US Army Corps of Engineers

FINAL

Injection Completion Report

In-Situ Chemical Oxidation Pilot Study

3800 Area PCE Site

Fort Drum Installation Restoration Program
Fort Drum, New York

September 2015

Contract No.: W912DR-12-D-0007
Delivery Order No.: 0003

Prepared For:

U.S. ARMY CORPS OF ENGINEERS BALTIMORE DISTRICT
10 South Howard Street
Baltimore, Maryland 21201-2536

Prepared By:

PIKA-MP JV LLC
12723 Capricorn Drive, Suite 500
Stafford, Texas 77477

PIKA INTERNATIONAL, INC. A JOINT VENTURE MALCOLM PIRNIE

Injection Completion Report
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Pilot Study
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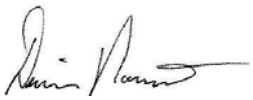
Our Ref.:
GP14DRUM.0001
Date:
22 September, 2015

Srini Neralla, PhD
JV Program Manager

Andy Vitolins, PG
JV Project Manager



Daria Navon, PE
Task Manager

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Acronyms and Abbreviations

bgs	below ground surface
CVOC	Chlorinated Volatile Organic Compound
DER	Division of Environmental Remediation
DMP	Data Management Plan
DO	Dissolved Oxygen
DPW	Department of Public Works
ELAP	Environmental Laboratory Approval Program
ft	feet
gpm	gallons per minute
ISCO	In-Situ Chemical Oxidation
JV	Joint Venture
MAES	Multiple Award Environmental Services
NYSDEC	New York State Department of Environmental Conservation
ORP	Oxidation-Reduction Potential
PCE	Tetrachloroethene
PID	Photoionization Detector
psi	pounds per square inch
RI	Remedial Investigation
ROI	Radius of Influence
QAPP	Quality Assurance Project Plan
SOP	Standard Operating Procedures
TAL	Target Analyte List

TCMI	Temporary Central Mixing and Injection
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds
µg/L	micrograms per liter

1. Introduction

The PIKA - MP Joint Venture (JV), LLC[1] (hereinafter referred to as the JV) has prepared this Injection Completion Report to document the activities and procedures used to perform an oxidant injection in support of an in-situ chemical oxidation (ISCO) pilot study at the 3800 Area Tetrachloroethene (PCE) Site (the Site). Oxidant injection activities (including injection well and monitoring well installation and oxidant application) were completed between May and July 2015.

This work was conducted in support of the Installation Restoration Program (IRP) at Fort Drum, New York in accordance with the New York State Department of Environmental Conservation (NYSDEC)-approved *In-Situ Chemical Oxidation Pilot Study and Groundwater Monitoring Work Plan – 3800 PCE Site* (ISCO Pilot Study Work Plan; PIKA-MP JV, 2015a). Additionally, field and laboratory activities were conducted in accordance with the Quality Assurance Project Plan (QAPP) and Data Management Plan (DMP) submitted as Appendix A and Appendix B to the NYSDEC-approved *Work Plan, Installation Restoration Program, Fort Drum, New York* (IRP Work Plan; PIKA-MP JV, 2015b). Field work followed the health and safety procedures described in the *Accident Prevention Plan, Installation Restoration Program, Fort Drum, New York* (PIKA-MP JV, 2015c). This work is funded under the United States (US) Army Corps of Engineers (USACE) Baltimore District Multiple Award Environmental Services (MAES) contract, Award No. W912DR-12-D-0007, Delivery Order 0003.

[1] The PIKA-MP LLC Joint Venture is comprised of PIKA International, Inc. and its mentor ARCADIS-U.S. Inc.

2. ISCO Pilot Study Activities

2.1 Site Background

A Draft Final Remedial Investigation Report (RIR) was completed in February 2013 (PARS, 2013a) and presents the findings of field investigations activities performed between 2010 and 2012 to characterize the extent of PCE and other chlorinated volatile organic compounds (CVOCs) at the Site. A Draft Final addendum to the RIR was prepared in August 2013 (PARS, 2013b) and includes the results of a bench study and a 2012 ISCO pilot study performed at the Site. Information pertinent to the basis, rationale, and design of the current Pilot Study was presented in the ISCO Pilot Study Work Plan (PIKA-MP JV, 2015a). The 3800 Area location and the pilot study layout are presented on **Figures 1** and **2**, respectively.

2.2 Pilot Study Overview

As a continuation to the initial 2012 ISCO pilot testing program, the JV installed additional injection and monitoring wells (**Figure 2**) and performed a second sodium permanganate ($NaMnO_4$) injection at the Site between May and July 2015. The design for the second injection optimized the initial pilot approach by injecting a larger volume of permanganate solution to improve oxidant distribution. To focus resources on volume distribution, the permanganate injection concentration was reduced from 10% $NaMnO_4$ used during the initial pilot study to approximately 3% $NaMnO_4$. Additionally, a total of approximately 1,460 lbs of 40% permanganate was applied per injection well, as compared to approximately 1,100 pounds of 40% permanganate applied per injection well during the initial pilot study. The pilot study expanded the original treatment footprint to target dissolved phase PCE upgradient of the original pilot test injection wells, including injection upgradient of Building1885. The selection of this target treatment area was based on an evaluation of the data collected during the RI, as discussed in the ISCO Pilot Study Work Plan (PIKA-MP JV, 2015a).

Baseline groundwater monitoring was performed prior to starting the ISCO injection and post-injection monitoring will commence in August 2015. ISCO pilot study performance monitoring results will be discussed in a future pilot study report.

2.2.1 ISCO Pilot Study Objectives

The primary objectives of the 2015 pilot study are to verify and determine the following site-specific parameters:

- Determine injection flow rates that can be safely sustained under gravity feed or low pressure injection.

- Estimate the volume-distribution radius relationship (mobile porosity fraction in soil) by measuring and recording $NaMnO_4$ arrival at dose response wells.

- Assess concentration trends in performance monitoring wells located within and downgradient of the ISCO injection area to ensure that the ISCO system is providing CVOC treatment as expected.

2.2.2 ISCO Pilot Study Design

Based on the analytical and investigation data provided in the RI, the target injection area was moved upgradient of the initial pilot study area. The injection well network was designed to provide distribution of the oxidant solution throughout the target interval. Given the permeable geology and the importance of achieving distribution, a radius of influence (ROI) of 12.5 ft was selected. The target injection volume, $V_{injection}$, necessary to achieve breakthrough of a working strength concentration of permanganate at the targeted injection radius of 12.5 ft was estimated using the following equation, based on the volume of a cylinder:

$$V_{injection} = z^{*}\pi^{*}r^{2^{*}}N_m$$

Where: $V_{injection}$ = Required injection volume

z = Saturated injection interval (5 ft)
r = Target radius of influence (12.5 ft)
N_m= Mobile fraction of soils (15 percent [%])

For the pilot injections:

$V_{injection} = 5\ ft * \pi * (12.5)^2 * 0.15 = 368\ ft^3 * 7.48\ gal/ft^3 = 2{,}752\ gallons$

The 15% mobile fraction determination for the injection was based on site soil conditions presented in historical documents and those observed during well installation.

The design volume of solution was approximately 2,800 gallons for each injection well. Dose response wells (IMW-3, IMW-5, IMW-6, PCERI-25S, and PCERI-MW25I) were

used to confirm the target ROI and to assess whether distribution of the injected solution was achievable.

2.2.3 Permitting

A United Stated Environmental Protection Agency (USEPA) Inventory of Injection Wells Form 7520-16 was filed with the USEPA Underground Injection Control Section, USEPA Region II Offices in New York City and approved prior to ISCO implementation (**Appendix A**). Borehole and well construction permits were secured through the Fort Drum Department of Public Works (DPW).

2.2.4 Injection and Monitoring Well Installation

This section discusses specific components of the injection and monitoring well installation including utility clearance, drilling and well installation, well development, and waste characterization.

2.2.4.1 Utility Clearance

Prior to drilling activities, three lines of evidence were utilized to clear utilities. The following lines of evidence were used:

- A Fort Drum Dig Permit was obtained and known utilities were marked by Fort Drum personnel.
- Dig Safely New York One-Call was notified.
- Site-specific markout was performed using a privately contracted utility locator using ground penetrating radar and magnetic locating equipment to identify utilities.
- Hand cleared each boring location to five feet vertical depth using a soft-dig technology.

2.2.4.2 Drilling and Well Installation

Two new dose response monitoring wells were installed (IMW-5 and IMW-6) and monitoring well PCERI-MW19S was replaced on May12 and 13, 2015. The target permanganate injection depths and the total depth of monitoring wells in the area were

based on RI results as discussed in the ISCO Pilot Study Work Plan (PIKA-MP JV, 2015a). Thirty-five injection wells were installed between May 26 and June 3, 2015 (with the exception of IW-07, which was installed on May 11, 2015). Monitoring and injection well construction details are as follows:

- Monitoring wells (IMW-5, IMW-6, and PCERI-MW19SR) were constructed of 2-inch diameter, Schedule 40 polyvinyl chloride (PVC) casing with 10 feet (ft) of 0.020-inch slotted Schedule 40 PVC screen. A minimum of six inches of clean filter pack sand was emplaced into the bottom of the borehole prior to well installation. Clean filter pack sand was tremied into the annular space between the formation and the monitoring well assembly. The filter pack sand was extended approximately two feet above the screened interval. A two-foot lift of fine sand was emplaced above the filter pack. A No. 0 sand was used for the filter packs and No. 00 sand for the choker sand. The annular seal consisted of neat cement, which was tremied from the fine sand to the ground surface. The neat-cement consisted of a mixture of 6.5 to 7 gallons of water to one 94-pound sack of Portland cement.

- Split spoon samples were collected from 28 ft bgs to up to 42 ft bgs from three wells (IMW-05, IMW-06, and IW-07) to log and confirm geology. The injection wells targeted the most permeable (coarse sand) zones within the targeted vertical interval (32 – 42 ft bgs). Because photoionization (PID) detections in the select boring split spoon samples did not exceed 0.3 ppm, the permeability was used to determine the final depth of the injection wells. The sample core logs are provided in **Appendix B**.

- Prior to installation of the injection wells, a test well (IW-07) was advanced in the ISCO treatment area to obtain soil samples for grain size analyses. The grain size analyses, provided in **Appendix B**, allowed selection of the most appropriate sand pack size and the well screen slot size.

- For the injection wells, separate boreholes were advanced using hollow stem auger drilling methods with 9-inch inner diameter steel augers. Total depth of the injection wells is between 37 and 42 ft bgs. The injection wells were constructed of 2-inch diameter, Schedule 40 PVC casing and five feet of PVC wire-wrapped screen. Approximately six inches of sand was placed in the borehole prior to installing the screen. After installing the sand pack, a two-ft layer of choker sand was placed above the sand pack. A No. 0 sand was used for the filter packs and No. 00 sand for the choker sand. The wells were then grouted with neat cement using the tremie pipe method, which was placed above the choker sand to within

two ft bgs. The neat-cement consisted of a mixture of 6.5 to 7 gallons of water to one 94-pound sack of Portland cement. Well construction logs are provided in **Appendix B**.

- The injection and monitoring wells were fitted with locking, steel protective casings (flush-mount), set in concrete well pads.

2.2.4.3 Well Development

The wells were developed to improve their hydraulic properties by removing sediment and clearing the well screen of fine particles. Well development was performed no sooner than 24 hours after well installation to allow the neat cement to set and no later than five days after the well has been installed. Prior to developing each monitoring and injection well, the initial water level and total depth was measured. Following well development, the total depth was again measured to evaluate the quantity of sediment removed (if any).

Well development proceeded with repeated alternating sequences of surging and removal of water from the well. The effectiveness of the development procedure was monitored after each well volume was removed by measurements of field parameters, such as turbidity, pH, oxidation-reduction potential (ORP), temperature, and specific conductivity. Monitoring well development was discontinued after a minimum of 10 well volumes were removed and stabilization of field parameter measurements occurred, or when the turbidity of the discharge water measured 50 nephelometric turbidity units or less.

2.2.4.4 Waste Characterization

Drill cuttings and well development water were retained on-site in 30 cubic yard roll offs and 55-gal drums pending waste characterization and appropriate off-site disposal. The drill cuttings and well development water were transported and disposed by Environmental Products & Services of Vermont; bills of lading are provided in **Appendix C**.

2.2.5 Baseline Groundwater Sampling

Baseline groundwater sampling was conducted prior to initiation of the ISCO injection to establish pre-injection baseline conditions. Groundwater sampling was performed in accordance with the ISCO Pilot Study Work Plan (PIKA-MP JV, 2015a). Baseline and

post-ISCO performance monitoring results will be discussed in a future pilot study report.

2.2.6 Injection Equipment and Methodology

This section discusses the equipment and procedures used to implement the oxidant injection. Oxidant injection activities were performed between June 24, 2015 and July 15, 2015. Oxidant injection field logs are provided in **Appendix E**.

2.2.6.1 Injection Equipment

Oxidant ($NaMnO_4$) injections were performed using a temporary central mixing and injection (TCMI) system. Therefore, no permanent injection solution mixing and distributing infrastructure was needed. The injection system consisted of a large mixing tank, injection/mixing pump, injection manifold, and well head assemblies (flow meter and pressure gauge). In consultation with Fort Drum DPW, injection water was obtained from one of the fire hydrants located near Bldg 1885. A certified Reduced Pressure Zone backflow device was placed between the hydrant and discharge hose to prevent backflow of water into the distribution system. The injection solution was distributed via above grade hose/pipe to each injection area. Each injection area had a manifold, allowing concurrent injection of at least half of the injection wells. Secondary containment was utilized at the mixing area and each manifold location. Seventeen 275 gallons totes of $NaMnO_4$ were delivered as a 40% solution. The TCMI system was used to dilute the delivered solution to the target injection concentration (i.e., between 2.5% and 3% by weight).

Several Fort Drum departments, including Public Works Environmental and Directorate of Emergency Services Fire Department were notified of the oxidant delivery and use before mobilizing to the Site. Fort Drum personnel were also provided a site plan of where the oxidant would be stored and quantity of reagent. In addition, the Safety Data Sheet for $NaMnO_4$ (**Appendix D**) was provided to site personnel and taped to the mixing tank while work was conducted onsite.

2.2.6.2 Injection Implementation

Following mobilization and setup of the ISCO distribution equipment, initial injection activities included injection startup/shakedown procedures, operation, and performance monitoring. Startup/shakedown procedures were conducted using clean water prior to injecting reagent solutions through the mixing and delivery system. During

startup/shakedown operation, system piping, valves, and appurtenances were checked for leaks and proper operation.

After the clean water injection was completed and the injection piping was primed, oxidant was mixed and injected. During mixing, oxidant was handled in accordance with manufacturer's instructions and with appropriate personal protective equipment. The $NaMnO_4$ solution was mixed on-site in batches in a temporary tank prior to injection. In order to mix a 2.5% to 3% solution, approximately 5.5 gallons of concentrated solution was needed per 100 gallons of water. $NaMnO_4$, at the target injection concentration, is soluble and gentle agitation/stirring with a solution recirculation with a pump achieved adequate dissolution.

The dilute $NaMnO_4$ injection solution was pumped to the injection well manifold. Injection solution flow rate, cumulative injected volume, and observed wellhead pressure were monitored and recorded at each injection well periodically throughout the injection (i.e., once per every few hundred gallons injected per well). Injection pressures were monitored to reduce the risk of well failure or surfacing of the injection solution. The injection pressure did not exceed 5 pounds per square inch (psi). The piping components conveying the injection solution were chemically compatible hoses and/or PVC (compatible with $NaMnO_4$) and were connected via cam locks with tethers or coder pins. Flow meters and pressure gauges with chemically compatible wetted components were used to measure injection flow rates, injection pressures, and cumulative volume injected.

A total of 98,394 gallons of 2.6% sodium permanganate solution was injected into the 35 newly installed injection wells. With the exception of IW-10, which received 2,714 gallons of solution, all the injection wells achieved the target volume of 2,800 gallons (note: injected volumes at IW-1, IW-11, IW-19, IW-21 were within 10 gallons of the target volume). The average injection rate was 3.55 gallons per minute (gpm) with the minimum average rate observed at IW-16 (1.46 gpm) and the maximum average rate observed at IW-7 (9.03 gpm). The measured flow rates at low injection pressures confirm the injection wells were installed in the targeted permeable geology.

Monitoring wells IMW-3, IMW-5, IMW-6, PCERI-MW25S, and PCERI-MW25I were used as dose response wells. The injection volume necessary to influence particular ROIs was established by analyzing the specific conductance and pH response at respective dose response wells, compared to the injected volume (see specific conductance and pH graphs in **Appendix E**). Additionally, grab samples were analyzed for visual evidence of permanganate (i.e., via visual color analysis) and using

field test kits for permanganate. All of the permanganate test kit results were less than the detection limits of the test kit (0.3 to 3.0 percent permanganate). Manual depth to water measurements were also collected to understand the aquifer response to the applied hydraulic pressure. Positive dose response was observed at IMW-3, IMW-5 and PCERI-MW25S with both conductivity measurements and visual confirmation of permanganate arrival.

2.2.7 Post Injection Performance Monitoring

Performance monitoring will be initiated in August 2015. Three rounds of ISCO performance monitoring (i.e., at the same wells sampled for baseline conditions) will be conducted at approximately 30 days (August 2015), 75 days, and 120 days after injection. Performance monitoring results will be presented in a future pilot study report.

3. References

PARS, 2013a. Draft Final Remedial Investigation Report for Chlorinated Solvent Contaminants, Fort Drum, New York. February.

PARS, 2013b. Draft Final Remedial Investigation Report – Addendum. Pilot Testing of Permanganate Injection. Fort Drum PCE Remedial Investigation for Chlorinated Solvent Contaminants, Fort Drum, New York. August.

PIKA-MP JV, 2015a. In-Situ Chemical Oxidation Pilot Study and Groundwater Monitoring Work Plan – 3800 PCE Site, Fort Drum Installation Restoration Program, Fort Drum, New York. February.

PIKA-MP JV, 2015b. Work Plan, Installation Restoration Program, Fort Drum, New York. February.

PIKA-MP JV, 2015c. Accident Prevention Plan, Fort Drum Installation Restoration Program, Fort Drum, New York. Updated March.

PIKA INTERNATIONAL, INC.
A JOINT VENTURE
MALCOLM PIRNIE

Figures

LEGEND

Approximate 3800 Area PCE Site Boundary

0 400 800

GRAPHIC SCALE

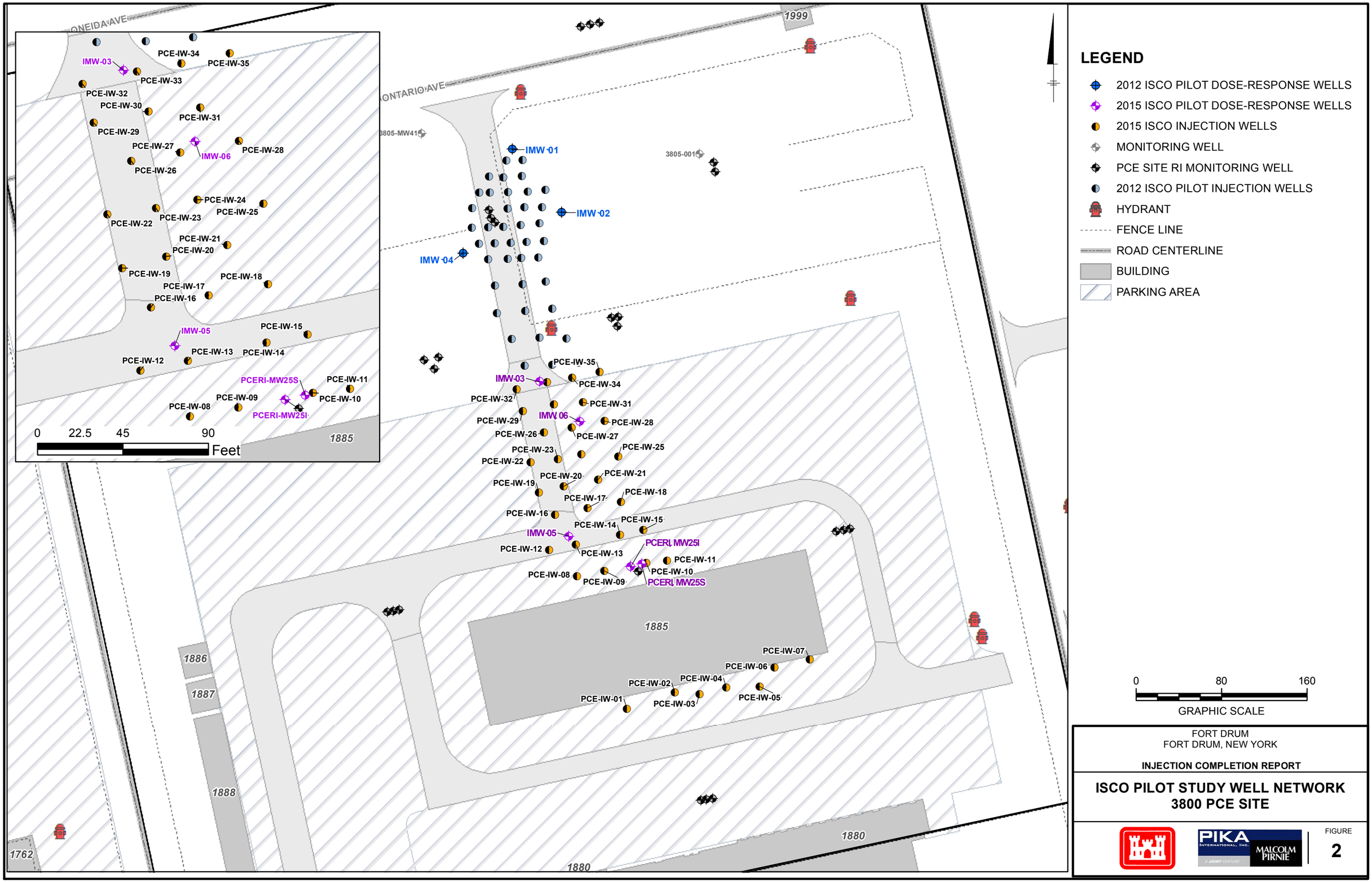
FORT DRUM
FORT DRUM, NEW YORK

INJECTION COMPLETION REPORT

3800 AREA PCE SITE AND VICINITY

FIGURE 1

CITY:(CHARLOTTE) DIV/GROUP:(ENV/GIS) DB:ssutton LD: S.SUTTON PIC: PM: TM:
PROJECT: XX000000.0000.00000 PATH: Z:\GIS\PROJECTS_ENV\ENV_FORTDRUM_IRP\MXD\PCE Site Injection Completion ReportF1_SITE PLAN.mxd



LEGEND

- 2012 ISCO PILOT DOSE-RESPONSE WELLS
- 2015 ISCO PILOT DOSE-RESPONSE WELLS
- 2015 ISCO INJECTION WELLS
- MONITORING WELL
- PCE SITE RI MONITORING WELL
- 2012 ISCO PILOT INJECTION WELLS
- HYDRANT
- FENCE LINE
- ROAD CENTERLINE
- BUILDING
- PARKING AREA

0 80 160

GRAPHIC SCALE

FORT DRUM
FORT DRUM, NEW YORK

INJECTION COMPLETION REPORT

ISCO PILOT STUDY WELL NETWORK 3800 PCE SITE

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FIGURE **2**

CITY:(CHARLOTTE) DIV/GROUP:(ENV/GIS) DB:ssutton LD:S.SUTTON PIC: PM: TM: DATE SAVED: 8/10/2015 4:30:42 PM
PROJECT: XX000000.0000.00000 PATH: Z:\GIS\PROJECTS_ENV\ENV_FORTDRUM_IRP\MXD\PCE Site Injection Completion Report\F2_IW LAYOUT.mxd Last Saved By: ssutton

Tables

Table 1
ISCO Injection Summary
Fort Drum IRP - 3800 PCE Site
Fort Drum, New York

Injection Well ID	Cumulative Volume (gal)	Average Flow Rate (gpm)
IW-1	2799	2.74
IW-2	2801	2.40
IW-3	2801	2.53
IW-4	2802	2.54
IW-5	2803	4.99
IW-6	2800	6.56
IW-7	2803	9.03
IW-8	2840	5.58
IW-9	2800	4.49
IW-10	2714	8.36
IW-11	2796	6.43
IW-12	2975	2.24
IW-13	2800	2.76
IW-14	2800	2.73
IW-15	2863	3.71
IW-16	2800	1.46
IW-17	2801	2.26
IW-18	2800	3.04
IW-19	2797	3.44
IW-20	2800	2.87
IW-21	2793	2.95
IW-22	2800	2.21
IW-23	2800	2.28
IW-24	2801	2.72
IW-25	2804	2.89
IW-26	2800	2.40
IW-27	2800	5.55
IW-28	2800	2.27
IW-29	2800	2.25
IW-30	2800	3.16
IW-31	2800	2.58
IW-32	2998	2.16
IW-33	2800	3.57
IW-34	2800	3.10
IW-35	2800	4.07
TOTAL:	**98394**	

Notes:
gal - gallons
gpm - gallons per minute

APPENDIX A

Underground Injection Control
Program Permit

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

MAY 19 2015

Paul Zang
Fort Drum Department of Public Works
85 First Street W
Fort Drum, NY 13602

Re: Underground Injection Control (UIC) Program Regulation
Fort Drum Area 3800 PCE Site (**Reference UICID: 15NY04599040**)
Ontario Avenue
Fort Drum, NY 13602
Jefferson County
Authorization to Inject

Dear Mr. Zang:

This letter serves to inform you that the U.S. Environmental Protection Agency is in receipt of inventory information addressing wells authorized by rule located at the above-referenced facility in accordance with 40 Code of Federal Regulations (CFR) §144.26. The operation of the following Underground Injection Control wells are authorized by rule, pursuant to 40 CFR §144.24:

35 injection wells (IW-01-IW-35) will be used to inject a total of approximately 98,000 gallons of a 2.5-3% solution of sodium permanganate to remediate a chlorinated VOC plume.

