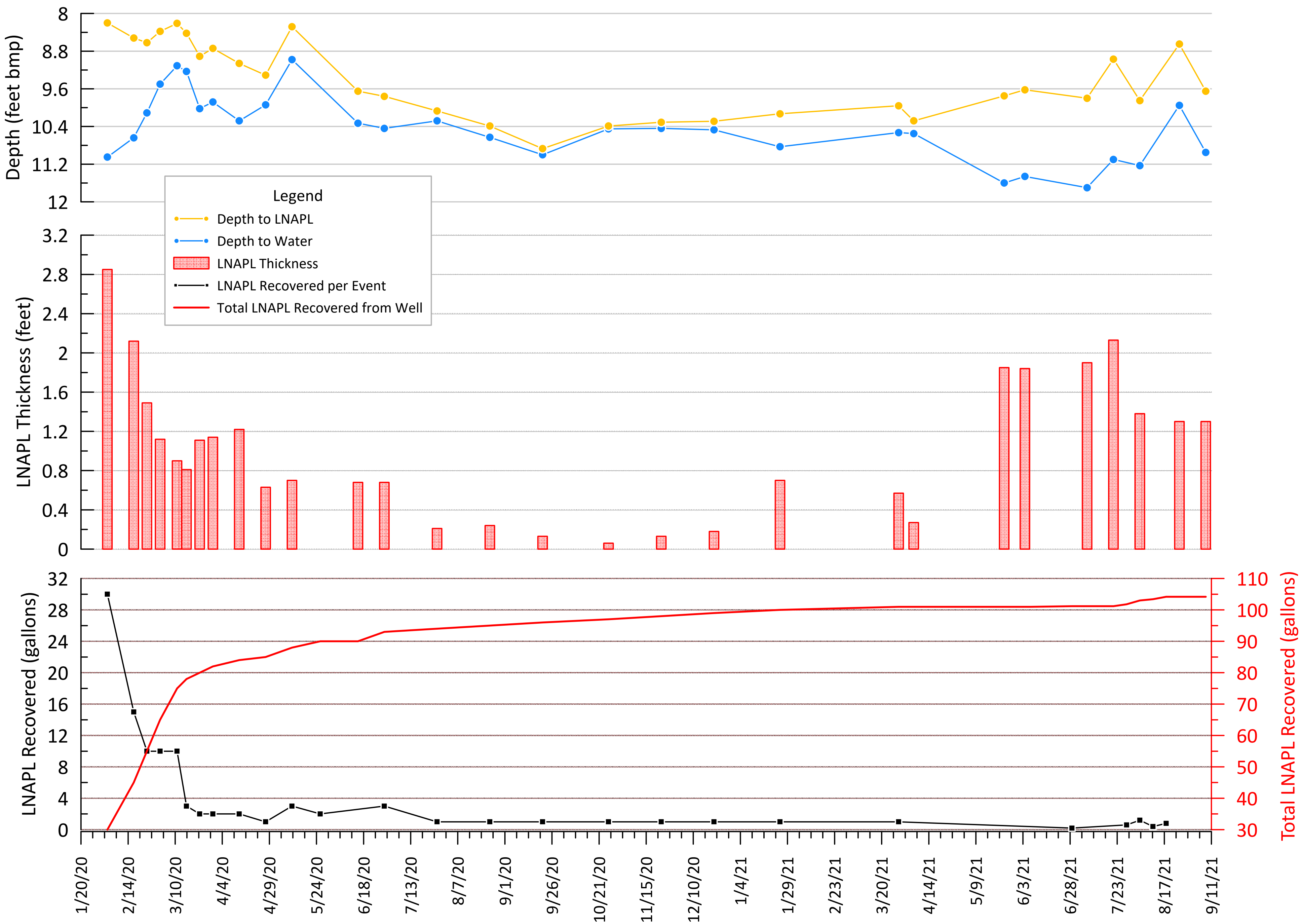
Skimmer Unit 2
MW-2S

Cold Springs Site - Hillside Road, Lysander, NY
Southern Terminals Group
GHD Project Number 11137172



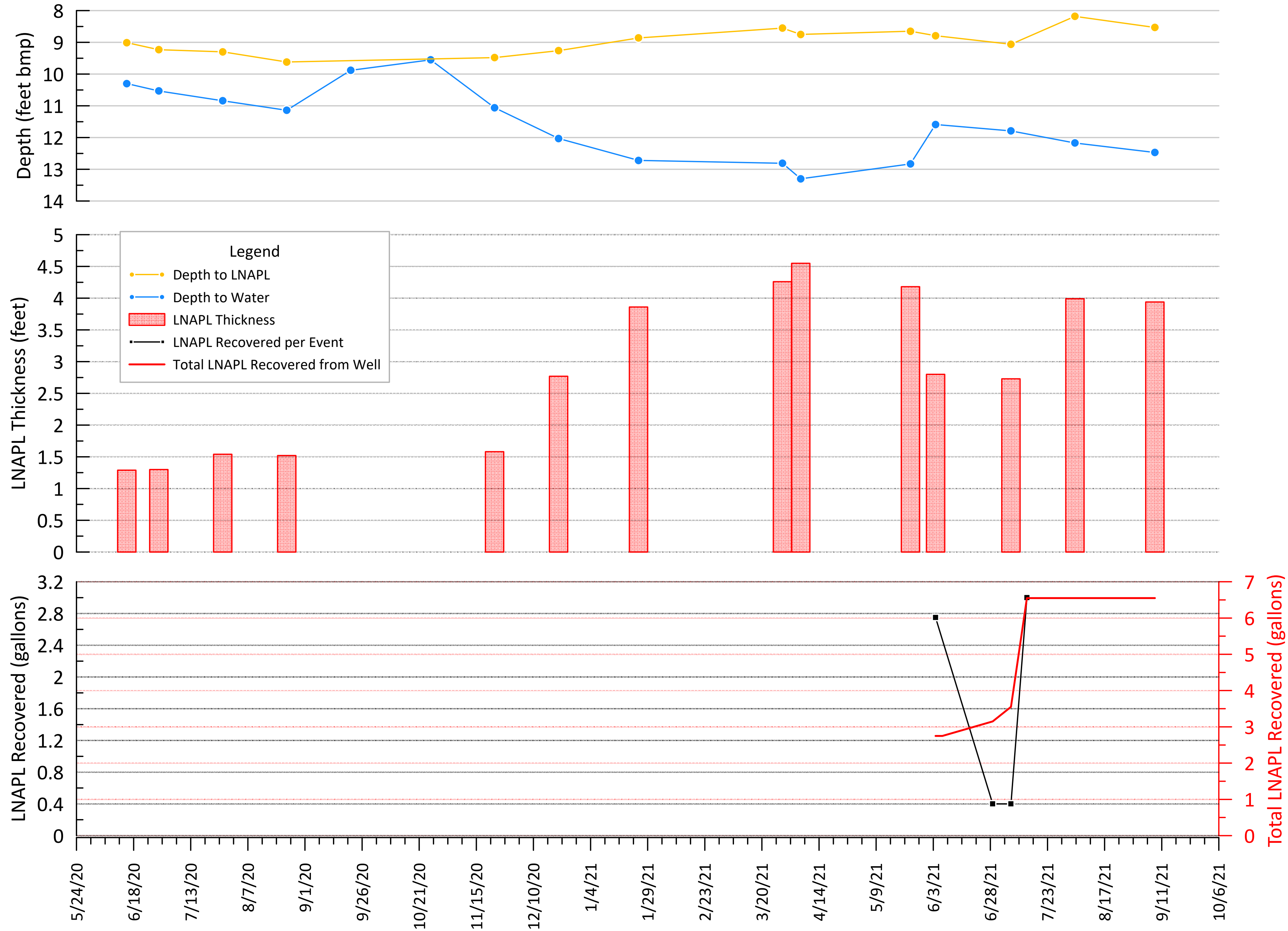
Skimmer Unit 2
RW-3

Cold Springs Site - Hillside Road, Lysander, NY
Southern Terminals Group
GHD Project Number 11137172



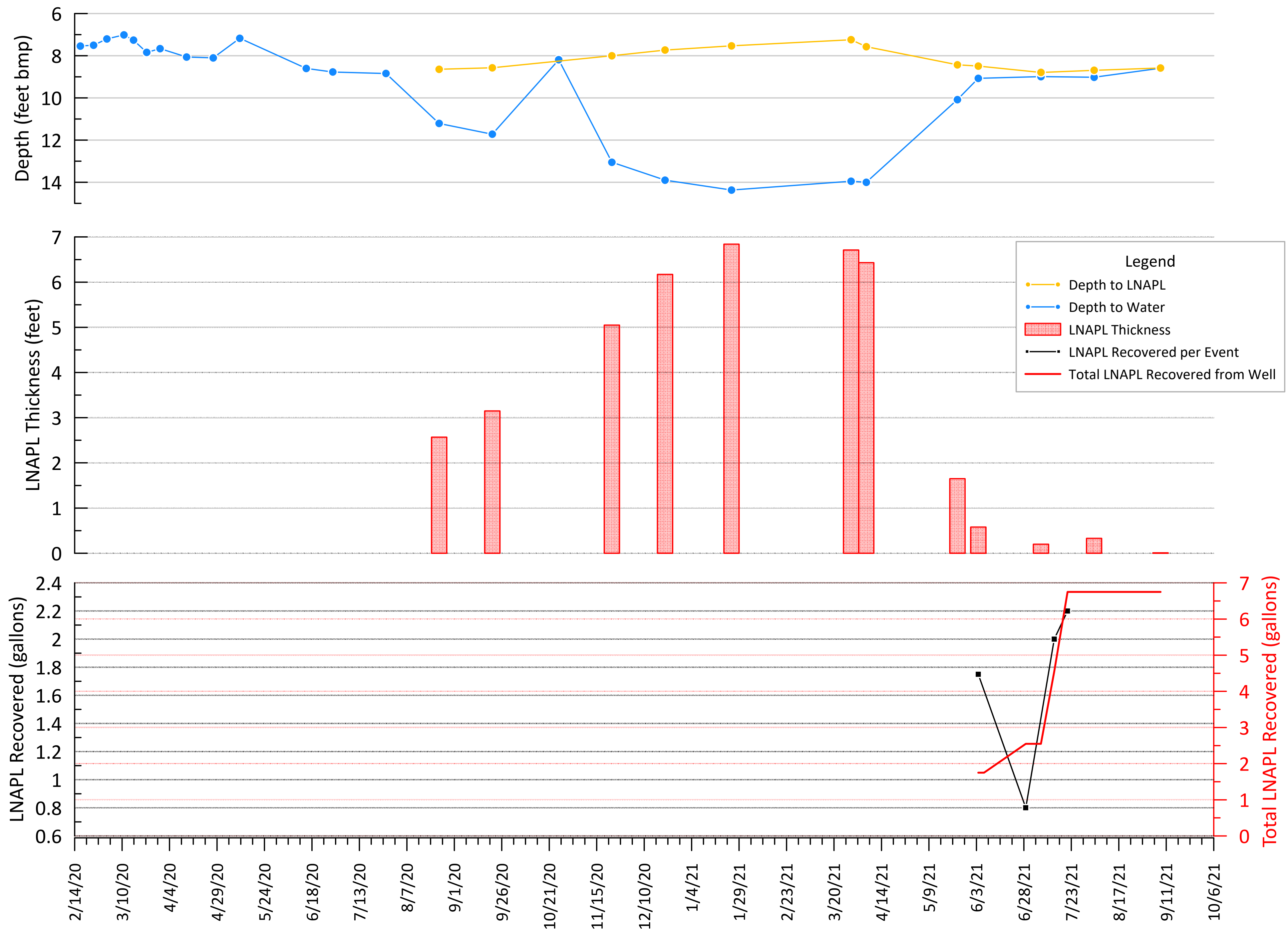
Cold Springs Site - Hillside Road, Lysander, NY
Southern Terminals Group
GHD Project Number 1113717

Skimmer Unit 3
MW-5SR

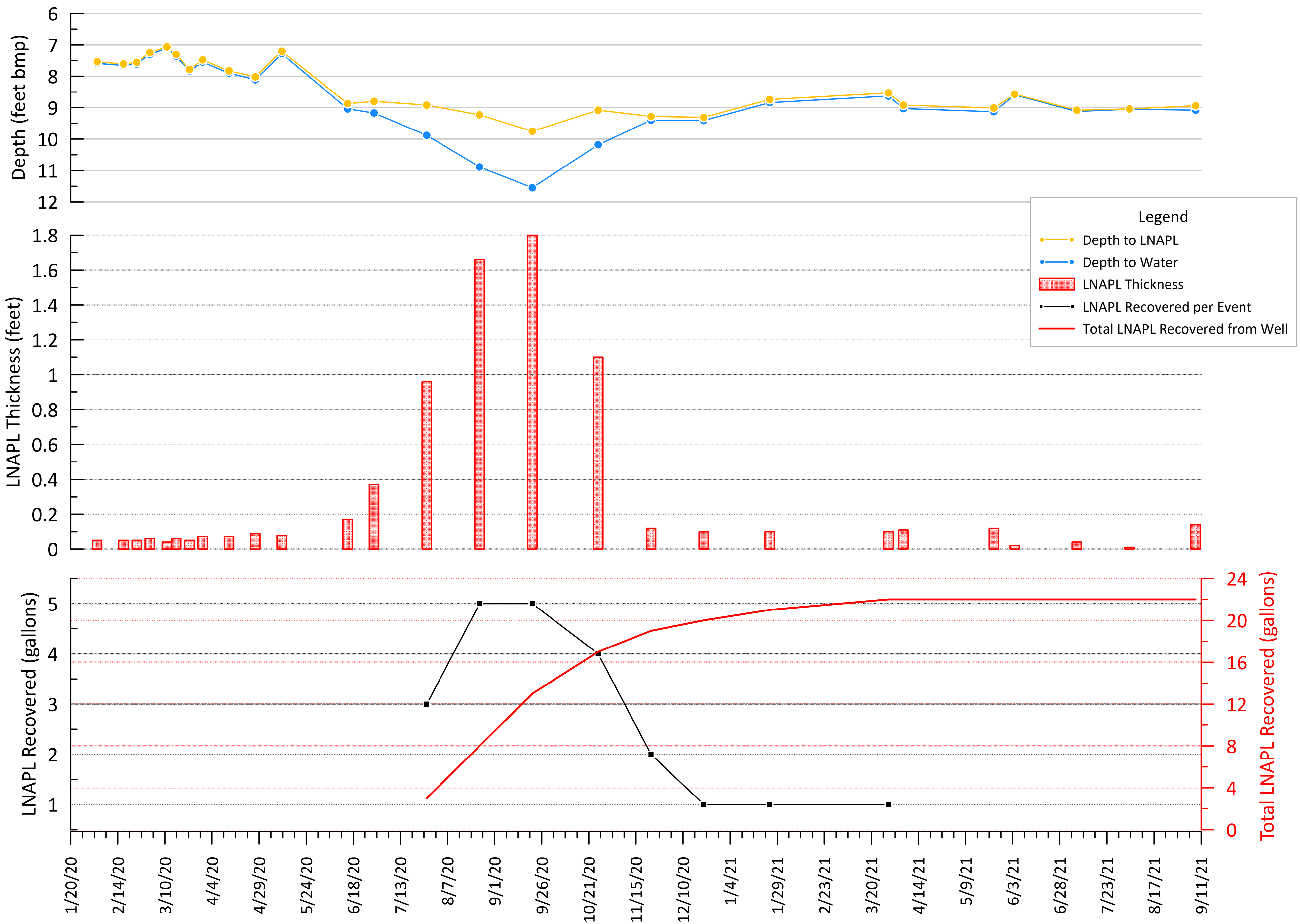


Cold Springs Site - Hillside Road, Lysander, NY
Southern Terminals Group
GHD Project Number 11137172

Skimmer Unit 3
MW-7S



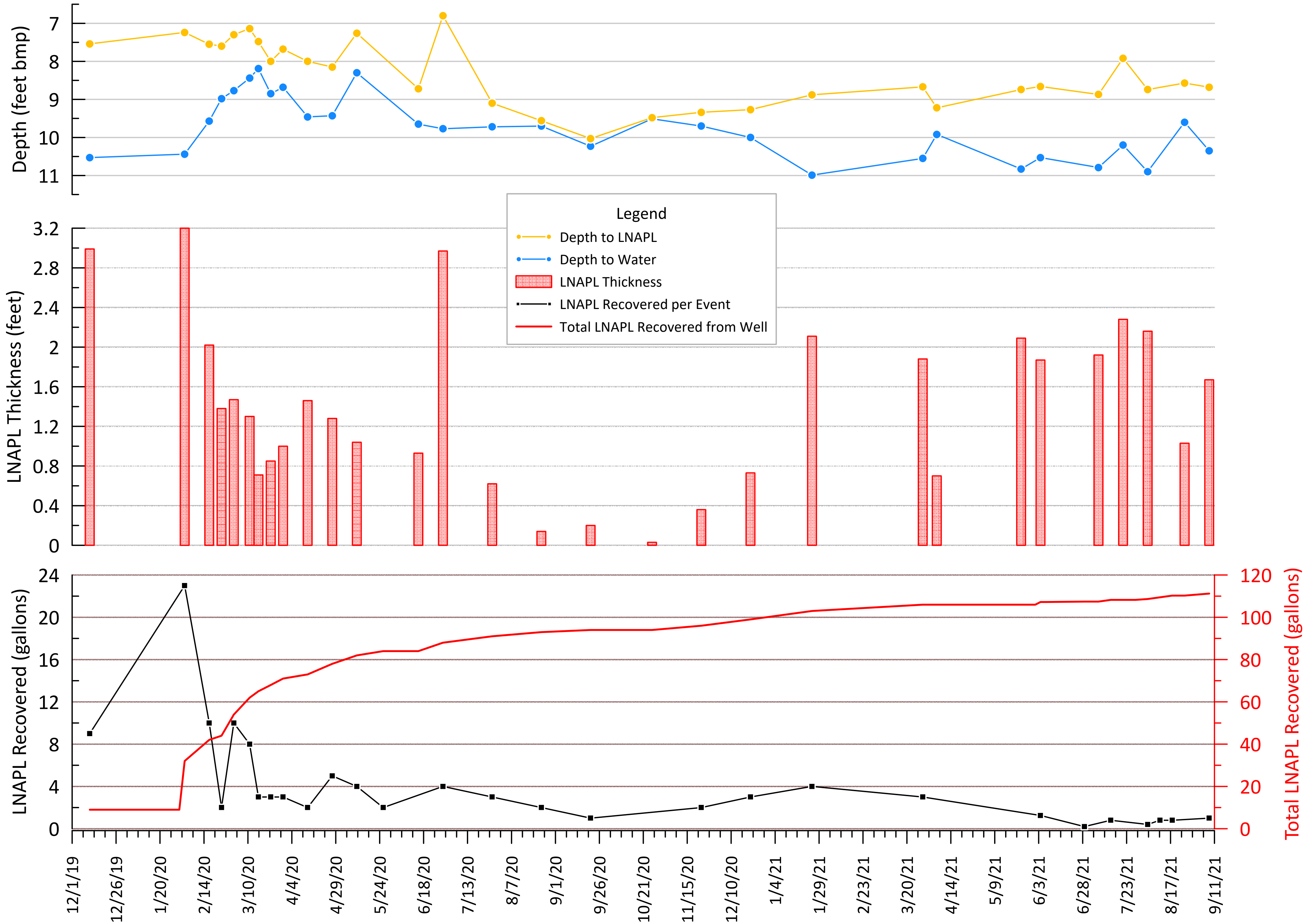
Skimmer Unit 3
RW-4



Cold Springs Site - Hillside Road, Lysander, NY
Southern Terminals Group
GHD Project Number 11137172

Skimmer Unit 3

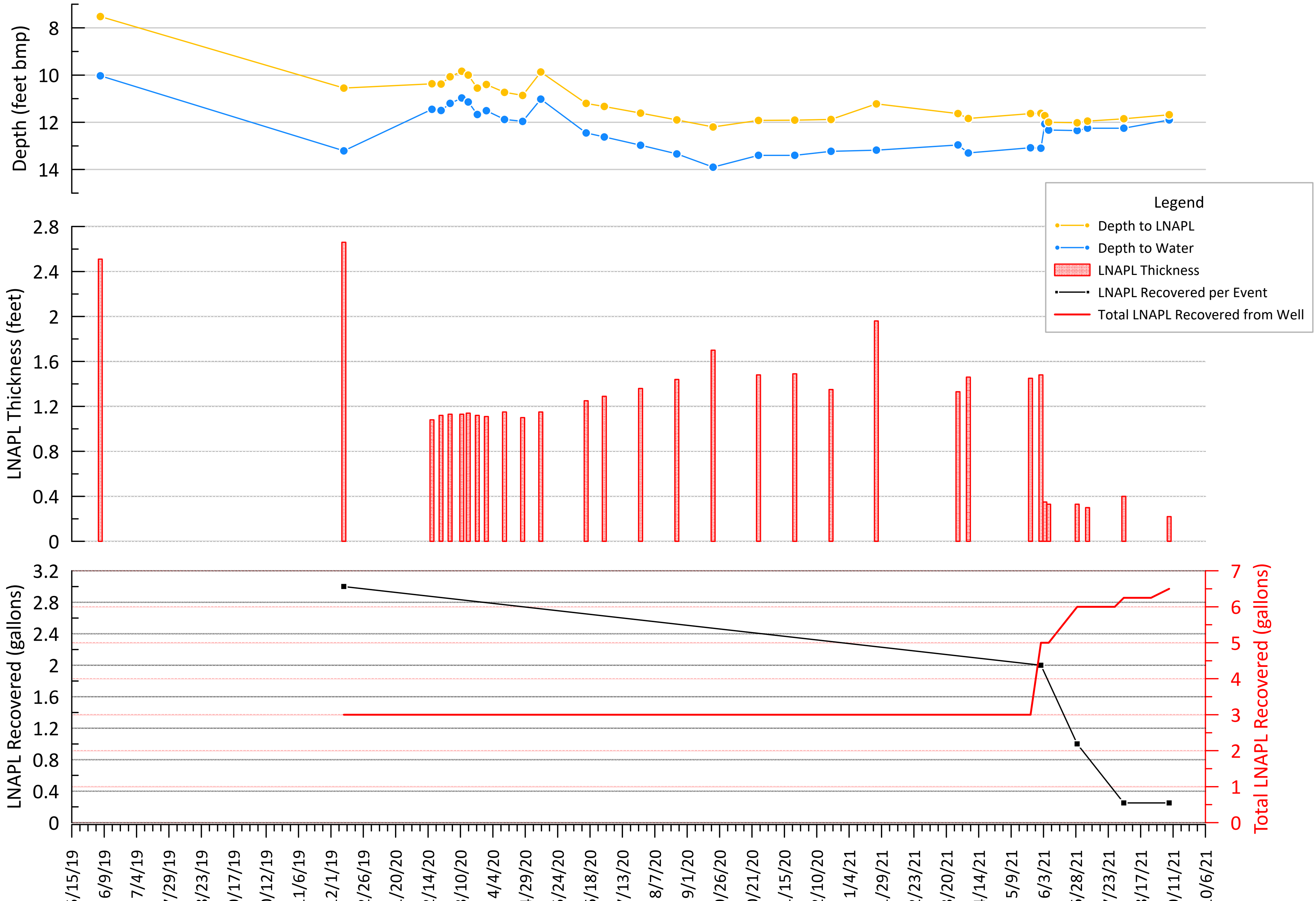
RW-5



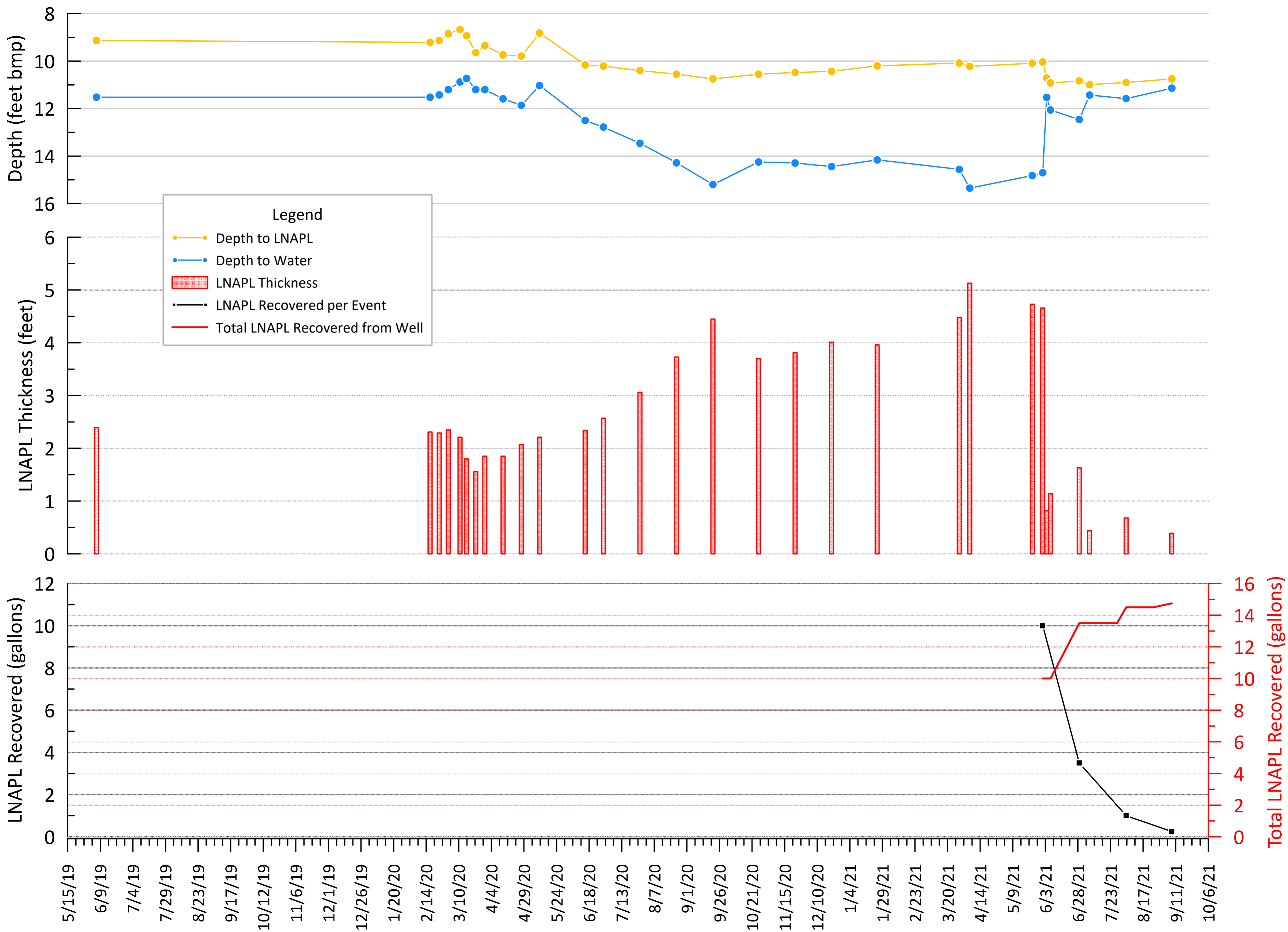
Manual Recovery Well

Cold Springs Site - Hillside Road, Lysander, NY
Southern Terminals Group
GHD Project Number 11137172

A13

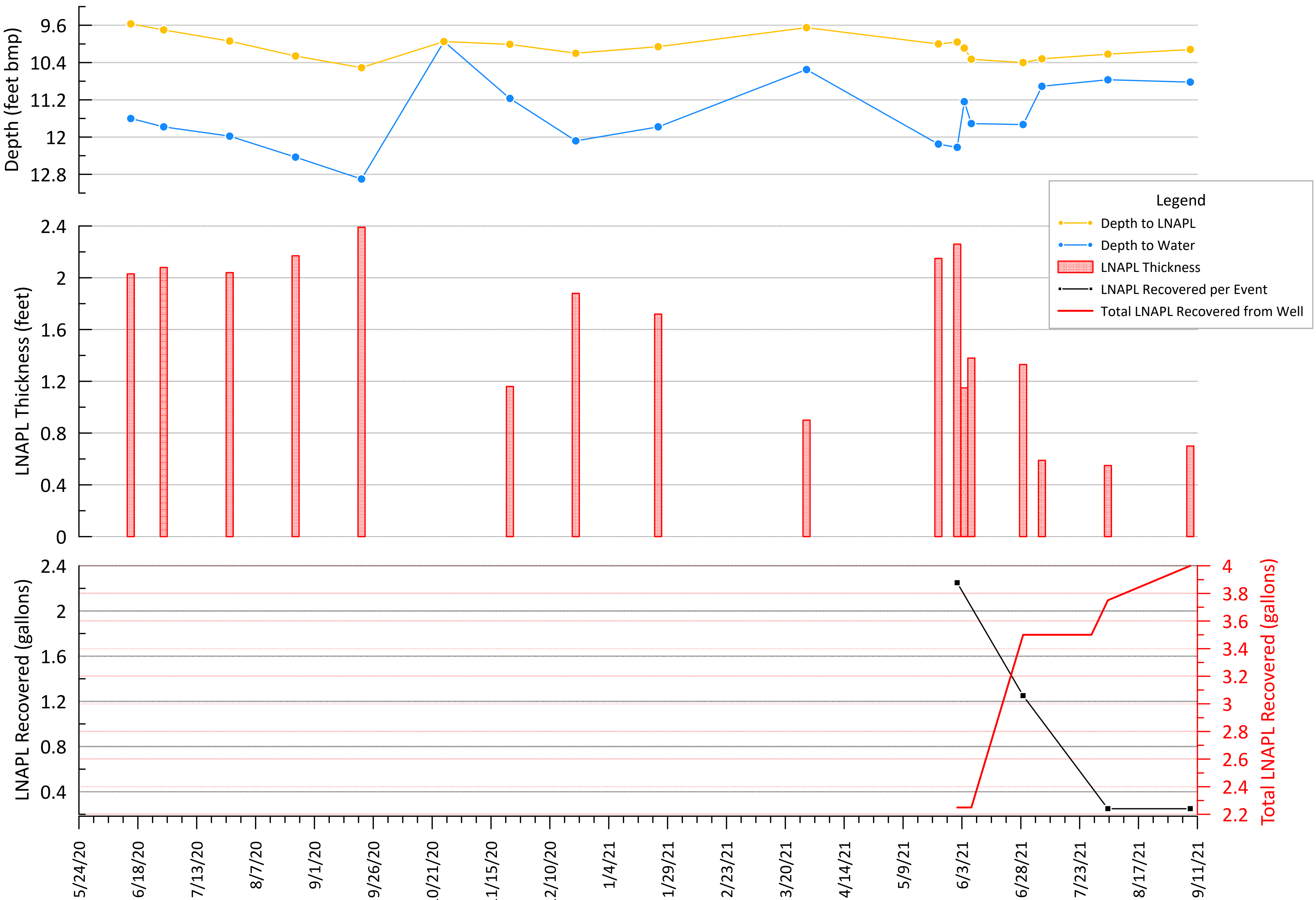


Manual Recovery Well
A14



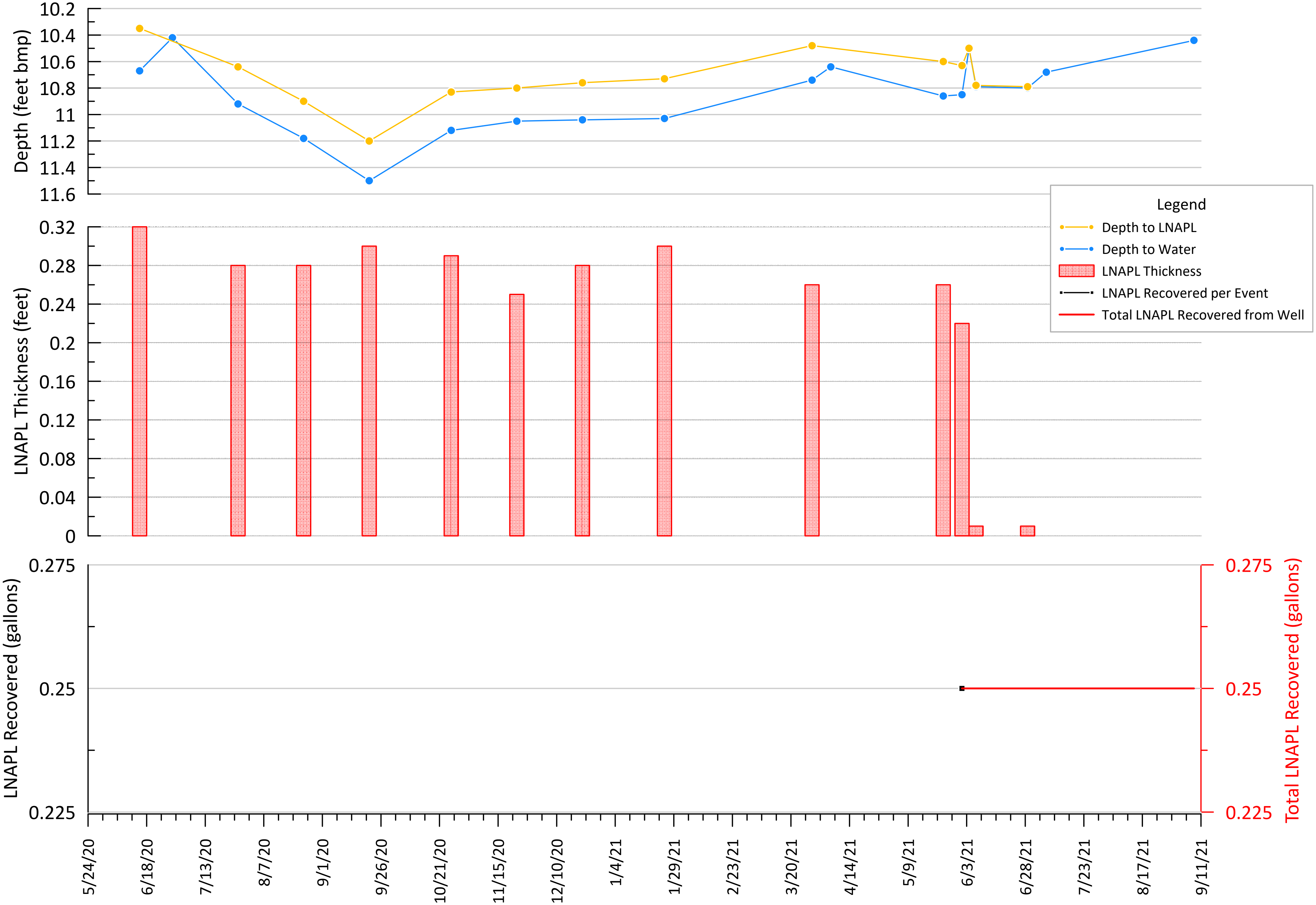
Manual Recovery Well

A12



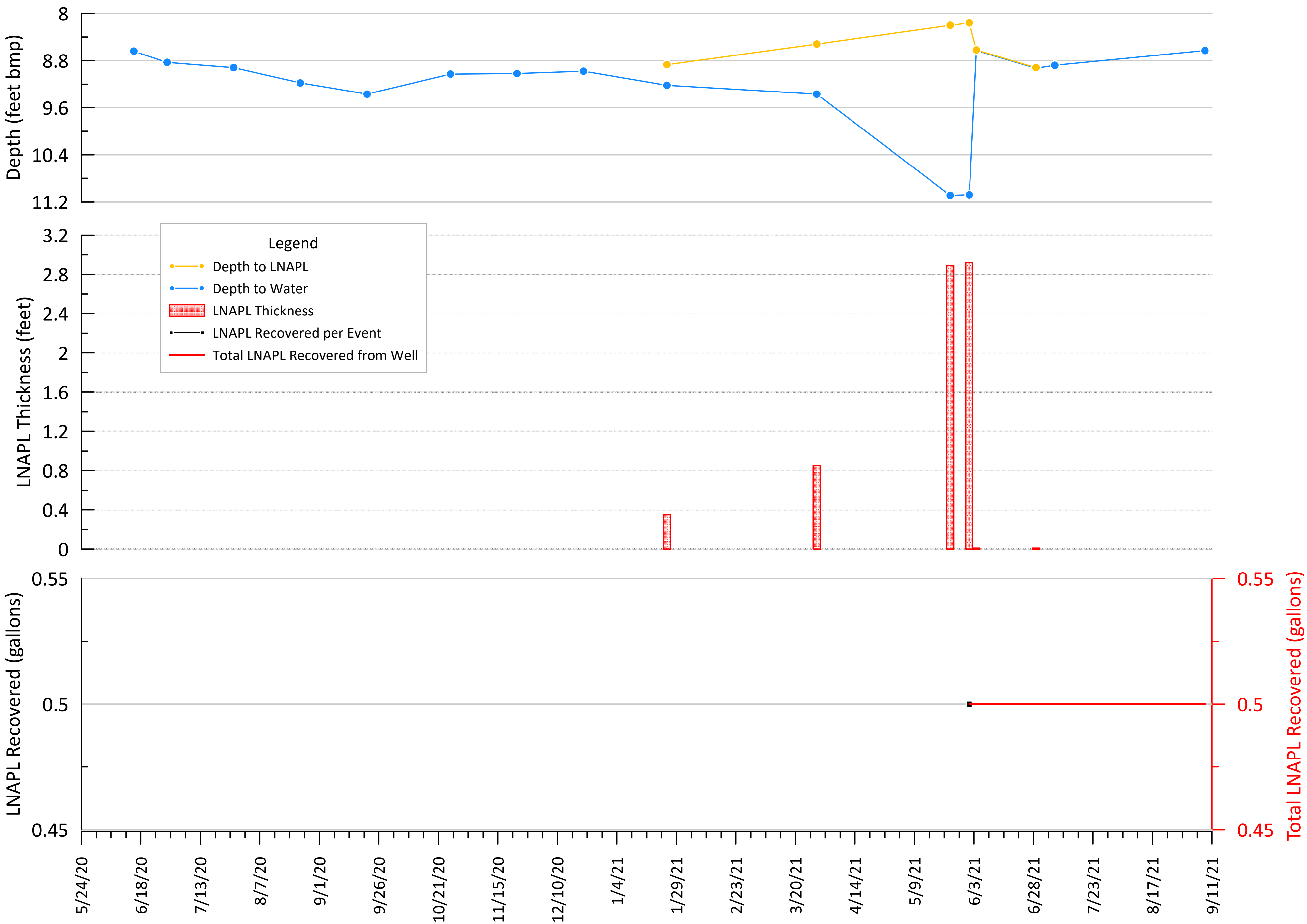
Manual Recovery Well
A18

Cold Springs Site - Hillside Road, Lysander, NY
Southern Terminals Group
GHD Project Number 11137172

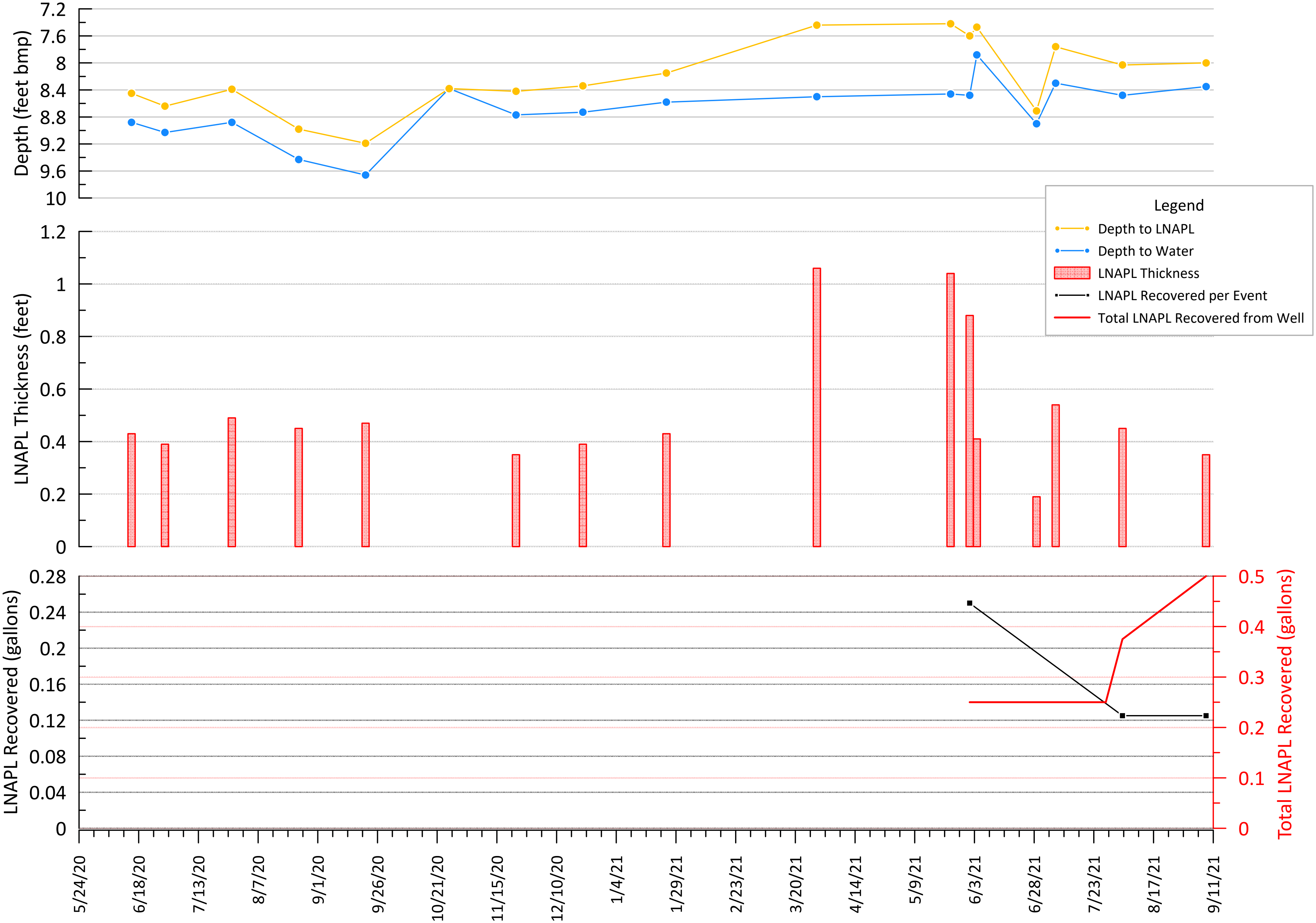


Manual Recovery Well
MW-6D

Cold Springs Site - Hillside Road, Lysander, NY
Southern Terminals Group
GHD Project Number 11137172

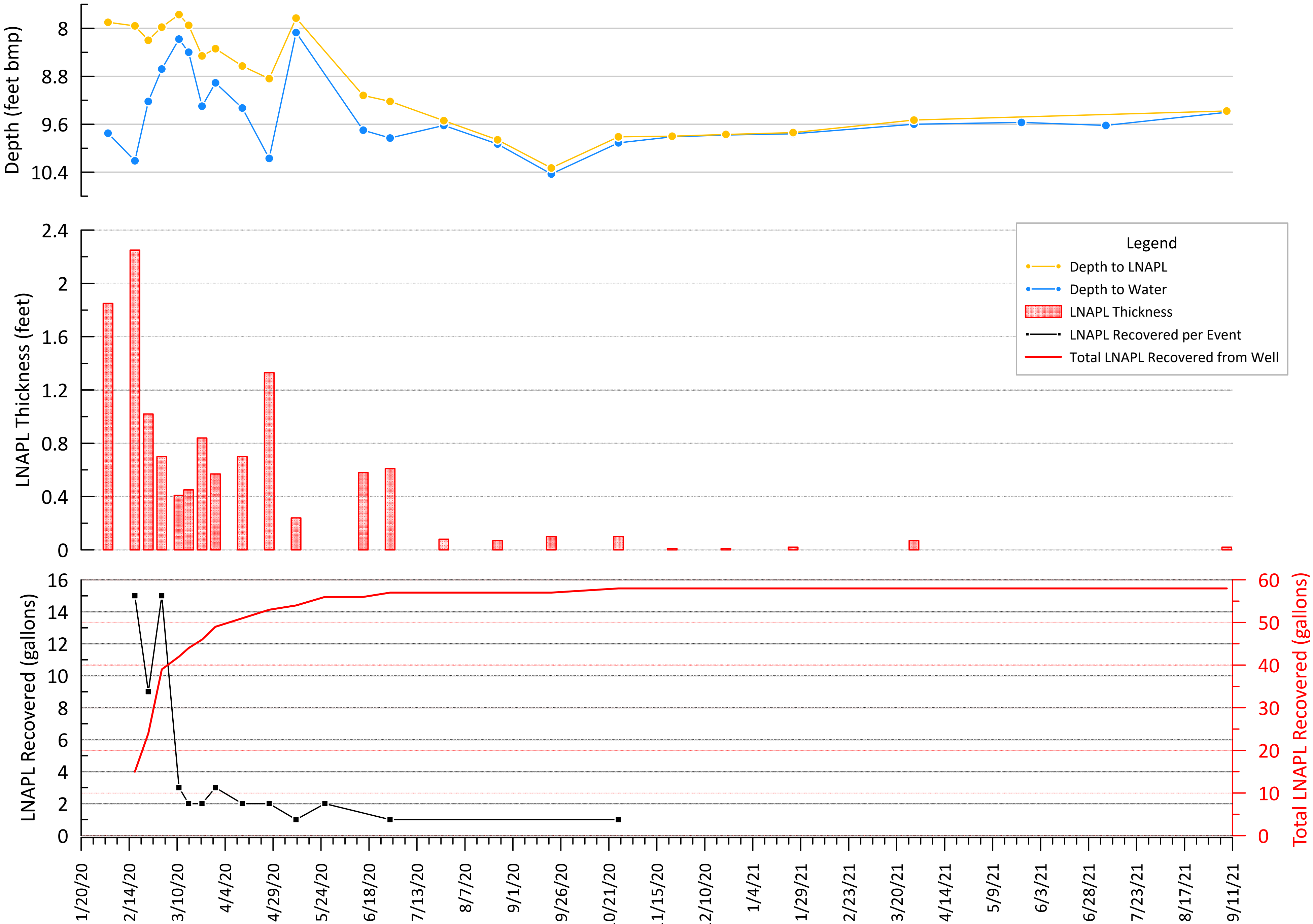


Manual Recovery Well
MW-6S

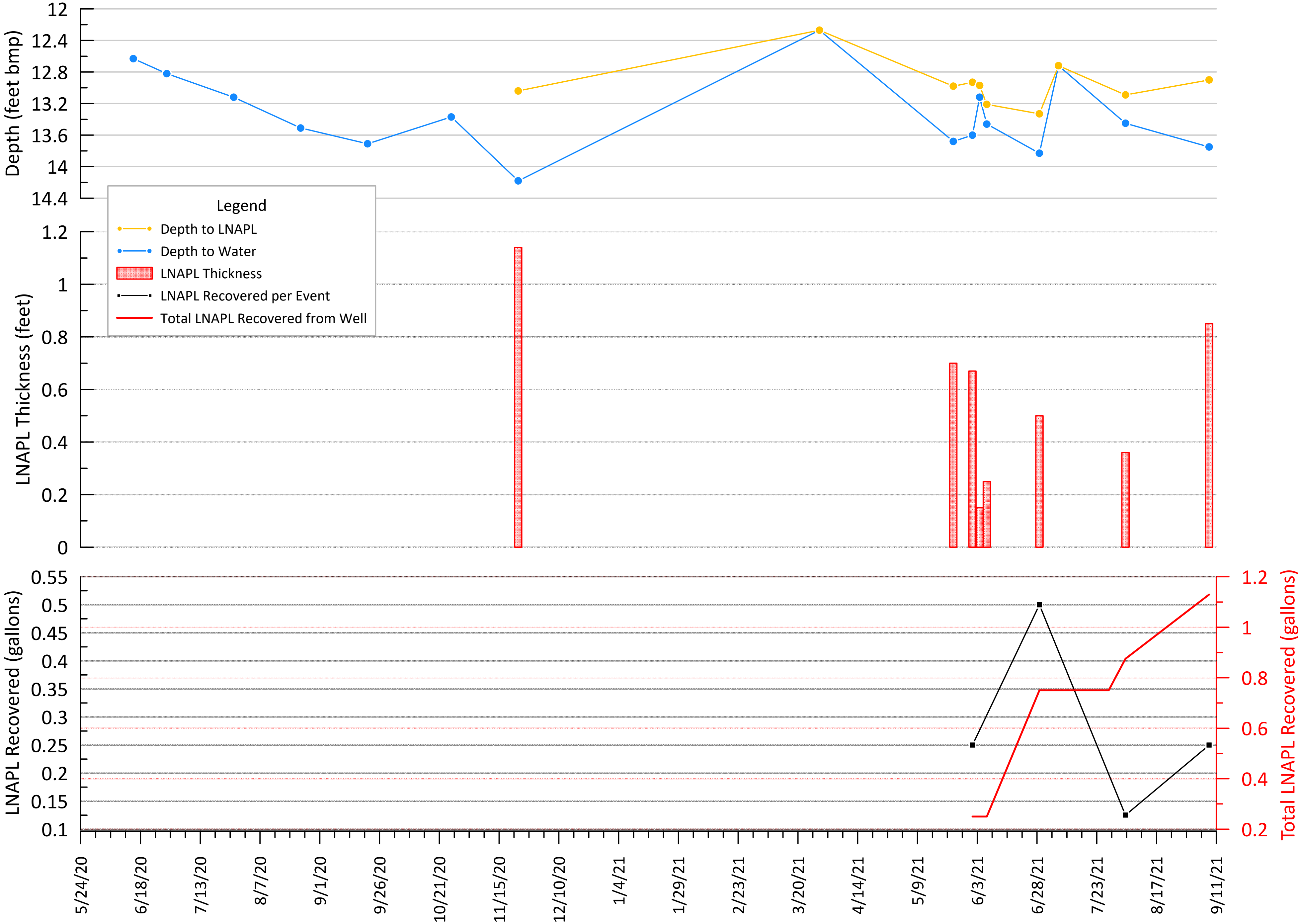


VEFR and Manual Recovery Well

RW-2

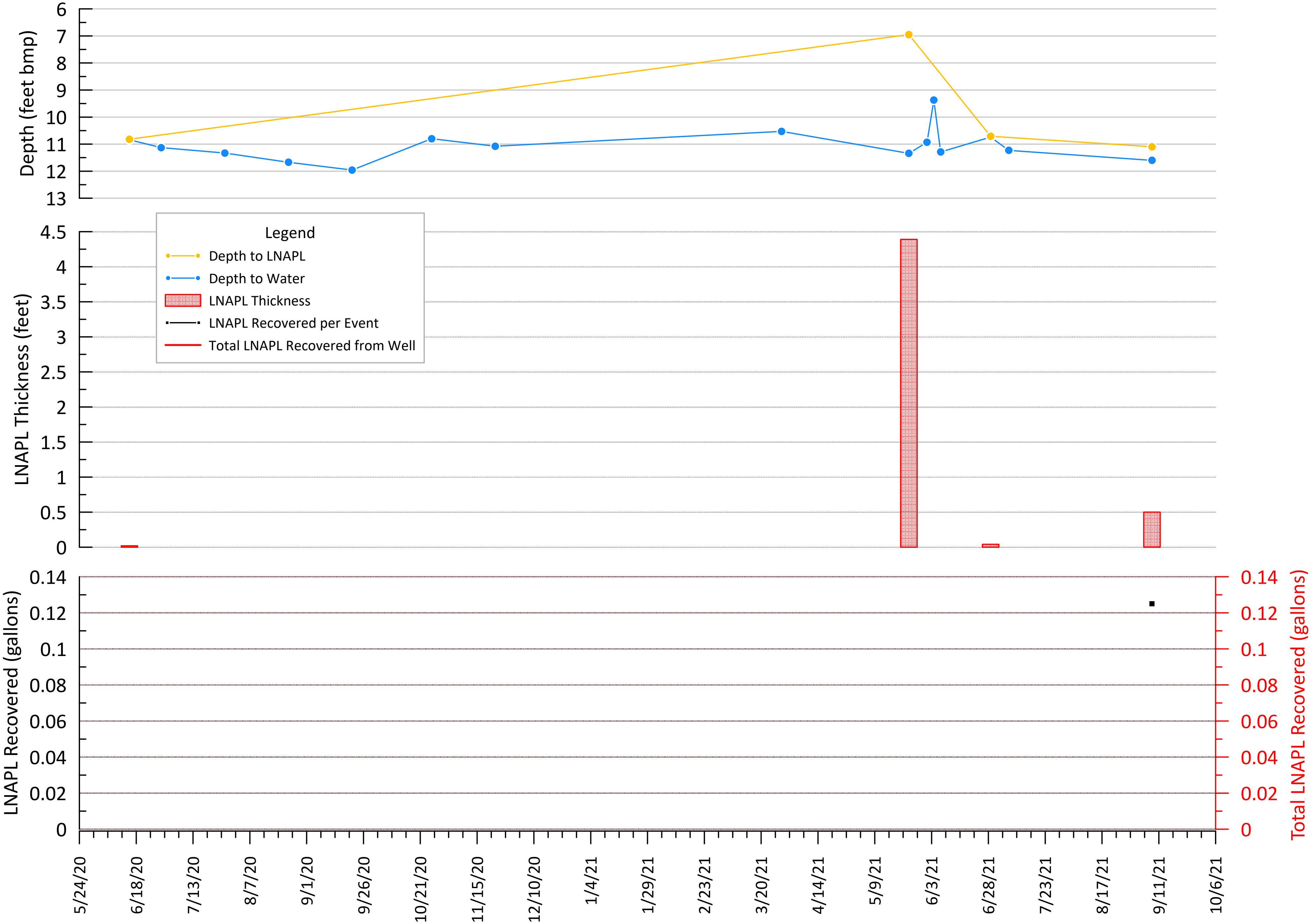


Manual Recovery Well
MWA



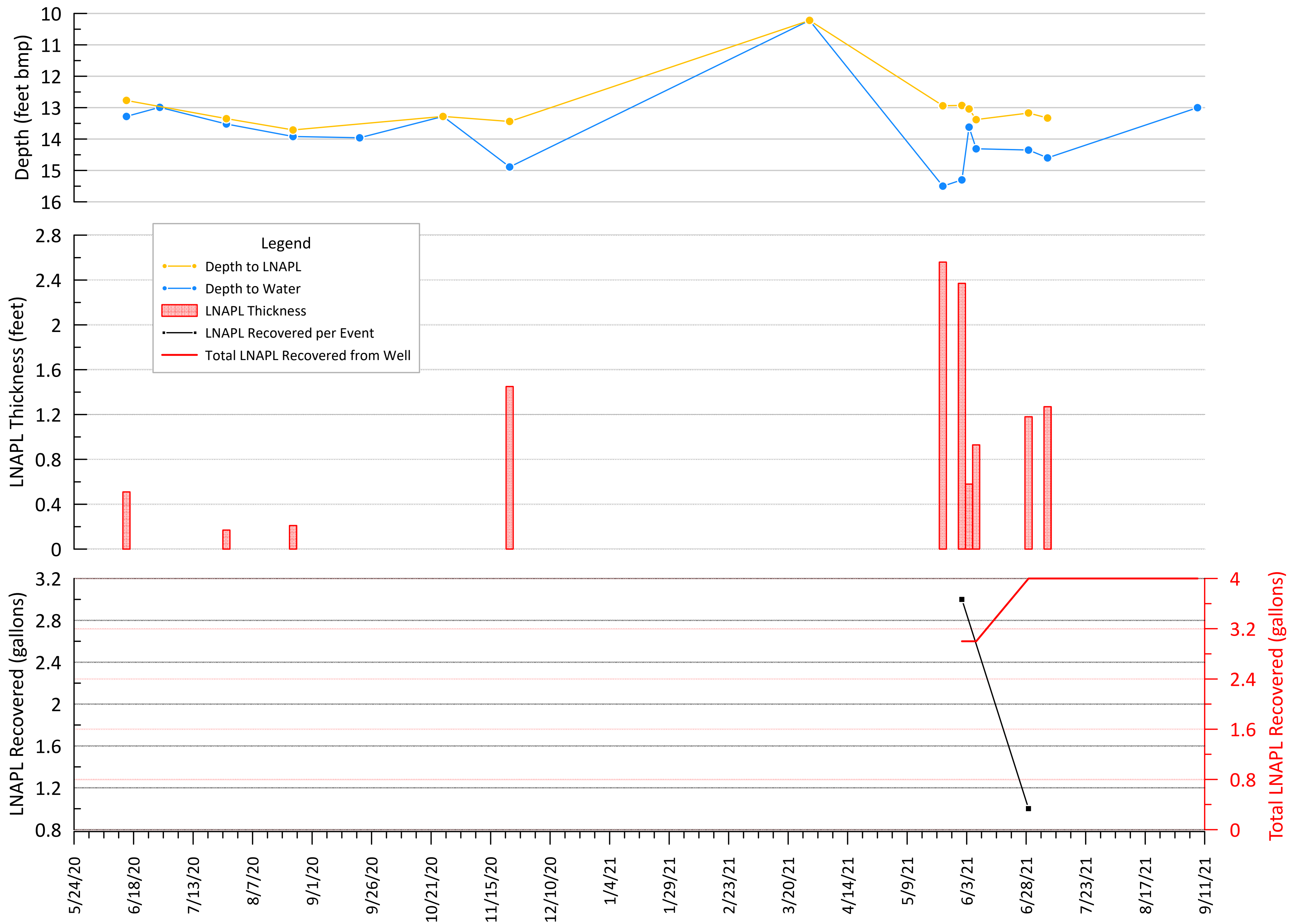
Cold Springs Site - Hillside Road, Lysander, NY
Southern Terminals Group
GHD Project Number 11137172

