Global Environmental
Compliance & Sustainability

April 28, 2017 Reference No. 013968

Mr. Peter Ramanauskas
Project Manager for IND 0060306099
Land and Chemicals Division
U.S. EPA Region 5
77 West Jackson Blvd. (LU-9J)
Chicago, IL 60604-3507

Dear Mr. Ramanauskas:

Re: AOI 8 Area NAPL Recovery Design Report – CH-2A Automated Pumping System
GM CET – Bedford Facility, IND 006036099, AOC Docket No. RCRA-05-2014-0011
RCRA Corrective Action
Bedford, Indiana

Enclosed for your review, please find a copy of the AOI 8 NAPL Recovery System Design Report - CH-2A Automated Pumping System (Report). This Report has been submitted by GHD Limited, on behalf of General Motors LLC (GM), to present the design for recovery of NAPL from the AOI 8 Area in accordance with the Conditions of the Administrative Order on Consent (AOC) dated August 4, 2014 (AOC Docket No. RCRA-05-2014-0011).

Should you have any questions regarding this document, please do not hesitate to contact me at (313) 510-4328.

Yours truly,

General Motors LLC

Cheryl R. Hiatt
Project Manager

Encl.

c.c.: See Attached Distribution List

GM Bedford Distribution List

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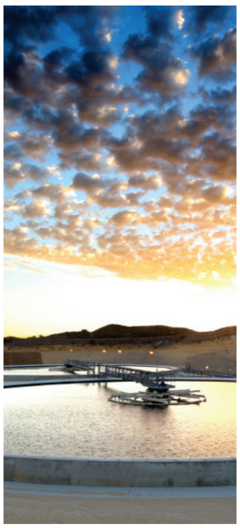

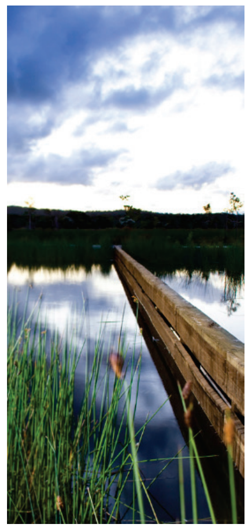

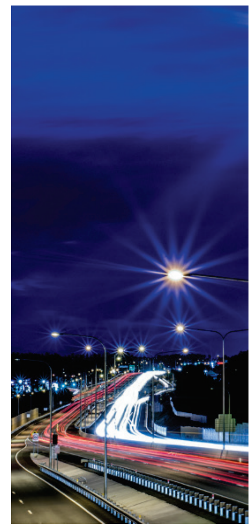

AOI 8 NAPL Recovery Design Report CH-2A Automated Pumping System

GM CET Bedford Facility
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General Motors LLC

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Terms and Acronyms

AOI	Area of Interest
AOI 8	Former South Lagoons and Outfall 002 Area of Interest
CCR	Current Conditions Report
CET	Castings, Engines, and Transmissions
CRA	Conestoga Rovers & Associates, Inc.
DNAPL	Dense Non Aqueous Phase Liquid
Facility	GM CET Bedford Facility
ft	feet or foot
Geotech	Geotech Environmental Equipment, Inc.
GHD	GHD Services, Inc.
GM	General Motors LLC
GMC	General Motors Corporation
IM	Interim Measure
ISBH	Indiana State Board of Health
LNAPL	Light Non Aqueous Phase Liquid
NAPL	Non Aqueous Phase Liquid
ND	Non-detect
NPDES	National Pollutant Discharge Elimination System
NRC	National Response Center
PCB	Polychlorinated Biphenyl
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
TSCA	Toxic Substances Control Act
US DOT	U.S. Department of Transportation
US EPA	U.S. Environmental Protection Agency
IM Work Plan	AOI 8 Groundwater Source Collection System Interim Measures Work Plan
WMP	Waste Management Plan
WWTP	Wastewater Treatment Plant

1. Introduction

GHD Services, Inc. (GHD[1]) has prepared this Design Report to present the work to be completed as part of an Interim Measure (IM) for the Former South Lagoons and Outfall 002 Area of Interest (AOI 8) at the General Motors LLC (GM) Castings, Engines, and Transmissions (CET) Bedford Facility (Facility) located in Bedford, Indiana. The overall Facility Location and Plan, including the location of AOI 8 are presented on Figures 1.1 and 1.2, respectively.

Evidence of recoverable Light Non-Aqueous Phase Liquid (LNAPL) and Dense Non-Aqueous Phase Liquid (DNAPL) have been observed within AOI 8 at monitoring wells CH-5 and CH-2A, respectively. Long-term removal of Non-Aqueous Phase Liquid (NAPL) from the AOI 8 area will be accomplished by removing accumulating NAPL from wells CH-2A and CH-5, as outlined in the report entitled “AOI 8 Area Groundwater Source Collection System Interim Measures Work Plan – Revision 1” (IM Work Plan), dated March 2, 2017). LNAPL observed in CH-5 will be removed utilizing a passive collection system comprised of absorbent socks that will be routinely replaced based on sock saturation. DNAPL observed in CH-2A will be removed by an automated pumping system. It is the automated pumping system that is the focus of this Design Report.

A summary of the AOI 8 investigations, along with a general discussion of the passive LNAPL collection system (absorbent socks) for CH-5 and the recommended conceptual design for the automated DNAPL pumping system at CH-2A were previously presented in the IM Work Plan.

2. Background

2.1 Facility Location

The Bedford CET Facility is located at 105 GM Drive in the City of Bedford, Shawswick Township, Lawrence County, Indiana on approximately 152.2 acres of land located on both sides of GM Drive. The overall Facility location is presented on Figure 1.1. The East Plant Area represents the portion of the Facility that is bounded by GM Drive to the west and Bailey Scales Road to the east (see Figure 1.2). The West Plant represents the portion of the Facility that is bounded by GM Drive to the east and an abandoned railroad line to the west. Manufacturing operations are included in the West Plant Area. The AOI 8 area is located within both the East Plant and West Plant Areas, as shown on Figures 1.1 and 1.2.

2.2 Regional Environmental Setting

A detailed description of the regional environmental setting (physiography, topography, land use, geology, hydrogeology, and hydrology) was previously provided in the Current Conditions Report (CCR) prepared by Conestoga Rovers & Associates, Inc (CRA), dated May 25, 2001 and has been updated as required based on findings from various phases of the Resource Conservation and

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1 On July 2, 2014, GHD and Conestoga-Rovers & Associates (CRA) merged. On July 1, 2015, CRA changed its name to GHD. Where work was conducted prior to July 1, 2015, CRA is identified as the entity performing the work.

Recovery Act (RCRA) Facility Investigation (RFI) Work Plan (CRA, October 29, 2001) at the CET Bedford Facility. The complete regional environmental setting description has not been reproduced for this report; however some of the pertinent bedrock geological and hydrogeological information regarding the Facility is presented here for background purposes.

The uppermost bedrock formation beneath the Facility is comprised of the lower beds of the Middle Mississippian St. Louis Limestone (the oldest formation within the Blue River Group). This bedrock formation is approximately 25 ft thick (Melhorn and Smith, 1959) in the immediate vicinity of the Facility. Immediately underlying the St. Louis Limestone, and outcropping to the east of the Facility, are the Salem Limestone, Harrodsburg Limestone and the Ramp Creek formations, respectively. These three Mississippian formations make up most of the Sanders Group. The Salem Limestone is approximately 70 to 80 ft thick, the Harrodsburg Limestone is approximately 80 to 90 ft thick, and the Ramp Creek is approximately 20 ft thick (Melhorn and Smith, 1959).

The near surface regional geology is characterized by karst rock topography. Several geomorphic features, such as sinkholes, characterize the land surface near Bedford. This karst topography is especially prominent along the western portion of Lawrence County, with substantially less surface expression through the middle and eastern portions of the county. The City of Bedford lies within the physiographic province known as the Mitchell Plain, or Plateau (karst plain). The Mitchell Plain extends from near Bloomington to the north and south to the Ohio River within the State of Indiana.

There are two basic types of aquifers: unconfined and confined. Unconfined aquifers in Lawrence County generally occur along Salt Creek and the East Fork of the White River within the proglacial outwash deposits, glaciolacustrine deposits, and recent alluvium. The unconsolidated aquifers are often exposed to the ground surface or have a very thin covering of non-aquifer material, generally comprised of silt and clay (Fenelon and Bobay, 1994).

Groundwater flow within the confined (carbonate) aquifers takes place along the joints, fractures, and bedding planes that eventually may become enlarged by solution to cave passages or karst features. Recharge to a karst rock system occurs through surface openings that vary in scale from narrow, solutionally widened joints to large sinkholes. Discharge typically occurs through springs, from solutionally widened joints or bedding planes, but may be enlarged, to sizable cave openings. Most groundwater within this aquifer system discharges to surficial water bodies, to underground water bodies, and to springs (Etzel, 1982).

3. Historical Operations

3.1 Former Lagoon Closure Activities

The former General Motors Corporation (GMC) utilized five lagoons (South Lagoons #1 through #5) at the Facility for the purpose of treating process wastewater from their manufacturing operations prior to discharge to Outfall 002, pursuant to a National Pollutant Discharge Elimination System (NPDES) permit (IN 0003573), originally issued in 1974. These five former South Lagoons (also referred to as the Process Lagoons) operated in a cascading-type fashion in order to separate and reclaim the heavier hydraulic oils (settled to the bottom) contained in the process wastewater. The process wastewater was primarily from the existing service tunnels beneath the die cast machines.

GMC constructed the former South Lagoons in 1959. These Lagoons were eventually removed as a more complete treatment system was installed to treat process water prior to discharge. South Lagoon #4 (also referred to as the Sludge Storage Lagoon) was the last lagoon to be removed and was remediated in 1983. The Facility's existing wastewater treatment plant (WWTP) occupies the location of former South Lagoons 1#, #2, #3, and #5. Although there have been no documented releases from the area of the former South Lagoons #1, #2, #3, and #5, there is a potential that subsurface conditions may have been impacted due to the nature of the operations of the lagoons. The Facility's WWTP currently discharges treated wastewater through Outfall 002. The location of the five former South Lagoons is presented on Figure 2.1.

GMC completed closure activities (soil and sediment removal and disposal) for the lagoon settling basin within the former South Lagoon #4 in 1983. GMC retained CECOS to complete the closure of the South Lagoon #4. Excavation activities at former South Lagoon #4 began on August 22, 1983, with removed soil and sludge being transported under manifest for disposal at the Toxic Substances Control Act (TSCA) approved Secure Chemical Management Facility near Williamsburg, Ohio. The excavation activities were completed on September 30, 1983.

On October 5, 1983, GMC notified the National Response Center (NRC), the Indiana State Board of Health (ISBH), and the United States Environmental Protection Agency (U.S. EPA) that water was flowing into the bottom of the former lagoon, as observed upon completion of the excavation. Small amounts of oil were also observed entering the excavation along with the water. It was estimated that approximately 1,500 to 2,000 gallons per day (gpd) of water was entering the excavation. Analytical results of the oil indicated a PCB concentration of 36,000 milligrams per liter (mg/L).

As such, prior to backfilling and capping the excavation, a collection system was installed for the purpose of collecting the oil and accumulating water. The collection system consisted of four-inch diameter, perforated polyvinyl chloride (PVC) pipe placed around the perimeter of the excavation bottom. Approximately one foot of gravel was used to cover the pipe and a compacted clay berm was constructed around the gravel. The horizontal pipe drained to a five-foot diameter manhole (sump), where an electric pump was installed. The collection system discharge was tied into the existing WWTP at the Bedford Facility for treatment.

Approximately 27,000 tons of clay was used to backfill the excavation, with six inches of topsoil cover that was seeded to create a (unused) grassy area. GMC notified the ISBH and U.S. EPA of the completion of the final cleanup of former South Lagoon #4 on January 11, 1984. The installed sump is still in place but is currently not being operated.

3.2 RFI Investigation Summary

Under the RFI Work Plan, four soil borings were advanced within AOI 8 for the purpose of verifying the existing conditions. B-X193Y098 was advanced within the area of the former South Lagoon #4, while B-X219Y095, B-X223Y097A, and B-X223Y097B were advanced within the area of the former South Lagoon #5. Borings could not be completed at the former locations of South Lagoons #1, #2, or #3 due to the presence of the Facility's WWTP at these locations.

The subsurface conditions at former South Lagoon #4 (B-X193Y098) consisted of topsoil underlain by approximately 13 ft of clay fill. At approximately 12 ft below ground surface (bgs), the clay fill was observed to be visibly stained and exhibited a noticeable petroleum odor. Bedrock was encountered at 14 ft bgs. The subsurface conditions in the three soil borings within the former South Lagoon #5 area generally consisted of variable fill materials (clay, sand, and gravel) ranging in thickness from 6 to 14 ft, below which bedrock was encountered.

Five of the 12 soil samples (including one duplicate) collected from the subsurface within the AOI 8 area exceeded the polychlorinated biphenyl (PCB) screening level of 7.4 mg/kg. Exceedances were from soil collected near the bedrock at each of the boring locations. Concentrations of total PCBs ranged from non-detect (ND) to a maximum concentration of 1,700 mg/kg. The maximum PCB concentration was found immediately above bedrock beneath former South Lagoon #4 (13 to 14 ft bgs at soil boring B-X193Y098).

In May 2002 after a period of significant rainfall, DNAPL/oil was discovered in the creek bottom, downgradient from the Former South Lagoons #4 and 5, following soil removal near the existing Outfall 002. The DNAPL was observed to be seeping into the excavated area from the underlying bedrock. Measures were implemented to contain, remove, and appropriately dispose of the DNAPL. In order to determine a possible source for the DNAPL, several borings were advanced between the Facility's WWTP and the Outfall 002 area, as described in the RFI Work Plan Addendum No. 1 (CRA, November 2002) to evaluate the water and NAPL in the rock.

Three borings (B-X209Y078A/B/C) were advanced within the footprint of the removed million gallon above ground storage tank, just south of the Former South Lagoon #4. One of these borings was later advanced into bedrock for installation of a shallow monitoring well (MW-X209Y078S). Two wells were advanced northeast of the million gallon aboveground storage tank (AST) Monitoring well MW-X225Y080S was completed within the shallow bedrock, while adjacent TMW-X225Y080 was completed within the overburden due to the presence of perched groundwater during drilling. Soil samples collected indicated no results exceeding screening levels.

To further characterize the transport of water/NAPL within the bedrock in the vicinity of Outfall 002, a series of shallow bedrock monitoring wells were installed at a 30 degree angle (to vertical). The borings were completed on an angle to increase the chance in locating vertical fractures within the bedrock. These wells are located along a line perpendicular to the flow of the creek at Outfall 002 (along east side of GM property). Fifteen angle-monitoring wells were completed at nine locations in total. Six of the nine monitoring well locations were completed as well nests (shallow and deep wells completed next to each other). The monitoring well nests were completed as a result of substantial loss of drilling fluids via the shallow bedrock fractures that occurred during drilling at those locations. Therefore, many of the shallow wells within a well nest were completed above the water table and a nested monitoring well was installed deeper. Eighteen (including one duplicate) soil samples were submitted for laboratory analysis for PCBs.

4. Review of NAPL Recovery Investigations

The initial scope of work for the AOI 8 area investigation was described in the memorandum entitled "Work Plan Addendum, AOI 8 Interim Measures" (CRA, January 22, 2008). After submittal and review of several additional memoranda containing responses to comments on the scope of work in the initial Work Plan Addendum (CRA, February 20, 2008; July 16, 2008; September 23, 2009; and July 16, 2010), the scope of work was finalized in a revised memorandum entitled "Work Plan Addendum, AOI 8 Interim Measures - Revision 1", dated September 2, 2010.

The finalized Work Plan Addendum included additional investigations of AOI 8, including installation of additional monitoring wells and a plan for implementing a NAPL removal and monitoring test at two wells with historical NAPL presence (CH-2A and CH-5). The following section provides a short summary of the additional investigative activities that have occurred in the AOI 8 area since the RFI.

4.1 NAPL Delineation and Recovery Evaluation

Bedrock coreholes CH-1B, CH-2A. and CH-5 were installed in 2005 as part of an investigation to determine the proposed bedrock groundwater collection trench alignment. NAPL was first observed at corehole CH-5 in July 2005, and later observed in CH-1B and CH-2A, as well as monitoring wells MW-X209Y053 and MW-X227Y049. MW-X209Y053 and MW-X227Y049 were installed as part of the NAPL delineation discussed in Section 4.1.1 below.

4.1.1 NAPL Delineation (2006)

Eight (8) groundwater monitoring wells (MW-X190Y048; MW-X192Y048; MW-X209Y053; MW-X214Y041; MW-X227Y049; MW-X227Y054; MW-X228Y032; and MW-X234Y042, all of which have subsequently been abandoned due to placement of the East Plant Area cover system), were installed between July and December 2006 to delineate the extent of NAPL in shallow bedrock south and southeast of AOI 8. Measureable thicknesses of NAPL were present in two of the eight monitoring wells (MW-X209Y053 and MW-X227Y049). A trace amount of NAPL (not measurable or recoverable) was noted upon removal of the pump from MW-X227Y054; but NAPL has not been observed since.

During subsequent sampling, groundwater samples were not collected from the two groundwater monitoring wells that exhibited NAPL (MW-X209Y053 and MW-X227Y049) presence. An oil-water characterization sample was collected from MW-X209Y053, which exhibited a PCB concentration of 400,000 mg/kg (but this well did not contain NAPL in later sampling).

4.1.2 NAPL Recovery Evaluation (2007)

In October 2007 (based on the scope of work presented to U.S. EPA on June 19, 2007), inflatable packers were installed at various vertical intervals at five monitoring well locations (MW-X209Y053, MW-X227Y049, CH-1B, CH-2A, and CH-5) in an attempt to identify the vertical interval in which the NAPL was present or entering at each location. This study was completed to collect pertinent data for determination of the potential for a full scale recovery system at any of these well or corehole locations, particularly to determine the most effective locations for significant NAPL removal.

The results of this testing were inconclusive in determining actual intervals. Additional follow-up testing for longer durations was proposed at CH-2A and MW-X209Y053, once the Parcel 201 cap was completed (see subsequent discussion in this Design Report). NAPL accumulation at each monitoring well was removed manually on a weekly basis from March 2008 to August 2008. The recovery was halted due to worker safety concerns during construction activities in the area. Manual NAPL removal was never resumed due to continuing construction activities, as well as the pending installation of an automated NAPL recovery system and finalization of a waste profile for off-Site disposal of NAPL.

4.2 AOI 8 Work Plan Addendum

On March 17, 2010, a meeting was held between GM and U.S. EPA to discuss the results of the NAPL investigation at AOI 8 and to determine if additional data would be necessary in order to approve the Interim Measures design. At this meeting it was agreed that two additional monitoring wells (MW-X146Y084 and MW-X165Y068) would be installed to the west and southwest of AOI 8 and that temporary pumping would be performed at two of the NAPL locations (CH-2A and CH-5). This pumping would be used to conduct NAPL recovery tests and monitor sustainability and rate of NAPL recovery within CH-2A and CH-5.

4.2.1 Vertical DNAPL Entry Evaluation (CH-2A and MW-X209Y053)

An evaluation was conducted in March 2011 at corehole CH-2A and monitoring well MW-X209Y053 via discrete interval packer testing to determine the vertical intervals where DNAPL was present at each location. Based on the monitoring and observations of separate vertical zones at CH-2A and MW-X209Y053 during the packer testing, clear indication was obtained of the vertical intervals the DNAPL is present at each well location. The lowest elevation that DNAPL appears to be present in corehole CH-2A is 652.0 ft AMSL and the lowest elevation that DNAPL appears to be present in monitoring well MW-X209Y053 is 657.5 ft AMSL. Results of the packer testing activities conducted at CH-2A and MW-X209Y053 were discussed with U.S. EPA at a May 26, 2011 meeting, with the final memorandum sent to U.S. EPA on July 5, 2011.