Should any conditions change in the operation of any of the wells listed above (such as injectate composition, closure of the well, injection of cooling water greater than 98 degrees Fahrenheit, construction of additional wells, etc.) you are required to notify this office within five (5) days. Any accidental spills into a well should be reported within twenty-four (24) hours after the event. Change in operation information should be addressed to:

Nicole Foley Kraft, Chief
Groundwater Compliance Section
United States Environmental Protection Agency
290 Broadway, 20th Floor
New York, NY 10007-1866
Re: 15NY04599040
Attn: Frank Brock

Should you own or operate **other** facilities using underground injection wells, please use the enclosed inventory form (EPA Form 7520-16) and instructions, copy for multiple facilities, and submit them to the address listed above. These documents can also be found on the internet at:

http://www.epa.gov/safewater/uic/pdfs/7520-16.pdf
http://www.epa.gov/region02/water/compliance/supplemental_instructions_inventory.pdf
http://www.epa.gov/region02/water/compliance/wellclasstypetable_inventoryc_form

Failure to respond to this letter truthfully and accurately within the time provided may subject you to sanctions authorized by federal law. Please also note that all information submitted by you may be used in an administrative, civil judicial, or criminal action. In addition, making a knowing submission of materially false information to the U.S. Government may be a criminal offense.

Should you have any questions, please contact Frank Brock of my staff at (212) 637-3762 or brock.frank@epa.gov.

Sincerely,

Nicole Foley Kraft, Chief
Ground Water Compliance Section

Enclosure

cc: Steven Botsford, P.E.,
NYSDEC, Region 6
317 Washington St.
Watertown, NY 13601-3787

Stefan Bagnato, P.E.
PIKA-MP JV, Inc.
855 Route 146, Suite 210
Clifton Park, NY 12065

APPENDIX B

Well Construction and
Development Logs

ARCADIS
Infrastructure · Water · Environment · Buildings

Checked By:_____ Date: _____

Sieve Analysis ASTM D-6913

Project No:	GP14DRUM.0001	Boring No:	IW-07	Test Method : A [ ] B [ ]	
Project Name	Fort Drum IRP	Sample No		Mfr/Model Sieve shaker:	
Project Engr:	Stafan Bagnato	Depth:	36-42'		
Initial Visual Classification:			Dark Brown, silty sand, wet		
Testing Tech:	D. Wilcoxson	Start Date:	5/13/2015	Date Finished:	5/13/2015

Specimen Selected From:		Selection Method:		State of Materal when Selected:	
[ ]	Bulk Sample	[x]	Splitter	[x]	Moist
[ ]	SPT Sample	[ ]	Quatering	[ ]	Air Dried
[x]	Other:	[ ]	Rep. Scoop or Slice	[ ]	Oven Dried

Washing:

_____ minutes soaking [ ] Sodium Hex used [ ] Coarser Sieve used over No. 200 Size: _____

Mass of total specimen before wash:	142.18
Mass of total specimen after wash:	132.98
Total loss:	9.2
% loss in washing:	6.5

Moisture Content:

Mass of Sample Moist	501.36
Mass of Sample Dry	424.51
Mass of Moisture	76.85

Sieve Analysis

Sieve No.	Cumulative Mass Retained	% Retained	%Finer
1		0.0	100.0
3/4		0.0	100.0
3/8		0.0	100.0
4		0.0	100.0
10	0.06	0.0	100.0
40	5.64	4.0	96.0
60	37.05	26.1	73.9
100	91.97	64.7	35.3
200	129.65	91.2	8.8
Pan	132.96		

Results

Passing No. 10: 424.45 g
Passing No. 200: 12.53 g
% Moisture: _____

Plasticity:

LL	PL	PI

Final Classification:

USCS Designation: _____

0.02

Wt. of Sample 142.18
% Passing No. 10 100.0

Notes/Information:

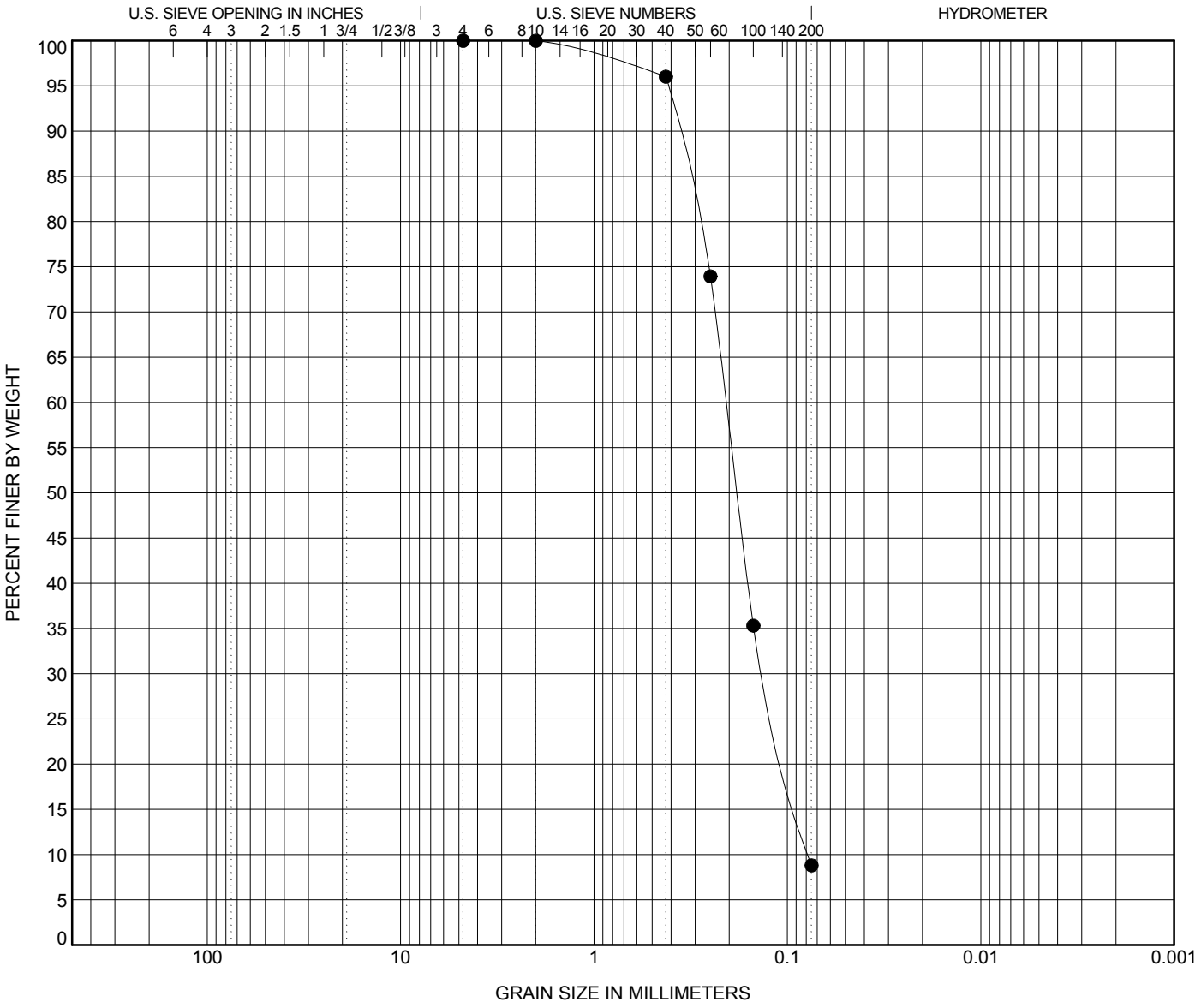
GRAIN SIZE DISTRIBUTION

ARCADIS
Infrastructure · Water · Environment · Buildings

ARCADIS U.S., Inc.
1000 Cobb Place Blvd, Suite 500A
Kennesaw, GA 30144

CLIENT Fort Drum **PROJECT NAME** Fort Drum IRP

PROJECT NUMBER GP14DRUM.0001 **PROJECT LOCATION** Fort Drum, NY



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BOREHOLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	**IW-07**	**36.0**	**POORLY GRADED SAND with SILT(SP-SM)**	**NP**	**NP**	**NP**	**1.06**	**2.69**

	BOREHOLE	DEPTH	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**IW-07**	**36.0**	**4.75**	**0.208**	**0.131**	**0.077**	**0.0**	**91.2**	**8.8**	

ARCADIS

Sample/Core Log

Boring/Well IMW-05 Project/No. GP14Drum.0001 Page 1 of 2

Site Location 3800 PCE Site

Drilling Started 5/12/15 Drilling Completed 5/12/15

Total Depth Drilled 40.5 Feet Hole Diameter 9 inches Type of Sample/ Coring Device Split spoon

Length and Diameter of Coring Device 2' x 1.5" s Sampling Interval 28-40 feet

Land-Surface Elev. _____ feet ☐ Surveyed ☐ Estimated Datum _____

Drilling Fluid Used None Drilling Method HSA

Drilling Contractor Nothnagle Driller Steve Helper Greg

Prepared By Suzie Ellsworth Hammer Weight _____ Hammer Drop _____ ins.

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	PID Reading (ppm)	Time/Hydraulic Pressure or Blows per 6 Inches	Sample/Core Description
28.0	28.5	1.5	0.0	10	
28.5	29.0		0.0	8	Brown, fine to coarse SAND, trace med. to coarse Gravel, wet
29.0	29.5		0.3	8	Brown, fine SAND and SILT, wet
29.5	30.0		0.0	16	SAA
30.0	30.5	1.5	0.0	8	
30.5	31.0		0.0	8	Brown fine to coarse SAND, trace fine Gravel, wet
31.0	31.5		0.0	10	Brown fine SAND and SILT wet
31.5	32.0		0.0	13	SAA
32.0	32.5	1.5	0.0	8	
32.5	83.0		0.0	8	Brown fine to medium SAND, trace fine to med. Gravel, wet
33.0	33.5		0.0	10	Brown fine SAND and SILT wet
33.5	34.0		0.0	13	SAA
34.0	34.5	2.0	0.0	10	Brown fine SAND and SILT, trace fine Gravel, wet
34.5	35.0		0.0	12	SAA
35.0	35.5		0.0	16	SAA
35.5	36.0		0.0	28	Brown fine SAND and SILT, wet
36.0	36.5	2.0	0.0	12	SAA
36.5	37.0		0.0	16	SAA
37.0	37.5		0.0	28	SAA
37.5	38.0		0.0	28	SAA

ARCADIS

Sample/Core Log (Cont.d)

Boring/Well IMW-05

Prepared by Suzie Ellsworth

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	PID Reading (ppm)	Time/Hydraulic Pressure or Blows per 6 Inches	Sample/Core Description
38.0	38.5	1.5	0.0	1	SAA
38.5	39.0		0.0	3	SAA
39.0	39.5		0.0	10	SAA
39.5	40.0		0.0	20	SAA

ARCADIS

Sample/Core Log

Boring/Well: MW-06 | Project/No.: 6P14DRUM.0001 | Page: 1 of 2

Site Location: 3800 PCE Site

Drilling Started: 5/13/15 | Drilling Completed: 5/13/15

Total Depth Drilled: 40.5 Feet | Hole Diameter: 9 inches | Type of Sample/Coring Device: Split spoon

Length and Diameter of Coring Device: 2' x 1.5" | Sampling Interval: 28-40 feet

Land-Surface Elev.: _____ feet | [ ] Surveyed | [ ] Estimated | Datum: _____

Drilling Fluid Used: None | Drilling Method: HSA

Drilling Contractor: Nothnagle | Driller: Steve | Helper: Mark

Prepared By: Suzie Ellsworth | Hammer Weight: _____ | Hammer Drop: _____ ins.

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	PID Reading (ppm)	Time/Hydraulic Pressure or Blows per 6 Inches	Sample/Core Description
28.0	28.5	2.0	0.0	3	Brown, fine to med SAND and SILT, little fine gravel, wet
28.5	29.0		0.0	23	Brown, fine SAND and SILT, wet
29.0	29.5		0.0	39	SAA
29.5	30.0		0.0	34	SAA
30.0	30.5	1.5	0.0	8	Brown, fine to med SAND
30.5	31.0		0.0	13	Brown, fine SAND and SILT, wet
31.0	31.5		0.0	16	SAA
31.5	32.0		0.0	29	SAA
32.0	32.5	2.0	0.0	8	SAA
32.5	33.0		0.0	28	SAA
33.0	33.5		0.0	28	SAA
33.5	34.0		0.0	30	SAA
34.0	34.5	2.0	0.0	13	SAA
34.5	35.0		0.0	17	SAA
35.0	35.5		0.0	16	SAA
35.5	36.0		0.0	21	SAA
36.0	36.5	1.5	0.0	5	SAA
36.5	37.0		0.0	7	SAA
37.0	37.5		0.0	10	SAA
37.5	38.0		0.0	20	SAA

ARCADIS

Sample/Core Log (Cont.d)

Boring/Well IMW-06

Prepared by Suzie Ellsworth

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	PID Reading (ppm)	Time/Hydraulic Pressure or Blows per 6 Inches	Sample/Core Description
38.0	38.5	1.25	0.0	7	SAA
38.5	39.0		|	17	SAA
39.0	39.5		|	17	SAA
39.5	40.0		↓	18	SAA

ARCADIS

Sample/Core Log

Boring/Well IW-07 Project/No. GP14Drum.0001 Page 1 of 2

Site Location 3800 PCE Site Drilling Started 5/11/15 Drilling Completed 5/11/15

Total Depth Drilled 42 Feet Hole Diameter 9 inches Type of Sample/ Coring Device split spoon

Length and Diameter of Coring Device 2'x1.5" split spoon Sampling Interval 28-42 feet

Land-Surface Elev. _____ feet ☐ Surveyed ☐ Estimated Datum _____

Drilling Fluid Used None Drilling Method HSA

Drilling Contractor Nothnagle Driller Steve Helper Mark

Prepared By Suzie Ellsworth/Amber Goodrich Hammer Weight _____ Hammer Drop _____ ins.

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	PID Reading (ppm)	Time/Hydraulic Pressure or Blows per 6 Inches	Sample/Core Description
28.0	28.5	2.0	0.0	17	Brown fine to medium trace Coarse SAND, wet
28.5	29.0		0.0	26	Brown fine SAND and SILT, wet
29.0	29.5		0.0	36	SAA
29.5	30.0		0.0	27	SAA
30.0	30.5	2.0	0.0	20	SAA
30.5	31.0		0.1	40	SAA
31.0	31.5		0.1	58	SAA
31.5	32.0		0.0	74	SAA
32.0	32.5	2.0	0.0	10	SAA
32.5	33.0		0.0	17	SAA
33.0	33.5		0.0	27	SAA
33.5	34.0		0.0	38	SAA
34.0	34.5	1.25	0.0	4	SAA
34.5	35.0		0.0	5	SAA
35.0	35.5		0.0	8	SAA
35.5	36.0		0.1	20	SAA
36.0	36.5	1.75	0.0	7	SAA
36.5	37.0		0.0	13	SAA
37.0	37.5		0.0	22	SAA
37.5	38.0		0.0	25	SAA

ARCADIS

Sample/Core Log (Cont.d)

Boring/Well: MW-07

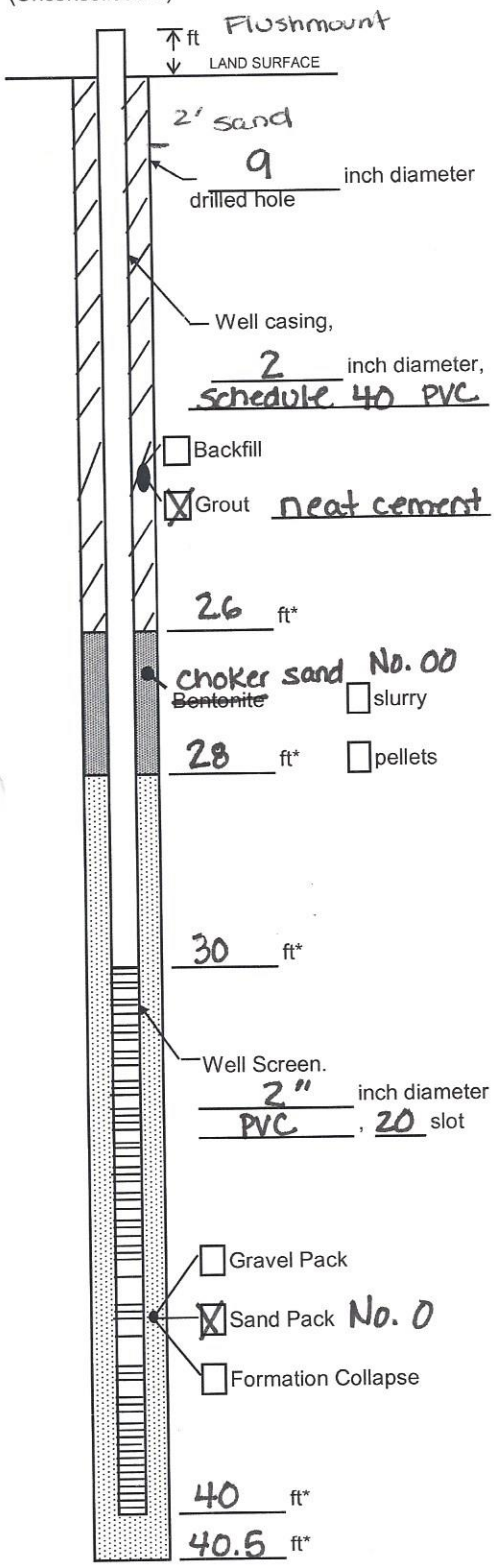
Prepared by: Suzie Ellsworth / Amber Goodrich

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	PID Reading (ppm)	Time/Hydraulic Pressure or Blows per 6 Inches	Sample/Core Description
38.0	38.5	1.75	0.0	8	SAA
38.5	39.0		0.0	8	SAA
39.0	39.5		0.0	20	SAA
39.5	40.0		0.0	20	SAA
40.0	40.5	1.75	0.0	11	SAA
40.5	41.0		0.0	22	SAA
41.0	41.5		0.0	23	SAA
41.5	42.0		0.0	21	SAA

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IMW-05

Town/City Fort Drum

County Jefferson State NY

Permit No. J

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 5/12/15

Drilling Method HSA

Drilling Contractor Nothnagle

Drilling Fluid None

Development Technique(s) and Date(s)

5/13/15: Venturi (air lifting) and surging

Fluid Loss During Drilling 50 gallons

Water Removed During Development ~98 gallons

Static Depth to Water 19.41 feet below M.P.

Static Depth to Bottom 39.45 feet below M.P.

Pumping Depth to Water NA feet below M.P.

Pumping Duration 48 ~~hours~~ minutes

Surging duration: 6 minutes

~~Yield~~ (pumping rate) ~2.2 gpm Date 5/13/15

Specific Capacity NA gpm/ft

Well Purpose SHE ~~Injection~~ Monitoring Well

Remarks Depth to bottom post development: 40.01' below M.P.

(M.P. was cut post development ~~1.25~~ 0.11" cut off)

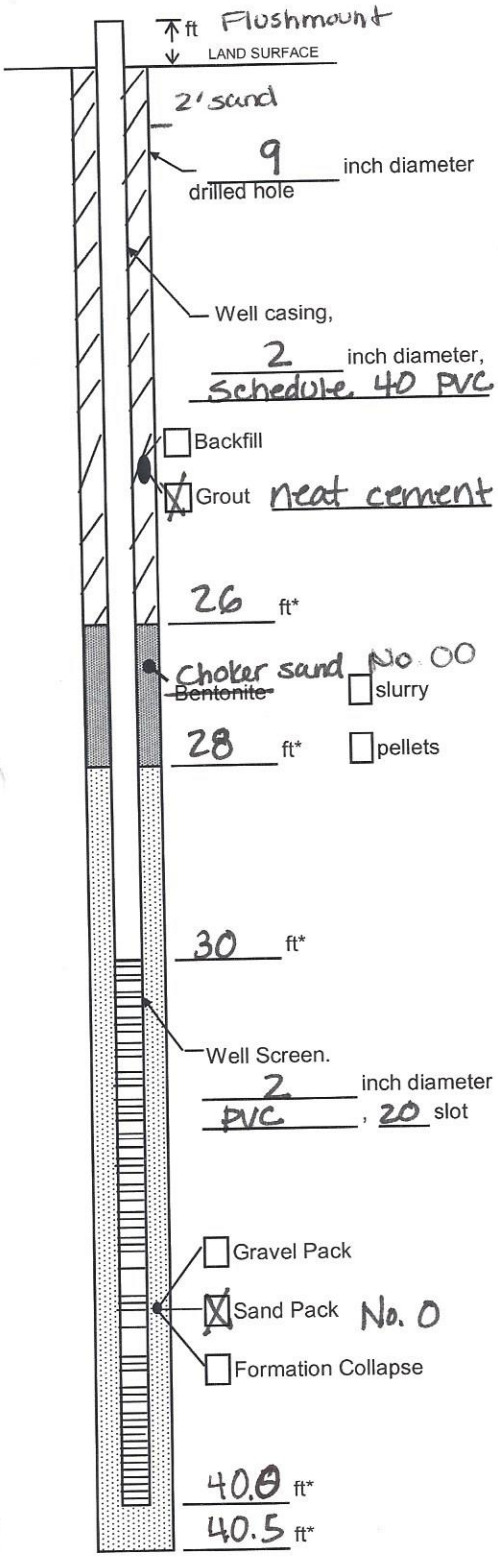
Final Turbidity: 8.12 NTU

Prepared by Suzie Ellsworth

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IMW-06

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 5/12/15 and 5/13/15 (finished grouting)

Drilling Method HSA

Drilling Contractor Nothnagle.