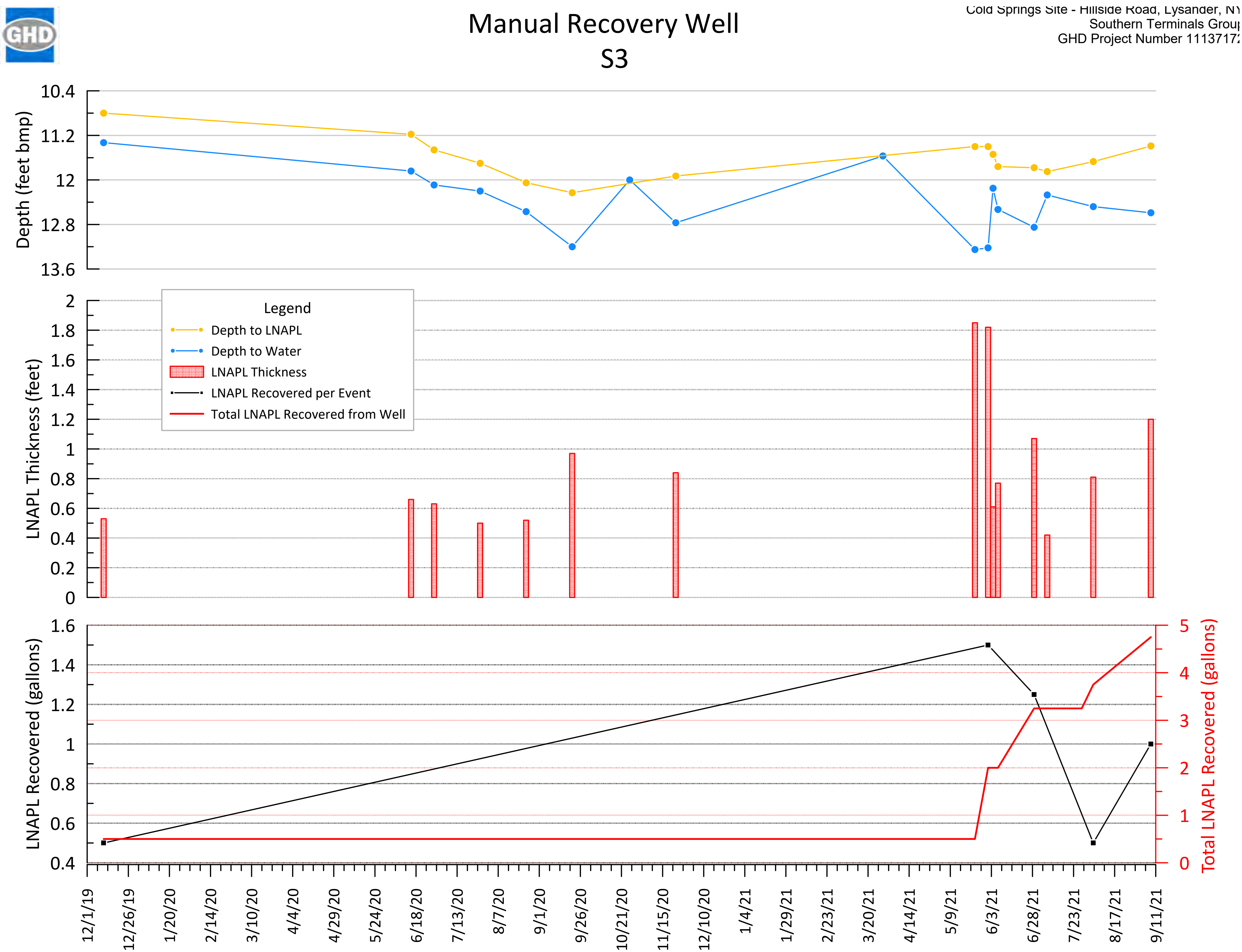
Manual Recovery Well
MWB



Cold Springs Site - Hillside Road, Lysander, NY
Southern Terminals Group
GHD Project Number 11137172

Manual Recovery Well
S2

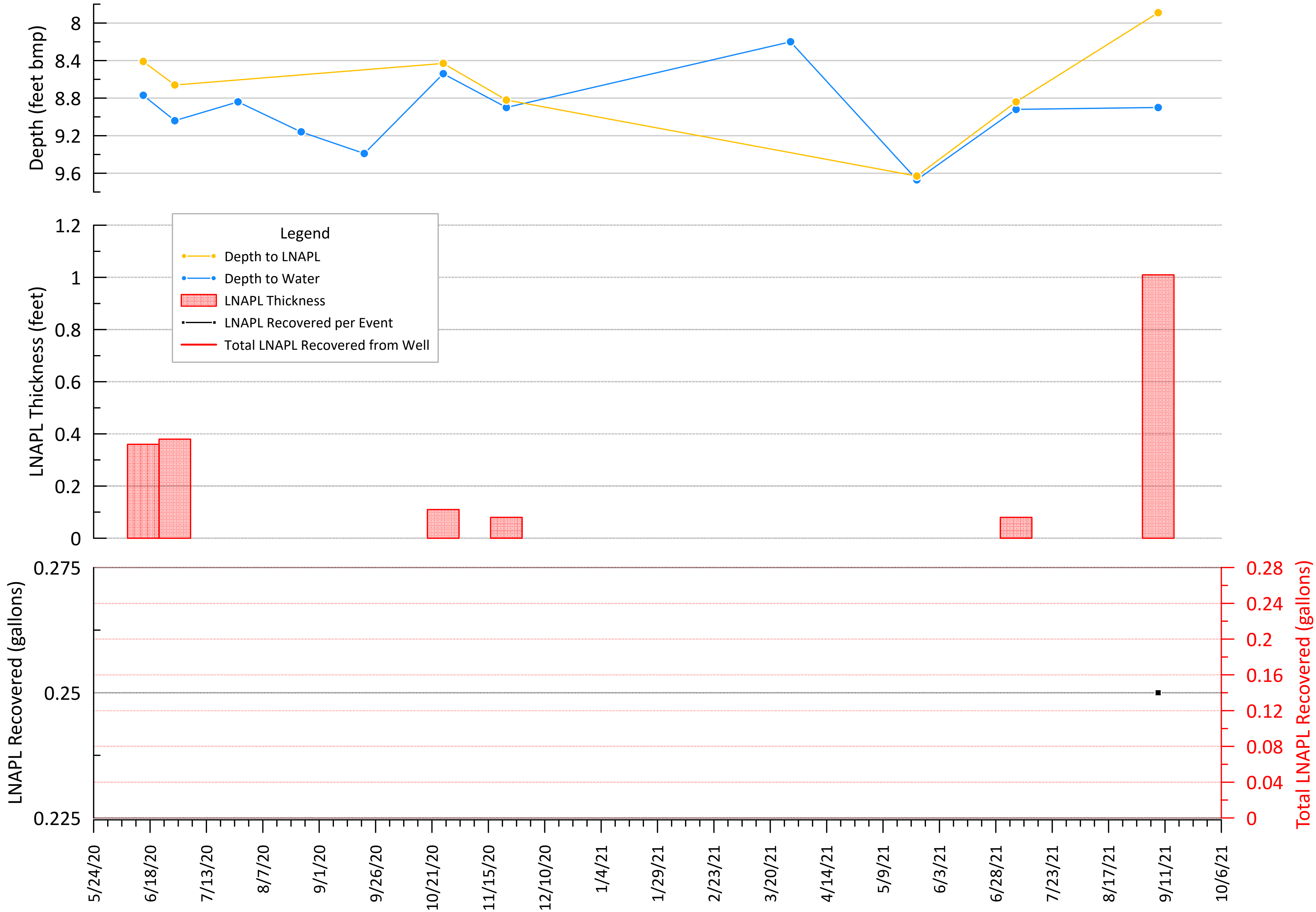




Manual Recovery Well
S3
Cold Springs Site - Hillside Road, Lysander, NY
Southern Terminals Group
GHD Project Number 1113717
Depth (feet bmp)
10.4
11.2
12
12.8
13.6
Legend
Depth to LNAPL
Depth to Water
LNAPL Thickness
LNAPL Recovered per Event
Total LNAPL Recovered from Well
LNAPL Thickness (feet)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
LNAPL Recovered (gallons)
1.6
1.4
1.2
1
0.8
0.6
0.4
Total LNAPL Recovered (gallons)
5
4
3
2
1
0
12/1/19
12/26/19
1/20/20
2/14/20
3/10/20
4/4/20
4/29/20
5/24/20
6/18/20
7/13/20
8/7/20
9/1/20
9/26/20
10/21/20
11/15/20
12/10/20
1/4/21
1/29/21
2/23/21
3/20/21
4/14/21
5/9/21
6/3/21
6/28/21
7/23/21
8/17/21
9/11/21

Manual Recovery Well

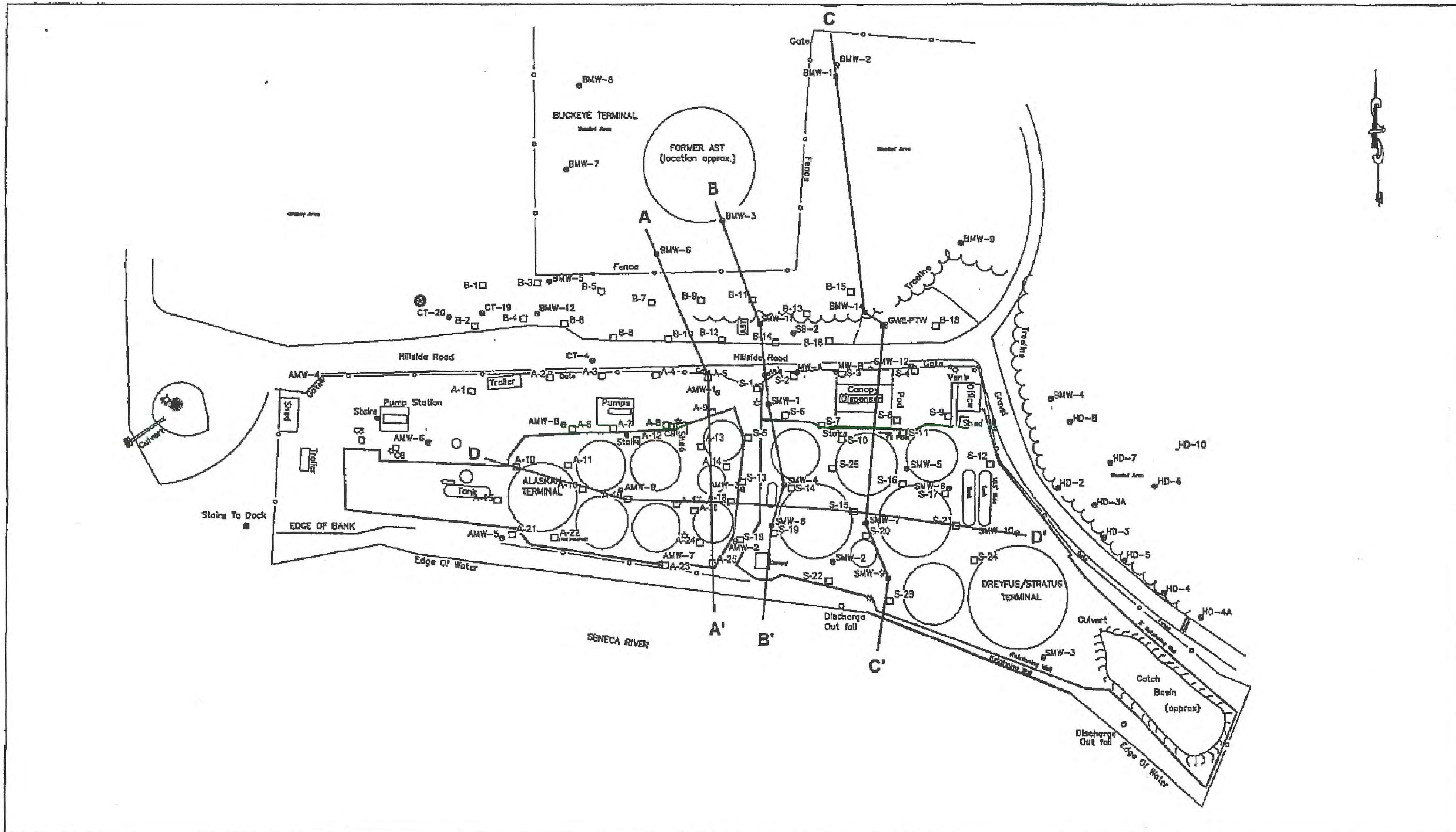
S9



Attachments

Attachment 1

Historical Geologic Cross Sections



EXPERTISE YOU CAN COUNT ON

Aztech Technologies, Inc.

5 McCrea Hill Road
Ballston Spa
New York, 12020

Phone: 518-885-5383
Fax: 518-885-5385
www.aztechtech.com

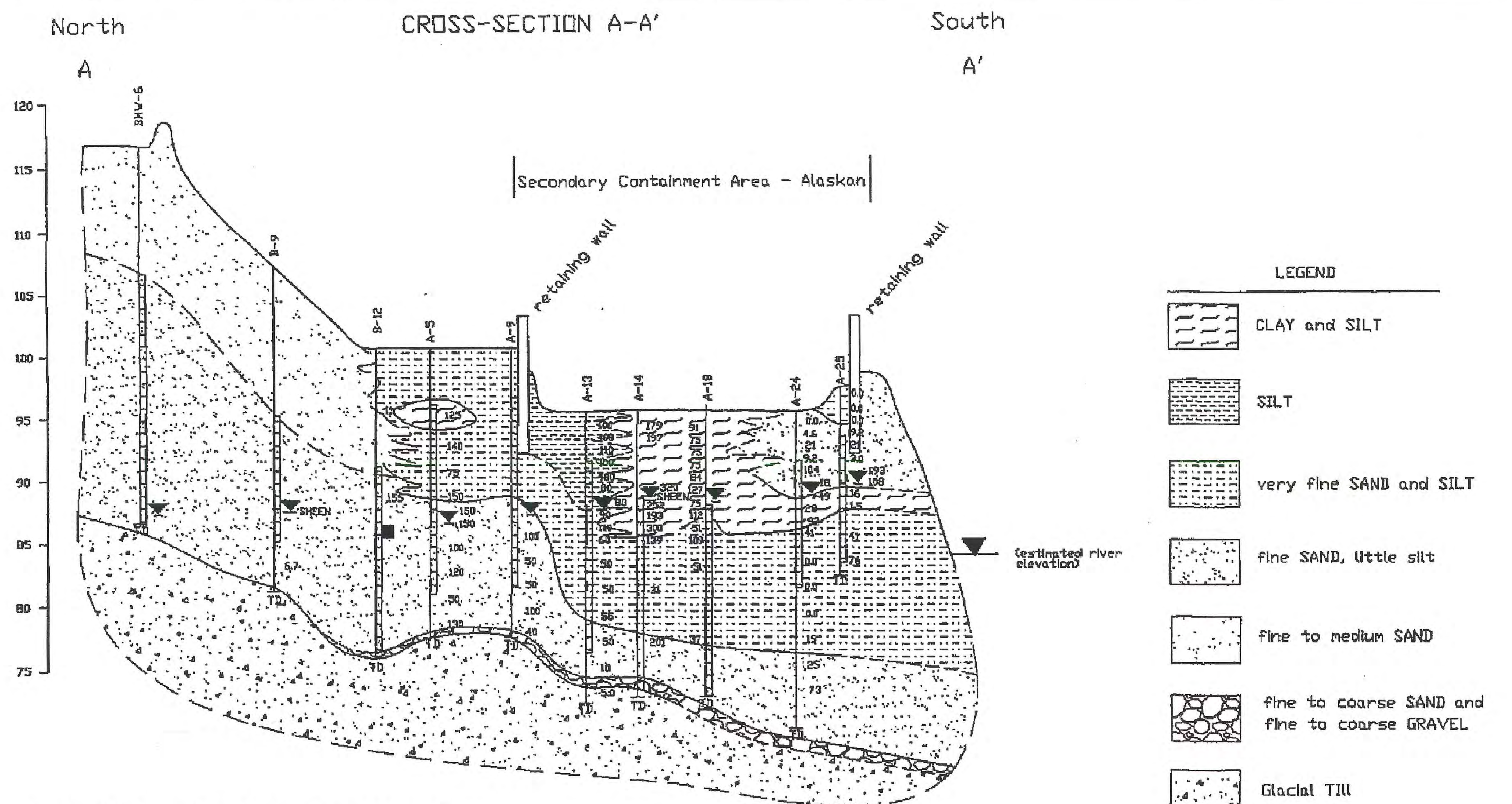
SITE: Cold Springs Terminals
Buckeye, Alaskan & Dreyfus/Stratus Terminals
Lysander (Cold Springs), NY
NYSDEC Spill No. 89-09423 PIN No. 99528

DATE: 12-15-06

Scale (in feet) 0 40 80 120

Site Map
with Cross-Section Locations
CEC FIGURE 4

Legend:
☐ Remedial Well



Horizontal Scale 1" = 40'; Vertical Scale as Shown

Topographic profile estimated through secondary containment area - survey pending

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Lysander (Cold Springs), NY
NYSDEC Spill No. 89-09423 PIN No. 99528

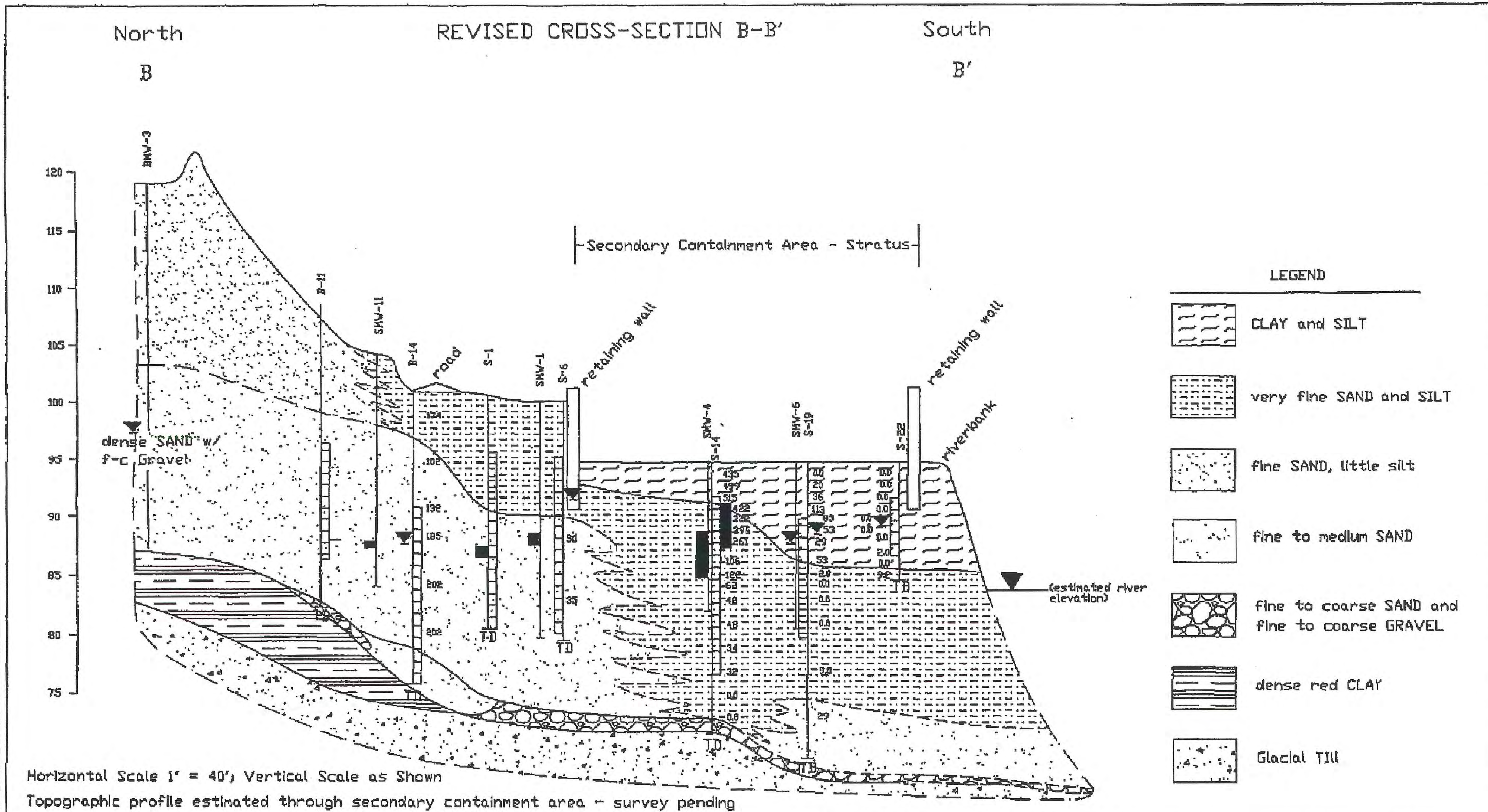
DATE: 12-19-06

SCALE: 1" = 40'

Cross Section A - A'

CEC FIGURE 5

LEGEND:
Static GW Elevation 10-26-06
Apparent Product Thickness 10-26-06
73 = Total VOC concentration in soil (ppm) - PID screening



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NYSDEC Spill No. 89-09423 PIN No. 99528

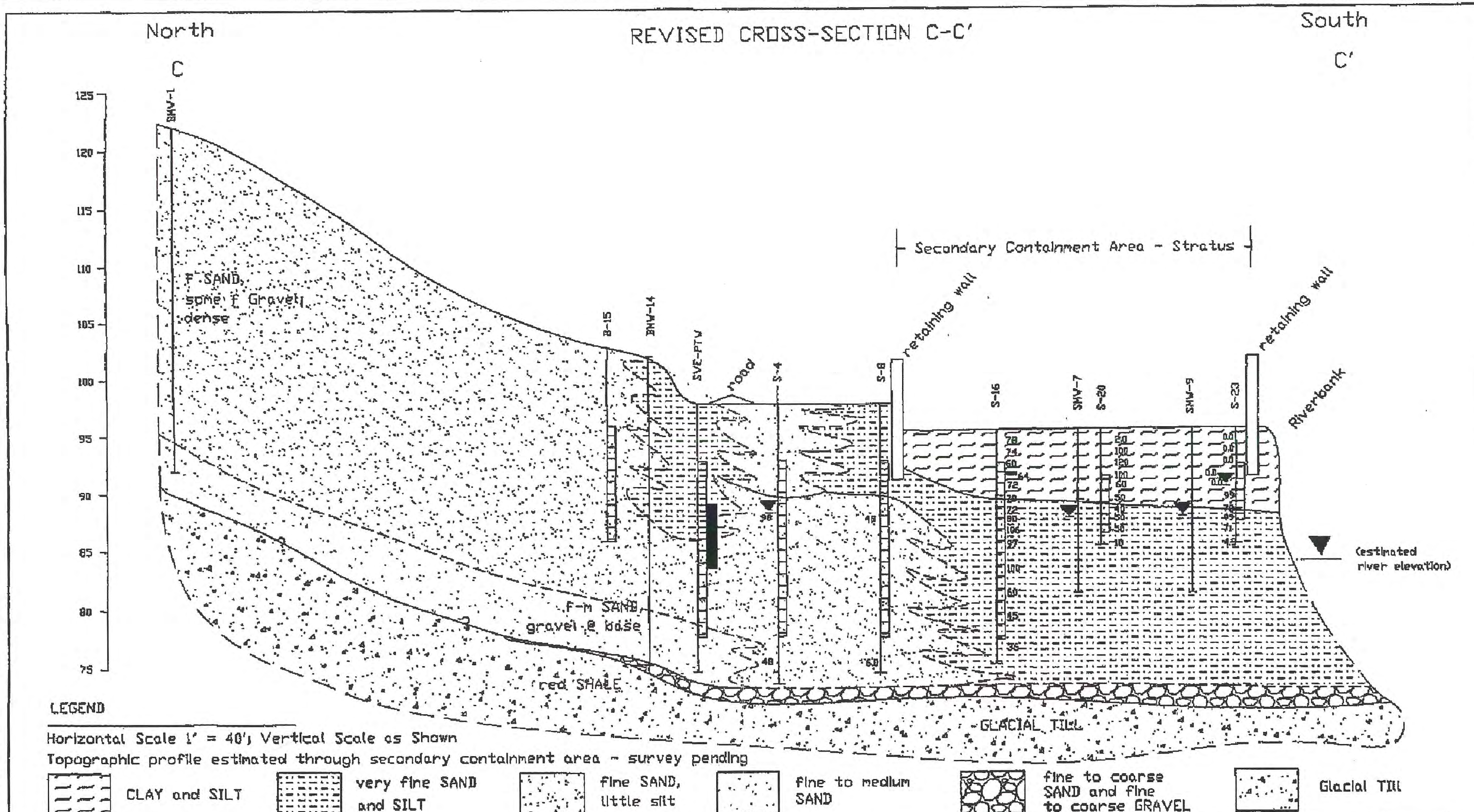
DATE: 10-19-06

SCALE: 1" = 40'

Revised Cross Section B - B'

CEC FIGURE 6

LEGEND:
▼ Static GW Elevation 10-26-06 ■ Apparent Product Thickness 10-26-06
29 = Total VOC concentration in soil (ppm) - PID screening



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Lysander (Cold Springs), NY
NYSDEC Spill No. 89-09423 PIN No. 99528

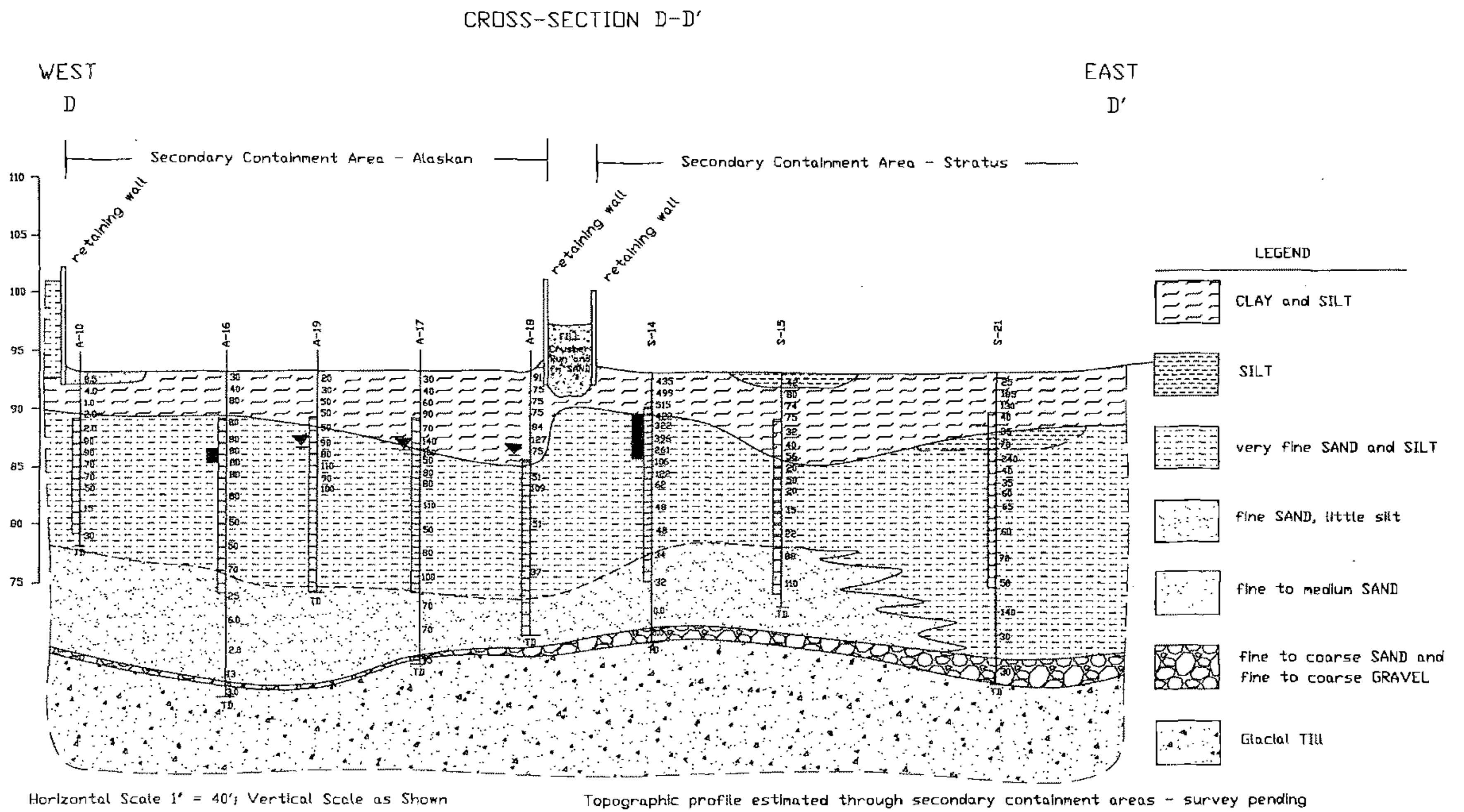
DATE: 10-19-06

SCALE: 1" = 40'

Revised Cross Section C - C'

CEC FIGURE 7

LEGEND:
Static GW Elevation 10-26-06 — Apparent Product Thickness 10-26-06
98 = Total VOC concentration in soil (ppm) - PID screening



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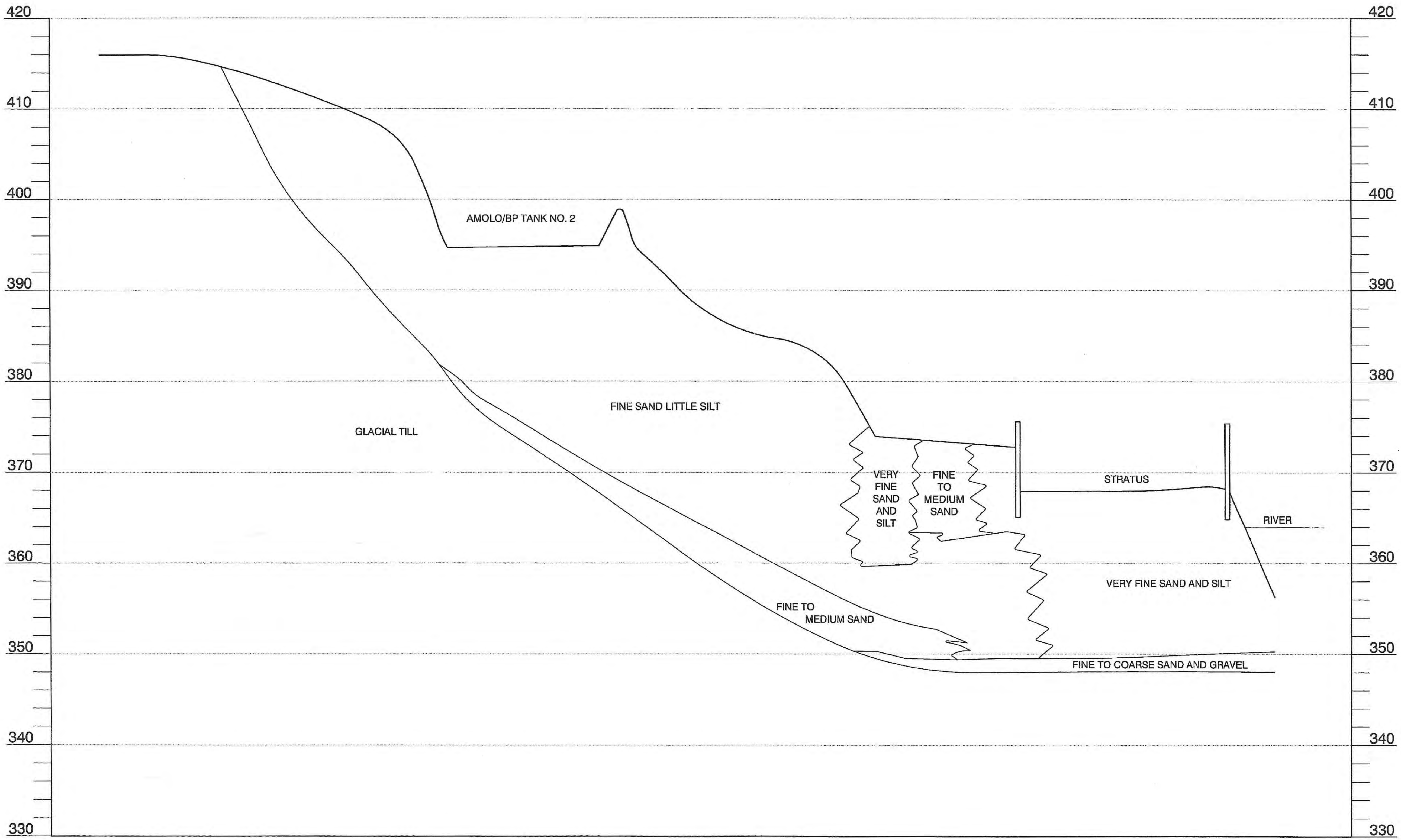
Buckeye, Alaskan and Dreyfus/Stratus Terminals
Lysander (Cold Springs), NY
NYSDEC Spill No. 89-09423 PIN No. 99528

FIGURE 5

DATE: 10-19-06 | SCALE: 1" = 40'

Cross Section D - D'

LEGEND:
Static GW Elevation 10-26-06
Apparent Product Thickness 10-26-06
140 = Total VOC concentration in soil (ppm) - PID screening



INFORMATION TAKEN FROM
LIDAR TOPOGRAPHIC MAP AND AZTECH (25 JAN 2007)

SCALE IN FEET
0 10 20

REVISION RECORD

NO	DATE	DESCRIPTION

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100 - Columbus, OH 43240
614-540-6633 · 888-598-6808
www.cecinc.com

BUCKEYE PIPE LINE CO.
LIVERPOOL TERMINAL, NEW YORK

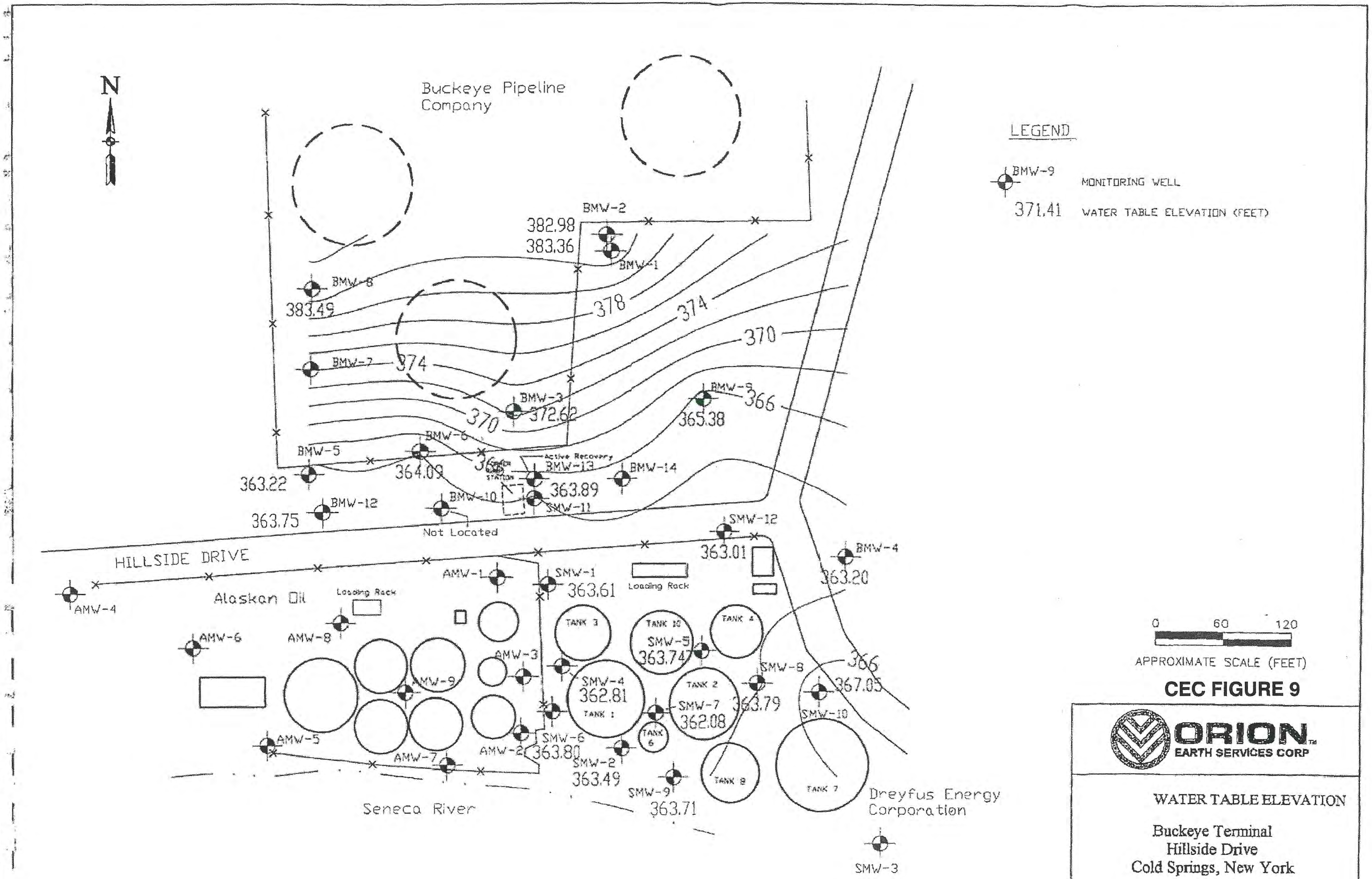
CONCEPTUAL GEOLOGIC PROFILE
THROUGH SITE AREA

DATE:	FEB 2010	DRAWN BY:	BTW
DWG SCALE:	1" = 10'	CHECKED BY:	JSC
PROJECT NO:	091-821	APPROVED BY:	JRK*

* HAND SIGNATURE ON FILE

DRAWING NO.: 8

SHEET 1 OF 1



CEC FIGURE 9

ORION EARTH SERVICES CORP

WATER TABLE ELEVATION

Buckeye Terminal
Hillside Drive
Cold Springs, New York

PROJ. NO: 004001	D/B: TLD	DATE: 12/02

UPLAND DEPOSITS ANALYSIS

$Q = KiA$

WHERE,

Q = FLOW RATE
K = HYDRAULIC CONDUCTIVITY
i = GRADIENT
A = CROSS-SECTION OF FLOW

WE CAN CALCULATE Q, i AND A AND THEN SOLVE FOR K.

$K = \frac{Q}{iA}$

i = 20 FT/200 FT = 0.1 (FROM ORION MAP)

$A = 15\ FT^2$

Q = INFILTRATING PRECIPITATION - ANNUAL PRECIPITATION IS 38+" PER YEAR - ASSUME ONE-HALF INFILTRATES OR 19" PER YR (0.05'/DY) A 500FT RECHARGE STRIP ALONG CROSS-SECTION WITH A WIDTH OF 1FT IS A $500FT^2$ RECHARGE AREA, AND

$Q = \frac{0.05"}{12"/FT}(500FT^2) = 2\ FT^3/DY$ PER FOOT OF WIDTH.

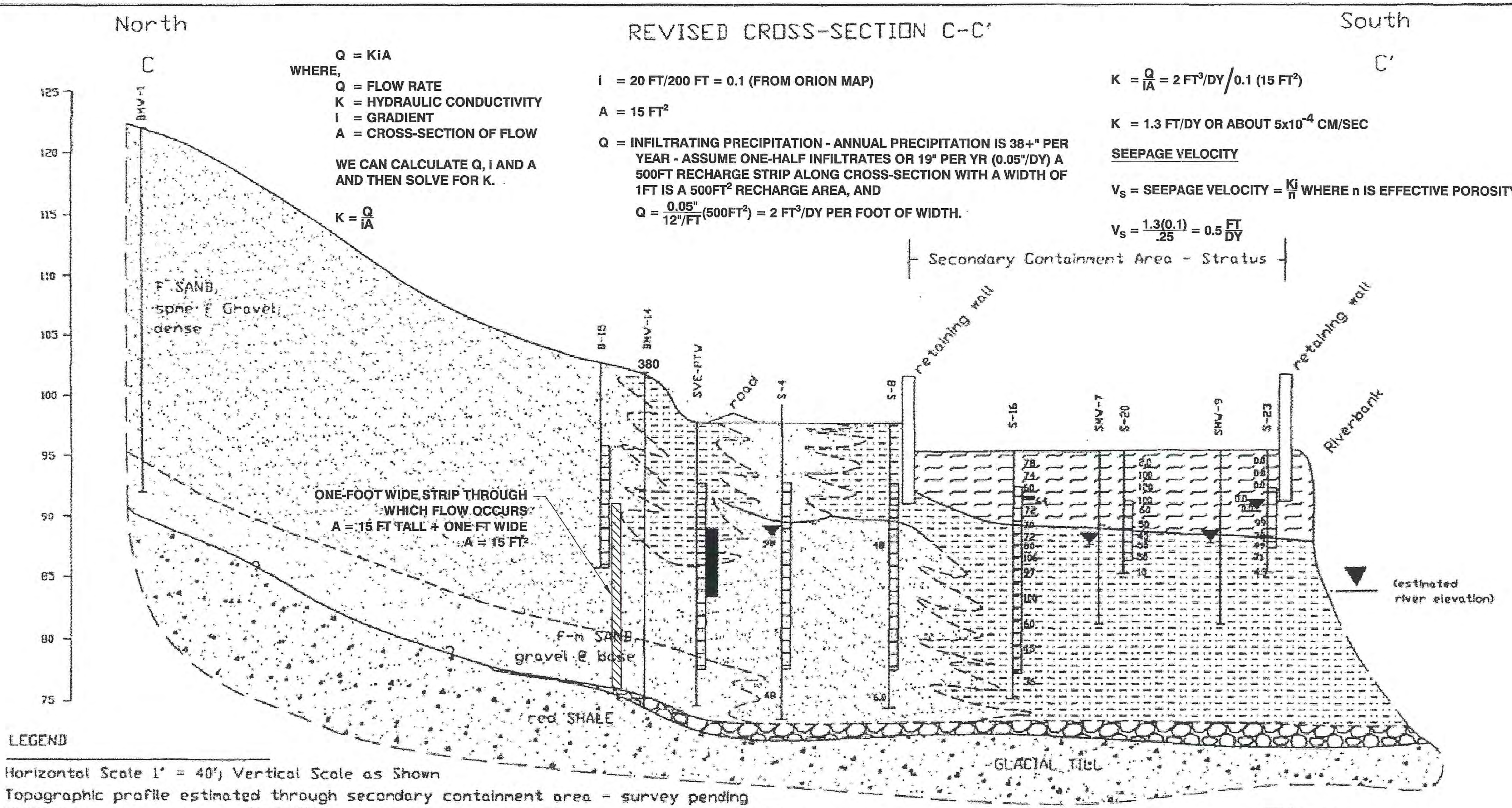
$K = \frac{Q}{iA} = 2\ FT^3/DY \big/ 0.1\ (15\ FT^2)$

K = 1.3 FT/DY OR ABOUT 5×10^{-4} CM/SEC

SEEPAGE VELOCITY

V_S = SEEPAGE VELOCITY = $\frac{Ki}{n}$ WHERE n IS EFFECTIVE POROSITY

$V_S = \frac{1.3(0.1)}{.25} = 0.5 \frac{FT}{DY}$



LEGEND

Horizontal Scale 1" = 40'; Vertical Scale as Shown

Topographic profile estimated through secondary containment area - survey pending

CLAY and SILT | very fine SAND and SILT | fine SAND, little silt | fine to medium SAND | fine to coarse SAND and fine to coarse GRAVEL | Glacial Till

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Buckeye, Alaskan and Dreyfus/Stratus Terminals
Lysander (Cold Springs), NY
NYSDEC Spill No. 89-09423 PIN No. 99528

DATE: 10-19-06

SCALE: 1" = 40'

Revised Cross Section C - C'

CEC FIGURE 10

LEGEND:
▼ Static GW Elevation 10-26-06
■ Apparent Product Thickness 10-26-06
98 = Total VOC concentration in soil (ppm) - PID screening

ANALYSIS OF FLOODPLAIN DEPOSITS

REVISED CROSS-SECTION C-C'

$Q = KiA$

WHERE,
- K = HYDRAULIC CONDUCTIVITY
- i = GRADIENT
- A = CROSS-SECTIONAL AREA OF FLOW
- Q = FLOW RATE

HYDRAULIC CONDUCTIVITY OF VERY FINE SAND AND SILT IS 10^{-4} TO 10^{-5} CM/SEC (FREEZE AND CHERRY) USE 5×10^{-5} CM/SEC - ONE ORDER OF MAGNITUDE LOWER THAN UPLAND DEPOSITS, K = 0.13 FT/DY.

GRADIENT IS ROUGHLY 1 FT IN 200 FT OR $I = \frac{1FT}{200FT} = 0.005$.

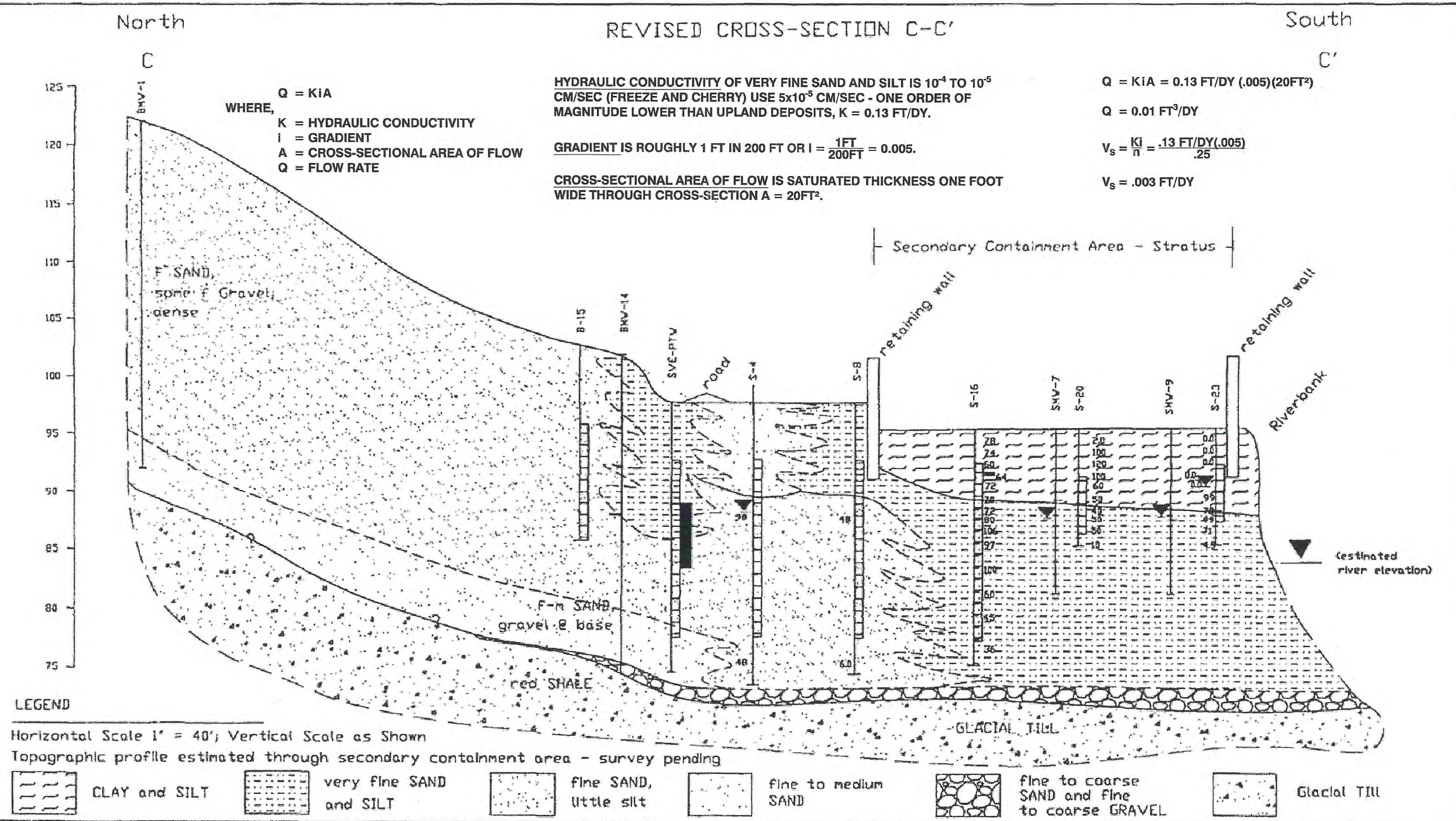
CROSS-SECTIONAL AREA OF FLOW IS SATURATED THICKNESS ONE FOOT WIDE THROUGH CROSS-SECTION $A = 20FT^2$.

$Q = KiA = 0.13\ FT/DY\ (.005)(20FT^2)$

$Q = 0.01\ FT^3/DY$

$V_s = \frac{Ki}{n} = \frac{.13\ FT/DY(.005)}{.25}$

$V_s = .003\ FT/DY$



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Buckeye, Alaskan and Dreyfus/Stratus Terminals
Lysander (Cold Springs), NY
NYSDEC Spill No. 89-09423 PIN No. 99528

DATE: 10-19-06 SCALE: 1" = 40'

Revised Cross Section C - C'

CEC FIGURE 11

LEGEND:
- ▼ Static GW Elevation 10-26-06
- ■ Apparent Product Thickness 10-26-06
- 98 = Total VOC concentration in soil (ppm) - PID screening

ANALYSIS OF FINE TO COARSE SAND AND GRAVEL

REVISED CROSS-SECTION C-C'

$Q = KiA$

WHERE,
- K = HYDRAULIC CONDUCTIVITY
- i = GRADIENT
- A = CROSS-SECTIONAL AREA OF FLOW
- Q = FLOW RATE

HYDRAULIC CONDUCTIVITY OF FINE TO COARSE SAND AND GRAVEL IS 0.1 CM/SEC (FREEZE AND CHERRY) AND K = 283 FT/DY.

FLOW RATE IS ESSENTIALLY 2 FT^3/DY PER FOOT OF WIDTH SINCE FLOOD PLAIN DEPOSITS TRANSMIT SO LITTLE FLOW. Q = 2 FT^3/DY.

CROSS-SECTIONAL AREA OF FLOW IS SATURATED THICKNESS ONE FOOT WIDE THROUGH THE CROSS-SECTION AND A = 2 FT^2.

$Q = KiA$ AND $i = Q/KA$

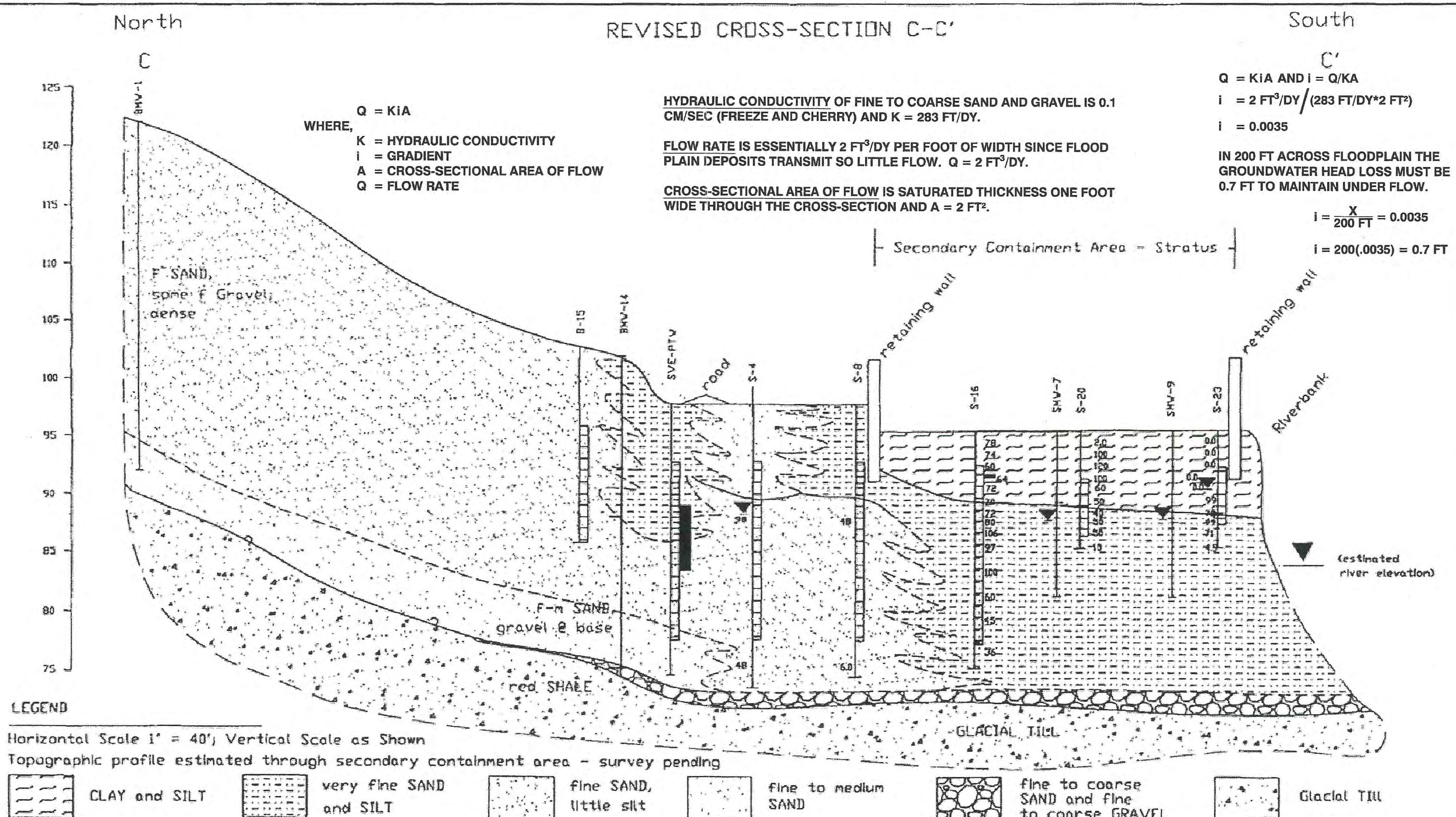
$i = 2\ FT^3/DY \,/\, (283\ FT/DY * 2\ FT^2)$

$i = 0.0035$

IN 200 FT ACROSS FLOODPLAIN THE GROUNDWATER HEAD LOSS MUST BE 0.7 FT TO MAINTAIN UNDER FLOW.