4.2.2 NAPL Removal and Monitoring at CH-2A and CH-5

The scope of work presented in the final Work Plan Addendum for AOI 8 included performing NAPL removal testing at two locations (CH-2A and CH-5). Results of the NAPL removal testing at the two coreholes is summarized in the following sub-sections of this report.

4.2.2.1 LNAPL Removal Testing at CH-5

In September 2012, pumping of total fluids (water and NAPL) was performed at CH-5 using a QED Pulse pneumatic pump with a bottom intake. Pressure transducers were installed in ten adjacent monitoring wells and coreholes to determine background groundwater elevations prior to initiation of pumping. The well was evacuated (pumped dry) within 88 minutes, with approximately 10.5 gallons of total fluids (mostly water) recovered from CH-5 during the pumping cycle. The pumping rate at CH-5 averaged 0.12 gallons per minute (gpm). Within three hours, the fluid level within CH-5 had recovered approximately 80 percent of the recorded pre-pumping level and the recovery phase was deemed to have ended.

Due to the appearance of an emulsified oil product (or mixed water/LNAPL), samples of the CH-5 oil/water mixture were shipped to an off-site laboratory for determination of treatment options. The results of the laboratory testing showed that the oil/water mixture could be effectively treated in a two-step process. Initially, the recovered oil/water could be processed through a batch treatment process utilizing a clay-based flocculent for removal of the free product, with the resultant sludge discharged into a collection container while the filtrate (water) could be secondarily processed through an organophillic clay filter media.

When collecting the oil/water mixture for laboratory testing, field technicians noted that the mixture quickly separated into visible LNAPL and water. The fluid removal within CH-5 continued until the fluid column was evacuated - approximately 10 to 15 gallons. The water level in the well recovered within 24 hours, but NAPL was much slower to respond (weeks). Based on this data, an on-Site bench scale test was performed to determine if a passive collection system would be effective for oil recovery at CH-5. The on-Site bench scale testing consisted of removing the LNAPL/water mixture from CH-5 and placing the LNAPL/water mixture into clear sample containers. Various coagulants were added to the different sample containers to separate the emulsion. Absorbent socks were then lowered into the separated LNAPL/water mixtures.

The on-Site bench scale tests determined that the recovered liquid did not appear to stay emulsified upon removal from the well, as there was noticeable separation upon minimal settlement time, even before coagulant was added. The addition of coagulant did not appear to have a significant effect on separation time. During the bench scale tests, absorbent socks appeared to readily remove the separated LNAPL, suggesting that implementation of a manual system of using absorbent socks in CH-5 is a viable solution for LNAPL removal. This is important because pumping action appears to contribute to emulsification of the LNAPL present in CH-5. Based on previous testing, LNAPL enters CH-5 quite slowly, so absorbent socks are expected to be quite effective. The quantity of DNAPL in CH-5 appears to be insignificant, but will be periodically monitored.

4.2.2.2 DNAPL Removal at CH-2A

In September 2012, oil-water interface probes were utilized to attempt to measure the thickness of the DNAPL at the CH-2A location. Two separate interface probes from two different manufacturers were both unable to get an accurate reading due to coating of the probe by DNAPL, so the initial thickness was unknown. Pumping at CH-2A was performed using a QED Pulse pneumatic pump. Pumping was conducted for 45 minutes, with approximately 5.5 gallons of heavy oil (i.e., DNAPL) being removed from CH-2A, with very little water present. The pump failed just as traces of water were starting to be observed in the discharge. The pumping rate at CH-2A averaged 0.12 gpm. Within three hours, the water level within CH-2A had recovered to more than 70 percent of its pre-pumping level and the recovery phase was deemed to have ended.

4.2.2.3 NAPL Recovery Testing Conclusions

A summary memorandum presenting the AOI 8 NAPL Pumping Results was sent to U.S. EPA on February 26, 2013.

Previously reported NAPL entrance rates and thicknesses at CH-5 were shown to be inaccurate during both the pre-field (bench scale and laboratory testing) and field activities. A separate LNAPL phase (globules of oil) at the surface of the water were shown to coat the oil-water interface probe, thereby giving false readings of true thickness of NAPL within CH-5 in the past. As such, it appears that recoverable total fluids from CH-5 were essentially greater than 95 percent water. In addition, it was shown CH-5 could not sustain a prolonged pumping rate before being completely evacuated. As such, due to the nature of the water/LNAPL mixture at CH-5, future removal at this location was determined to be best suited for a passive collection system (not part of this Design Report).

Results of pumping at CH-2A confirmed previously estimated DNAPL removal rates. This DNAPL forms a distinct layer that is denser than water and remains at the bottom of the corehole. As such, it was determined that future DNAPL removal from CH-2A could be completed using an automated pumping system designed to cycle on a timed basis. However; the actual timing of operation and non-operation would need to be determined by making adjustments once the automated system was installed and operational. This is the focus of the next section of this Design Report.

5. Recommended Design For CH-2A

5.1 CH-2A Automated Pumping System

Data collected from previous investigations to define the vertical interval of DNAPL presence at corehole CH-2A and its recovery rate determined it to be an effective location for DNAPL removal. DNAPL will be removed from CH-2A using a dedicated, automated pumping system designed to cycle on a timed basis, with a sensor to prevent the system from pumping water (i.e., just DNAPL) out of CH-2A. The system will be set up such that removed DNAPL will be transferred directly into a receiving vessel (drum) placed within a hazardous materials (HAZMAT) enclosure with TSCA compliant secondary containment.

Due to the remote location of CH-2A, there are special considerations for the continuous operation of an automated pumping system. As discussed in the AOI 8 IM Work Plan, the system is intended to operate on solar power without the use of conventional power sources (e.g., power grid or diesel generator). The selection of solar powered equipment was also incorporated into the design as part of GM's approach at Bedford to the RCRA Greener Remediation Best Management Practices (BMP), as requested by the U.S. EPA for the AOI 8 IM in a letter to GM dated November 1, 2013.

Further details including placement, operation, and monitoring of the CH-2A automated pumping system are presented in the sections below.

5.1.1 Solar Sipper System

The system proposed for use at CH-2A is called the Solar Sipper, and is manufactured by Geotech Environmental Equipment, Inc. (Geotech). The Solar Sipper is a solar powered remediation system, designed for remote applications. The Solar Sipper system is typically provided with a HAZMAT enclosure that is capable of storing two standard 55-gallon drums, as well as a control panel and deep cycle battery pre-mounted and pre-wired before delivery for ease of installation. The unique Fixed Intake Downwell vacuum/pressure canister pump assembly, as provided by Geotech, will be inserted down the well to recover DNAPL. The pump includes a conductivity sensor, which will be placed at or below the oil/water interface to ensure only DNAPL recovery is performed (i.e., not a total fluids recovery pump). The canister assembly fills under vacuum, and once full the canister is pressurized to push the recovered fluid (DNAPL) to the surface storage vessel (drum). The control box mounted to the HAZMAT enclosure is connected to the Downwell pump assembly.

The vacuum cycle for filling of the canister with recovered product can be set by the operator over a range of 0 to 30 seconds. The subsequent pressure cycle for emptying the canister can be adjusted by the operator over a range of 30 seconds to four minutes, dependent upon the collected product removal volume. There is then a delay cycle before the next vacuum/pressure cycle, which ranges from 30 seconds to 24 hours. These different cycle settings will be established upon initiation of DNAPL pumping, but will need to be monitored and adjusted over time as the volume of available DNAPL within the well decreases as a result of pumping.

Vendor information provided by Geotech is presented in Appendix A.

5.1.2 Equipment Placement

The proposed location of the Solar Sipper System is presented on Drawing C-02 – Site Works, as part of the complete design drawing package included in Appendix B. Drawing C-02 illustrates the construction of an 8 ft by 10 ft concrete pad directly west of the CH-2A location for the placement of the HAZMAT enclosure, modular spill containment pallet, and the solar panels. The concrete pad will be 8 inches thick and will be reinforced with No. 5 steel bars at 12-inch centers and underlain with 6 inches of #53 stone for sub-base. The HAZMAT enclosure and solar panel assembly will be mounted to the concrete pad.

An access road consisting of 12 inches of #53 stone will be constructed along the north slope of Parcel 201 in provide access to the concrete pad and CH-2A by equipment required for handling the collected DNAPL. The granular access road will be constructed at an approximate 10 percent slope to climb from an elevation of approximately 690 ft AMSL at the base of the slope to approximately 696 ft AMSL in the vicinity of CH-2A.

5.1.3 Energy Consumption/Backup Power

The Solar Sipper uses photovoltaic cells, which convert sunlight continuously into electrical energy. As there is no conventional power source available in the CH-2A area, a solar powered system was selected to meet the power source needs and to meet the RCRA Greener Remediation BMPs. The pumping system itself uses a 12VDC, 75 amp hour deep cycle glass mat battery (which has better freeze resistance than a standard deep cycle lead acid marine battery) placed within a stainless steel box mounted on the side of the HAZMAT enclosure that will be charged by an 85 Watt solar panel. As such, excess converted energy is stored within the back-up battery. During extended periods of cloudy weather and winter-like conditions, the Solar Sipper system will continue to be operational; however, its conversion efficiency will decrease (up to 50 percent on exceptionally cloudy days). To maximize the amount of sunlight received, the solar panels will be placed at the optimal angle (to be determined in the field). In particular, the panels will be oriented and adjusted with respect to seasonal sunlight variations.

Although the HAZMAT enclosure itself is not insulated, the battery compartment on the outside of the enclosure can be insulated in order to protect the battery during unusually cold temperatures. In addition, a backup battery will be kept on-Site at the Groundwater Treatment Plant (GWTP) should the battery fail to hold a charge during extremely cold weather. An electric powered battery charger will also be available at the GWTP to insure a fully-charged battery is always available on site.

5.1.4 DNAPL Pumping and Temporary Storage

Historically, CH-2A has shown an estimated recovery of approximately one gallon per day. Since the proposed system recovers 0.2 gallons per cycle, the system will initially be set to pump for five cycles in a 24-hour period. As the recharge rate varies, the conductivity sensor will alert the control box to disengage a cycle if it detects water.

The recovered DNAPL from CH-2A will be pumped and collected within two product drums located within the HAZMAT enclosure, which includes a secondary containment system (110% of primary container, or approx. 60 gallons) in the base of the enclosure. If it is observed that the first storage drum is nearly full, then the operator will change the discharge tubing over to the second (backup) storage drum. The Solar Sipper system is designed to shut off on high level in the drums.

The storage drum(s) will periodically be emptied and prepared for off-Site transport and disposal based on applicable RCRA and TSCA storage requirements (including use of overpack drums if required). A modular spill containment pallet (minimum 60 gallon storage capacity) will be placed on the concrete pad directly in front of the HAZMAT enclosure to ensure any leaks within the transfer tubing are collected. The intent of providing a modular spill containment pallet (i.e., temporary spill containment instead of permanently constructed within the concrete pad) allows for the unit to be turned over when not in use and avoid rain water collection. Should a spill occur during DNAPL transfer, the spill containment pallet will be decontaminated prior to reuse.

As the drums are filled, the drums will need to be placed in a drum storage facility while awaiting off-site disposal. As an alternative to the integrated HAZMAT enclosure provided by Geotech, the final design for the CH-2A automated NAPL recovery system may incorporate installation of the separate components of Geotech Solar Sipper system (i.e., control panel and battery) within the drum storage facility (i.e,, roof and walls) constructed on the same concrete pad. For the alternative design, the concrete pad would be constructed with secondary containment equivalent 25 percent of the total volume of all staged drums. The drum(s) will be staged/stored until such time (not to exceed 90 days) that they can be loaded into an authorized transport vehicle for transport to the approriate disposal facility. At the time of the collected product transfer, the volume of DNAPL recovered will be recorded. Waste containers designated for off-Site disposal will be labeled and marked, as required by law, prior to shipping to off-Site facilities for treatment and/or disposal.

A conceptual; design for the drum storage and HAZMAT enclosure, the modular spill containment pallet, and the solar panel on aluminum mounting frame is presented on Drawing C-02, with the specifications for this equipment listed in the notes. Appendix A presents photographs of the Solar Sipper System and HAZMAT enclosure, as provided by Geotech. As GM and GHD make decisions regarding the appropriate and most cost-effective procedures for drum handling and NAPL disposal in accordance with TSCA regulations, the final detailed design may combine the automated NAPL recovery system and the drum storage facility on the same (slightly larger) concrete pad. Should a building be constructed within the curbs for secondary containment, the HAZMAT enclosure will be eliminated as the required equipment (other than the solar panels) could be placed within the small building.

5.1.5 Manual Evacuation

In Section 5.1.3, there was a reference to the potential requirement for manual operation of the DNAPL recovery pump due to low battery voltage or the potential removal of the battery during extremely cold weather. The intent would be to manual operate the dedicated pump at the same cycle frequency as the automated system, if possible. This periodic manual operation would mimic the automated pumping when colder weather would not allow the battery to remain outdoors at the well location, but is not intended for long-term operation.

Another reason for potential manual evacuation would be if the long-term (future) recovery rates at CH-2A do not allow for continuation of automated DNAPL removal due to insufficient volume. The dedicated pump would be maintained and manually operated routinely, based on recovery rates, to remove accumulated DNAPL. The field technician would pump accumulated DNAPL to the storage drum within the HAZMAT enclosure and would cease manual pumping when the visual presence of DNAPL could no longer be detected (i.e., only water being pumped). Over time, the frequency of manual pump operation may decrease further as the DNAPL accumulation further diminishes.

Regular or consistent manual evacuation is not expected or predicted at this time. The automated pumping system is expected to be resilient under many conditions and manual evacuation will only be initiated following unforeseen site situations and circumstances (i.e., breakdown of the permanent system or the pumps.

5.1.6 Operation, Maintenance and Monitoring

Operation, Maintenance, and Monitoring (OM&M), which includes pulling the downhole sipper pump to manually inspect the pump intake screen and discharge tubing, will be conducted quarterly. It is noted that the pump manufacturer recommends monthly OM&M, but that frequency is directed at the skimmer assembly for removing floating LNAPL (which is not included in our configuration as we have a fixed intake downhole pump for DNAPL removal). The requirement to open the pump and clean out the interior will be maintained at the yearly frequency.

The Installation and Operational Manual for the Geotech Sipper Pump is presented in Appendix C.

6. Waste Disposal

The recovered NAPL, collection and sampling equipment, absorbent socks, and personal protective equipment (PPE) will be contained within steel drums. The NAPL recovered from both the CH-2A corehole where the automated pumping system will be installed, as well as the CH-5 location where passive NAPL removal will be performed using absorbent socks, has been previously determined to be a TSCA and RCRA hazardous material. As such, the drums will be stored consistent with TSCA and RCRA regulations.

Collected NAPL will be properly containerized within United States Department of Transportation (U.S. DOT) approved bulk storage containers (drums) and transported off Site for treatment and/or disposal. Storage, transportation, and disposal activities will be completed in accordance with the Waste Management Plan (WMP) (current version in draft form at the time of this publication). Although there will be secondary containment for both systems, it is currently the intent that drums will be shipped for proper disposal every four weeks. The waste stream has been previously approved for disposal at Veolia's Port Arthur, Texas facility.

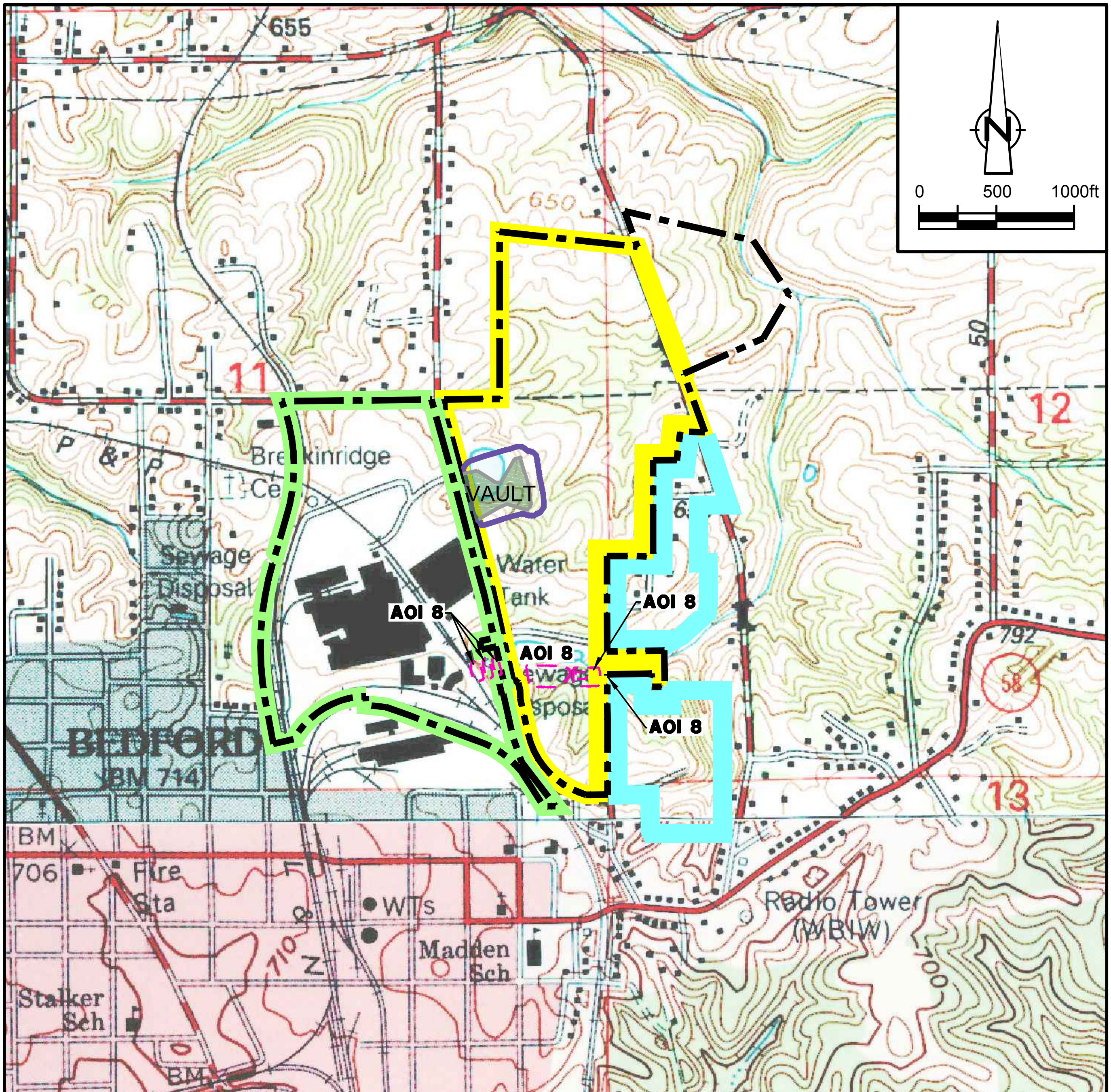
7. Schedule

Preparation of the area and installation of the Solar Sipper unit is anticipated to occur upon approval of this Design Report by U.S. EPA, but will likely need to be coordinated with currently planned Facility decommissioning activities which may be occurring in 2017 and 2018.

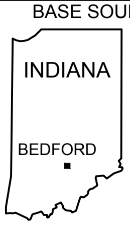
8. References

GHD, July 11, 2016. AOI 8 Groundwater Source Collection System Interim Measures Work Plan – Revision 1, GM CET Bedford Facility, 105 GM Drive, Bedford, Indiana.

GHD, (draft at the time of this publication). Waste Management Plan, GM CET Bedford Facility, 105 GM Drive, Bedford, Indiana.