Drilling Fluid None

Development Technique(s) and Date(s)

5/14/15 Venturi (air lifting) and surging

Fluid Loss During Drilling 140 gallons

Water Removed During Development ~99 gallons

Static Depth to Water 18.0 feet below M.P.
Static Depth to Bottom 38.44' feet below M.P.

Pumping Depth to Water 19.6 feet below M.P.

Pumping Duration 47 hours minutes
Surge duration: 6 min

~~Yield~~ (pumping rate) ~2.2 gpm Date 5/14/15

Specific Capacity NA gpm/ft

Well Purpose Monitoring Well

Remarks Depth to Bottom post development: 40.31' ~~below~~ below M.P.

Prepared by Suzie Ellsworth

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IMW-06 Date 5/14/16

Purge Method: Centrifugal ____ Submersible ____ Other Airlifting

Developed By Steve (Nothnagle) S. Ellsworth (Arcadis)

Total Depth 38.44' (static below M.P.)
Water Level 18.0'
Water Column 20.44'

Casing Diameter (inches) 2
Well Volume (gal) 3.27
Total Volume Purged ~99 gallons

Pump On 0837 / 0916 Pump Off 0901 / 0939

Well Casing Volumes

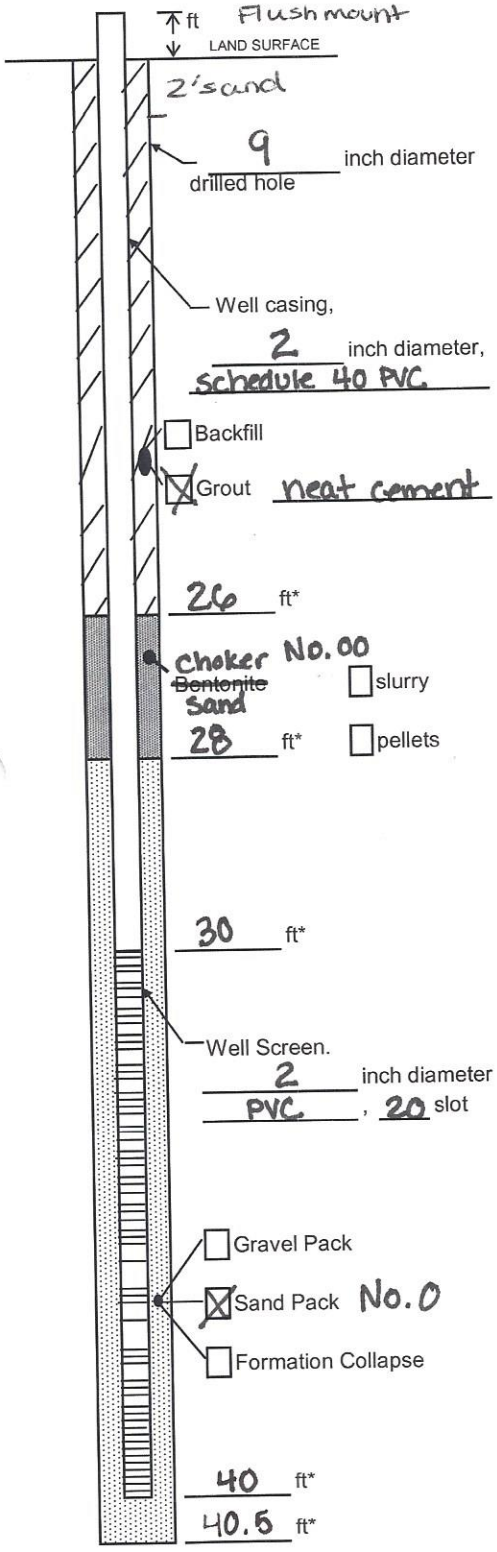
gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
0843	6	~2.2			6.62	0.976	12.01	>1000	ORP 233
0852	15	2.2			7.46	0.885	12.05	139	125
0857	20	2.2			7.84	0.879	11.94	74.7	75
0901	24	2.2		~49	7.91	0.883	12.08	49.9	80
surged well							~~13.36~~		
0921	5	2.2			8.02	0.867	13.36 ~~12.24~~	856	84
0925	9	2.2			8.00	0.885	12.24 ~~12.58~~	167	66
0931	15	2.2			7.99	0.888	12.58	56.7	87
0934	18	2.2			7.98	0.906	12.02	428	55
0939	23	2.2		~99				34.8	—
More than 10 well volumes removed and turbidity <50 NTU									
Final DTB: 40.31' below MP									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well PCERI-MW19SR

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

feet ☐ Surveyed ☐ Estimated

Installation Date(s) 5/13/15

Drilling Method HSA

Drilling Contractor Nothnagle

Drilling Fluid None

Development Technique(s) and Date(s)

5/14/15 Venturi (air lifting) and surging

Fluid Loss During Drilling 80 gallons

Water Removed During Development ~95 gallons

Static Depth to Water 16.70 feet below M.P.
~~Static DTB~~ 37.84 ~~feet below M.P.~~

Pumping Depth to Water 18.74 feet below M.P.

Pumping Duration 43 ~~hours~~ minutes
~~Surge Duration~~ 6 minutes

~~Yield~~ ~2.2 gpm Date 5/14/15
~~Pumping Rate~~ *

Specific Capacity NA gpm/ft

Well Purpose

Monitoring Well

Remarks Replaced PCERI-MW19S. installed in 12/10.
DTB post Development: 39.91' below M.P.

Prepared by Suzie Ellsworth

ARCADIS

Monitoring Well Development Log

Page 1 of 1

Project/No. 3800 PCE Site Well PCERI-MW19SR Date 5/14/15

Static Below M.P

Total Depth 37.84' Casing Diameter (inches) 2

Water Level 16.70' Well Volume (gal) 3.38

Water Column 21.14' Total Volume Purged ~95 gallons

Pump On 1300/~~1321~~ 1335 Pump Off 1321/1357

Purge Method: Centrifugal ____ Submersible ____ Other Airlifting

Developed By Steve (Nothnagle) S. Ellsworth (Arcadis)

Well Casing Volumes

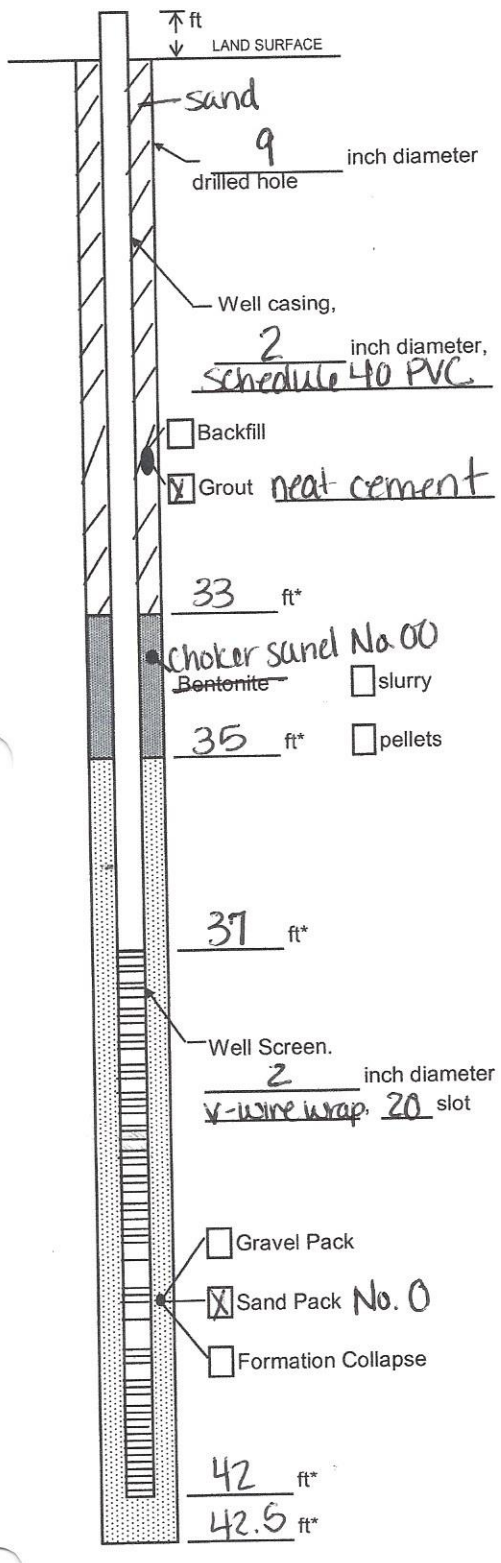
gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1305	5	2.2			7.90	0.684	18.67	425	ORP 81
1310	10	2.2			7.86	0.687	14.96	119	65
1315	15	2.2			7.62	0.732	13.92	71.1	92
1320	20	2.2		~45	7.55	0.756	13.05	40.8	94
Surged well									
1337	2	2.2			7.82	0.782	13.85	>1000	79
1343	8	2.2			7.85	0.804	13.01	113	89
1348	13	2.2			7.87	0.808	12.63	74.5	90
1353	18	2.2			7.87	0.826	12.32	54.3	88
1357	22	2.2		~95	7.88	0.837	11.99	43.1	71
More than 10 well volumes removed and turbidity <50 NTUs									
Final DTB:	39.91'	below MP							

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IW-01

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 6/3/15

Drilling Method HSA (6.25")

Drilling Contractor Nothnagle (Steve/Greg)

Drilling Fluid None

Development Technique(s) and Date(s)

Airlifting 6/8/15

Fluid Loss During Drilling ~ 40 gallons

Water Removed During Development 36.55 gallons

Static Depth to Water 19.38 feet below M.P.

~~Static total depth~~ 38.31 ~~feet below M.P.~~

Pumping Depth to Water 21.51 feet below M.P.

Pumping Duration 24 ~~hours~~ minutes

~~Yield~~ Pumping rate 1.52 gpm Date 6/8/15

Specific Capacity NA gpm/ft

Well Purpose Injection Well

Remarks Final DTB 41.21' below M.P.

M.P. was before coupling was added

Prepared by Suzie Ellsworth

ARCADIS

Monitoring Well Development Log

Page 1 of 1

Project/No. 3800 PCE Site Well IW-01 Date 06/08/15

static below MP { Total Depth 38.31' / Water Level 19.38' }

Water Column 18.93'

Pump On 1327

Casing Diameter (inches) 2

Well Volume (gal) 3.03

Total Volume Purged 36.55 gallons

Pump Off 1351

Purge Method
- Centrifugal ____
- Submersible ____
- Other x air lifting

Developed By M. Kixr, S. Ellsworth (ARCADIS) Kevin (Nothnagel)

Well Casing Volumes

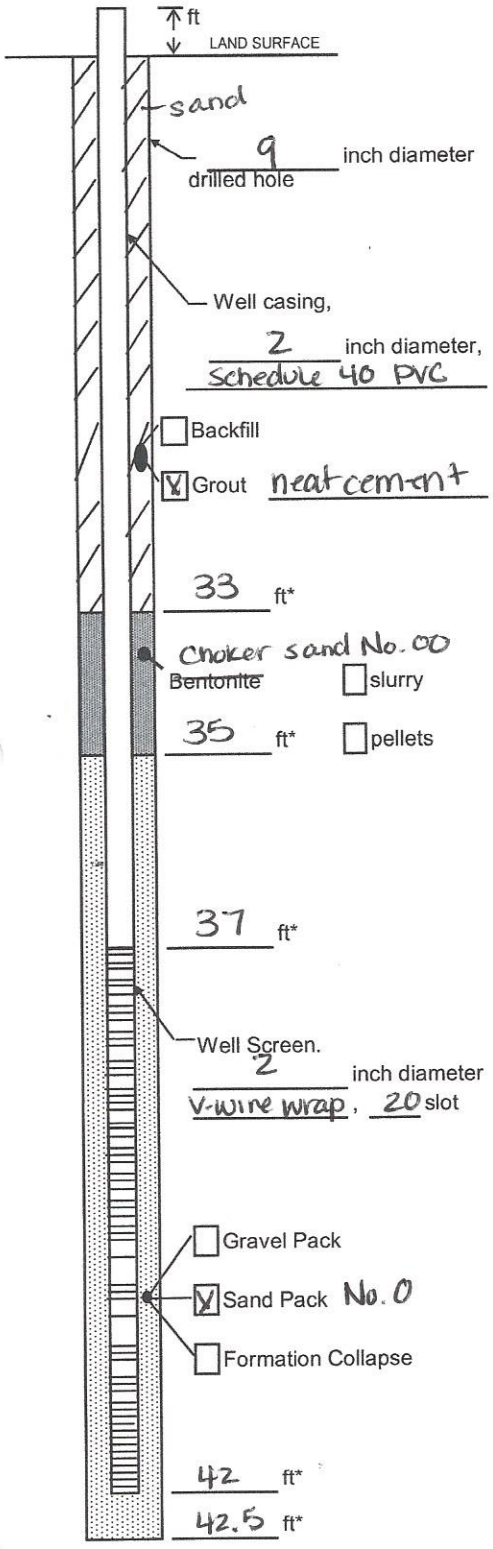
gallon/foot 1-¼" = 0.06, 1-½" = 0.09, 2" = 0.16, 2-½" = 0.26, 3" = 0.37, 3-½" = 0.50, 4" = 0.65, 6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1333	6	↓	21.51	↓	7.00	0.678	16.01	3627	ORP: 81 mV
1340	13	↓	21.70	↓	7.41	0.721	14.93	69.2	ORP: 121 mV
1344	17	1.52	21.61	36.55	7.42	0.721	14.37	11.3	ORP: 130 mV
More than 10 well volumes removed and turbidity < 50 NTU									
Final DTB: 41.21' below MP									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well LW-02

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 6/3/15

Drilling Method HSA (6.25")

Drilling Contractor Nothnagle (Steve/Greg)

Drilling Fluid None

Development Technique(s) and Date(s)

Airlifting 6/4/15

Fluid Loss During Drilling ~40 gallons

Water Removed During Development 42 gallons

Static Depth to Water 19.1 feet below M.P.

Pumping Depth to Water 21.65 feet below M.P.

Pumping Duration 21 ~~hours~~ minutes

~~Yield~~ Pumping rate 2.0 gpm Date 6/4/15

Specific Capacity NA gpm/ft

Well Purpose Injection Well

Remarks Static total depth (ft below MP): 38.20
final total depth (ft below MP): 41.15

MP was before coupling was added

Prepared by Suzie Ellsworth

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well MW-02 Date 6/4/15

Static Below M.P.

Total Depth 38.20' Casing Diameter (inches) 2 Purge Method: Centrifugal ____

Water Level 19.10' Well Volume (gal) 3.06 Submersible ____

Water Column 19.10' Total Volume Purged ~42 gallons Other Airlifting

Pump On 12:33 Pump Off 12:54 Developed By Steve (Nothnagle) S. Ellsworth (Arcadis)

Well Casing Volumes

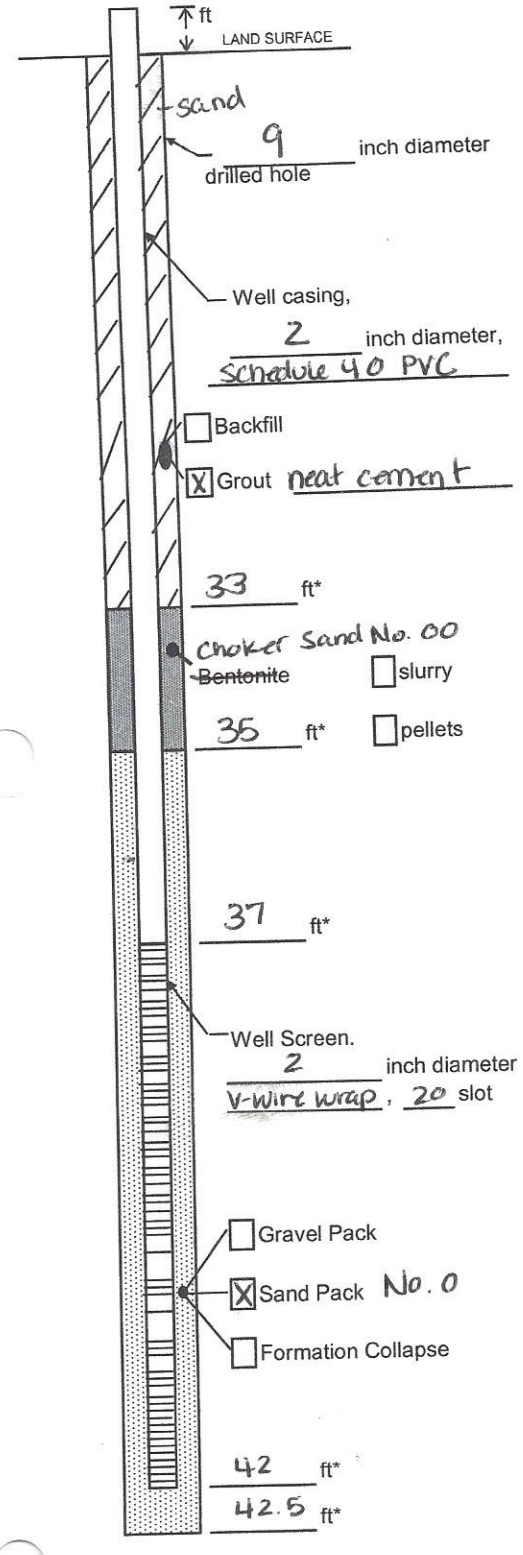
gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1237	4	2.0	21.65	↓	7.41	0.625	17.44	888	ORP 180
1242	9	2.0	21.61	↓	7.38	0.667	15.15	33.6	177
1247	14	2.0	21.63	↓	7.36	0.674	13.90	29.0	163
1252	19	2.0	21.65	~42	7.38	0.689	13.90	18.3	144
— Turbidity less than 50 NTUs and more than 1D well volumes removed —									
Final Total Depth: 41.15' below MP									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE site Well IW-03

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 6/3/15

Drilling Method HSA (6.25")

Drilling Contractor Nothnagle (Steve/Greg)

Drilling Fluid None

Development Technique(s) and Date(s)

06/04/15 venturi (air lifting)

Fluid Loss During Drilling ~50 gallons

Water Removed During Development 39.0 gallons

Static Depth to Water 18.88 feet below M.P.

Pumping Depth to Water 20.72 ~~38.56~~ HR feet below M.P. (see well dev. log)

Pumping Duration 20 ~~hours~~ minutes

~~Yield~~ pumping rate 1.95 gpm Date 06/04/15

Specific Capacity NA gpm/ft

Well Purpose Injection Well

Remarks static depth to bottom: 38.56
*completed prior to adding coupling/fitting to well
MP was before coupling was added
completed DTW: 18.96' below MP
completed DTB: 41.65' below MP

Prepared by Suzie Ellsworth / Meghan Kiser

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-03 Date 06/04/15

static below MP

Total Depth 38.56' Casing Diameter (inches) 2 Purge Method: Centrifugal ____

Water Level 18.88' Well Volume (gal) 3.15 Submersible ____

Water Column 19.68' Total Volume Purged 39.0 gallons Other x Airlifting

Pump On 1215 Pump Off 1235 Developed By M. Kiser (ARCADIS) Kevin (Nothnagle)

Well Casing Volumes

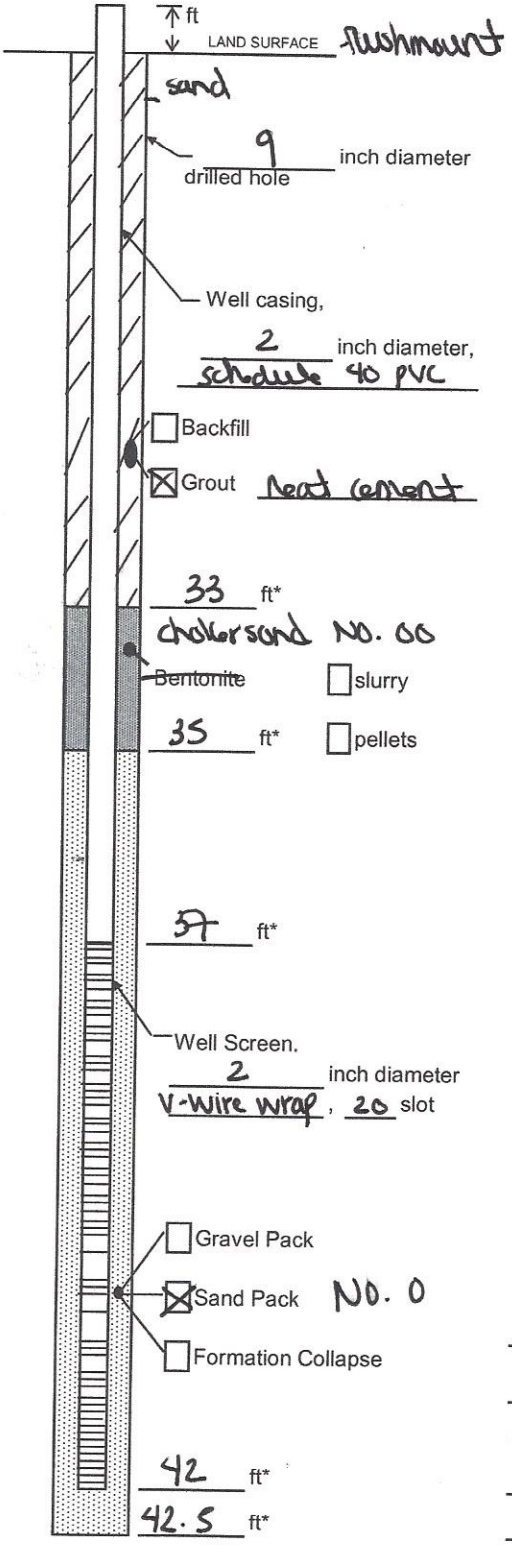
gallon/foot			
1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1218	3	↓	20.65	↓	7.31	0.648	16.17	1957	
1223	8	↓	20.71	↓	7.31	0.696	14.70	86.8	
1228	13	↓	20.72	↓	7.26	0.741	14.32	30.5	
1233	18	~1.95	20.72	~39	7.29	0.735	14.01	26.2	
More than 10 well volumes removed and turbidity <50 NTU									
Final DTB: 41.65 ft below MP									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project: 3800 ICE Site — Well: IW-04

Town/City: Fort Drum

County: Jefferson — State: NY

Permit No.:

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s): 06/03/15

Drilling Method: HSA (6.25")

Drilling Contractor: Nothnagle

Drilling Fluid: None

Development Technique(s) and Date(s)

Airlifting 6/8/15

Fluid Loss During Drilling: 30 gallons

Water Removed During Development: 38 gallons

Static Depth to Water: 18.72 feet below M.P.