$i = \frac{X}{200\ FT} = 0.0035$

$i = 200(.0035) = 0.7\ FT$



EXPERTISE YOU CAN COUNT ON

Aztech Technologies, Inc.
5 McCrea Hill Road
Ballston Spa
New York, 12020
Phone: 518-885-5383
Fax: 518-885-5385
www.aztechtech.com

SITE: Cold Springs Terminals
Buckeye, Alaskan and Dreyfus/Stratus Terminals
Lysander (Cold Springs), NY
NYSDEC Spill No. 89-09423 PIN No. 99528

[redacted]

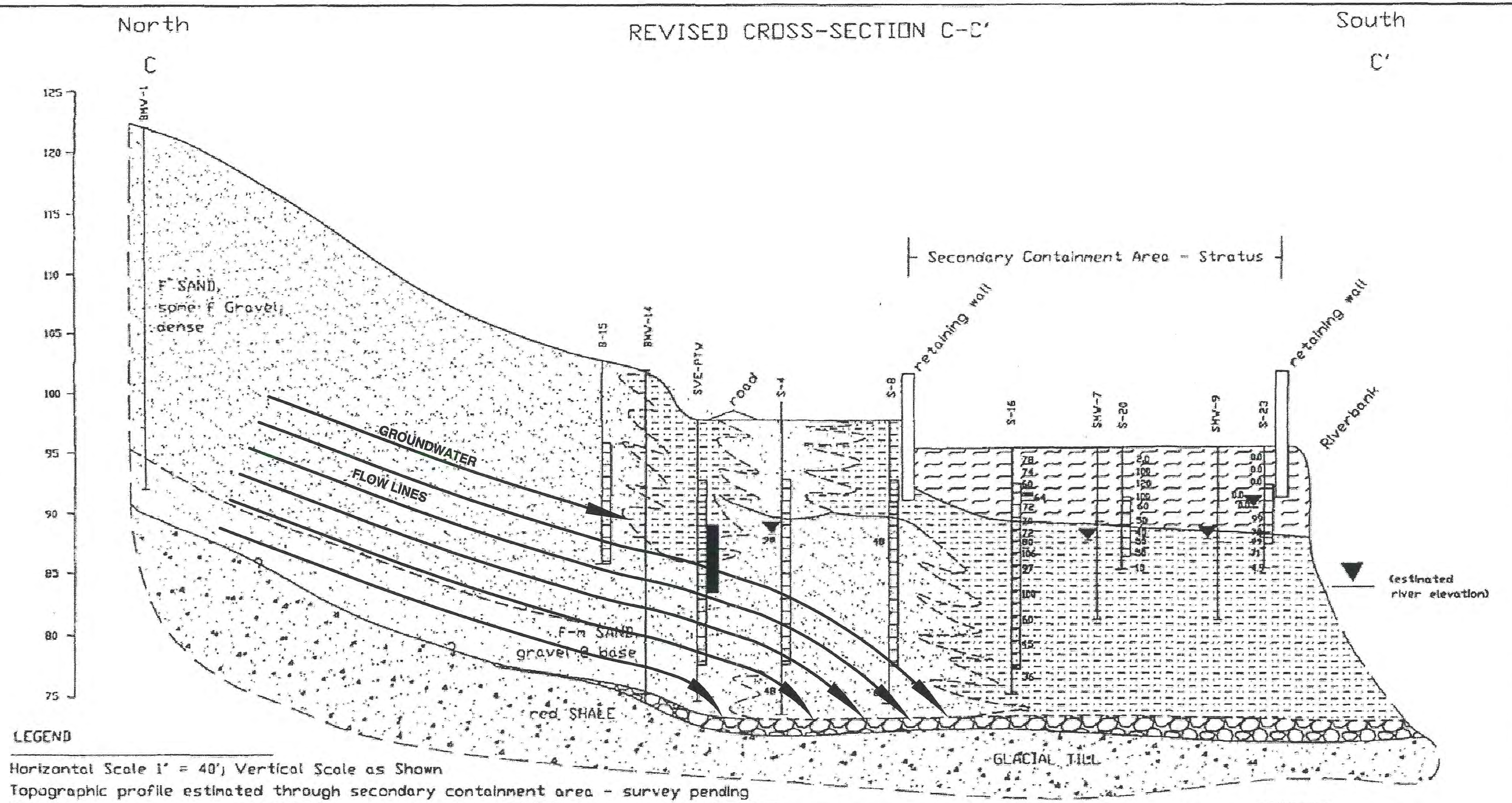
DATE: 10-19-06

SCALE: 1" = 40'

Revised Cross Section C - C'

CEC FIGURE 12

LEGEND:
- ▼ Static GW Elevation 10-26-06
- ■ Apparent Product Thickness 10-26-06
- 98 = Total VOC concentration in soil (ppm) - PID screening



LEGEND

Horizontal Scale 1" = 40'; Vertical Scale as Shown

Topographic profile estimated through secondary containment area - survey pending

CLAY and SILT | very fine SAND and SILT | fine SAND, little silt | fine to medium SAND | fine to coarse SAND and fine to coarse GRAVEL | Glacial Till

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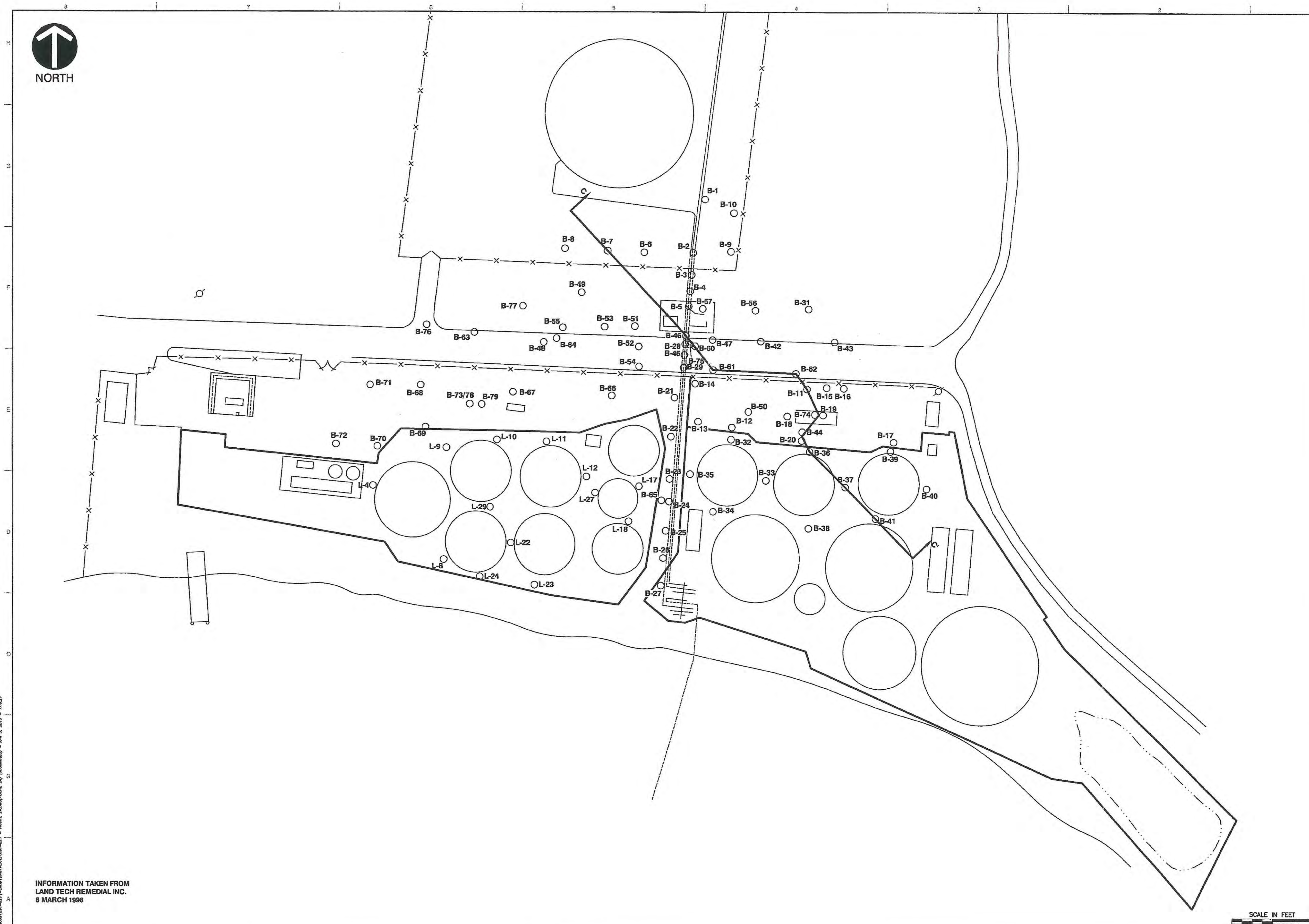
SITE: Cold Springs Terminals
Buckeye, Alaskan and Dreyfus/Stratus Terminals
Lysander (Cold Springs), NY
NYSDEC Spill No. 89-09423 PIN No. 99528

DATE: 10-19-06 SCALE: 1" = 40'

Revised Cross Section C - C'

CEC FIGURE 13

LEGEND:
Static GW Elevation 10-26-06 ■ Apparent Product Thickness 10-26-06
98 = Total VOC concentration in soil (ppm) - PID screening



REVISION RECORD		
NO	DATE	DESCRIPTION

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100 · Columbus, OH 43240
614-540-6633 · 888-598-6808
www.cecinc.com

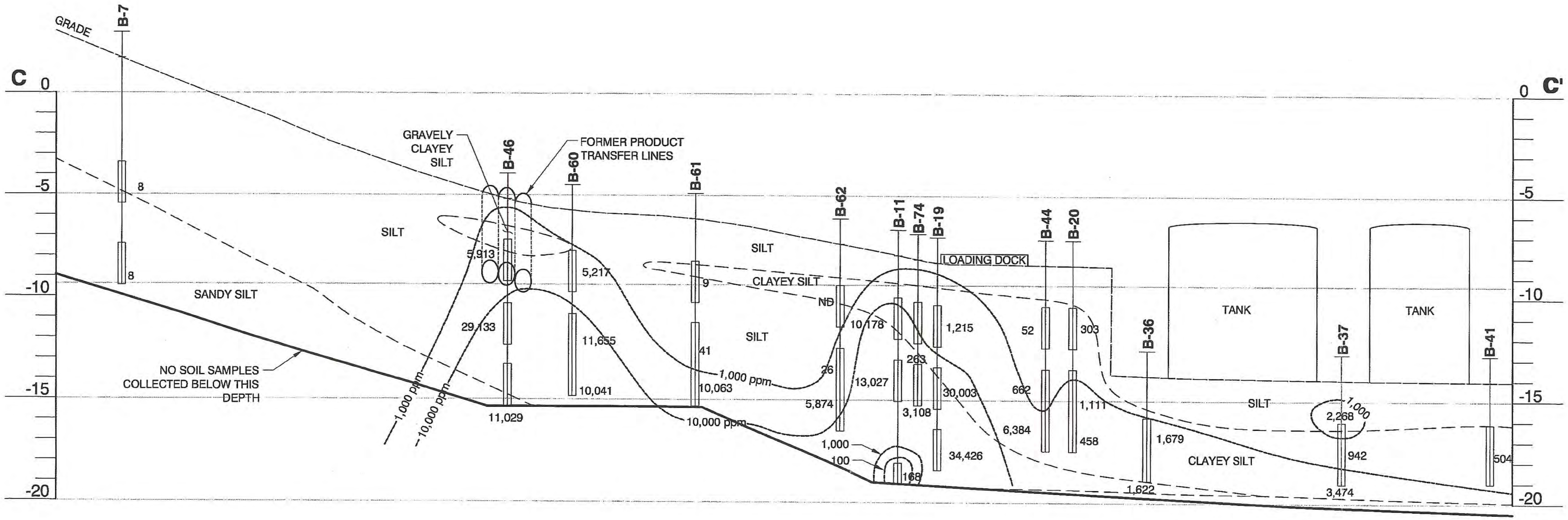
BUCKEYE PIPE LINE CO.
LIVERPOOL TERMINAL, NEW YORK

* HAND SIGNATURE ON FILE

CROSS SECTION LOCATION
C - C'

DATE:	FEB 2010	DRAWN BY:	BTW
DWG SCALE:	1"=30'	CHECKED BY:	JSC
PROJECT NO:	091-821		
APPROVED BY:			JRK*

DRAWING NO.: **24**
SHEET 1 OF 1



INFORMATION TAKEN FROM
LAND TECH REMEDIAL INC.
8 MARCH 1996

SCALE IN FEET
0 10 20

REVISION RECORD

NO	DATE	DESCRIPTION

Civil & Environmental Consultants, Inc.
8740 Orion Place, Suite 100 - Columbus, OH 43240
614-540-6633 · 888-598-6808
www.cecinc.com

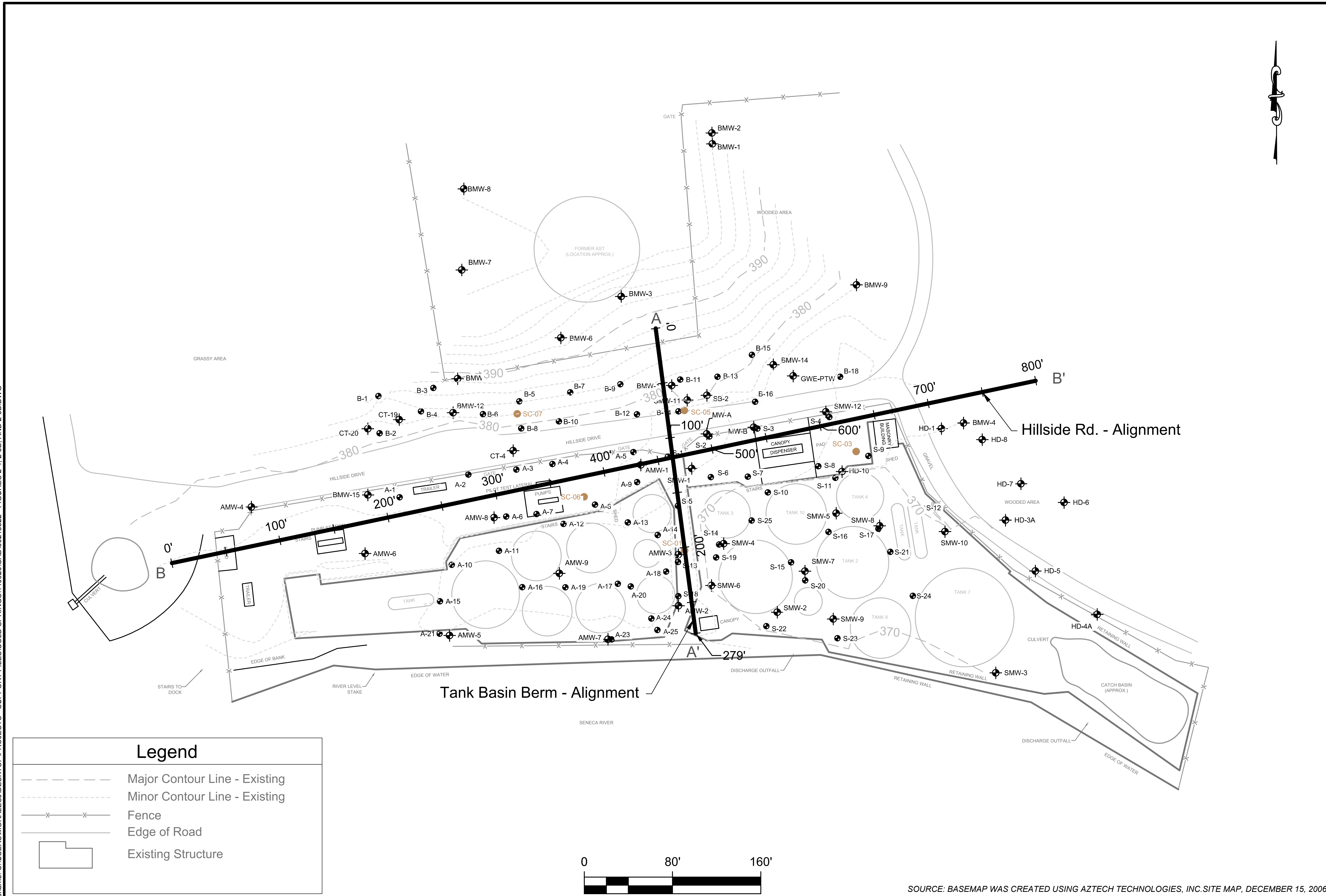
BUCKEYE PIPE LINE CO.
LIVERPOOL TERMINAL, NEW YORK

CROSS SECTION FROM LTR REPORT
C - C'

DATE:	FEB 2010	DRAWN BY:	BTW
DWG SCALE:	1"=10'	CHECKED BY:	JSC
PROJECT NO:	091-821		
APPROVED BY:	JRK*		

* HAND SIGNATURE ON FILE

DRAWING NO.:
25
SHEET 1 OF 1



AECOM

Figure: 2-4

CROSS SECTION LOCATIONS
COLD SPRINGS TERMINALS
SEPTEMBER 2014

COLD SPRINGS TERMINALS
LYSANDER (COLD SPRINGS), NY
NYSDEC SPILL NO. 89-09423 PIN NO. 99528
60248522

ANSI B 11" x 17" Approved: ____ Checked: ____ Designer: JM Project Management Initials:

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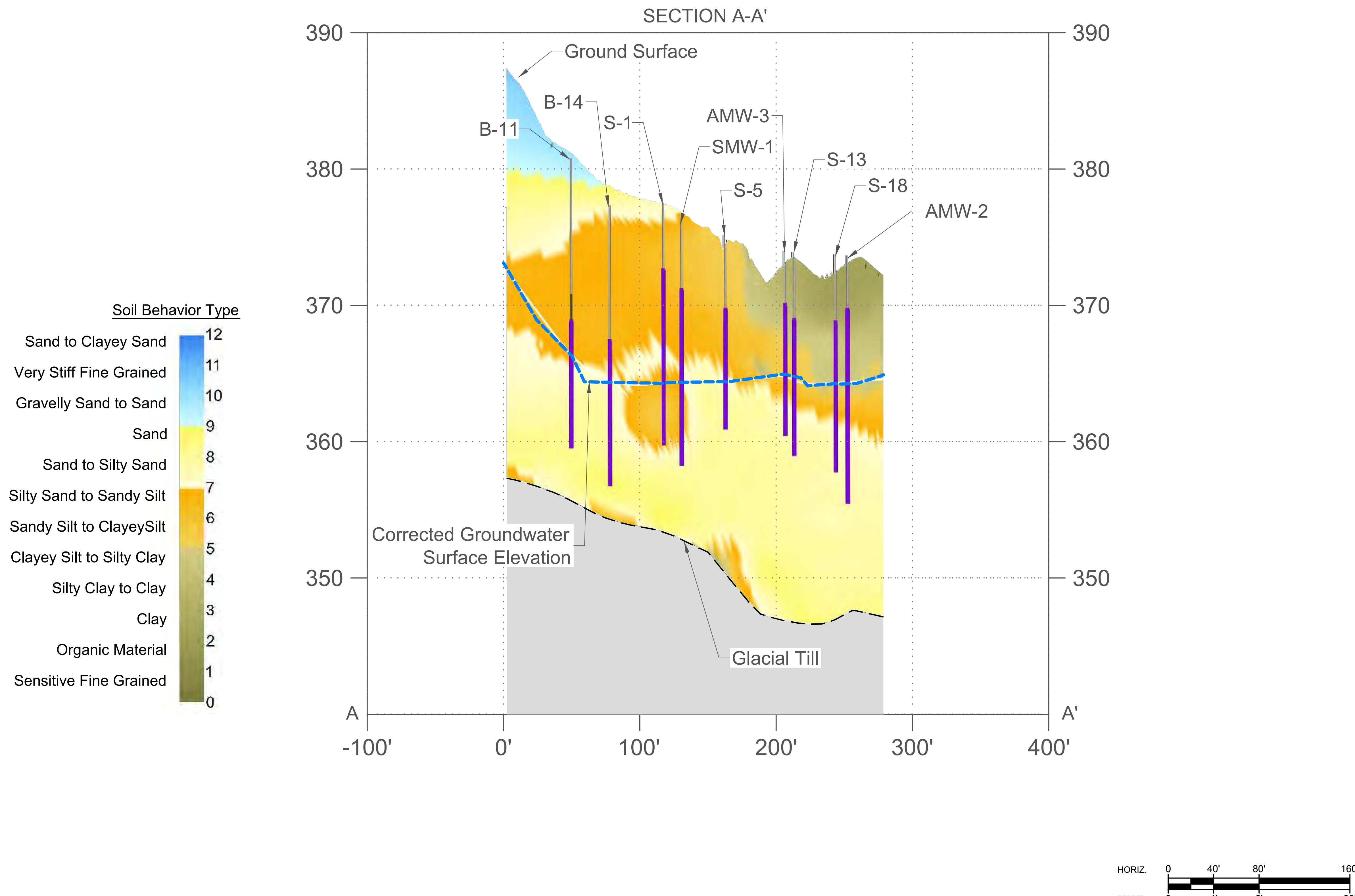
Filename: C:\USERS\MORALESJ\DESKTOP\PROJECTS - SUPPORT FILES\COLD SPRINGS\140920\CAD\60248522 - FIGURES 2-4, 2-5B, AND 2-6B.DWG



Notes:
1. Purple posts at monitoring well locations indicate the well screen interval.

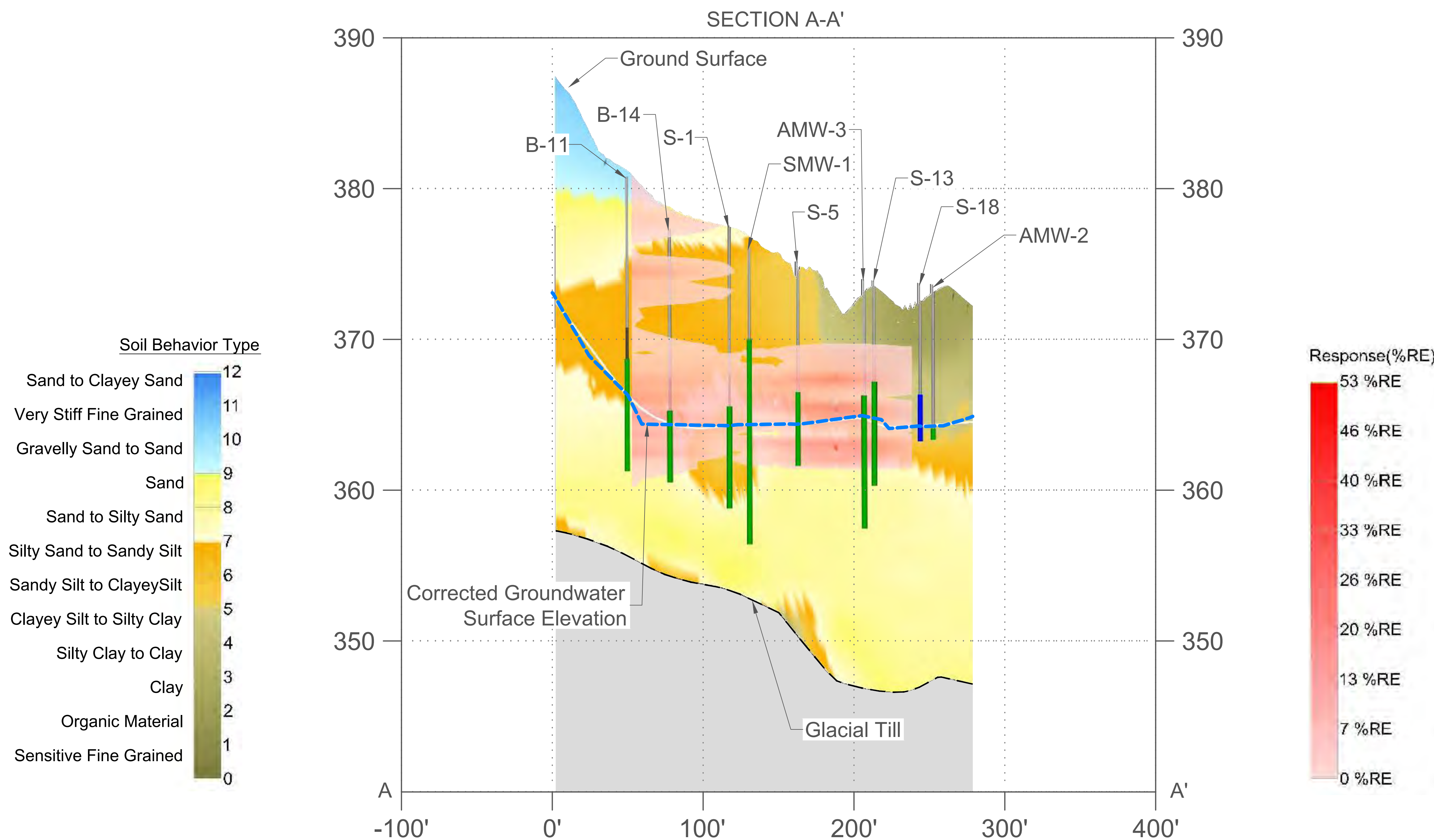
Corrected groundwater surface as measured in July 2013

AECOM

Figure: 2-5A

CROSS SECTION A-A' - TANK BASIN BERM
COLD SPRINGS TERMINALS
SEPTEMBER 2014

COLD SPRINGS TERMINALS
LYSANDER (COLD SPRINGS), NY
NYSDEC SPILL NO. 89-09423 PIN NO. 99528
60248522



Notes:

1. Green posts at monitoring well locations indicate that LNAPL has been historically detected at that well. The depth interval shown represents the historic high elevation of the air-LNAPL interface and the historic low elevation of the LNAPL-water interface.
2. Blue posts at monitoring well locations indicate that LNAPL has not been historically detected at that well. The depth interval shown represents the historic high and low groundwater potentiometric surface elevations.

%RE - Percent of Reference Emitter
Corrected groundwater surface as measured in July 2013

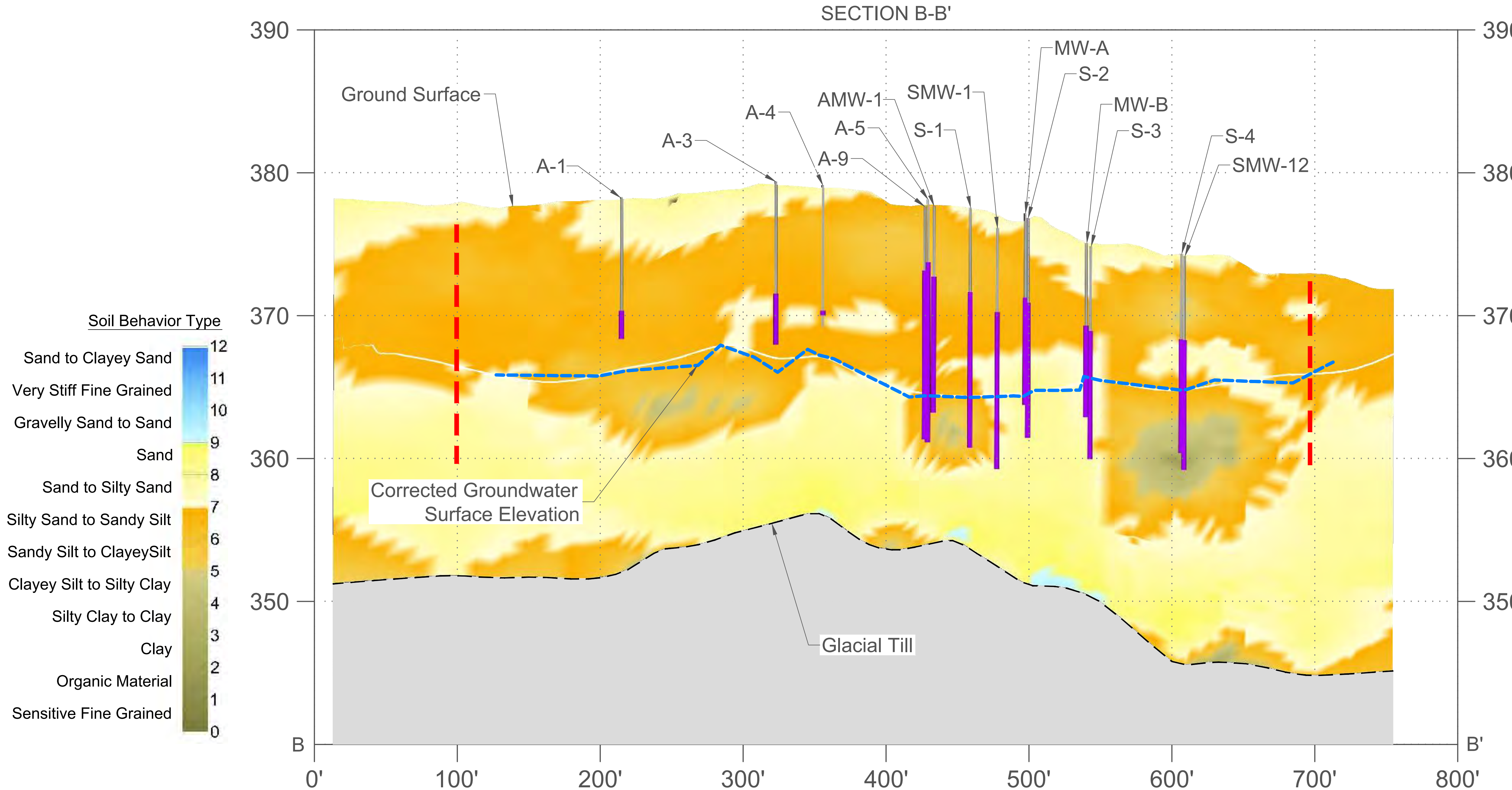
HORIZ. 0 40' 80' 160'
VERT. 0 4' 8' 80'

AECOM

Figure: 2-5B

CROSS SECTION A-A' - TANK BASIN BERM
COLD SPRINGS TERMINALS
SEPTEMBER 2014

COLD SPRINGS TERMINALS
LYSANDER (COLD SPRINGS), NY
NYSDEC SPILL NO. 89-09423 PIN NO. 99528
60248522



HORIZ. 0 40' 80' 160'
VERT. 0 4' 8' 80'

Notes:
1. Purple posts at monitoring well locations indicate the well screen interval.
2. Red dashed lines represent extent of LIF investigation.

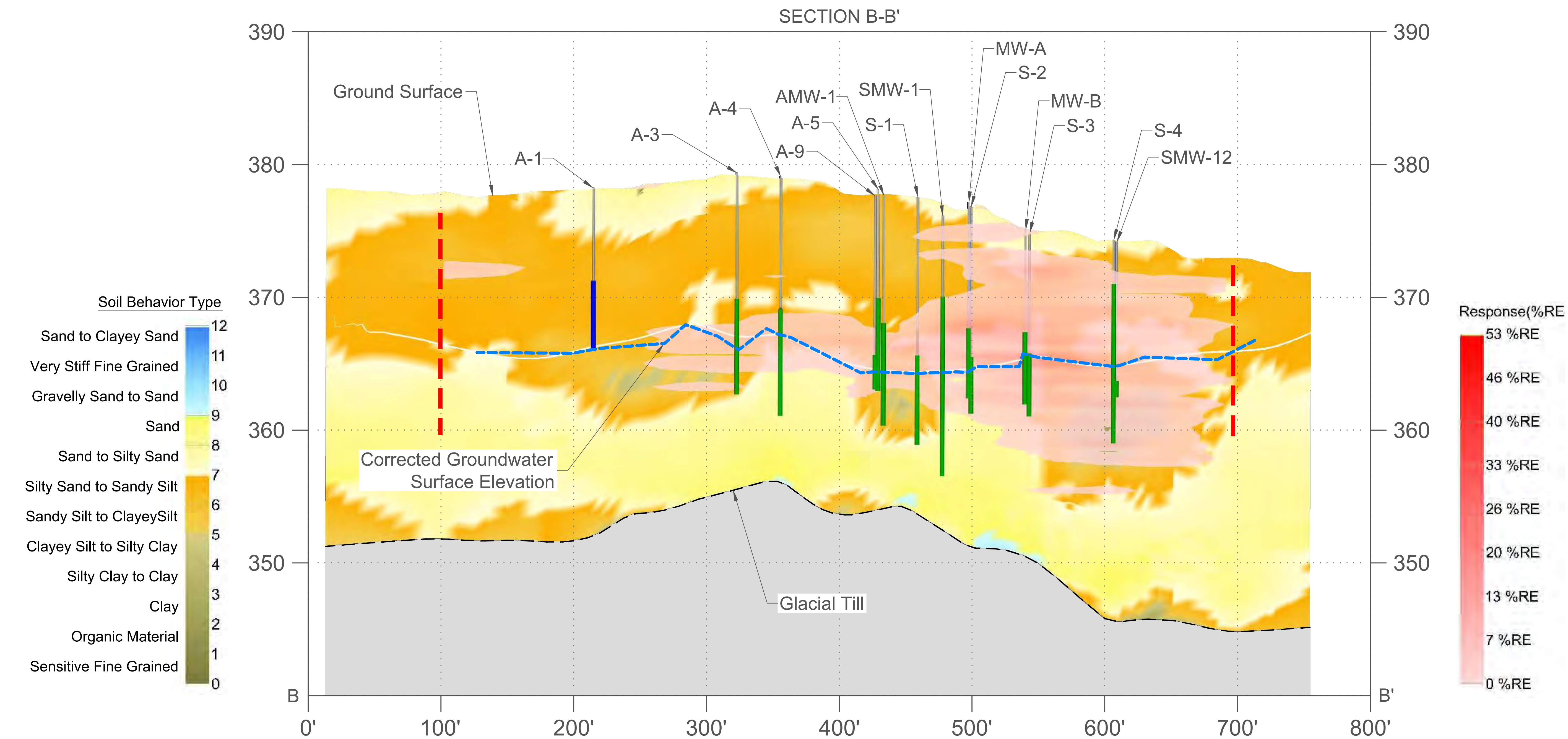
Corrected groundwater surface as measured in July 2013

Figure: 2-6A

CROSS SECTION B-B' - HILLSIDE ROAD
COLD SPRINGS TERMINALS
SEPTEMBER 2014

COLD SPRINGS TERMINALS
LYSANDER (COLD SPRINGS), NY
NYSDEC SPILL NO. 89-09423 PIN NO. 99528
60248522

Last saved by: MORALESJ(2014-09-22) Last Plotted: 2014-09-29
Filename: C:\USERS\MORALESJ\DESKTOP\PROJECTS - SUPPORT FILES\COLD SPRINGS\140920\CAD\60248522 - FIGURES 2-5A AND 2-6A.DWG
Project Management Initials: Designer: JM Checked: Approved: ANSI B 11" x 17"



Notes:

1. Green posts at monitoring well locations indicate that LNAPL has been historically detected at that well. The depth interval shown represents the historic high elevation of the air-LNAPL interface and the historic low elevation of the LNAPL-water interface.
2. Blue posts at monitoring well locations indicate that LNAPL has not been historically detected at that well. The depth interval shown represents the historic high and low groundwater potentiometric surface elevations.
3. Red dashed lines represent extent of LIF investigation. %RE values were not extrapolated beyond investigation extent.

%RE - Percent of Reference Emitter
Corrected groundwater surface as measured in July 2013

HORIZ. 0 40' 80' 160'
VERT. 0 4' 8' 80'

AECOM
Figure: 2-6B

CROSS SECTION B-B' - HILLSIDE ROAD
COLD SPRINGS TERMINALS
SEPTEMBER 2014

COLD SPRINGS TERMINALS
LYSANDER (COLD SPRINGS), NY
NYSDEC SPILL NO. 89-09423 PIN NO. 99528
60248522

ANSI B 11" x 17"
Approved:____
Checked:____
Designer: JM
Project Management Initials:
Last saved by: MORALESJ(2014-09-22) Last Plotted: 2014-09-29
Filename: C:\USERS\MORALESJ\DESKTOP\PROJECTS - SUPPORT FILES\COLD SPRINGS\140920\CAD\60248522 - FIGURES 2-4, 2-5B, AND 2-6B.DWG

Attachment 2

Skimmer System Operations and Maintenance Manual

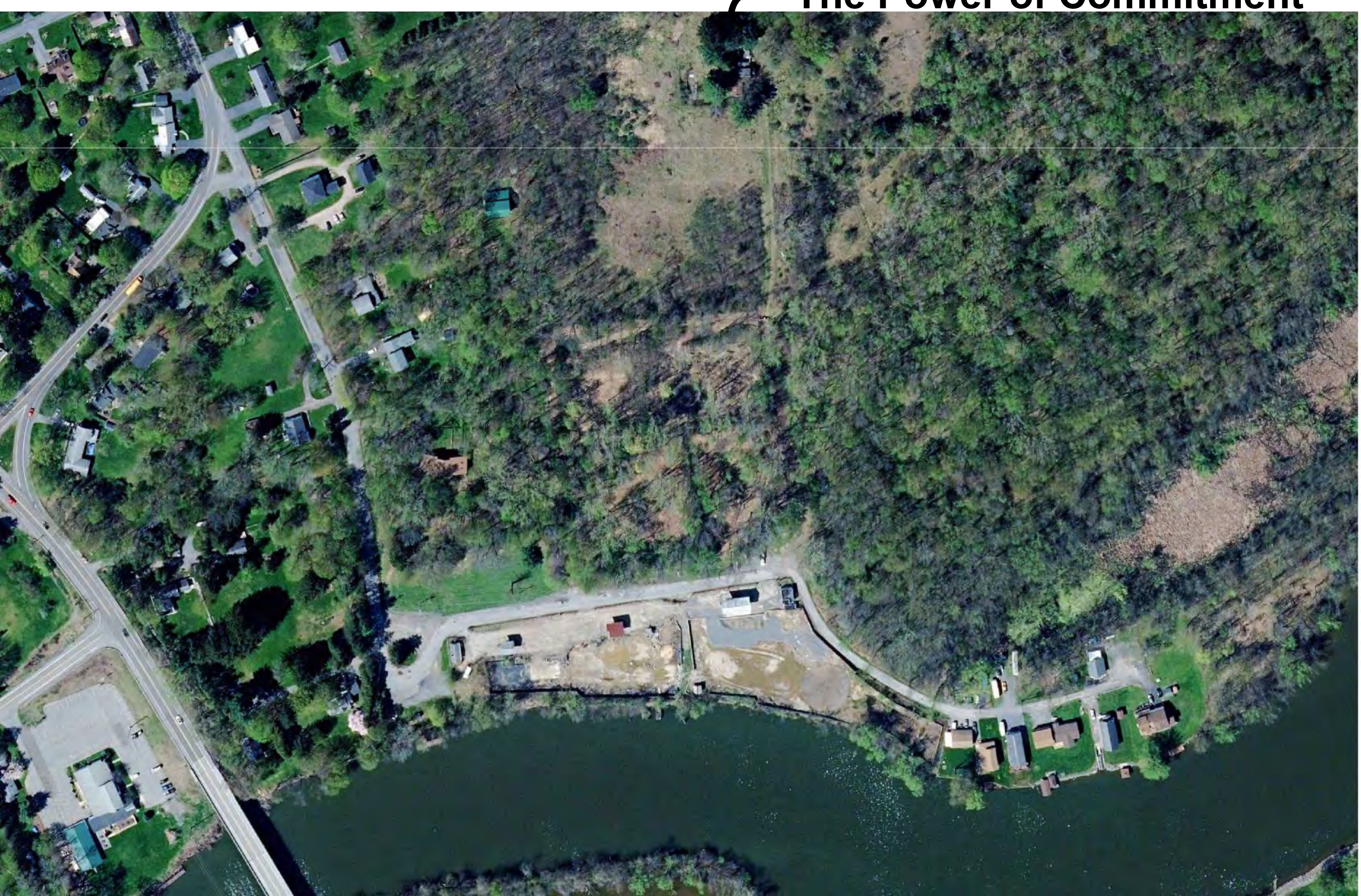
Cold Springs Terminal Site

NYSDEC Spill No. 89-04923, Skimmers Operations and Maintenance Manual

Cold Springs Settling Defendants Group

January 24, 2022

→ **The Power of Commitment**



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Printed date	1/24/2022 3:42:00 PM
Last saved date	January 24, 2022
File name	G:\Projects\564\11137172\Tech\Geotech Solar Sipper O&M\Rev1 Site Operation and Maintenance Plan.docx
Author	Dyson Sprouse
Project manager	Ian McNamara
Client name	Cold Springs Settling Defendants Group
Project name	Cold Springs Settling
Document title	Cold Springs Terminal Site | NYSDEC Spill No. 89-04923, Skimmers Operations and Maintenance Manual
Revision version	Rev [00]
Project number	11137172

Document status

Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date

Contents

Figure Index

Attachments

1. Introduction

1.1 Purpose

The purpose of this document is to outline the operations and maintenance requirements for the light non-aqueous phase liquid (LNAPL) solar-powered skimmer systems installed at the Cold Springs Terminal Site located along Hillside Road, Lysander, Onondaga County, New York (the 'Site', Figure 1). The skimmer systems were installed and are being operated as described in the Remedial Action Work Plan (GHD, September 2021 and Revised January 2022).

The Site is currently being remediated using three (3) solar-powered skimmer units purchased from Geotech Environmental Equipment, Inc. (Geotech). Each skimmer unit consists of a control panel (Geotech Solar Sipper Controller, Part #16550176) and 2-inch diameter skimmer assemblies and pumps (Geotech Pump and Skimmer Assembly, Part #16550181) installed in Site wells to recover LNAPL from the subsurface. Each skimmer unit control panel is housed in its own wooden shed, which also contain separate 55-gallon steel collection drums for each of the wells connected to the skimmer unit. The dedicated collection drums are within a secondary containment structure and allow LNAPL recovery effectiveness to be monitored for each well independently. An extra containment drum is included in each shed in case a swap-out is needed, an extra skimmer unit is connected, or to contain manually recovered LNAPL until disposed off-Site. At the time of initial startup of the system:

- Unit 1 (westernmost shed) is connected to wells A10, AMW5, RW-1, and MW-1S
- Unit 2 (central shed) is connected to wells RW-3 and MW-2S (A13 and A14 were to be connected, but the wells were damaged such that the skimmer assemblies could not be placed in the wells)
- Unit 3 (easternmost shed) is connected to wells RW-4, MW-5SR, MW-7S, and RW-5.

The following figures are included in this O&M manual for reference, and will be updated as applicable as remedial actions progress:

- Figure 2 shows the Site layout and which wells are connected to each skimmer system at the time of startup.
- Figure 3 depicts the inferred groundwater contours and flow direction based on information obtained during the December 2019 gauging event.
- Figure 4 shows the inferred extents of LNAPL in the subsurface based on measurements from December 2019 (remedial action "baseline" conditions)
- Figure 5 shows the inferred extents of LNAPL in the subsurface based on measurements from August 2021 (at completion of the remedial action pilot test)
- Figure 6 provides a summary of observations from all the LNAPL gauging events performed at the Site between December 2019 and August 2021.
- Figure 7 provides a schematic of the remedial system components.

2. Site Monitoring and Maintenance

2.1 Site Activities

Site activities include: weekly drum measurements to track LNAPL recovery effectiveness; weekly system component checks; monthly skimmer assembly checks; and monthly well gauging events to characterize LNAPL thickness across the Site, record groundwater elevation fluctuations, and manually recover LNAPL in wells not connected to the skimmer systems. The activities and applicable data recording forms are outlined in the table below:

Item	Description	Frequency	Form
Drum Measurements	Interface probe measurements in each dedicated drum for Units 1, 2, and 3 to determine thickness of LNAPL and thickness of water, which is used to calculate volumes recovered	Weekly	LNAPL Recovery Log (Attachment 1)
System Component Inspection	Visual inspection of above grade system components for each of the skimmer units	Weekly	LNAPL Recovery System Inspection Checklist (Attachment 2)
Site-Wide Well Gauging	Gauging of each accessible on-Site well using an interface probe to track LNAPL presence and groundwater elevations	Monthly	LNAPL Investigation Record (Attachment 3)
Skimmer Assembly Inspection	Visual inspection and cleaning of down-well skimmer system components and adjustment of skimmer intake height settings	Monthly	LNAPL Recovery Log and LNAPL Recovery System Inspection Checklist (Attachment 1 and Attachment 2)
Manual LNAPL Recovery	Following Site-wide well gauging event – If thickness of LNAPL measured meets the following minimum criteria: • 2" well = 0.5' LNAPL • 4" or 6" well = 0.25' LNAPL Manually pump out LNAPL using peristaltic pump into 5-gallon bucket and transport to spare 55-gallon drum in sheds	Monthly	LNAPL Investigation Record (Attachment 3)
Drum Vacuuming	Vacuum truck recovery of LNAPL stored in 55-gallon drums for off-Site transport and disposal	As needed – Drums not to exceed 80% capacity	LNAPL Recovery Log (Attachment 1)

3. Installation, Operation, and Maintenance

System components are provided by Geotech as pre-assembled units. The skimmer assemblies, consisting of a skimmer and pump, are installed into the selected wells at the required depths and connected to the control panels mounted in the sheds via two tubing runs. One tubing run provides vacuum and pressure to the assembly and the other tubing run directs LNAPL from the pump to the corresponding dedicated 55-gallon discharge drum. Another tubing run inside the sheds connects two desiccant air dryers, connected in series, to the control panel's air compressor inlet port. Power for the system is provided via a roof-mounted solar panel and deep cycle battery located within each shed. A generalized system schematic is shown on Figure 7. The Geotech Sipper Installation and Operation Manual is included in Attachment 4 and includes system specifications, parts lists, and system troubleshooting guidance. The general operation and maintenance of the skimmer system is summarized in the following sections.

3.1 Skimmer Installation

The depth of skimmer placement is based on the measured depth to the LNAPL/water interface at the time of assembly installation. Deployment depth is adjustable by utilizing a compression fitting in the pre-fabricated well cap provided with the assemblies, which grabs onto the tubing and suspends the skimmer assembly intake screen at the desired depth. To place the skimmers:

1. Measure and record the depth to product and depth to water
2. Run the air and discharge lines through the well cap and securely attached to their corresponding fittings at the top of the pump housing
3. Place the skimmer intake screen at the approximate midpoint of its travel, measure from there to the well cap, and set the distance to be equal to the measured LNAPL/water interface recorded previously
4. Condition the intake screen with similar product as that anticipated to be recovered
5. Lower the assembly into the well and place the well cap over the riser pipe.

Once the skimmers are installed into the wells, extend the tubing runs to the control panels in the system shed. Connect the air tubing to the appropriate fitting on the control panel and connect the discharge tubing to the well's dedicated discharge drum, which have been placed inside a secondary containment structure in case of accidental releases. Confirm the passive vent piping and discharge are clear to allow the drums to be vented to the exterior of the shed to prevent accumulation of vapors. Confirm that the drums are properly grounded. Finally, connect the drum's tank full probe to the corresponding location on the system's control panel.

Once all connections are made and verified, the skimmer assemblies can undergo initial startup. Appropriate vacuum and pressure settings should be approximated based on information contained in the manuals provided with the equipment (Attachment 4). As the systems begin to operate, all tubing runs need to be inspected for leaks. The initial set points will likely need to be adjusted over time based on observed recovery of LNAPL.

3.2 Skimmer Operation, Adjustment, and Maintenance

3.2.1 Weekly Inspections

During the weekly skimmer system inspections, the following procedures must be implemented and recorded on the form included as Attachments 1 and 2 to this manual:

1. Inspect Site fence, access gate, and sheds for evidence of unwanted tampering
2. Inspect air tubing close to the well cap to ensure no product is present. If product is observed in the air tubing:
    a. pull the skimmer assembly from the well

b. disconnect the air tubing at its connection to the pump
c. use the control panel to set the pump vacuum to 0 seconds and the discharge to 60 seconds
d. run the pump cycle for the disconnected well only to force product out of the tubing, being sure to catch in a container
e. repeat the discharge cycle for the pump until all product is forced out of the tubing
f. check the vacuum/pressure solenoid for correct operation, repair in accordance with the manual if necessary
g. reduce vacuum time for the pump from its previous setting
h. reconnect the air tubing to the pump
i. reinstall the skimmer assembly in the well and restart.

3. Inspect tubing runs from well caps to control panel or discharge drum for evidence of cracks or leaks and repair or replace as needed
4. Measure and record amount of LNAPL and water accumulated in the drums
5. Check remaining capacity of desiccant in the air dryer vessels and replace if needed
6. Check control panel for active faults
7. Inspect drum vents to ensure no blockages and clear as appropriate
8. Inspect solar panel to ensure no accumulated debris and clean as necessary
9. Inspect connections to deep cycle battery.

Refer to the system operation documentation provided by Geotech and included as Attachment 4 to this manual for more detailed information on the above maintenance activities, as appropriate.

3.2.2 Monthly Well Gauging

A monitoring well gauging event will occur once a month, at a minimum, at all accessible monitoring wells. Prior to commencing the gauging event, skimmer assemblies installed in 2-inch diameter wells must be removed and placed next to the well in 5-gallon buckets to contain potential petroleum product releases. This will allow sufficient time for the water levels in the well to return to static conditions following skimmer removal and prior to gauging. Skimmer assemblies installed in 4- or 6-inch diameter wells can remain in the wells during the gauging event. For these wells, simply remove the well cap and set off to the side on top of the riser pipe such that the interface probe can pass.

The gauging events will include measuring and recording the depth to LNAPL (if present) and the depth to water in each of the accessible Site wells. Periodically, if determined to be necessary, the total depth of each well will also be measured and recorded. Observations are to be recorded on the LNAPL Investigation Record form included as Attachment 3 to this manual.

3.2.3 Monthly Skimmer Assembly Inspections

Following each monthly gauging event, the following procedures to inspect, clean, and adjust skimmer assemblies must be implemented and recorded on the forms included as Attachment 1 and 2 to this manual:

1. Inspect the skimmer assembly's intake screen for accumulated debris or damage and clean as appropriate
2. Inspect tubing and connections on intake assembly and pump for signs of deterioration and replace as needed
3. Adjust the pump and skimmer assembly so that the midpoint of the intake float travel is situated at the level of the LNAPL/water interface measured
4. Place the pump and Skimmer assembly back into the well.

For additional information reference the Geotech Pump and Skimmer Assembly Manual (Attachment 4).

3.2.4 Monthly Manual LNAPL Recovery

Manual LNAPL recovery will be performed as necessary following the monthly Site-wide gauging events. If observations of the gauging event identify the presence of sufficient LNAPL (i.e., greater than 0.5 feet in a 2-inch diameter well or greater than 0.25-feet in a 4- or 6-inch diameter well), it will be manually recovered. Information is to be recorded on the form included in Attachment 3.

Polyethylene tubing will be lowered down the well to the LNAPL surface and LNAPL will be pumped into 5-gallon buckets using a peristaltic pump. Recovery will continue until the LNAPL is drawn off and water begins to be recovered. The recovered LNAPL will be containerized in a steel 55-gallon drum located in a system shed that does not have a skimmer assembly discharging to it.

If manually recover events routinely show recoverable thicknesses of LNAPL in a well, and if there is capacity of an adjacent skimmer control panel, it will be determined whether or not it is warranted to install a skimmer assembly in the well. If a skimmer is installed, the procedures outlined in Section 3.1 will be followed.

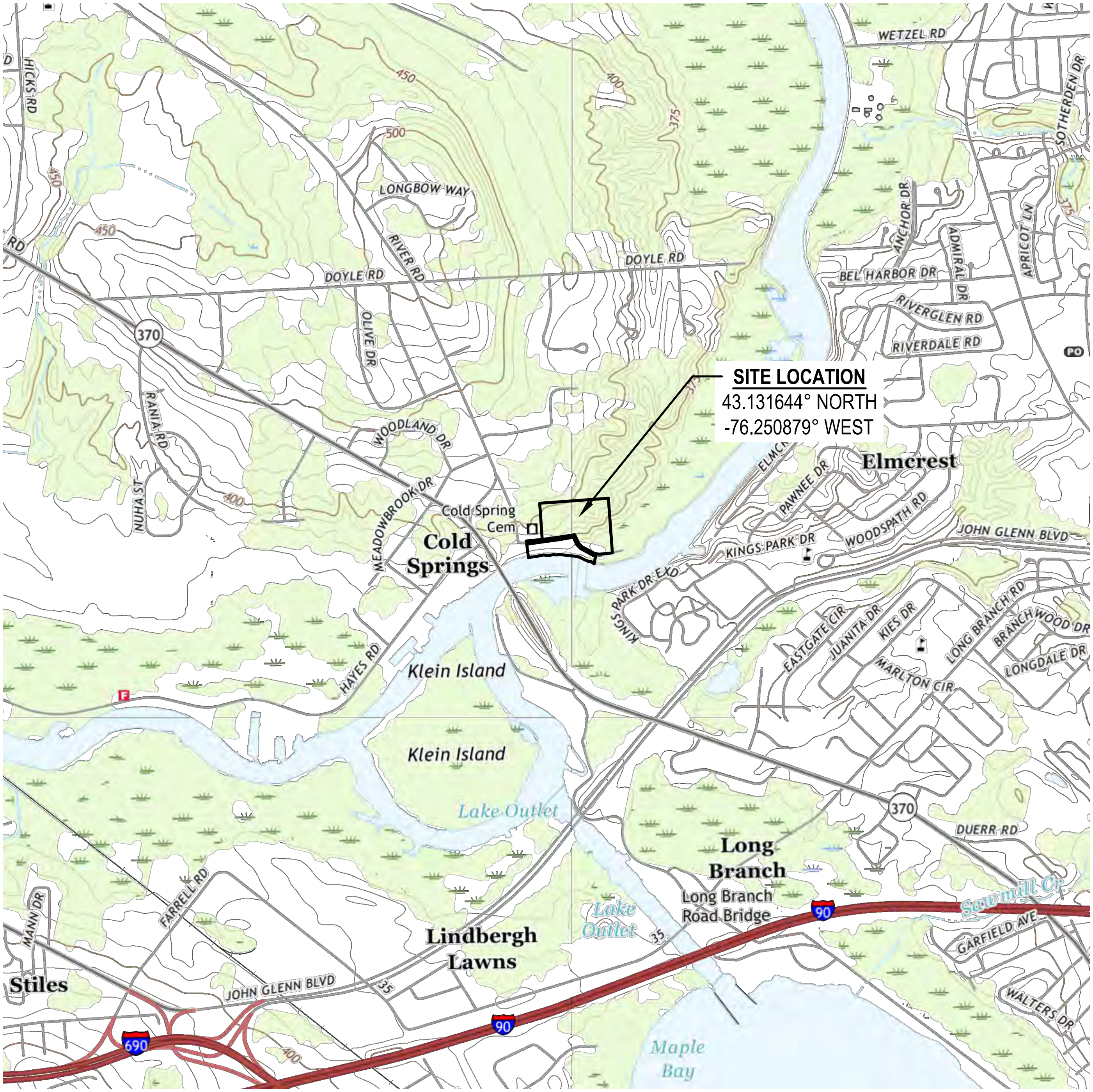
3.2.5 Drum Vacuuming and Disposal

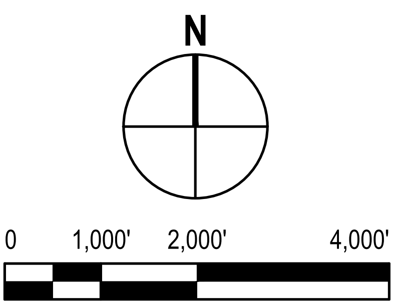
As needed, the discharge drums will be vacuumed out and the LNAPL and water will be transported off-Site for disposal at a permitted facility. Disposal events will occur such that accumulation in the drums is not allowed to exceed 80% of the drum’s capacity, whenever possible.

On the day of the vacuum event:

1. the amount of LNAPL and water contained in the drums must be measured and recorded on the form included as Attachment 1 to this manual (also need to note that the recordings are associated with a drum emptying event)
2. the control panel must be paused to disable the skimmers (use the left arrow on the panel to go back to the main menu)
3. the product discharge lines and vent pipes must be disconnected
4. the lids of the drums must be removed so the vacuum truck hose can be placed into the drum to recover the liquid
5. the vacuum truck will empty each drum, at which point the lids will be replaced and the tubing runs will be reconnected
6. following reconnection of system components, the skimmers can be reactivated by using the control panels
7. confirmation of successful skimmer restart should be recorded on Attachment 1 prior to leaving Site.
8. obtain disposal documentation for each event for the file and periodic reporting.