BASE SOURCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLES;
BARTLETTSVILLE, INDIANA 1994
BEDFORD EAST, INDIANA 1978
BEDFORD WEST, INDIANA 1993
OOLITIC, INDIANA 1987
GM PROPERTY BOUNDARY SURVEY BY
BLEDSOE RIGGERT GUERRETTAZ
RECEIVED OCTOBER 2007



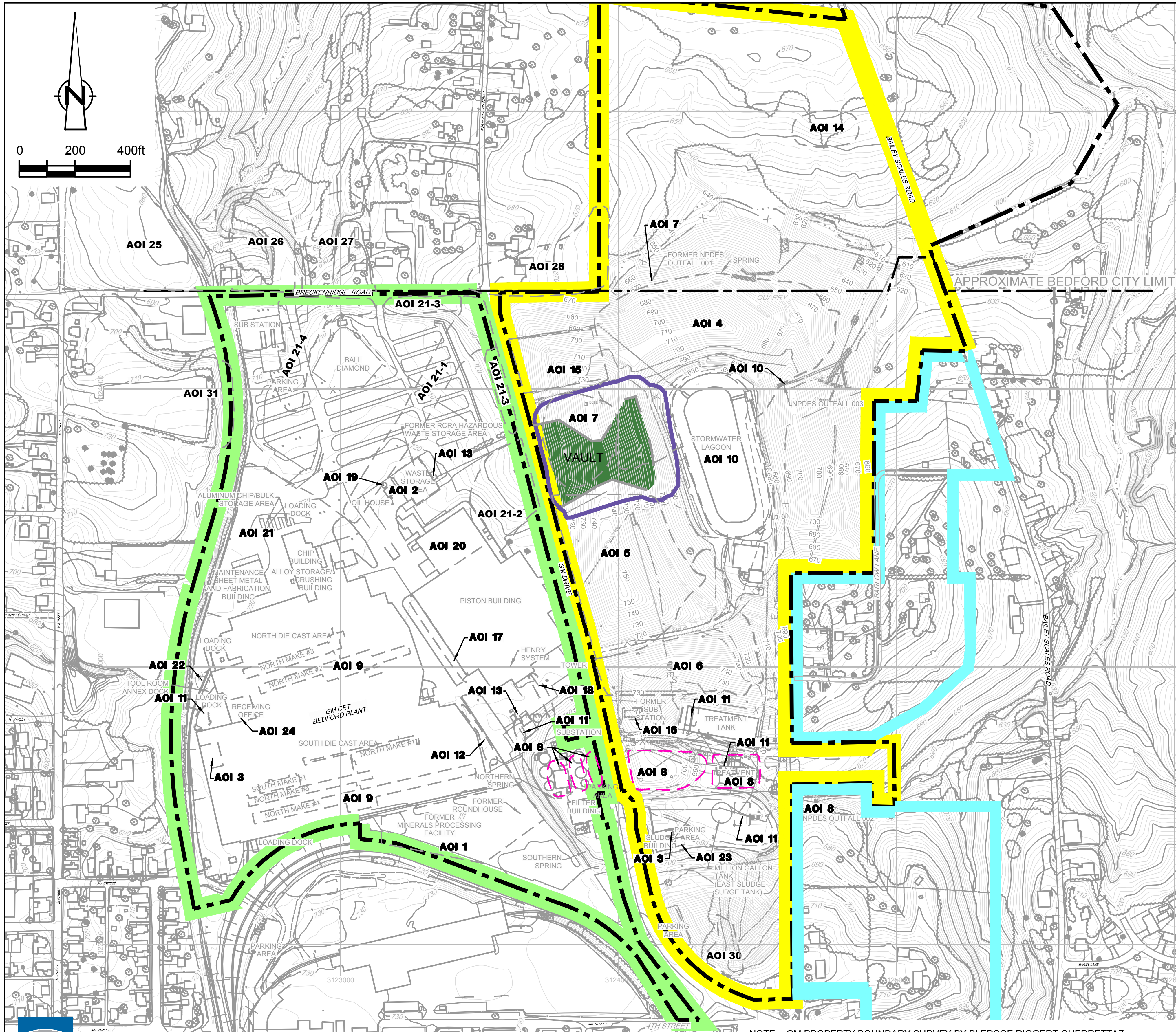
LEGEND

- APPROXIMATE FACILITY BOUNDARY
- GM LLC OWNED RESIDENTIAL PROPERTIES
- EAST PLANT AREA BOUNDARY
- WEST PLANT AREA BOUNDARY
- FINAL VAULT COVER SYSTEM AT SURFACE
- VAULT LIMIT
- AOI 8

figure 1.1

FACILITY LOCATION
AOI 8 PRELIMINARY DESIGN REPORT
GM CET BEDFORD FACILITY
Bedford, Indiana

13968-00(390)GN-WA001 JAN 13, 2016



SOURCE: BASE MAP COMPLETED BY AIR-LAND SURVEYS, FLINT, MI, APRIL 2001 AND CRA SURVEYS 2002 TO 2008.

NOTE: GM PROPERTY BOUNDARY SURVEY BY BLEDSOE RIGGERT GUERRETTAZ RECEIVED OCTOBER 2007. ADJACENT PROPERTY BOUNDARY LOCATIONS APPROXIMATED FROM THE LAWRENCE COUNTY SURVEY PLATS. ADJOINING PROPERTY LINES MAY NOT ACCURATELY REPRESENT THE TRUE PROPERTY BOUNDARIES

LEGEND

- 600 — EXISTING GROUND SURFACE ELEVATION CONTOURS (feet AMSL)
- APPROXIMATE FACILITY BOUNDARY
- STREAMS
- FENCE LINE
- RAILROAD TRACKS
- DIRT ROADS
- ROADS / PAVED AREAS
- AOI BOUNDARY
- AOI 8
- WEST PLANT AREA BOUNDARY
- EAST PLANT AREA BOUNDARY
- FINAL VAULT COVER SYSTEM AT SURFACE
- VAULT LIMIT
- GM LLC OWNED RESIDENTIAL PROPERTIES

AOI SUMMARY

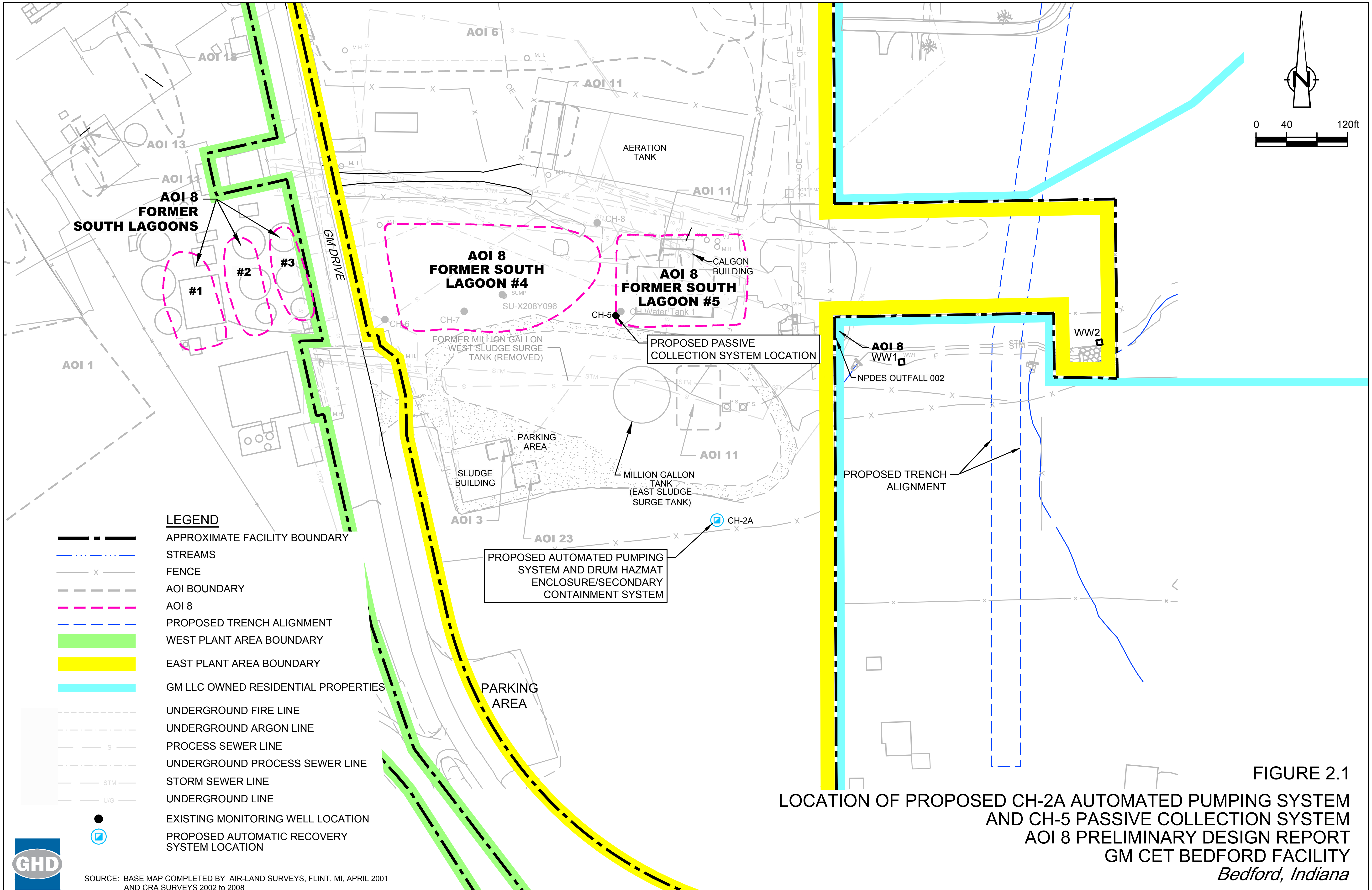
AOI ID	Description
AOI 1	Former Railroad Operations and Minerals Processing Facility
AOI 2	Waste Storage Area
AOI 3	PCB Storage Areas
AOI 4	Former North Disposal Area
AOI 5	Former East Sand Disposal Area
AOI 6	Former Sludge Disposal and Fire Training Area
AOI 7	Former North Lagoon and Outfall 001
AOI 8	Former South Lagoons and Outfall 002
AOI 9	Service Tunnels
AOI 10	Existing Stormwater Lagoon and Outfall 003
AOI 11	Aboveground Storage Tanks
AOI 12	Area Affected by the Reclaimed Hydraulic Fluid Release
AOI 13	Underground Storage Tanks
AOI 14	McBride Cows Disposal Area
AOI 15	Former Equipment Storage Area
AOI 16	Former East Electrical Substation
AOI 17	Piston Building Oil Accumulations
AOI 18	Area Affected by the Henry System Discharge
AOI 19	Area Affected by the Paint and Thinner Spill
AOI 20	Northern Portion of the Piston Building
AOI 21	Filled Ravine North of Die Cast Building
AOI 21-1	Former Drainage Valley Under Hourly Parking Lot
AOI 21-2	Former Drainage Valley Northeast of Piston and Office Buildings
AOI 21-3	Surface Water Ditches Located Along GM Drive and Breckenridge Road
AOI 21-4	Former Drainage Valley East of Electrical Sub-Station, Breckenridge Road
AOI 22	Tool Room Annex Dock Release
AOI 23	Area Affected by the 1996 Wastewater Treatment Filter Cake Release
AOI 24	Area Affected by the June 2000 Die Lube 5150 Release
AOI 25	Off-Site Suspected Fill Area - Parcel 398
AOI 26	Off-Site Suspected Fill Area - Parcels 384 & 386
AOI 27	Off-Site Suspected Fill Area - Parcels 381 & 382
AOI 28	Off-Site Suspected Fill Area - Parcel 401
AOI 30	On-Site Suspected Fill Area - Parcel 201
AOI 31	Off-Site Suspected Fill Area - Parcel 400

figure 1.2

FACILITY PLAN
AOI 8 PRELIMINARY DESIGN REPORT
GM CET BEDFORD FACILITY
Bedford, Indiana

GHD

13968-00(390)GN-WA002 JAN 13, 2016



SOURCE: BASE MAP COMPLETED BY AIR-LAND SURVEYS, FLINT, MI, APRIL 2001 AND CRA SURVEYS 2002 to 2008

FIGURE 2.1

LOCATION OF PROPOSED CH-2A AUTOMATED PUMPING SYSTEM
AND CH-5 PASSIVE COLLECTION SYSTEM
AOI 8 PRELIMINARY DESIGN REPORT
GM CET BEDFORD FACILITY
Bedford, Indiana

13968-00(390)GN-WA003 APR 28, 2017

Appendices

Appendix A
Geotech Vendor Information

GO TO GEOTECH

geotech

Hydrocarbon Recovery System

Geotech Single & Multi-Well Solar Sipper

The Geotech Solar Sipper is a solar powered remediation system, designed for remote applications where electrical power is either not available or not economically feasible. This uniquely flexible system can be configured for up to eight wells. The compact, easy to install features make this unit efficient to move and implement multiple wells.

The Solar Sipper uses a unique downwell pump to recover hydrocarbons through a floating oleophilic/hydrophobic intake filter. Once the pump canister is filled via the vacuum cycle, the pump reverses, pressurizes the system and pumps the recovered fluid to the surface and into a storage vessel.

The Geotech Solar Sipper can effectively extract fluids from depths to 180 feet below ground surface and recover viscous hydrocarbons such as 90 weight oil when our heavy oil skimmer is utilized.

EASE OF DEPLOYMENT

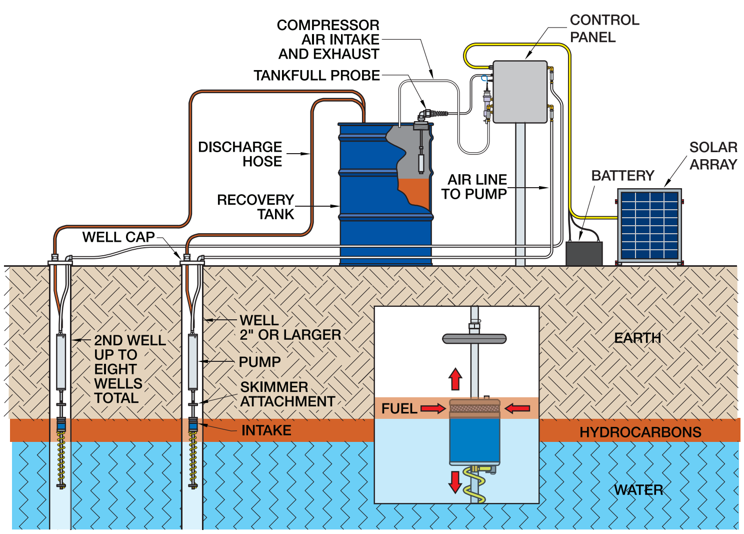
The Solar Sipper can reduce overall project costs and dramatically improve deployment:

- Available in single or multi-well configurations
- 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.

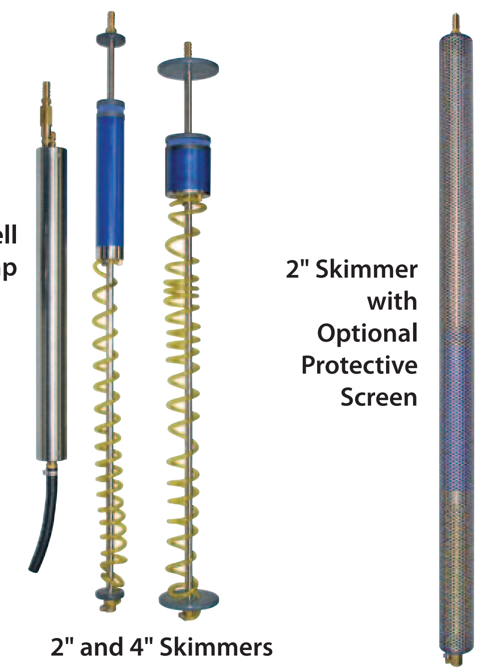
OPERATION

The Geotech Solar Sipper recovers floating hydrocarbons (LNAPL) from wells using a solar powered pressure/vacuum pump. The standard Skimmer features a unique product intake assembly that incorporates both a density float and an oleophilic/hydrophobic filter that differentiates between floating hydrocarbons and water. The skimmer floats just above the oil/water interface to collect and remove hydrocarbons from the well into an optional above ground storage tank.

The Geotech Solar Sipper is also available for recovery of sinking product (DNAPL) from wells when using a fixed intake.



Control Panel and Pressure/Vacuum Pump
(eight-well controller shown)



Downwell Pump

2" Skimmer with Optional Protective Screen

2" and 4" Skimmers

CALL GEOTECH TODAY (800) 833-7958

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

Hydrocarbon Recovery System

Geotech Single & Multi-Well Solar Sipper

DESIGN YOUR RECOVERY SYSTEM

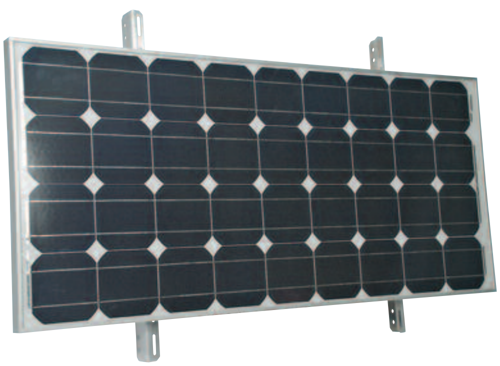
Step 1: Control Panel

✔ Choose from 1 to 8 wells
- NEMA 3R Enclosure
- Tankfull Shut-Off Switch (3/4" or 2" NPT bung-fitting)
- Microprocessor Controlled 2-Line LCD Display with four scroll buttons
- On/Off Switch
- Pressure/Vacuum Pump
- Pressure/Vacuum Gauge

Step 2: Solar Accessories

✔ 100 watt solar panel(s) with adjustable mounting frame
✔ AGM Solar Batteries 104 AH, 12 Volt

AC powered versions are available



Step 3: Downwell Equipment

✔ Downwell Pump(s)
✔ Skimmer(s)
- 2" or 4" Skimmer with 100 or 60 Mesh Intake
- Protective Screen
- 4" Skimmer with Extended Travel
- Heavy Oil Skimmer
- High Temperature/Heavy Oil Skimmer
- DNAPL Intake with Conductivity Probe

Other Options:

✔ 2" or 4" Slip Fit Well Cap(s)
✔ Choose Length: Air and Discharge Tubing
✔ 55 Gallon Steel Product Drum(s)
✔ Dual-Wall Containment Product Recovery Tank(s)
✔ Lockable Weatherproof Enclosure
✔ Trailer for Mounting Mobile System

SPECIFICATIONS

Applications:	2" (50 mm) or larger recovery wells	
Recovery Rate:	.2 gallons (757 ml) per cycle	
Maximum Operating Depth:	180 feet (55m)	
Power Requirements:	12-15 Volts DC input @ up to 14.5 Amps 90~240 Watts continuous	
Maximum Pressure:	100 PSIG (7 bar)	
Maximum Vacuum:	20" Hg @ MSL (50mm Hg)	
Oil/Water Separation:	Oleophilic/hydrophobic mesh screen	
Controller:		
Operating Temperature	32° to 104°F (0° to 40°C)	
Storage Temperature Range	-20° to 150°F (-29° to 66°C)	
Humidity	90% non-condensing (max)	
Size	10" D x 18" T x 16" W (25.4cm D x 45.7cm T x 40.6cm W)	
Approximate Weight	34 lbs. (15.4 kg) single channel 49 lbs. (22. 2 kg) eight channel	
Rating	NEMA 3R	
Optional Solar Panel w/Frame:		
Rated Power	100 Watts (standard unit)	
Operating Voltage	17.4 Volts DC	
Maximum Voltage	21.5 Volts DC	
Operating Amperage	4.88 Amps (standard unit)	
Maximum Amperage	5.8 Amps	
Size	41.2" H x 27.5" W (105 cm H x 70 cm W)	
Approximate Weight	23.3 lbs. (10.5 kg)	
Optional Downwell Pump:		
Size	23.5" L x 1.75" OD (59.7cm L x 4.4cm OD)	
Weight	4.5 lbs. (2.04 kg)	
Materials	303 and 304 Stainless Steel, Flexible Rubber Tubing, PVC, Brass	
Optional Skimmer Assemblies:	**2" Model**	**4" Model**
Effective Travel Range	12" (30.5cm)	24" (61 cm)
Size	35.5" L x 1.75" OD (90.2cm L x 4.4cm OD)	35.5" L x 3.75" OD (90.2cm L x 9.5cm OD)
Weight	1.75 lbs. (.79 kg)	2.25 lbs. (1.02 kg)
Operating Temperature	32° to 104°F (0° to 40°C)	
Storage Temperature	-20° to 150°F (-29° to 66°C)	
Materials	304 Stainless Steel, Polyethylene, PVC, Polypropylene, Brass	
Optional Tubing:		
Air	.17" ID (4.3mm ID)	
Discharge	.375" ID (9.5mm ID)	

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email: sales@geotechenv.com website: www.geotechenv.com

Geotech Sipper

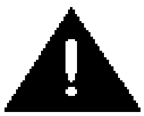
Installation and Operation Manual

Rev 01/05/2015 Part # 16550176

Table of Contents

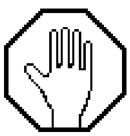
DOCUMENTATION CONVENTIONS

This manual uses the following conventions to present information:



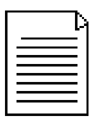
WARNING

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.