Static DTB: 40.53 feet below M.P.

Pumping Depth to Water: 21.65 feet below M.P.

Pumping Duration: 17 ~~hours~~ minutes

~~Yield~~ pumping rate: 2.2 gpm Date: 6/8/15

Specific Capacity: NA gpm/ft

Well Purpose: Injection well

Remarks: Final DTB: 41.21' below MP

MP was before coupling/fitting was added

Prepared by: Meghan Kiser

Drilling Forms.xlsx.xls
Well Constr

ARCADIS

Monitoring Well Development Log

Page 1 of 1

Project/No. 3800 PCE Site Well IW 04 Date 06/08/15

Static Below M.P.

Total Depth 40.53' Casing Diameter (inches) 2 Purge Method

Water Level 18.72' Well Volume (gal) 3.49 Centrifugal ____

Water Column 21.81' Total Volume Purged ~38 gallons Submersible ____

Pump On 1468 Pump Off 1425 Other Airlifting

Developed By Kevin (Nothnagle) M. Kiser / S. Ellsworth (Arcadis)

Well Casing Volumes

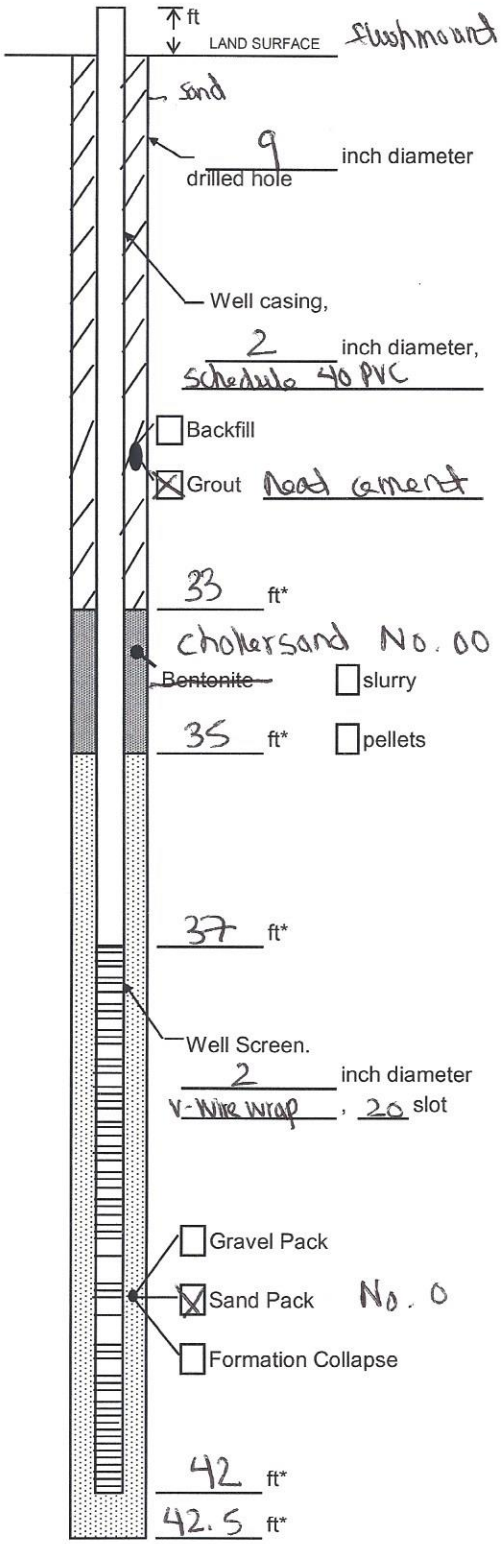
gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1410	2	↓	21.65	↓	7.36	0.777	15.09	2478	ORP 148
1415	7	↓	21.65	↓	7.33	0.984	14.96	31.9	158
1418	10	↓	21.71	↓	7.24	1.02	13.70	7.36	163
1422	14	~2.2	21.48	~38	7.16	1.01	13.46	6.59	Clear, 167
More than 10 well volumes removed and turbidity <50 NTUs									
Final DTB: 41.21' below MP									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project: 3800 PCE Site Well: IW-05

Town/City: Fort Drum

County: Jefferson State: NY

Permit No.:

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s): 06/03/15

Drilling Method: HSA (6.25")

Drilling Contractor: Nothnagle

Drilling Fluid: None

Development Technique(s) and Date(s)

06/04/05 venturi (air lifting)

Fluid Loss During Drilling: 30 gallons

Water Removed During Development: 40.0 gallons

Static Depth to Water: 18.50 feet below M.P.

Pumping Depth to Water: 20.18 feet below M.P. (see well diver log)

Pumping Duration: 20 ~~hours~~ minutes

~~Yield~~ pumping rate: 2.0 gpm Date: 06/04/15

Specific Capacity: NA gpm/ft

Well Purpose: Injection Well

Remarks: static well depth to bottom: 41.21
*completed prior to adding coupling/fitting to well
MP was before coupling/fitting was added
completed DTW: 18.49 ft below MP
completed DTB: 41.62 ft below MP

Prepared by: Meghan Kiser

ARCADIS

Monitoring Well Development Log

Page 1 of 1

Project/No. 3800 PCE Site Well IW-05 Date 06/04/15

Static Below M.P.

Total Depth 41.21' Casing Diameter (inches) 2 Purge Method Centrifugal _____

Water Level 18.50' Well Volume (gal) 3.63 Submersible _____

Water Column 22.71' Total Volume Purged 40.0 gallons Other x Airlifting

Pump On 1142 Pump Off 1202 Developed By M. Kiser (ARCADIS) Kevin (Nothnagle)

Well Casing Volumes

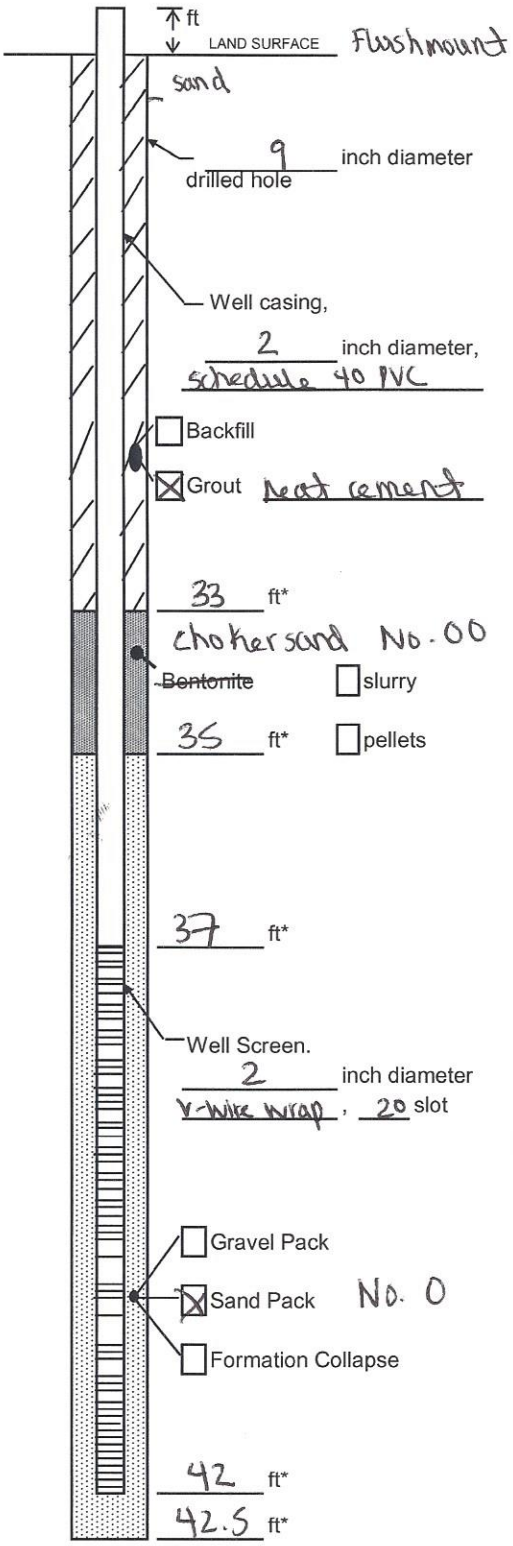
gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1145	3		20.12		7.73	1.08	16.59	927	
1150	8		20.31		7.61	1.09	15.41	103	
1155	13	↓	20.18	↓	7.49	1.11	14.65	10.9	
1200	18	~2.0	20.18	~40.0	7.48	1.09	13.94	9.4	
More than 10 well volumes removed and turbidity < 50 NTU									
Final PTB: 41.62' below M.P.									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project: 3800 PCE Site Well: IW-06

Town/City: Fort Drum

County: Jefferson State: NY

Permit No.:

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s): 06/02/15

Drilling Method: HSA (6.25")

Drilling Contractor: Nothnagle

Drilling Fluid: None

Development Technique(s) and Date(s)

06/04/15 venturi (air lifting)

Fluid Loss During Drilling: 30 gallons

Water Removed During Development: 42.5 gallons

Static Depth to Water: 18.56 feet below M.P.

Pumping Depth to Water: 20.90 feet below M.P. (see well dev. log)

Pumping Duration: 23 ~~hours~~ minutes

~~Yield~~ pumping rate: 1.85 gpm Date: 06/04/15

Specific Capacity: NA gpm/ft

Well Purpose: Injection Well

Remarks: static depth to bottom 40.52 ft

* completed prior to adding fitting to well MP was before coupling was added

completed DTW: 18.61 ft below MP

completed DTB: 41.41 ft below MP

Prepared by: Meghan Kizer

ARCADIS

Monitoring Well Development Log

Page 1 of 1

Project/No. 3800 PCE Site Well IW-06 Date 06/04/15

static below MP

Total Depth 40.52' Casing Diameter (inches) 2 Purge Method

Water Level 18.56' Well Volume (gal) 3.51 Centrifugal ____

Water Column 21.96' Total Volume Purged 42.5 gallons Submersible ____

Pump On 0817 Pump Off 0840 Other X airlifting

Developed By Meghan Kiker (AK/APD) Kevin (Nothnagle)

Well Casing Volumes

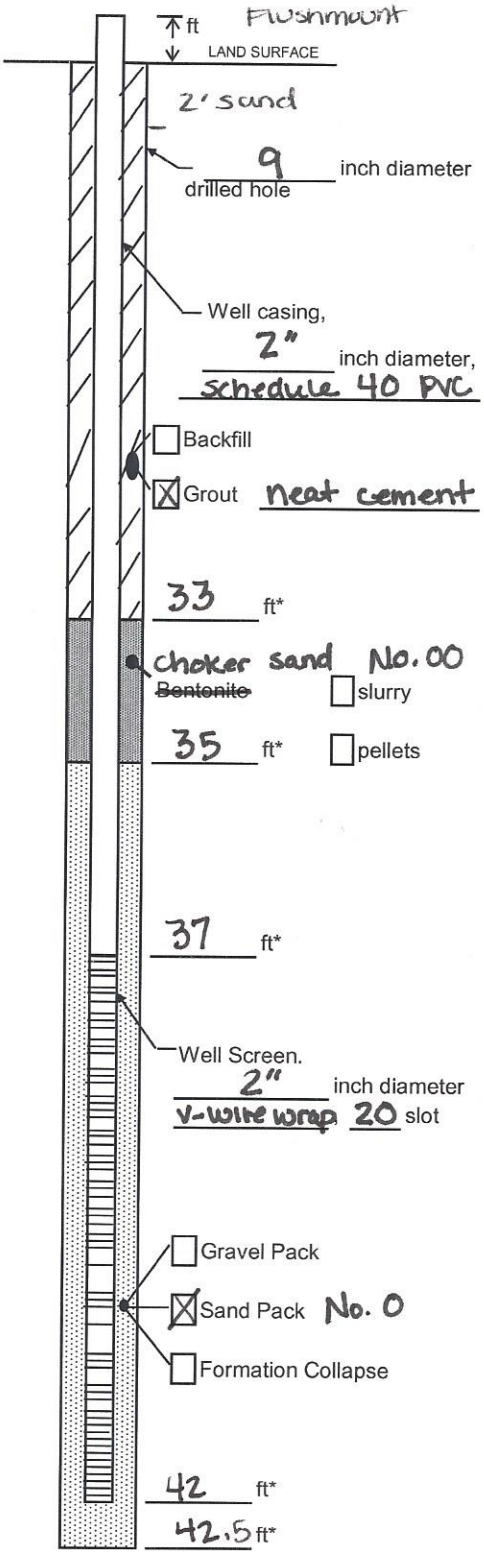
gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
0822	5		20.90		8.22	0.822	5.66	1622	
0827	10		20.85		7.85	0.937	13.84	52.6	
0832	15	↓	20.91	↓	7.74	0.930	13.44	12.4	
0837	20	~1.85	20.90	~42.5	7.66	0.937	12.93	10.9	
More than 10 well volumes removed and turbidity < 50 NTU									
Final PTB: 41.41 ft below M.P.									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IW-07

Town/City Fort Drum.

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 5/11/15

Drilling Method HSA (6.25")

Drilling Contractor Nothnagle.

Drilling Fluid None.

Development Technique(s) and Date(s)

5/13/15

~~Air~~ Venturi (air lifting) and surging.

~~photos~~ (L→R) shows turbidity 25 gal/14 gal/7 gal prior to surging

Fluid Loss During Drilling 500 gallons

Water Removed During Development ~~500~~ same 82 gallons

Static Depth to Water 41.05 feet below M.P.

Static Depth to ~~Bottom~~ 39.95 ft below M.P.

Pumping Depth to Water NA feet below M.P.

Pumping Duration 39 ~~hours~~ minutes

Surged ~7 minutes

~~Yield~~ pumping rate ~2.3 gpm Date 5/13/15

Specific Capacity NA gpm/ft

Well Purpose Injection Well

Remarks Depth to ~~water~~ bottom post development: 42.49' below M.P.

M.P. was cut post development (~0.52' cut off)

DTB 4/14/15: ~~41.54~~ 42.06' below MP (without 0.52' that was removed)

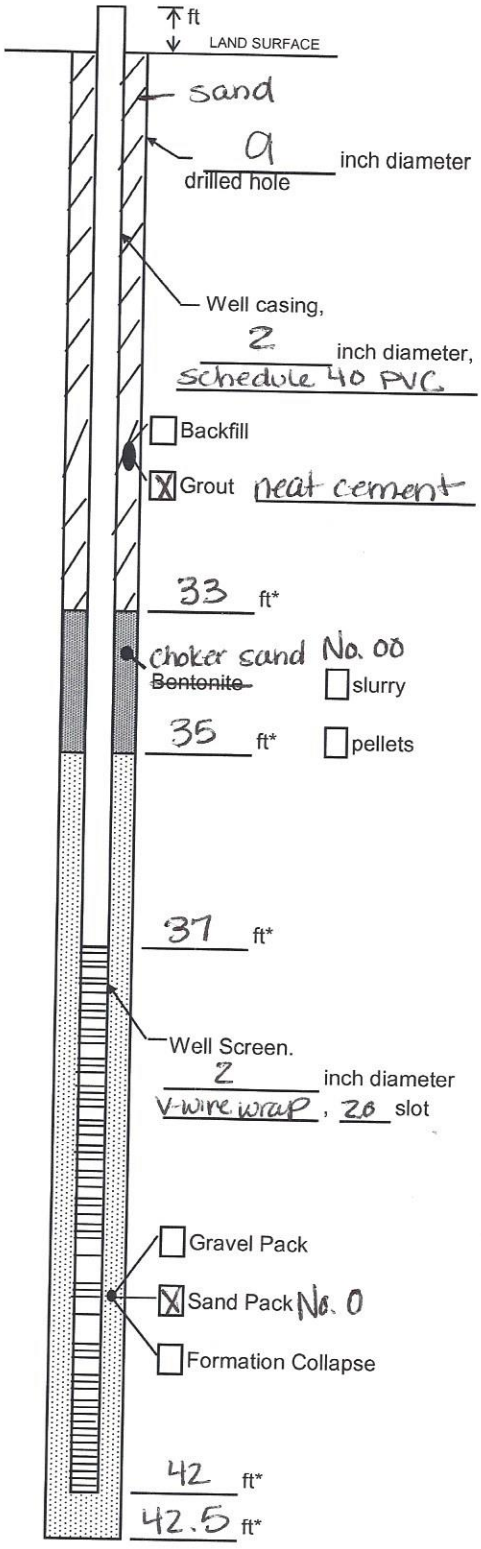
Prepared by Suzie Ellsworth

Drilling Forms.xlsx.xls
Well Constr

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IW-08

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 6/2/15

Drilling Method HSA (6.25")

Drilling Contractor Nothnagle (Steve/Greg)

Drilling Fluid None

Development Technique(s) and Date(s)

Air Lifting 6/8/15

Fluid Loss During Drilling ~40 gallons

Water Removed During Development ~40 gallons

Static Depth to Water 19.73 feet below M.P.

~~Static DTB~~ 39.16 ~~feet~~ below M.P.

Pumping Depth to Water 23.51 feet below M.P.

Pumping Duration 23 ~~hours~~ minutes

~~Yield~~ pumping rate 1.7 gpm Date 6/8/15

Specific Capacity NA gpm/ft

Well Purpose Injection well

Remarks Final DTB: 41.68' below MP

MP was taken before coupling was added.

Prepared by Suzie Ellsworth

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE site Well IW-08 Date 6/8/15

Static Below M.P.

Total Depth 39.12' Casing Diameter (inches) 2 Purge Method

Water Level 19.73' Well Volume (gal) 3.10 Centrifugal ____

Water Column 19.39' Total Volume Purged ~40 gallons Submersible ____

Pump On 1516 Pump Off 1539 Other Airlifting

Developed By Kevin (Nothnagle), S. Ellsworth/M. Kiser (Arcadis)

Well Casing Volumes

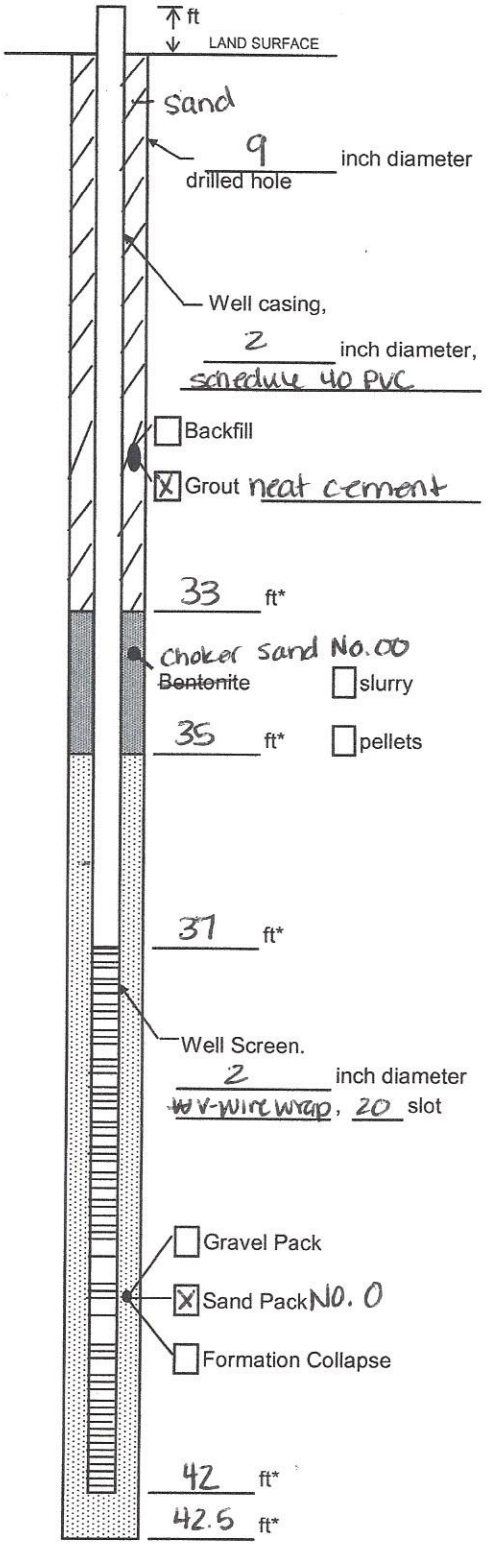
gallon/foot			
1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1521	5	↓	23.51	↓	7.18	0.750	16.26	1191	ORP 194
1526	10	↓	24.12	↓	7.17	0.867	14.47	40.6	195
1529	13	↓	24.21	↓	7.06	0.876	14.44	26.9	203
1533	17	↓	24.01	↓	7.03	0.891	14.23	7.04	206
1536	20	~1.7	24.16	~40	~~6.80~~ 7.00	0.902	14.01	1.03	207
More than 10 well volumes removed and turbidity was < 50 NTUs									
Final DTB: 41.68' below M.P.									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IW-09

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 6/2/15

Drilling Method HSA (6.25")

Drilling Contractor Nothnagle (Steve/Greg)

Drilling Fluid None

Development Technique(s) and Date(s)

Air lifting 6/4/15

Fluid Loss During Drilling ~40 gallons

Water Removed During Development ~50 gallons

Static Depth to Water 19.75 feet below M.P.

Pumping Depth to Water 24.43 feet below M.P.

Pumping Duration 25 ~~hours~~ minutes

~~Yield~~ Pumping rate 2.0 gpm Date 6/4/15

Specific Capacity NA gpm/ft

Well Purpose injection well

Remarks Static total depth (ft. below MP) - 39.90
Final total depth (ft below MP) - 41.10
MP before coupling was added

Prepared by Suzie Ellsworth

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-09 Date 6/4/15

Static Below M.P.

Total Depth 39.90' Casing Diameter (inches) 2 Purge Method: Centrifugal ____

Water Level 19.75' Well Volume (gal) 3.22 Submersible ____

Water Column 20.15' Total Volume Purged ~50 gallons Other Airlifting

Pump On 11:16 Pump Off 1141 Developed By Steve (Nothnagle) S. Ellsworth (Arcadis)

Well Casing Volumes

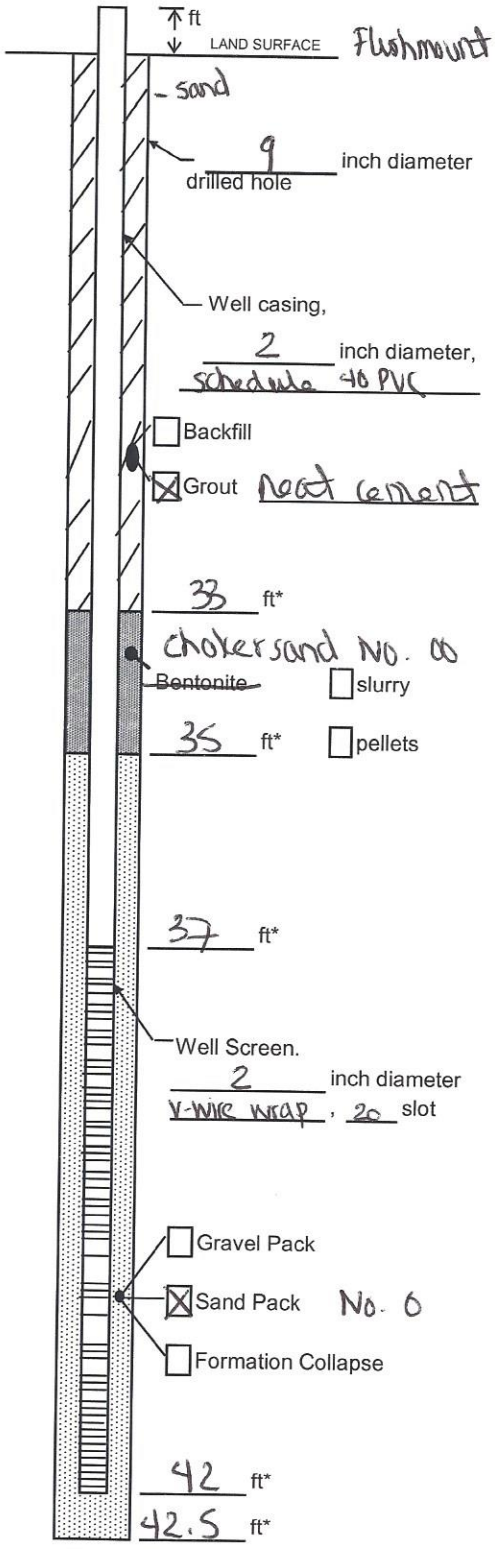
gallon/foot			
1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1120	4	2.0	24.43	↓	7.49	0.898	15.78	2887	ORP 182
1125	9	2.0	24.37		7.58	0.953	15.44	33.7	168
1130	14	2.0	24.37		7.54	0.973	15.10	14.5	171
1135	29	2.0	24.39		7.46	1.01	15.04	12.2	176
1140	34	2.0	24.35	~50	7.45	1.03	15.05	12.8	177
More than 10 well volumes removed and turbidity less than 50 NTU.									
Final DTB: 41.10'		below M.P.							