Figures





CONTOUR INTERVALS: 5 FEET AND 10 FEET

MAPS TAKEN FROM: USGS 7.5 MINUTE SERIES TOPOGRAPHIC QUADRANGLES: BALDWINSVILLE, NY (2019), BREWERTON, NY (2019), CAMILLUS, NY (2019), AND SYRACUSE WEST, NY (2019) (U.S. GEOLOGICAL SURVEY WEBSITE)

GHD

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

SITE LOCATION MAP

Project No. **11137172**
Report No. **-**
Date **JAN 22**

FIGURE 1

Filename: G:\Projects\564\11137172\Tech\Geotech Solar Sipper O&M\Figures\11137172 - Figure 1.dwg
Plot Date: 20 January 2022 - 10:47 AM

LEGEND

- PRE-EXISTING SOUTHERN TERMINALS MONITORING WELL LOCATION
- NESTED SOUTHERN TERMINALS MONITORING WELL LOCATION (INSTALLED NOVEMBER 2019)
- SOUTHERN TERMINALS LNAPL RECOVERY WELL LOCATION (INSTALLED NOVEMBER 2019)
- ADDITIONAL SOUTHERN TERMINALS MONITORING WELL LOCATION (INSTALLED MAY 2020)
- PRE-EXISTING NORTHERN TERMINALS MONITORING WELL
- SIGNIFICANTLY DAMAGED MONITORING WELL - CANNOT BE GAUGED
- DECOMMISSIONED MONITORING WELL (MARCH 2020)
- ACCESS ROADS
- SKIMMER CONTROL PANEL SHED LOCATIONS
- WELLS CONNECTED TO SKIMMER CONTROL PANELS

N

0 100'

GHD

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

SITE LAYOUT AND INITIAL STARTUP SKIMMER LOCATIONS

Project No. 11137172
Report No. -
Date JAN 22

FIGURE 2

Filename: G:\Projects\564\11137172\Tech\Geotech Solar Sipper O&M\Figures\11137172 - Figure 2.dwg
Plot Date: 20 January 2022 - 11:04 AM

LEGEND

- PRE-EXISTING SOUTHERN TERMINALS MONITORING WELL LOCATION
- NESTED SOUTHERN TERMINALS MONITORING WELL LOCATION (INSTALLED NOVEMBER 2019)
- SOUTHERN TERMINALS LNAPL RECOVERY WELL LOCATION (INSTALLED NOVEMBER 2019)
- ADDITIONAL SOUTHERN TERMINALS MONITORING WELL LOCATION (INSTALLED MAY 2020)
- PRE-EXISTING NORTHERN TERMINALS MONITORING WELL
- MONITORING WELL NOT GAUGED (DECEMBER 2019)
- DECOMMISSIONED MONITORING WELL (MARCH 2020)
- 364.42 GROUNDWATER ELEVATION
- 390 MAJOR GROUNDWATER CONTOUR
- 392 MINOR GROUNDWATER CONTOUR

NOTES:

1. WELLS WITHOUT A GROUNDWATER ELEVATION WERE NOT ABLE TO BE LOCATED OR ACCESSED, OR WERE NOT INSTALLED AT THE TIME, AND WERE NOT GAUGED.
2. MONITORING WELLS MW-5SR, MW-5DR, MW-8S, MW-8D, MW-11S, MW-11SR, MW-11D, MW-12S, MW-12D, MW-13S, MW-13D, MW-14, AND MW-15 WERE NOT INSTALLED AT THE TIME OF THE DECEMBER 2019 GAUGING EVENT.

NOTES

1. GROUNDWATER ELEVATIONS CORRECTED FOR LNAPL PRESENCE ON TOP OF THE GROUNDWATER TABLE :
   CORRECTED GROUNDWATER ELEVATION = ELEVATION + (LNAPL DENSITY [0.79] X LNAPL THICKNESS)
2. GROUNDWATER ELEVATIONS FROM DEEP WELLS NOT SHOWN OR INCLUDED IN CONTOURING

N

0 100'

GHD

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

GROUNDWATER CONTOURS AND INFERRED FLOW DIRECTION (DECEMBER 2019)

Project No. 11137172
Report No. -
Date JAN 22

FIGURE 3

Filename: G:\Projects\564\11137172\Tech\Geotech Solar Sipper O&M\Figures\11137172 - Figure 3.dwg
Plot Date: 20 January 2022 - 12:48 PM

LEGEND

- PRE-EXISTING SOUTHERN TERMINALS MONITORING WELL LOCATION
- NESTED SOUTHERN TERMINALS MONITORING WELL LOCATION (INSTALLED NOVEMBER 2019)
- SOUTHERN TERMINALS LNAPL RECOVERY WELL LOCATION (INSTALLED NOVEMBER 2019)
- ADDITIONAL SOUTHERN TERMINALS MONITORING WELL LOCATION (INSTALLED MAY 2020)
- PRE-EXISTING NORTHERN TERMINALS MONITORING WELL
- MONITORING WELL NOT GAUGED DURING DECEMBER 2019 EVENT
- DECOMMISSIONED MONITORING WELL (MARCH 2020)
- 1.09 APPARENT LNAPL THICKNESS (DECEMBER 2019)
- NML NO MEASURABLE APPARENT LNAPL THICKNESS (DECEMBER 2019)

NOTES:

1. WELLS WITHOUT AN APPARENT LNAPL THICKNESS OR "NML" DESIGNATION WERE NOT ABLE TO BE LOCATED OR ACCESSED, OR WERE NOT INSTALLED AT THE TIME, AND WERE NOT GAUGED.
2. MONITORING WELLS MW-5SR, MW-5DR, MW-8S, MW-8D, MW-11S, MW-11SR, MW-11D, MW-12S, MW-12D, MW-13S, MW-13D, MW-14, AND MW-15 WERE NOT INSTALLED AT THE TIME OF THE DECEMBER 2019 GAUGING EVENT.

APPARENT LNAPL THICKNESS IN FEET

0-1	3-4
1-2	4-5
2-3	5+

N

0 100'

GHD

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

APPARENT LNAPL THICKNESS
DECEMBER 2019

Project No. 11137172
Report No. -
Date JAN 2022

FIGURE 4

Filename: G:\Projects\564\11137172\Tech\Geotech Solar Sipper O&M\Figures\11137172 - Figure 4 Apparent LNAPL Thickness - December 2019.dwg
Plot Date: 20 January 2022 - 11:11 AM

APPARENT LNAPL THICKNESS IN FEET

0-1	3-4
1-2	4-5
2-3	5+

N

0 100'

GHD

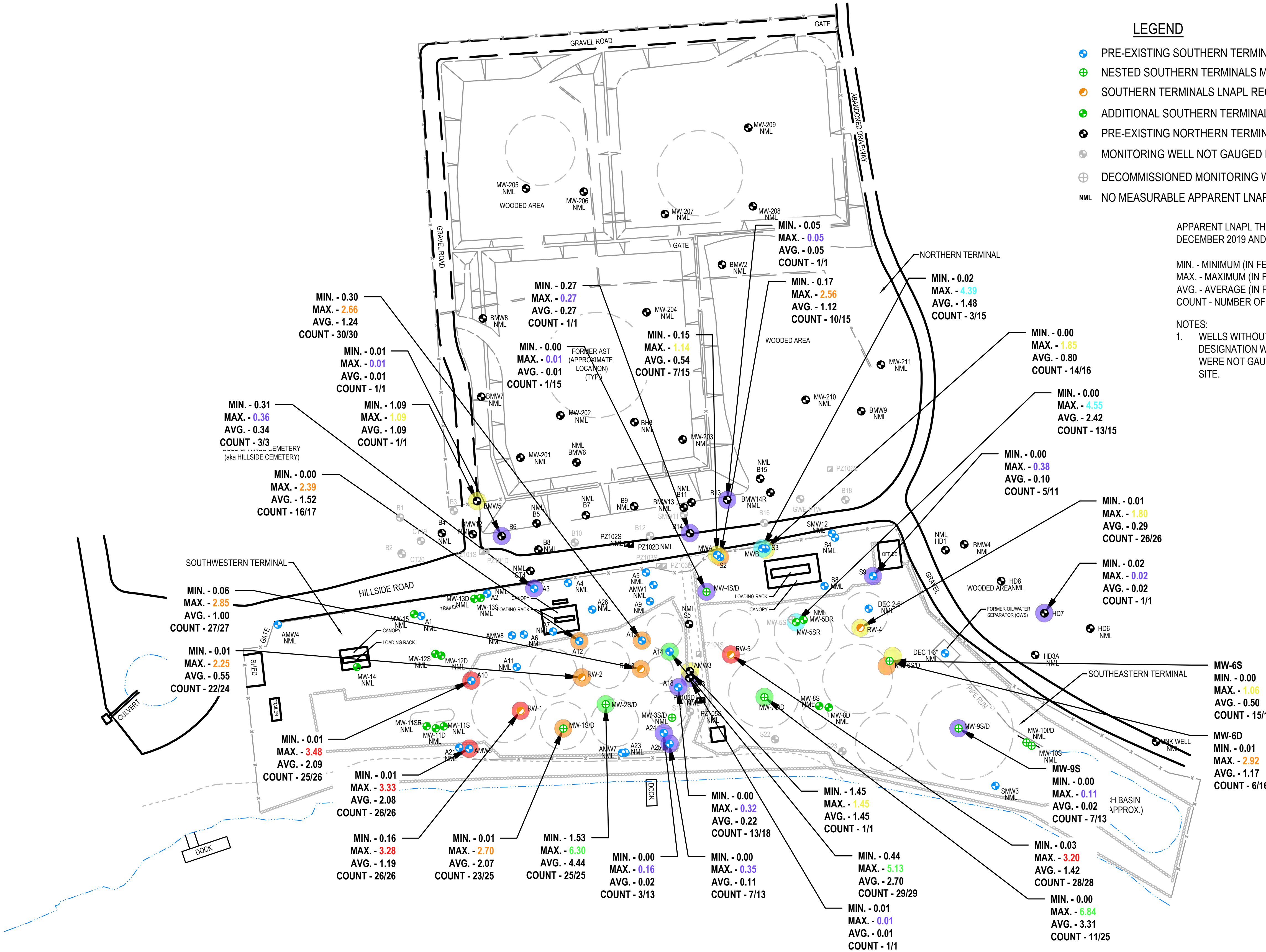
SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

APPARENT LNAPL THICKNESS
AUGUST 2021

Project No. 11137172
Report No. -
Date JAN 2022

FIGURE 5

Filename: G:\Projects\564\11137172\Tech\Geotech Solar Sipper O&M\Figures\11137172 - Figure 5 Apparent LNAPL Thickness - August 2021.dwg
Plot Date: 20 January 2022 - 11:13 AM



LEGEND

- PRE-EXISTING SOUTHERN TERMINALS MONITORING WELL LOCATION
- NESTED SOUTHERN TERMINALS MONITORING WELL LOCATION (INSTALLED NOVEMBER 2019)
- SOUTHERN TERMINALS LNAPL RECOVERY WELL LOCATION (INSTALLED NOVEMBER 2019)
- ADDITIONAL SOUTHERN TERMINALS MONITORING WELL LOCATION (INSTALLED MAY 2020)
- PRE-EXISTING NORTHERN TERMINALS MONITORING WELL
- MONITORING WELL NOT GAUGED DURING ANY EVENT
- DECOMMISSIONED MONITORING WELL (MARCH 2020)
- NML NO MEASURABLE APPARENT LNAPL THICKNESS (DURING ANY GAUGING EVENT)

APPARENT LNAPL THICKNESSES MEASURED BETWEEN DECEMBER 2019 AND AUGUST 2021

MIN. - MINIMUM (IN FEET)
MAX. - MAXIMUM (IN FEET)
AVG. - AVERAGE (IN FEET)
COUNT - NUMBER OF TIMES LNAPL PRESENT / NUMBER OF TIMES WELL GAUGED

NOTES:

1. WELLS WITHOUT AN APPARENT LNAPL THICKNESS SUMMARY OR "NML" DESIGNATION WERE NOT ABLE TO BE LOCATED OR ACCESSED AND WERE NOT GAUGED DURING ANY GAUGING EVENT PERFORMED AT THE SITE.

APPARENT MAXIMUM LNAPL THICKNESS IN FEET

0-1	3-4
1-2	4-5
2-3	5+

N

0 100'

GHD

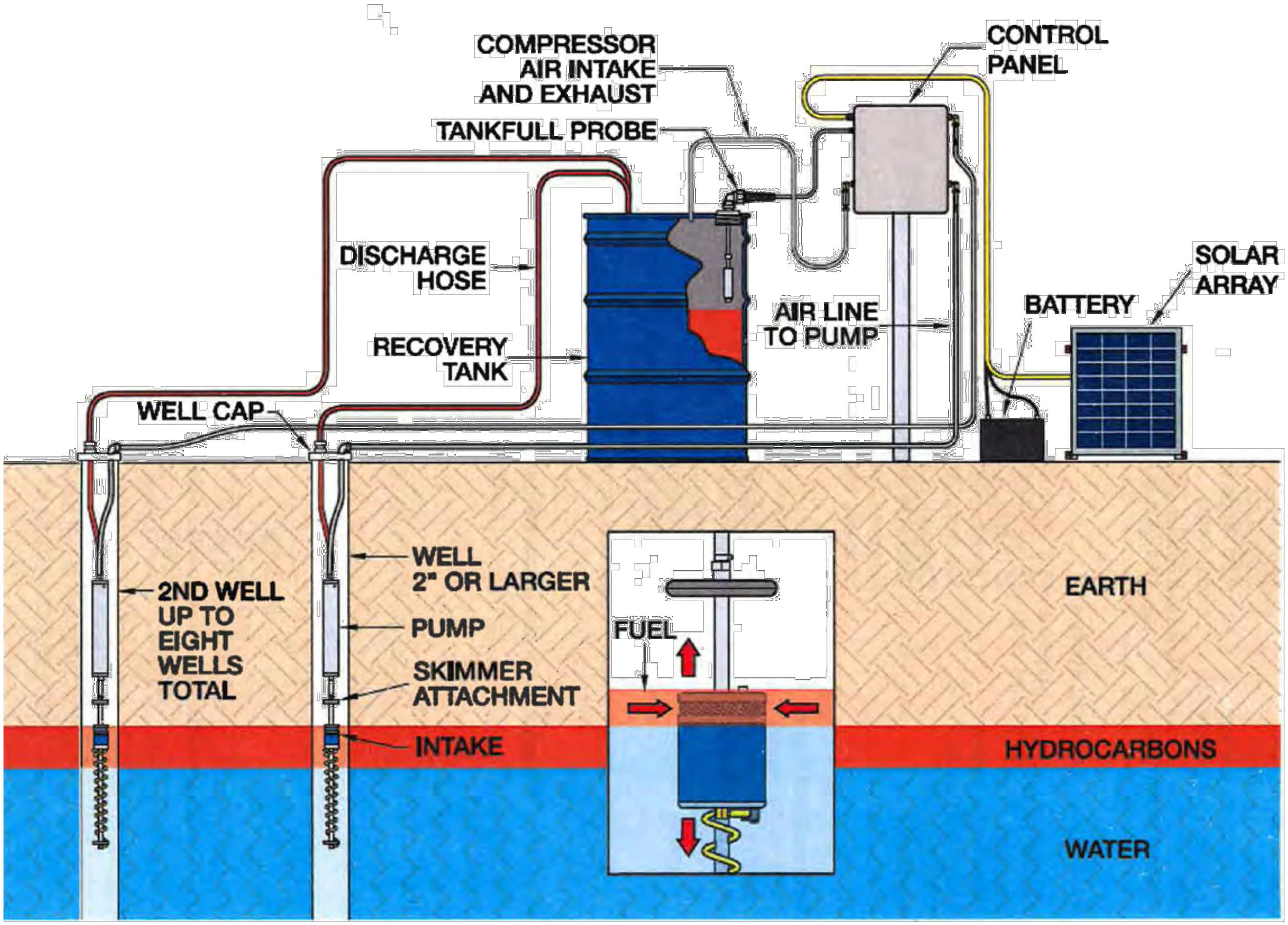
SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

APPARENT LNAPL THICKNESS SUMMARY (DECEMBER 2019 TO AUGUST 2021)

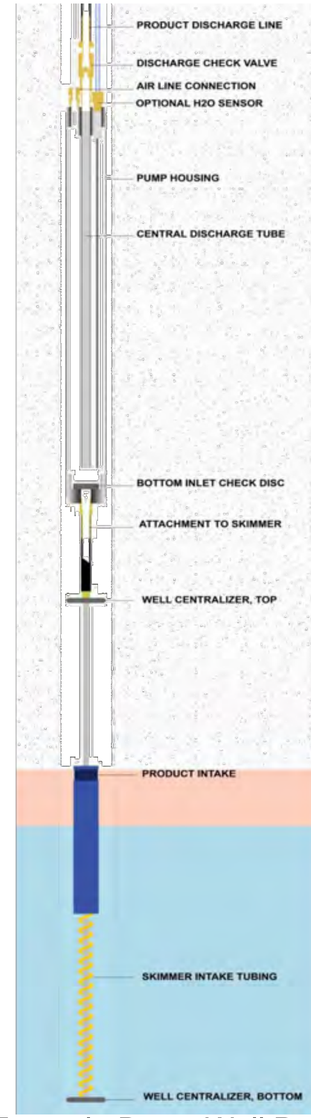
Project No. 11137172
Report No. -
Date JAN 2022

FIGURE 6

Filename: G:\Projects\564\11137172\Tech\Geotech Solar Sipper O&M\Figures\11137172 - Figure 6 Apparent LNAPL Thickness - Overall MAX.dwg
Plot Date: 20 January 2022 - 11:16 AM



Generic Solar Sipper Schematic



Example Down Well Pump and Skimmer Assembly

NOTES:

1. Schematics provided by Geotech and are representative of typical equipment setup.

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINAL SITE
HILLSIDE ROAD, LYSANDER, NEW YORK

SKIMMER SCHEMATICS

Project No. **11137172**
Report No. **-**
Date **JAN 22**

FIGURE 7

Filename: G:\Projects\564\11137172\Tech\Geotech Solar Sipper O&M\Figures\11137172 - Figure 7.dwg
Plot Date: 20 January 2022 - 11:26 AM

Attachments

Attachment 1

LNAPL Recovery Log

LNAPL RECOVERY LOG

Well ID Unit #

Date	Measurements Within Drum									Controller and Skimmer Settings				
	Depth to Product	Depth to Water	Depth to Bottom	Thickness of Product	Amount of Product*	Amount of Product this Round**	Thickness of Water	Amount of Water*	Amount of Water this Round**	Vacuum Duration	Pressure Duration	Cycle Delay	Pump Intake Depth	Pump Travel Set-Point
	(feet below top of inlet piping)			(feet)	(gallons)	(gallons)	(feet)	(gallons)	(gallons)	(seconds)	(seconds)	(hours)	(feet)	

* - Amount of product/water is calculated as: 0.20 gallons of product/water per 0.01 feet of product/water within drum
** - Amount of product/water this round is calculated as the total amount minus the total amount from the previous recording. Make note of Vac events as this resets Total to zero.

Attachment 2

Inspection Checklist

SITE INSPECTION FORM

Cold Springs Terminal Site

NYSDEC Spill No. 89-04923

Date: ______________________

Personnel: ______________________

Site:	Acceptable Condition	Needs Repairs	Comments
Access Gate and Lock			
Perimeter Fence			
Skimmer System Sheds			
Vegetation Overgrowth			
Ponding Water			
Accumulated IDW or Other Materials			

Skimmer Systems:	Acceptable Condition	Needs Repairs	Comments
Control Panels			
Operating			
Faults			
Tubing Connections			
Tank Full Connections			
Desiccant Dryers			
% Consumed			
Containment Drums			
Releases			
Tubing Connections			
Venting Pipes			
Amount Full			
Tubing			
Signs of Deterioration			
Signs of Leaks			
Air Line Free of Liquid			
Well Caps Secure			
Solar Panels			
Free of Debris			
Batteries Securely Connected			
Skimmer Assemblies (Monthly)			
Intake Screens Free of Debris			
Signs of Tubing Deterioration/Damage			
Buoys Floating/Free Moving			

Attachment 3

LNAPL Investigation Record

LNAPL Investigation Record

Personnel: ______________________ **Interface Probe No.:**

Date	**Well No.**	**Time**	**Headspace Reading** (ppm)	**Depth to Product** (feet bmp)	**Depth to Water** (feet bmp)	**Total Well Depth** (feet bmp)	**Notes**

bmp = below measuring point

Attachment 4

Geotech System Manuals

Geotech Sipper

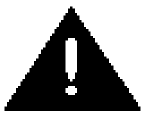
Installation and Operation Manual

Rev 6/8/2021 Part # 16550176

Table of Contents

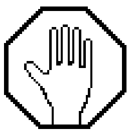
DOCUMENTATION CONVENTIONS

This manual uses the following conventions to present information:



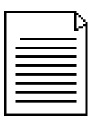
WARNING

An exclamation point icon indicates a **WARNING** of a situation or condition that could lead to personal injury or death. You should not proceed until you read and thoroughly understand the **WARNING** message.



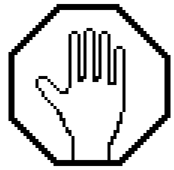
CAUTION

A raised hand icon indicates **CAUTION** information that relates to a situation or condition that could lead to equipment malfunction or damage. You should not proceed until you read and thoroughly understand the **CAUTION** message.



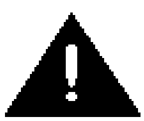
NOTE

A note icon indicates **NOTE** information. Notes provide additional or supplementary information about an activity or concept.



In order to ensure your Solar Sipper has a long service life and operates properly, adhere to the following cautions and read this manual before use.

- **Controller power input source must not exceed specified ratings.**
- **Controller may not operate properly with wiring not supplied by manufacturer.**
- **Avoid spraying fluid directly at controller.**
- **Never submerge controller.**
- **Avoid pulling on wires to unplug controller wiring.**
- **Avoid using a controller with obvious physical damage.**
- **To prevent damage, DO NOT drop the controller.**



WARNING

Do not operate this equipment if it has visible signs of significant physical damage other than normal wear and tear.

Notice for consumers in Europe:

This symbol indicates that this product is to be collected separately.

The following applies only to users in European countries:

- This product is designated for separate collection at an appropriate collection point. Do not dispose of as household waste.
- For more information, contact the seller or the local authorities in charge of waste management.

Section 1: System Description

Function and Theory

The Geotech Solar Sipper (Sipper) is a unique solar powered hydrocarbon recovery system used for operating an active down well remediation pump with an attached Skimmer. It is designed for applications where electrical power is not available or not economically feasible. Electrical power used to run the Solar Sipper is generated on-site by solar panels. The internal compressor is capable of producing up to 20” (51 cm) Hg vacuum and 100 PSI (6.9 bar) pressure. This alternating vacuum/pressure process allows the user to recover a wide range of fluids, from very viscous to ultra-light Non-Aqueous Phase Liquid (NAPL), from depths as deep as 180’ (4.6 m) below ground surface. Optional multiple channel controllers can operate up to eight (8) pumps in separate recovery wells.

In this manual, a stainless steel pump with Skimmer, or any other down well assembly used with a Sipper system, will be referred to as a pump. A chart containing a range of viscous products can be found in *Section 4: System Operation.*

The standard Solar Sipper uses a 12VDC, 75-amp hour battery that is charged with an attached 85-Watt solar panel. Systems can be expanded to utilize several solar panels and larger capacity batteries. Multiple channel controllers can be implemented in areas where there are multiple recovery wells within close proximity of each other. The Sipper operates up to eight (8) wells per controller.

In general, Geotech recommends a maximum distance of 500’ (152 m) (including the well depth) between the Sipper controller and the pump. Longer runs can be accommodated but are not recommended. Careful consideration must be given to additional power requirements as well as protecting the tubing from damage. In certain situations, multiple controllers with separate solar panels and batteries may be a better solution on sites of a relatively larger area. The optional AC Sipper is designed for locations where line voltage is readily available.

Ease of Deployment

The Solar Sipper can reduce overall project costs and dramatically improve deployment as follows:

- Reduces the time and cost for a power line to be run to a site.
- Eliminates the need for electricians to do install work and permitting.
- The simple and safe low voltage system can be installed without special training or licensing and requires minimal experience.
- No trenching or transformer equipment is required.
- Relocating equipment to follow a plume or to adjust to new site characterization information is fast and easy.

Sipper Operation

The Sipper controller has an integrated programmable cycle timer for controlling the internal compressor vacuum, pressure, and the time between cycles. This allows the user to calibrate the Sipper to run at its most efficient rate based on the down well product recharge rate, product viscosity, and Skimmer depth.

Pumps can be equipped with an H20 sensor to enhance efficiency and act as a failsafe to protect the system and to avoid pumping water. See the *Sipper Pump and Skimmer Assembly* user manual *Section 3: System Operation* for more information.

During the vacuum timer cycle, vacuum is applied to the airline tubing connected to the stainless steel pump in order to move product through the oleophilic/hydrophobic mesh screen and into the pump cavity.

When the programmed vacuum time expires, the system initiates the pressure timer cycle. During the pressure timer cycle, air is compressed into the air line tubing, evacuating the product from the pump. Once the programmed pressure time has expired, the compressor shuts down and the system initiates the programmed delay timer. Upon expiration of the delay timer, the process is repeated.

On multiple channel Sippers the vacuum, pressure, and delay cycles are set individually per well. This accommodates recharge and recovery rates unique to individual wells on the same site. To maximize efficiency, the Sipper's programming is specifically designed to prioritize which well to pump based on the user defined recharge and recovery rate.

The Sipper controller has several feedback data recording mechanisms that can be used to gauge effectiveness of the remediation system. Two cycle counter screens are available, one records the total lifetime cycles of the controller, the other counter is resettable by the user for monitoring purposes. These cycle counts can be compared with total recovered fluid to determine how much fluid is being recovered per pump cycle. There is also a runtime clock which only increments when the battery is charged and when the system is operating. This clock can be compared with actual recorded deployment time to determine if more solar panels are required to keep the system running. More on this can be found in *Section 6: System Troubleshooting* of this manual.

The Solar Sipper Controller is dependent upon the annual average solar resources, which can vary from region to region. Geotech assists in determining how much potential recovery can be expected depending on where the site is and how many solar panels will be required. More information about solar panel location can be found in *Section 2: System Installation.*

Recovery Rates

The available solar energy and number of solar panels will determine how quickly available product can potentially be recovered. Recovery will ultimately be limited by the recharge rate of the product layer in the well. Repeatedly removing the entire product layer can reduce fluid conductivity to the well and in turn reduce recovery rates overall.

When the product layer is completely depleted, air enters into the well screen and surrounding sub surface soil or strata. This air can act to block fluid conductivity as well as to promote bacteria growth and breakdown of the product being recovered. This will eventually 'clog' the fluid path to the well and so reduce the product layer recharge rate. Geotech recommends recovering smaller amounts of product more frequently. This will promote continued fluid conductivity to the well. Pumps can be equipped with an H20 Sensor to act as a failsafe to protect against product layer depletion and minimize water intake. See the *Sipper Pump and Skimmer Assembly* user manual *Section 3: System Operation* for more information.

In the event that the intake screen, discharge line or check valve should get blocked, remove the Skimmer and clean the intake cartridge and connections as described within the "System Maintenance" Section of the *Geotech Sipper Pump and Skimmer Assembly* user manual.

Geotech offers a variety of tools and training to provide you with information on properly maintaining your Sipper system and on obtaining a recharge rate. Contact Geotech to discuss your specific application in detail.

SiteView Telemetry

Geotech's SiteView Telemetry Systems use cellular networks to provide data from remote sites that streamlines the data management process. The use of Geotech's SiteView cloud-based data acquisition and data management software enables the collection, analysis, reporting, and storage of data. SiteView can be accessed from any computer or smartphone with internet connectivity. SiteView manages data from multiple locations reducing the need for localized data management software and data collection hardware.

Antenna

Mounted to the interior of the enclosure is a 915MHz flexible antenna. The antenna provides an omni-directional patterns allowing for large coverage ranges for installations.

If greater ranges are required, contact Geotech for exterior/remote mount antenna options.

Section 2: System Installation

The standard Geotech Sipper is designed for installation and operation in a non-hazardous, non-classified location with intrinsically safe extension into a hazardous classified location. Geotech does not determine classification of a location. Classification of location is subject to local jurisdiction enforcement of NFPA regulations. All installations should be performed in accordance with NEC.

FPN: NEC 2008 section 500.5 (A) classification of locations says:
Through the exercise of ingenuity in the layout of electrical installations for hazardous (classified) locations, it is frequently possible to locate much of the equipment in an unclassified location and, thus, to reduce the amount of special equipment required. FPNs are informational only and are not enforceable as requirements of the NEC.

Sipper installations are to be performed by qualified personnel. If you are not familiar with electrical power equipment, contact a qualified technician to assist you with your installation.

Solar Sipper systems can be modularized and delivered on pallets that can be quickly and easily deployed. This simplifies deployment where existing concrete pads or other infrastructure, does not already exist. Geotech also offers training on proper installation of your Sipper system at its Denver, Colorado manufacturing headquarters.

Installation of the Solar Sipper

AC Sipper Controller - Ensure the main line is turned off at the breaker and that the ON/OFF switch for the control panel is in the OFF position before proceeding with ANY external or internal wiring.

Since the solar array and battery have live voltage, exercise caution when handling either item. Special attention is required to ensure that the correct polarity is known when making connections to the battery and solar panels. Even though the system runs on a safe low voltage, the battery is capable of storing very large amounts of energy from a low impedance source. This can pose a fire and burn hazard.

Avoid shorting out (making contact between both positive and negative terminals) the battery with any tool or bare grounding wire. Leave protective caps in place and only terminate a wire when you have verified it is the correct polarity (positive or negative.) The system can tolerate reverse polarity connections as long as the ON/OFF switch remains in the OFF position.

Solar Panel Location

The annual average solar resources vary from region to region. Geotech assists in determining how much recovery you can expect (depending on where the site is located in the world) and how many solar panels will be required. The site latitude will determine seasonal differences in recovery rate. For example, in the northern hemisphere recovery rates will decline over the winter months and increase during the summer months.

Site-specific information must be considered. Large objects like tress or building structures can block sunlight from the reaching the solar panels. To maximize sun exposure, other unpredictable factors, such as more or less cloud cover, must be also be considered when planning solar power capacity requirements.

Geotech offers two different solar panel mounts, pole or standalone, to allow for installation in diverse locations.

Pick a location with a maximum exposure to sunlight. Avoid shadows, especially during the middle of the day. Orient the module so that the surface will receive the maximum sun exposure over the year for your particular site. The general guideline for positioning is as follows:

- Solar panels should face south in the northern hemisphere and north in the southern hemisphere.

- A solar panel's angle should be set to the equivalent of your location's latitude; plus 15 degrees during the winter or minus 15 degrees in the summer.

For example: Denver, Colorado's latitude is around 39 degrees. In winter, the panel should be raised to 54 degrees (from 0°) for optimum sun. For permanent installations, setting the panel angle equal to your latitude will suffice.

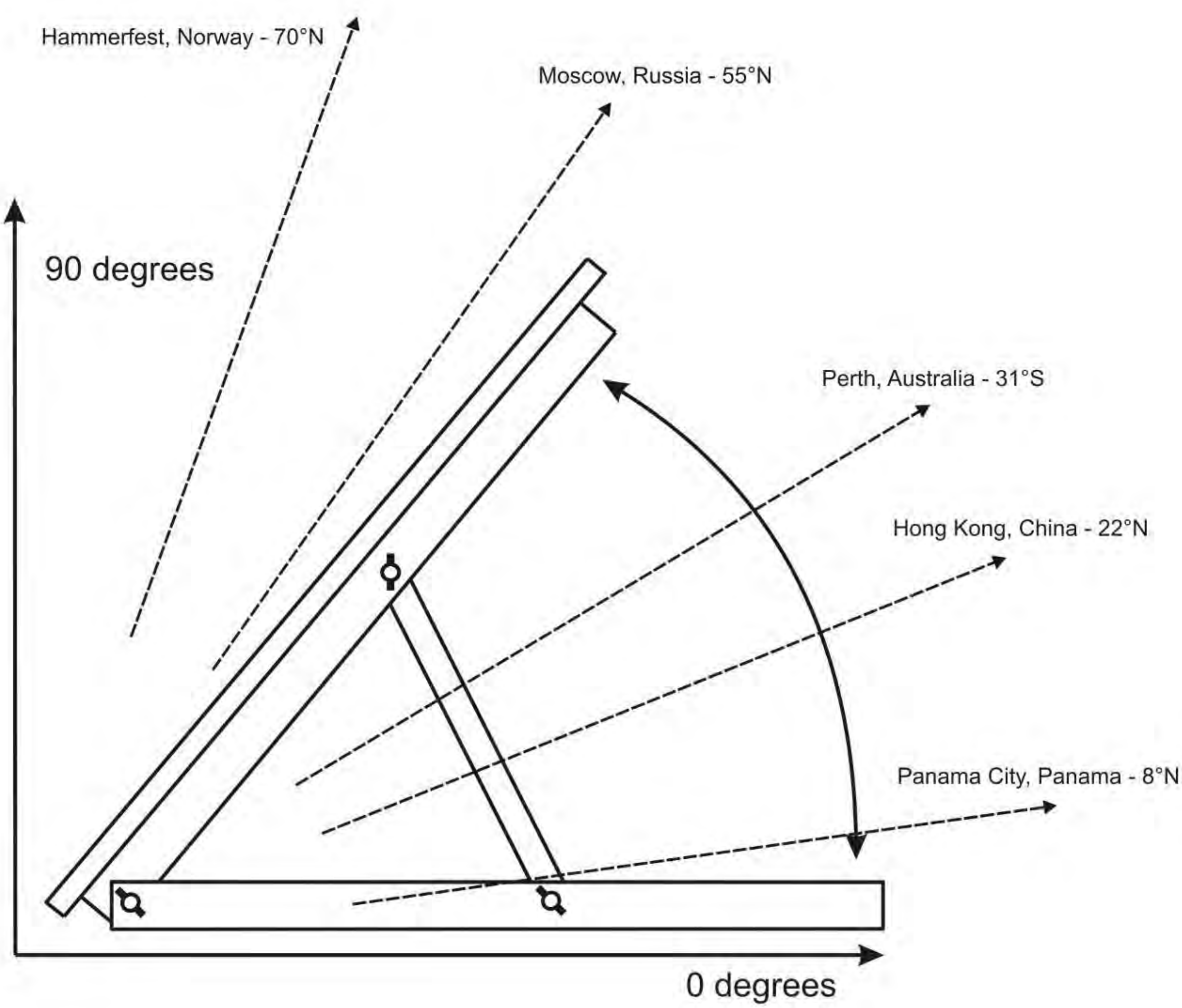


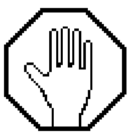
Figure 2-1: Side view of solar panel assembly

Mounting the Control Panel

The enclosure for the Solar Sipper allows the customer the option to place the control panel in a convenient and accessible location. It is recommended the control panel enclosure be placed out of the direct path of weather and sunlight. If power is to be wired to the enclosure, then all conduit runs are to be rigid metal and grounded to an equipment conductor common for non-current carrying metal parts.

The enclosure needs to be elevated above the height of the wellheads to prevent kinks to the exhaust line and all air lines to the pumps. When selecting a location for your Sipper Controller, consider the placement of air lines to and from the unit to prevent kinks, damage, or the buildup of fluid in sagging lines.

Figure 2-2 is an example of a Sipper control panel mounted to a back panel with 2” (5cm) U-bolts. Using a back panel will support the enclosure while giving you the ability to pole mount the unit.



NEVER drill mounting holes from, or through the inside of the enclosure when attaching the controller to another surface. It is advised that you mount the enclosure to a strong back panel, using the brackets supplied, before attaching the unit to a pole or other surface.

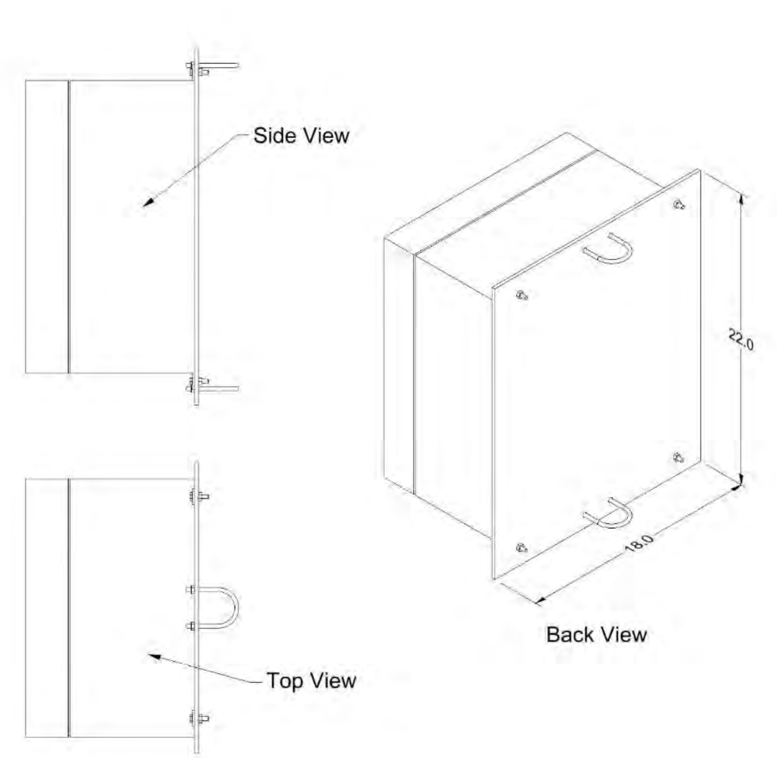


Figure 2-2: Example of Sipper enclosure mounted to back panel with additional U-bolts for pole attachment.

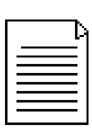


Diagram is an example only. Mounting hardware shown is available through Geotech. See *Section 9: Parts and Accessories*. Always avoid drilling through the enclosure body.

Solar Sipper Wiring

Operational flow charts are affixed to the inside door of each controller. Refer to *Section 8: System Schematics.*

Before installing the solar panel for the Solar Sipper controller, cover the array with an opaque material before making your wiring connections. This will prevent the modules from producing electricity while making the connections and reduce the risk of sparks. Use safe electrical practices at all times. Make connections in well-ventilated areas free from flammable gas vapors and open flames.

Solar Sipper systems are supplied with 25' (7.6 m) of 4 conductors 14 AWG cable. DO NOT modify the length of this power cable. After ensuring the power switch on the controller is set to OFF, make all external power connections as shown in Figure 2-3.

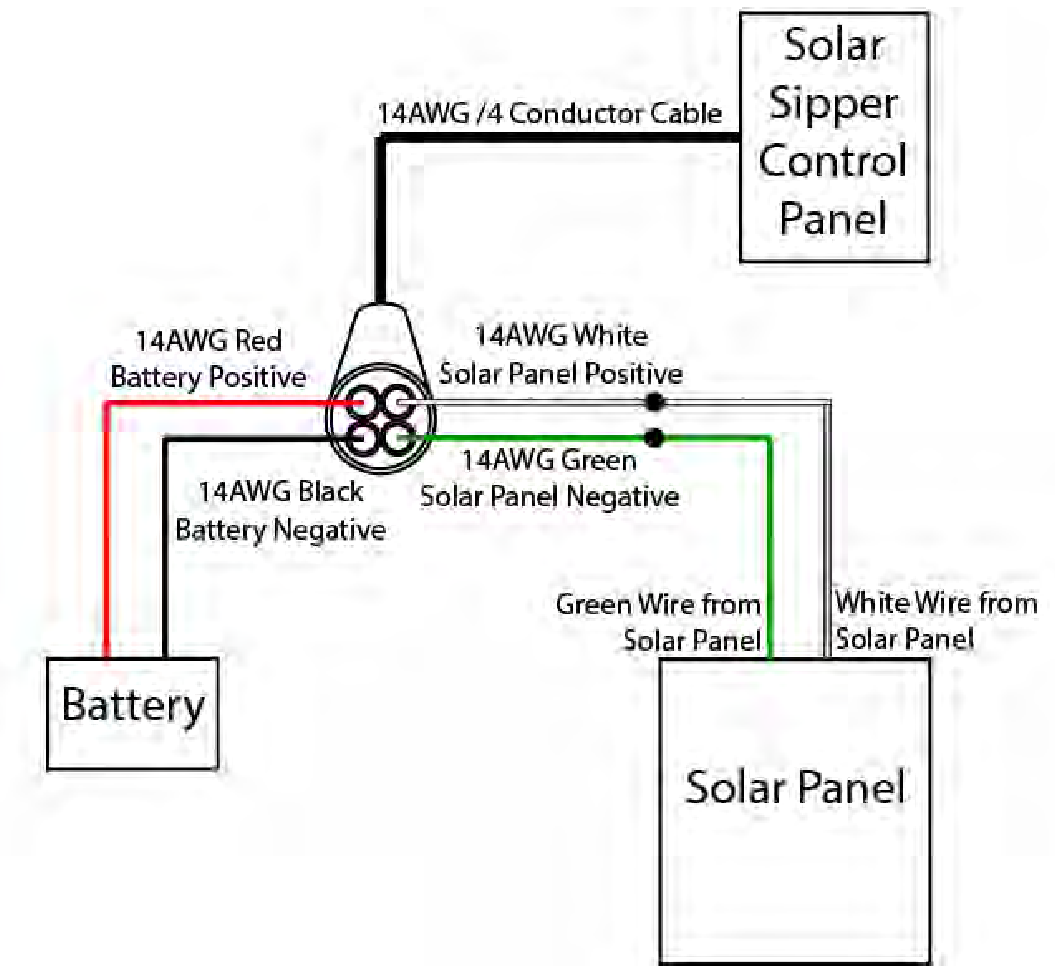


Figure 2-3: Example of external wiring for a Solar Sipper system.

A new or replacement battery may not be fully charged. This will cause the Solar Sipper to go into low voltage shutdown when initially powered up. Allowing the battery to fully charge before deployment will accelerate initial startup. Otherwise, the system could take several days to begin operating depending on the number of solar panels used and the amount of sun exposure. If freeze conditions exist, insulate your battery. Do not use a battery that is frozen or has been frozen. See *Section 3: Timer/Cycle Settings and Display Descriptions* for minimum voltage requirements.

Adding Additional Panels

During the winter months when the sunlight decreases, additional solar panels can easily be added to the Solar Sipper system. Additional panels will ensure production during the winter months when there are fewer hours of sunlight and the excess energy will not be used in the summer. As a general guideline, up to four (4) 80W panels may be connected to the Solar Sipper System.

To wire an additional panel to the system configuration, use the wiring diagram shown in Figure 2-3. Using insulated wire nuts, connect all red wires (positive) from the solar panel(s) to the white wire on the Sipper controller, then connect all black wires (negative) from the solar panel to the green wire on the Sipper controller.

AC Sipper Wiring

AC Sipper systems are supplied with 25' (7.6 m) of 3 conductors 12 AWG cable. DO NOT extend or add to the length of this power cord. After ensuring that the power switch is set to OFF, make the power connections using Figure 2-4 below:

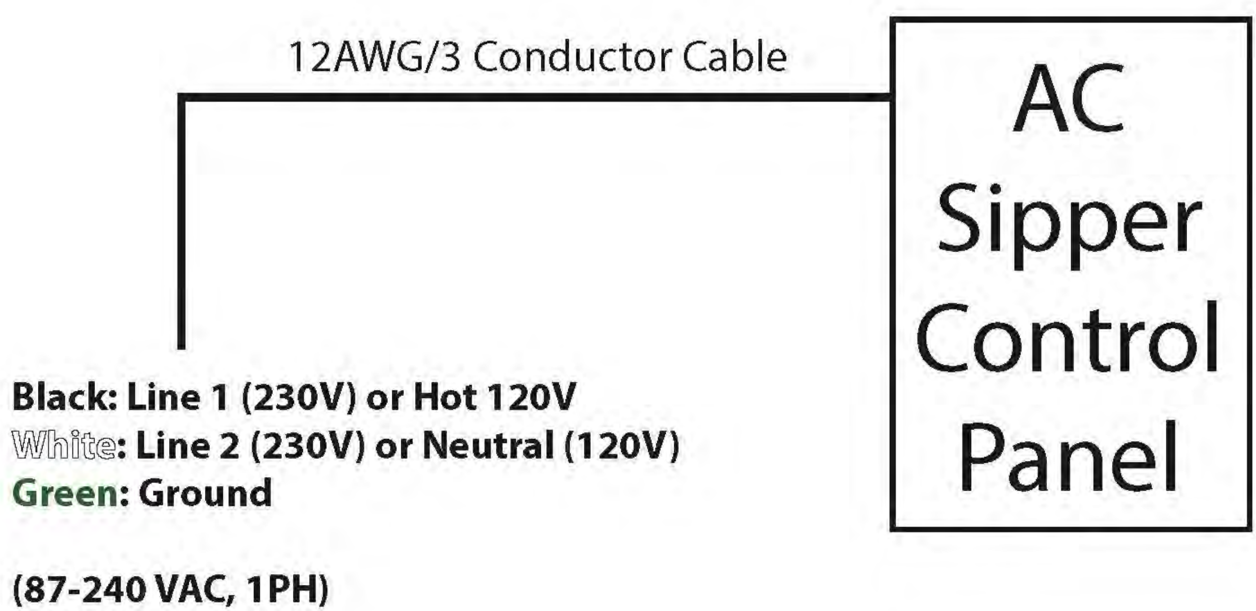


Figure 2-4: Example of external wiring for an AC Sipper system.

Dangerous shock and fire hazard will exist with any line/mains voltage wiring termination. Sipper installations are to be performed by qualified personnel. If you are not familiar with electrical power equipment, contact a qualified electrician to assist you with your installation.

Always verify that live voltage is not present at terminals to be worked on. Shut off all circuit breakers and disconnects, then use a voltmeter or voltage detector to verify power has been removed. Verify the meter is functional by turning the power on and off once or twice before proceeding. Only proceed wiring to AC power terminals when you are certain it is safe.

Grounding

If no earth ground terminal is available, then a ground spike must be installed. Connect all non-current carrying metal parts to the common ground. An earth ground terminal can be purchased from Geotech with your Sipper. *See Section 9: Parts and Accessories* for a complete listing of available accessories.

Connect All Tubing Runs

The Sipper is equipped with brass hose barb fittings that accept .170” ID Tubing, for the Air In/Exhaust, and Pump connections. If a different size hose barb is needed, the factory installed hose barbs can be removed and ¼” NPTM fitting can be used to accommodate different fittings. See *Section 7: System Specifications.*

Lay out all tubing lengths to the wellheads and secure the ends to the hose barbs using environmentally rated clamps. Geotech can supply your Sipper system with a variety of tubing and clamp choices. See *Section 9: Parts and Accessories* for a list of available parts.

When installing tubing runs, consider the placement of air lines to and from the unit to prevent kinks, damage, or the buildup of fluid in sagging lines. Keep all air lines flat and straight, and avoid sharp bends, which can kink your line.

It is recommended that air lines and hoses be protected. However, check local and state regulations regarding fuel transmission lines before installing the product discharge lines.

If there is a chance the Sipper system will be exposed to freezing conditions (see temperature range in *Section 7: System Specifications*), then it is suggested all discharge lines, including the battery, be insulated or your system be kept within a temperature controlled shelter during operation.

The last line connected will be from the compressor air intake and exhaust port, on the side of the Sipper controller, to the top of the recovery tank. The Sipper controller will use this line as an air source and as a failsafe should product be vacuumed into the compressor and solenoids.

Deploy the Stainless Steel Pump and Skimmer

Read user manual *Geotech Pump and Skimmer Assembly* (P/N 16550181) for more information on Skimmers, their parts, and functions.

The oleophilic/hydrophobic mesh screen discriminates between water and product when it is properly “conditioned”. To condition (or prime) a cartridge, use a soft brush and coat the mesh screen with the same or a like product found in the well. DO NOT use baby oil, lamp oil or other similar dyed, perfumed or hydrogenated oils.

Do not damage the float or screened intake before or during deployment. Use a scrap piece of plywood or cardboard (something that can be properly disposed of if contaminated) on which to set the pump and Skimmer assembly on instead of the ground.

Good site characterization is important for successfully placing the pump and Skimmer assembly at the optimal level in the well. If seasonal or tidal fluctuations in the groundwater table exceed the travel of the Skimmer, periodic manual adjustment may be required. Otherwise, and in most cases, the Skimmer should be placed such that its center of travel is at the nominal ground water level (refer to Figure 8-1 and 8-2.) If the groundwater table level is unknown, Geotech can provide you with an oil/water interface probe to determine the current water level and product layer thickness. Contact Geotech for more information on this important device for site characterization.

Using a separate measuring tape, measure from the middle of the center rod on the Skimmer (also the center of vertical travel of the Skimmer intake float) to where the discharge tubing will exit the well cap. Using contrasting tape or chalk, mark the discharge tubing at this point. The lower end of the Skimmer assembly will displace fluid in the well causing the fluid level to rise initially. The float travel will accommodate this rise in fluid level. The fluid level will take some time to return to normal depending on permeability/hydraulic conductivity of the formation surrounding the well.

Read user manual *Geotech Pump and Skimmer Assembly* (P/N 16550181) for more information on Skimmer operation, float travel, and other dimensions.

In some cases, the initial displacement of fluid can ‘displace’ the product layer from the well and back into the formation. This can happen especially where there is low fluid conductivity surrounding the well. It is best to trust the site characterization data and test with a Geotech oil/water interface probe to verify that the float is at the expected level within the well. If you cannot access an oil/water interface probe, or are deploying pumps in a 2” (5 cm) well without enough clearance for the probe, you can judge productivity by how much product is in the recovery tank.

For accurate results, measure well to determine the best placement for the Skimmer. Use a Geotech oil/water interface probe to measure water level and product layer thickness, then record this information to your remediation/characterization log.

Implementing the use of a Geotech oil/water interface probe and keeping a record of the water level and product layer thickness is recommended for maintaining optimal system performance.

Product Recovery Tank

A product recovery tank is not provided with the Solar Sipper system. A tank, preferably a 55 gallon (208 L) drum or larger, must be provided by the customer with the following attributes:

- A 3/4” (2 cm) or 2” (5 cm) threaded bung opening in which the Tankfull probe will be attached.
- A product inlet opening for the system discharge hose.
- A vent opening.
- A fluid discharge fitting for draining.

A Tankfull probe, shown in Figure 2-5, is provided with new Solar Sipper systems. Additional Tankfull probes can be ordered and utilized with the controller. See *Section 9: Parts and Accessories*.

Ensure that the compressor air intake and exhaust air line is secured to the top of the recovery tank prior to turning on the Sipper controller. Do not allow the end of this tubing to reach the product already collected.

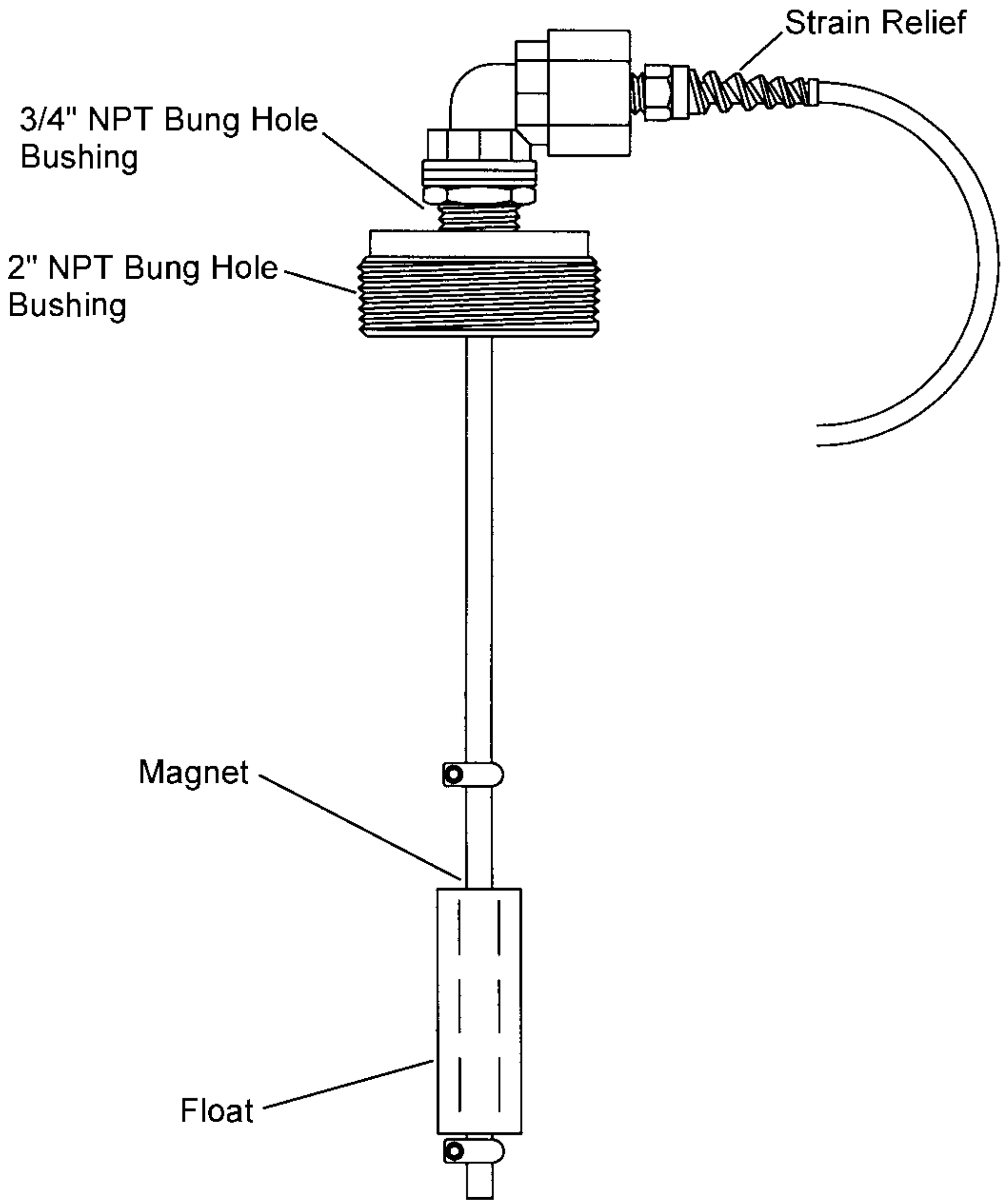


Figure 2-5: Example of Tankfull Probe

Installation Guide: Desiccant Dryer Kit for Geotech Sipper (Solar or AC)

If operating in humid environments, it is recommended to install a desiccant dryer kit with the Geotech Sipper (Solar or AC) to minimize the amount of moisturized air that enters the pneumatic system. This will minimize solenoid maintenance and optimize compressor performance.

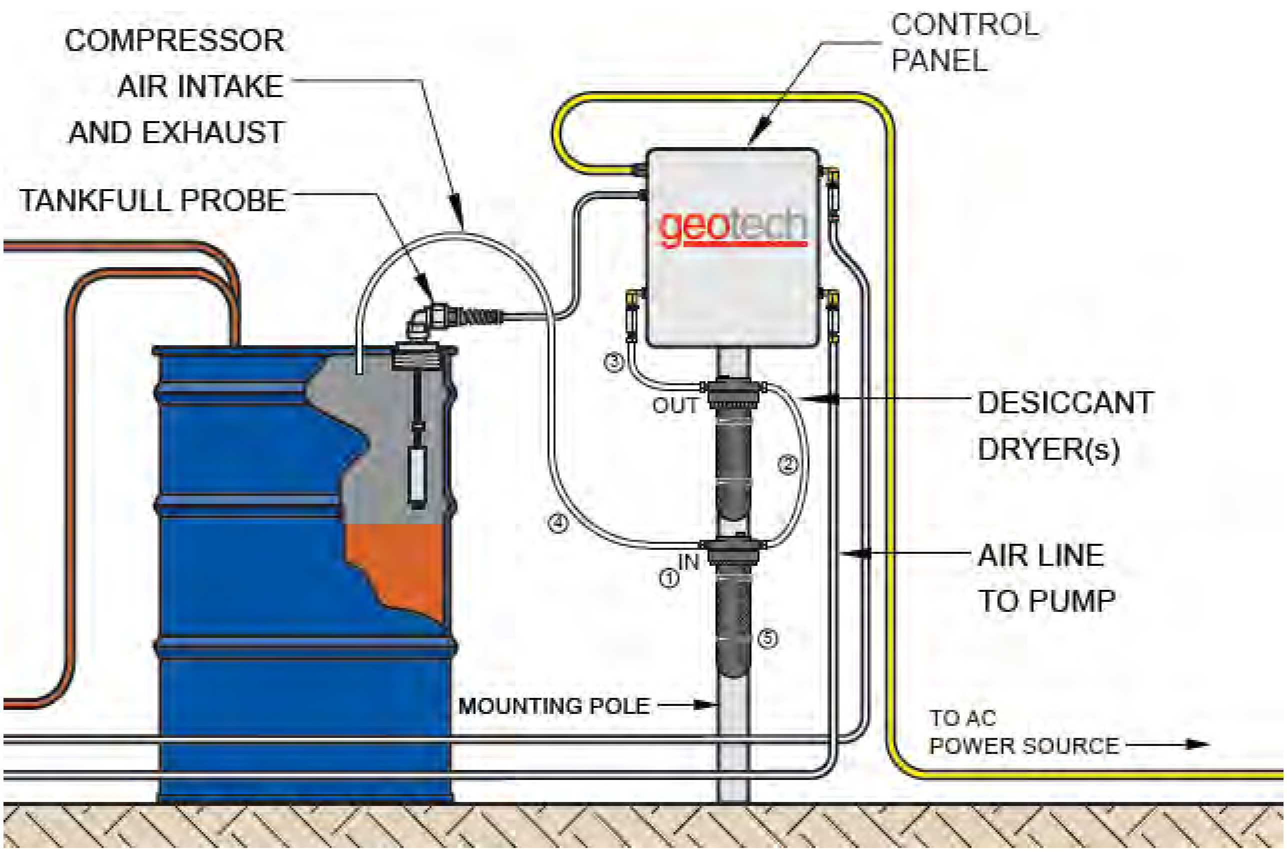


Figure 2-6: System Set-up with Desiccant Dryer Kit

Install the desiccant dryers on the Compressor Air Intake and Exhaust line:

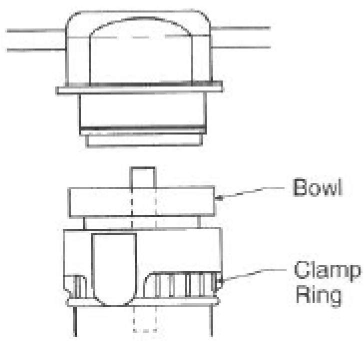
1. Locate the "IN" and "OUT" ports on the dryers.
2. Stack the two dryer's together by connecting an "OUT" port on one dryer to an "IN" port on the other dryer using .17" (4mm) ID tubing.
3. Connect the remaining "OUT" port to the Intake/Exhaust fitting on the Sipper Enclosure using .17" (4mm) ID tubing.
4. Connect the .17" (4mm) ID tubing to the remaining "IN" port on the dryer. The end of this tubing will terminate to the recovery tank (position above tankfull probe), or to where site requirements permit.
5. Mount the desiccant dryers to a pole using the provided worm-drive clamps. Desiccant dryers should remain vertical for optimal moisture recovery.