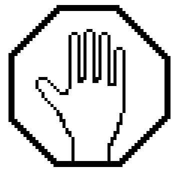
CAUTION

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.



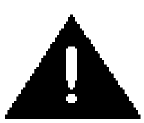
NOTE

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 downwell 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-inches Hg vacuum and 100 psig 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 feet below ground surface. Optional multiple channel controllers can operate up to eight pumps in separate recovery wells.

In this manual, a stainless steel pump with Skimmer, or any other downwell 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.

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. Up to eight separate wells can be operated per controller.

In general, Geotech recommends a maximum distance of 500 feet (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 downwell product recharge rate, product viscosity, and Skimmer depth.

During the vacuum timer cycle, vacuum is applied to the air line tubing, stainless steel pump, and intake; helping the product to flow 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. A variety of timer setups can be implemented to maximize recovery. For example; different wells can be pumped more or less often than others to maximize recovery. The programming prioritizes the pumps so one pump is operational at a time.

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 up and running. More on this can be found within the troubleshooting section of this manual.

The Solar Sipper Controller is dependent upon the annual average solar resources, which can vary from region to region. Geotech can assist 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.

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 is invited 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.

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 Pump and Skimmer Assembly 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.

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 can simplify deployment where existing concrete pads or other infrastructure, which could serve as a mounting base for the equipment, do not already exist. It is more efficient to have the equipment ready for immediate deployment upon delivery. 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.

Because the solar array and battery have live voltage, caution should be exercised when dealing with either item. Special attention is required to ensure that the correct polarity is observed 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.

Special care must be taken to 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 will vary from region to region. Geotech can assist you 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.

Other location specific information must be considered as well. Large objects like trees or building structures can block sunlight from reaching the solar panels. In such cases the solar panels can be mounted atop poles or other available structures to maximize sun exposure. Other unpredictable factors, such as more or less cloud cover, must also be considered when estimating potential recovery rates.

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.

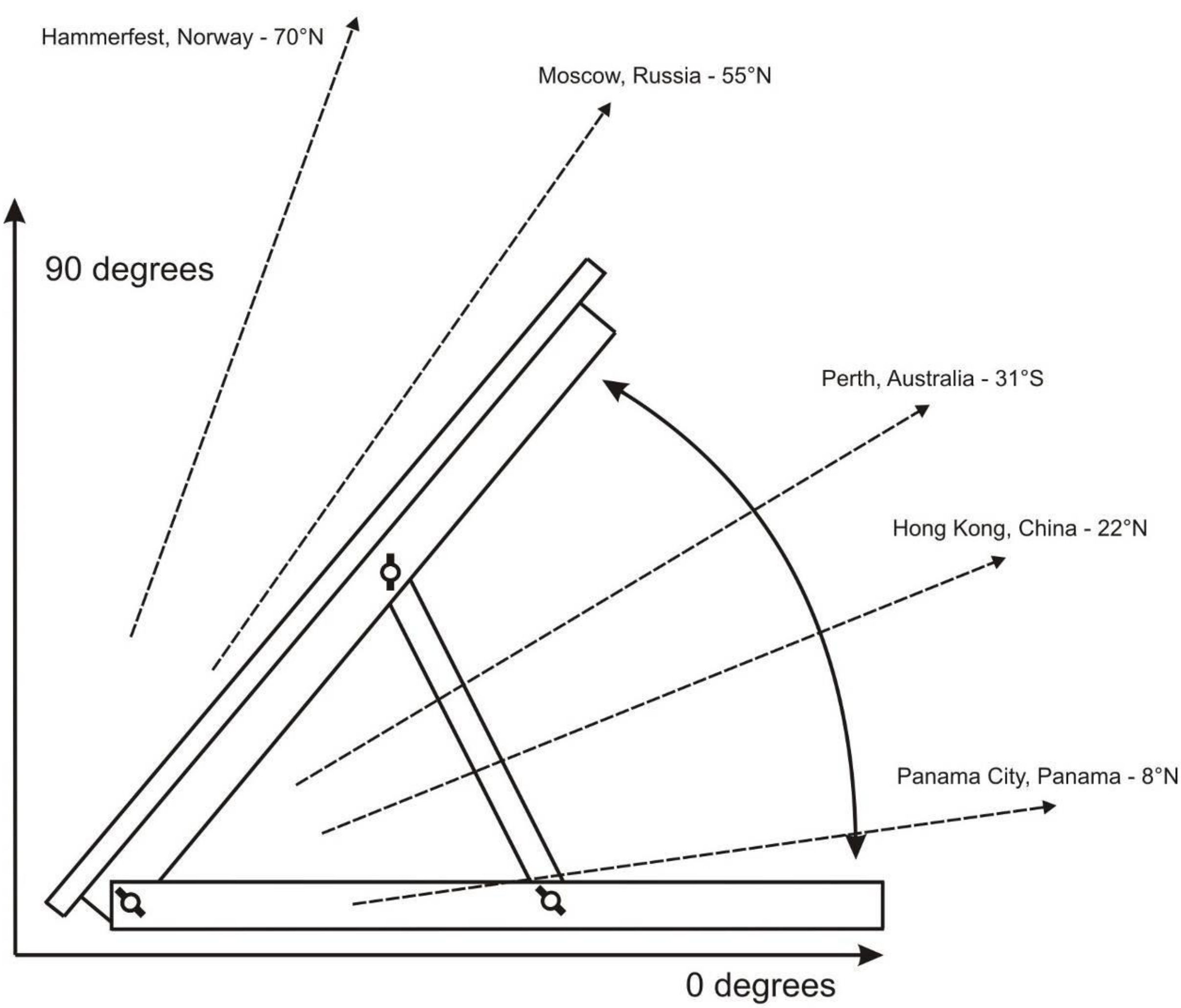


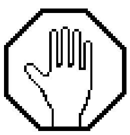
Figure 2-1 – Side view of solar panel assembly.

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. If possible, it is recommended the control panel enclosure be placed out of the direct path of weather and sun light whenever possible. If power is to be plumbed 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 also needs to be elevated above the height of the well heads to prevent kinks to the exhaust line and the various 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” 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.

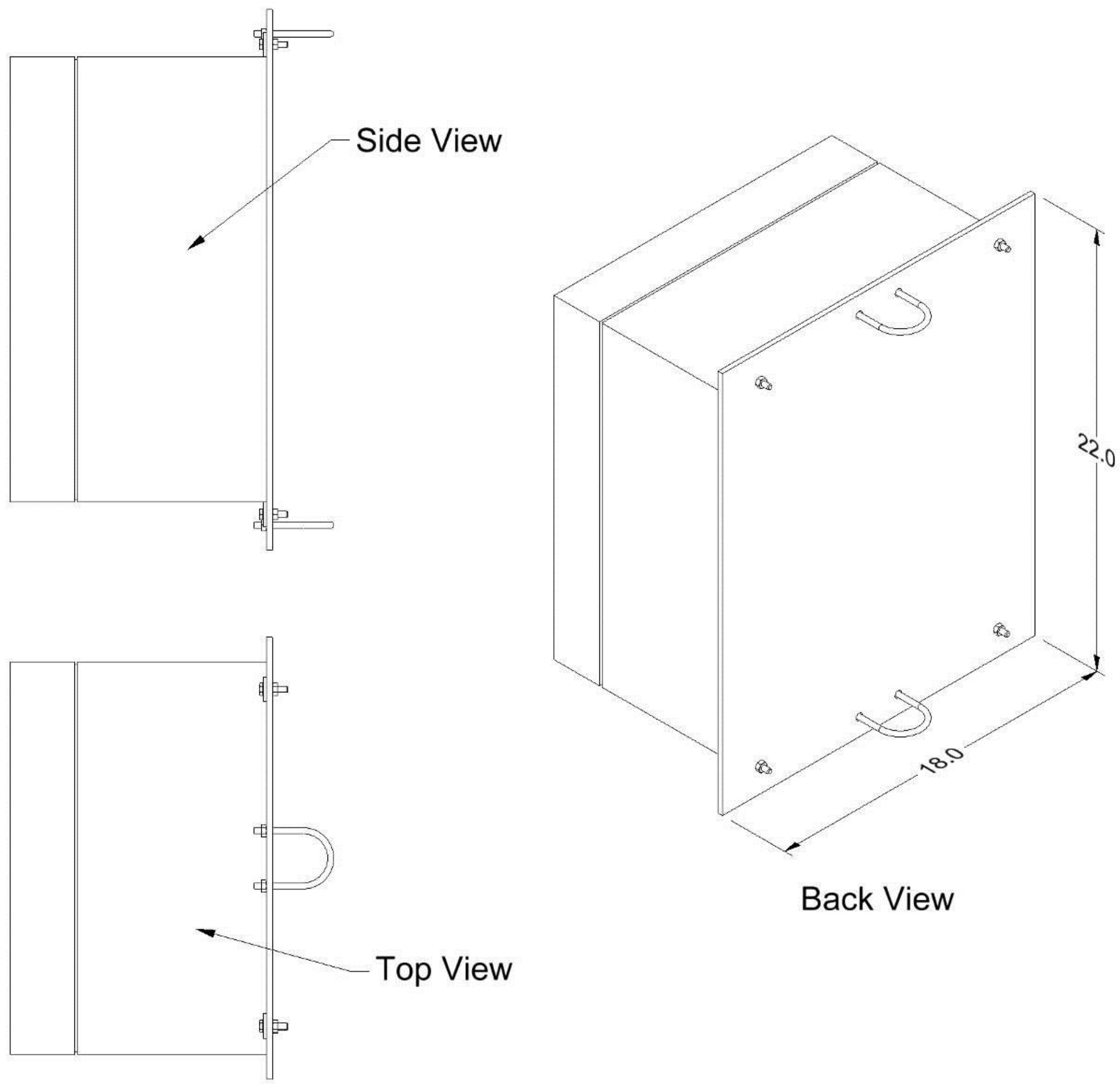


Figure 2-2 – Example of Sipper enclosure mounted to back panel with additional u-bolts for pole attachment.

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

A full size, internal wiring diagram accompanies new Sipper controllers when delivered (pg. 39 or 40). Also, operational flow charts are affixed to the inside door of each controller (pg. 22). Contact Geotech for a replacement wiring diagram as

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. Observe 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 feet of 4 conductor 14 AWG cable. DO NOT extend or add to 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.

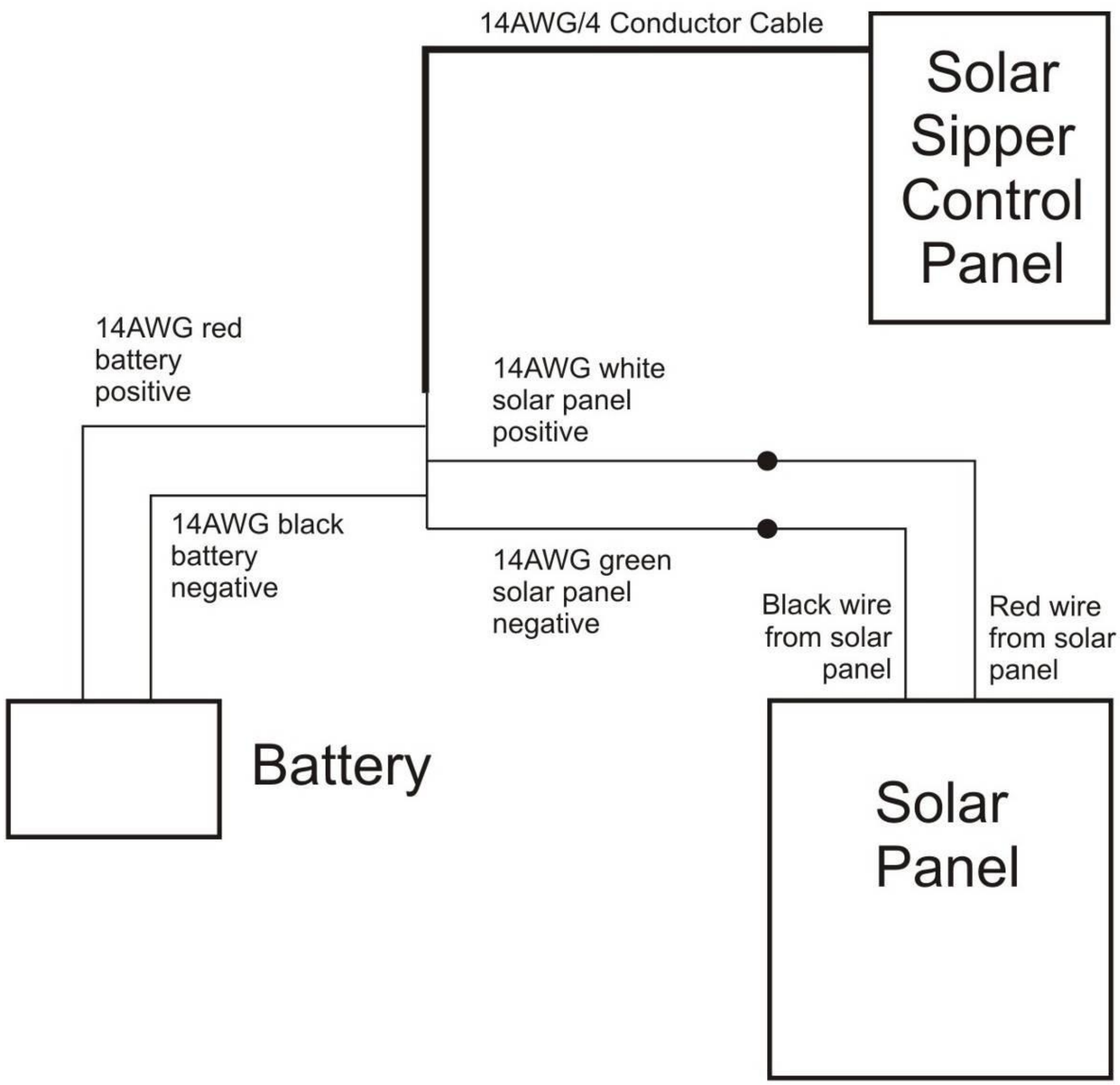


Figure 2-3 – Example of external wiring for a Solar Sipper system.

A brand 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. A frozen battery will not charge until it is thawed. See Section 3 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. The addition of one or two more panels will boost production during the winter months, with fewer hours of sunlight, and the excess energy will not be used in the summer. As a general guideline, up to 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 feet of 3 conductor 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 the following wiring diagram:

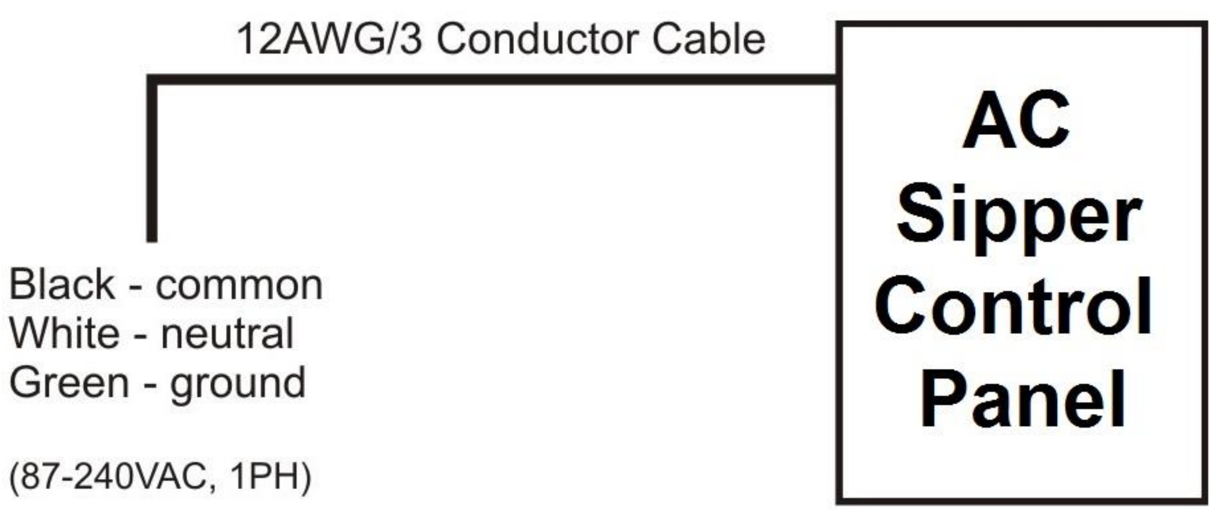


Figure 2-4 – Example of external wiring for a AC Sipper system.

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 double-check that live voltage is not present at terminals to be worked on. Shut off all circuit breakers and disconnects and use a volt meter 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 for a complete listing of available accessories.

Connect All Tubing Runs

Lay out all tubing lengths to the well heads and secure the ends to the hose barbs using adequate clamps. Geotech can supply your Sipper system with a variety of tubing and clamp choices. See Section 9 for a list of available parts.

When installing your tubing runs, DO NOT hang or situate air lines in such a way that they are left sagging with low points in which fluid can collect. Avoid sharp bends which can kink your line.

It is recommended that air lines and hoses be protected. Conduit or PVC pipe can provide protection. 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.

Special care must be taken not to damage the float or screened intake before or during deployment. Use a scrap piece of plywood or card board (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 Figures 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’s 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” well without enough clearance for the probe, you can judge productivity by how much product is in the recovery tank.

Simply guessing or feeling for placement of the Skimmer within the well column is a recipe for failure. 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 drum or larger, must be provided by the customer with the following attributes:

- A ¾” or 2” 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 probes can be ordered from Geotech. 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.