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IW-10

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

feet ☐ Surveyed ☐ Estimated

Installation Date(s) 06/02/15

Drilling Method HSA (6.25")

Drilling Contractor Dothnagle

Drilling Fluid None

Development Technique(s) and Date(s)

Air Lifting 6/4/15

Fluid Loss During Drilling 30 gallons

Water Removed During Development ~44 gallons

Static Depth to Water 19.70 feet below M.P.

Pumping Depth to Water 20.44 feet below M.P.

Pumping Duration 23 hours minutes

~~Yield~~ Pumping rate ~2.0 gpm Date 6/4/15

Specific Capacity Na gpm/ft

Well Purpose Injection Well

Remarks Static total depth (ft below MP) - 40.82
Final total depth (ft. below MP) - 41.48
MP was before coupling was added.

Prepared by Suzie Ellsworth / Meghan Kiser

ARCADIS

Monitoring Well Development Log

Page 1 of 1

Project/No. 3800 PCE Site Well IW-10 Date 6/4/15

Total Depth 40.82' Casing Diameter (inches) 2 Purge Method: Centrifugal ____

Water Level 19.70' (static below M.P.) Well Volume (gal) 3.38 Submersible ____

Water Column 21.12' Total Volume Purged ~44 gallons Other Air Lifting

Pump On 0931 Pump Off 0954 Developed By Steve (Nathnagle) S. Ellsworth (Arcadis)

Well Casing Volumes

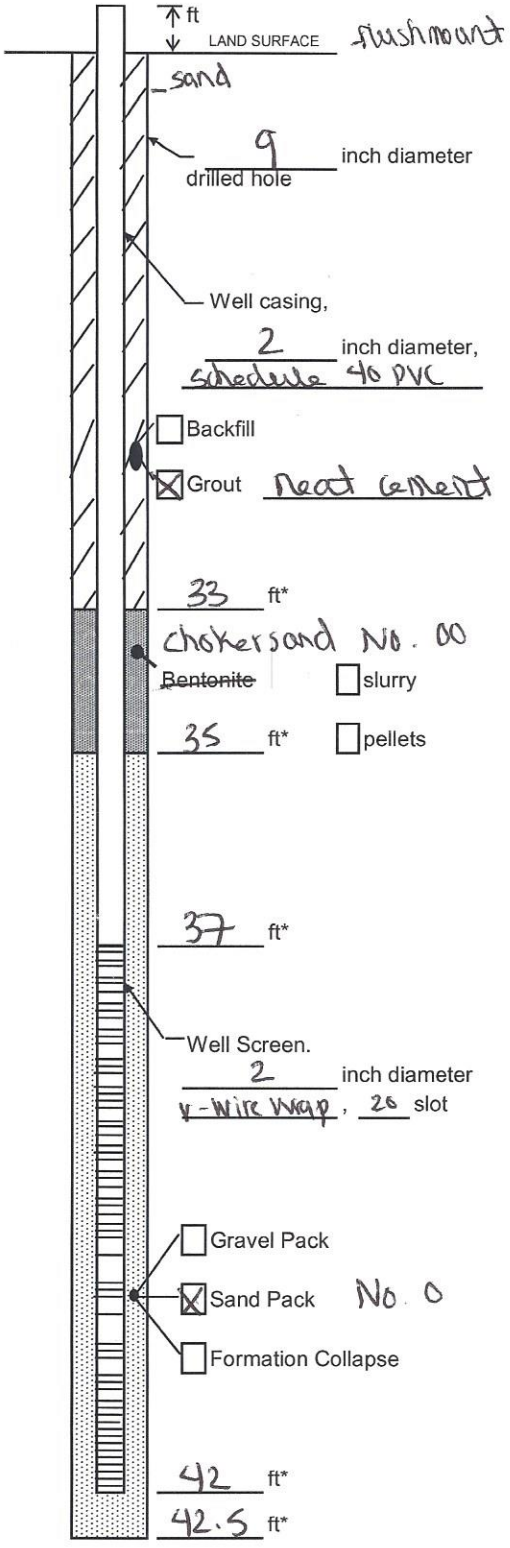
gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~gallon (mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
0932	1	2.0	20.44	↓	7.44	0.795	15.68	>1000	ORP 120
0937	6	2.0	21.65		7.34	0.992	14.75	1184	143
0942	11	2.0	21.68		7.42	1.02	14.26	123	138
0947	16	2.0	21.67		7.24	1.02	14.28	42.2	147
0952	21	2.0	21.65	~44	7.32	1.02	13.97	38.4	158
— More than 10 well volumes removed and turbidity below 50 NTUs —									
~~Final WL~~									
Final DTB:		41.48'	below	M.P.					

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project: 3800 PCE Site Well: IW-11
Town/City: Fort Drum
County: Jefferson State: NY
Permit No.:

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s): 06/02/15
Drilling Method: HSA (6.25")
Drilling Contractor: Nothnagle
Drilling Fluid: None

Development Technique(s) and Date(s)

Airlifting 6/4/15

Fluid Loss During Drilling: 30 gallons
Water Removed During Development: 44 gallons
Static Depth to Water ~~Final Brute~~: 19.54 feet below M.P.
Pumping Depth to Water: 21.45 feet below M.P.
Pumping Duration: 22 ~~hours~~ minutes
~~Yield~~ pumping rate: ~2.0 gpm Date: 6/4/15
Specific Capacity: NA gpm/ft
Well Purpose: Injection Well

Remarks: Static total depth (ft. below M.P) - 40.56
Final total depth (ft. below M.P) - 41.47

MP. was before coupling was added

Prepared by: Meghan River / Suzie Ellsworth

ARCADIS

Monitoring Well Development Log

Page 1 of 1

Project/No. 3800 PCE Site Well IW-11 Date 6/4/15

Static below M.P.

Total Depth 40.56' Casing Diameter (inches) 2

Water Level 19.54' Well Volume (gal) 21.3.36

Water Column 21.02' Total Volume Purged ~44 gallons

Pump On 0900 Pump Off 0922

Purge Method: Centrifugal ____ Submersible ____ Other Air Lifting

Developed By Steve (Nothnagle) S. Ellsworth (Arcadis)

Well Casing Volumes

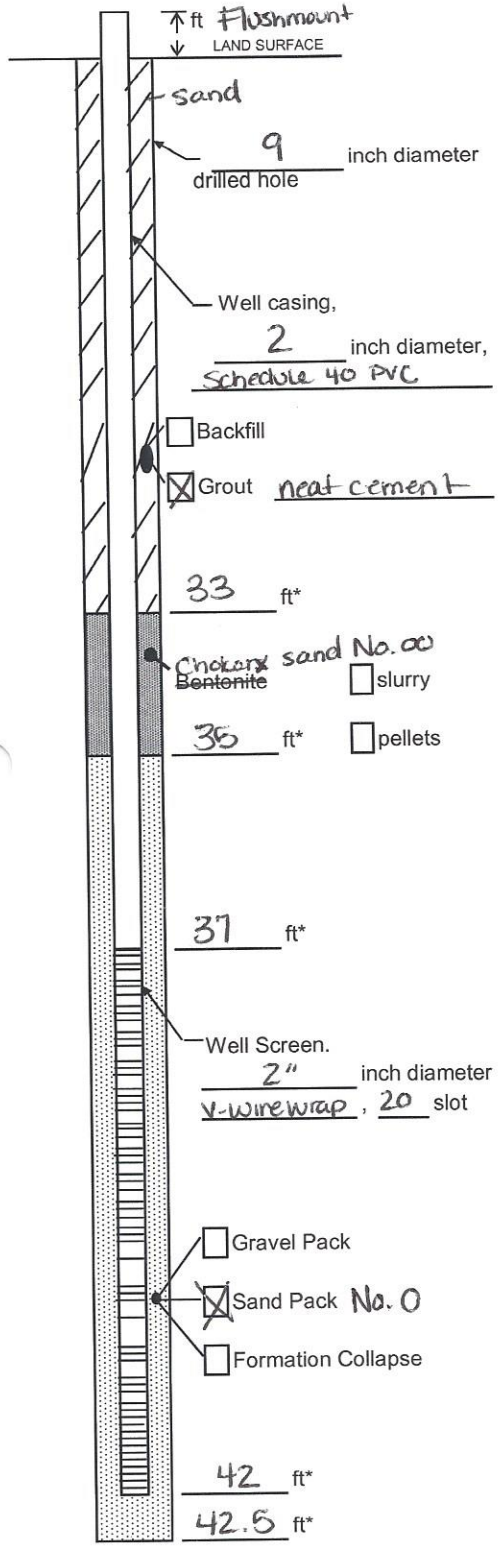
gallon/foot			
1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL~~ gal/min)	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
0903	3	2.0	21.45	↓	8.29	0.716	18.00	71000	ORP 86
0909	9	2.0	21.50		7.79	0.727	15.40	43	93
0915	15	2.0	21.47		7.65	0.723	14.75	37.2	108
0920	20	2.0	21.43	~44	7.69	0.726	14.27	20.6	110
———	Turbidity below 50 NTUs and more than 10 well volumes removed ———								
Final DTB: 41.47' below M.P.									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IW-12

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 6/1/15

Drilling Method HSA (6.25")

Drilling Contractor Nothnagle (Steve and Greg)

Drilling Fluid None

Development Technique(s) and Date(s)

Air lifting 6/8/15

Fluid Loss During Drilling 40 gallons

Water Removed During Development 44 gallons

Static Depth to Water 19.44 feet below M.P.

~~Static DTB~~ 38.45 feet below M.P.

Pumping Depth to Water 21.65 feet below M.P.

Pumping Duration 27 ~~hours~~ minutes

~~Yield~~ pumping rate ~1.6 gpm Date 6/8/15

Specific Capacity NA gpm/ft

Well Purpose Injection Well

Remarks Final DTB (ft. below MP): 41.23

MP was before coupling was added.

Prepared by Suzie Ellsworth

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-12 Date 6/8/15

Static Below M.P.
- Total Depth 38.45'
- Water Level 19.44'

Casing Diameter (inches) 2

Well Volume (gal) 3.04

Water Column 19.01'

Total Volume Purged 44 gallons

Pump On 1553 Pump Off 1620

Purge Method
- Centrifugal ____
- Submersible ____
- Other Airlifting

Developed By Kevin (Nothnagle) M. Kiser / S. Ellsworth (Arcadis)

Well Casing Volumes

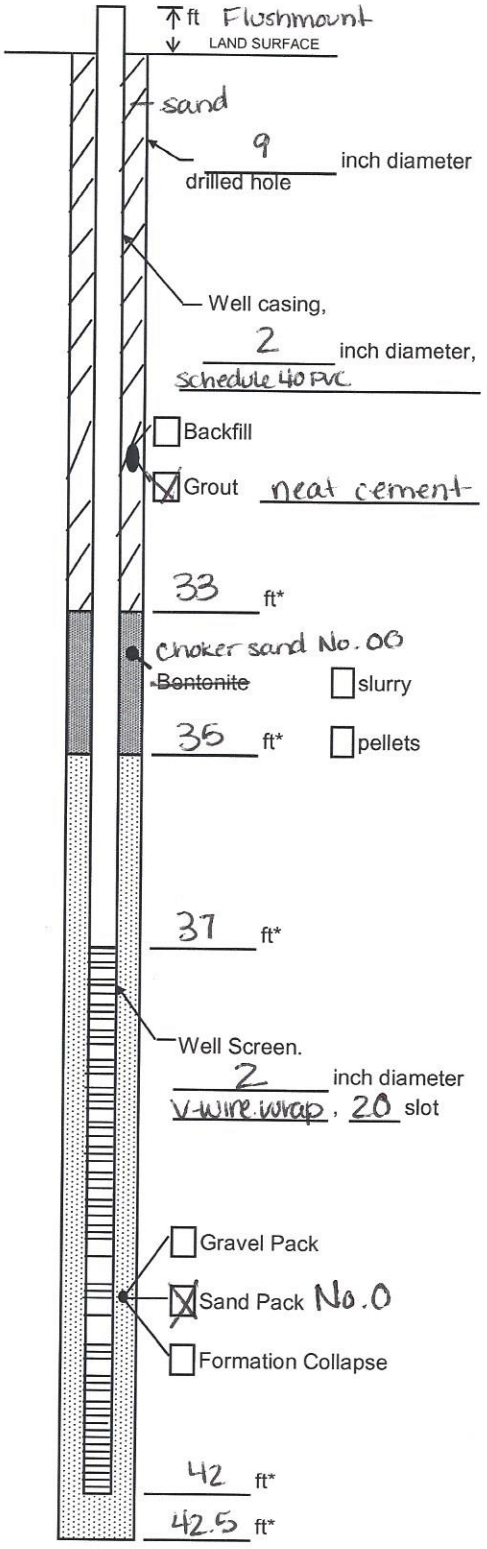
gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1558	5	↓	21.65	↓	6.83	0.914	18.13	1058	ORP: 160
1601	8	↓	21.98	↓	7.12	1.05	14.79	23.8	149
1611	18	↓	21.98	↓	6.98	1.06	15.76	7.16	204
1619	26	~1.6	22.04	44	6.92	1.10	14.75	4.15	212
More than 10 well volumes removed and turbidity less than 50 NTUs									
Final DTB: 41.23' below M.P.									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IW-13

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 6/1/15

Drilling Method HSA (6.25")

Drilling Contractor Nothnagle (Steve and Greg)

Drilling Fluid None

Development Technique(s) and Date(s)

Air lifting 6/8/15

Fluid Loss During Drilling 40 gallons

Water Removed During Development 42 gallons

Static Depth to Water 19.31 feet below M.P.
~~Static DTB~~ 38.32 ~~feet below M.P~~

Pumping Depth to Water 24.63 feet below M.P.

Pumping Duration 29 ~~hours~~ minutes

~~Yield~~ pumping rate 1.45 gpm Date 6/8/15

Specific Capacity NA gpm/ft

Well Purpose Injection well

Remarks Final DTB (feet below MP): 41.27

MP (was used before coupling/fitting was added)

Prepared by Suzie Ellsworth

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-13 Date 6/8/15

Static Below M.P.
- Total Depth 38.32'
- Water Level 19.31'
- Water Column 19.01'

Casing Diameter (inches) 2
Well Volume (gal) 3.04
Total Volume Purged 42 gallons
Pump On 16:38 Pump Off 1707

Purge Method
- Centrifugal
- Submersible
- Other Air lifting

Developed By Kevin (Nothnagle) M.Kiser/S.Ellsworth (Arcadis)

Well Casing Volumes

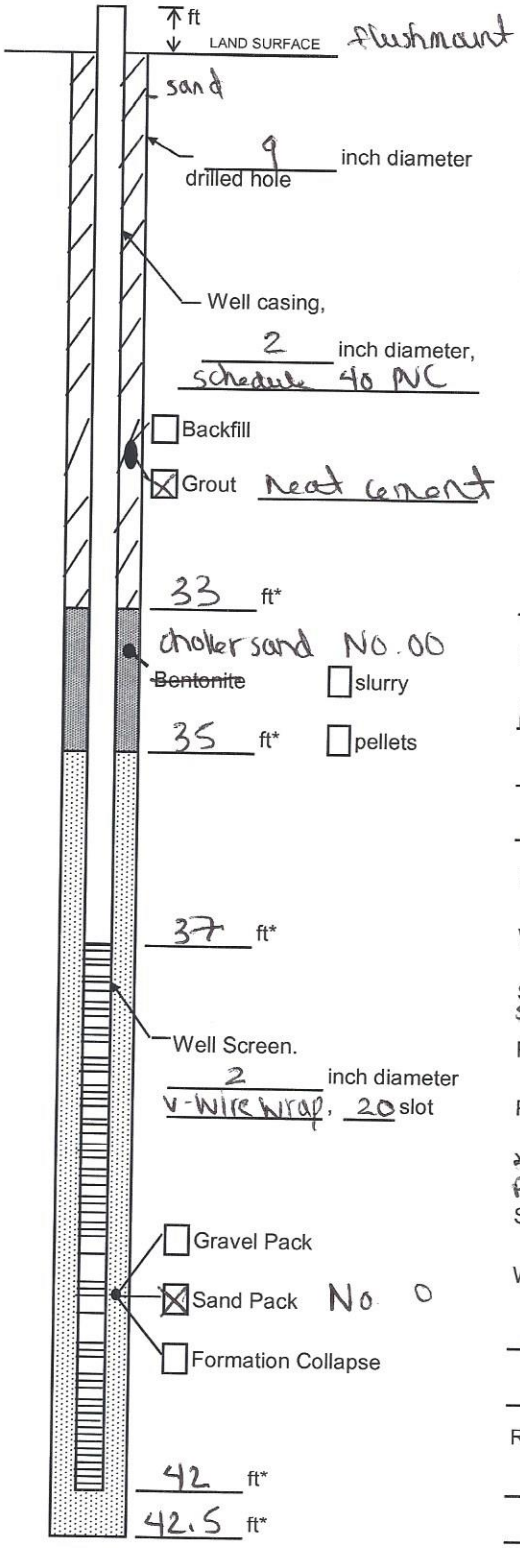
gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1646	8	↓	24.63	↓	7.15	1.20	15.33	84	ORP 212
1650	12	↓	22.64	↓	6.99	1.26	14.56	57.4	229
1654	16	↓	22.64	↓	6.94	1.27	14.15	37.9	226
1658	20	1.45	22.64	42	6.93	1.26	13.81	28.9	229
More than 10 well volumes removed and turbidity less than 50 NTUs									
Final DTB: 41.27' below M.P.									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project: 3800 PCE Site — Well: IW-14

Town/City: Fort Drum

County: Jefferson — State: NY

Permit No.:

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s): 06/01/15

Drilling Method: HSA (6.25")

Drilling Contractor: Nothnagle

Drilling Fluid: None

Development Technique(s) and Date(s)

Air lifting 6/9/15

Fluid Loss During Drilling: 30 gallons

Water Removed During Development: 40.8 gallons

Static Depth to Water: 19.17 feet below M.P.
~~Static DTB~~ 41.35 ~~feet below M.P~~

Pumping Depth to Water: 20.38 feet below M.P.

Pumping Duration: 23 ~~hours~~ minutes

~~Yield~~ Pumping rate: 1.7 gpm Date: 6/9/15

Specific Capacity: NA gpm/ft

Well Purpose: Injection Well

Remarks: Final DTB (feet below MP): 41.48

MP was before coupling was added.

Prepared by: Meghan River

ARCADIS

Monitoring Well Development Log

Page 1 of 1

Project/No. 3800 PCE Site Well IW-14 Date 6/9/15

Static Below M.P.

Total Depth 41.35' Casing Diameter (inches) 2 Purge Method

Water Level 19.17' Well Volume (gal) 3.55 Centrifugal ____

Water Column 22.18' Total Volume Purged ~40.8 gallons Submersible ____

Pump On 0853 Pump Off 0916 Other x Airlifting

Developed By Kevin (Nothnagle) S. Ellsworth / M. Kiser (Arcadis)

Well Casing Volumes

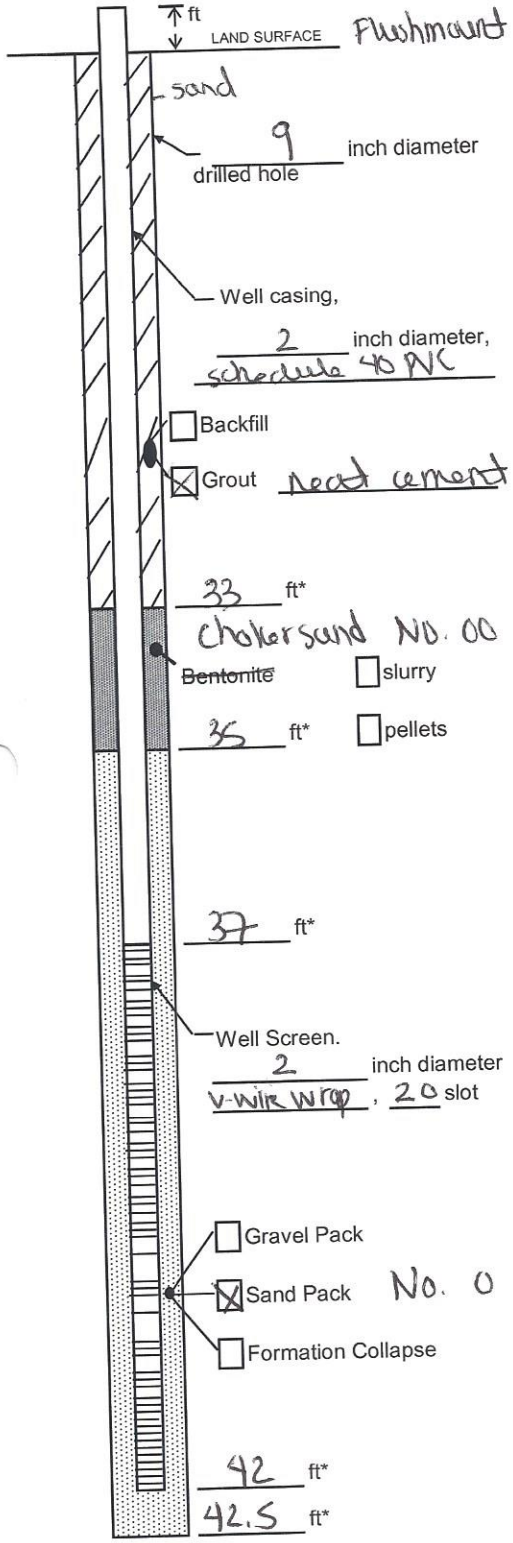
gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
0857	4	↓	20.38	↓	7.47	1.15	16.79	673	ORP 36
0908	15	↓	23.01	↓	7.55	1.15	15.05	33.6	70
0912	19	~1.7	22.91	~40.8	7.36	1.15	14.43	15.42	85
More than 10 well volumes purged and turbidity <50 NTUs									
Final DTB: 41.48' below M.P.									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project: 3800 PCE Site Well: IW-15

Town/City: Fort Drum

County: Jefferson State: NY

Permit No.:

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s): 06/01/15

Drilling Method: HSA (6.25")

Drilling Contractor: Nothnagle

Drilling Fluid: None

Development Technique(s) and Date(s)

Air Lifting 6/9/15

Fluid Loss During Drilling: 30 gallons

Water Removed During Development: 40.8 gallons

Static Depth to Water: 19.15 feet below M.P.
~~Static DTB~~ 39.94 feet below MP

Pumping Depth to Water: 21.15 feet below M.P.