The Desiccant Dryer's silicone beads will change from blue to pink as the dryer is saturated. Replace desiccant as necessary.

Desiccant Maintenance

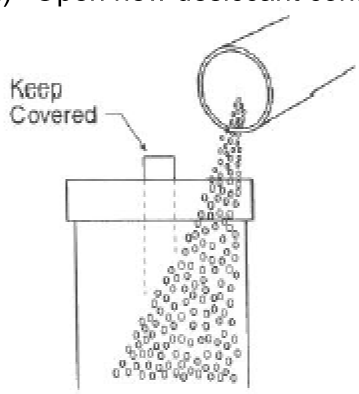
When the desiccant has turned from blue (dry) to pink (wet)

1) Turn off unit.
2) Loosen the clamp ring and remove the bowl from the top of the housing

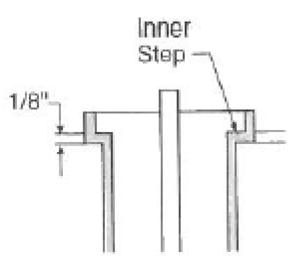


Desiccant Replacement

1) Pour out used desiccant.
2) Open new desiccant container and fill bowl.



3) Shake or tap bowl to settle the desiccant.
4) Fill bowl to 1/8" (3.175 mm) below the top.



5) Replace bowl and guard, clamp ring onto unit.
6) Ensure clamp ring is securely locked in place before repressurizing unit.

Section 3: Timer/Cycle Settings and Display Descriptions

This section describes the display functions and the operation of the Sipper controller. Each controller comes with a User Interface Flowchart (shown in Figure 3-1) inside the enclosure lid. The flowchart, used in conjunction with the arrow buttons on the control panel (shown in Figure 3-2) is designed to provide the following operator functions:

- Setting the cycle time (vacuum, pressure, and delay) for each pump and Skimmer assembly.
- Initiating the run time for Sipper system.
- Accessing system status and diagnostic displays.

The following pages show examples of all controller displays and a brief description of their function. Contact Geotech for any assistance in operating your Sipper controller.

Setup Displays

Once the Sipper system has been installed and all wiring to the controller is complete, turn on the main power switch to the Sipper controller. The unit will perform a quick internal self-check and memory configuration, after which the Main Menu will appear on the display as follows:

```
Geotech Sipper
L=Setup  R=Start
```

If the internal self-check fails then the screen will display the appropriate alarm condition. See *Alarm (condition)* and *Fault Displays* later in this section.

First, set your timer/cycle settings using the Setup displays. The Setup displays allow you to select each pump individually and assign a unique cycle time (vacuum, pressure, and delay) for the pump based on the performance of the well it resides. (See *Section 4: System Operation* for more information on evaluating the appropriate cycle time.) The cycle time range for each function is as follows:

Vacuum	0 second minimum to a 3 minute maximum.
Pressure	0 second minimum to a 4 minute maximum.
Delay	30 second minimum to a maximum of 24 hours.

Factory default for all timer settings, for each pump installed, are 1 second of vacuum, 30 seconds of pressure, 5 minutes of delay.

Set timers based on site requirements.

To access the Setup displays, press the left arrow button. The following display will appear:

```
Select Well
n  L=Main Menu
```

Where n = the well number

Using the UP and DOWN arrow buttons, select the well number for which cycle time you wish to set (the number of wells per Sipper controller can be between 1 and 8, depending on the configuration.) After selecting a well number, press the RIGHT arrow. The Vacuum display will appear:

```
Set Vacuum mm:ss
00:01
```

Using the UP and DOWN arrow buttons, scroll to the time required for the vacuum phase of the cycle, and then press the RIGHT arrow button. The Pressure display will appear:

```
Set Pres   mm:ss
00:30
```

Using the UP and DOWN arrow buttons, scroll to the time required for the pressure phase of the cycle, and then press the RIGHT arrow button. The Delay display will appear:

```
Set Del hh:mm:ss
00:05:00
```

Using the UP and DOWN arrow buttons, scroll to the time required for the delay time of the cycle, then press the RIGHT arrow button one more time. The system will return you to the Select Well display from which you can set the cycle time for any remaining wells.

If the LEFT arrow button is pressed at any time while setting the vacuum, pressure, and delay times, the new or adjusted setting entered will <u>not</u> be retained. To lock in the cycle time entered, press the RIGHT arrow button.

After all cycle times have been entered, press the left arrow button (while on the Select Well display) to return to the Main Menu.

Start (Runtime) Displays

The Start (Runtime) displays allow you to:

- Reset the cycle count and runtime (see also “Runtime” display under System Status).
- Turn ON/OFF the low temperature shutoff.
- Set the well number to start pumping with.
- Start and activate the preset cycle times for all the pumps attached.

Once the Sipper has been started (Runtime activated for all pumps), you can do one of two things:

- Press the DOWN arrow button (to review and page through the System Status displays).
- Press the LEFT arrow button (which will complete the current pump’s cycle time, then return you to the Main Menu).

To start the Solar Sipper and activate the runtime to all pumps attached, proceed as follows:

From the Main Menu, press the RIGHT arrow button. The following display will appear:

```
Reset Timer?
    YES
```

The Reset Timer display allows you to clear the cycle count and runtime shown in both the system Runtime and the Status Runtime displays. Use the UP and DOWN arrow buttons to change this setting to YES or NO then press the RIGHT arrow button for the next screen.

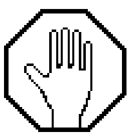
```
Low Temp ShutOff
    OFF
```

The Low Temp Shutoff display (when enabled), will shut down the Sipper controller at 0°C (32°F). Since the Sipper system primarily operates above ground, this feature prevents the controller from operating during a time when product lines could freeze. The Sipper will automatically restart at a temperature of 3.3°C (38°F). Use the UP and DOWN arrow buttons to change this setting to ON or OFF.

```
Start with Well
     n
```

Where n = the number of well (between 1 and 8).

The Start with Well display allows the user to choose the well to pump first upon startup. The well number selection is limited by the number of channels in use. Use the UP and DOWN arrow buttons to change the well number to start with.



The Sipper system is now ready for startup (Runtime). However, before proceeding, thoroughly read *Section 4: System Operation* to better understand the required timer adjustments needed for the product being recovered.

Once all cycle times have been entered and the previous three screens have been entered, press the RIGHT arrow button one more time to start the Sipper. The Sipper controller will begin cycling the first pump in the series and give you the following Runtime display:

```
00:00:00       nn
0000:00:00:00 wf
```

Where nn = the total number of cycles since activation (1 to 99999)
w =the well number currently activated
f =the pump function currently in progress (V for vacuum, P for pressure, D for Delay)

After verifying all pumps are running, you can re-verify the System Status at any time by pressing the DOWN arrow button during operation. After viewing the status displays, leave the last display as is and the system will automatically return to the Runtime display.

When a well has an active condition (pump conductivity, IR override, tankfull), the main screen will change to

```
00:00:00      WF
WELL:  12_*___8
```

Where 00:00:00 = the remaining timer for the current operation
W = the well number currently activated
f = the pump function currently in progress (V for vacuum, P for pressure, D for delay)
# = the well has an active condition (pump conductivity, IR override, tankfull…etc.)
_ = the well does not have an active condition
* = the well is not enabled

If all wells have an active condition, preventing the system from running any operations, the top line of the display will change from showing the remaining cycle time to showing.

```
NO WELLS READY
WELL:  12345678
```

When SiteView is updating the configuration and settings of the Sipper, the following screen will be shown on the display:

```
  Please Wait
Settings Update
```

While this display is shown, the operator is prevented from changing the operation mode of the device, or from entering new device settings. This ensures consistency with settings between a local operator, and a SiteView user updating settings remotely.

If a settings update occurs while the system is running, the current run cycle is completed and the device is held in the delay state until the settings are fully updated.

Stopping Sipper Operation (Runtime)

If further adjustments are needed to the cycle time of a particular pump or when the Sipper controller needs to be shut down, press the LEFT arrow button once during the Runtime mode. If the Sipper is currently in the middle of a pump's cycle time, it will give you the following display:

```
Please wait for
Main Menu mm:ss
```

This display will show how much time is left with the current well. Once the pressure phase of the cycle completes, the unit will stop all processes and display the Main Menu. Further adjustments can then be made to the pump cycle times, information retrieved from the Status Displays, or the unit can be turned off for service.

System Status and Diagnostic Displays

The value "nn" within this section can represent a count anywhere from 1 to 999999.

For fault displays, the value "0000:00:00:00" will reflect the real-time Clock (yymmdd hh:mm:ss) if the system includes access to the SiteView. If the system does not include access to SiteView, the value 0000:00:00:00 will reference the system Lifetime (dddd:hh:mm:ss). The Lifetime display will not indicate any specific events. Event time will need to be manually calculated.

While at the Main Menu, system Status Displays can be viewed by pressing the UP and DOWN arrow buttons. These displays contain a variety of information that can be used to record important activity to your Sipper system. These displays can also be viewed during the system's Runtime by pressing the UP or DOWN arrow buttons at any time during operation. After viewing a status display, leave the system as is. Within 1 minute, the Main Menu (or Runtime display) will reappear.

The following status displays (as shown on the Interface Flowchart, Figure 3-1) will appear with each press of the DOWN arrow button. The following pages will show you an example of each status display (as they appear) followed by a definition and use of the display.

```
Runtime: nn
0000:00:00:00
```

The Runtime display shows the number of completed cycles (for all pumps attached) along with the total runtime of the Sipper system since the controller was last reset. These values can be cleared with the Reset Timer display during initial startup.

```
Lifetime: nn
0000:00:00:00
```

The Lifetime display shows the total number of completed cycles (for all pumps attached) along with the total runtime of the Sipper system since the unit was first put into service. Lifetime values cannot be cleared. Many of the status displays will retrieve their time stamps from this display when something occurs, such as the last time there was a low battery, the last time a tankfull alarm was activated, the last time a low temp shutoff occurred, etc.

```
Power On: nn
0000:00:00:00
```

The Power On display shows the total number of times the unit has been powered ON/OFF (since being put into service, including factory testing) along with a time record of when the unit was last powered on.

```
Enabled Wells:
* * * * * * * *
```

Where * = Well is not enabled.

The Enabled Wells display shows the total number of wells included with the system.

To change enabled/disabled wells, the user will need to go through the startup process (see Figure 3-1, Start note 2). Pressing the UP arrow will enable the well and the asterisk will change to the well number that has been enabled. There can be up to 8 wells per device.

```
Fluid Override:
* * * * * * * *
```

Where * = Well is not detecting fluid.

The Fluid Override display shows which well(s) fluid is detected in. A warning is triggered in SiteView.

```
Fluid In Pump
* * * *
```

Where * = Pump is not detecting water.

The Fluid In Pump screen displays which pump is detecting water if a conductivity probe is being used in any well.

```
Well nn Delay:
hh:mm:ss
```

The Well Delay display shows how much delay time is left for each well assigned to the Sipper. Use the DOWN arrow button to page through all eight (8) displays. Channels not in use will have a display value of 0.

If more than one pump reaches the delay expiration (the delay countdown time reaches 0), the delay time will track a negative value. The well with the most negative value will be the next well to run.

```
Comp:  nnn
0000:00:00:00
```

The Comp display shows how many times the compressor has powered ON/OFF (since being put into service, including factory testing) along with the total run time of the compressor.

```
AUX Input:nnnnnn
0000:00:00:00
```

The AUX Input display shows how many times the switch has been disconnected for the accessory input devices on the Normally Closed switch (since being put into service, including factory testing) along with a time record of when the switch was last disconnected.

```
Tankfulls: nn
0000:00:00:00
```

The Tankfulls display shows the total number of times a tankfull alarm has been activated (since being put into service, including factory testing), due to a full recovery tank(s), along with a time record of when the unit last had a tankfull alarm. This display can be used to determine how long it takes the recovery tank to fill or if a larger tank is required.

Tankfull Status:
* * * * * * * *

Where * = Indicates the recovery tank is not detecting a tankfull alarm.

The Tankfull Status display shows which recovery tank is full.

```
Low Batts: nn
0000:00:00:00
```

The Low Batts display shows the total number of times the unit has experienced a low battery condition (since being put into service, including factory testing) along with a time record of when the unit last had a low battery condition. This display can help in evaluating battery usage (in comparison to how much product is being recovered) showing the need for either a cycle adjustment or the need for additional solar panels. It can also help in determining if the battery is losing its ability to maintain a charge.

The Solar Sipper controller is designed to shut itself down when the battery voltage reaches 11.4V and will resume operation when the battery charge reaches 12.1V. The Solar Sipper is designed to charge the battery to a maximum of 14.5V.

If the battery becomes frozen, the screen will be blank; the system will not operate. Discard the battery according to local regulations and connect a new battery.

```
Low Temps: nn
0000:00:00:00
```

The Low Temps display (when Low Temp Shutoff is enabled during the startup process) shows the total number of times the unit has experienced a low temperature condition (since being put into service, including factory testing) along with a time record of when the unit last had a low temperature condition. A low temperature shutoff (when enabled) will occur at 0°C (32°F).

```
Clock
yymmdd  hh:mm:ss
```

> Where “hh:mm:ss” is displayed in 24-hour clock time. This will be real-time if telemetry is equipped.

```
Intake OR: nn
0000:00:00:00
```

The Intake OR display shows the total number of times the unit has experienced an Intake Override condition (since being put into service, including factory testing) along with a time record of when the unit last had an Intake Override condition.

```
Temperature:
nnC nnF xxx
```

The Temperature display shows current temperature of the unit in Celsius and Fahrenheit followed by a diagnostic number.

```
Battery: (STATUS)
nn.nV  xxxx
```

The Battery display shows the current battery voltage for the Sipper system followed by the status. The status will read:

> `IDLE` – Nothing is happening.
> or
> `BULK` – Solar panel is fully connected to the battery.

```
Voltage:
nn.n
```

The Voltage display shows the voltage powering the system. This screen is only used for systems without a solar panel.

```
Well:n
Version: n.n0nnn
```

The Well/Version display shows the number of wells the system can operate and the software version the system is running.

```
Radio-nnnn   AI=n
ss=nn       █████
```

Where nnnn = the last 4 digits of the radio serial number.
Where ss = Signal strength
Where nn = decibel miliwatts
Where █= Signal strength bar graph
*Good signal strength = 3 bars and up
*Bad signal strength = 2 bars or less

The Radio display shows the radio information and signal strength.

```
Order #:
nnnnnn-n
```

Where –n = is included if more than 1 device is on the order.

The Order # display shows the order number and the number of devices included in the order.

```
Name:
```

Shows the name of the system. If the system comes with access to SiteView, the name of the system can be changed on the SiteView website.

```
Outputs:
Nnnnnnnn
```

The Outputs display shows the Well Solenoid outputs on PCB board.

```
HOA
nnnnnnnnnnnnnnnn
```

The HOA display shows the state of the HOA input bank on the PCB.

```
ISO
nnnnnnnnnnnnnnnn
```

The ISO display shows the intrinsically safe inputs on the PCB board.

```
 ADC <1-3>  (val)   ADC <4-6>   (val)   ADC <7-8>   (val)
 nnn nnn nnn        nnn nnn nnn         nnn nnn nnn
```

The ADC display shows the numerical value of the analog inputs.

Alarm (Condition) and Fault Displays

All faults will reference real world clock time when the SiteView is enabled. Systems without SiteView enabled will reference the lifetime counter.

Besides low battery, low temperature, a blown fuse, or no battery connection, only a few other conditions will cause the Sipper controller to shut down. The following display alarms will require attention from the user before the system can be restarted:

```
AUX Input
L=Main Menu
```

The AUX Input alarm will appear when an external device with a Normally Closed connection is wired into the PCB and the Normally Closed connection opens.

```
TANKFULL
L=Main Menu
```

The TANKFULL display will appear when the recovery tank becomes full or when there is damage to the tankfull probe cable. When this display appears, the Sipper controller will stop all activity until the alarm is addressed. To clear the alarm and restart the Sipper controller, press the left arrow button (to obtain the Main Menu), then initiate the startup process.

```
INTAKE OVERRIDE
L=Main Menu
```

The INTAKE OVERRIDE display will appear when the Intake Sensor detects the presence of fluid in the air line, between the compressor and manifold. SiteView will show a Manifold fault. This occurs when:

- An optic sensor failed.
- Product is pulled through the air line from the well due to excessive vacuum time,
- A directional solenoid becomes stuck on the compressor
- There is an accumulation of moisture in the air line during operation.

See *Section 6: System Troubleshooting* for information on resolving an Intake Override alarm.

When the INTAKE OVERRIDE display appears, the Sipper controller will stop all activity until the alarm is addressed. After clearing all effected lines, clear the alarm and restart the Sipper controller by pressing the left arrow button (to access the Main Menu), then initiate the startup process.

You may also need to clear the air line by setting the vacuum to 0 and allowing the pressure cycle to push any residual fluid out of the line and into the pump reservoir. *See Section 6: Troubleshooting*, for more information.

```
Battery Fault
Check Cables
```

The Battery Fault display will appear when the voltage on the battery cables is 14.7VDC or greater. This may occur if the solar panel has been miss-wired to the battery input cables. This display will also appear if an overcharged battery has been installed. In any case, when this display is shown, turn the unit off and disconnect all voltage sources immediately. Review Solar Sipper Wiring in *Section 7: System Specifications*. Contact Geotech with any questions on wiring and installation.

PCB Damage

On rare occasions the following display may appear:

```
System:
```

The System message will only appear when damage has occurred to the PCB within the Sipper controller. Should this display appear, contact Geotech about the fault. Inform the Geotech Technical

Sales Representative of all conditions (weather, temperature, vibration, etc.) and when the fault occurred. A fault message of this kind will usually require the unit be sent to Geotech for diagnostics and repair.

Optional Conductivity Sensor

Pumps can be equipped with an H20 sensor to enhance efficiency and act as a failsafe to protect the system and to avoid pumping water. See the *Sipper Pump and Skimmer Assembly* user manual *Section 3: System Operation* for more information.

To configure the GECM

Starting with the GECM turned off, press and hold all four Arrow Buttons at the same time and move the ON/OFF switch to the ON position. When the text "ENTERING FACTORY CONFIG" appears on the LCD screen, release all Arrow Buttons. The first configuration screen is used to reset the well timers to factory default settings. To navigate to the optional conductivity configuration menu, press the UP Arrow button until the screen displays:

```
ENABLE ?
PUMP H2O DETECT
```

When this screen is displayed, press the RIGHT Arrow Button to enter the configuration menu. The screen will display:

```
PUMP H2O DETECT
* * * *
```

Where * = Indicates the conductivity probe is not enable.

Use the RIGHT arrow key to navigate to the well that has a conductivity probe – only the first four wells can utilize a conductivity probe. To enable conductivity for the well, press the UP Arrow button and the display will change from '*' to the well number. If you wish to operate without the conductivity probe, navigate to the desired well and press the DOWN Arrow button.

When finished configuring well conductivity, continue to press the RIGHT Arrow button until the display shows a new configuration menu. From there, repeatedly press the UP Arrow button until the display shows:

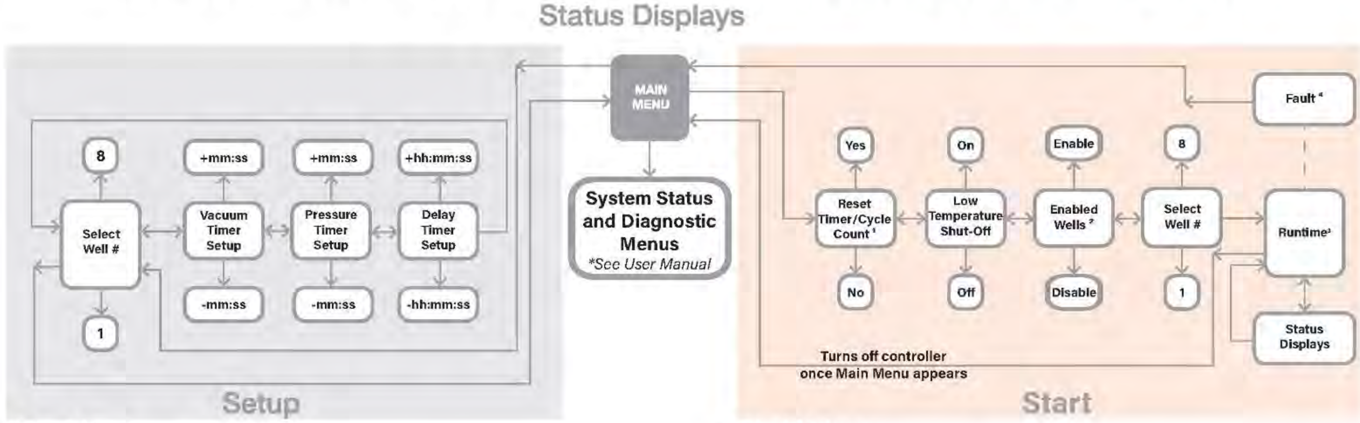
```
EXIT ?
FACTORY CONFIG
```

Press the RIGHT Arrow button to exit. If you did not make any changes, the display will indicate no changes. If changes were made, the display will show:

```
FACTORY CONFIG
SAVE: L=No R=Yes
```

Press the RIGHT Arrow button to save the changes and exit, press the LEFT Arrow button to cancel the changes and exit.

Geotech Sipper User Interface Flow Chart



Setup Steps

1. From MAIN MENU, press the left arrow button.
2. Press up or down arrow buttons to select well number.
3. Press the right arrow button to enter vacuum, pressure, and time delay for the selected well #.
4. Press up or down arrow buttons to adjust timer settings.
5. Press the left arrow button to move to Start menu from Select Well menu.

See User Manual for complete user interface description.

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Start Notes

1. Both Reset Timer/Cycle Count,Low Temperature Shut-Off, and Enabled Wells need an On/Off, Yes/No, and Enabled/Disabled response, respectively, prior to progressing to the next command.
2. Enable wells by pressing the up arrow. Disable the well by pressing the down arrow.
3. Runtime:

Current Cycle Time → HH:MM:SS nn ← Cycle count
Total Runtime → DDDD:HH:MM:SS wf ← Well#/Function

If an alarm/condition is detected, "WELL" will show on the display and indicate which well the alarm/condition is detected.

Cycle Time → HH:MM:SS wf ← Well#/Function
WELL 12_ _ _678 ← Well the alarm is detected in

# = Active Condition → *
_ = No active condition
* = Not enabled

4. Faults

Press left arrow key to clear faults. ← FAULT*
L=Main Menu

Note:

Status Display may include more information on custom systems. See the user manual for more information.

** See user manual for specific information.*

Figure 3-1: Flowchart of User Interface Label

Figure 3-2: Example of Solar Sipper front panel.

Section 4: System Operation

If Sipper system is to be deployed in humid conditions, Geotech recommends installing the optional Desiccant Dryer to prevent frequent solenoid maintenance. See *Section 9: Parts and Accessories* for part information.

Establishing the Product Recovery Cycle Time

The first thing to consider will be a product recovery rate target. The maximum product amount that can be recovered is determined by the recharge rate of each individual well. You can size and adjust your system for optimal recovery rate potential based on the parameters obtained from the well.

The best measure of success is the average measured recovery of fluid in the recovery tank, over a specific time frame, compared to the recovery rate target. Due to seasonal and weather related variability in available solar energy it may be very difficult to schedule site visits to coincide with the system pumping product. If observation of the system in action is desired, schedule a visit in the midafternoon. Otherwise, record your cycle counter value and total run time and compare these with the amount of product recovered.

The vacuum cycle pulls the product into the pump housing. The system compressor will then switch to pressure mode. The compressor is capable of providing up to 100 PSIG (7 bar) (pressure to the pump and the discharge line). The pressure cycle pushes the intake valve shut and forces the product past the discharge valve and up the discharge line to the surface.

It is important that you verify that all product is being pushed out of the pump housing before the next vacuum cycle begins. If the vacuum time interval is set too long, or the pressure cycle set for too short of a period, it is possible for the pump to overfill and for the product to be pulled up the airline and into the Sipper controller. If this happens, set the vacuum time back to 0 seconds and the pressure to 30 seconds and evacuate all the fluid from the float switch housing. After the system is clear of excess fluid, try setting the vacuum time to a lower setting and increase your pressure time to a higher setting for better operation. It is better to start with a higher pressure and lower vacuum setting and adjust over time.

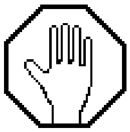
The standard stainless steel pump is capable of holding 0.2 gallons (0.750 mL) of fluid per cycle. That translates into:

- 14” (35 cm) of product layer in a 2” (5 cm) well
- 3.5” (8.9 cm) of product layer in a 4” (10 cm) well

This represents the minimum product layer thickness required to achieve one full pump housing of product per cycle. Even if there is that much product in the well, it is not advisable to pump the product layer all the way down. See Recovery Rates in *Section 1: System Description* for further explanation.

Initiating the Sipper Runtime

Once Runtime has been started, the Solar Sipper system will initiate the vacuum cycle for well number one (or whichever well is selected to start), complete that well's cycle, then continue on through any remaining wells as per the individual user input settings.



The vacuum timer limits are 0 seconds minimum, 30 seconds maximum.

The pressure timer limits are 30 seconds minimum, 4 minutes maximum.

Custom timer settings outside of these min/max parameters can be adjusted through restricted access menus (contact Geotech for more information.) Timer settings outside of the default min/max warrant special consideration to avoid damage to the equipment and otherwise unsatisfactory performance of the system.

The amount of product per cycle will depend on how much product is in the well. In addition, depending on the viscosity of the fluid and temperature, the product layer could have a somewhat slower recharge rate. This can make it difficult to determine what the best cycle times should be for a particular site.

If you have a less than 1 gallon (3.8 L) per hour recharge rate, then simply increase the delay time proportionally. For example: if your product recharge rate is 1/2 gallon (1.9 L) per hour, double the delay time.

- After accounting for more or less recharge rate, you can account for additional tubing and depth to fluid.
- Add 2 seconds per 25' (7.6 m) of tubing for vacuum and 3 seconds per 25' (7.6m) of tubing for pressure.
- Add an additional 2 seconds per 25' (7.6 m) depth to product vacuum (the product only needs to be lifted at most to the top of the pump housing).
- Add an additional 3 seconds per 25' (7.6 m) depth to product pressure to start. You will have to adjust this setting to account to the specific viscosity of the product and the amount of product in the discharge tubing.

It is not necessary to empty the entire length of discharge tubing per cycle. It will be a waste of energy to pump air through the lines when it is not acting to move product. If you observe airflow from the discharge line after the product has stopped flowing, reduce your pressure time by approximately the same amount of time as the extra airflow.

Example: You have a pressure time of 50 seconds; it takes 20 seconds for product to reach the exit end of the discharge tube, product flows for only 20 seconds then air flows freely for 10 seconds. You can reduce your pressure time by 10 seconds. That is an immediate 20 percent reduction in pressure time. This will increase your battery life and, in turn, improve your recovery potential.

Fluid Viscosity

It is impossible to account for the many site-specific variables in this manual. Pump rates for specific applications can only be determined with a careful site analysis.

The following table has been compiled based on lab testing as well as real world Sipper deployments.

If you have a higher recharge rate and require higher production rates than those shown below, please contact Geotech so that we can determine if more solar panels or batteries are necessary.

In some cases, such as in the southwest United States, the standard Solar Sipper can easily outperform the rates shown in the following chart.

The viscosity range shown is based on an average ground water temperature of 50° to 70°F.

Table: 4-1: Fluid Viscosity and Sipper Operation (Imperial)

Depth to Fluid in **ft**	Intake Type	Air Line Length in **ft**	Product Weight/ Viscosity (SSU) @ 70° F	Product Recharge Rate in **GPH**	Vacuum Time (mm:ss)	Pressure Time (mm:ss)	Delay Time (hh:mm:ss)
10	100 mesh	25	Gasoline - Light/27.7	1	0:00:15	0:00:30	0:11:00
10	100 mesh	25	Transformer Oil - Light/80	2	0:00:15	0:00:30	0:05:00
10	60 mesh	25	No. 4 Fuel Oil - Medium/170	1	0:00:30	0:01:00	0:11:00
10	60 mesh	25	Hydraulic Oil - Medium/200	2	0:00:30	0:01:00	0:05:00
10	Heavy oil	25	SAE 30 Oil - Heavy/1000	1	0:01:30*	0:03:00*	0:11:00
10	Heavy oil	25	SAE 50 Oil - Heavy/3000	2	0:01:30*	0:03:00*	0:05:00

Table 4-2: Fluid Viscosity and Sipper Operation (Metric)

Depth to Fluid in **m**	Intake Type	Air Line Length in **m**	Product Weight/ Viscosity (SSU) @ 21°C	Product Recharge Rate in **LPH**	Vacuum Time (mm:ss)	Pressure Time (mm:ss)	Delay Time (hh:mm:ss)
0.3	100 mesh	7.6	Gasoline - Light/27.7	3.78	0:00:15	0:00:30	0:11:00
0.3	100 mesh	7.6	Transformer Oil - Light/80	7.5	0:00:15	0:00:30	0:05:00
0.3	60 mesh	7.6	No. 4 Fuel Oil - Medium/170	3.78	0:00:30	0:01:00	0:11:00
0.3	60 mesh	7.6	Hydraulic Oil - Medium/200	7.5	0:00:30	0:01:00	0:05:00
0.3	Heavy oil	7.6	SAE 30 Oil - Heavy/1000	3.78	0:01:30*	0:03:00*	0:11:00
0.3	Heavy oil	7.6	SAE 50 Oil - Heavy/3000	7.5	0:01:30*	0:03:00*	0:05:00

**Contact Geotech for instructions on how to enable timer settings beyond the standard limits. The standard limits are in place to protect against accidentally setting vacuum or pressure times that could reduce system up time and potentially damage the equipment.*

******The standard stainless steel pump is capable of holding 0.2 gallons (0.750 mL) of fluid per cycle.*

**In perfect conditions, you could recover 55 gallons of product per day. That is 0.2 gallons per cycle per minute for 4.6 hours in one well.*

Recovery Tank is Full

When the tankfull probe detects a full recovery tank, the Sipper will complete the current cycle before shutting the Sipper controller off. The following message will appear:

```
TANKFULL
L=Main Menu
```

During this time, the unit will continue to charge the battery, and if enabled, monitor the temperature. Once the recovery tank is emptied, press the left arrow button for the Main Menu and restart the unit as described in the beginning of *Section 3: Time/Cycle Settings and Display Descriptions*.

Section 5: System Maintenance

Sipper controllers must be returned to Geotech for internal repairs or service.

Sipper Controller

<u>Weekly Maintenance</u>

- Record the level of the recovery tank (depending on the recovery rate).
- Visually inspect all air lines and power cords for damage.

<u>Monthly Maintenance</u>

- Rinse debris off the solar panel with clean water – DO NOT use anything abrasive on the panel surface. Clean the front surface of the solar panel and controller enclosure as needed with mild soap and water and a soft cloth.
- Inspect the product pump and Skimmer. Visually inspect the Skimmer, making sure that the coiled hose is not tangled, and that the intake assembly moves freely over its travel range.
- Visually inspect the vent plugs in the bottom of the controller enclosure. Clean if obstructed with debris.
- Record the uptime counter from the Lifetime display monthly during the first year. This information can be used to schedule yearly maintenance for the least productive times of the year (due to local variations in the weather and solar exposure).
- Record the level of the recovery tank (depending on the recovery rate).
- Check to see if wildlife (insects, birds, mice, etc.) have not taken up residence in the controller or battery enclosures. Nests and debris can result in vent plug blockage in the battery box, allowing hazardous and explosive gas to build up. Build-up on the controls can result in overheating the electronics and possible failure of components.
- Verify fluid levels in the well using a Geotech Interface Probe. Make sure the pump and Skimmer are set at the correct interval for collection of product.
- Verify pump vacuum, pressure, and delay settings. Make sure the cycling rate of the system is correct for the amount of product available. If the well is slow to recharge and/or there is only a small volume of product to pump, the pumping rate should be decreased to conserve air and minimize controller and battery wear. Consult Geotech Technical Sales and this User Manual for guidance on how to properly set these times. DO NOT adjust if unsure.
- If using the optional Desiccant Dryer for the Sipper system, check the saturation of the desiccant packs and replace packs if necessary.

<u>Quarterly Maintenance</u>

- Verify fluid (or air flow if no product in the well) is being discharged into the recovery tank to ensure pump check valves and tubing are free from blockage and that the discharge hose is not kinked or cut.
- Verify that the Tankfull float moves freely and operates to shut off the Sipper controller when activated.
- Verify Intake Sensor Switch detects fluid.
- Inspect the exterior of the controller for loose fittings. Over time, vibration may cause some fittings to loosen and air leaks to develop. If uncorrected, excess air consumption and shortened controller life will result.

- Verify that your solar panel is correctly positioned for maximum sunlight. Panels can be out of place from either the wind, shade from tall structures near the panel, or sun position due to the time of the year.

Yearly Maintenance

- Turn off Sipper controller.
- Remove and test the battery. Replace it if needed.
- Replace the inline particle filters on the air lines if needed.
- Contact Geotech for solar panel warranty confirmation and extension.

For technical assistance, call Geotech Environmental Equipment, Inc. at 1-800-833-7958.

Stainless Steel Pump and Skimmer

In order to provide a full and long service life, keep the Skimmer intake cartridge clear of debris or bio growth. The floating intake cartridge on the Skimmer is the heart of the Sipper system. Therefore, the intake cartridge (oleophilic/hydrophobic screen, float, float shaft, flexible intake hose and clamps) should receive periodic thorough inspections. The floating height of the intake screen should always stay above the waterline. The intake cartridge screen will not pass water unless:

1. The intake cartridge has risen to the top of its travel allowing water to rise above the top of the cartridge (thus indicating that the system should be raised to a height at which the intake is floating within its 12” (30.5 cm) to 24” (61 cm) of working travel).
2. An inordinate amount of debris is allowed to build up on the surface of the screen.
3. A detergent (surfactant) contacts the screen. (A detergent will “wet” the screen and allow water to pass.)

If the screen is found to be clogged with debris or has been submerged in water, a gentle rinsing in kerosene or gasoline is recommended. When the presence of detergents is suspected, samples should be taken and tested.

Since the pump and Skimmer assembly must be removed from the well to perform maintenance on the intake screen, such occasions should be used to carry out a general inspection of the entire assembly.

Use the maintenance procedures found in the Geotech Pump and Skimmer Assembly User Manual to properly care for your pump and Skimmer assemblies.

Solar Panel

On Solar Sipper applications, it is important to keep all debris, dust and dirt from accumulating on the solar panel surface. Clean the front surface of the solar panel as needed with mild soap and water. **DO NOT use abrasive cleaners, solvents or pads.** Simply rinsing off the panel with clean, clear water will usually suffice.

Solenoid Maintenance (Stuck Solenoid)

The following procedure outlines how to remove, dis-assemble, and clean a stuck solenoid plunger.

1. Remove plug on solenoid with Phillips screwdriver.
   ***Do not lose the gasket for the plug**.*

2. Remove the three (3) screws and solenoid with a small flathead screwdriver (Figure 5-1).

Figure 5-1: Removing Solenoid

3. Using the small flathead screwdriver, remove the two (2) screws of the square metal cap (Figure 5-2).
   **Note the black gasket on the underside Figure 5-2. If the gasket is lost or stolen, contact Geotech for a replacement gasket (PN: 16550353).*

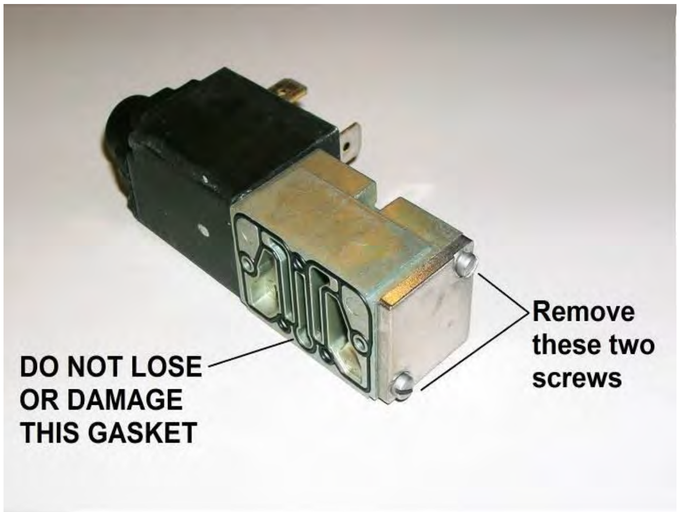


Figure 5-2: Gasket

4. Carefully remove the spring, the O-ring, the bushing, and the plunger (Figure 5-3).

Figure 5-3: Solenoid Parts

5. Clean the plunger and plunger cavity with a spray lubricant and cotton swab.
   **Silicon based or aerosol lubricant OK.*

6. Orient and insert the plunger as shown in Figure 5-4.

Figure 5-4: Solenoid Plunger

7. Place the O-ring and bushing back into the opening (no orientation needed) followed by the spring (Figure 5-5).

Figure 5-5: Solenoid Spring

8. Carefully place the square cap onto the end, compressing the spring, and reattach the two (2) screws. Make the connection snug but do not over tighten. (Figure 5-6)

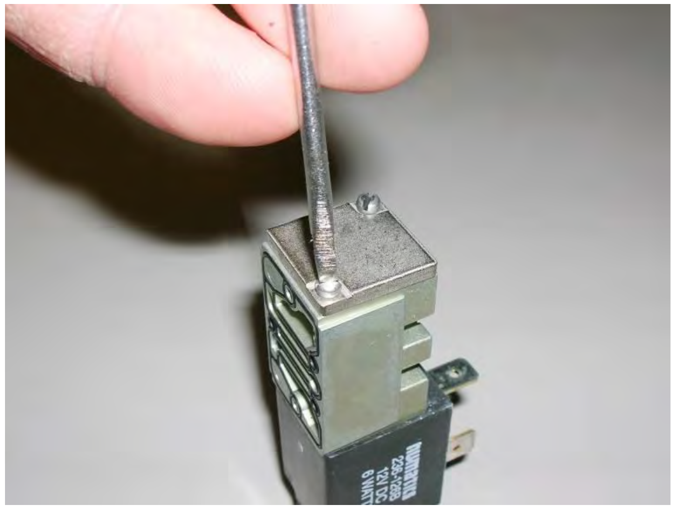


Figure 5-6: Replacing Solenoid Cap

9. Verify that the plunger will move easily by depressing the small black button on the other end of the solenoid with a small Phillips screwdriver.

10. After verifying the solenoid gasket is in place, re-attach the solenoid with the three screws
**Be very careful not to lose or allow the gasket to fall out of place and be crushed*

11. After securing the solenoid, re-attach the plug with gasket to the solenoid.

If this procedure does not resolve a suspected vacuum/pressure problem, then please call Geotech Technical Sales for further troubleshooting advice @ 1-800-833-7953.

Optic Fluid Sensor Install/Replacement

Each Optic Sensor comes pre-wired and ready for install. Use the Analog/Non I.S. Input Terminals page of the wiring diagram to ensure the sensors are wired into the unit correctly.

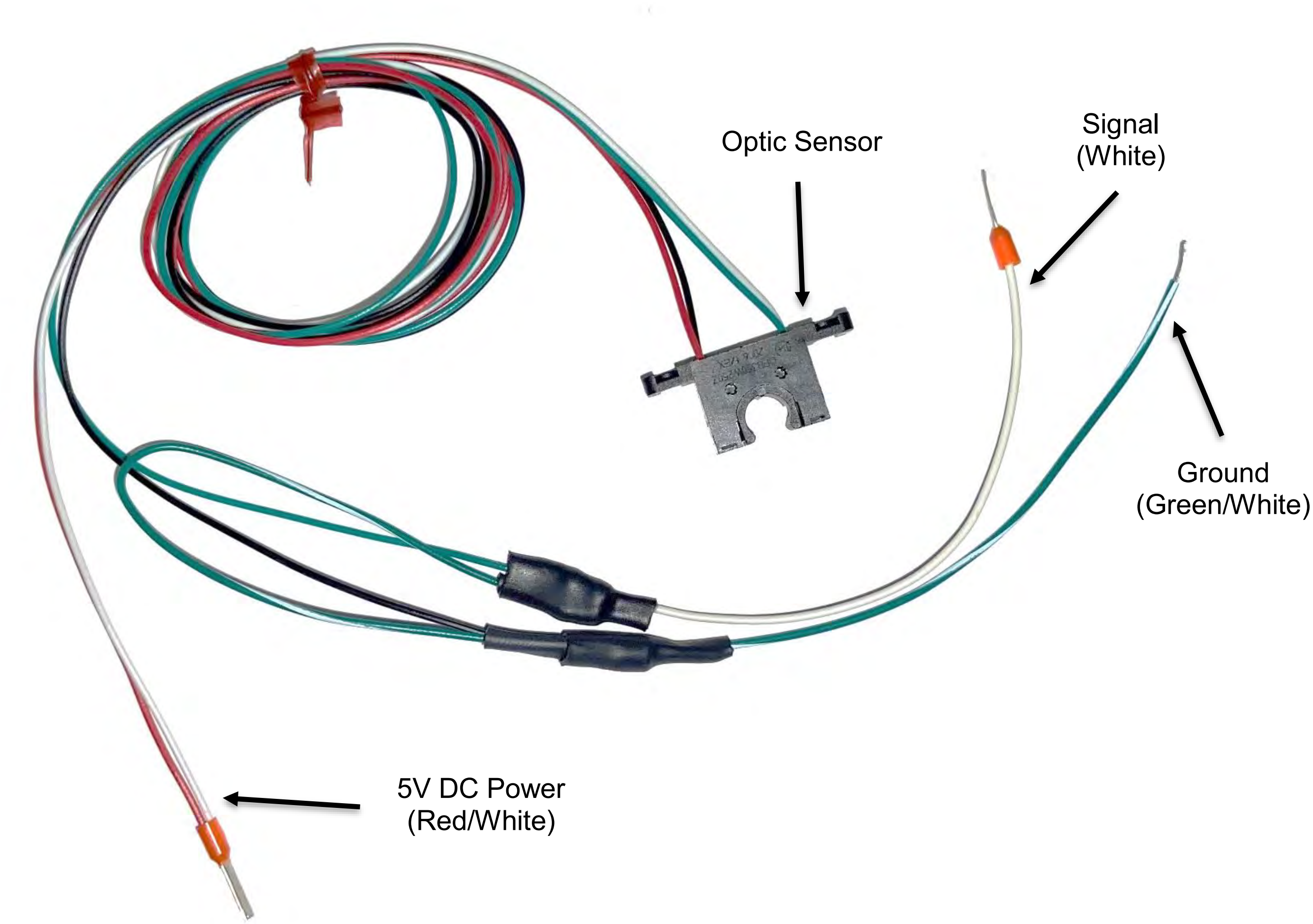


Figure 5-7: Optic Sensor

The following steps will use Well #1 as an example. If replacing a different well, ensure to follow the steps for that specific well input.

1. Label each sensor to the corresponding well the sensor will replace or the wells being added to the unit.
    - If one sensor replaces Well # 5, label the corresponding sensor “5” before replacing.
    - If unit will be configured to run with more than one optic sensor, label the corresponding sensors 1-6 (6 is the maximum number of sensors that can be installed) and 1 intake Override Sensor.

2. Wire the DC Power red and white wire bundle from the optic sensor into the #11 analog input seen in figure 5-8.

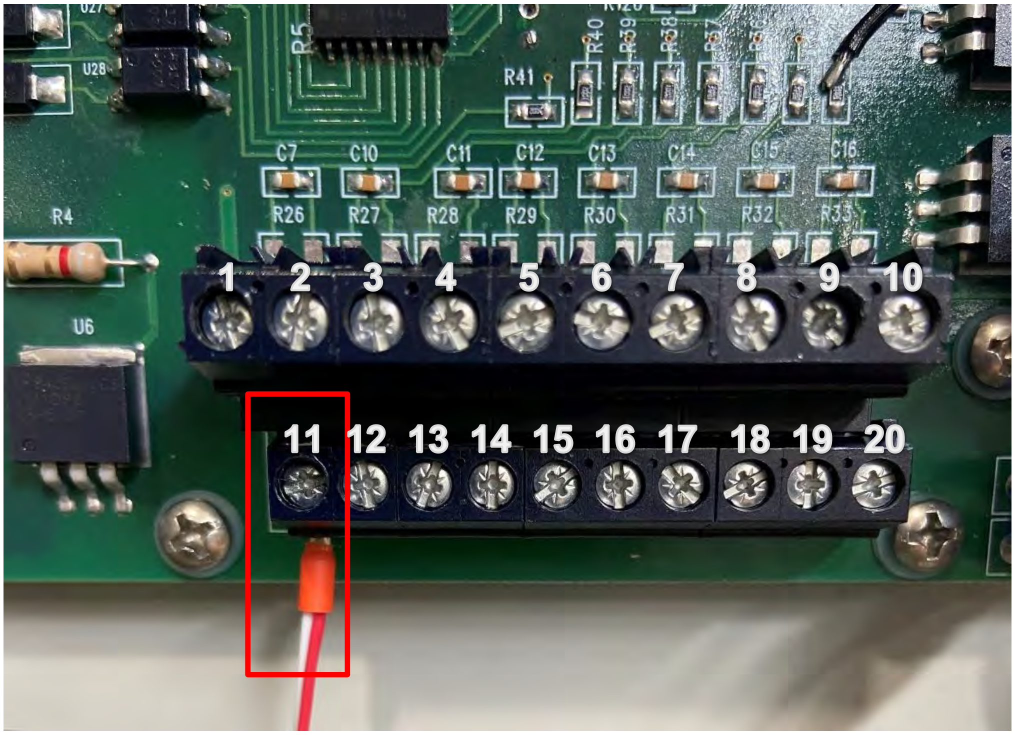


Figure 5-8: DC Power Connection

3. For well #1, wire the Signal white wire from the optic sensor into the #1 analog input seen in Figure 5-9

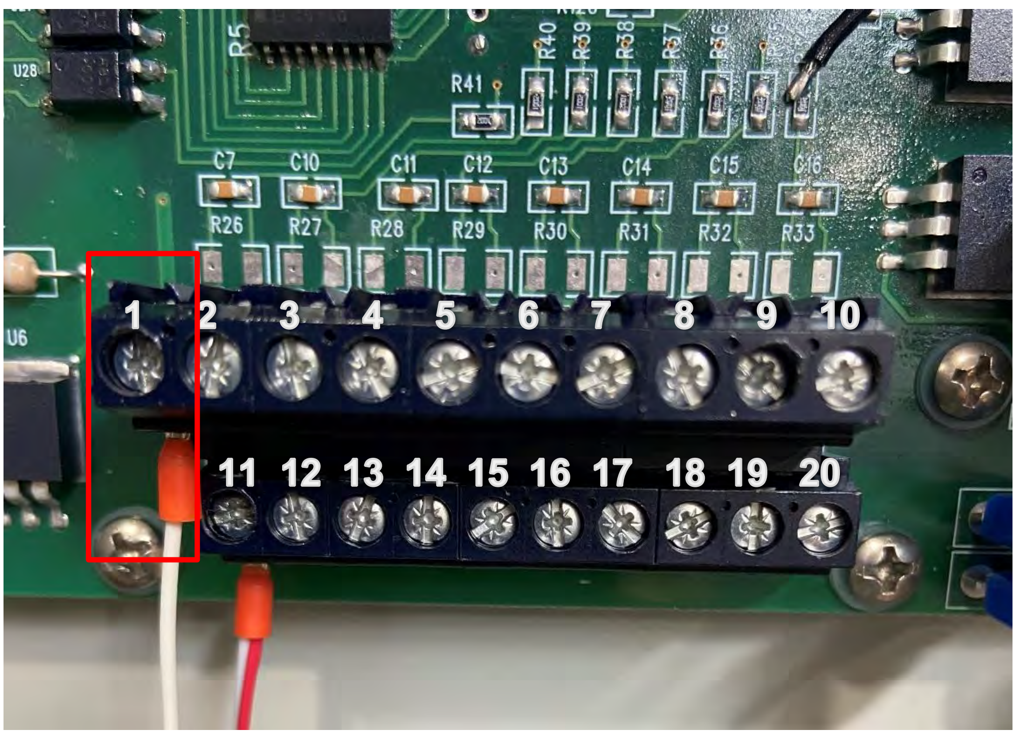


Figure 5-9: Signal Connection

4. For additional optic sensors, install wires along the terminal strip.
   - EX: Sensor 2 DC Power red and white bundle on terminal #12 and Sensor 2 Signal white wire on terminal #2. Sensor 3 DC Power red and white bundle on terminal #13 and Sensor 3 Signal white wire on terminal #3, and so on, up to 6 wells.

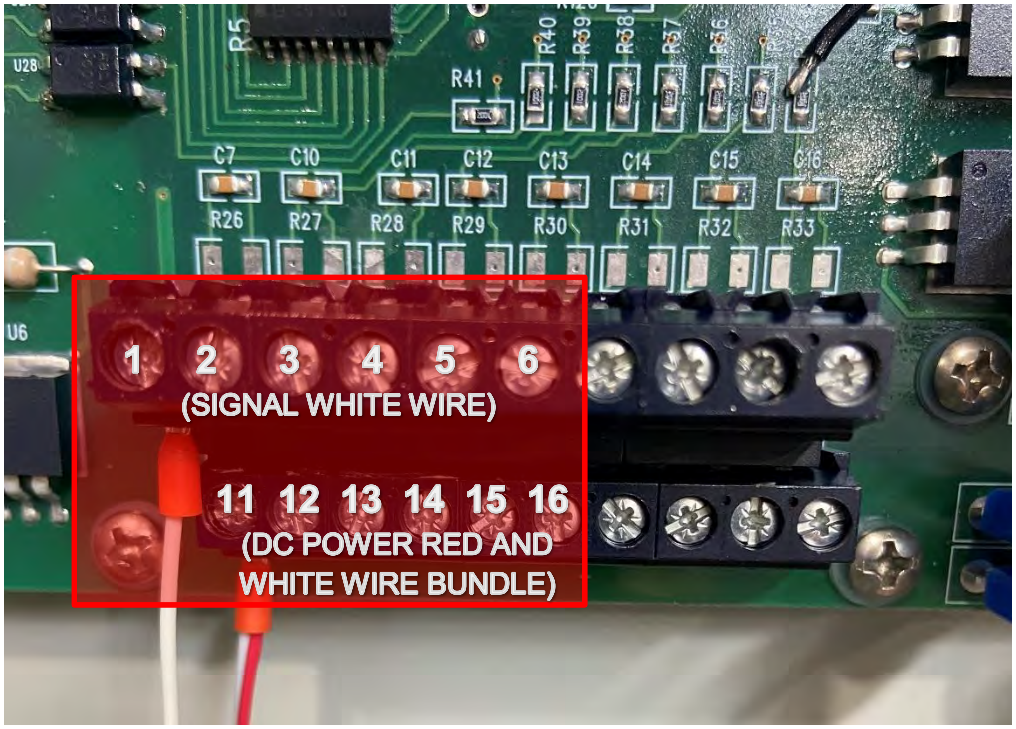


Figure 5-10: Additional optic sensor input DC Power/Signal

5. Once all sensors are wired, strip the Ground green wire on the optic sensor with wire strippers.
   - Do this for all optic sensors that will be installed.

6. Twist the stripped Ground green wires from sensors 1-4 together.
   - If there are more than 4 sensors, twist the remaining green wires together in a separate bundle

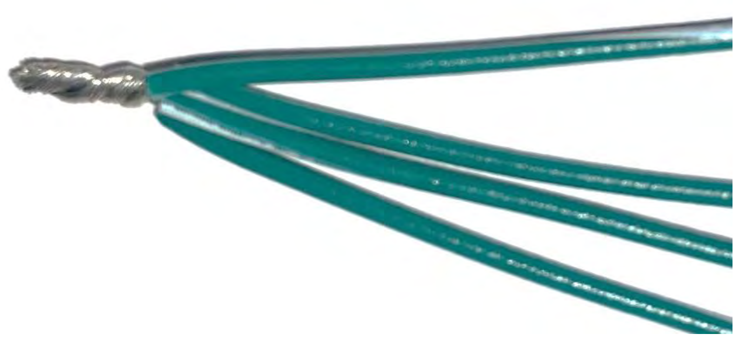


Figure 5-11: Ground Wire Bundle

7. Wire the first four Ground green wires into #9 Analog input seen in Figure 5-12.
    - If there are more than 4 sensors, then wire the remaining green wires into #10 Analog input.