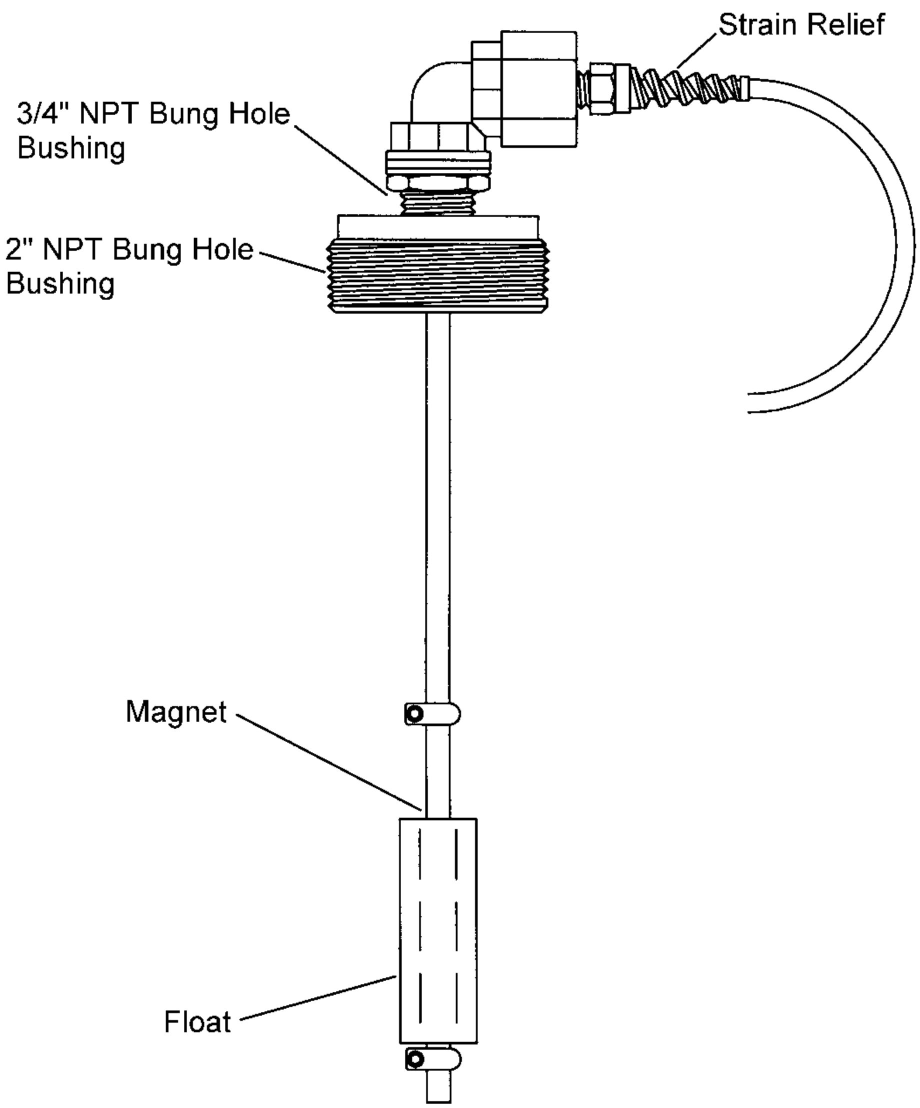


Figure 2-5 – Example of Tankfull Probe

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 Technical Sales 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 on page 21.

The first task will be to 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 on 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 30 second maximum.
Pressure	30 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.
Please 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
00:10
```

Using the up and down arrow buttons, scroll to the time required for the vacuum phase of the cycle, 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, 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 not 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.

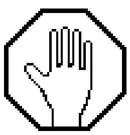
```
Low Temp ShutOff
     OFF
```

The Low Temp Shutoff display (when enabled), will shutdown 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 Start up (Runtime). However, before proceeding, thoroughly read Section 4 on 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.

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 99999.

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 which can be used to record important activity to your Solar 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 20 seconds the Main Menu (or Runtime display) will reappear.

The following status displays (as shown on the Interface Flowchart) 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.

```
Well n Delay:
hh:mm:ss
```

Where n = the Delay time for the well number shown (between 1 and 8) followed by the time.

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 displays. Channels not in use will have a display value of 0.

```
Power Ons: nn
0000:00:00:00
```

The Power Ons display shows the total number of times the unit has been powered ON/OFF (since being put into service) along with a time record of when the unit was last powered on.

```
Tankfulls: nn
0000:00:00:00
```

The Tankfulls display shows the total number of times the tankfull alarm has been activated (since being put into service), due to a full recovery tank, 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.

```
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) 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. The system will also display a low battery condition when the battery becomes frozen. Allow the battery to thaw prior to re-charging.

```
Low Temps: nn
0000:00:00:00
```

The Low Temps display (when Low Temp Shutoff is enabled during the Start up process) shows the total number of times the unit has experienced a low temperature condition (since being put into service) 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).

```
Temperature:
nnC  xxx
```

The Temperature display shows the current temperature of the unit in Celsius followed by a diagnostic number.

```
Battery Voltage:
nn.nV  xxxx
```

The Battery Voltage display shows the current battery voltage for the Sipper system followed by a diagnostic number.

```
Ver: v.v  Wls: n
ID: iii  SS: sss
```

This final display contains the following information for the Sipper controller:

Where	v.v =	software version
	n =	number of wells for which the unit was designed (1 thru 8)
	iii =	controller ID
	SS =	Signal Strength (used on wireless Sippers)
	sss =	signal strength in a numeric value (used on wireless Sippers)

Alarm (Condition) and Fault Displays

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:

```
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 Start up process.

```
INTAKE OVERRIDE
L=Main Menu
```

The INTAKE OVERRIDE display will appear when the float on the Intake Float Switch (located on the side of the control box) rises. This will usually happen when product is pulled through the air line from the well (due to an excessive vacuum time or when a directional solenoid becomes stuck on the compressor) or from an accumulation of moisture during operation. See Section 6, Trouble Shooting procedures, for information on resolving an Intake Float Switch alarm.

When the INTAKE OVERRIDE display appears, the Sipper controller will stop all activity until the alarm is addressed. After draining the Intake Float Switch and clearing all effected lines, clear the alarm and restart the Sipper controller by pressing the left arrow button (to obtain the Main Menu), then initiate the Start up 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, Trouble Shooting, 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 on page 11. Contact Geotech with any questions on wiring and installation.

PCB Damage

On rare occasions the following display may appear:

```
Bad display val:
```

The Bad Display Value 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.

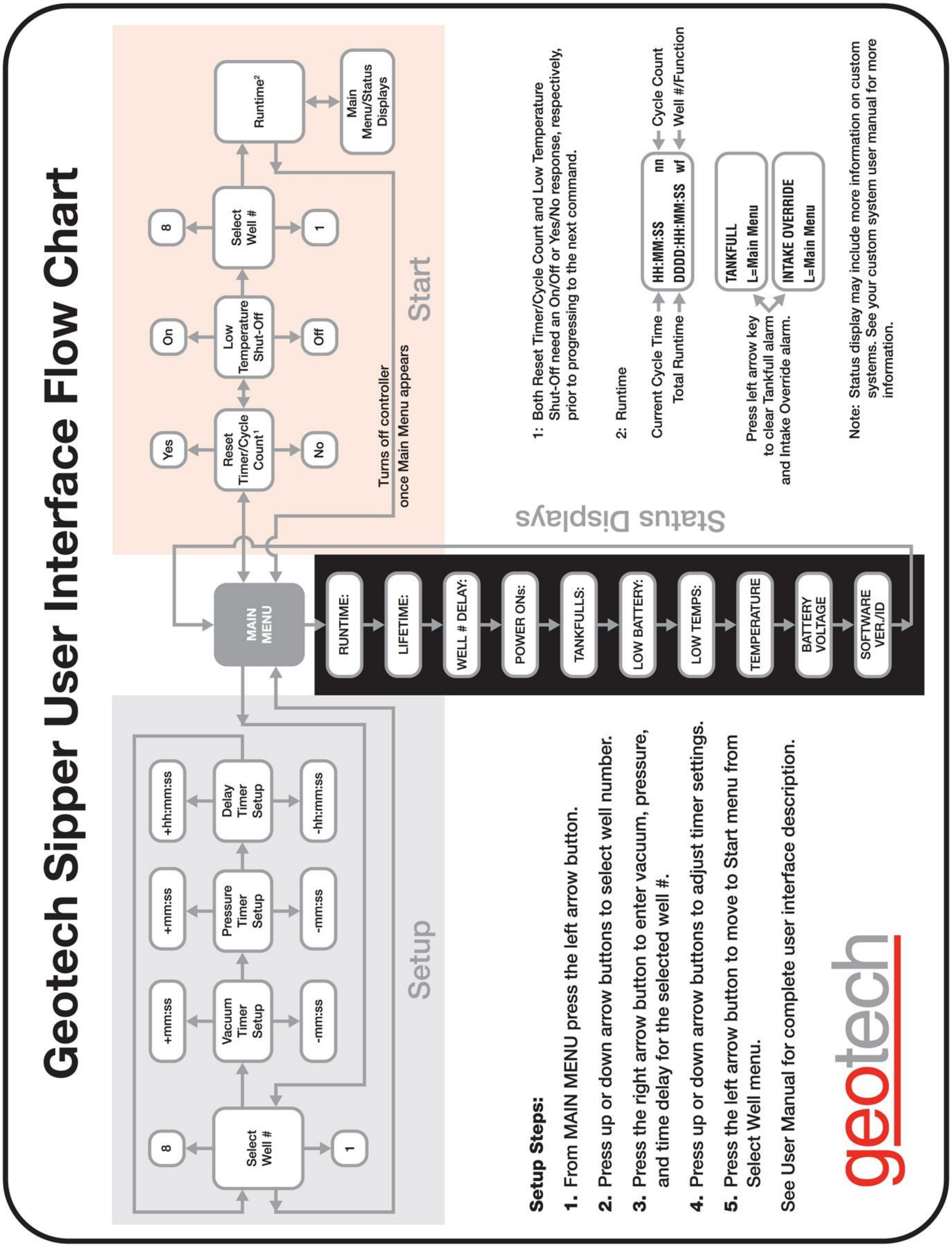


Figure 3-1 – Flowchart of User Interface Label

Figure 3-2 – Example of Solar Sipper front panel.

Section 4: System Operation

If Sipper system is to be deployed in humid conditions, it is recommended to install 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 mid afternoon. Otherwise, record your cycle counter value and total run time and compare these with the amount of product recovered.

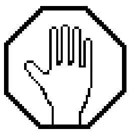
The vacuum cycle pulls the product into the pump housing. The system compressor will then switch to pressure mode. The compressor is capable of providing up to 100 PSIG pressure to the pump and the discharge line. The pressure cycle pushes the intake valve shut and forces the product past the discharge 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 air line and into the Intake Float Switch. 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’s better to start with a higher pressure and lower vacuum setting and adjust over time.

The standard stainless steel pump is capable of holding .2 gallons (750 ml) or 46 cubic inches of fluid per cycle. That translates into over 14 inches of product layer in a 2 inch well and about 3.5 inches of product layer in a 4” 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 (pg. 6) in Section 1 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 second 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.

As mentioned before, the amount of product per cycle will depend on how much product is in the well. Also, 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 one gallon per hour recharge rate, then simply increase the delay time proportionally. For example; if your product recharge rate is ½ gallon per hour, double the delay time.

- After you account for more or less recharge rate, you can account for additional tubing and depth to fluid.
- Add 2 seconds per 25 feet of tubing for vacuum and 3 seconds per 25 feet of tubing for pressure.
- Add an additional 2 seconds per 25 feet 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 feet 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 tempting to want to see product at the recovery tank end of the discharge tube but 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 isn't acting to move product. If you observe air flow from the discharge line after the product has stopped flowing, reduce your pressure time by approximately the same amount of time as the extra air flow.

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's an immediate 20% reduction in pressure time. This will increase your battery life and, in turn, improve your recovery potential.

Fluid Viscosity

The following chart has been compiled based on lab testing as well as real world Sipper deployments. It is impossible to account for the many site specific variables in this manual. If you have a higher recharge rate and require higher production rates than those shown below, then 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.

Depth to Fluid (feet)	Intake Type	Air Line Length (feet)	Product Weight/ Viscosity (SSU) @ 70° F	Product Recharge Rate (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

*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.

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.

Section 5: System Maintenance

Sipper controllers must be returned to Geotech for internal repairs or service.

Sipper Controller

Weekly Maintenance

- Turn the Sipper controller off and drain the Intake Float Switch (if needed).
- Record the level of the recovery tank (depending on the recovery rate).
- Visually inspect all air lines and power cords for damage.

Monthly Maintenance

- 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.
- Inspect the Intake Float Switch assembly and clean it as needed using the methods described within your Geotech Pump and Skimmer Assembly User Manual.
- 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.

Quarterly Maintenance

- 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 and Intake Switch floats move freely and operate to shut off the Sipper controller when activated.

- 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” to 24” 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) (Figure 5-1).

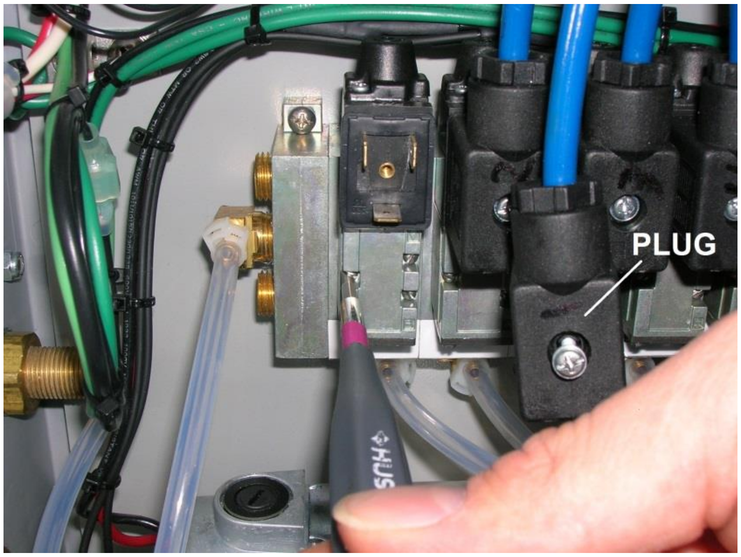


Figure 5-1

2. Remove the three screws and solenoid with a small flathead screwdriver (Figure 5-1). Note the black gasket on the underside Figure 5-2). **Do not lose or damage this gasket.**

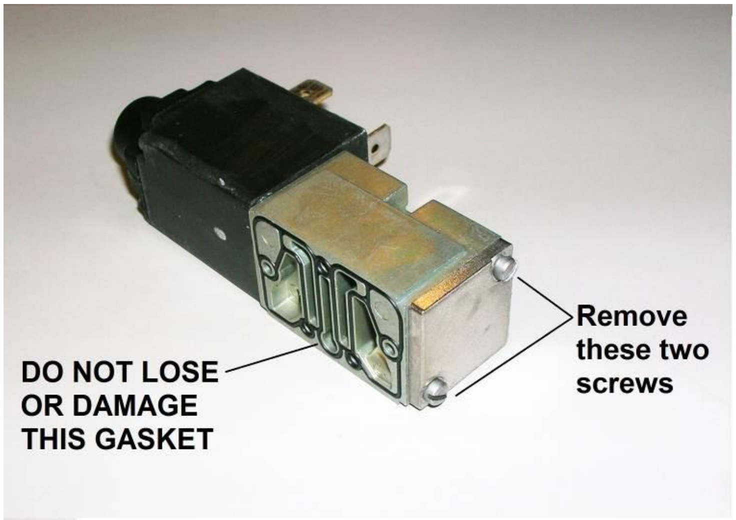


Figure 5-2

3. Using the small flathead screwdriver, remove the two screws to the square metal cap (Figure 5-2). Carefully remove the spring, the o-ring, the bushing, and the plunger (Figure 5-3). Clean the plunger and plunger cavity with a spray lubricant and cotton swab (silicon based or aerosol lubricant OK).

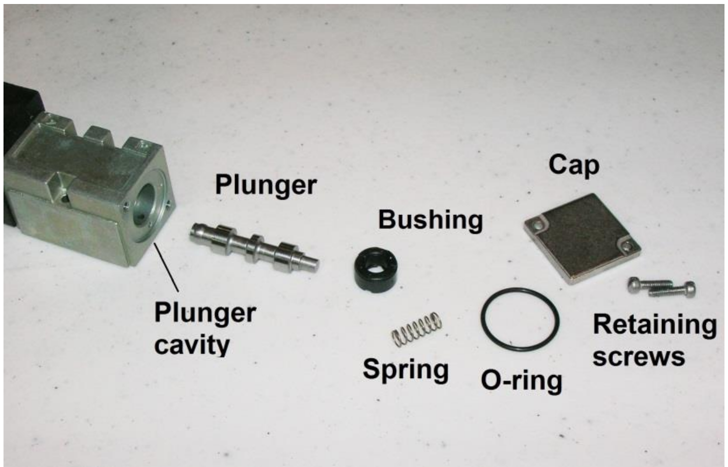


Figure 5-3

4. Orient and insert the plunger as shown in Figure 5-4. Place the o-ring and bushing back into the opening (no orientation needed) followed by the spring (Figure 5-5).

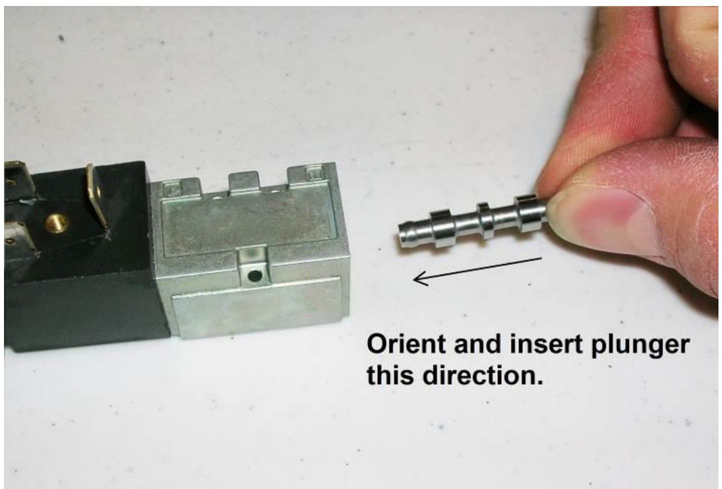


Figure 5-4

Figure 5-5

5. Carefully place the square cap onto the end, compressing the spring, and re-attach the two screws. Make the connection snug but do not over-tighten (Figure 5-6).

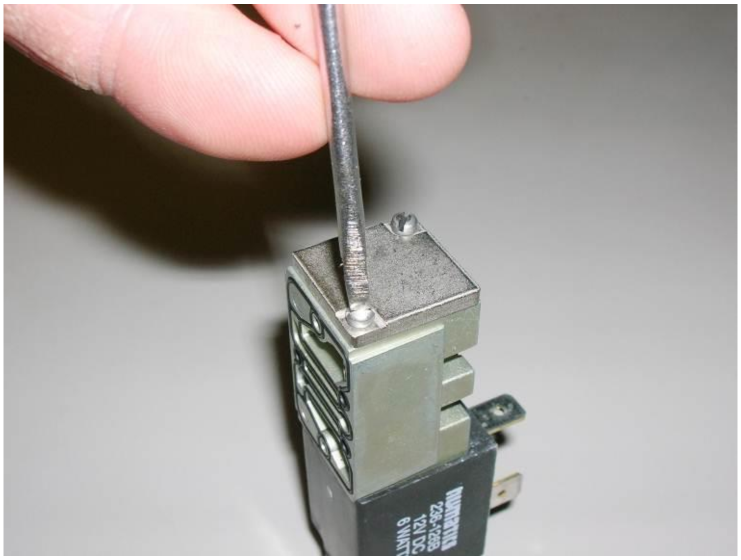


Figure 5-6

6. 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.
7. 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 get crushed.) 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.