Pumping Duration: 23 ~~hours~~ minutes

~~Yield~~ pumping rate: 1.7 gpm Date: 6/9/15

Specific Capacity: NA gpm/ft

Well Purpose: Injection Well

Remarks: Final DTB (feet below MP): 41.24

MP was before coupling was added

Prepared by: Meghan Kiser

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-15 Date 6/9/15

Purge Method: Centrifugal ____ Submersible ____ Other Air lifting

Developed By Nothnagle S. Ellsworth/M. Kiser (Arcadis)

Static Below M.P.

Total Depth 39.94' Casing Diameter (inches) 2

Water Level 19.15' Well Volume (gal) 3.33

Water Column 20.79' Total Volume Purged ~40.8 gallons

Pump On 0853 Pump Off 0916

Well Casing Volumes

gallon/foot			
1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
0904	11	↓	21.15	↓	7.34	0.860	16.56	108	ORP 140
0911	18	↓	21.76	↓	7.36	0.851	15.01	38.9	132
0915	22	~1.7	21.88	~40.8	7.31	0.858	14.60	24.9	144
More than 10 well volumes purged and turbidity <50 NTUs									
Final DTB: 41.24' below M.P.									

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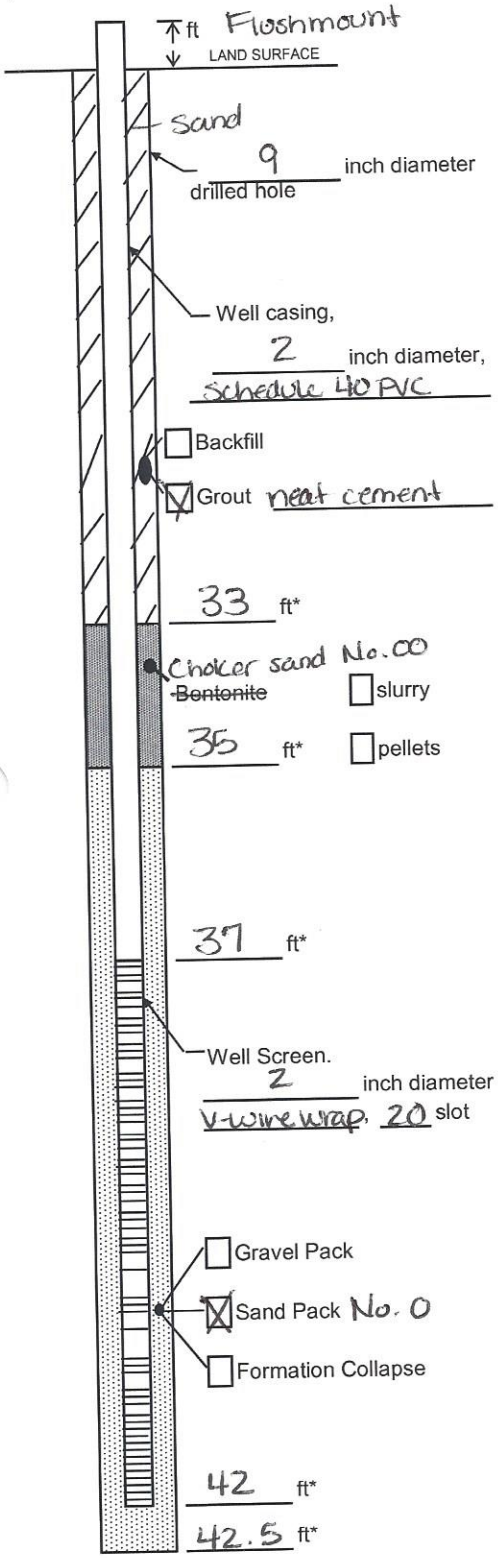
Well Construction Log

(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IW-16

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 5/29/15

Drilling Method HSA (6.25")

Drilling Contractor Nothnagle (Steve and Greg)

Drilling Fluid None

Development Technique(s) and Date(s)

Air lifting 6/9/15

Fluid Loss During Drilling 40 gallons

Water Removed During Development 39 gallons

Static Depth to Water 19.00 feet below M.P.
~~Static DTB~~ 39.49 ~~feet below MP~~

Pumping Depth to Water 20.95 feet below M.P.

Pumping Duration 17 ~~hours~~ minutes

~~Yield~~ pumping rate 2.3 gpm Date 6/9/15

Specific Capacity NA gpm/ft

Well Purpose Injection Well

Remarks Final DTB (feet below MP) 41.73

MP was determined before coupling/fitting was added

Prepared by Suzie Ellsworth

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-16 Date 6/9/15

Purge Method: Centrifugal ____ Submersible ____ Other Airlifting

Developed By Kevin/Mark (Nothnagle) S. Ellsworth / M. Kiser (Arcadis)

Static Below M.P.
- Total Depth 39.49'
- Water Level 19.00'
- Water Column 20.49'
- Pump On 1023

Casing Diameter (inches) 2
Well Volume (gal) 3.28
Total Volume Purged ~39 gallons
Pump Off 1040

Well Casing Volumes

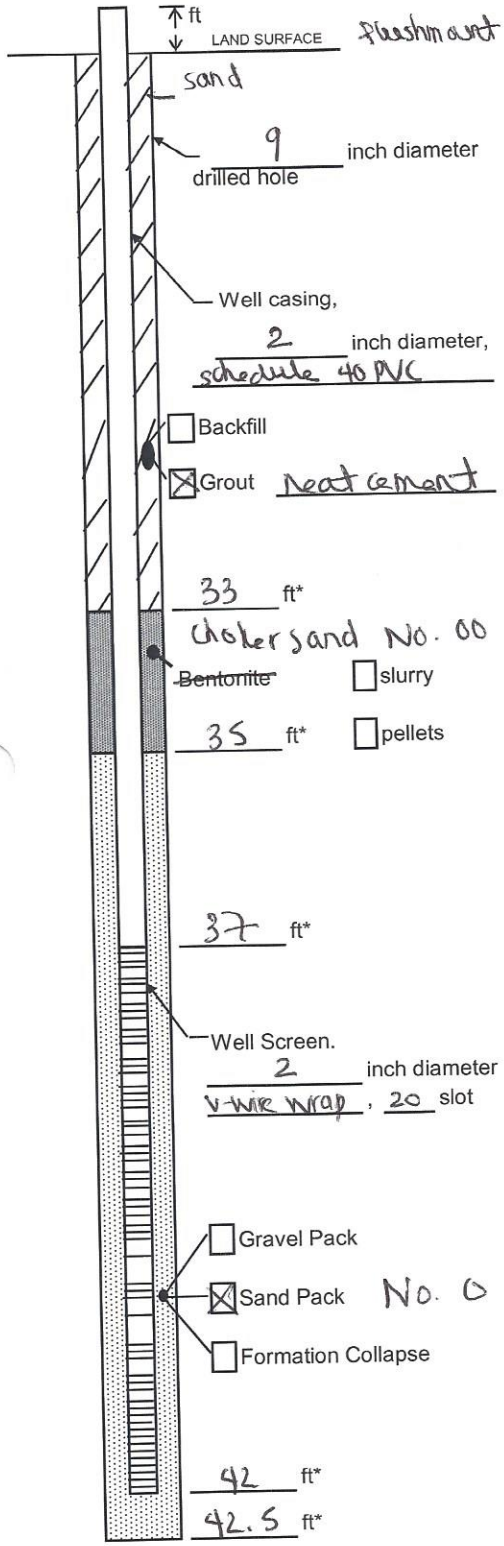
gallon/foot			
1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) (mL/min)	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1024	1	↓	20.95	↓	7.56	1.16	15.61	628	ORP 113
1030	7	↓	21.02	↓	7.37	1.18	14.48	28.2	123
1035	12	2.3	21.02	~39	7.29	1.19	15.21	6.65	129
More than 10 well volumes removed and turbidity <50 NTUs									
Final DTB: 41.73' below M.P.									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IW-17

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 05/29/15

Drilling Method HSA (6.25")

Drilling Contractor Nothnagle

Drilling Fluid None

Development Technique(s) and Date(s)

Air lifting 6/9/15

Fluid Loss During Drilling 30 gallons

Water Removed During Development 37.4 gallons

Static Depth to Water 18.82 feet below M.P.
~~Static DTB~~ 41.03 ~~feet below M.P.~~

Pumping Depth to Water 20.83 feet below M.P.

Pumping Duration 19 ~~hours~~ minutes

~~Yield~~ pumping rate ~~41.20~~ 1.97 gpm Date 6/9/15

Specific Capacity NA gpm/ft

Well Purpose Injection Well

Remarks Final DTB (feet below MP) 41.20

MP was ~~taken~~ determined before coupling/fitting was added

Prepared by Meghan Kiser

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-17 Date 6/9/15

Static Below M.P.
- Total Depth 41.03'
- Water Level 18.82'
- Water Column 22.21'

Casing Diameter (inches) 2
Well Volume (gal) 3.55
Total Volume Purged 37.4 gallons
Pump On 0931 Pump Off 0950

Purge Method
- Centrifugal
- Submersible
- Other Air lifting

Developed By Nothnagle (Kevin/Mark) S. Ellsworth / M. Kiser (Arcadis)

Well Casing Volumes

gallon/foot							
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
0936	5		20.83		7.34	0.892	15.16	18.2	ORP 99 (clear)
0945	14	↓	20.89	↓	7.32	0.901	14.45	6.13	99
0949	18	1.97	20.81	37.4	7.25	0.923	13.84	2.71	106
More than 10 well volumes removed and turbidity < 50 NTUs									
Final DTB: 41.20' below M.P.									

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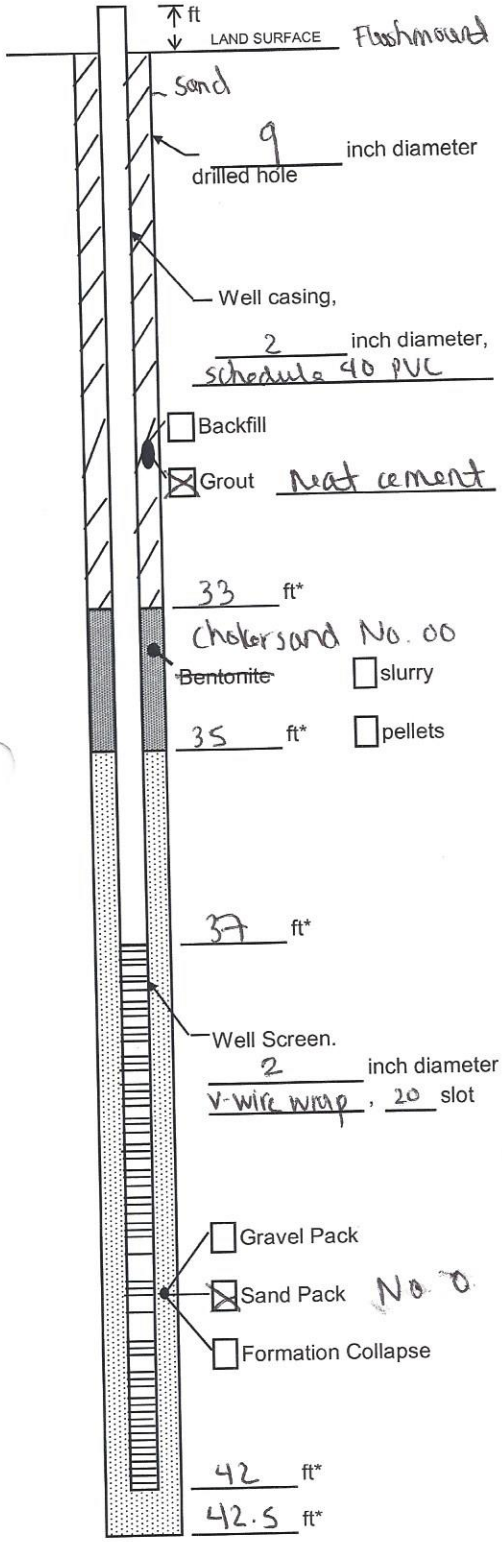
Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project: 3808 PCE Site Well: IW-18

Town/City: Fort Drum

County: Jefferson State: NY

Permit No.:

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s): 05/27/15 and 05/28/15

Drilling Method: HSA (6.25")

Drilling Contractor: Nothnagle

Drilling Fluid: None

Development Technique(s) and Date(s)

Air lifting 6/9/15

Fluid Loss During Drilling: 30 gallons

Water Removed During Development: 42.5 gallons

Static Depth to Water: 18.72 feet below M.P.
Static DTB: 40.54 feet below M.P.

Pumping Depth to Water: 20.91 feet below M.P.

Pumping Duration: 19 ~~hours~~ minutes

~~Yield~~ pumping rate: 2.2 gpm Date: 6/9/15

Specific Capacity: NA gpm/ft

Well Purpose: Injection Well

Remarks: Final DTB (feet below M.P.) 41.74

MP was taken before coupling/fitting was added.

Prepared by: Meghan Kiser

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-18 Date 6/9/15

Static Below M.P.

Total Depth 40.54' Casing Diameter (inches) 2

Water Level 18.72' Well Volume (gal) 3.49

Water Column 21.82' Total Volume Purged 42.5 gallons

Pump On 0931 Pump Off 0950

Purge Method: Centrifugal ____ Submersible ____ Other Airlifting

Developed By Kevin/Mark (Nothnagle) S. Ellsworth/M. Kiser (Arcadis)

Well Casing Volumes

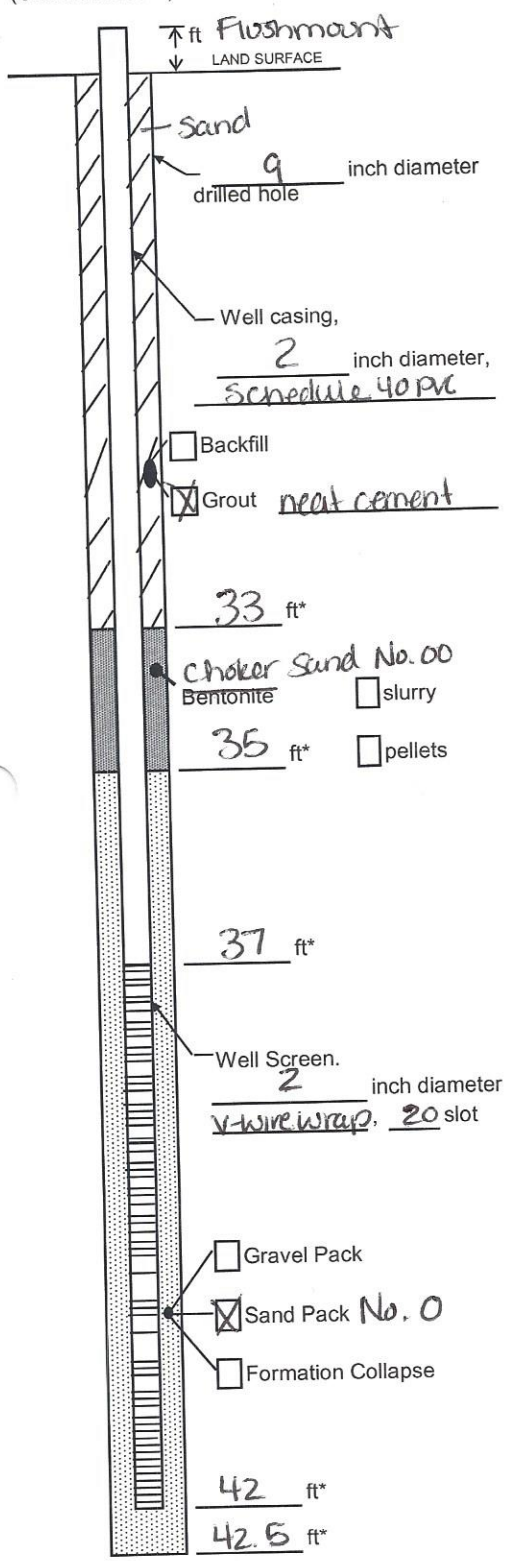
gallon/foot: 1-¼" = 0.06; 1-½" = 0.09; 2" = 0.16; 2-½" = 0.26; 3" = 0.37; 3-½" = 0.50; 4" = 0.65; 6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
0934	3	↓	20.91	↓	7.30	0.875	15.38	1,194	ORP 162
0939	8		21.04		7.17	0.907	14.22	38.1	172
0943	12		21.02		7.07	0.922	13.72	11.7	163
0948	17	2.2	20.82	42.5	7.07	0.926	13.64	5.83	170
More than 10 well volumes removed and turbidity <50 NTUs									
Final DTB: 41.74' below M.P.									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site. Well IW-19

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 5/28/15

Drilling Method HSA (6.25")

Drilling Contractor Nothnagle (Steve and Greg)

Drilling Fluid None

Development Technique(s) and Date(s)

Air lifting 6/9/15

Fluid Loss During Drilling 40 gallons

Water Removed During Development 45 gallons

Static Depth to Water 18.58 feet below M.P.
~~Static DTB~~ 37.21 ~~feet below MP~~

Pumping Depth to Water 19.53 feet below M.P.

Pumping Duration 22 ~~hours~~ minutes

~~Yield~~ pumping rate 2.05 gpm Date 6/9/15

Specific Capacity NA gpm/ft

Well Purpose Injection well

~~FF~~

Remarks Final DTB (feet below MP): 41.78

MP was determined before coupling/fitting was added

Prepared by Suzie Ellsworth

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-19 Date 6/9/15

Static Below MP

Total Depth 37.21' Casing Diameter (inches) 2

Water Level 18.58' Well Volume (gal) 2.98

Water Column 18.63' Total Volume Purged 45 gallons

Pump On 1016 Pump Off 1038

Purge Method: Centrifugal ____ Submersible ____ Other Air lifting

Developed By Kevin/Mark (Nothnagle) S. Ellsworth / M. Kiser (Arcadis)

Well Casing Volumes

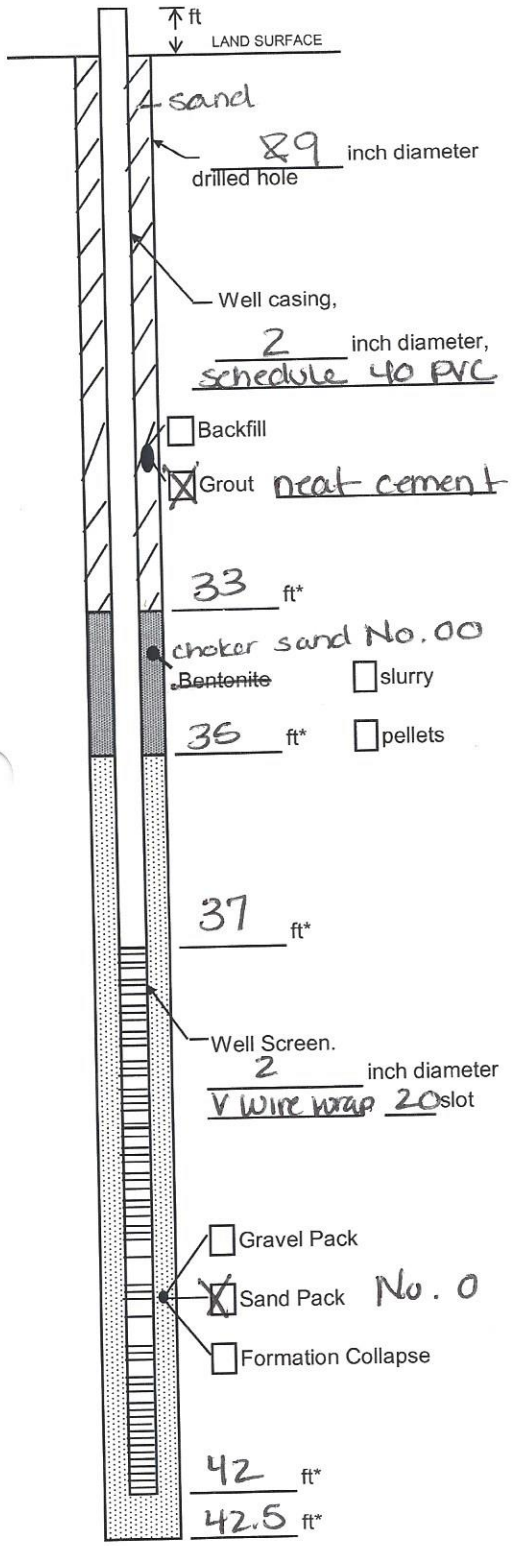
gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1023	7	↓	19.53	↓	7.02	1.26	17.05	622	ORP 163
1027	11	↓	20.43	↓	7.07	1.33	14.40	21.0	174
1033	17	2.05	20.87	45	7.02	1.34	13.92	10.96	183
More than 10 well volumes removed and turbidity <50 NTUs									
Final DTB: 41.78' below M.P.									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IW-20

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 5/28/15

Drilling Method HSA (6.25")

Drilling Contractor Nothnagle (Steve/Greg)

Drilling Fluid None

Development Technique(s) and Date(s)

Airlifting 6/9/15

Fluid Loss During Drilling 40 gallons

Water Removed During Development 46 gallons

Static Depth to Water 18.38 feet below M.P.

Static DTB 37.68 feet below M.P.

Pumping Depth to Water 20.58 feet below M.P.

Pumping Duration 20 ~~hours~~ minutes

~~Yield~~ pumping rate 2.3 gpm Date 6/9/15

Specific Capacity NA gpm/ft

Well Purpose Injection Well

Remarks Final DTB (feet below M.P): 41.17

MP was determined prior to adding coupling/fitting.