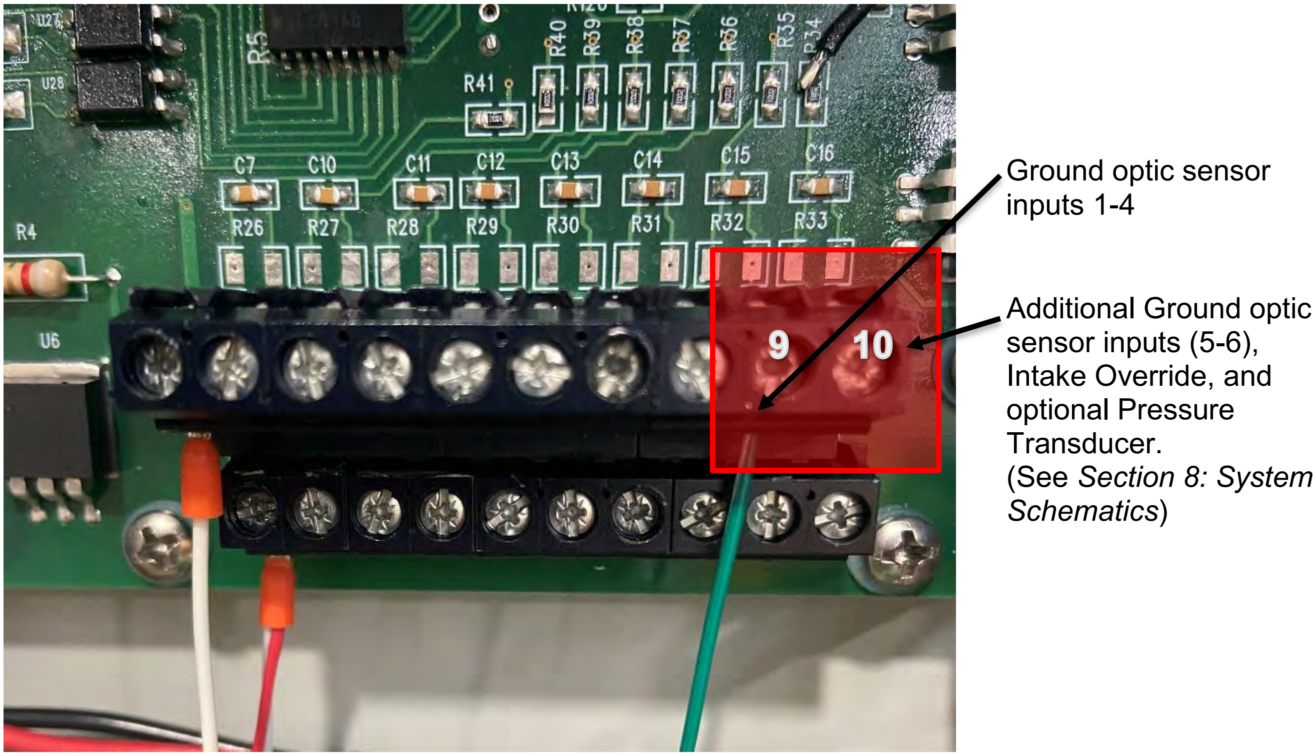


Figure 5-12: Ground optic sensor inputs

8. Install Intake Override sensor.

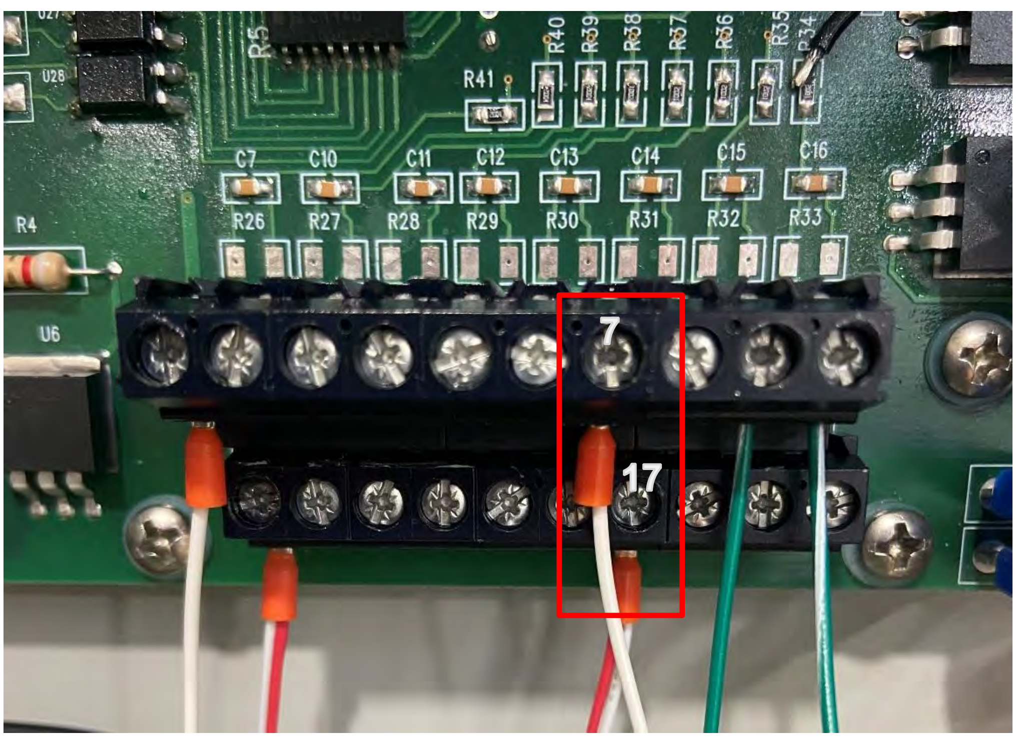


Figure 5-13: Intake Override input

9. Snap the optic sensor onto the appropriate well tubing near the bulkhead and place a zip tie to secure into place.
    - Orientation of sensor does not matter.

Figure 5-14: Optic sensor tubing installation

If this procedure does not resolve the issue, or if your system is equipped with a Intake Float Switch (see Figure 5-14), then contact Geotech Technical Sales for further troubleshooting advice @ 1-800-833-7953.

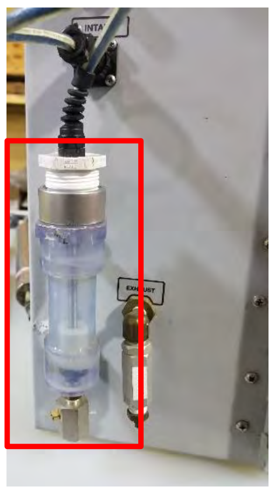


Figure 5-14: Intake Float Switch

Section 6: System Troubleshooting

Problem: No product is being recovered but system cycles and gauge indicates vacuum and pressure generation.

Solution:

- Inspect product hose for kinks and blockage. Replace if needed. If freezing conditions have occurred, check the discharge lines for frozen product.
- Remove and inspect the check valve at the top of the stainless steel pump. If the check ball is stuck in the UP position, clean and gently dislodge the ball. (Periodic replacement of the check valve may be required depending on duty cycle.)
- The check valve in the top of the pump may have been re-installed upside down. The arrow on the check valve should point away from the pump and toward the discharge tubing.
- The directional solenoid plumbed directly to the compressor could be stuck. If it is locked up, it may be cleared by depressing the small button on the black end of the solenoid using a small Phillips screwdriver or paper clip to actuate the solenoid manually. If this does not work, remove the small plate at the other end of the solenoid and clean the plunger and plunger cavity using the procedure found in *Section 5: System Maintenance*.
- Visually inspect the wiring connections to see that they are not loose or otherwise compromised.

Problem: System cycles but gauge does not indicate vacuum or pressure generation.

Solution:

- Inspect product hose for abrasion, cuts, or open connections. Replace if needed.
- Make sure the airline connection goes to the pump and that the vent connection (the exhaust) is plumbed to the recovery tank.
- Verify that there is product in the well. If so, verify that the Skimmer intake is at the correct level in the well so that product can be recovered.
- Open the controller panel and verify that all air line connections are intact.

Problem: A pump is stuck in either vacuum or pressure.

Solution:

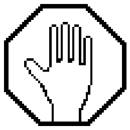
- Inspect the solenoid for residue or debris. If it is locked up, it may be cleared by depressing the small button on the black end of the solenoid using a small Phillips screwdriver or paper clip to actuate the solenoid manually. If this does not work, remove the small plate at the other end of the solenoid and clean the plunger and plunger cavity using the procedure found in *Section 5: System Maintenance*.
- Visually inspect the wiring connections to see that they are not loose or otherwise compromised.

Problem: Solenoid continues to stick, even with frequent cleaning (as per *Section 5 – Solenoid Maintenance*).

Solution:

- System is operating in humid conditions, which can cause residue or debris to accumulate within the solenoid. System may be installed with optional Desiccant Dryers. *See Section 9: Parts and Accessories* for Desiccant Dryer information, or contact Geotech Technical Sales for assistance.

Problem: The screen is blank.



DO NOT TURN THE SIPPER SWITCH OFF AND ON AGAIN TO FORCE A CYCLE.

Solution:

- Press the UP arrow button. If the system is currently in a low voltage shut down, a low voltage display will be present. If all equipment is functional, then allow the unit time to recharge. See also the low battery definition in *Section 3: Timer/Cycle Settings and Display Descriptions*.
- Check for loose or damaged battery connections and solar panel connections.
- Use a voltmeter to test the battery voltage. If it is below 10V remove the battery and charge it on a separate charger to verify that a charge can be retained. Reconnect the battery and test the system. Otherwise, when the solar panel is exposed to enough sun, the battery will eventually recharge and the system will automatically resume normal operation.
- Turn off the power and check the main fuse.

Problem: The screen shows unintelligible characters.

Solution:

- Use a voltmeter and ensure the battery voltage is over 12.1V if not, remove the battery and charge it on a separate charger. Otherwise, when the solar panel is exposed to enough sun the battery will eventually recharge and the system will automatically resume normal operation.
- The screen display has no effect on the other hardware functions. If the voltage is over 12.1V, turn the ON/OFF switch to OFF and wait 60 seconds before switching on again.

Problem: System is displaying a Battery Fault Check Cables alarm.

Solution:

- Disconnect all voltage sources (battery, solar panel) then check Figure 2-3 and re-wire the solar panel and battery to the correct terminals.
- The fuse may have blown, check the fuse with a Multimeter and replace if necessary.
- Battery may have been overcharged by another charging system and may need to be replaced. Verify battery voltage with a voltmeter.
- Visually inspect the wiring connections to see that they are not loose or otherwise compromised.

Problem: System is displaying a TANKFULL alarm.

Solution:

- Recovery tank is full. Empty and restart the system.
- Tankfull probe is disconnected or cable is damaged. Inspect probe and cable. Replace if needed.
- Verify the tankfull float is not stuck in the UP position.
- If the tankfull alarm will not clear then contact Geotech for assistance.

Problem: System is displaying an INTAKE OVERRIDE alarm.

Solution:

- The Intake Sensor detects the presence of fluid. This is caused when product or moisture is pulled through the air line due to:

  1. Long cycle time on vacuum.
  2. The directional solenoid on the compressor is stuck.
  3. An accumulation of moisture in the air line during operation.

  Allow the system to clear product out of the manifold and past the air filter. Disconnect the line and use a standalone air source. Do not use more than 100 PSI (6.9 bar) of pressure to finish evacuating the air line of product.

  Temporarily set the vacuum to 0 and the pressure to 30. Allow the Sipper controller to clear product out of the lines. Once product has been cleared from the lines, adjust the vacuum and pressure to previous settings.

  If fluid is seen in the line, replace tubing.

Problem: A pump and Skimmer assembly is not functioning, or has been removed from service, on a multiple pump system.

Solution:

- Set the vacuum, pressure, and delay for the inoperable pump to the lowest setting possible. Then disconnect the airline at the air filter on the side of the Sipper enclosure. The unit will continue to run all pumps in sequence with minimal use of battery power on the out of service pump.

Problem: Controller displays a low battery condition and the battery will not recharge.

Solution:

- If the system experienced freezing conditions, then the battery may be frozen. Place the battery in a warm spot and allow it time to thaw, then reconnect and let it re-charge as normal.
- Battery may need to be replaced. See wiring schematics in *Section 2: System Installation*.
- Additional solar panels may be required to keep the system running.
- Turn unit off and back on to reset the clock crystal.

Problem: Counters running slow.

Solution:

- Turn unit off and back on to reset the clock crystal.

If your solution cannot be found within this section, please call Geotech Technical Sales for expert troubleshooting advice @ 1-800-833-7958.

Section 7: System Specifications

Applications	2" (5.8 cm) or larger recovery wells
Recovery Rate	.2 gallons (.76 liters) per cycle
Max. Operating Depth	180’ (54.86 m)
Max. Pressure	100 PSIG (7 bar)
Max. Vacuum	20" (50 cm) Hg @ MSL (mean sea level)
Oil/Water Separation	Oleophilic/hydrophobic mesh screen

Power

Power Maximums	(AC Sipper) 87 to 240VAC, 2.7 to 1 Amp(s) (Solar Sipper) 12-15VDC input @ up to 14.5 Amps 90 ~240 Watts continuous

Power usage will vary depending on application.

Controller

Operating Temperature	32° to 104º F (0° to 40° C)
Storage Temperature Range	-20º to 150º F (-29° to 66° C)
Humidity	90% non-condensing (max)
Size	10" D x 18" T x 16” W (25cm D x 46cm T x 40.5cm W)
Rating	NEMA 3R
Approximate Weight	35 lbs (16 kg) (single channel AC Sipper)
Approximate Weight	34 lbs (15 kg) (single channel Solar Sipper)
Approximate Weight	51 lbs (23 kg) (eight channel AC Sipper)
Approximate Weight	49 lbs (22 kg) (eight channel Solar Sipper)
Fittings	.17 x 1/4” MPT Brass Hose barb

Additional customizations and accessories could add more weight.

Pump Assembly

Size:	23.5”L x 1.75” OD (60 cm L x 4.5 cm OD)
Weight:	4.5 lbs. (2 kg)
Materials:	303 and 304 SS, flexible rubber tubing, PVC, Brass

Skimmer Assembly	**2” Model**	**4”Model**
Effective travel range:	12” (30.5 cm)	24” (61 cm)
Size:	35.5” L x 1.75” OD (90 cm L x 4.4 cm OD)	35.5” L x 3.75” OD (90 cm L x 9.5 cm OD)
Weight:	1.75 lbs. (.8 kg)	2.25 lbs. (1.02 kg)
Operating Temperature:	32° to 104º F (0° to 40° C)	
Storage Temperature:	-20º to 150º F (-29° to 66° C)	
Materials:	304 SS, Polyethylene, PVC, Polypropylene, Brass	
Tubing - Air:	.17" ID x .25" OD (4 mm ID x 6 mm OD)	
Tubing - Discharge:	.375" ID x .5" OD (9.53 mm ID x 12.7 mm OD)	

Solar Panel:

Rated Power	100 Watts (standard unit)
Operating Voltage	17.4 VDC
Maximum Voltage	21.5 VDC
Operating Amperage	4.88 Amps (standard unit)
Maximum Amperage	5.8 Amps
Size:	43.31” X 28.15” X 3.15” (110 cm X 71.5 cm X 8 cm)
Approx. Weight:	19.62 lbs (8.9 kg)

Solar Panel Mounting System:

Module Tilt Range	15 to 65 degrees
Pole Size	2" (5 cm), 4" (10 cm), and 6" (15cm)
Module Orientation	Landscape/Portrait
Max Wind Speed	125 mph (200 kph)
Wind Exposure	Category B & C
Materials	5052-H32 Aluminum Powder Coated Steel Stainless Steel Fasteners

Ground/Roof Mount

Module Tilt Range	0 to 90°
Module Orientation	Landscape/Portrait
Wind Speed Max	Dependent on mounting
Wind Exposure	Dependent on mounting
Materials	Powder Coated Steel Stainless Steel Fasteners

Cellular Radio Specifications

Cellular Network	2G to 4G LTE, NB-IoT, 5G, CAT-M, and eSIM (Most global cellular networks available) 4FF Nano
End Device Certified (LTE-M)	AT&T, Verizon, Bell, Telus
Compatible with other carriers offering LTE-M and NB-IoT services	Bands 1, 2, 3, 4, 5, 8, 12, 13, 18, 19, 20, 25, 26, 28 and 39
Regulatory Approvals	FCC (USA) MCQ-XB3M1 IC (CANADA) 1846A-XB3M1 CE / RED (EUROPE) Complete RCM (AUSTRALIA/NEW ZEALAND) Complete

FCC certified and carrier end-device certified

Section 8: System Schematics

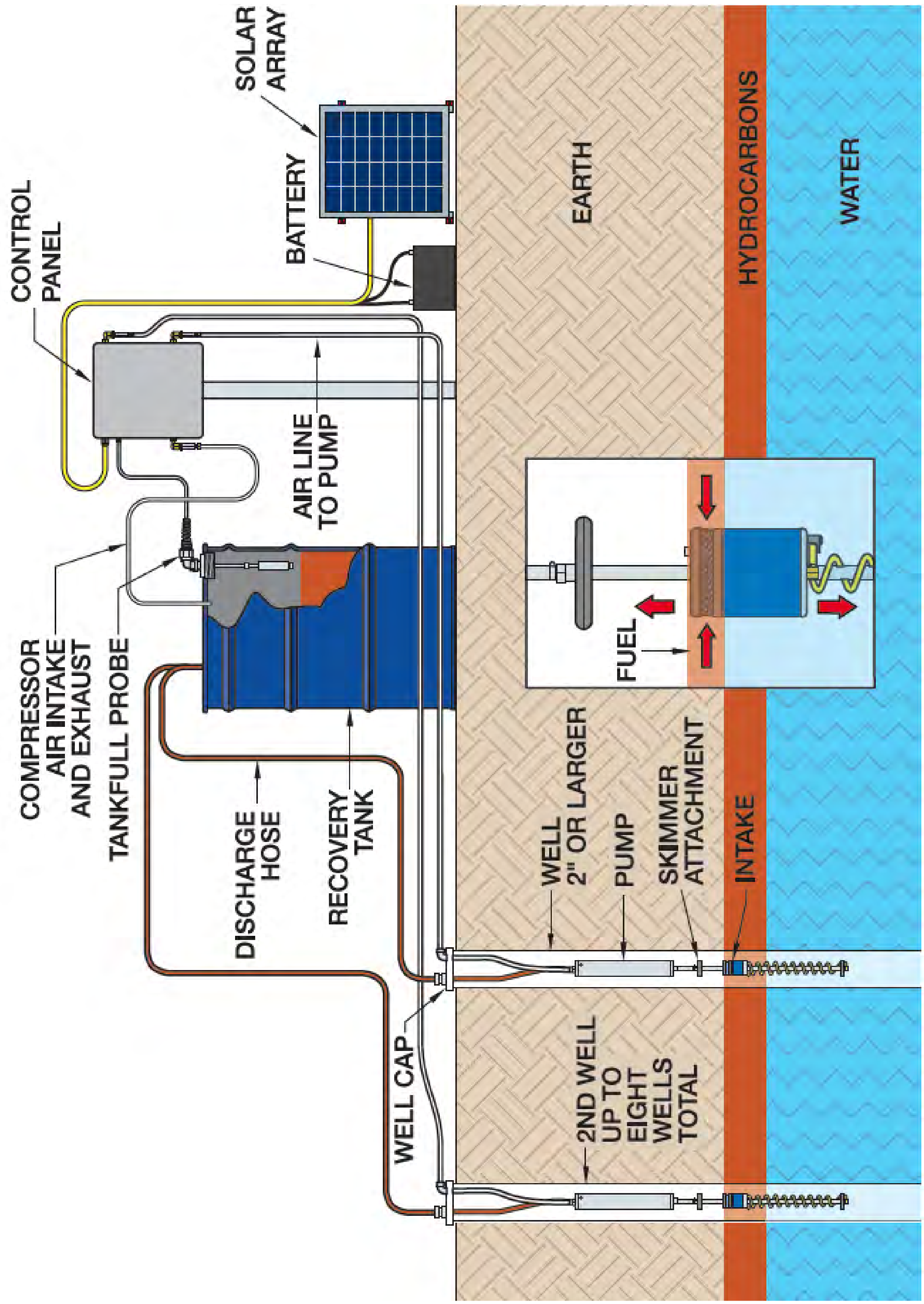


Figure 8-1: Solar Sipper Schematic

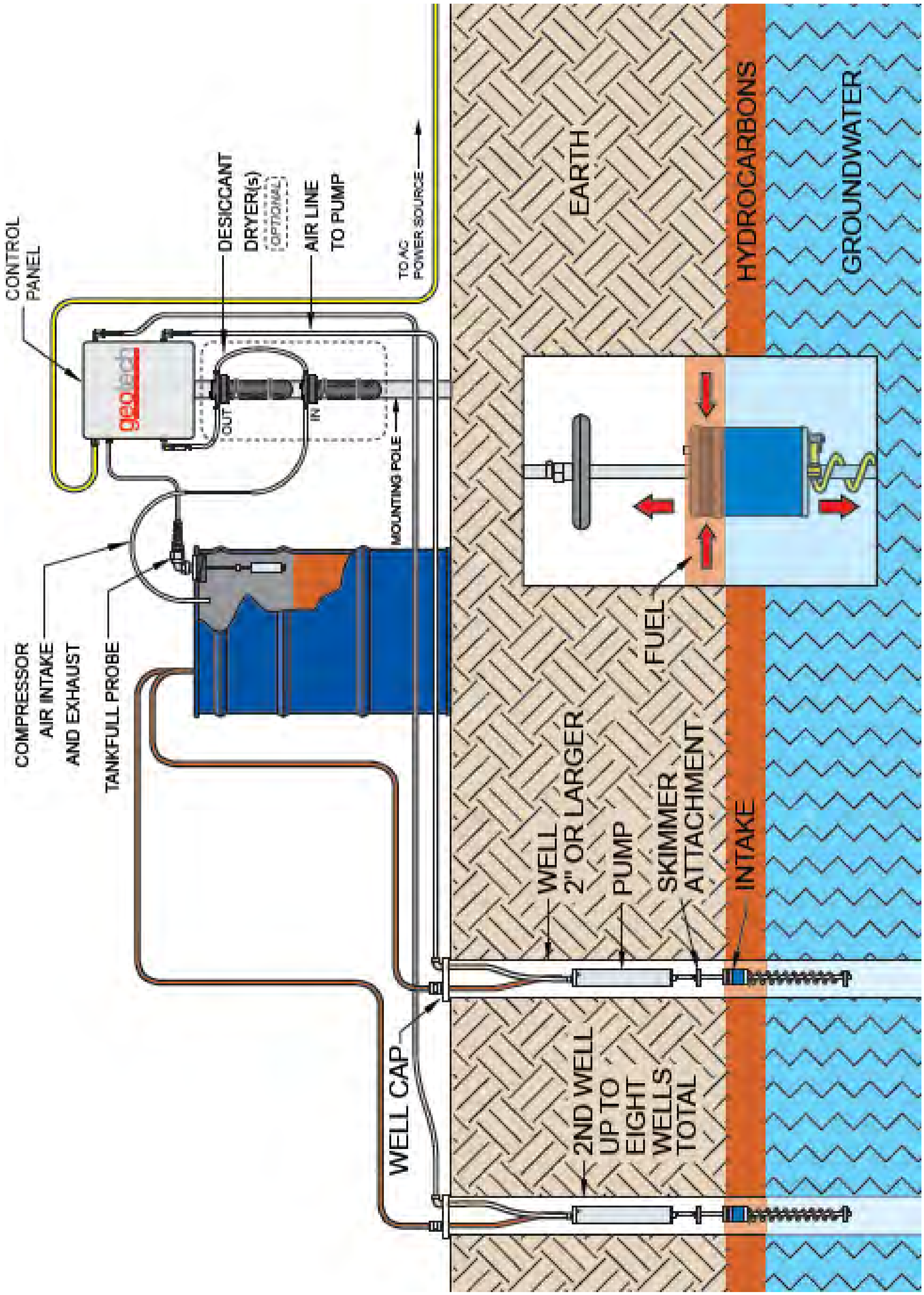


Figure 8-2: AC Sipper Schematic, shown with optional Desiccant Dryers

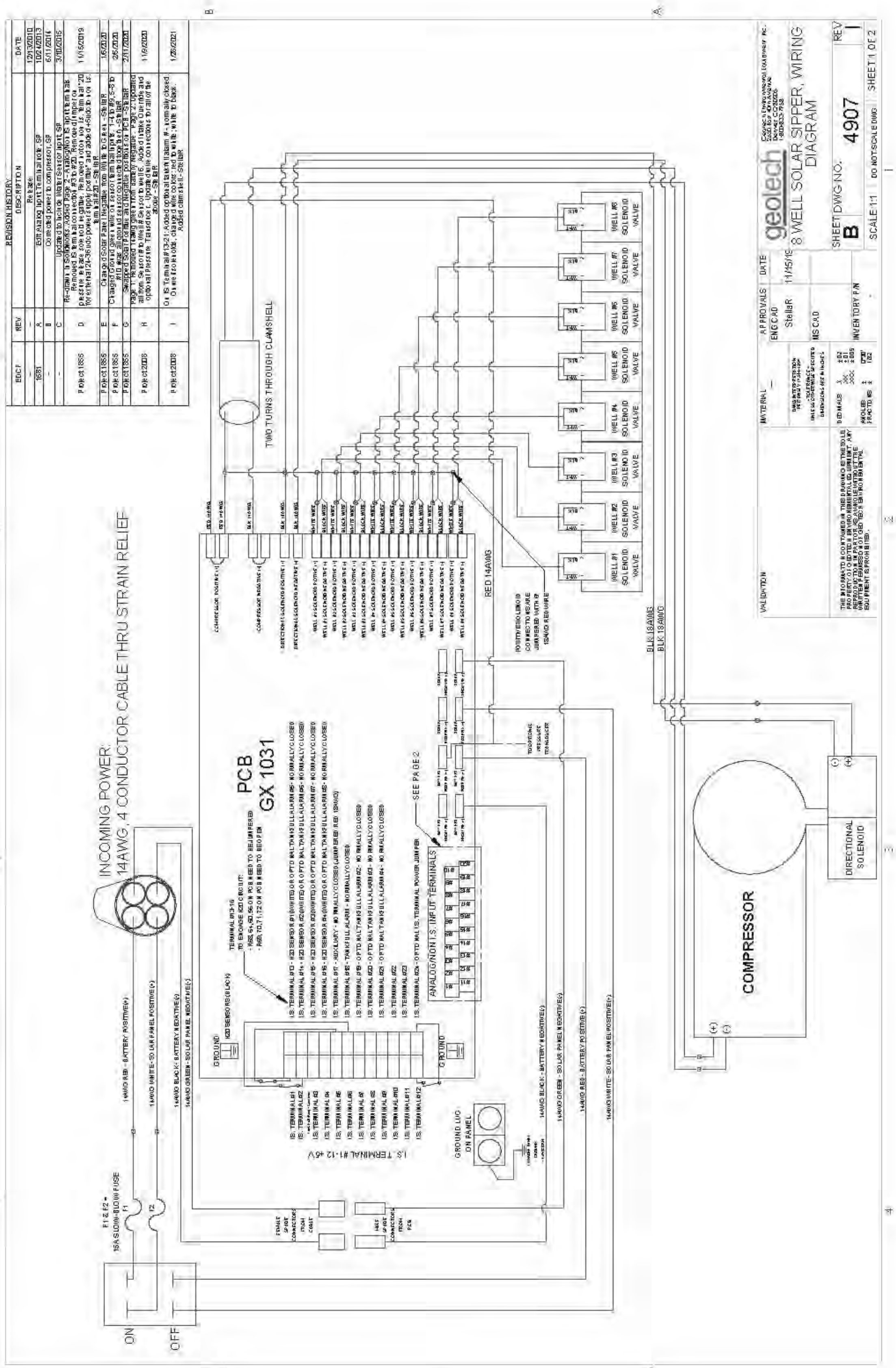


Figure 8-3: 8 Well Solar Sipper Internal Wiring Diagram

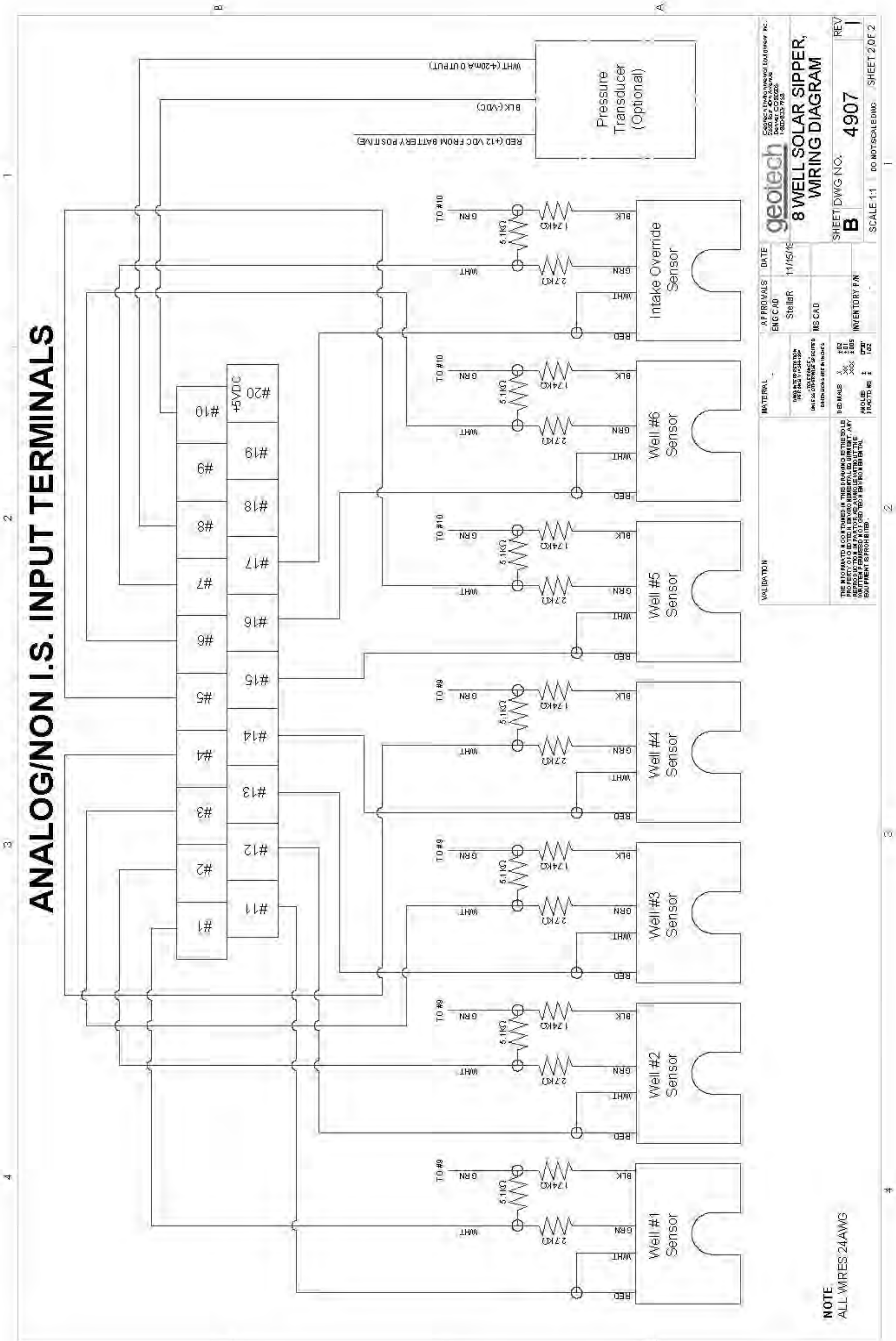


Figure 8-4: Solar Sipper Analog/Non I.S. Input Terminals

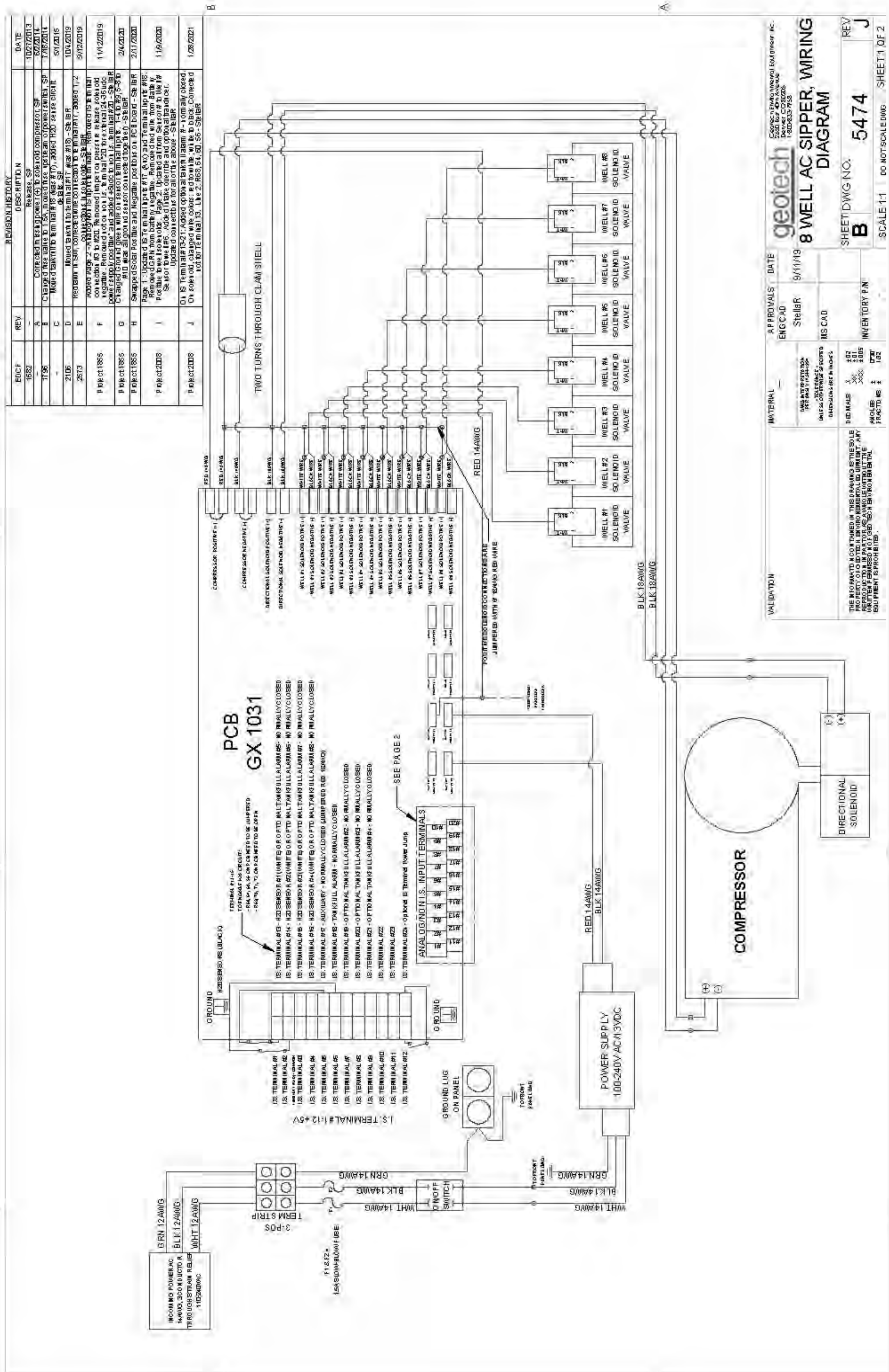


Figure 8-5: 8 Well AC Sipper Internal Wiring Diagram

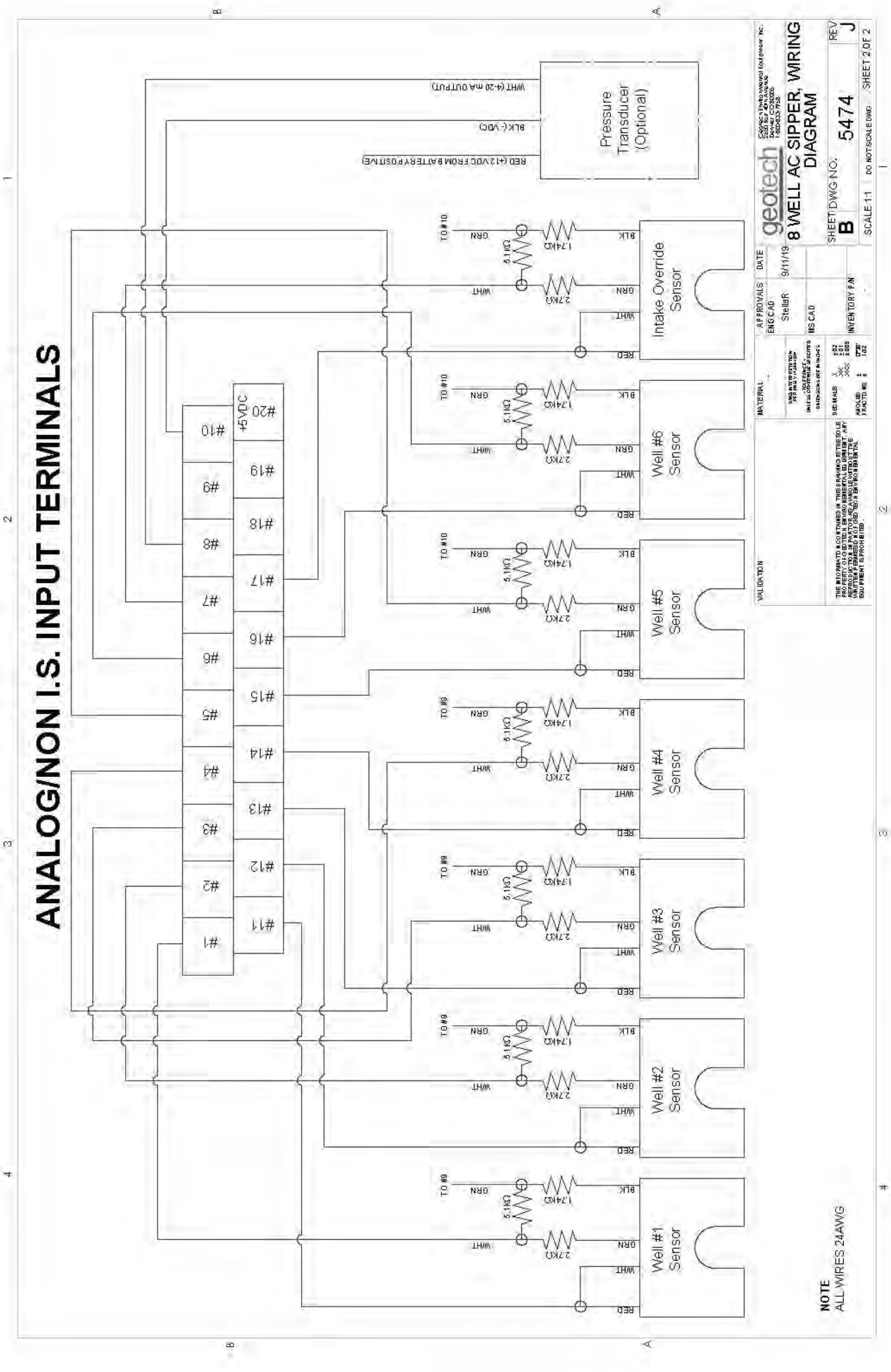


Figure 8-6: AC Sipper Analog/Non IS Input Terminals

Section 9: Parts and Accessories

Description	Part Number
MANUAL, SOLAR SIPPER	16550176
MANUAL, SIPPER PUMP & SKIMMER ASSEMBLY	16550181
MOUNTING HARDWARE TABS (FEET)	16110181
FUSE HOLDER ASSEMBLY	2010029
COMPRESSOR,PRO,SIPPER	11150325
SOL/SPRING,2POS,12VDC,1/8"NPT	16550262
SOLENOID,GEOCONTROL PRO	11150249
GASKET, SIPPER VALVE, 20/PK FOR VALVE 16550262	16550353
ORING,SIPPER VALVE,20/PK	16550352
SIPPER TANK, MANIFOLD, 2 WELL	56550050
SIPPER TANK, MANIFOLD, 3 WELL	56550051
SIPPER TANK, MANIFOLD, 4 WELL	56550052
SIPPER TANK, MANIFOLD, 5 WELL	56550053
SIPPER TANK, MANIFOLD, 6 WELL	56550054
SIPPER TANK, MANIFOLD, 7 WELL	56550055
SIPPER TANK, MANIFOLD, 8 WELL	56550056
AC Sipper	
CABLE,MOTORLEAD,12/3,SEOPRENE SEOOW,YELLOW	17050002
ASSY, POWER SUPPLY, AC SIPPER	56600090
FUSE,1.5A,250V,SLO-BLO	PPE011025
Solar Sipper	
CABLE,SEO,14/4,YELLOW	10014
FUSE,15A,MDL TYPE	PPE011035
Solar Panel	
SOLAR PANEL WITH FRAME,100 WATT	86550007
SOLAR PANEL,100 WATT	16550251
MOUNTING RACK,SOLAR PANEL	16550252
CABLE,THW,12AWG SUBMERSIBLE PUMP,BLACK/RED,RIBBON	11200479
BATTERY,SOLAR AGM,104 AH,12V	16550253
FLAT MOUNT,SOLAR PANEL	16550356
Float Switch Assemblies	
PROBE, TANKFULL, SOLAR SIPPER 25'	56650100
ASSY,OPTIC-SENSOR,SIPPER	56550049
Sipper Well Cap and Tubing Accessories	
WELL CAP,2",SLIP W/ CMPRSN FTG SIPPER	86600061
WELL CAP,4",SLIP W/ CMPRSN FTG SIPPER	86600062

Sipper Tubing (Air) – available by the foot or in 500' rolls.

TUBING,PE,.170x1/4,FT POLYETHYLENE	87050501
TUBING,TLPE,.170x1/4,FT FEP LINED POLYETHYLENE	87050529
TUBING,FEP,.170x1/4,FT FEP	87050509

Sipper Tubing (Discharge) – available by the foot or in 500' rolls.

TUBING,RBR,3/8x5/8,FT PRODUCT DISHCARGE	16600019
TUBING,TLPE,3/8x1/2,FT FEP LINED POLYETHYLENE	87050506
TUBING,FEP,3/8x1/2,FT FEP	87050511

Tubing Clamps

CLAMP,NYL,1/4" SNAPPER	11150259
CLAMP,SS,STEPLESS EAR,17MM	16600004
CLAMP,SS6,WORM,7/32-5/8"	16600063

Optional Parts and Accessories

REBUILD KIT, COMPRESSOR, SIPPER PRO	11150334
DESICCANT DRYER, SIPPER	56550048
SILICA GEL, DESICCANT DRYER REFILL, 8 PACK	16600323
SITEVIEW,SETUP FEE,PER RADIO	12350014
SITEVIEW,15 MINUTE LOGGING ANNUAL DATA AND CLOUD SERVICES	12350012
RF TXRX,CELL,4G LTE,AT&T/VERIZ	12350000
ANTENNA,CYCLOPS,3G/2G,WALL MT	12050954
DRUM,55GAL,STEEL,EPOXY LINED,BLUE,W/2&3/4 BUNG	10759

**Systems equipped with Telemetry send Text Message Alarms from the system.
Ask your Geotech Sales Representative for more information.*

Sipper Pump and Skimmer Parts and Accessories

See "Geotech Pump and Skimmer Assembly Installation and Operation Manual" (P/N 16550181), for a complete description and listing of available pumps, skimmers, and their accessories.

DOCUMENT REVISIONS		
EDCF#	DESCRIPTION	REV/DATE
-	Previous Release	2/15/2013
1583	Added Compressor Repair Kit to Replacement Parts List. Added Revision History Table - SP	5/24/2013
1713	Edited Section 9: Parts and Accessories – Solar Panel now 100 Watts (was 85 Watts), updated Solar Panel Specs - SP	12/18/2013
1725	Edited Section 3: Timer/Cycle Settings and Display Descriptions – Factory Default timers will be set to 0 seconds for vacuum, pressure, and delay – SP	1/10/2014
Project 1377	Added Desiccant Dryer Kit details to Section 4: System Operation, Section 6: System Troubleshooting, and Section 9: Parts and Accessories – SP	1/10/2014
Project 1411	Edited Section 3: Timer/Cycle Settings and Display Descriptions – Factory Default timers will be set to 1 second of vacuum, 30 seconds of pressure, 5 minutes of delay – SP	3/21/2014
-	Added Desiccant Dryer Installation Guide, updated 8- well wiring diagram (rev B) - SP	1/5/2014
Project 1976	Updated new AC Sipper Power supply PN. Added Wireless Telemetry Communication parts to accessories list, updated Solar Panel wire colors, 3-well and 8-well page footers. -JH	6/14/2016
1993	General Formatting and Checking for Accuracy. Changed part number for power supply to 56600090 - StellaR	10/12/2017
-	Added AC Wiring Diagrams and replacement fuse, clarified Fluid Viscosity – StellaR	7/19/2018
Project 1765	Added detailed timer description, clarified text. Changed specifications to match spec sheet. Added mounting specification, added desiccant replacement instructions – StellaR	5/10/2019
Project 1805	Added PN 16550352 to parts list – StellaR	7/26/2019
Project 1855	Removed intake float and added intake switch. Added intake switch notes. Updated 8 Well AC and Solar wiring diagrams. Updated Solar Panel wiring diagram. Added Optic Sensor installation instructions. Added new PN for optic sensor. Updated images to remove intake float switch. – StellaR/LL	2/7/2020
Project 1855	Updated figure 8-3 to 8-6 - StellaR	2/13/2020
Project 1970	Added PNs 56550050-0056 – StellaR	4/17/2020
Project 1993	Added fitting size in specs – StellaR	7/1/2020
Project 2008	Updated displays, added SitePro, updated displays updated flow chart, updated wiring diagrams - StellaR	2/2/2021
Project 2008	Updated figure 3-1 – StellaR	3/23/2021
Project 2008	Updated figure 2-4 – StellaR	3/25/2021
Project 2160	Updated content to explain conductivity sensor and how to configure controller for conductivity sensor. – StellaR	6/8/2021

NOTES

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The Warranty

For a period of one (1) year from date of first sale, product is warranted to be free from defects in materials and workmanship. Geotech agrees to repair or replace, at Geotech's option, the portion proving defective, or at our option to refund the purchase price thereof. Geotech will have no warranty obligation if the product is subjected to abnormal operating conditions, accident, abuse, misuse, unauthorized modification, alteration, repair, or replacement of wear parts. User assumes all other risk, if any, including the risk of injury, loss, or damage, direct or consequential, arising out of the use, misuse, or inability to use this product. User agrees to use, maintain and install product in accordance with recommendations and instructions. User is responsible for transportation charges connected to the repair or replacement of product under this warranty.

Equipment Return Policy

A Return Material Authorization number (RMA #) is required prior to return of any equipment to our facilities, please call our 800 number for appropriate location. An RMA # will be issued upon receipt of your request to return equipment, which should include reasons for the return. Your return shipment to us must have this RMA # clearly marked on the outside of the package. Proof of date of purchase is required for processing of all warranty requests.

This policy applies to both equipment sales and repair orders.

FOR A RETURN MATERIAL AUTHORIZATION,
PLEASE CALL OUR SERVICE DEPARTMENT AT 1-800-833-7958

Model Number: _________________

Serial Number: _________________

Date of Purchase: _________________

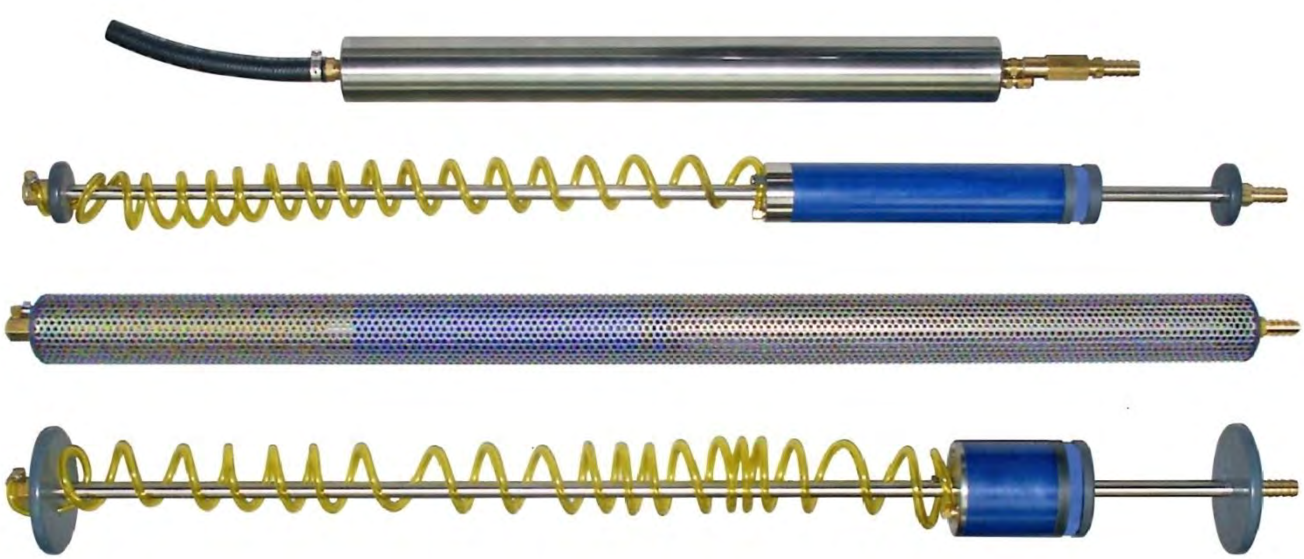
Equipment Decontamination

Prior to return, all equipment must be thoroughly cleaned and decontaminated. Please make note on RMA form, the use of equipment, contaminants equipment was exposed to, and decontamination solutions/methods used.

Geotech reserves the right to refuse any equipment not properly decontaminated. Geotech may also choose to decontaminate equipment for a fee, which will be applied to the repair order invoice.

Geotech Sipper Pump & Skimmer Assembly

Installation and Operation Manual



Rev 08/15/2019 Part # 16550181

TABLE OF CONTENTS

DOCUMENTATION CONVENTIONS

This document uses the following conventions to present information:

WARNING

An exclamation point icon indicates a **WARNING** of a situation or condition that could lead to personal injury or death. You should not proceed until you read and thoroughly understand the **WARNING** message.

CAUTION

A raised hand icon indicates **CAUTION** information that relates to a situation or condition that could lead to equipment malfunction or damage. You should not proceed until you read and thoroughly understand the **CAUTION** message.

NOTE

A note icon indicates **NOTE** information. Notes provide additional or supplementary information about an activity or concept.

Section 1: System Description

Function and Theory

The Geotech Pump and Skimmer assembly (Skimmer), when used in conjunction with the Geotech Sipper Controller efficiently collects free-floating hydrocarbons in 2” (5 cm) or larger recovery wells. The system consists of a Solar or AC Sipper controller, a stainless steel pump assembly, an attached Skimmer with floating intake cartridge (or buoy), and a Tankfull probe as shown in Figure 1-1.

The Sipper controller regulates, or cycles, the pump and Skimmer assembly with three timer settings (vacuum, pressure, and delay) which vary the cycle time and recovery rate of the Skimmer. See the Geotech Sipper User Manual for more details on Sipper operation.

Timed vacuum and pressure is applied to the pump to draw product from the Skimmer attachment, which is then discharged into an optional above ground recovery tank. The standard Skimmer features a unique product intake assembly that incorporates both a density float and an oleophilic/ hydrophobic membrane that differentiates between floating hydrocarbons and water.

The intake assembly follows the water table fluctuations and places the screen at the water/product interface, skimming light, non-aqueous phase liquid (LNAPL) down to a sheen within the range of the float travel. As the system cycles, product is drawn through the intake screen and is transferred to the pump through a coiled hose and the Skimmer’s transfer shaft. Optional heavy oil and high temperature Skimmers, using intake buoys, are also available to recover product in 4” (10 cm) diameter and larger wells.

The stainless steel pump is primarily an air driven reservoir with upper and lower check valves. The pump is designed to provide a two-phase pumping cycle. During the first phase, or pump intake phase, vacuum is applied to the pump. This vacuum closes the top discharge check valve while opening the bottom intake check valve, causing product to be drawn through the Skimmer intake screen and into the pump reservoir.

During the second phase, or pump discharge phase, the same airline is pressurized with air. This action closes the bottom, intake check valve on the pump and opens the discharge check valve, forcing the recovered product from the pump reservoir, into the product discharge line, up to the surface, and into a recovery tank. See Figure 1-2 for an example of a typical stainless steel pump cycle.

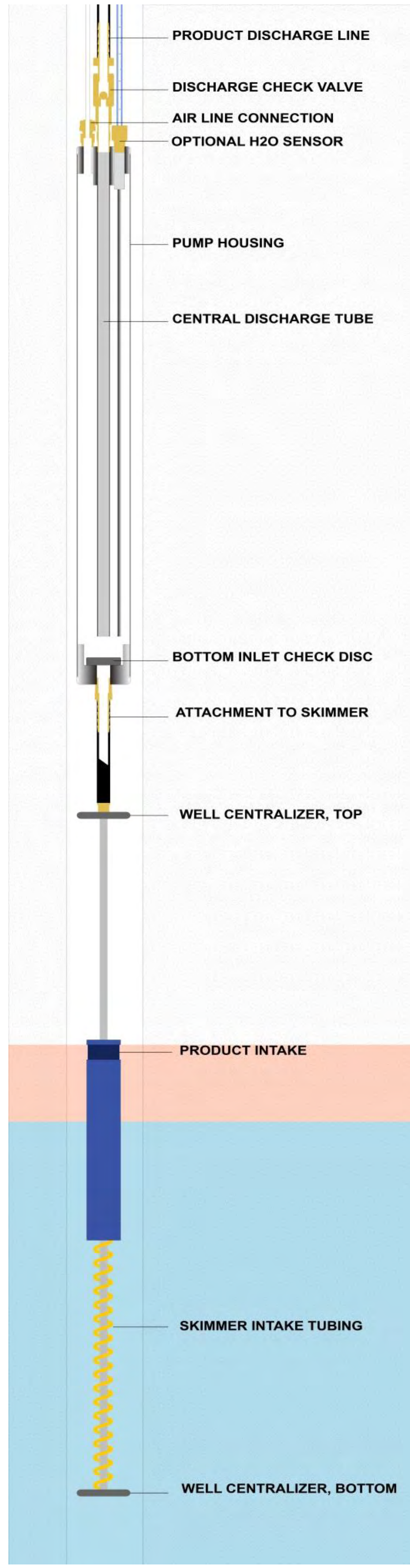


Figure 1-1: Example of a down well pump assembly

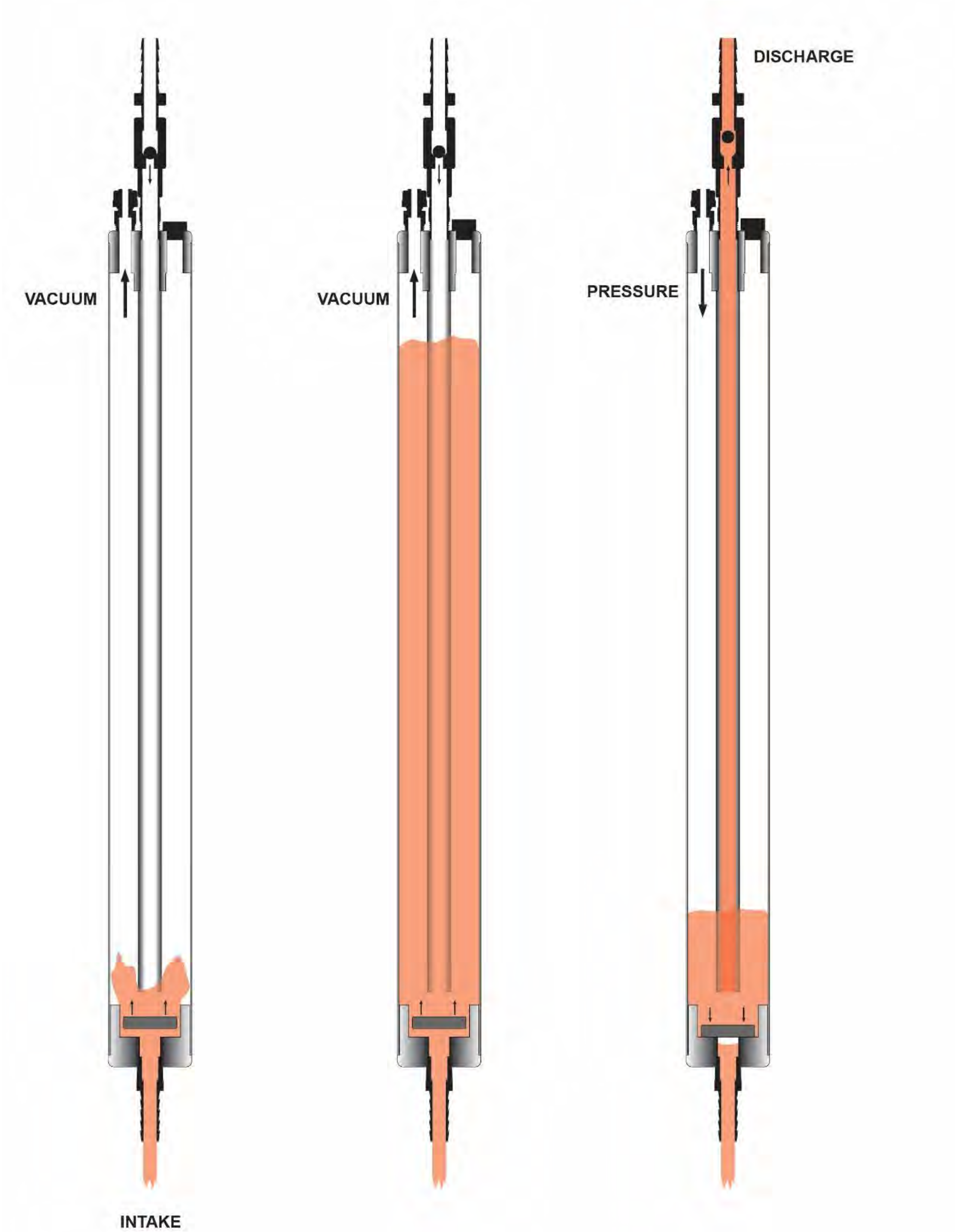


Figure 1-2: Typical Product Recovery Cycle in Stainless Steel pump

The stainless steel pump can be equipped with an optional Water (H2O) Sensor, which minimizes water intake by immediately purging the pump when water is present in the stainless steel housing. See *Section 3: System Operation* for more details.

Specific Gravity and Viscosity Limitations of Skimmer

The specific gravity of the product to be recovered with a Skimmer must be less than 1.0 and its viscosity less than 50 SSU for use with the "light" oil membrane, and 400 SSU for use with the "heavy" oil membrane cartridge. Geotech application engineers may be consulted for product recovery operations with viscosities outside that range. See Geotech Manual, "Hydrocarbon Viscosity Test Kit" for more information on choosing the correct intake membrane.

This type of membrane technology is designed to be used in wells with free product of at least 1/8" (3 mm) thickness.