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 doesn’t 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.
- 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:

- Verify the valve on the intake float assembly is closed.
- Inspect product hose for abrasion, cuts or open connections. Replace if needed.
- Make sure the air line 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 is able to 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:

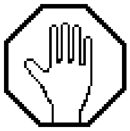
- Inspect the solenoid for residue or debris. If it is locked up it may be cleared by depressing the small button on the black end of the solenoid using a small Phillips screwdriver or paper clip to actuate the solenoid manually. If this doesn’t work, remove the small plate at the other end of the solenoid and clean the plunger and plunger cavity using the procedure found in Section 5.
- 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.
- Check for loose or damaged battery connections and solar panel connections.
- Use a volt meter to test the battery voltage. If it is below 10 volts 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 volt meter and ensure the battery voltage is over 12.1 volts, 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 12.1 volts, 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) and 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 volt meter.
- 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 float on the Intake Float Switch is high. This is caused when product or moisture is pulled through the air line due to:

  1. Too long of vacuum time in the cycle.
  2. The directional solenoid on the compressor is stuck.
  3. An accumulation of moisture in the air line during operation.

  Drain the intake and restart the system. Allow the system to clear product out of the manifold and past the air filter. Disconnect the line and use a standalone air source (with no more than 100 PSI of pressure) to finish evacuating the air line of product.

  Temporarily set the vacuum to 0 and the pressure to 30 or more seconds and allow the Sipper controller to force the line to empty, after which you can restore (or adjust) the vacuum and pressure to previous settings.

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 air line 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.
- Additional solar panels may be required to keep the system up and running.
- Turn unit off and back on to rest 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" (5.8cm) or larger recovery wells
Recovery Rate	.2 gallons (.750 ml) per cycle
Max. Operating Depth	180 feet (54.86m)
Max. Pressure	100 PSIG (7 bar)
Max. Vacuum	20" Hg @ MSL
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	0° to 40° C (32° to 104º F)
Storage Temperature Range	-29° to 66° C (-20º to 150º F)
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 (single channel AC Sipper)
Approximate Weight	34 lbs (single channel Solar Sipper)
Approximate Weight	51 lbs (eight channel AC Sipper)
Approximate Weight	49 lbs (eight channel Solar Sipper)

Additional customizations and accessories could add more weight.

Pump Assembly

Size:	23.5"L x 1.75" OD (60cm L x 4.5cm 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"	24"
Size:	35.5" L x 1.75" OD	35.5" L x 3.75" OD
Weight:	1.75 lbs. (.8 kg)	2.25 lbs. (1 kg)
Operating Temperature:	0° to 40° C (32° to 104º F)	
Storage Temperature:	-29° to 66° C (-20º to 150º F)	
Materials:	304 SS, Polyethylene, PVC, Polypropylene, Brass	
Tubing - Air:	.17" ID x .25" OD (4.32mm ID x 6.35mm OD)	
Tubing - Discharge:	.375" ID x .5" OD (9.53mm ID x 12.7mm 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:	41.2” H x 27.5” W (105 cm H x 70 cm W)
Approx. Weight:	23.3 lbs (10.5 kg)

Mounting System:

Module Tilt Range	15 to 65 degrees
Pole Size	2", 4", and 6"
Max Wind Speed	90
Module Orientation	Landscape/Portrait
Wind Exposure	Category B & C
Materials	5052-H32 Aluminum Powder Coated Steel Stainless Steel Fasteners

Section 8: System Schematics

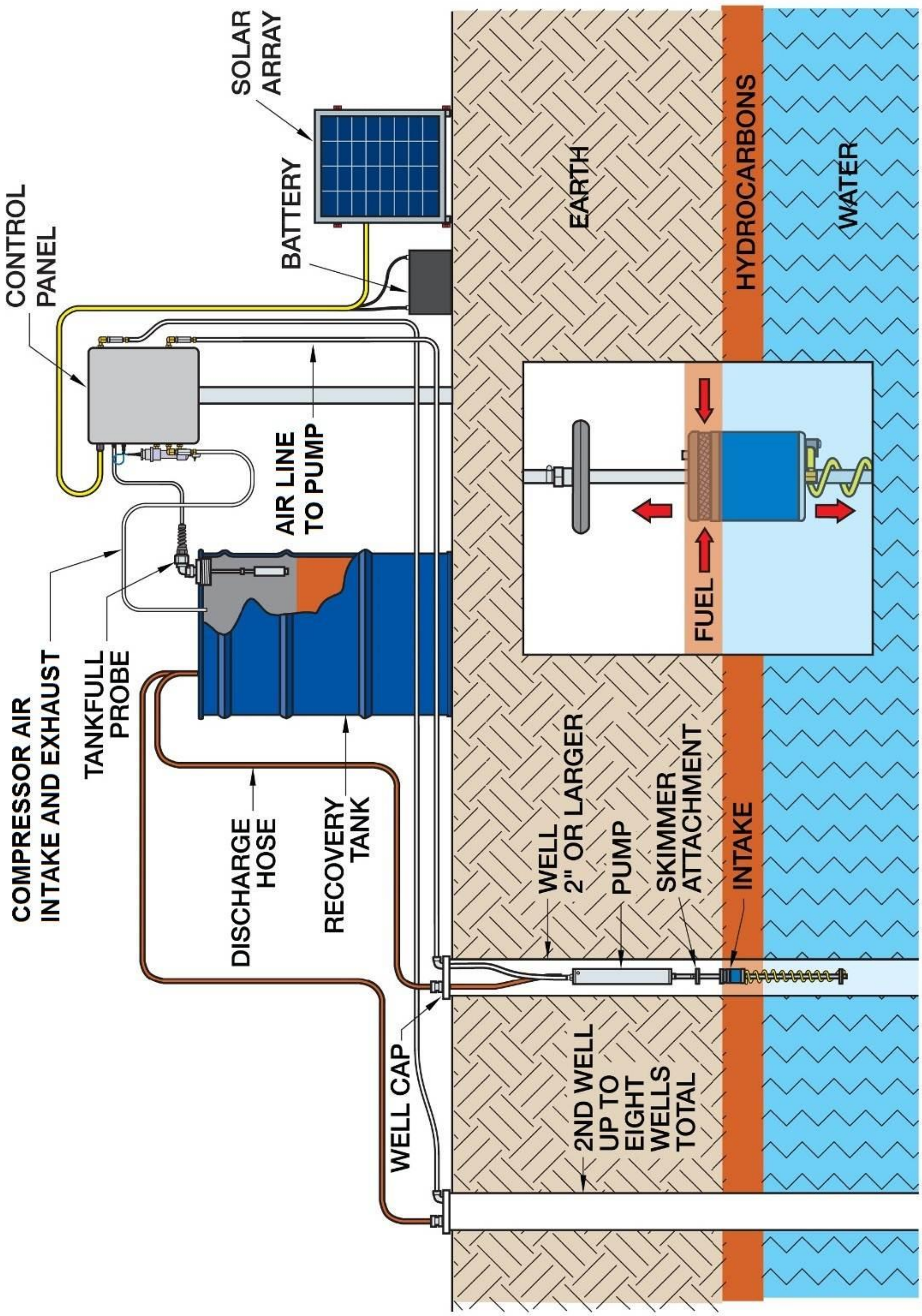


Figure 8-1 - Solar Sipper Schematic

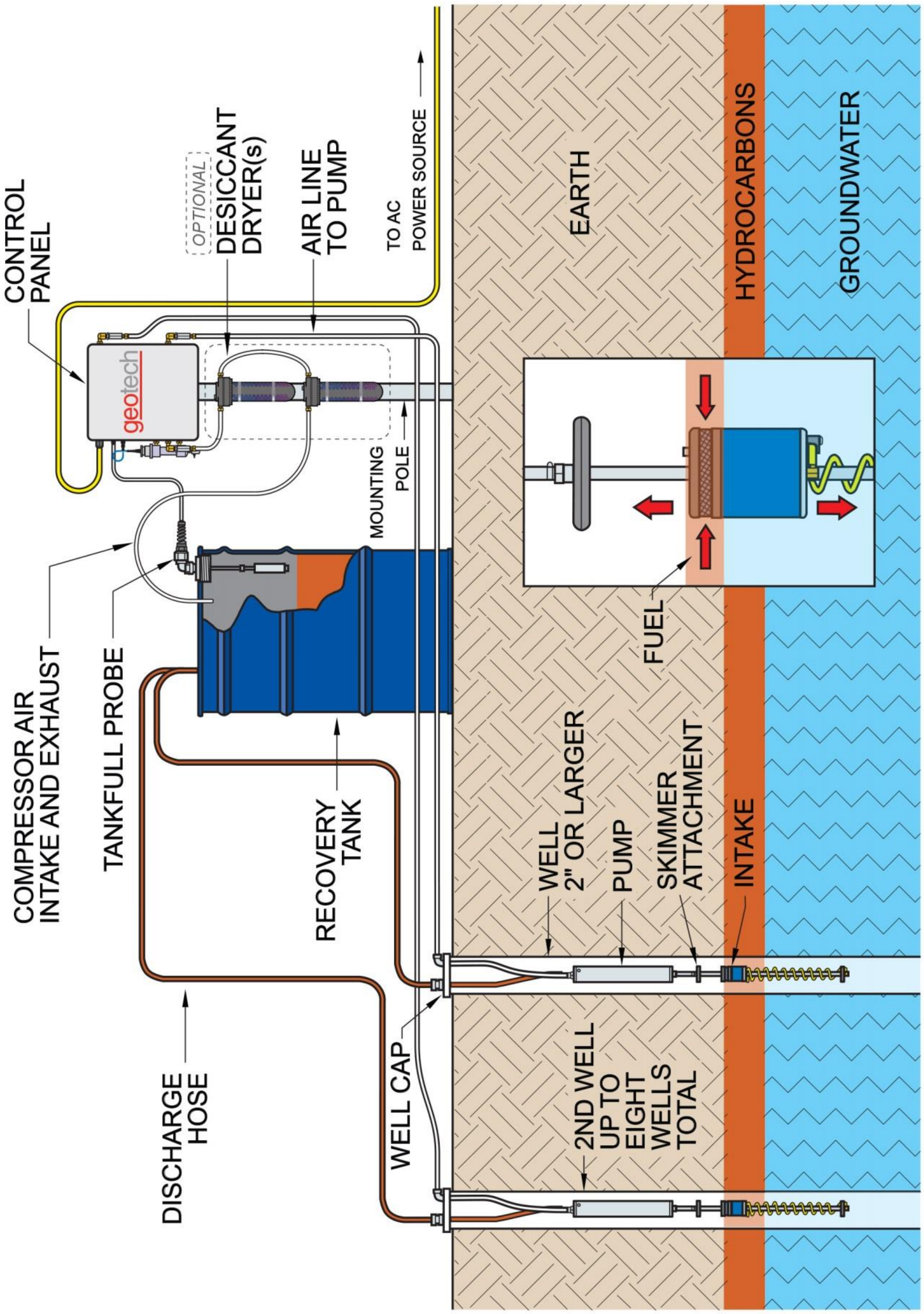


Figure 8-2 - AC Sipper Schematic, shown with optional Desiccant Dryers

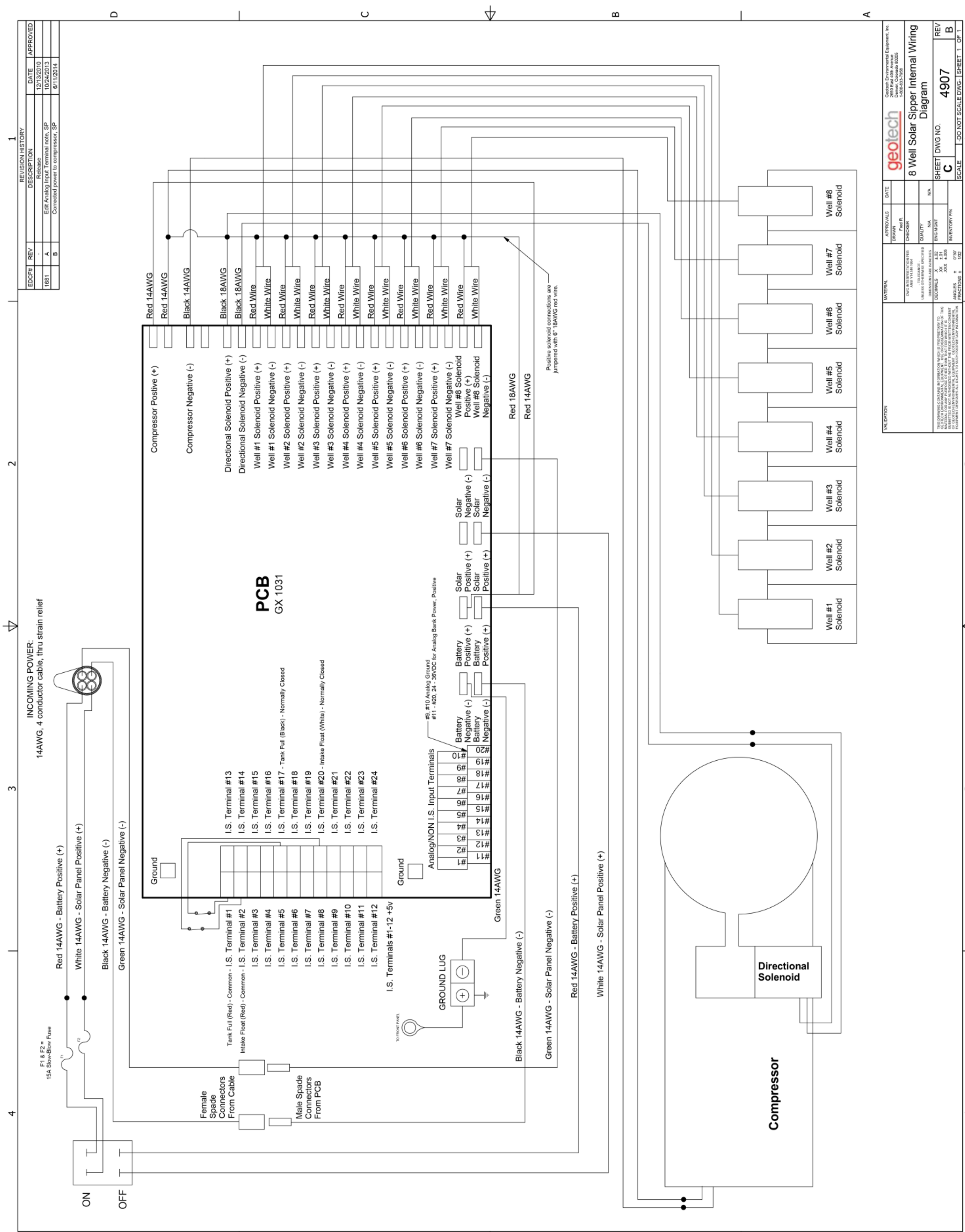


Figure 8-3 – 3 Well Solar Sipper Internal Wiring DiagraM

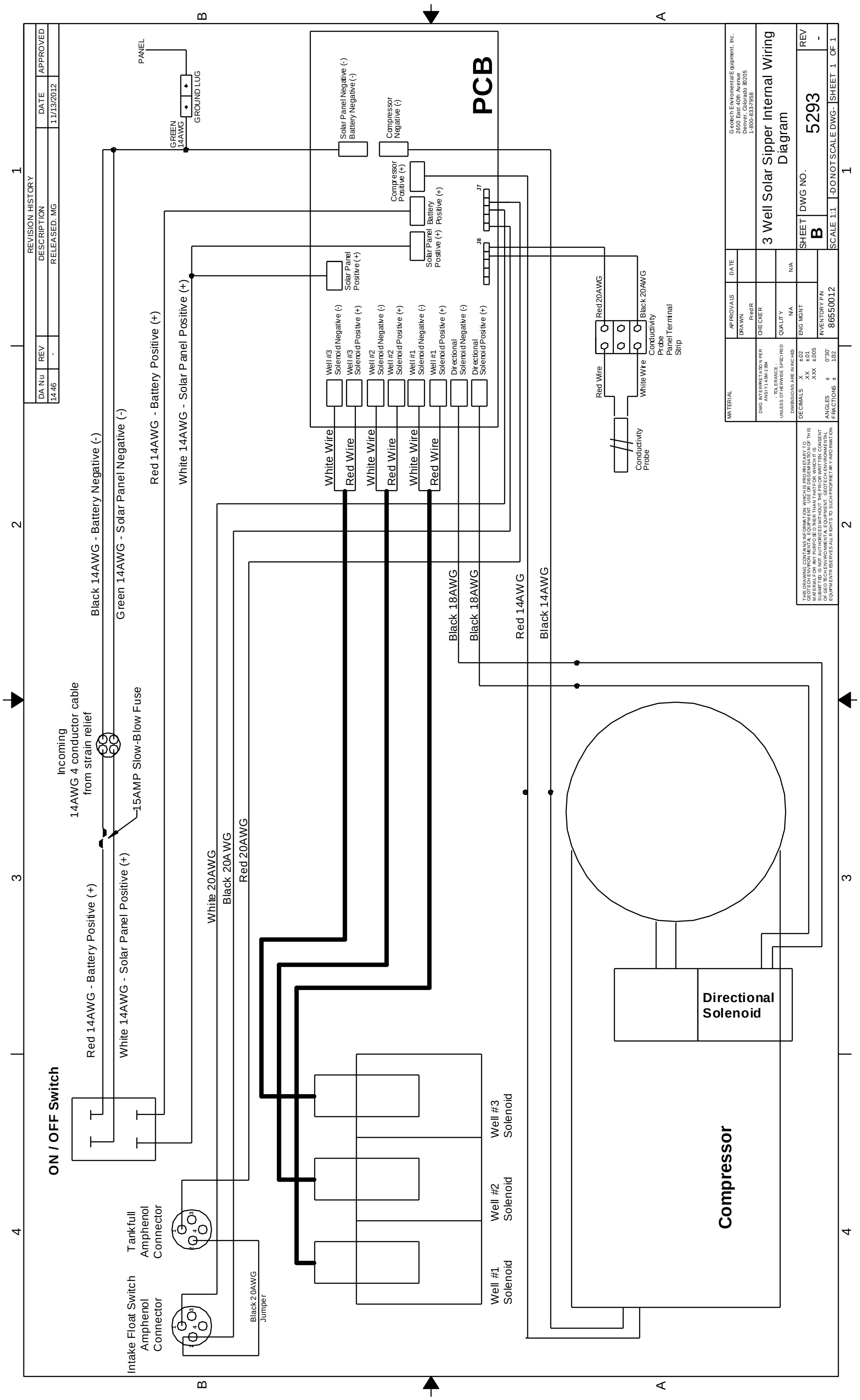


Figure 8-4 – 8 Well Solar Sipper Internal Wiring Diagram

Section 9: Parts and Accessories

Description	Part Number
MANUAL, SOLAR SIPPER	16550176
MANUAL, SIPPER PUMP & SKIMMER ASSEMBLY	16550181
MOUNTING HARDWARE TABS (FEET)	16110181
FUSE,15A,MDL TYPE	PPE011035
FUSE HOLDER ASSEMBLY	2010029
COMPRESSOR,PRO,SIPPER	11150325
SOL/SPRING,2POS,12VDC,1/8"NPT 031SA4004000060	16550262
SOLENOID,GEOCONTROL PRO	11150249
AC Sipper	
CABLE,MOTORLEAD,12/3,SEOPRENE SEOOW,YELLOW	17050002
POWER SUPPLY,12V,100W, CE APPROVED,GEOCONTROL PRO	11150010
Solar Sipper	
CABLE,SEO,14/4,YELLOW	10014
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
Float Switch Assemblies	
SOLAR SIPPER INTAKE FLOAT SWITCH	86600095
PROBE, TANKFULL, SOLAR SIPPER 25'	56650100
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

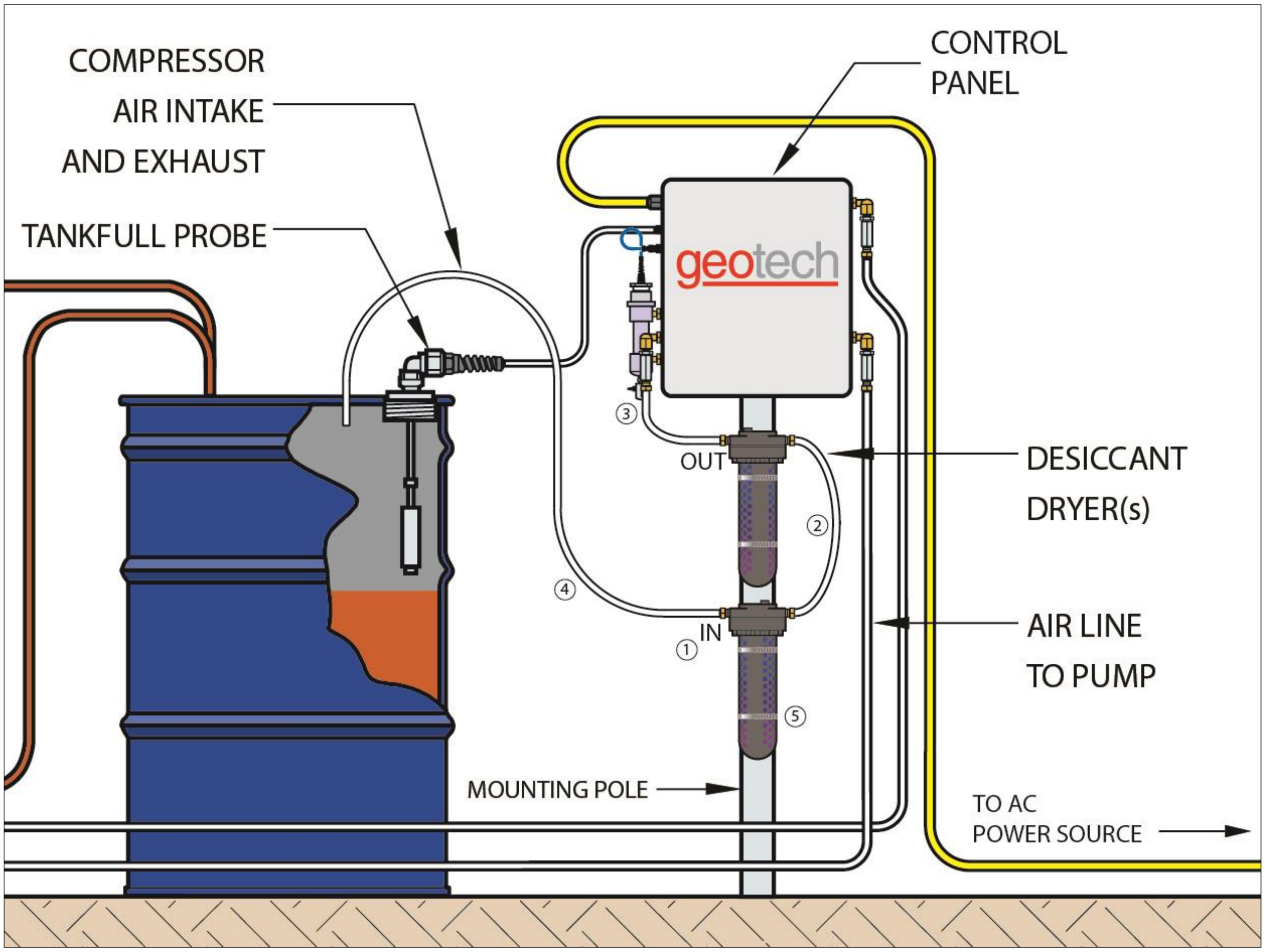
REBUILD KIT, COMPRESSOR, SIPPER PRO	11150334
DESICCANT DRYER, SIPPER	56550048
SILICA GEL, DESICCANT DRYER REFILL, 8 PACK	16600323

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.

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.



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” ID tubing.
3. Connect the remaining “OUT” port to the Intake/Exhaust fitting on the Sipper Enclosure using .17” ID tubing.
4. Connect the .17” 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.

DOCUMENT REVISIONS		