Prepared by Suzie Ellsworth

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-20 Date 6/9/15

Static Below M.P.
Total Depth 37.68'
Water Level 18.38'
Water Column 19.3'

Casing Diameter (inches) 2
Well Volume (gal) 3.09
Total Volume Purged ~46 gallons

Pump On 1052 Pump Off 1112

Purge Method
Centrifugal ____
Submersible ____
Other Air lifting

Developed By Kevin/Mark (Nothnagle) S. Ellsworth/M. Kiser (Arcadis)

Well Casing Volumes

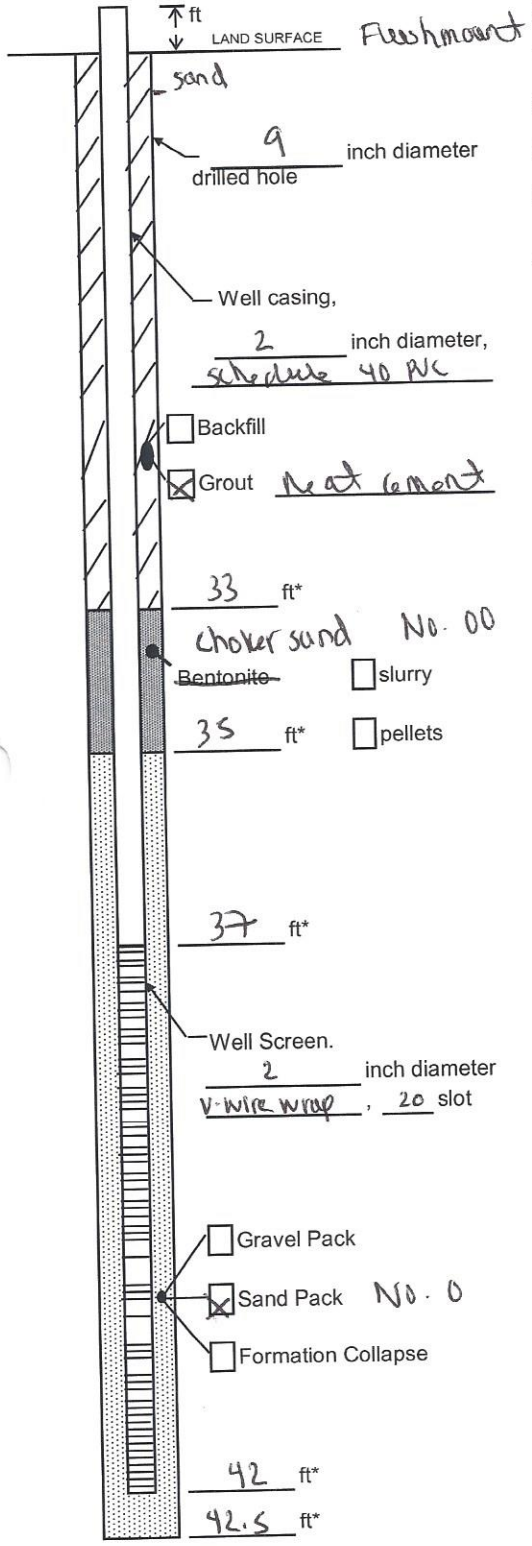
gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) (mL/min)	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) (F)	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1055	3		20.58		7.38	0.972	15.06	1,552	ORP 101 (turbid)
1101	9	↓	20.95	↓	7.34	0.978	14.44	40.2	103
1110	18	2.3	20.90	46	7.34	0.990	14.58	9.80	95
More than 10 well volumes removed and turbidity < 50 NTUs									
Final DTB: 41.17' below M.P.									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project: 3800 PCE Site Well: IW-21

Town/City: Fort Drum

County: Jefferson State: NY

Permit No.:

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s): 05/28/15

Drilling Method: HSA (6.25")

Drilling Contractor: Nothnagle

Drilling Fluid: None

Development Technique(s) and Date(s)

Air lifting 6/9/15

Fluid Loss During Drilling: 30 gallons

Water Removed During Development: 41 gallons

Static Depth to Water: 18.35 feet below M.P.

Static DTB: 41.21 feet below M.P.

Pumping Depth to Water: 20.02 feet below M.P.

Pumping Duration: 20 ~~hours~~ minutes

~~Yield~~ pumping rate: 2 gpm Date: 6/9/15

Specific Capacity: NA gpm/ft

Well Purpose: Injection Well

Remarks: Final DTB (feet below M.P): 41.23

MP was determined prior to adding coupling/fitting.

Prepared by: Meghan Kiser

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well MW-21 Date 6/9/15

Purge Method: Centrifugal ____ Submersible ____ Other Airlifting

Developed By Kevin/Mark (Nothnagle) S. Ellsworth/M. Kiser (Arcadis)

Static Below M.P.:
- Total Depth 41.21'
- Water Level 18.35'
- Water Column 22.86'
- Pump On 1054

Casing Diameter (inches) 2
Well Volume (gal) 3.66
Total Volume Purged ~41 gallons
Pump Off 1014

Well Casing Volumes

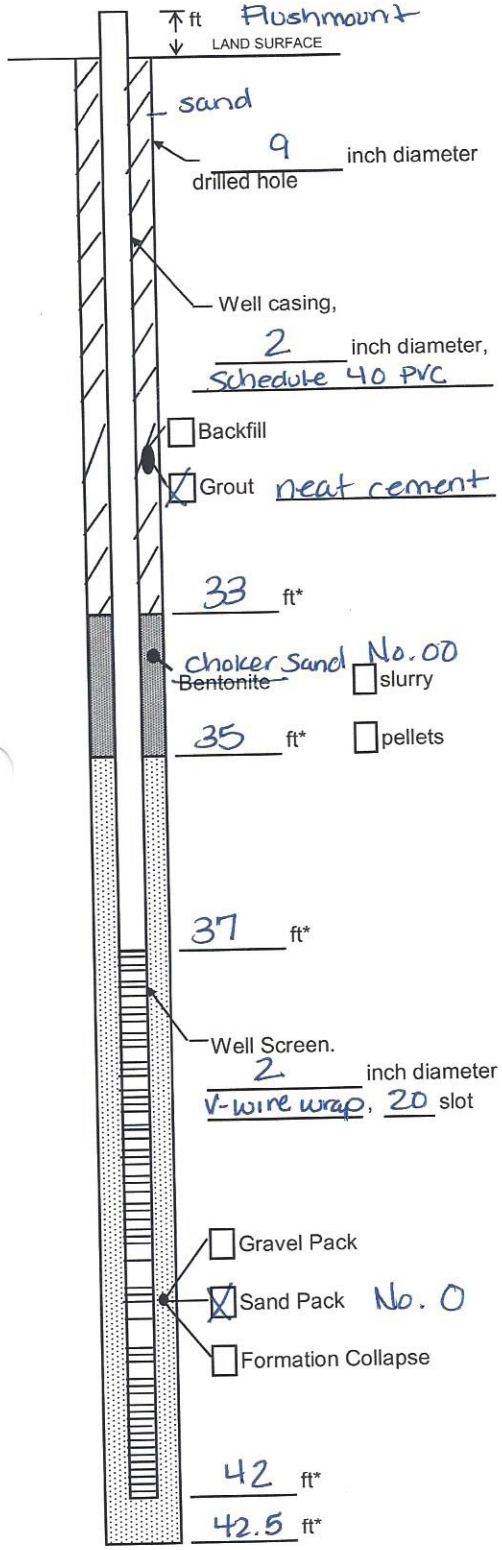
gallon/foot			
1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) (mL/min)	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) (F)	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1057	3	↓	20.02	↓	7.20	0.991	14.63	6.97	ORP 164 (clear)
1104	10	↓	20.18	↓	7.01	0.975	14.52	0.70	175
1113	19	~2	20.02	41	7.04	0.982	14.49	1.42	158
More than 10 well volumes removed and turbidity <50 NTUs									
Final DTB: 41.23' below M.P.									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site. Well IW-22

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

feet ☐ Surveyed ☐ Estimated

Installation Date(s) 5/27/15

Drilling Method HSA (6.25")

Drilling Contractor Nothnagle (Steve/Greg)

Drilling Fluid None

Development Technique(s) and Date(s)

Air lifting 6/9/15

Fluid Loss During Drilling 40 gallons

Water Removed During Development 40 gallons

Static Depth to Water 18.01 feet below M.P.
~~Static DTB~~ 39.56 ~~feet below M.P.~~

Pumping Depth to Water 20.02 feet below M.P.

Pumping Duration 20 ~~hours~~ minutes

~~Yield~~ pumping rate 2 gpm Date 6/9/15

Specific Capacity NA gpm/ft

Well Purpose Injection well

Remarks Final DTB (feet below M.P) 41.00

MP was determined prior to adding coupling/fitting.

Prepared by Suzie Ellsworth

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-22 Date 6/9/15

Static Below MP

Total Depth 39.56' Casing Diameter (inches) 2 Purge Method: Centrifugal ____

Water Level 18.01' Well Volume (gal) 3.45 Submersible ____

Water Column 21.55' Total Volume Purged 40 gallons Other Air lifting

Pump On 1210 Pump Off 1230 Developed By Kevin/Mark (Nothnagle) S. Ellsworth/M. Kiser (Arcadis)

Well Casing Volumes

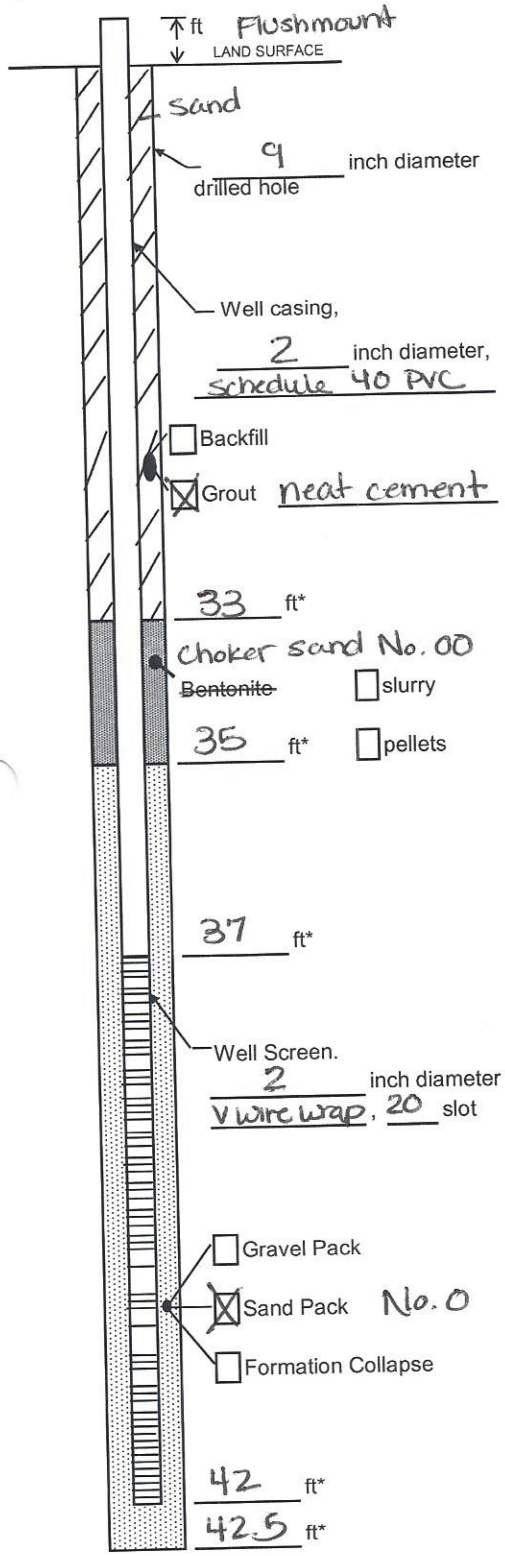
gallon/foot			
1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1218	8	↓	20.02	↓	7.46	1.21	15.03	77.5	ORP 122
1223	13	↓	20.02	↓	7.34	1.20	14.25	33.2	130
1230	20	2	20.21	40	7.34	1.19	13.69	32.8	131
More than 10 well volumes removed and turbidity <50 NTUs									
Final DTB: 41.00' below M.P.									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE site Well IW-23

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 5/28/15

Drilling Method HSA (6.25")

Drilling Contractor Nothnagle (Steve/Greg)

Drilling Fluid None

Development Technique(s) and Date(s)

Air lifting 6/9/15

Fluid Loss During Drilling 40 gallons

Water Removed During Development 41 gallons

Static Depth to Water 18.02 feet below M.P.

Static DTB 41.02 feet below M.P.

Pumping Depth to Water 18.95 feet below M.P.

Pumping Duration 18 ~~hours~~ minutes

~~Yield~~ Pumping rate 2.3 gpm Date 6/9/15

Specific Capacity N/A gpm/ft

Well Purpose Injection Well

Remarks Final DTB (feet below M.P.) 41.02

M.P. was determined prior to adding coupling/fittings

Prepared by Suzie Ellsworth

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-23 Date 6/9/15

Static Below M.P.

Total Depth 41.02' Casing Diameter (inches) 2

Water Level 18.02' Well Volume (gal) 3.68

Water Column 23.0' Total Volume Purged 41 gallons

Pump On 1210 Pump Off 1228

Purge Method: Centrifugal ____ Submersible ____ Other Air lifting

Developed By Kevin/Mark (Nothnagle) S. Ellsworth/M. Kiser (Arcadis)

Well Casing Volumes

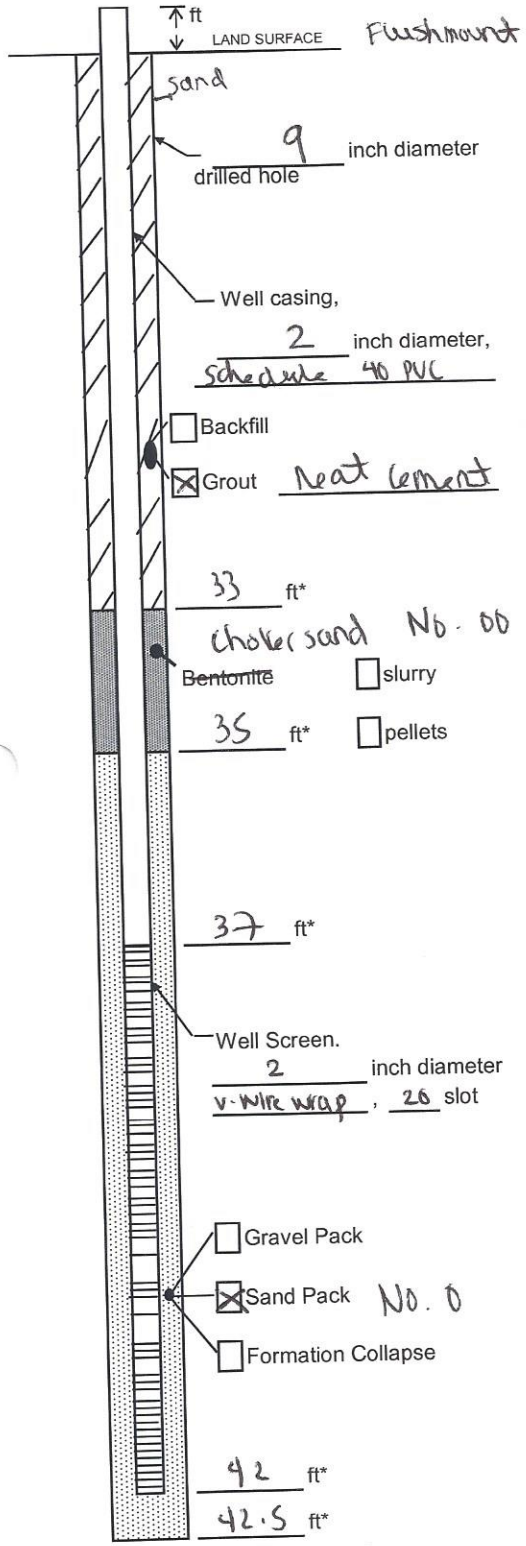
gallon/foot: 1-¼" = 0.06; 1-½" = 0.09; 2" = 0.16; 2-½" = 0.26; 3" = 0.37; 3-½" = 0.50; 4" = 0.65; 6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1214	4	↓	18.95	↓	7.22	0.891	15.65	945	ORP 172
1221	11	↓	20.51	↓	7.21	0.866	14.54	9.63	157
1228	~~13~~ 18	2.3	~~20.02~~ 20.45	41	7.13	0.907	13.92	6.74	164
More than 10 well volumes removed and turbidity <50 NTUs									
Final DTB: 41.02' below M.P.									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project: 3800 PCE Site Well: IW-24

Town/City: Fort Drum

County: Jefferson State: NY

Permit No.:

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s): 05/28/15

Drilling Method: HSA (6.25")

Drilling Contractor: Nothnagle

Drilling Fluid: None

Development Technique(s) and Date(s)

Air lifting 6/9/15

Fluid Loss During Drilling: 30 gallons

Water Removed During Development: ~49 gallons

Static Depth to Water: 17.91 feet below M.P.

Static DTB: 41.28 feet below M.P.

Pumping Depth to Water: 20.52 feet below M.P.

Pumping Duration: 20 ~~hours~~ minutes

~~Yield~~ Pumping rate: 2.45 gpm Date: 6/9/15

Specific Capacity: NA gpm/ft

Well Purpose: Injection Well

Remarks: Final DTB (feet below M.P.): 41.24

MP was determined prior to adding coupling/fitting

Prepared by: Meghan Kiser

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-24 Date 6/9/15

State Below M.P.

Total Depth 41.28' Casing Diameter (inches) 2 Purge Method: Centrifugal ____

Water Level 17.91' Well Volume (gal) 3.78 Submersible ____

Water Column 23.37' Total Volume Purged 49 gallons Other Airlifting

Pump On 1132 Pump Off 1152 Developed By Kevin/Mark (Nothnagle) S. Ellsworth / M. Kiser (Arcadis)

Well Casing Volumes

gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) (~~mL/min~~)	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) (~~F~~)	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1141	9	8	20.52	↓	7.34	1.05	15.53	1.95	ORP 105
1150	18	↓	20.65	↓	7.29	1.06	14.36	1.93	112
1152	20	2.45	20.65	49	7.29	1.05	14.29	1.04	113
More than 10 well volumes removed and turbidity < 50 NTUs									
Final DTB: 41.24 ft below MP									

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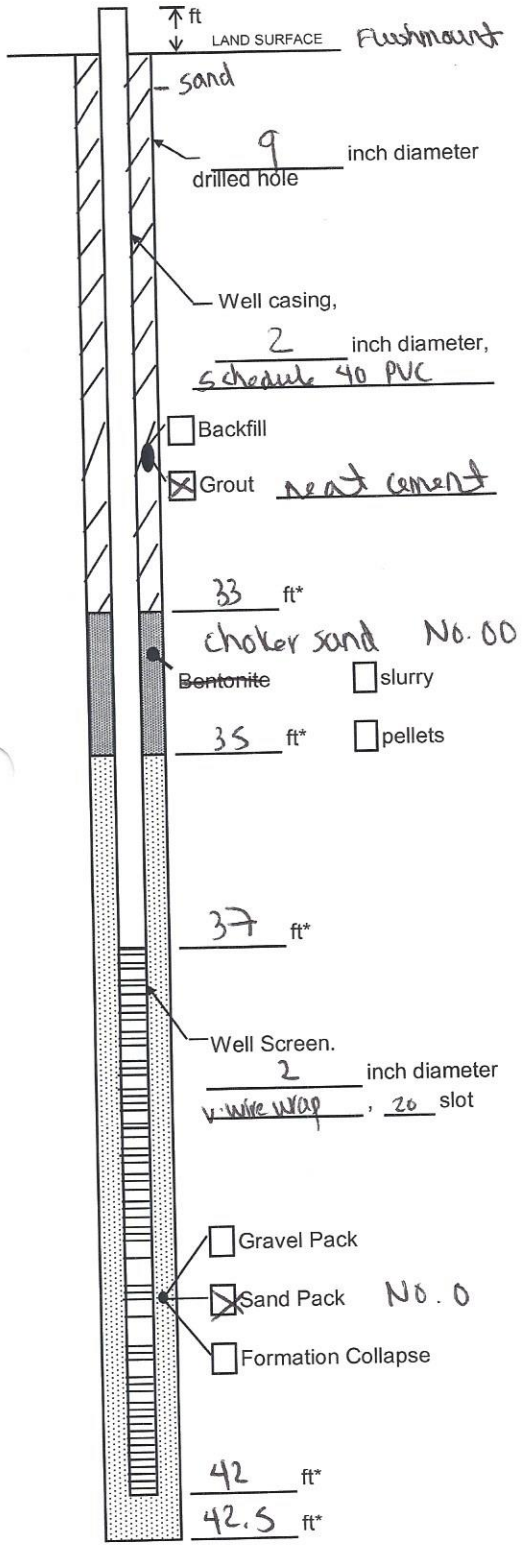
Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project: 3800 PCE Site — Well: IW-25

Town/City: Fort Drum

County: Jefferson — State: NY

Permit No.:

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s): 05/28/15

Drilling Method: HSA (6.25")

Drilling Contractor: Nothnagle

Drilling Fluid: None

Development Technique(s) and Date(s)

Air lifting 6/9/15

Fluid Loss During Drilling: 30 gallons

Water Removed During Development: 40 gallons

Static Depth to Water: 18.02 feet below M.P.

~~Static DTB~~ 40.07 ~~feet below M.P.~~

Pumping Depth to Water: 18.13 feet below M.P.

Pumping Duration: 27 ~~hours~~ minutes

~~Yield~~ pumping rate: 1.5 gpm — Date: 6/9/15

Specific Capacity: NA gpm/ft

Well Purpose: Injection Well

Remarks: Final DTB (feet below MP): 41.40

MP was determined prior to adding coupling/fitting

Prepared by: Meghan Kizer

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-25 Date 6/9/15

Purge Method: Centrifugal ____ Submersible ____ Other Airlifting

Developed By Kevin/Mark (Nothnagle) S. Ellsworth/ M. Eiser (Arcadis)

Static Below M.P.:
- Total Depth 40.07'
- Water Level 18.02'
- Water Column 22.05'

Casing Diameter (inches) 2
Well Volume (gal) 3.53
Total Volume Purged 40 gallons
Pump On 1130
Pump Off 1157

Well Casing Volumes

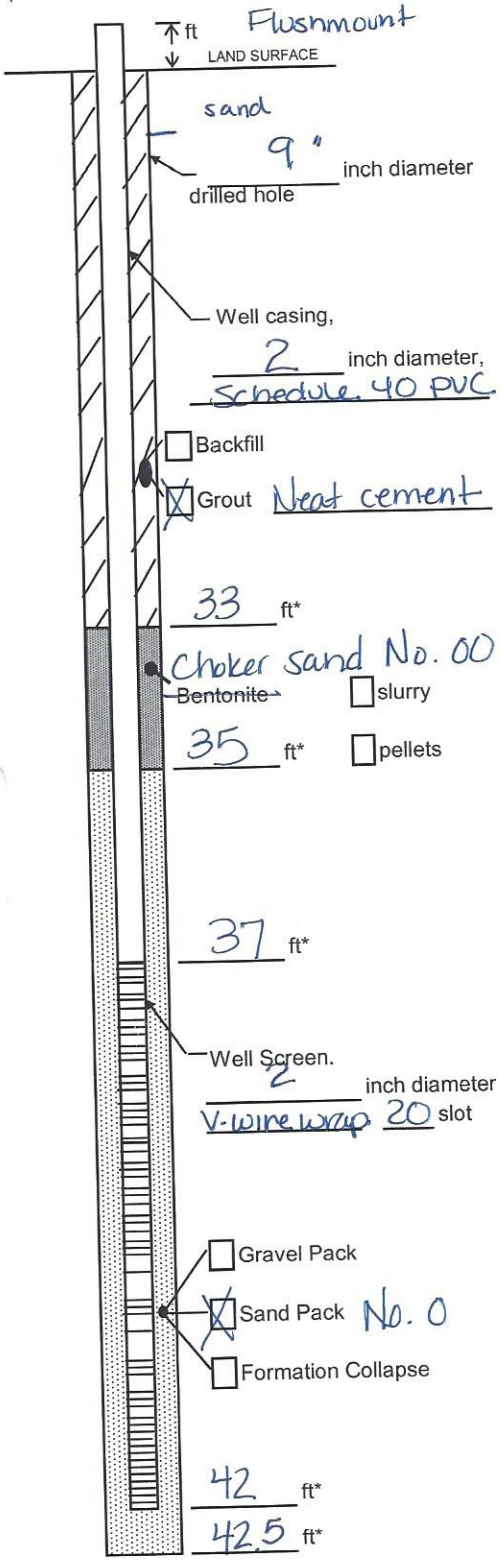
gallon/foot			
1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) (mL/min)	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) (F)	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1136	6		18.13		7.24	0.680	16.15	1,626	ORP 128
1146	16	↓	19.71	↓	7.22	0.852	14.63	30.6	139
1155	25	1.5	20.07	40	7.17	0.794	17.83	20.1	150
More than 10 well volumes removed and turbidity <50 NTUs									
Final DTB: 41.40' below MP.									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IW-26

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 5/26/15

Drilling Method HSA (6.25")

Drilling Contractor Nothnagle (Steve/Greg)

Drilling Fluid None

Development Technique(s) and Date(s)

Airlifting 6/9/15

Fluid Loss During Drilling 30 gallons

Water Removed During Development 45 gallons

Static Depth to Water 17.92 feet below M.P.