The presence of surfactants or detergents in the product requires careful application. Surfactants and detergents may interfere with oil/water interface surface tension. This may interfere with pumping product layers of less than 1/8" (3 mm) as the oil water interface may become mixed.

The system will continue to operate and pump oil/water mixtures. When confronted with these contaminants please consult Geotech.

If using water sensor in stainless steel pump, the sensor may need to be temporarily removed/disconnected to allow oil/water mix to be pumped.

Other Applications for Stainless Steel Pump

The typical configuration of Stainless Steel Pump with attached Skimmer is implemented when floating hydrocarbons with density less than 1g per mL, or water, are pumped. Without the Skimmer, the stainless steel pump can be used either as a standalone total fluids pump or a DNAPL recovery pump.

Dense Non Aqueous Liquids (DNAPL) are liquids that have a specific gravity greater than 1, or water. Sources of DNAPL contamination are typically chlorinated solvents leaked from industrial processing and storage. DNAPL is particularly difficult to find in free phase in ground water aquifers. Typically, when free phase DNAPL is found it is at a solid rock barrier or a very low permeability material, such as tight clay. In either case, the recharge rate of the free phase DNALP layer at the bottom of a recovery well will typically be slow.

The stainless steel pump, when equipped with a Water Sensor and a screened intake is an effective way of pumping DNAPL. The water sensor will reduce the amount of non-DNAPL (water) pumped, and the screen intake will ensure proper operation of the pump's check valves in a potentially gritting environment. See Figure 1-3 for a DNAPL pumping configuration.

The system can be easily changed in the field from DNAPL recovery to a total fluid system by simply disconnecting the water sensing system.

Follow Skimmer attachment guidelines when connecting the DNAPL intake, see *Section 2: System Installation.*

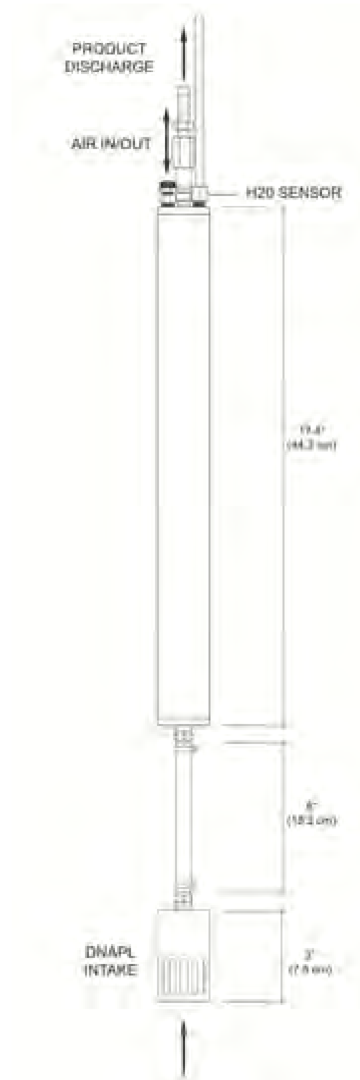


Figure 1-3: DNAPL recovery configuration for Stainless Steel Pump

System Components

Stainless Steel Pump Assembly

An air operated stainless steel pump is attached to the upper portion of the Skimmer. The pump consists of a stainless steel outer housing with top and bottom check valves.

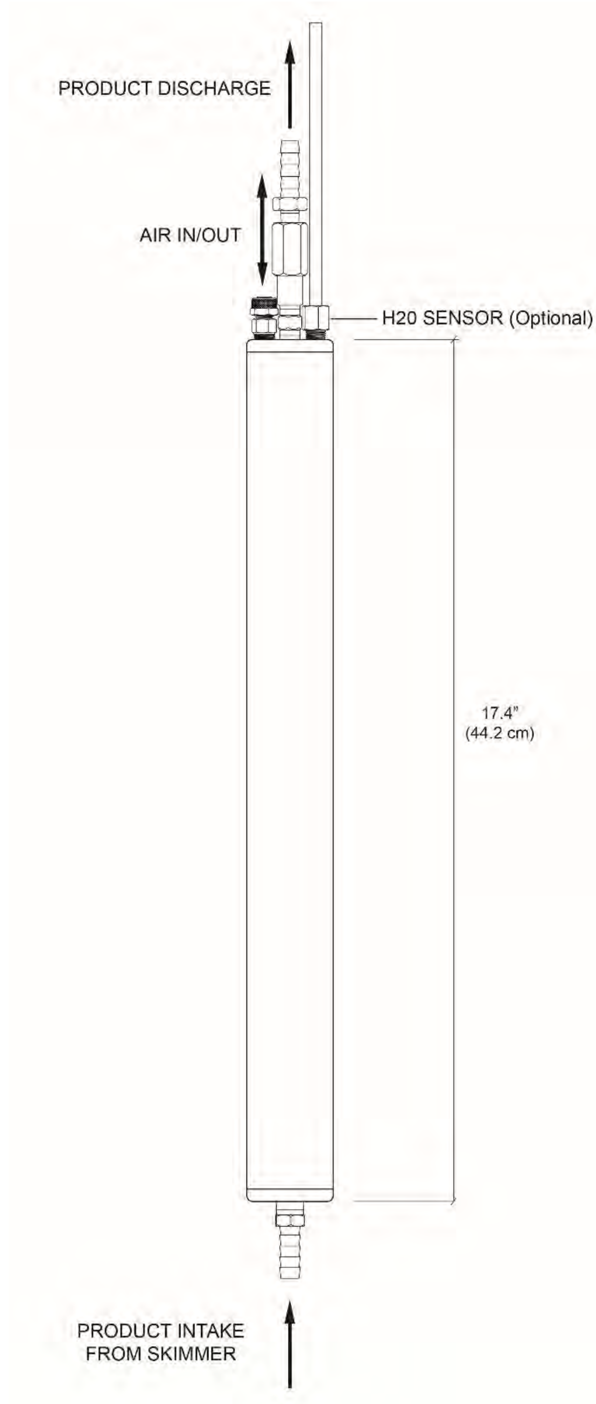


Figure 1-4: Stainless Steel Pump Assembly

Skimmer Attachments

A standard Skimmer attachment (when connected to the stainless steel pump assembly) is designed for use in either 2” (5 cm) diameter wells or 4” (10 cm) diameter and larger wells. Figure 1-5 shows an example of the two most common Geotech Skimmers. These Skimmers come with a standard 100-mesh intake screen. A 60-mesh intake screen is also available for use with higher viscosity fluids. See Geotech Manual “Hydrocarbon Viscosity Test Kit” for more information on choosing the correct intake cartridge.

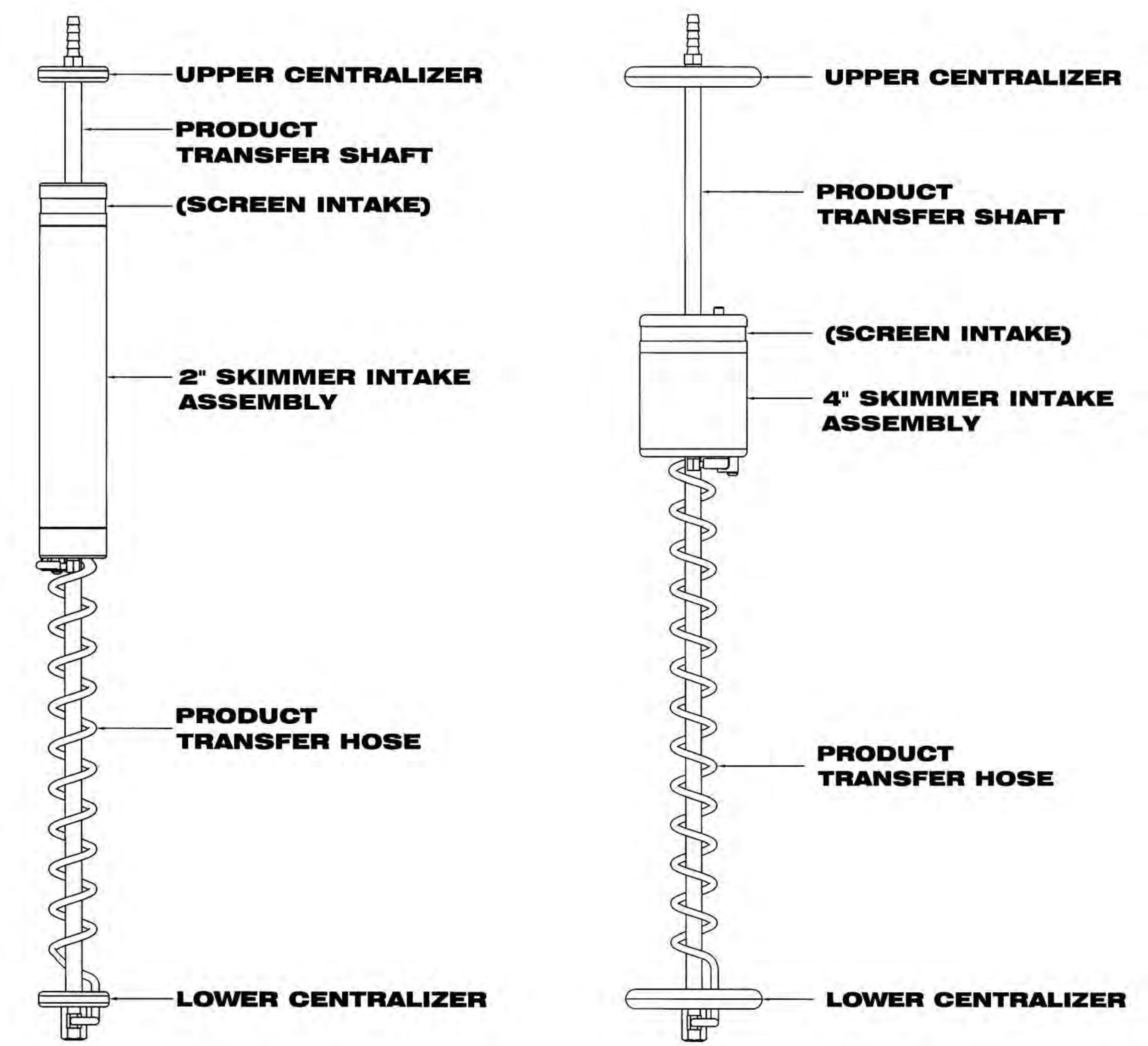


Figure 1-5: Standard 2” and 4” Skimmer Attachments

The Skimmer assembly is connected to the bottom of the stainless steel pump with a 6” piece of durable, fuel grade hose. The Skimmer consists of a product intake float, a coiled product transfer hose, and a transfer shaft. Well centralizers are placed at the top and bottom of the Skimmer shaft to protect the intake float and to allow unobstructed travel within the well. Standard Skimmers can provide 12” (30 cm) to 24” (61 cm) of intake travel. Geotech can provide up to 5’ (1.5 m) of travel (4” Skimmers only) on a custom order basis.

A Skimmer assembly will not draw water unless the intake cartridge is forcibly submerged, surfactants are present, or when the “conditioning” of the intake screen has been removed. See *Section 4: System Maintenance* for information on reconditioning the intake screen.

<u>Heavy Oil Skimmer Attachment</u>

The optional heavy oil Skimmer attachment is designed to recover a range of fluids from gasoline to gear oil, skimming the product down to .01’ (3 mm) in 4” (10 cm) diameter and larger wells. This option is best suited when the viscosity of the hydrocarbon is greater than the capability of the membrane screen technology (screen can no longer pass the hydrocarbon fluid).

The heavy oil Skimmer consists of a polypropylene intake buoy, a coiled product transfer hose, and a transfer shaft with well centralizers placed at the top and bottom. The intake buoy on the heavy oil Skimmer is designed to “ride” at the oil water interface and has a travel range of 24” (61 cm).

This assembly is ideal for use where the oil/water interface is broken down by detergents or is emulsified.

The intake buoy can also be “fine-tuned” by adjusting the intake fitting on the top of the buoy. Turning the fitting clockwise will lower the intake fitting relative to the product/water interface. Turning the fitting counter-clockwise will raise the intake fitting away from the interface. Figure 1-6 is an example of a heavy oil Skimmer assembly.

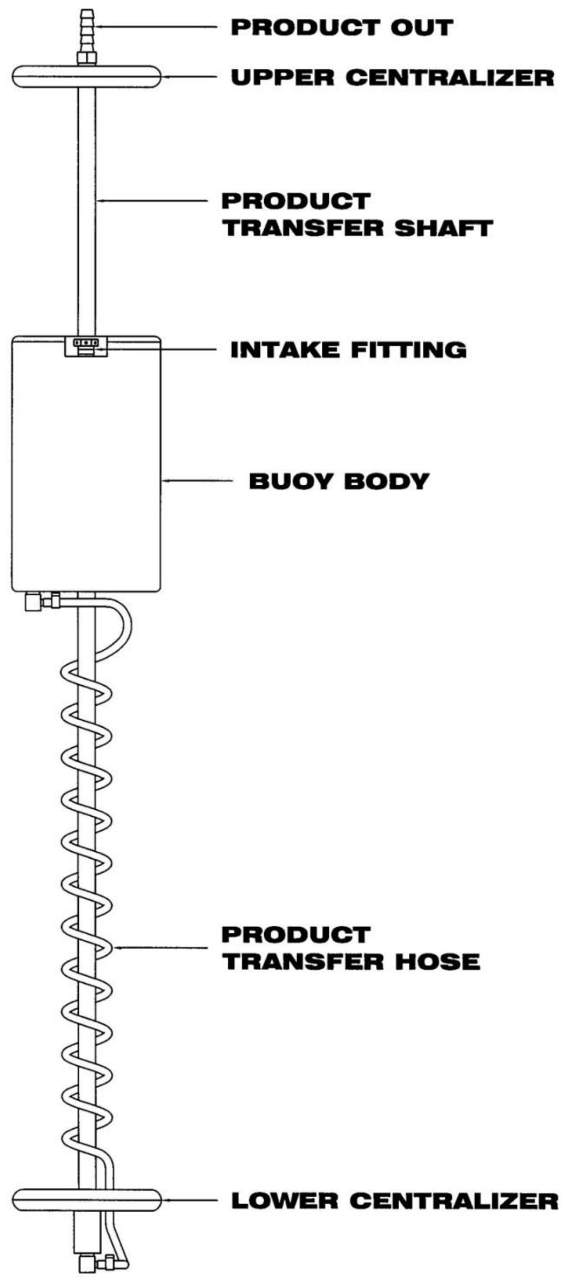


Figure 1-6: Heavy Oil Skimmer Attachment (optional)

High Temperature, Heavy Oil/Aggressive Chemical Skimmer Attachment

For high temperature well environments, Geotech provides a high temperature, heavy oil (HTHO) Skimmer that incorporates an ultra-high molecular weight (UHMW) polyethylene intake buoy. The HTHO Skimmer has stainless steel end caps placed at the top and bottom of a stainless steel screen to keep out debris. The intake buoy of the HTHO Skimmer has a travel range of 26" (66 cm).

Like the heavy oil Skimmer, the intake buoy can be "fine-tuned" by adjusting the intake fitting on the top of the buoy. Turning the fitting clockwise will lower the intake fitting relative to the product/water interface. Turning the fitting counter-clockwise will raise the intake fitting away from the interface.
Figure 1-7 is an example of the high temperature, heavy oil Skimmer.

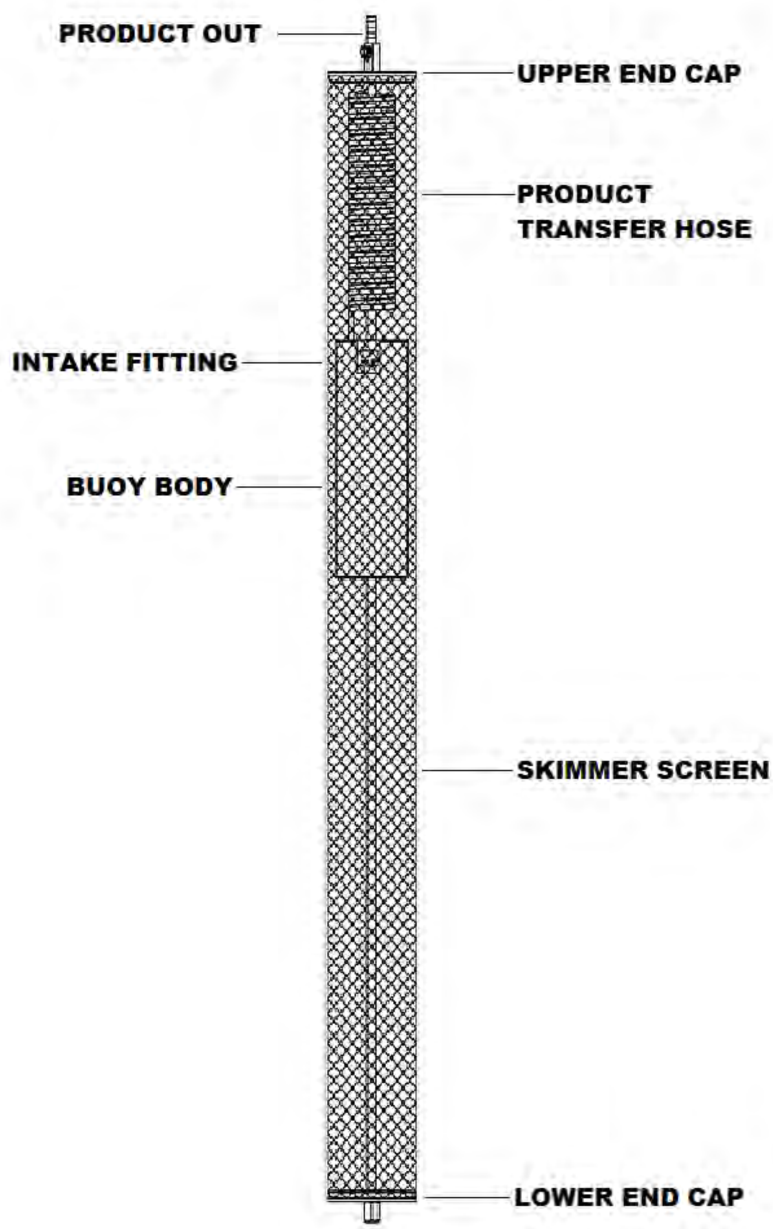


Figure 1-7: High Temp, Heavy Oil Skimmer Attachment (optional)

Section 2: System Installation

Prior to installation, ensure that the intake screen is “conditioned” (or primed, with diesel fuel or a similar hydrocarbon.) The optimum fluid would be to use the same down well hydrocarbon to be recovered. Use a soft, bristle brush to avoid damaging the screen intake.

Install well cap as per manufacturer guidelines.

Calculate the tubing lengths required to install the Skimmer. Normal tubing lengths are around 180’ (55 m) in well depth, suggested maximum is around 500’ (152 m) total system length. Longer systems can be accommodated if care is taken to protect tubing and account for longer cycle timers.

To calculate the amount of airline and discharge hose required to suspend the pump and Skimmer in the well, first determine the following lengths:

- Measure the static water depth in the well using a Geotech Interface Probe.
- Measure the distance between the wellhead and the Sipper controller.
- Measure the distance between the wellhead and the product recovery tank.

DO NOT cut tubing until all measurements, between the controller and wellhead, and from the wellhead to recovery tank have been made.

See Figure 2-1 for a view of the Skimmer in relation to the well cap and static water level.

If needed, attach the Skimmer or intake to the bottom of the stainless steel pump using the 6” (15 cm) piece of rubber fuel hose and hose clamps provided.

This hose connection is important. An old or brittle piece of fuel hose or a loose hose clamp between the pump and Skimmer could eventually cause the Skimmer to detach and fall into the well. Always inspect this connection prior to use.

1. Ensure both ends of the hose are placed as far as they can go on each hose barb and then tighten the hose clamps in place.

2. Check connection by gently tugging at each hose barb. The tubing should be secure.

3. Pull the measured lengths of airline and discharge hose through the fittings on the well cap (when applicable).

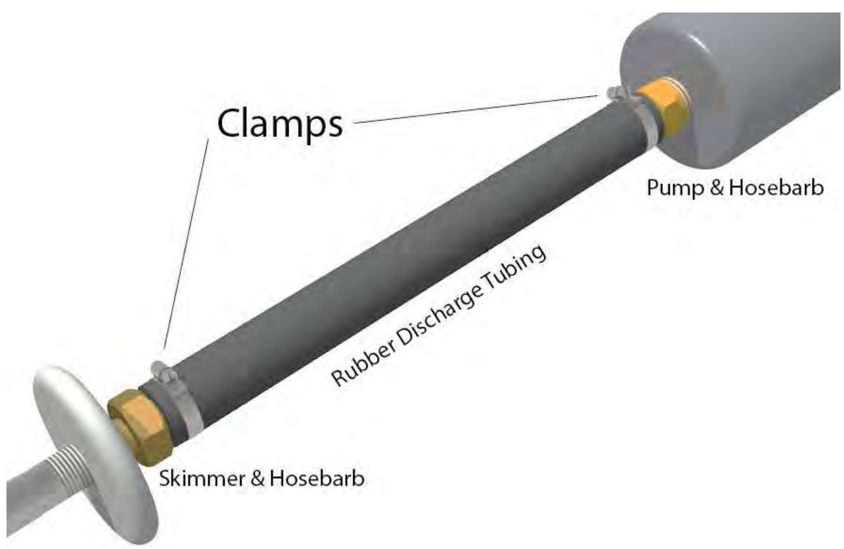


Figure 2-1: Connection between stainless steel pump and intake

4. Fully tighten the compression fittings around the hose and tubing at the well cap. The well cap is designed to suspend the pump and Skimmer assembly by the sturdier discharge hose
    - For system over 50’ (15 m) in well depth, a safety cable is highly suggested.

5. Attach the airline and discharge hose to the pump and Skimmer assembly with hose clamps.

6. After attaching the needed lengths of tubing, place the pump and Skimmer assembly into the well so that the midpoint of the intake float travel lies on the static water level measured.

7. Connect the airline from the pump to the Sipper controller.

8. Connect the product discharge hose from the pump to the product recovery tank.

9. Ensure that both lines are kept level and that there are no kinks or sags in the lines.
    - When possible, enclose the lines within a secondary pipe or conduit to protect them from damage.

10. Install the Tankfull probe in the recovery tank and connect the probe connector to the Sipper controller.

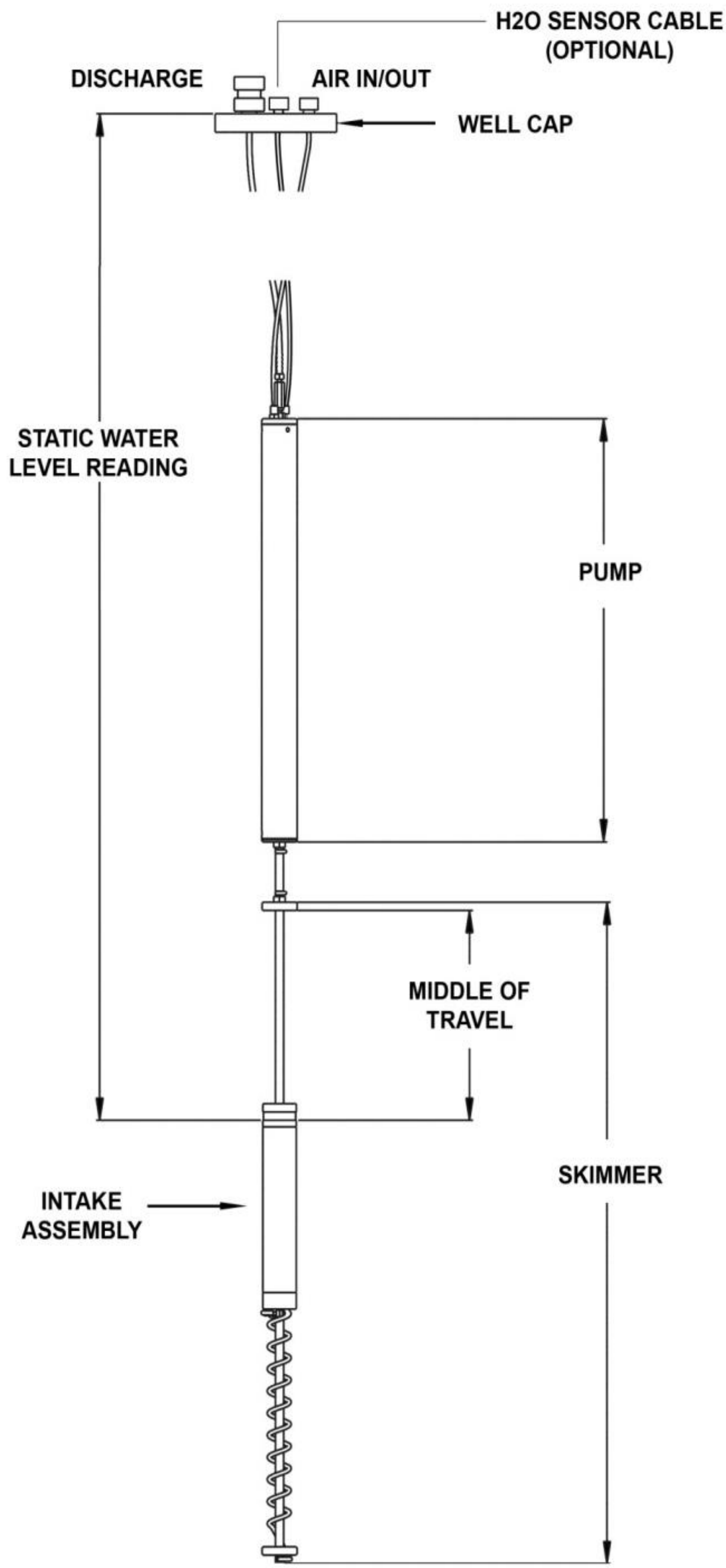


Figure 2-2: Pump and Skimmer Assembly with generalized Well Cap

Section 3: System Operation

The stainless steel pump assembly with Skimmer is designed to operate with the Geotech Sipper Controller. After all connections have been made, set the vacuum, pressure, and delay times for the pump and allow the unit to run. Make any needed adjustments to the timing before leaving the system. Read the Geotech Sipper User Manual (P/N 16550176) in conjunction with this manual to establish the operational requirements of your Sipper system.

The stainless steel pump can be equipped with an optional H2O sensor. Figure 3-1 is an example of a typical stainless steel pump cycle when water is sensed and then purged:

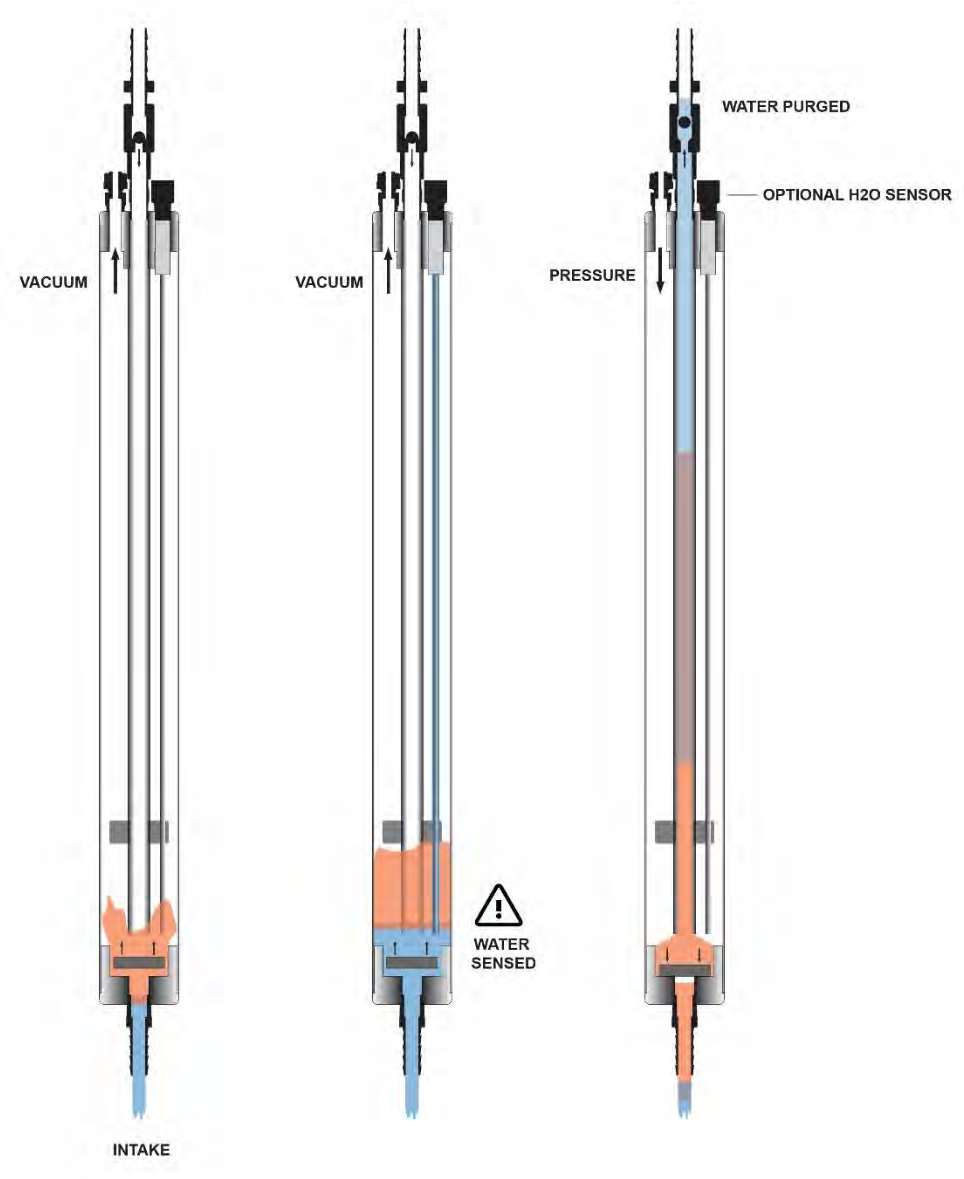
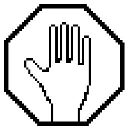


Figure 3-1: Active H2O Sensor Cycle in Stainless Steel Pump

The amount of water purged/pumped is minimal, <10mL, relative to the stainless steel pump's internal volume, which is around 200mL.

Section 4: System Maintenance



Always ensure all hose and tubing fittings at the pump and between the pump and Skimmer are tight prior to deploying the unit into the well.

Monthly (or per Site Visit, at minimum) Maintenance

- Pull the pump and Skimmer from the well.
- Inspect all tubing for cracks, kinks and damage. Replace any old and brittle tubing.
- Inspect the coiled tubing for physical damage or obstructions. Verify the intake assembly moves freely over its travel range.
- Inspect the float (buoy) and intake screen. Clean the intake screen and float using the method described in this section.
- Inspect the Skimmer assembly for signs of physical damage. Scrapes or dents in the screen intake may cause the Skimmer to take on water. If such damage is found, a new 2” (2 cm) or 4” (10 cm) intake assembly may be necessary.
- Clear away any debris collected in the well vault (or above ground casement).
- Measure the well and record product layer thickness and depth to water from top of well casing.
- Verify pump vacuum, pressure, and delay settings are adjusted for the recharge rate of the well.
- Place a pump positioning mark or zip tie on the discharge hose (usually black) even with the top of well casing.
- Re-deploy pump, aligning new depth to water mark on discharge hose with top of well casing.
- Check the Tankfull probe for proper operation.

Quarterly Maintenance

- Pull pump and Skimmer.
- Clean the well screen (site specific, primarily to clear bio growth and keep thick degraded product from impeding conductivity to the well at the product layer. Frequency to be determined by user.)
- Place float assembly in water to verify the screen stays out of the water at the top of the traverse range. If it does not, replace the coiled tubing and retest. If it still does not, replace the float assembly.

Yearly Maintenance

- Pull the pump and Skimmer from the well.
- Open pump and clean interior and parts with soapy water.
- Degrease the check disk and check ball seats. Spray with a silicone based lubricant or kerosene.
- Clean and prime intake screen using the method described in this section.

Cleaning the Skimmer and Intake Screen

Standard 2” and 4” Skimmers will usually come with a float containing a 100 or 60-mesh intake screen. When required, gently clean the screen with a silicone based lubricant or kerosene, using a soft, bristle brush, to remove emulsified product, bio growth or other debris. Take care to avoid damaging the screen intake. Rinse the product intake assembly with clean water and make sure it is completely dry before reconditioning the intake screen.

For heavy oil Skimmers, use warm, soapy water first, followed by a silicone-based lubricant or kerosene to remove debris or bio growth from the buoy body, then rinse and let dry.

Using warm soapy water, clean all debris and bio growth from the Skimmer shaft and coiled tubing.

Conditioning the Skimmer Intake Screen

Prior to initial deployment, and after every cleaning, the intake screen must be conditioned (or primed) with diesel fuel or other similar hydrocarbon. Use a soft, bristle brush to saturate the screen portion of the intake thoroughly. The optimum fluid would be to use the down well hydrocarbons being recovered. Take care to avoid damaging the screen intake.

Section 5: System Troubleshooting

Additional troubleshooting measures can be found in the Solar Sipper User Manual.

Problem: The pump is only discharging water, not product.

Solutions:
The water level has risen above the travel range of the Skimmer.

- Pull the pump and Skimmer out of the well. Purge the water out of the intake and pump by allowing the system to cycle for several minutes, prime the intake cartridge screen, and then reset the Sipper controller.

The pump position has slipped, or the pump was installed below the water level in the well.

- Prime the intake cartridge screen, re-position the pump and Skimmer, and then reset the Sipper controller.

The intake assembly will not slide freely, or the coiled hose is tangled.

- Inspect the Skimmer assembly and repair as necessary.

Loose hose or tubing on fittings below intake level.

- Check all fitting connections.

Problem: The pump discharges air only, no product.

Solutions:
Product has been removed.

- Recalculate and reduce the pumping rate at the Sipper controller.

The Product layer is below the bottom of the Skimmer's travel range.

- Adjust the position of the Skimmer assembly within the well and then reset the Sipper controller.

The Skimmer assembly has detached from the pump (due to a cut hose or loose hose clamp.)

- If the Skimmer assembly cannot be retrieved from the well then a new Skimmer will be needed.

Problem: The pump cycles but does not discharge product.

Solutions:
One or both of the pump check valves are malfunctioning.

- Remove and clean pump assembly from particulates, or replace check valve components.

The viscosity of the product is too thick for the Skimmer.

- Contact Geotech to discuss other Skimmer options for the type of product in the well.

The intake screen is obstructed or the coiled hose is kinked.

- Verify that the intake is clean of debris and bio growth
- Check the condition of the coiled hose.

Problem: The pump does not operate.

Solutions:
The product recovery tank is full.

- Empty the recovery tank, inspect the Tankfull probe float and then restart the Sipper controller.

The intake float switch is high.

- Drain the intake float switch assembly (on the side of the controller) and inspect all lines and solenoids for fluid vacuumed into the controller. Blow out all lines and parts, adjust vacuum timing and then restart the Sipper controller.

Problem:
Pump has to purge water with every cycle. *(Applicable if pump is equipped with optional H2O Sensor)*

Solutions:
The skimmer is submerged in water.

- The product layer has been fully recovered or the water table has raised beyond the skimmer's travel capabilities. Reset the pump position so that the intake screen and top of the hydrocarbon layer is in the middle of the skimmer's travel distance.

Section 6: System Specifications

Application:	2" (5 cm) or larger recovery wells
Recovery Rate:	.2 gallons (.76 liters) per cycle
Maximum Depth	180' (54.9 m)
Maximum Pressure:	100 PSIG (6.9 bar)
Oil/Water Separation:	Oleophilic/hydrophobic mesh screen

Stainless Steel Pump

Size:	23.5" L x 1.75" OD (59.7 cm L x 4.5 cm OD)
Weight:	4.5 lbs. (2 kg)
Materials:	303 and 304 SS, flexible tubing, PVC, and Brass
Air Line:	.170" ID x .25" OD (Polyethylene) (4 mm ID x 6 mm OD)
Discharge Line:	.375" ID x .5" OD (Polyethylene or fuel grade Synthetic Rubber) (10 mm ID x 13 mm OD)

Stainless Steel Pump with H20 Sensor

Size:	23.5" L x 1.75" OD (59.7 cm L x 4.5 cm OD)
Weight:	5 lbs. (2 kg)
Materials:	303 and 304 SS, flexible tubing, PVC, and Brass
Air Line:	.170" ID x .25" OD (Polyethylene) (4 mm ID x 6 mm OD)
Discharge Line:	.375" ID x .5" OD (Polyethylene or fuel grade Synthetic Rubber) (10 mm ID x 13 mm OD)
H2O Sensor cable:	Polyurethane insulated cable (28AWG), Acetal Resin

2" Skimmer Assembly

Size:	35.5" L x1.75" OD (90 cm L x 4.5 cm OD)
Weight:	1.75 lbs. (0.8 kg)
Materials:	304 SS, Polyethylene, PVC, Polypropylene, and Brass Fittings
Effective Travel:	12" (30.5 cm) Standard Travel
Operating Temperature:	32º to 100º F (0° to 38° C)

Minimum fluid level to activate Skimmer = 15" (38 cm)

4" Skimmer Assembly

Size:	35.5" L x 3.75" OD (90 cm L x 9.5 cm OD)
Weight:	2.25 lbs. (1 kg)
Materials:	304 SS, Polyethylene, PVC, Polypropylene, and Brass Fittings
Effective Travel:	24" (61 cm) Standard Travel, up to 5' (1.5 m) available
Operating Temperature:	32º to 100º F (0° to 38° C)

Minimum fluid level to activate Skimmer = 9" (23 cm)

4” Heavy Oil Skimmer Assembly

Size:	40” L x 3.75” OD (102 cm L x 9.5 cm OD)
Weight:	2.5 lbs. (1.1 kg)
Materials:	304 SS, PP, and Brass Fittings
Effective Travel:	24” (61 cm) Standard Travel
Operating Temperature:	32º to 100º F (0° to 38° C)

Minimum fluid level to activate Skimmer = 15” (38 cm)

4” High Temperature, Heavy Oil Skimmer Assembly

Size:	40” L x 3.75” OD (102 cm L x 9.5 cm OD)
Weight:	2.5 lbs. (1.1 kg)
Materials:	304 SS, HDPE, and Brass Fittings
Effective Travel:	24” (61 cm) Standard Travel
Operating Temperature:	32º to 212º F (0° to 100° C)

Minimum fluid level to activate Skimmer = 15” (38 cm)

Section 7: System Schematics

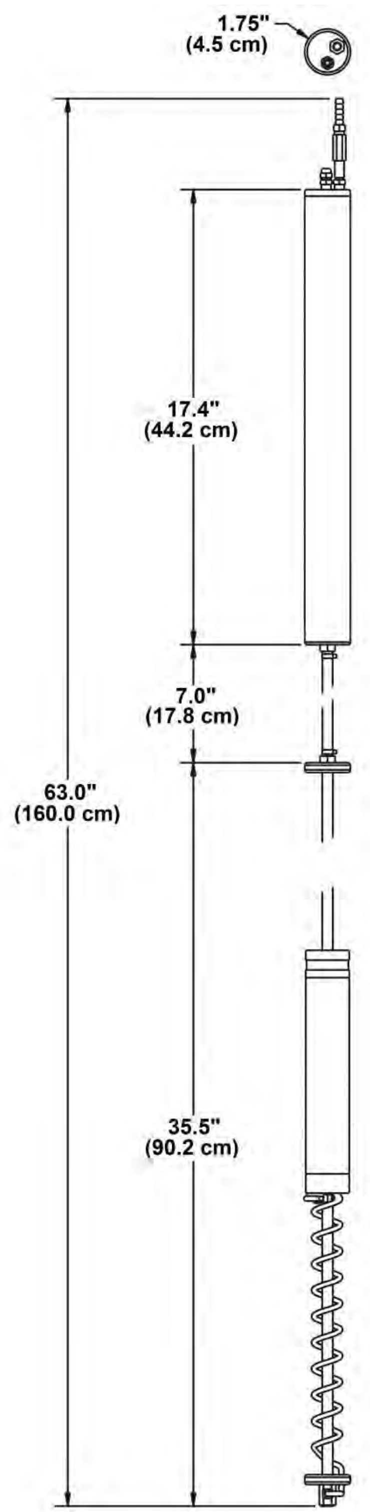


Figure 7-1: Stainless Steel Pump with Skimmer Dimensions

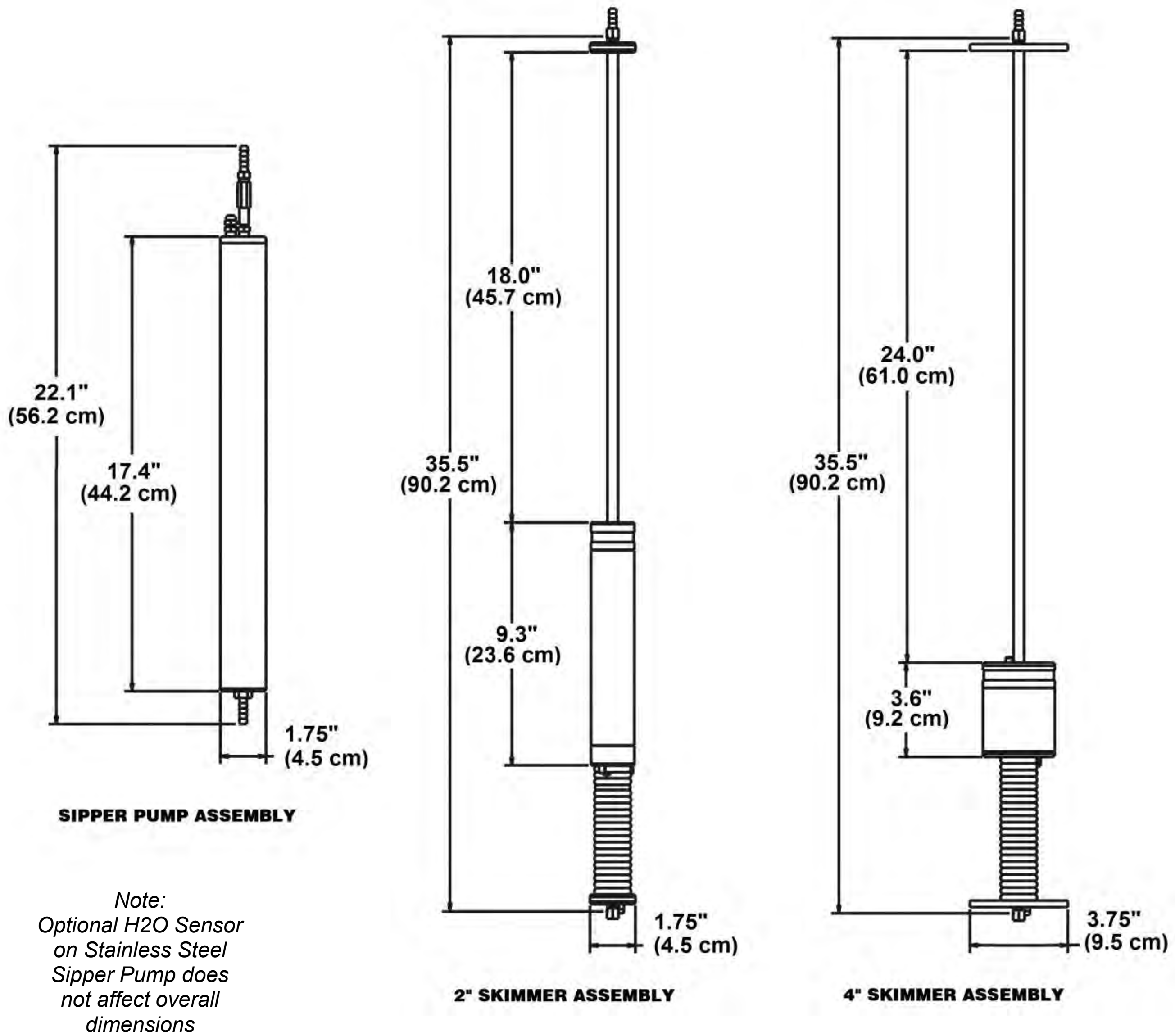


Figure 7-2: Standard Pump and Skimmer Dimensions

Section 8: Parts and Accessories

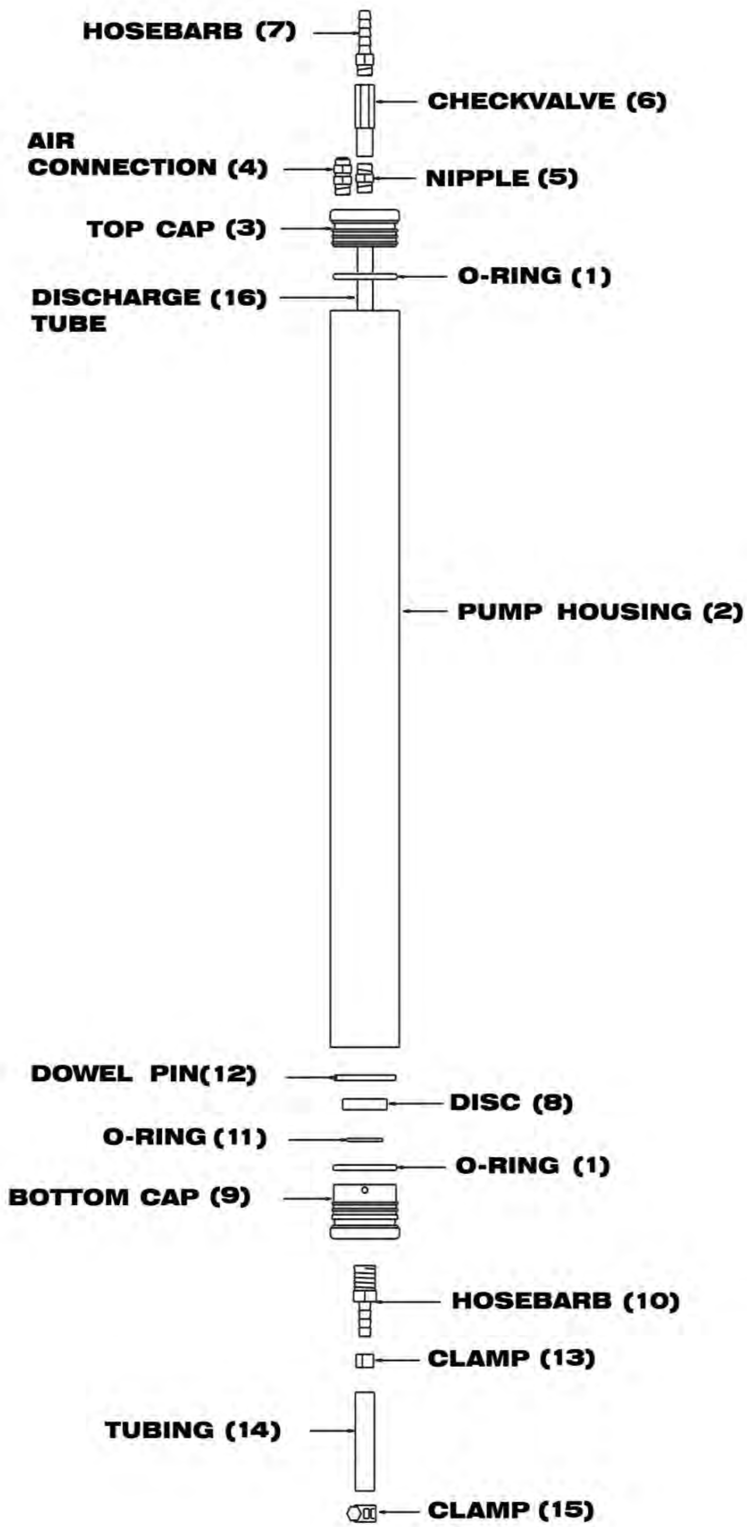


Figure 8-1: Stainless Steel Pump Assembly

Sipper Stainless Steel Pump Assembly (56600050)

Item #	Parts Description	Parts List
1	O-RING,VITON,#128	16600030
2	HOUSING,SS,PUMP,CRS/PRS	26600013
3	CAP,TOP,SS,CRS	26600019
4	TUBE,CONN,1/4X1/8MPT,POLYTITE PUMP	16600037
5	NIPPLE,BRS,HEX,1/8NPT	17500151
6	VALVE,CHECK,PRODUCT DISCHARGE CRS/PRS PUMP	26600157
7	HOSEBARB,BRS,3/8"X1/8MPT	16650310
8	DISC,PVC,CHECK	26600017
9	CAP,SS,BOTTOM,CRS/PRS	26600018
10	HOSEBARB,BRS,3/8"X1/4MPT	16650323
11	O-RING,VITON,#208	16600023
12	PIN,SS,DOWEL,CHK DISK CRS/PRS	26600162
13	CLAMP,SS,STEPLESS EAR,17MM	16600004
14	TUBING,RBR,3/8x5/8,FT PRODUCT DISHCARGE	16600019
15	CLAMP,SS6,WORM,7/32-5/8"	16600063
16	TUBE,INTERNAL,SIPPER PUMP	26600170

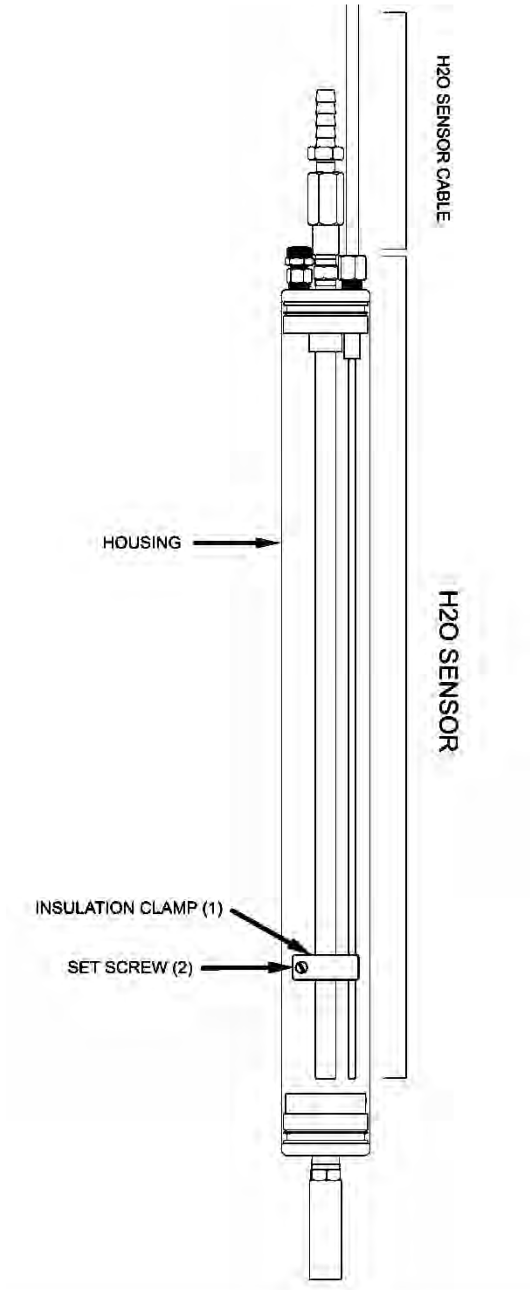


Figure 8-2: Stainless Steel Pump Assembly with optional H2O Sensor

Sipper Stainless Steel Pump with optional H2O Sensor Assembly* (56600059)

In addition to previously listed parts for Sipper Stainless Steel Pump Assembly (56600050):

-SENSOR, H2O, REPLACEMENT*	56600085
-CABLE, 28AWG, 8COND, URETH	ORS418005
-CLAMP,INSULATOR,PRS, W/H2O SENSOR	26600270
-SCREW,SS6,6-32x.75",PNH	PPF013012

**Requires specified cable length, maximum 500’ (152m)*

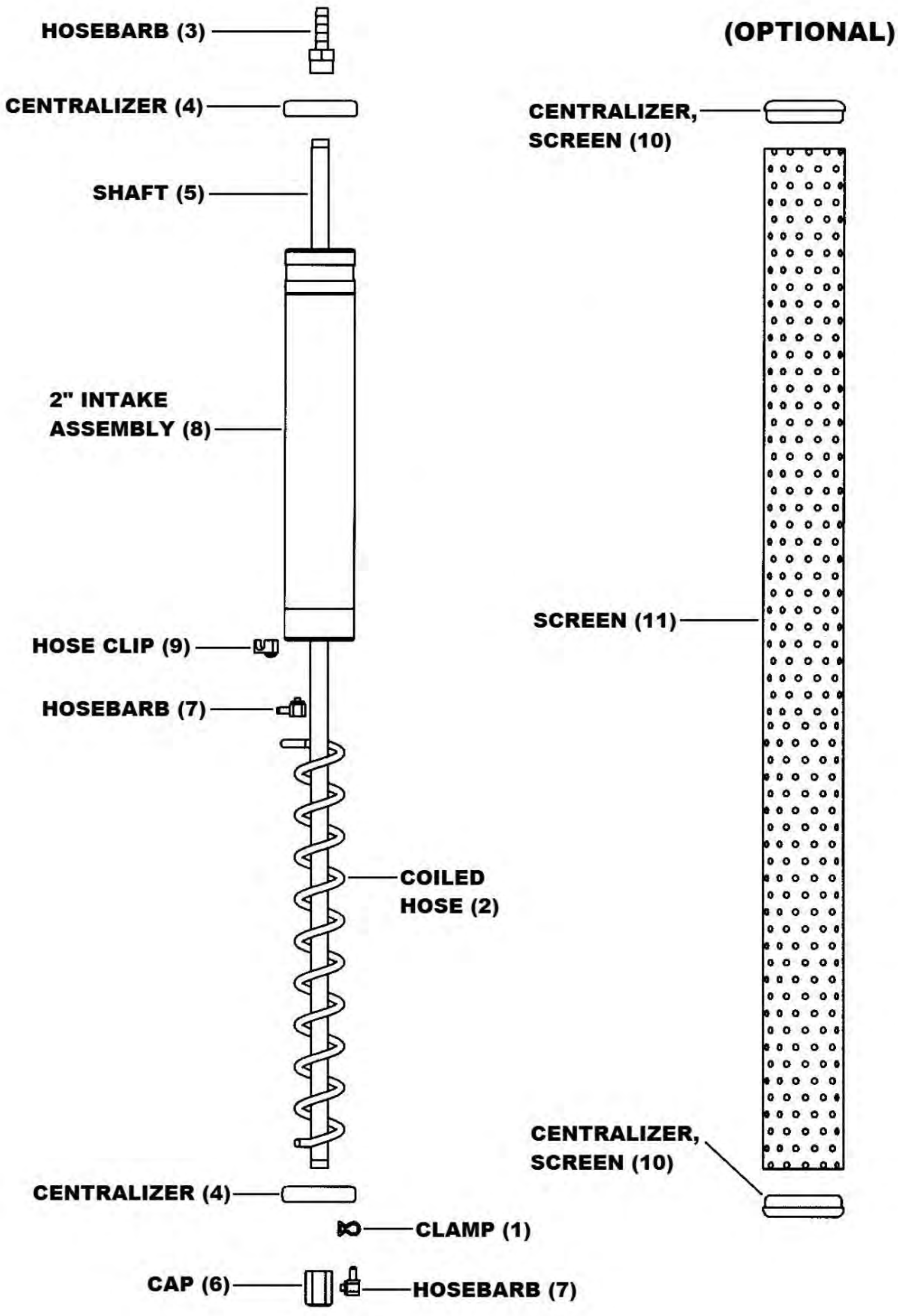


Figure 8-3: Standard 2” Skimmer Assembly

2” Standard Skimmer Assembly 100-mesh (56600003) or 60-mesh (56600069)

Item #	Parts Description	Parts List
1	CLAMP,SS,STEPLESS EAR,7MM	16600005
2	HOSE,COILED,PR2	26650304
3	HOSEBARB,BRS,3/8"X1/8FPT	16650308
4	CENTRALIZER,PVC,SKIMMER,2"	26650306
5	SHAFT,SS,SKIMMER,33.5",PRC	26600002
6	CAP,BRS,1/8FPTx10-32 90 DEG	16600064
7	HOSEBARB,BRS,1/8"X10-32,90DEG	17500149
8	ASSY,BUOY,SKIMMER,2"100MESH	56650309
	ASSY,BUOY,SKIMMER,2" 60 MESH	56650312
9	HOSE CLIP,SKIMMER FLOAT	26650028