EDCF#	DESCRIPTION	REV/DATE
-	Previous Release	02/15/2013
1583	Added Compressor Repair Kit to Replacement Parts List. Added Revision History Table - SP	05/24/2013
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	3/21/14
-	Added Desiccant Dryer Installation Guide, updated 8- well wiring diagram (rev B), SP	1/5/2014

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 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

Appendix B
Photographs

Photo 1: CH-2A looking west.

Appendix B: Site Photographs
AOI 8 Preliminary Design Report

Photo 2: CH-2A.

Photo 3: CH-2A

Appendix B: Site Photographs
AOI 8 Preliminary Design Report

Photo 4: CH-2A.

Photo 5: Geotech HAZMAT Enclosure

Photo 6: Geotech HAZMAT Enclosure

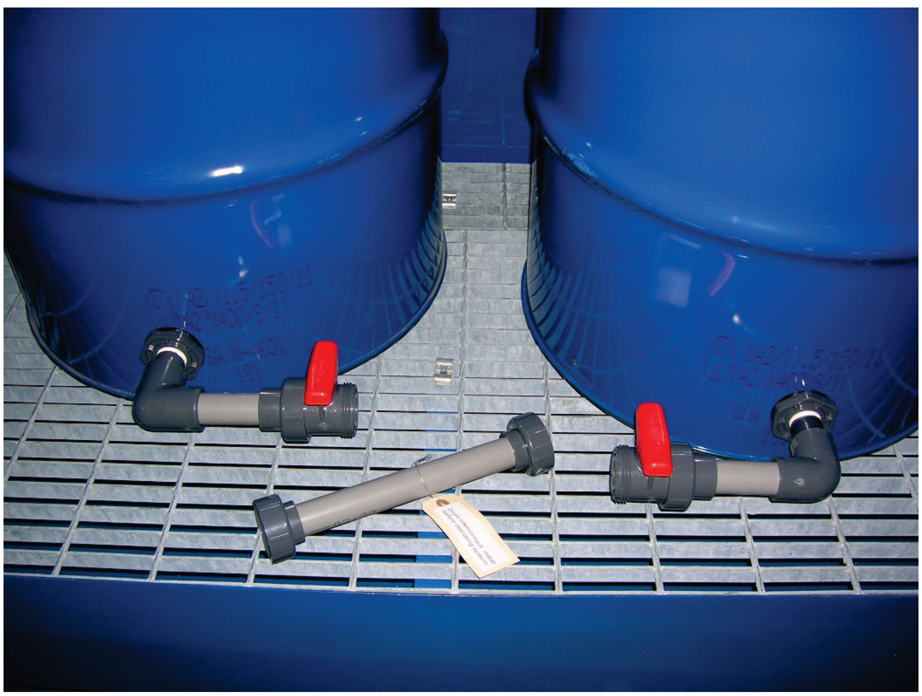
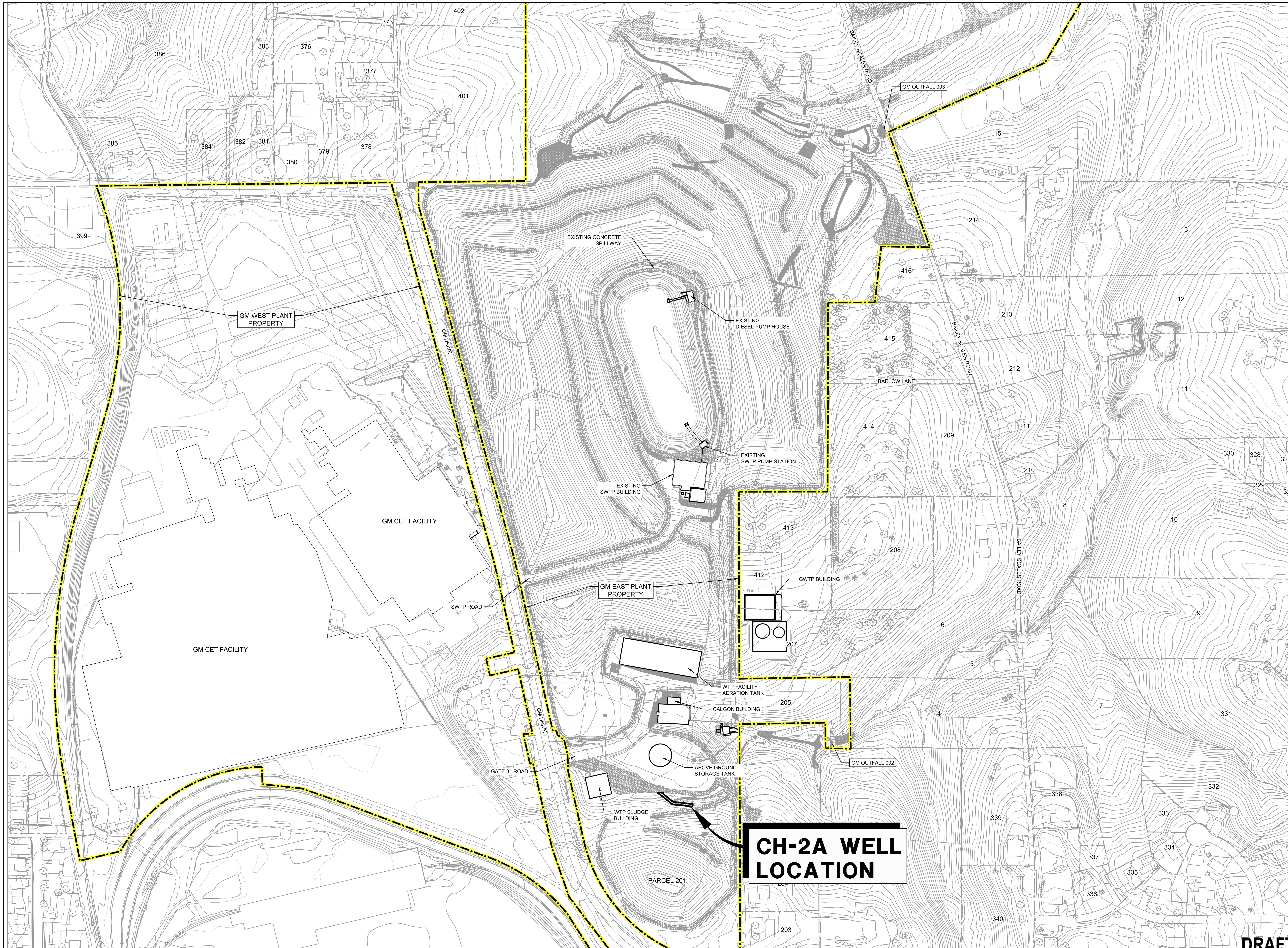


Photo 7: Drum Storage

Appendix B: Site Photographs
AOI 8 Preliminary Design Report

Appendix C
AOI 8 NAPL Recovery Design Drawings
CH 2A Automated Pumping System



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0 75 150 ft

Client
GENERAL MOTORS LLC. CET BEDFORD FACILITY

Project
AOI-8 NAPL RECOVERY DESIGN REPORT

No.	Issue	Drawn	Approved	Date
1	CLIENT REVIEW	BS	RH	10-17-2016

Drawn	B. SUSERSKI	Designer	A. WESOLOWSKI
Drafting Check		Design Check	R. HOEKSTRA
Project Manager	J. McGUIGAN	Date	Oct 17, 2016
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Project No. 13968-00

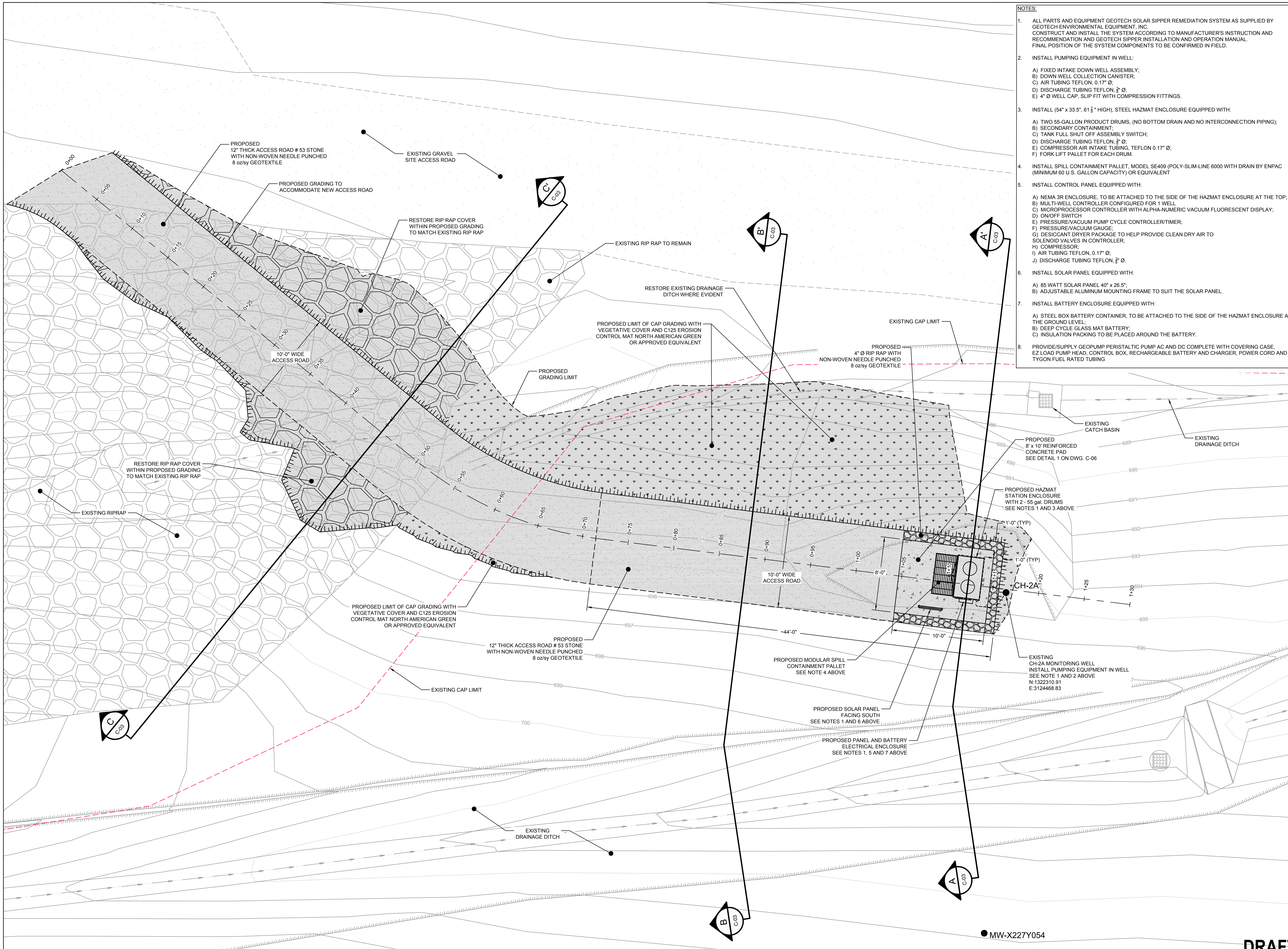
Title
CH-2A AUTOMATED PUMPING SYSTEM SITE LOCATION PLAN

Sheet No.
C-01

Sheet 1 of 6

NOTES:

1. ALL PARTS AND EQUIPMENT GEOTECH SOLAR SIPPER REMEDIATION SYSTEM AS SUPPLIED BY GEOTECH ENVIRONMENTAL EQUIPMENT, INC. CONSTRUCT AND INSTALL THE SYSTEM ACCORDING TO MANUFACTURER'S INSTRUCTION AND RECOMMENDATION AND GEOTECH SIPPER INSTALLATION AND OPERATION MANUAL. FINAL POSITION OF THE SYSTEM COMPONENTS TO BE CONFIRMED IN FIELD.
2. INSTALL PUMPING EQUIPMENT IN WELL:
   A) FIXED INTAKE DOWN WELL ASSEMBLY;
   B) DOWN WELL COLLECTION CANISTER;
   C) AIR TUBING TEFLON, 0.17" Ø;
   D) DISCHARGE TUBING TEFLON, ⅜" Ø;
   E) 4" Ø WELL CAP, SLIP FIT WITH COMPRESSION FITTINGS.
3. INSTALL (54" x 33.5", 61⅛" HIGH), STEEL HAZMAT ENCLOSURE EQUIPPED WITH:
   A) TWO 55-GALLON PRODUCT DRUMS, (NO BOTTOM DRAIN AND NO INTERCONNECTION PIPING);
   B) SECONDARY CONTAINMENT;
   C) TANK FULL SHUT OFF ASSEMBLY SWITCH;
   D) DISCHARGE TUBING TEFLON, ⅜" Ø;
   E) COMPRESSOR AIR INTAKE TUBING, TEFLON 0.17" Ø;
   F) FORK LIFT PALLET FOR EACH DRUM.
4. INSTALL SPILL CONTAINMENT PALLET, MODEL SE409 (POLY-SLIM-LINE 6000 WITH DRAIN BY ENPAC (MINIMUM 60 U.S. GALLON CAPACITY) OR EQUIVALENT
5. INSTALL CONTROL PANEL EQUIPPED WITH:
   A) NEMA 3R ENCLOSURE, TO BE ATTACHED TO THE SIDE OF THE HAZMAT ENCLOSURE AT THE TOP;
   B) MULTI-WELL CONTROLLER CONFIGURED FOR 1 WELL
   C) MICROPROCESSOR CONTROLLER WITH ALPHA-NUMERIC VACUUM FLUORESCENT DISPLAY;
   D) ON/OFF SWITCH
   E) PRESSURE/VACUUM PUMP CYCLE CONTROLLER/TIMER;
   F) PRESSURE/VACUUM GAUGE;
   G) DESICCANT DRYER PACKAGE TO HELP PROVIDE CLEAN DRY AIR TO SOLENOID VALVES IN CONTROLLER;
   H) COMPRESSOR;
   I) AIR TUBING TEFLON, 0.17" Ø;
   J) DISCHARGE TUBING TEFLON, ⅜" Ø.
6. INSTALL SOLAR PANEL EQUIPPED WITH:
   A) 85 WATT SOLAR PANEL 40" x 26.5";
   B) ADJUSTABLE ALUMINUM MOUNTING FRAME TO SUIT THE SOLAR PANEL.
7. INSTALL BATTERY ENCLOSURE EQUIPPED WITH:
   A) STEEL BOX BATTERY CONTAINER, TO BE ATTACHED TO THE SIDE OF THE HAZMAT ENCLOSURE AT THE GROUND LEVEL;
   B) DEEP CYCLE GLASS MAT BATTERY;
   C) INSULATION PACKING TO BE PLACED AROUND THE BATTERY.
8. PROVIDE/SUPPLY GEOPUMP PERISTALTIC PUMP AC AND DC COMPLETE WITH COVERING CASE, EZ LOAD PUMP HEAD, CONTROL BOX, RECHARGEABLE BATTERY AND CHARGER, POWER CORD AND TYGON FUEL RATED TUBING



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0 3 5 ft

Client
GENERAL MOTORS LLC.
CET BEDFORD FACILITY

Project
AOI-8 NAPL RECOVERY DESIGN REPORT

No.	Issue	Drawn	Approved	Date
1	CLIENT REVIEW	BS	RH	10-17-2016

Drawn	B. SUSERSKI	Designer	A. WESOLOWSKI
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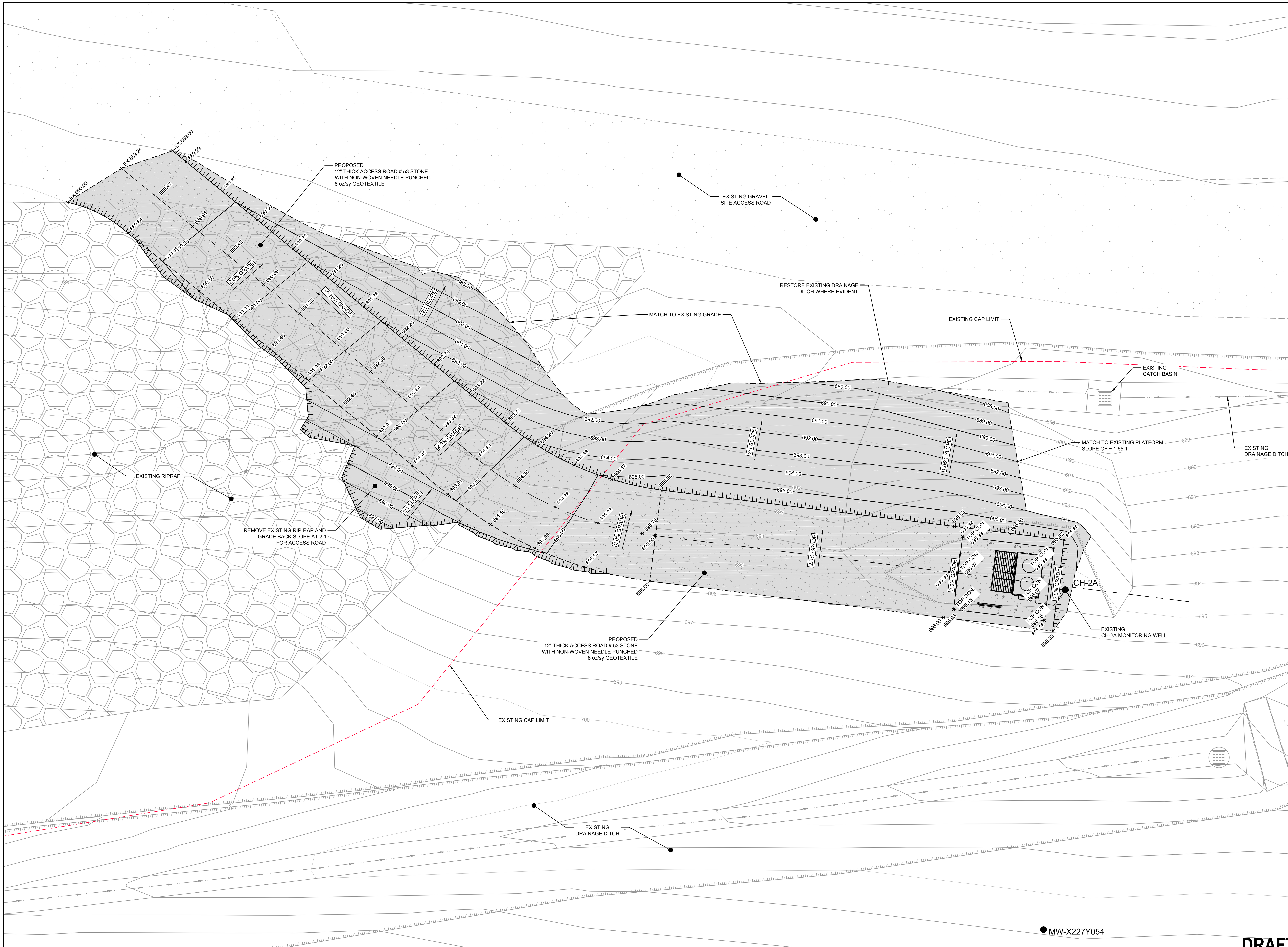
Project No. 13968-00

Title
CH-2A AUTOMATED PUMPING SYSTEM SITE WORKS

Sheet No.
C-02

Sheet 2 of 6



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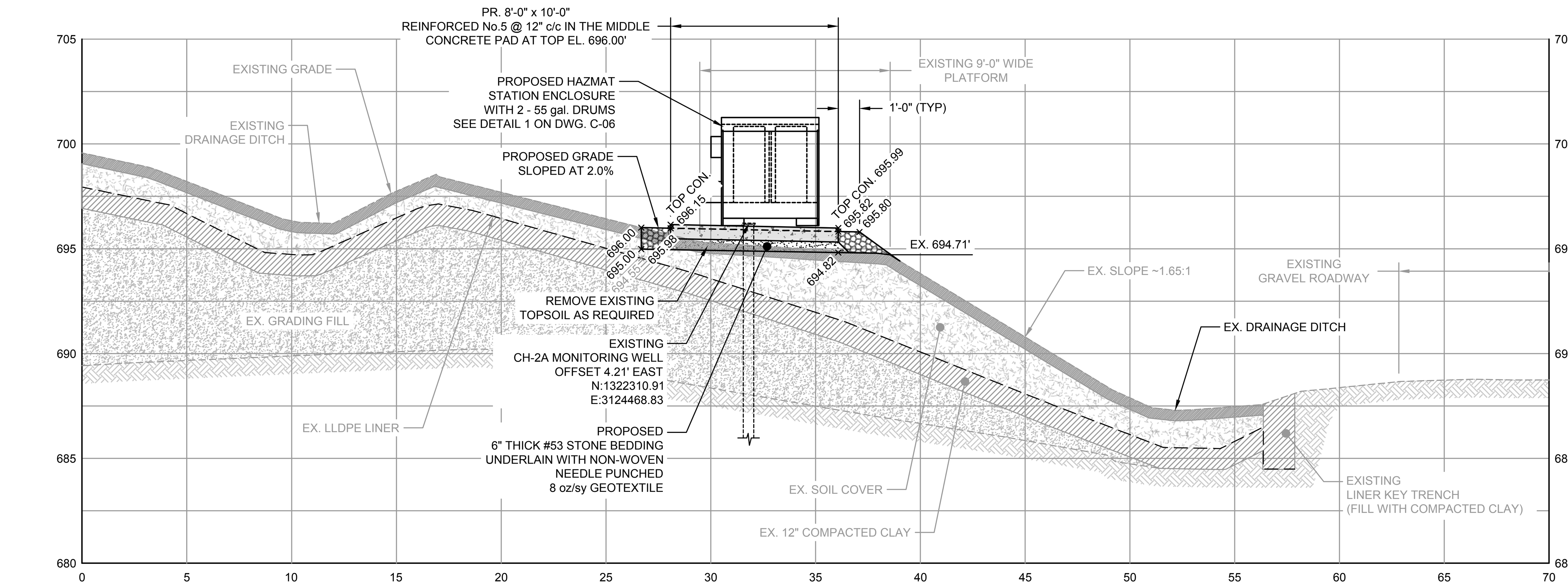
Project No. 13968-00

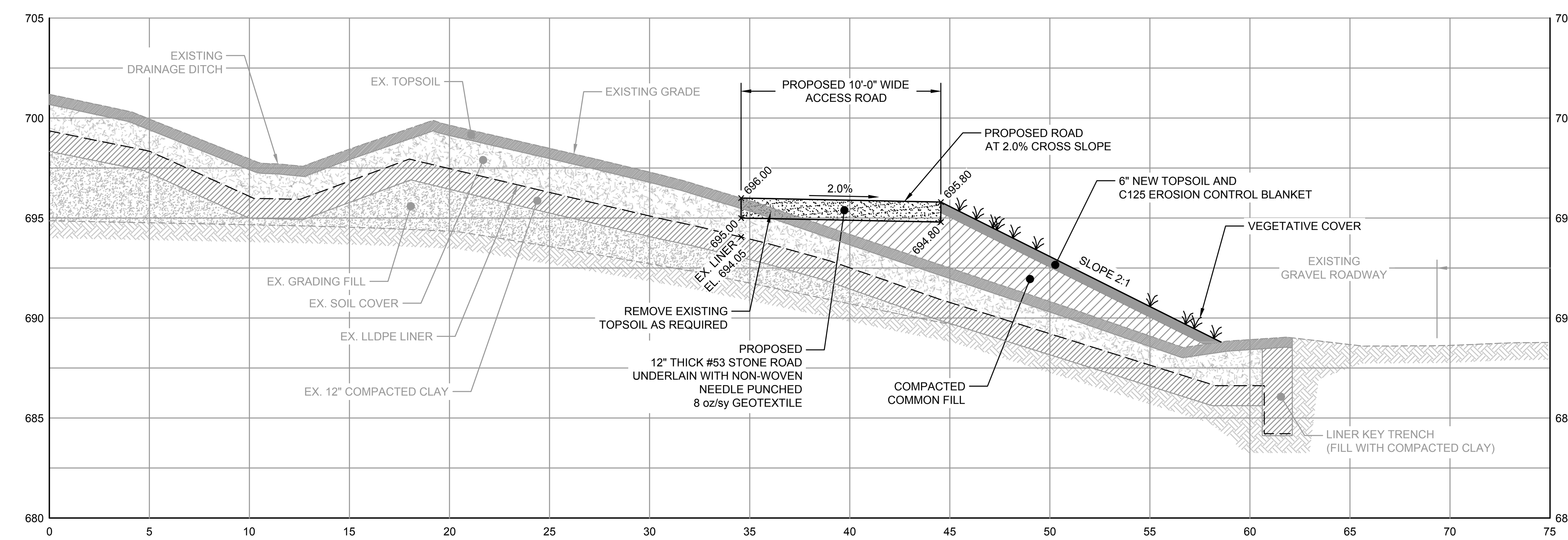
Title
CH-2A AUTOMATED PUMPING SYSTEM GRADING PLAN

Sheet No.
C-03

Sheet 3 of 6



SECTION A-A'
1" = 5'
C-02



SECTION B-B'
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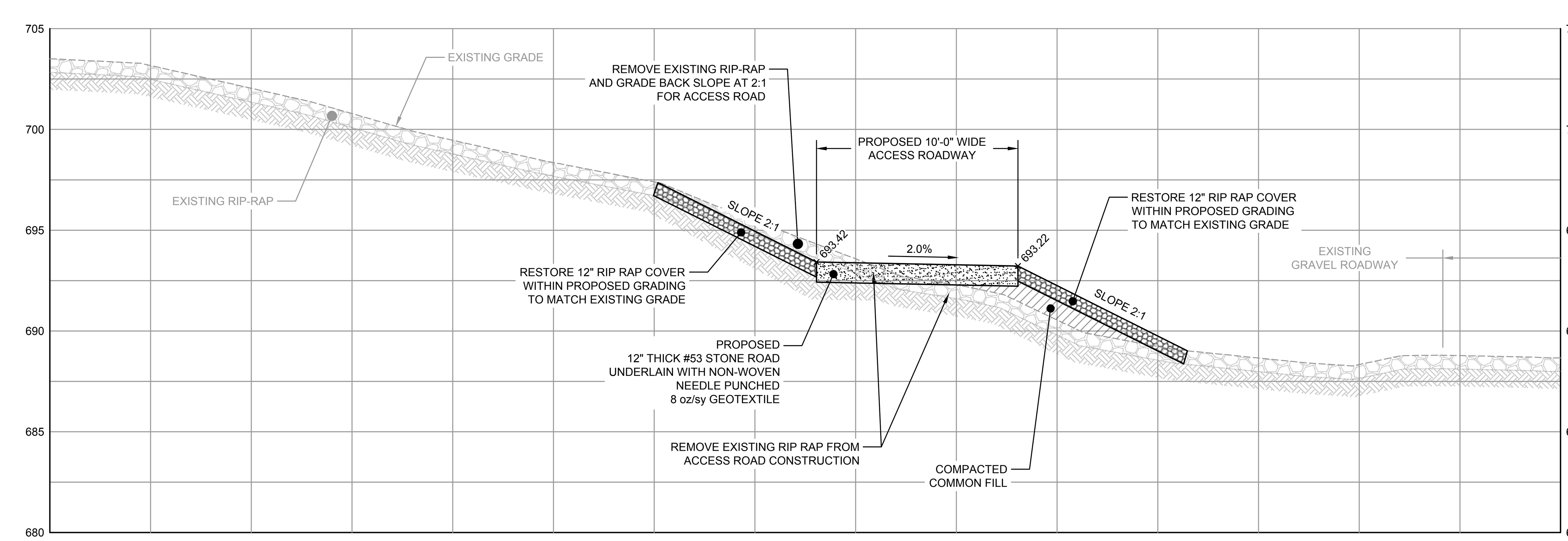
C-02



SECTION C-C'
1" = 5'
C-02

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Project Manager J. McGUIGAN — Date Oct 18, 2016
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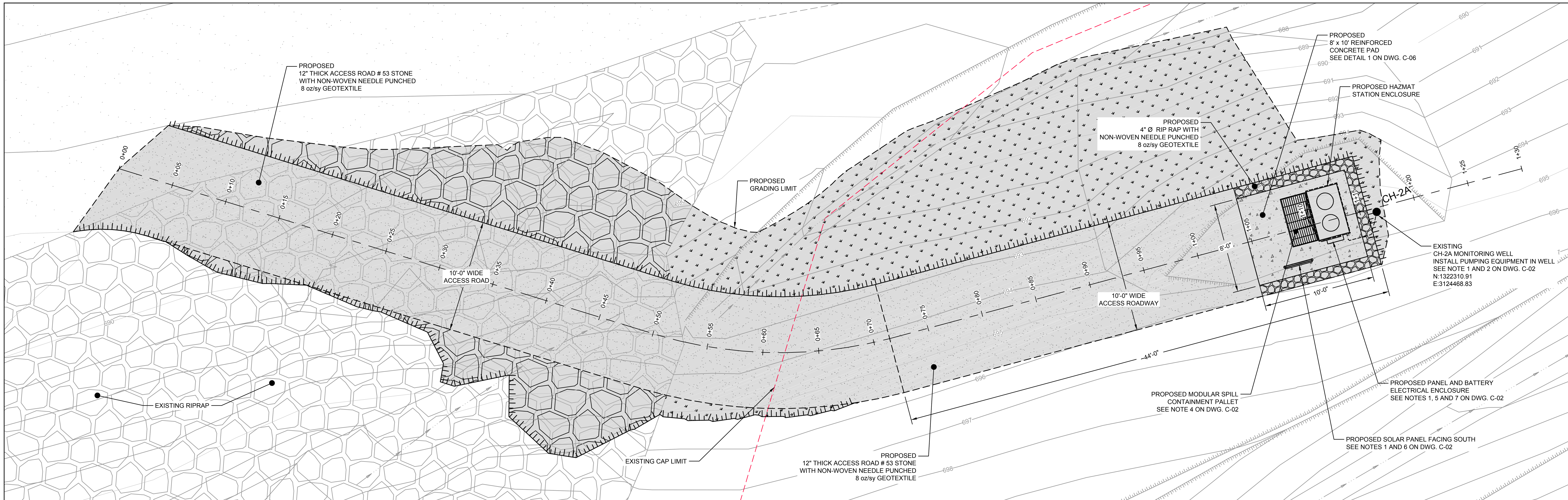
Title
CH-2A AUTOMATED PUMPING SYSTEM SECTIONS

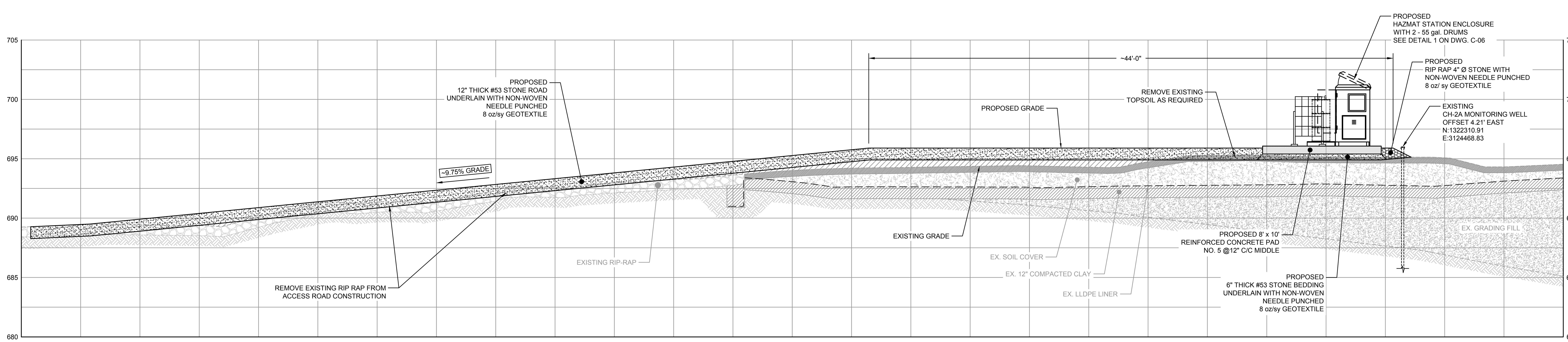
Sheet No.
C-04

Plot Date: 18 October 2016 - 2:53 PM   Plotted By: Branko Suserski   CAD File: P:\drawings\13000s\13968\13968-REPORTS\13968-00(390)\13968-00(390)CI\13968-00(390)CI-WA002.dwg



PLAN

SCALE: 1" = 5'



PROFILE

SCALE: 1" = 5'

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AOI-8 NAPL RECOVERY
DESIGN REPORT

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Project No. 13968-00

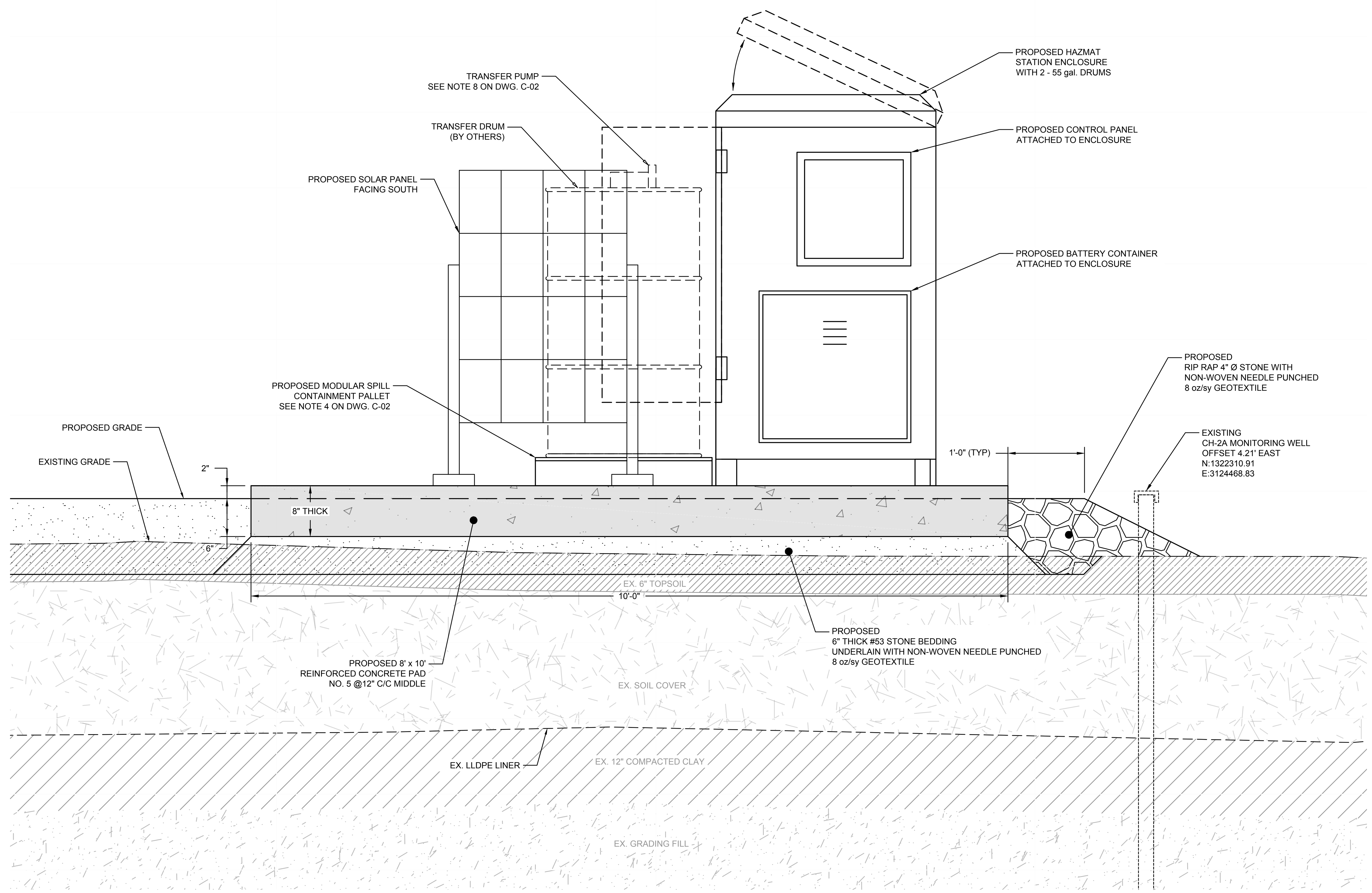
Title

CH-2A AUTOMATED PUMPING SYSTEM PLAN AND PROFILE

Sheet No.

C-05

Sheet 5 of 6



DETAIL 1 / C-02
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Project
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Project No. **13968-00**

Title
CH-2A AUTOMATED PUMPING SYSTEM DETAIL

Sheet No.
C-06

Sheet 6 of 6

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