2" Skimmer Optional Accessories

10	CENTRALIZER,PVC,SCREENED PR2	26600186
11	SCREEN,SS,1.88"ODX32.7" STRAIGHT WELD	26600188

Additional 2" Skimmers

	ASSY,SKIMMER,2”,100M,W/SCREEN	56600054
	ASSY,SKIMMER,2",60M,W/SCREEN	56600071

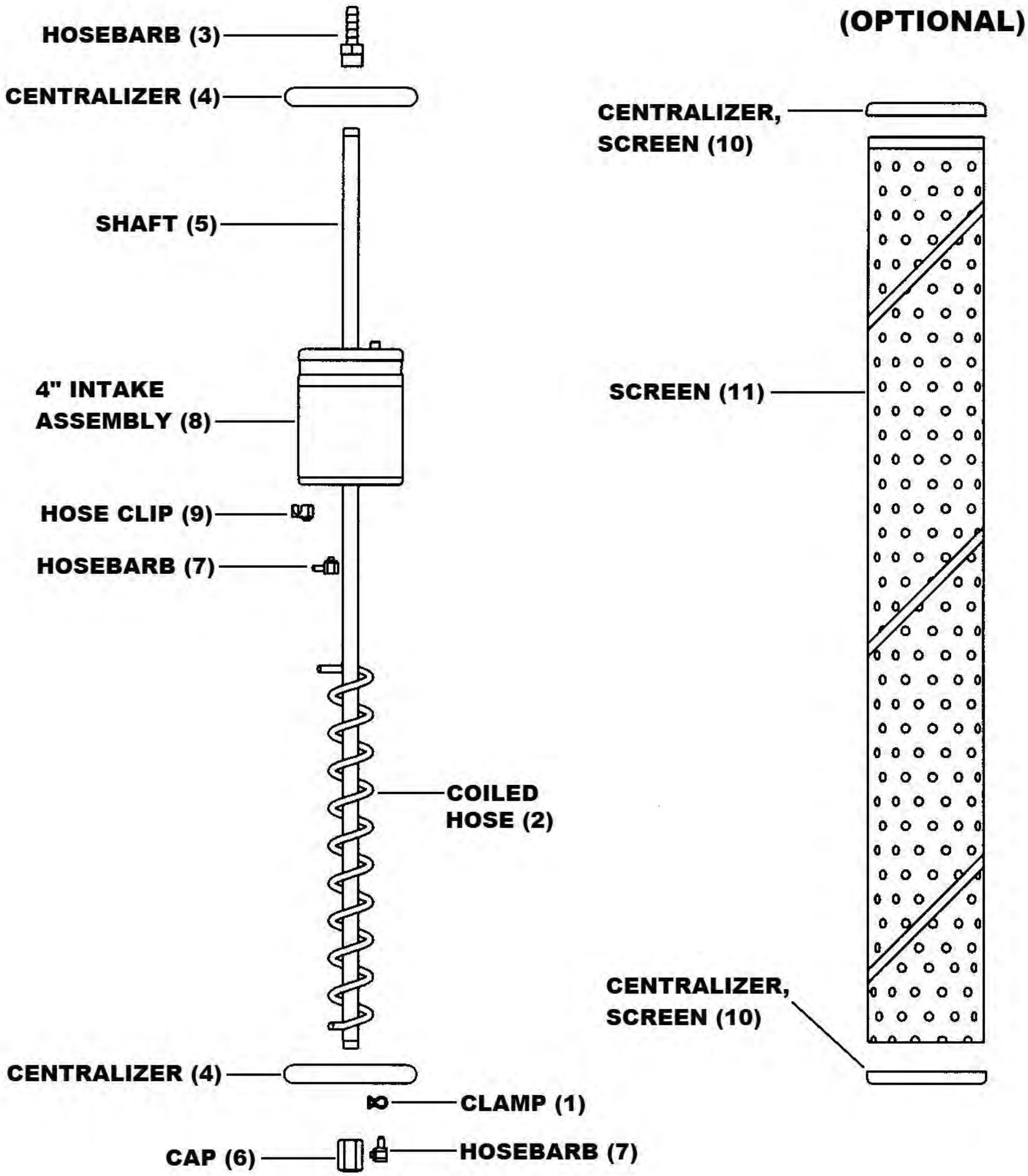


Figure 8-4: Standard 4” Skimmer Assembly, extended options available

4” Standard Skimmer Assembly 100-mesh (56600004) or 60-mesh (56600070)

Item #	Parts Description	Parts List
1	CLAMP,SS,STEPLESS EAR,7MM	16600005
2	HOSE,COILED,PR4	16650312
3	HOSEBARB,BRS,3/8"X1/8FPT	16650308
4	CENTRALIZER,SKIMMER,PR4	16600048
5	SHAFT,SS,SKIMMER,33.5",PRC	26600002
6	CAP,BRS,1/8FPTx10-32 90 DEG	16600064
7	HOSEBARB,BRS,1/8"X10-32,90DEG	17500149
8	ASSY,BUOY,SKIMMER,4"100 MESH	56650310
	ASSY,BUOY,SKIMMER,4" 60 MESH	56650313
9	HOSE CLIP,SKIMMER FLOAT	26650028

4" Skimmer Optional Accessories

10	CENTRALIZER,PVC,SCREENED PR4	26600187
11	SCREEN,SS,3.67" DIAM X32.7"	26600189

Additional 4" Skimmers

	ASSY,SKIMMER,4",100M,W/SCREEN	56600055
	ASSY,SKIMMER,4",60M,W/SCREEN	56600072

4” Extended Travel Skimmer 100-mesh (56600008) or 60-mesh (56600073)

Item #	Parts Description	Parts List
1	CLAMP,SS,STELESS EAR,7MM	16600005
2	HOSE,COILED, PR4	16650312
3	HOSEBARB,BRS,3/8X1/8”FPT	16650308
4	CENTRALIZERS,SKIMMER,PR4	26600106
5	SHAFT,SS,SKIMMER,74”,PR4	16600064
6	CAP,BRS,1/8FPTX10-32,90 DEG	17500149
7	HOSEBARB,BRS,1/8”X10-32,90 DEG	56650310
8	ASSY,BUOY,SKIMMER,4”100 MESH	56650310
	ASSY,BUOY,SKIMMER,4”60 MESH	56650313
9	HOSE CLIP,SKIMMER FLOAT	26650028

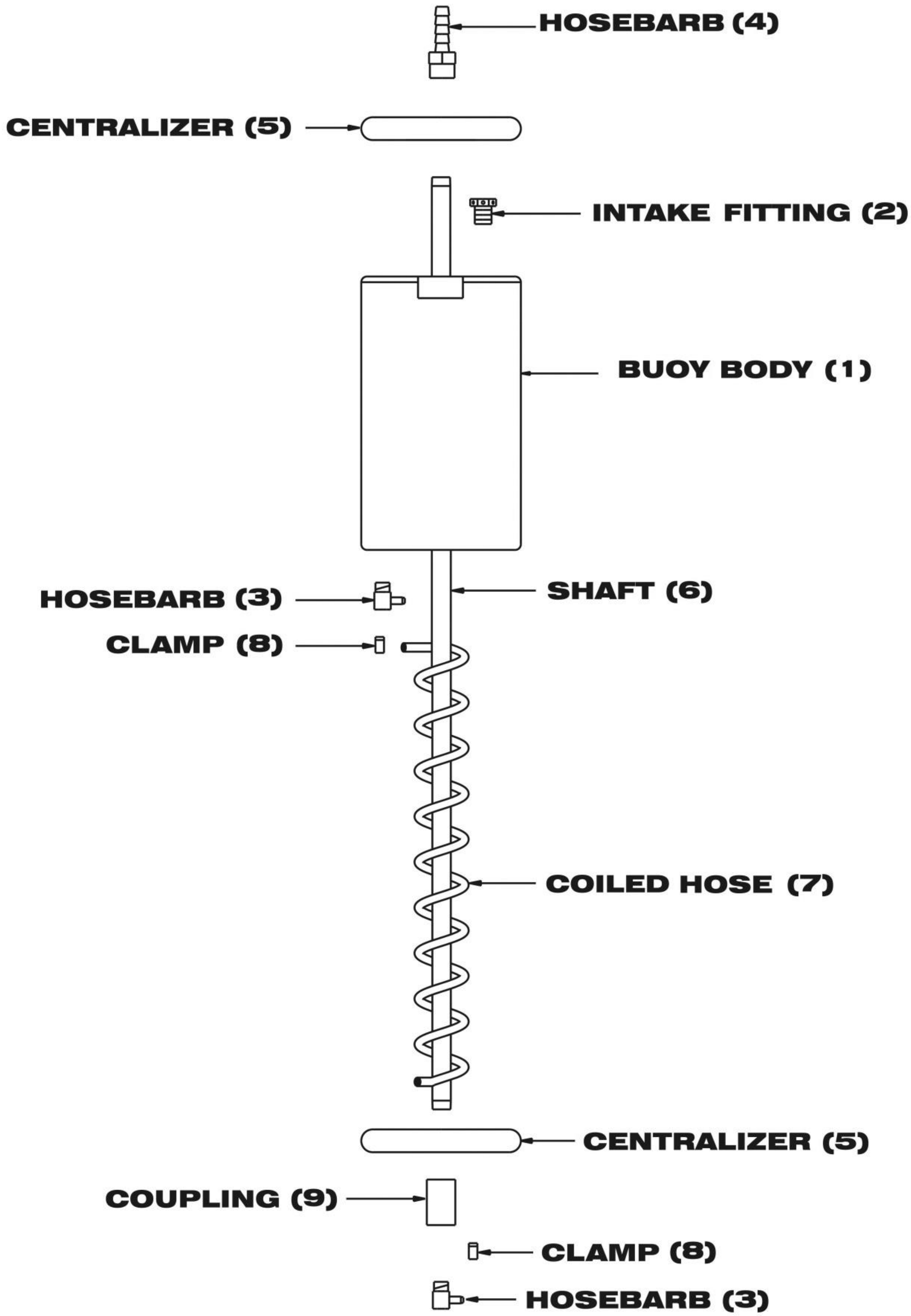


Figure 8-5: 4" Heavy Oil Skimmer Assembly

4” Heavy Oil Skimmer (56600005)

Item #	Parts Description	Parts List
1	BUOY,PP,HEAVY OIL	26600004
2	FTG,INTAKE,OIL BOUY	26600005
3	HOSEBARB,BRS,.170"X1/8MPT,90D	17500148
4	HOSEBARB,BRS,3/8"X1/8FPT	16650308
5	CENTRALIZER,SKIMMER,PR4	16600048
6	SHAFT,SS,OIL SKIMMER,38"	26600006
7	HOSE,COILED,PR4	16650312
8	CLAMP,SS,DBL PINCH,9/32-23/64"	11200273
9	COUPLING,BRS,1/8NPT	17200176

4" Heavy Oil Skimmer Optional Accessories

1 + 2	ASSY,BUOY,OIL SKIMMER,4"	56600060

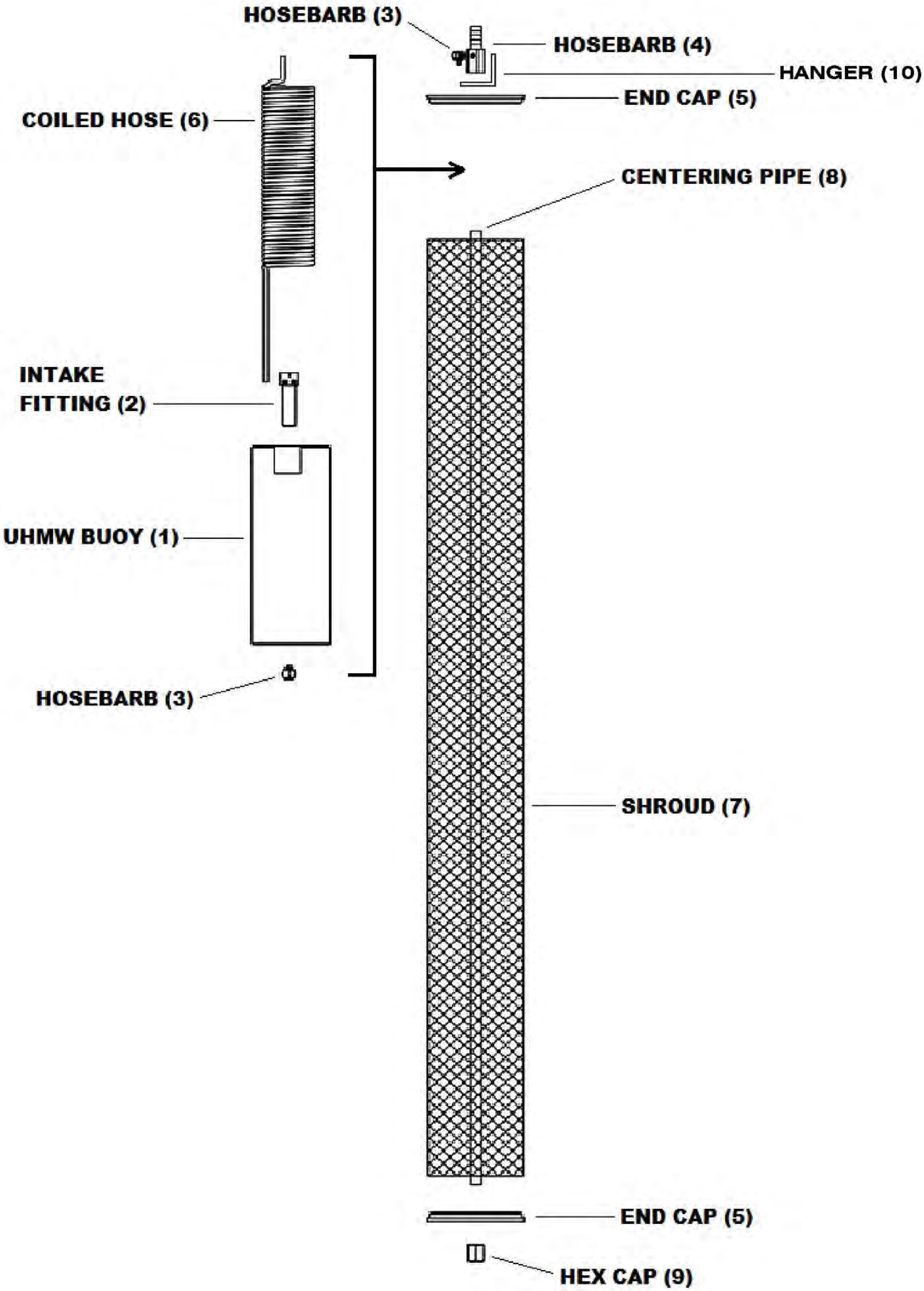


Figure 8-6: 4” High Temperature, Heavy Oil Skimmer Assembly, extended options available

4” High Temp, Heavy Oil Skimmer (56600012)

Item #	Parts Description	Parts List
1	BUOY,UHMW,HEAVY OIL,HI-TEMP	26600206
2	FITTING,BUOY INTAKE,HTHO	26600207
3	HOSEBARB,BRS,1/8"X10-32,90DEG	17500149
4	HOSEBARB,EXT,1/8M/F NPT,10-32	27200012
5	END CAP,BUOY INTAKE,HTHO	26600209
6	TUBING, COILED, PTFE, HTHO	56600074
7	SKIMMER,SHROUD,4",HTHO	26600210
8	PIPE,CENTERING,SCH80,1/8",HTHO	27500005
9	FITTING,HEX CAP,1/8FPT,HTHO	27200013
10	HANGER,SS6,BP,SAFETY CABLE	51150119

4” Extended Travel Skimmer (56600077)

Item #	Parts Description	Parts List
1	BUOY,UHMW,HEAVY OIL,HI-TEMP	26600206
2	FITTING,BUOY INTAKE,HTHO	26600207
3	HOSEBARB,BRS,1/8"X10-32,90DEG	17500149
4	HOSEBARB,EXT,1/8M/F NPT,10-32	27200012
5	END CAP,BUOY INTAKE,HTHO	26600209
6	TUBING,COILED,PTFE,HTHO,EXT	56600094
7	SCREEN,SS,3.67”ODX73.3”	26600224
8	SHAFT,SS,SKIMMER,74”,PR4	26600106
9	FITTING,HEX CAP,1/8FPT,HTHO	27200013
10	HANGER,SS6,BP,SAFETY CABLE	51150119

Sipper and Skimmer Optional Accessories

Parts Description	Parts List
MANUAL, SIPPER PUMP & SKIMMER ASSEMBLY	16550181
MANUAL, SOLAR SIPPER	16550176
MANUAL,TEST KIT,HYDROCARBON VISCOSITY	26030001
TEST KIT,HYDROCARBON VISCOSITY	86020001
WELL CAP,2",SLIP W/ CMPRSN FTG SIPPER	86600061
WELL CAP,4",SLIP W/ CMPRSN FTG SIPPER	86600062
TUBING,PE,.170x1/4,FT POLYETHYLENE	87050501
TUBING,TLPE,.170x1/4,FT FEP LINED POLYETHYLENE	87050529
TUBING,FEP,.170x1/4,FT FEP	87050509
TUBING,RBR,3/8x5/8,FT PRODUCT DISHCARGE	16600019
TUBING,TLPE,3/8x1/2,FT FEP LINED POLYETHYLENE	87050506
TUBING,FEP,3/8x1/2,FT FEP	87050511
CLAMP,NYL,1/4" SNAPPER	11150259
CLAMP,SS,STEPLESS EAR,17MM	16600004
CLAMP,SS6,WORM,7/32-5/8"	16600063

DOCUMENT REVISIONS		
EDCF#	DESCRIPTION	REV/DATE
-	Previous Release	06/05/2012
-	Updated manual to include PRS with H2O Sensor option – SP	6/12/2014
-	Clarify H2O Sensor as optional – SP	9/2/2014
-	General updates and clarifications, included DNAPL information – SP, JL	01/05/15
1993	Added hanger to HTHO, added extended pump options, general formatting and style edits - StellaR	4/24/2017
Project #1827	Corrected Stadard Skimmer Assembly part numbers – StellaR	8/15/2019

NOTES

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The Warranty

For a period of one (1) year from date of first sale, product is warranted to be free from defects in materials and workmanship. Geotech agrees to repair or replace, at Geotech's option, the portion proving defective, or at our option to refund the purchase price thereof. Geotech will have no warranty obligation if the product is subjected to abnormal operating conditions, accident, abuse, misuse, unauthorized modification, alteration, repair, or replacement of wear parts. User assumes all other risk, if any, including the risk of injury, loss, or damage, direct or consequential, arising out of the use, misuse, or inability to use this product. User agrees to use, maintain and install product in accordance with recommendations and instructions. User is responsible for transportation charges connected to the repair or replacement of product under this warranty.

Equipment Return Policy

A Return Material Authorization number (RMA #) is required prior to return of any equipment to our facilities, please call our 800 number for appropriate location. An RMA # will be issued upon receipt of your request to return equipment, which should include reasons for the return. Your return shipment to us must have this RMA # clearly marked on the outside of the package. Proof of date of purchase is required for processing of all warranty requests.

This policy applies to both equipment sales and repair orders.

FOR A RETURN MATERIAL AUTHORIZATION, PLEASE CALL OUR SERVICE DEPARTMENT AT 1-800-833-7958.

Model Number: ________________

Serial Number: ________________

Date of Purchase: ________________

Equipment Decontamination

Prior to return, all equipment must be thoroughly cleaned and decontaminated. Please make note on RMA form, the use of equipment, contaminants equipment was exposed to, and decontamination solutions/methods used. Geotech reserves the right to refuse any equipment not properly decontaminated. Geotech may also choose to decontaminate the equipment for a fee, which will be applied to the repair order invoice.

Geotech Environmental Equipment, Inc
2650 East 40th Avenue Denver, Colorado 80205
(303) 320-4764 ● **(800) 833-7958** ● FAX (303) 322-7242
email: sales@geotechenv.com website: www.geotechenv.com

Attachment 3

Natural Source Zone Depletion Work Plan

Natural Source Zone Depletion Work Plan

Cold Springs Settling Defendants Group

23 May 2022

The Power of Commitment

Project name	Cold Springs Settling						
Document title	Natural Source Zone Depletion Work Plan						
Project number	11137172						
File name	11137172-RPT01-ATT03-Final NSZD Work Plan.docx						
Status Code	**Revision**	**Author**	**Reviewer**		**Approved for issue**		
			Name	**Signature**	**Name**	**Signature**	**Date**
[Status code]							
[Status code]							
[Status code]							
[Status code]							
[Status code]							

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The Power of Commitment

Contents

1. Introduction

GHD Services Inc. (GHD) proposes to complete a natural source zone depletion (NSZD) study for the Southern Terminals Group at the Cold Springs Terminals (CST) site, NYSDEC Spill No. 89-04923, in Lysander, New York. The assessment will include locations on the south and north side of Hillside Road to understand the amount of biodegradation of light non-aqueous phase liquid (LNAPL) that exists in these areas. The intent of the assessment is to evaluate the magnitude of LNAPL mass losses attributable to NSZD at the CST and, in accordance with the decision logic diagrams provided in the Revised Remedial Action Work Plan (RAWP, GHD, September 2021, Revised: May 2022), determine the viability of NSZD (after LNAPL has been recovered to the extent practicable).

1.1 Scope and Limitations

This report has been prepared by GHD for Cold Springs Settling Defendants Group and may only be used and relied on by Cold Springs Settling Defendants Group for the purpose agreed between GHD and Cold Springs Settling Defendants Group as set out in this report.

GHD otherwise disclaims responsibility to any person other than Cold Springs Settling Defendants Group arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

Accessibility of documents

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

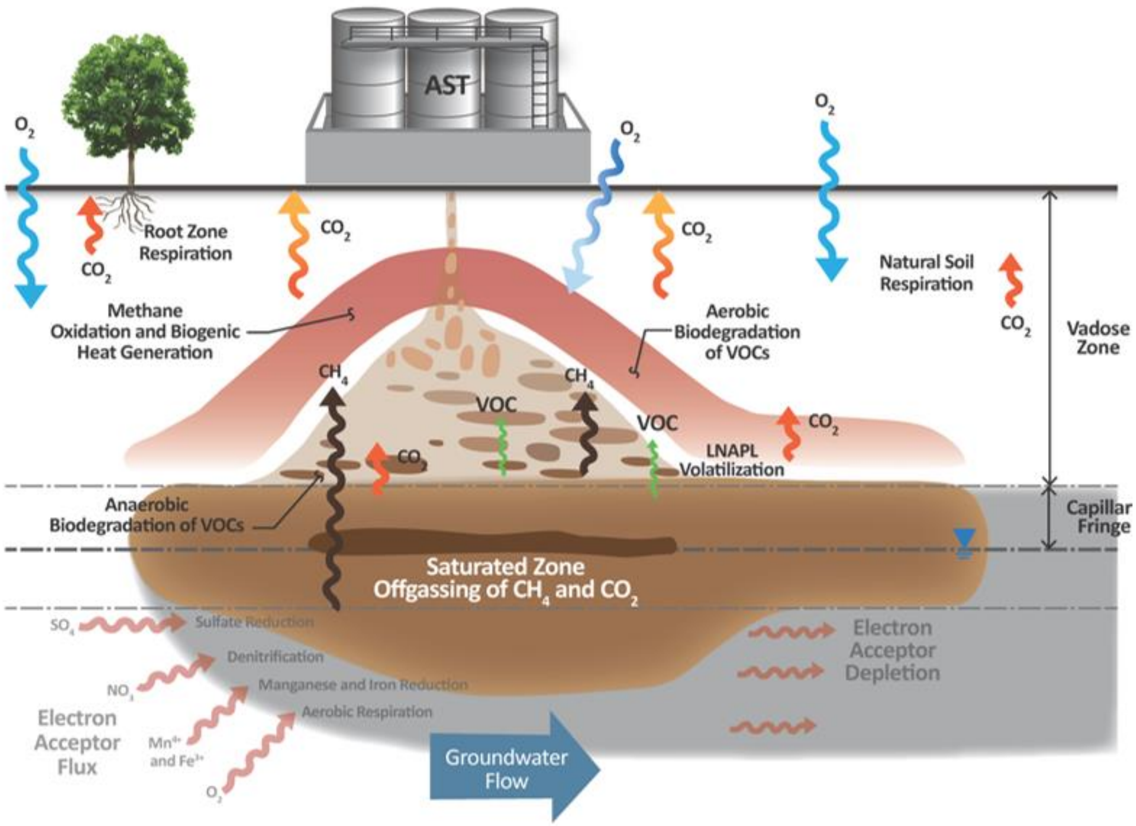
2. NSZD Background

NSZD occurs through the combined action of natural processes that reduce the mass of LNAPL in the subsurface. Key NSZD processes include volatilization, dissolution, and biodegradation; these processes reduce LNAPL mass, saturation, and mobility. NSZD is an underlying (and often principal) driver of progress toward remedial goals at almost all LNAPL sites, and promotes stability, effects compositional changes, and limits the longevity of LNAPL bodies.

The rate of LNAPL mass reduction through biodegradation depends on many factors, including the availability and type of electron acceptors present in the soils and groundwater to enable microbial and/or enzymatic activity.[1] The degradation of LNAPL will generally proceed anaerobically via methanogenesis, producing methane (CH_4) and carbon dioxide (CO_2), with CH_4 subsequently oxidized to CO_2 via an exothermic process in the vadose zone. A conceptual depiction of these processes follows.[2]

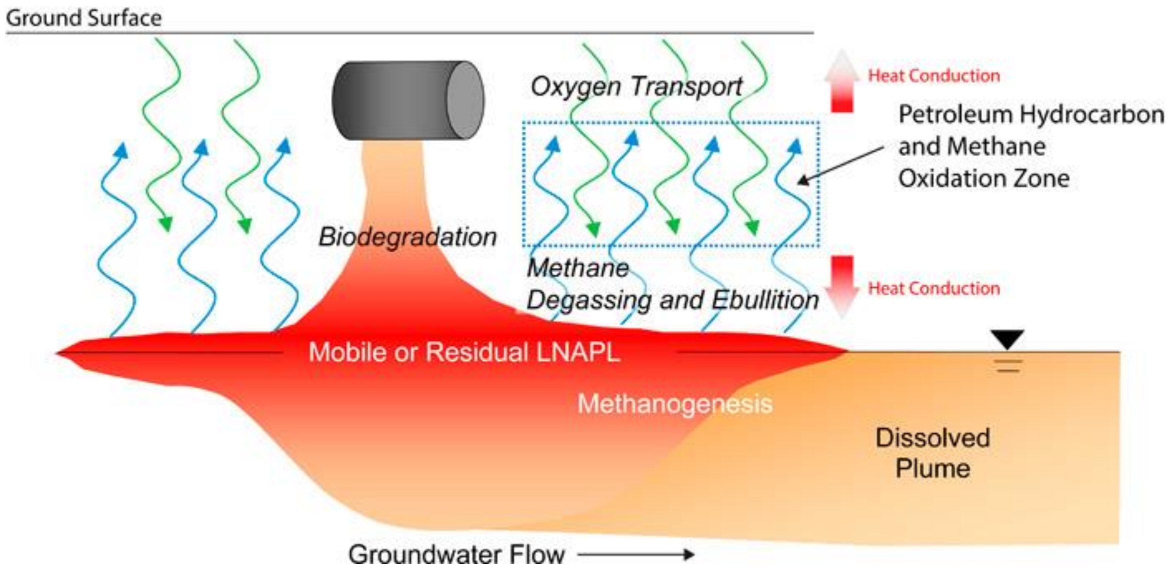
[1] ITRC (Interstate Technology & Regulatory Council). *Evaluating Natural Source Zone Depletion at Sites with LNAPL*. LNAPL-1. Washington, D.C.: Interstate Technology & Regulatory Council, LNAPL Teams. April 2009.

[2] NSZD conceptualization from American Petroleum Institute (API) Publication #4784 *Qualification of Vapor Phase-related Natural Source Zone Depletion Processes, First Edition*



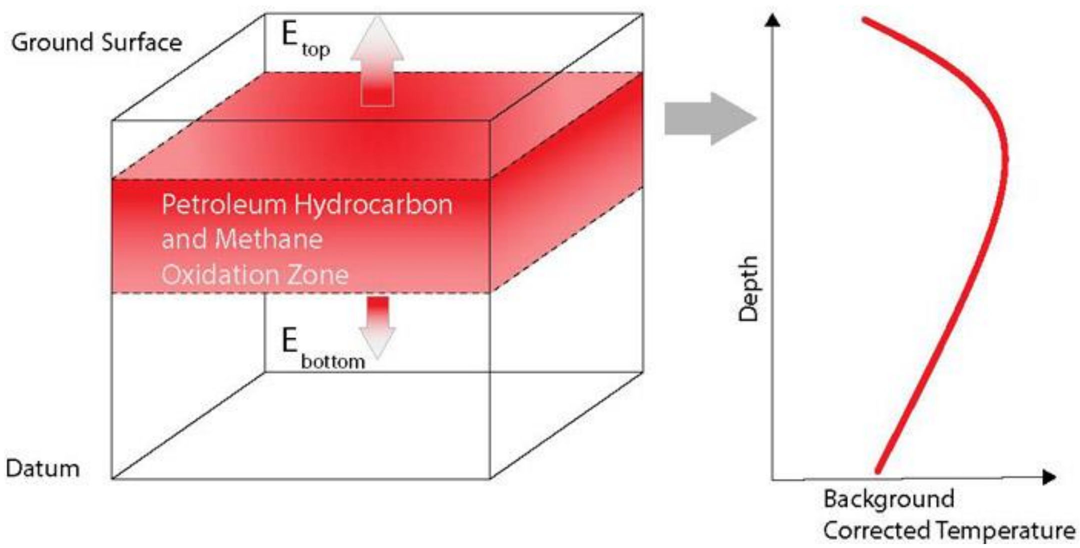
Since gaseous CO_2 is the ultimate product of LNAPL mineralization, rates of LNAPL degradation can be estimated by measuring the near surface flux of CO_2 at sites with petroleum hydrocarbon impacts and isolating the portion of the CO_2 that is petrogenic (as opposed to that which is produced by other natural processes such as plant respiration). In general, the confirmation of methanogenic conditions (O_2 depletion, CH_4 and/or CO_2 production) in the vadose zone as well as in groundwater represent complimentary lines of evidence of NSZD activity.

Additionally, the exothermic CH_4 oxidation reaction in the vadose zone presents another potential line of evidence of NSZD. Temperature anomalies within an LNAPL-impacted area compared with areas where LNAPL is not present can provide evidence that NSZD is active, particularly when correlated with other data such as CO_2 flux results. Vertical subsurface temperature profiling at locations both in and outside of LNAPL-impacted areas can be used to approximate NSZD rates by relating estimates of heat flux above background levels to the heats generated as a function of NSZD processes. The following figure provides a conceptualization of the methane oxidation related to LNAPL degradation and the associated heat conduction from the exothermic reaction.



Source: ITRC LNAPL-3

As seen below, the heat released during the exothermic CH_4 oxidation reaction can be conceptualized as two-dimensional heat transfer upward toward ground surface and downward toward the water table. This heat transfer can result in temperature anomalies/gradients that mimic this two-dimensional conceptualization when compared to background locations away from the contamination or modelled subsurface temperatures, resulting in a characteristic temperature profile that peaks in the heart of the CH_4 oxidation zone.



Source: ITRC LNAPL-3

These temperature gradients (i.e., temperature change over vertical distance or $\Delta T/\Delta z$) and the summation of the associated heat fluxes form the basis for the estimation of the biogenic heat NSZD estimate.

Natural attenuation processes play a large role in the long-term stability of both LNAPL and associated dissolved plumes. It is well established that natural attenuation in groundwater has a significant impact on the extent and stability of dissolved petroleum hydrocarbon plumes, which is the basis for the application of monitored natural attenuation (MNA) as a groundwater remedy. Similarly, it has been demonstrated that NSZD processes can result in LNAPL mass loss rates that are sufficient to balance mobile-phase LNAPL gradients, thereby stabilizing the LNAPL body/footprint.[3] Therefore, demonstrations of a stable (or diminishing) LNAPL body and/or related dissolved plumes represent complimentary lines of evidence of active natural attenuation, and vice versa. Additionally, NSZD represents a remedial option based on natural processes, and a comparison of LNAPL recovery system performance to NSZD rates can be part of a LNAPL recovery end-point demonstration (e.g., discontinue active LNAPL recovery if NSZD rates are comparable to or exceed active LNAPL recovery performance).

3. NSZD Scope of Work

As noted in the conceptualization of NSZD processes and accompanying discussion above, measurable by-products of NSZD include changes in soil gas concentrations with depth in the vadose zone (CH_4, CO_2, O_2), soil gas flux out of the surface (CO_2), and changes in temperature with depth that are anomalous compared with background conditions. Once quantified, the heat and soil gas fluxes (rates) can be used to back-calculate an associated quantity of LNAPL degraded through the known stoichiometry of the various reactions (e.g., this much CO_2 equates to this much LNAPL degraded).

The NSZD assessment will initially include the following methods to optimize the approach to developing multiple complementary lines of evidence to confirm that active LNAPL degradation is occurring in the vadose zone and to estimate LNAPL degradation rates at the CST: surficial CO_2 efflux, biogenic heat, and soil gas gradient methods. These methods will be implemented in general accordance with American Petroleum Institute (API) Publication No. 4784 and Cooperative Research Centre for Contaminated Site Assessment and Remediation (CRC CARE) Technical Report 44. The NSZD testing will be completed at six-month intervals to capture any temporal/seasonal variability. It is also noted that the evaluation of NSZD can have an iterative component to confirm what techniques will work best in different locations at different times on a site-specific basis. Accordingly, it is anticipated that the scope (which techniques are used when and where) will be re-assessed after the first two rounds.

More detail on each of the proposed methods and their implementation is provided in the following sections.

3.1 Surficial CO_2 Efflux

3.1.1 Dynamic Closed Chamber

Initial screening/estimation of NSZD rates will be determined via CO_2 efflux dynamic closed chamber (DCC) measurements taken at various locations with permeable surface cover throughout the assessment area using the LI-COR LI-8100A survey system. The DCC obtains readings over the course of several minutes at a given location, thereby allowing the rapid determination of short term NSZD rates at a large number of locations. This technique requires testing at background locations with similar stratigraphy and surface cover in order to correct the LNAPL zone readings and isolate the fraction of the total measured CO_2 that is derived from LNAPL degradation from the CO_2 produced by 'modern' sources such as plant respiration. DCC measurements will be completed at approximately fifty-five (55) locations on a grid with spacing of approximately 30 to 100 feet (see Figure 1).

[3] Mahler et al, 2012, *A Mass Balance Approach to Resolving LNAPL Stability*, Groundwater, Volume 50, Number 6, doi: 10.1111/j.1745-6584.2012.00949.x

Each location will require driving a PVC collar into the ground a depth of several inches to allow connection of flux chamber portion of the DCC. The flux chamber is then connected to an infrared CO_2 analyzer which is, in turn, connected to a laptop used to both control the analyzer and evaluate results (see photo inset). Three successive CO_2 flux measurements will be collected with the DCC at each location. The raw data is processed using the manufacturer-supplied software to determine the CO_2 flux rate in units of µmol CO_2 per square meter per second (µmol CO_2 m^{-2} s^{-1}). The CO_2 flux rates are averaged for the three replicates. The background CO_2 flux rate, from a location(s) outside the LNAPL body in an area with similar surface cover, is subtracted from the NSZD CO_2 flux rate for each LNAPL impacted location.

The estimation of NSZD rates from background-corrected CO_2 flux data is performed consistent with the principles and general methodology described by API, Interstate Technology & Regulatory Council (ITRC), and CRC CARE.[4] The procedure assumes that an LNAPL source is appropriately represented (average molecular weight) by octane (C_8H_{18}) and describes the process whereby the anaerobic degradation of LNAPL produces CH_4, which is in turn oxidized to CO_2 in the vadose zone. The following stoichiometry describes the process:

Anaerobic Reaction in Vadose Zone (immediately above source)

$$C_8H_{18} + 3.5\ H_2O \rightarrow 1.75\ CO_2 + 6.25\ CH_4$$

Aerobic Reaction in Vadose Zone (above anaerobic halo)

$$6.25\ CH_4 + 12.5\ O_2 \rightarrow 6.25\ CO_2 + 12.5\ H_2O$$

Overall Reaction (summation of both reactions)

$$C_8H_{18} + 12.5\ O_2 \rightarrow 8\ CO_2 + 9\ H_2O$$

The molecular weight of octane (C_8H_{18}) is 114.23 g/g·mole. Assuming an LNAPL specific gravity of 0.77 (upper range for gasoline), the conversion of CO_2 flux to LNAPL loss (NSZD) rate involves the conversion of the CO_2 flux in units of micromoles per square meter per second to a volumetric rate as follows:

$$1\,\frac{\mu\text{Mole } CO_2}{m^2\ s} =$$

$$\frac{\mu\text{Mole } CO_2}{m^2\ s} \times \frac{1\ \mu\text{Mole } C_8H_{18}}{8\ \mu\text{Mole } CO_2} \times \frac{\text{Mole}}{1 \times 10^6\ \mu\text{Mole}} \times \frac{4{,}046\ m^2}{1\ \text{acre}} \times \frac{3{,}600\ s}{1\ h} \times \frac{24\ h}{1\ d}$$

$$\times \frac{365\ d}{1\ yr} \times \frac{114.23\ g\ C_8H_{18}}{1\ \text{Mole } C_8H_{18}} \times \frac{1\ mL\ C_8H_{18}}{0.77\ g\ C_8H_{18}} \times \frac{1\ L}{1{,}000\ mL} \times \frac{1\ \text{gallon}}{3.75\ L}$$

$$= 625\ \frac{\text{gallon } C_8H_{18}}{\text{acre} \cdot \text{yr}}$$

Therefore, the approximate LNAPL loss rate for every micromole (µMole) of CO_2 measured per square meter (m^2) per second efflux represents 625 US gallons of LNAPL degraded per acre per year (or 0.58 liters C_8H_{18} per square meter per year).

[4] These techniques are discussed in more detail in American Petroleum Institute (API) Publication #4784: *Quantification of Vapor Phase-Related Natural Source Zone Depletion Processes* (May 2017); Interstate Technology & Regulatory Council (ITRC) Publication #LNAPL-3: *Light Non-Aqueous Phase Liquid Site Management: LCSM Evolution, Decision Process, and Remedial Technologies* (March 2018); and Cooperative Research Centre for Contaminated Site Assessment and Remediation (CRC CARE) Technical Report 44: *Technical measurement guidance for LNAPL natural source zone depletion* (August 2018).

3.1.2 CO_2 Traps

Subsequent CO_2 efflux measurements will be collected via deployment of passive CO_2 traps (see photo inset). The CO_2 Trap is a passive sampling device that contains a solid-state sorbent material. The sorbent is strongly basic, converting the CO_2 that passes through to stable carbonates that are retained in the trap. Traps typically remain in place for two weeks, which provides some level of normalization of any temporal variability in CO_2 flux measurements.

Locations will be primarily based on DCC results (thus, areas with permeable surface cover), with up to ten (10) locations chosen to provide good representation of the assessment area. The results of the biogenic heat method and soil gas gradient method discussed below will also be taken into consideration as appropriate when selecting CO_2 Trap locations. The installation of CO_2 Traps proceeds similarly to what is described above for the DCC: a PVC collar is inserted several inches into the ground with the Trap placed on top. Anchors and a rain hood are then added to secure the Trap and protect it from the elements. Following the 2-week sampling period, deployed traps and one undeployed trap (a trip blank) are collected and sent to the laboratory (E-Flux LLC of Fort Collins, CO) for analysis of total CO_2 and petrogenic CO_2 via unstable isotope analysis (^{14}C radiocarbon dating). The unstable isotope ^{14}C is present in modern carbon sources, but due to a half-life of 5,600 years, is not present in fossil fuel carbon sources. Consequently, CO_2 Trap analysis involves a 'built-in' location-specific background correction based on analytical data that results in much more reliable petrogenic CO_2 flux estimation than can reasonably be accomplished via the DCC method alone. NSZD rate determination is consistent with the stoichiometry/procedure outlined above for the DCC.

3.2 Biogenic Heat Method

Vertical subsurface temperature profiling of the vadose zone will be completed at monitoring wells within and adjacent to the LNAPL area to screen for evidence of biogenic heat production in the form of temperature anomalies compared with temperature profiles at monitoring wells outside the LNAPL area (i.e., background locations). Temperature measurements will be collected using a temperature meter and a string of 4 thermocouples spaced at 1-foot intervals. Water temperature measurements will also be collected to verify that water temperatures do not have an effect on vadose zone temperature profiles. If reliable background wells are not available, a modeled subsurface background will be used based on local historical temperature records. Vertical temperature profiles will be collected through the vadose zone and into the top of the water column at twenty-one (21) wells across the assessment area using a handheld temperature meter and four thermocouples cabled together at 1-foot intervals (see photo inset). This allows four readings across a 4-foot interval to be taken simultaneously.

The biogenic heat method uses temperature anomalies within an LNAPL-contaminated zone along with known heats of reaction and stoichiometry to estimate NSZD rates based on the heat released during the oxidation of petrogenic methane in the vadose zone. The method was first described by Sweeney & Ririe,[5] and, since then, has been further elaborated on by Warren & Bekins,[6] ITRC, API, and CRC CARE.[4] Background-corrected temperature gradients are used as the basis for the estimates. The temperature gradients are converted to heat fluxes according to the following equation.[4,8]

[5] Sweeney, R.E., and G.T. Ririe. 2014. *Temperature as a Tool to Evaluate Aerobic Biodegradation in Hydrocarbon Contaminated Soil*. Groundwater Monitoring & Remediation (doi:10.1111/gwmr.12064).

[6] Warren, E., and B.A. Bekins. 2015. *Relating subsurface temperature changes to microbial activity at a crude oil-contaminated site*. Journal of Contaminant Hydrology (doi: 10.1016/j.jconhyd.2015.09.007).

$$q_h = -K_T(\Delta T/\Delta z),$$

where:

q_h = heat flux (J/m²/s)

$-K_T$ = thermal conductivity of the soil/rock (J/s/m/˚C)

$\Delta T/\Delta z$ = temperature gradient (˚C/m)

Thermal conductivities for soil/rock are typically derived from reference material on the thermal properties of soil/rock.[6] The total heat flux, q_T, is then represented by the summation of the heat fluxes upwards and downwards as follows:[4,8]

$$q_T = -K_T(\Delta T/\Delta z)_{upward} - K_T(\Delta T/\Delta z)_{downward}$$

The ultimate estimation of the NSZD rate is facilitated by dividing the total heat flux, q_T, by the heat of reaction for the methane oxidation reaction as shown below:[4,8]

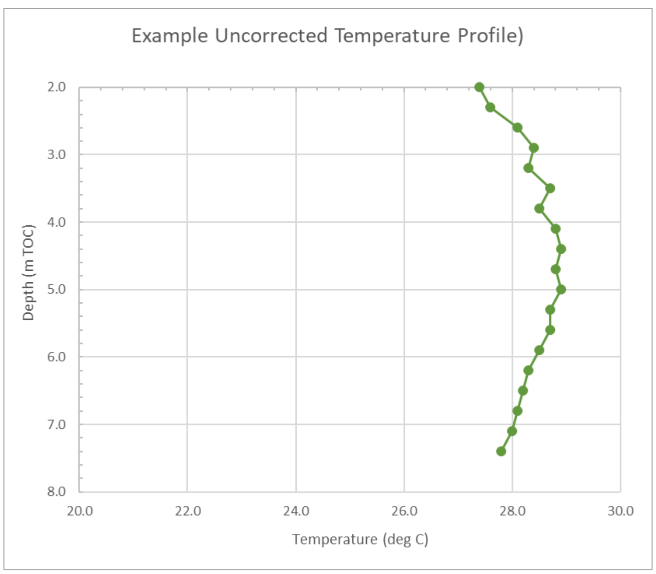
$$R_{NSZD} = q_T/\Delta H_{rxn},$$

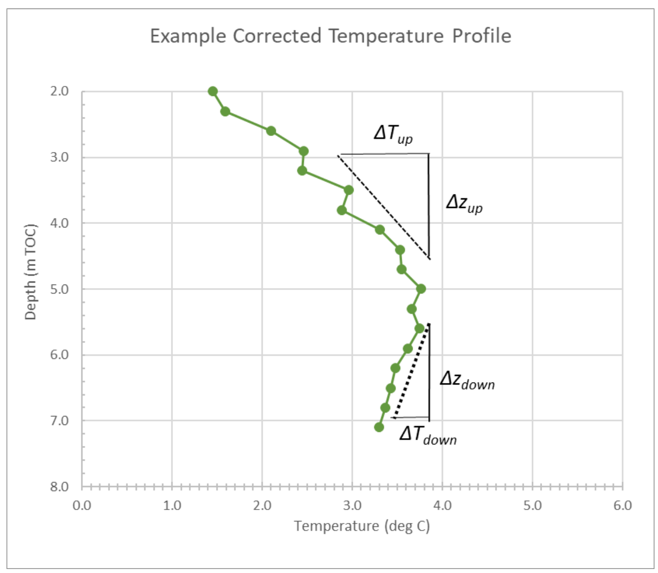
where:

R_{NSZD} = NSZD rate (g hydrocarbon degraded/m²/s)

ΔH_{rxn} = heat of reaction (J/g)

The concept behind using thermal gradients is illustrated below. The upward and downward temperature gradients (slopes) which are used to calculate an NSZD rate for this location are indicated in the figure with dotted lines.





Source: GHD

It is noted that the shallow depth to LNAPL/water in parts of the CST minimizes the thickness of the vadose zone where the heat-generating methane oxidation processes typically occur. This may be a complicating factor for NSZD rate measurement via the biogenic heat method and the gradient method described below. If that is determined to be the case at the CST during a particular event, the near surface CH_4 measurements will provide, at a minimum, a qualitative verification of the occurrence of methanogenesis.

3.3 Soil Gas Gradient Method

The soil gas gradient method assumes that estimates of LNAPL mass losses through volatilization and biodegradation are represented by vertical distributions of certain soil gases, in this case mainly CO_2, CH_4, and/or O_2. The underlying basis for this assumption is Fick's First Law, which is expressed as:

$$J = D_v^{eff} \frac{dC}{dz}$$

where:

J = steady state diffusive soil gas flux (g/m^2 soil/s)

D_v^{eff} = effective soil vapour diffusion coefficient or effective diffusivity (m^2/s)

$\frac{dC}{dz}$ = soil gas concentration gradient (g/m^{3}m)

Accordingly, the in-well soil gas gradient method involves the assessment of changes in the vertical distribution of soil gas constituents (mainly O_2, CH_4, and CO_2) over the LNAPL source zone footprint. Measurements of CH_4, CO_2, and O_2 levels will be collected near surface and at depth in the vadose zone using a GEM and SEM. The readings at depth will be obtained via the small-purge method,[7] which specifies that representative soil gas concentrations can be obtained from wells screened across the water table when using a sampling rate consistent with what is typical with handheld gas analyzers (even without the use of packers). For the at-depth readings, a well cap with tubing extending to the target sampling depth (approximately one foot above top of fluids) will be used with appropriate gas-tight fittings for connection to the GEM or SEM instruments. For the shallow readings, both a screening of the shallow well headspace with the GEM or SEM and an assumption of atmospheric conditions will be used to develop a range of NSZD estimates. Soil gas gradient profiles will be collected from the two target depths (shallow and at-depth) in the same twenty-one (21) wells used for the biogenic heat method in order to facilitate a comparison of results from different methods. The estimation of NSZD rates via soil gas O_2 data will be performed consistent with the principles and general methodology described by API, ITRC, and CRC CARE.[4] The procedure assumes that the average molecular weight of an LNAPL source is appropriately represented by octane (C_8H_{18}). The following stoichiometry describes the process:

Anaerobic Reaction in Vadose Zone (immediately above source)

$$C_8H_{18} + 3.5\ H_2O \rightarrow 1.75\ CO_2(g) + 6.25\ CH_4\ (g)$$

Aerobic Reaction in Vadose Zone (above anaerobic halo)

$$6.25\ CH_4 + 12.5\ O_2 \rightarrow 6.25\ CO_2\ (g) + 12.5\ H_2O$$

Overall Reaction (summation of both reactions)

$$C_8H_{18} + 12.5\ O_2 \rightarrow 8\ CO_2\ (g) + 9\ H_2O$$

This indicates 2 moles of C_8H_{18} react with 25 moles of O_2. The molecular weight of C_8H_{18} is 114.23 g/mole and the molecular weight of O_2 is 32 g/mole, giving a stoichiometric conversion ratio of C_8H_{18}:O_2 = 0.285.

[7] Sweeney and Ririe, 2017, *Small Purge Method to Sample Vapor from Groundwater Monitoring Wells Screened Across the Water Table*, Groundwater Monitoring & Remediation, doi: 10.1111/gwmr.12230

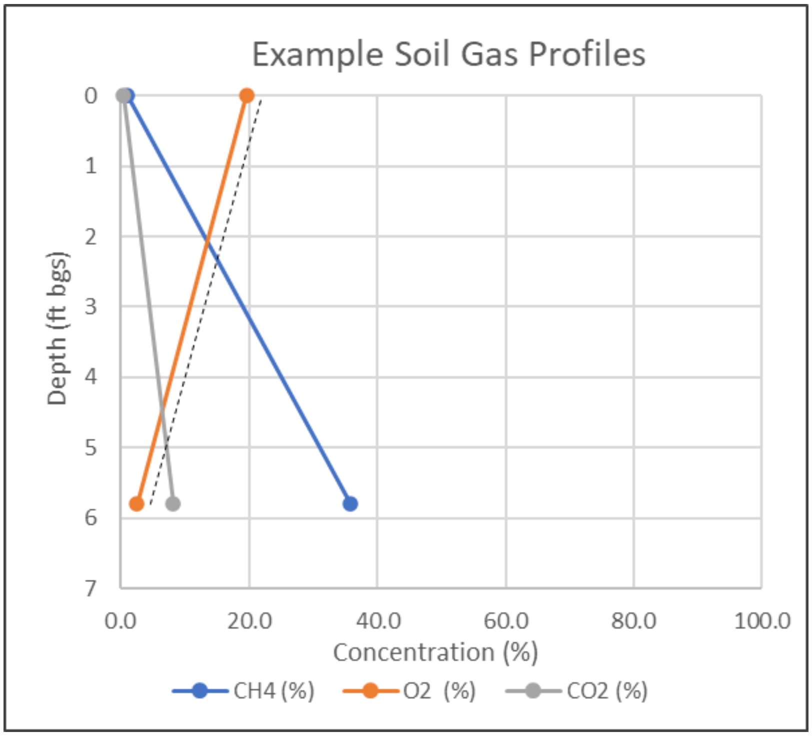
This conversion can be used to determine the amount of C_8H_{18} consumed based on the amount of O_2 depleted. Assuming an LNAPL specific gravity of 0.77 (upper range for gasoline[8]), an LNAPL loss rate (NSZD rate) can then be determined by converting the O_2 depleted as follows:

$$1\,\frac{\text{g } O_2}{\text{m}^2\text{ d}} \times 0.285\,\frac{\text{g } C_8H_{18}}{\text{g } O_2} \times \frac{1}{770\,\frac{\text{g HC}}{\text{L}}} \times \frac{1 \text{ U.S. gal}}{3.785 \text{ L}} \times \frac{4{,}047 \text{ m}^2}{1 \text{ acre}} \times \frac{365 \text{ d}}{1 \text{ yr}}$$

$$= 139.0\ \frac{\text{US gallon } C_8H_{18}}{\text{acre} \cdot \text{yr}}$$

Therefore, the approximate LNAPL loss rate for every gram (g) of O_2 depleted per square meter per day represents 139 US gallons of LNAPL degraded per acre per year (0.13 liters per square meter per year).

The concept behind using soil gas gradients is illustrated below. The O_2 gradient (i.e., the dC/dz for O_2) used to calculate an NSZD rate in the case of this example is indicated with the dotted line.



4. Summary

Natural source zone depletion processes have been shown to account for significant mass losses over time at other sites and preliminary data gathered from the CST to date indicates that these processes are likely occurring. The methods outlined in this work plan are intended to evaluate the natural on-going processes occurring at the CST and to quantify the magnitude of associated mass losses over time. Information gathered will be compiled in a NSZD Assessment Report for the NYSDEC's review and used to assist in determining when active recovery of LNAPL is no longer providing an increased benefit over natural processes alone.

[8] This is the specific gravity for octane, since that is the LNAPL surrogate that is assumed in NSZD calcs, which is the standard of practice.

5. References

1. American Petroleum Institute (API), May 2017. Publication #4784 – Qualification of Vapor Phase-related Natural Source Zone Depletion Processes, First Edition
2. Cooperative Research Centre for Contaminated Site Assessment and Remediation (CRC CARE), August 2018. Technical Report 44: Technical measurement guidance for LNAPL natural source zone depletion
3. Interstate Technology & Regulatory Council (ITRC), April 2009. Evaluating Natural Source Zone Depletion at Sites with LNAPL. Prepared by the Interstate Technology and Regulatory Council April 2009
4. ITRC, 2009. Evaluating Natural Source Zone Depletion at Sites with LNAPL, LNAPL-1. Washington, DC: Interstate Technology & Regulatory Council, LNAPLs Team
5. ITRC, 2009. Evaluating LNAPL Remedial Technologies for Achieving Project Goals, LNAPL-2. Washington, D.C.: Interstate Technology & Regulatory Council, LNAPLs Team
6. ITRC, 2018. LNAPL Site Management: LCSM Evolution, Decision Process, and Remedial Technologies, LNAPL-3. Washington, D.C.: Interstate Technology & Regulatory Council. LNAPL Update Team
7. Mahler et al, 2012. A Mass Balance Approach to Resolving LNAPL Stability, Groundwater, Volume 50, Number 6, doi: 10.1111/j.1745-6584.2012.00949.x
8. Sweeney, R.E., and G.T. Ririe. 2014. Temperature as a Tool to Evaluate Aerobic Biodegradation in Hydrocarbon Contaminated Soil. Groundwater Monitoring & Remediation (doi:10.1111/gwmr.12064)
9. Warren, E., and B.A. Bekins. 2015. Relating subsurface temperature changes to microbial activity at a crude oil-contaminated site. Journal of Contaminant Hydrology (doi: 10.1016/j.jconhyd.2015.09.007)

Figures

LEGEND

- PRE-EXISTING SOUTHERN TERMINALS MONITORING WELL LOCATION
- NESTED SOUTHERN TERMINALS MONITORING WELL LOCATION (INSTALLED NOVEMBER 2019)
- SOUTHERN TERMINALS LNAPL RECOVERY WELL LOCATION (INSTALLED NOVEMBER 2019)
- ADDITIONAL SOUTHERN TERMINALS MONITORING WELL LOCATION (INSTALLED MAY 2020)
- PRE-EXISTING NORTHERN TERMINALS MONITORING WELL
- SIGNIFICANTLY DAMAGED MONITORING WELL - CANNOT BE GAUGED
- DECOMMISSIONED MONITORING WELL (MARCH 2020)
- IMPERVIOUS SURFACES (APPROXIMATE)
- DYNAMIC CLOSED CHAMBER LOCATION (APPROXIMATE, TO BE FIELD DETERMINED)

APPARENT LNAPL THICKNESS IN FEET (DECEMBER 2019 GAUGING EVENT)

0-1 2-3
1-2 3-4

WELLS PROPOSED TO BE USED FOR BIOGENIC HEAT AND SOIL GAS GRADIENT ASSESSMENTS		
WITHIN LNAPL AREA	ADJACENT TO LNAPL AREA	OUTSIDE OF LNAPL AREA (BACKGROUND)
RW-1	MW-11S	MW-205
RW-2	MW-12S	MW-208
RW-3	AMW7	MW-211
RW-5	A9	AMW4
MW-5SR	MW-8S	MW-204
A10	MW-10S	
BMW5	BMW14R	
BMW13	BMW6	

NOTE THAT LOCATIONS SELECTED FOR SURFACE CO2 EFFLUX MEASUREMENTS WILL BE SELECTED BASED ON DCC RESULTS AND ARE NOT ABLE TO BE DETERMINED AT THIS TIME.

NOTES:

1. AERIAL PHOTOGRAPHS ARE 1-FOOT RESOLUTION TRUE COLOR ORTHOIMAGERY DATED 2018 AND TAKEN FROM THE NYSGIS CLEARINGHOUSE WEBSITE.
2. SITE FEATURES ARE BASED ON SURVEYS PROVIDED BY OTHERS.

N

0 100'

GHD

SOUTHERN TERMINALS GROUP
COLD SPRINGS TERMINALS
HILLSIDE ROAD, LYSANDER, NEW YORK

SITE LAYOUT AND PROPOSED NSZD ASSESSMENT LOCATIONS

Project No. 11137172
Date 05.2022

FIGURE 1

Filename: G:\Projects\564\11137172\Digital_Design\ACAD\Figures\11137172-FIG01-Site Layout with Proposed NSZD Locations.dwg
Plot Date: 23 May 2022 12:29 PM

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→ The Power of Commitment