~~Static DTB~~ 38.32 feet below M.P

Pumping Depth to Water 20.31 feet below M.P.

Pumping Duration 25 ~~hours~~ minutes

~~Yield~~ pumping rate 1.8 gpm Date 6/9/15

Specific Capacity NA gpm/ft

Well Purpose Injection well

Remarks ~~Final DTB (feet below M.P.)~~ 41.26

MP was determined prior to adding coupling / fitting

Prepared by Suzie Ellsworth

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-26 Date 6/9/15

Static Below M.P.
Total Depth 38.32'
Water Level 17.92'
Water Column 20.4'
Pump On 1250

Casing Diameter (inches) 2
Well Volume (gal) 3.26
Total Volume Purged 45 gallons
Pump Off 1315

Purge Method
Centrifugal ____
Submersible ____
Other Airlifting

Developed By Kevin/Mark (Nothnagle) S. Ellsworth / M. Kiser (Arcadis)

Well Casing Volumes

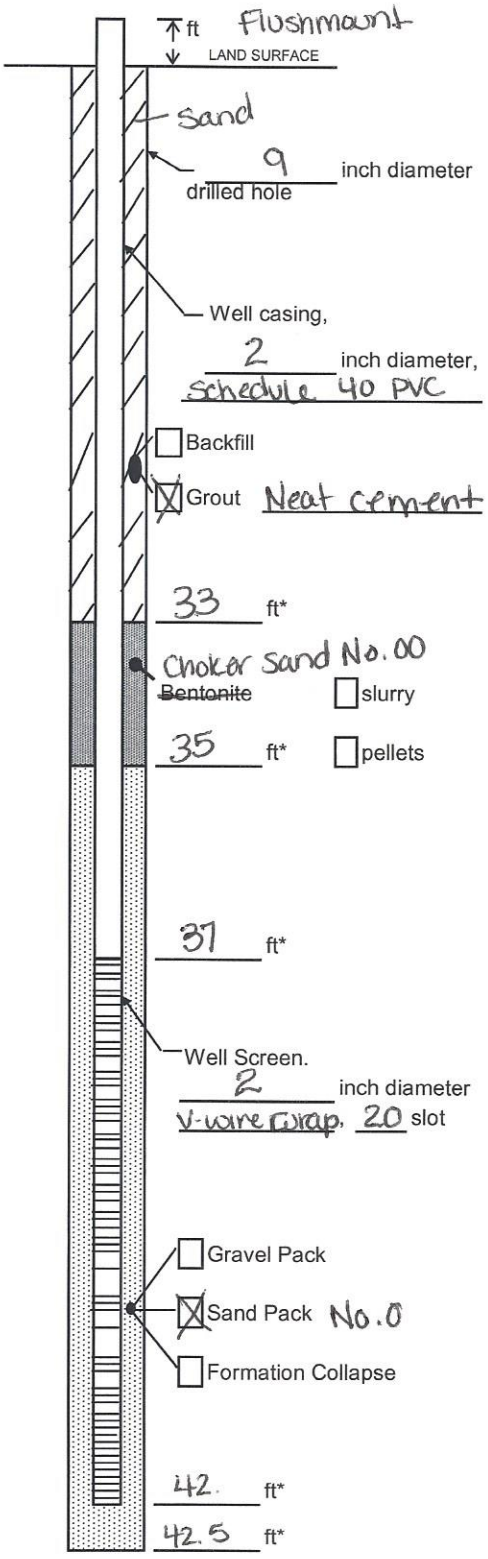
gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1254	4		20.31		7.42	1.07	14.38	44.9	ORP 137
1300	10		20.10		7.33	1.06	13.95	7.10	144
1311	21	↓	20.41	↓	7.30	1.06	13.85	43.4	146
1314	24	1.8	20.40	45	7.26	1.07	13.16	20.2	151
More than 10 well volumes removed and turbidity <50 NTUs									
Final DTB: 41.26' below MP									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE site Well LW-27

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 5/27 - 5/28/15

Drilling Method HSA (6.25")

Drilling Contractor Nothnagle (Steve/Greg)

Drilling Fluid None

Development Technique(s) and Date(s)

Air lifting 6/9/15

Fluid Loss During Drilling 40 gallons

Water Removed During Development 42.5 gallons

Static Depth to Water 17.98 feet below M.P.
~~Static DTB~~ 38.03 ~~feet below M.P.~~

Pumping Depth to Water 20.02 feet below M.P.

Pumping Duration 21 ~~hours~~ minutes

~~Yield~~ pumping rate 2 gpm Date 6/9/15

Specific Capacity NA gpm/ft

Well Purpose Injection well

Remarks Final DTB (feet below MP) 41.34

MP was determined prior to adding coupling/fitting

Prepared by Suzie Ellsworth

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-27 Date 6/9/15

Static Below M.P.

Total Depth 38.03' Casing Diameter (inches) 2 Purge Method

Water Level 17.98' Well Volume (gal) 3.21 Centrifugal ____ Submersible ____

Water Column 20.05' Total Volume Purged 42.5 gallons Other Airlifting

Pump On 1249 Pump Off 1310 Developed By Kevin/Mark (Nothnagle) S. Ellsworth/M. Kiser (Arcadis)

Well Casing Volumes

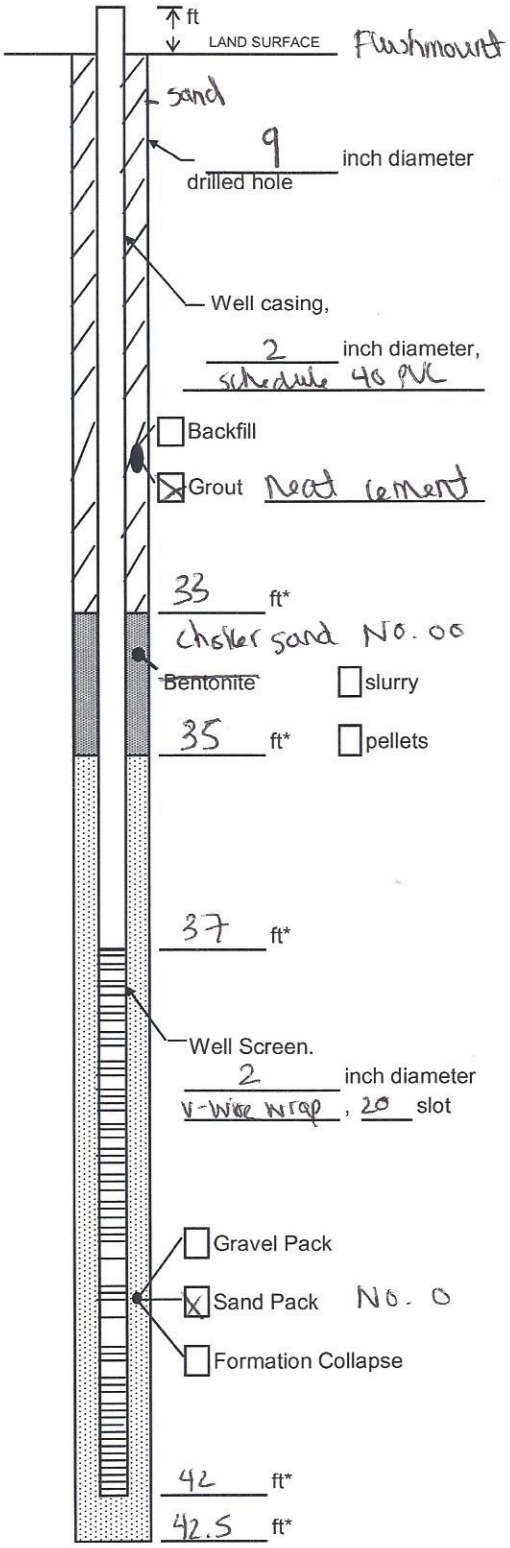
gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(ml/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1256	7		20.02		7.18	1.01	14.71	617	ORP 176
1302	13	↓	20.31	↓	7.09	1.10	14.36	15.8	185
1309	20	~2	20.31	42.5	7.03	1.10	14.17	3.66	192
More than 10 well volumes removed and turbidity <50 NTUs									
Final DTB:		41.34' below MP							

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project: 3800 PCE Site Well: IW-28

Town/City: Fort Drum

County: Jefferson State: NY

Permit No.:

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s): 05/27/15

Drilling Method: HSA (6.25")

Drilling Contractor: Nothnagle

Drilling Fluid: None

Development Technique(s) and Date(s)

Air lifting 6/9/15

Fluid Loss During Drilling: 30 gallons

Water Removed During Development: 46 gallons

Static Depth to Water: 17.58 feet below M.P.
~~Static DTB~~ 41.27 ~~feet below M.P.~~

Pumping Depth to Water: 20.43 feet below M.P.

Pumping Duration: 19 ~~hours~~ minutes

~~Yield~~ pumping rate: 2.4 gpm Date: 6/9/15

Specific Capacity: NA gpm/ft

Well Purpose: Injection Well

Remarks: Final DTB (feet below M.P): 41.27

MP was determined prior to adding coupling/fitting

Prepared by: Meghan Kizer

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-28 Date 6/9/15

Static Below M.P.

Total Depth 41.27' Casing Diameter (inches) 2 Purge Method Centrifugal _____

Water Level 17.58' Well Volume (gal) 3.80 Submersible _____

Water Column 23.69' Total Volume Purged 46 gallons Other Airlifting

Pump On 1356 Pump Off 1415 Developed By Kevin/Mark (Nothnagle) S. Ellsworth/M. Kiser (Arcadis)

Well Casing Volumes

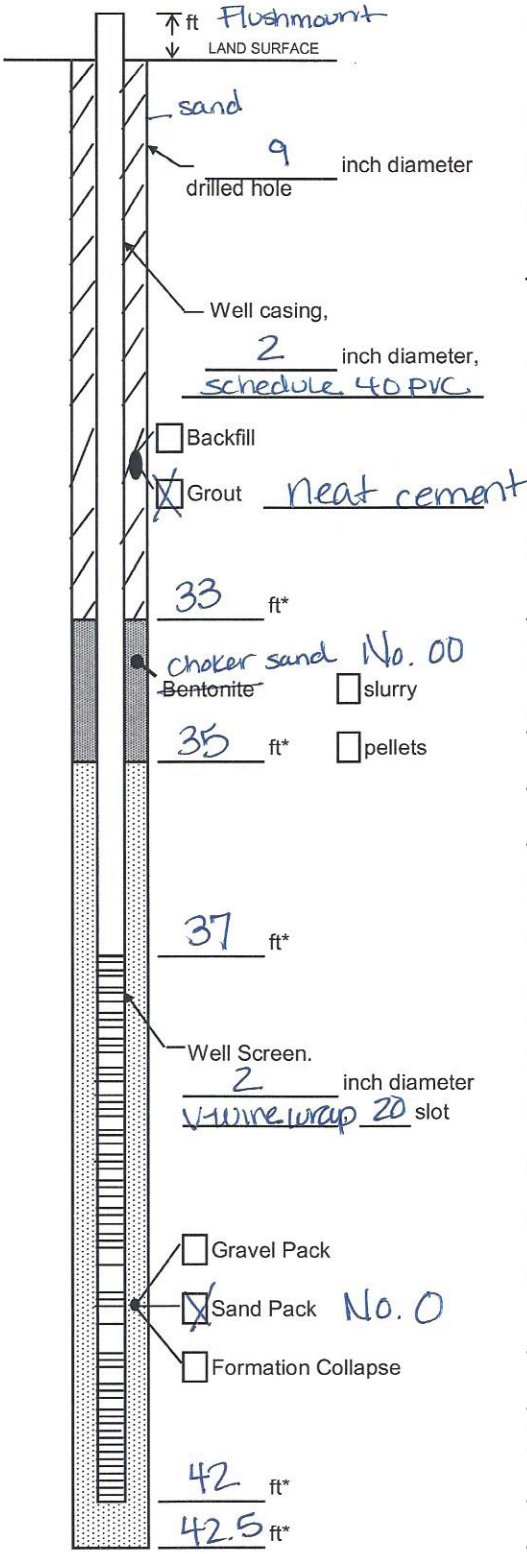
gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1358	2	↓	20.43	↓	7.41	0.710	14.37	40.5	ORP 140
1406	10	↓	20.43	↓	7.27	0.763	13.63	33.4	153
1411	15	2.4	20.52	46	7.26	0.762	13.55	20.0	157
More than 10 well volumes removed and turbidity <50 NTUs									
Final DTB: 41.27' below MP									

ARCADIS

Well Construction Log

(Unconsolidated)



Project: 3800 PCE Site Well: IW-29

Town/City: Fort Drum

County: Jefferson State: NY

Permit No.:

Land-Surface Elevation and Datum:

_____ feet ☐ Surveyed ☐ Estimated

Installation Date(s): 5/27/15

Drilling Method: HSA (6.25")

Drilling Contractor: Nothnagle (Steve/Greg)

Drilling Fluid: None

Development Technique(s) and Date(s)

Airlifting 6/9/15

Fluid Loss During Drilling: ~~None~~ 100 gallons

Water Removed During Development: 47 gallons

Static Depth to Water: 18.02 feet below M.P.

~~Static DTB~~ 36.76 feet below M.P

Pumping Depth to Water: 20.76 feet below M.P.

Pumping Duration: 23 ~~hours~~ minutes

~~Yield~~ Pumping rate: 2 gpm Date: 6/9/15

Specific Capacity: NA gpm/ft

Well Purpose: Injection Well

Remarks: Final DTB (feet below M.P) 41.71

Measuring Point is Top of Well Casing Unless Otherwise Noted.

MP was determined prior to adding coupling/fitting

* Depth Below Land Surface

Prepared by: Suzie Ellsworth

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-29 Date 6/9/15

Static Below M.P.

Total Depth 36.76' Casing Diameter (inches) 2 Purge Method Centrifugal _____

Water Level 18.02' Well Volume (gal) 3.0 Submersible _____

Water Column 18.74' Total Volume Purged ~47 gallons Other Airlifting

Pump On 1429 Pump Off 1452 Developed By Kevin/Mark (Nothnagle) S. Ellsworth/M. Kiser (Arcadis)

Well Casing Volumes

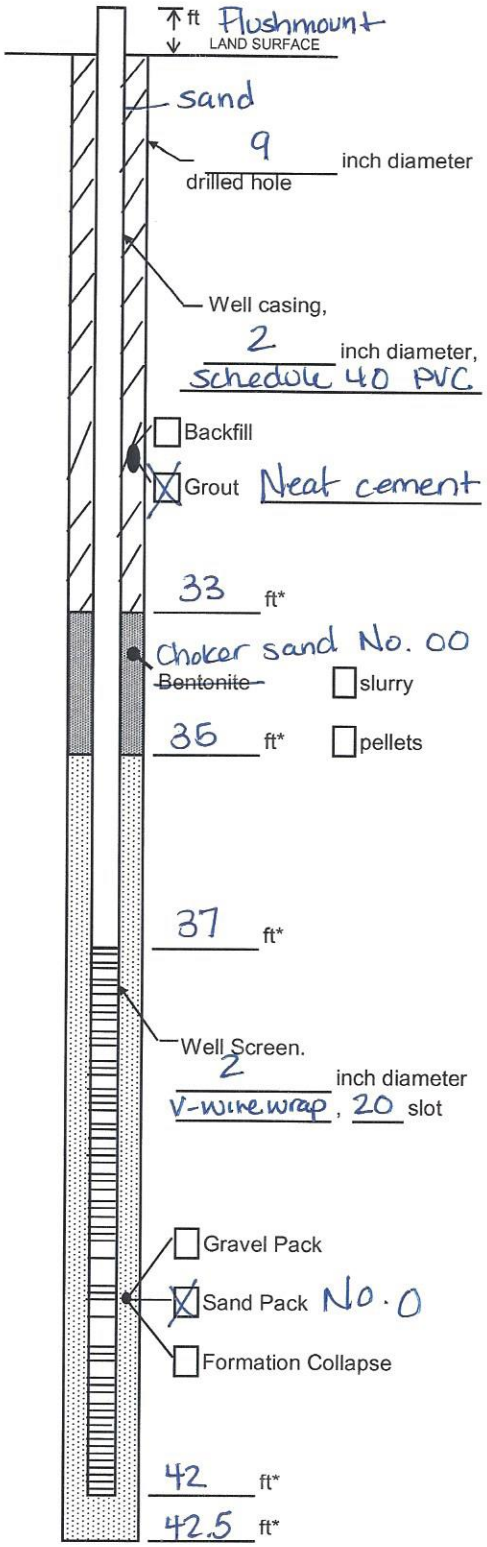
gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1441	12	↓	20.76	↓	7.25	1.09	13.85	20.6	ORP 181
1446	17	↓	20.91	↓	7.30	1.07	13.08	3.87	165
1452	23	2	20.91	47	7.27	1.13	13.06	5.78	166
More than 10 well volumes removed and turbidity < 50 NTUs									
Final DTB:		41.71'	below	M.P.					

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IW-30

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 5/27/15

Drilling Method HSA (6.25")

Drilling Contractor Nothnagle (Steve/Greg ~~6.25"~~)

Drilling Fluid None

Development Technique(s) and Date(s)

Airlifting 6/9/15

Fluid Loss During Drilling ~40 gallons

Water Removed During Development 41 gallons

Static Depth to Water ~~Static DTB~~ 18.01 feet below M.P. / 38.87 ~~feet below M.P~~

Pumping Depth to Water 20.43 feet below M.P.

Pumping Duration 23 ~~hours~~ minutes

~~Yield~~ pumping rate 1.8 gpm Date 6/9/15

Specific Capacity NA gpm/ft

Well Purpose Injection well

Remarks Final DTB (feet below MP): 40.78

MP was determined prior to adding coupling / fitting.

Prepared by Suzie Ellsworth

ARCADIS

Monitoring Well Development Log

Page 1 of 1

Project/No. 3800 PCE Site Well IW-30 Date 6/9/15

Static Below M.P.

Total Depth 38.87' Casing Diameter (inches) 2 Purge Method: Centrifugal ____

Water Level 18.01' Well Volume (gal) 3.34 Submersible ____

Water Column 20.86' Total Volume Purged 41 gallons Other Airlifting

Pump On 1429 Pump Off 1452 Developed By Kevin/Mark (Nothnagle) S. Ellsworth/M. Kiser (Arcadis)

Well Casing Volumes

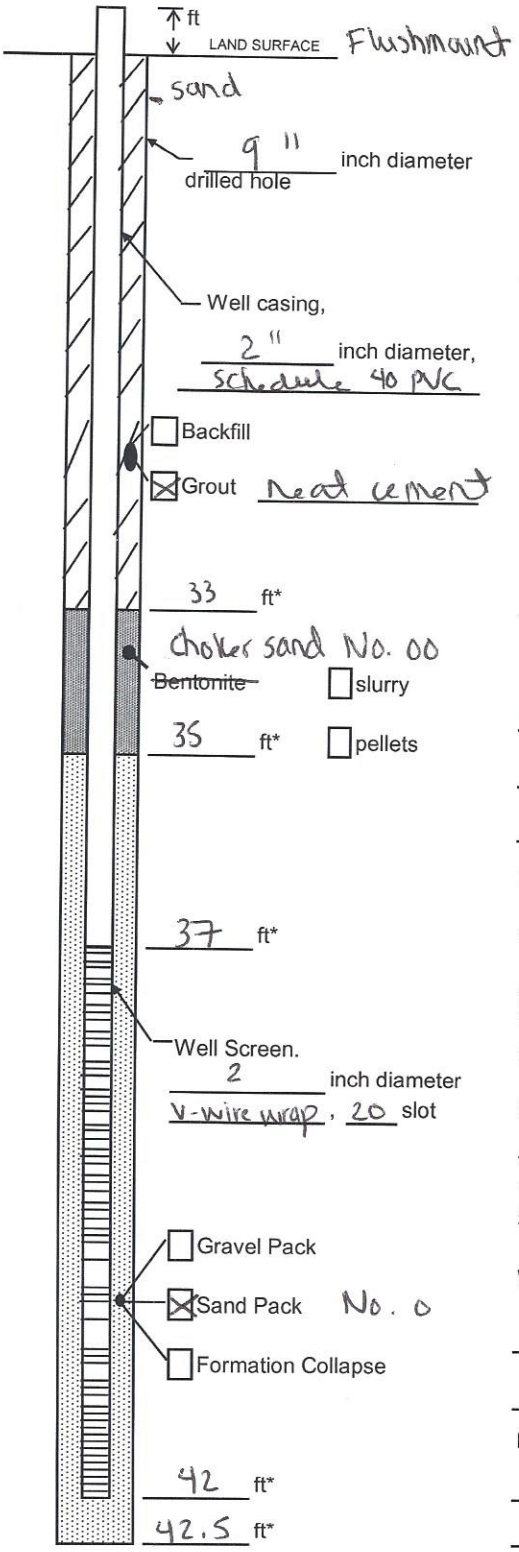
gallon/foot			
1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1434	5		20.43		7.18	0.00	18.14	77.0	ORP 161
1442	13	↓	20.60	↓	7.07	1.17	13.95	1059	209
1447	18	↓	20.65	↓	7.07	1.21	13.51	19.9	206
1452	23	1.8	20.65	41	6.95	1.15	13.12	4.14	212
More than 10 well volumes removed and turbidity <50 NTUs									
Final DTB: 40.78 below M.P.									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project	3800 PCE Site
Well	IW-31
Town/City	Fort Drum
County	Jefferson
State	NY
Permit No.	

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s)	05/27/15
Drilling Method	HSA (6.25")
Drilling Contractor	Nothnagle
Drilling Fluid	None

Development Technique(s) and Date(s)

Air lifting 6/9/15

Fluid Loss During Drilling	30 gallons
Water Removed During Development	41 gallons
Static Depth to Water	17.83 feet below M.P.
Static DTB	41.21 feet below M.P.
Pumping Depth to Water	19.58 feet below M.P.
Pumping Duration	19 ~~hours~~ minutes
~~Yield~~ pumping rate	2.2 gpm
Date	6/9/15
Specific Capacity	NA gpm/ft
Well Purpose	Injection Well

Remarks: Final DTB (feet below M.P): 41.31

MP was determined prior to adding coupling/fitting

Prepared by: Meghan River

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-31 Date 6/9/15

Static Below M.P.

Total Depth 41.21' Casing Diameter (inches) 2 Purge Method: Centrifugal ____

Water Level 17.83' Well Volume (gal) 3.75 Submersible ____

Water Column 23.38' Total Volume Purged 41 gallons Other Air lifting

Pump On 1355 Pump Off 1414 Developed By Kevin/Mark (Nothnagle) S. Ellsworth/M. Kiser (Arcadis)

Well Casing Volumes

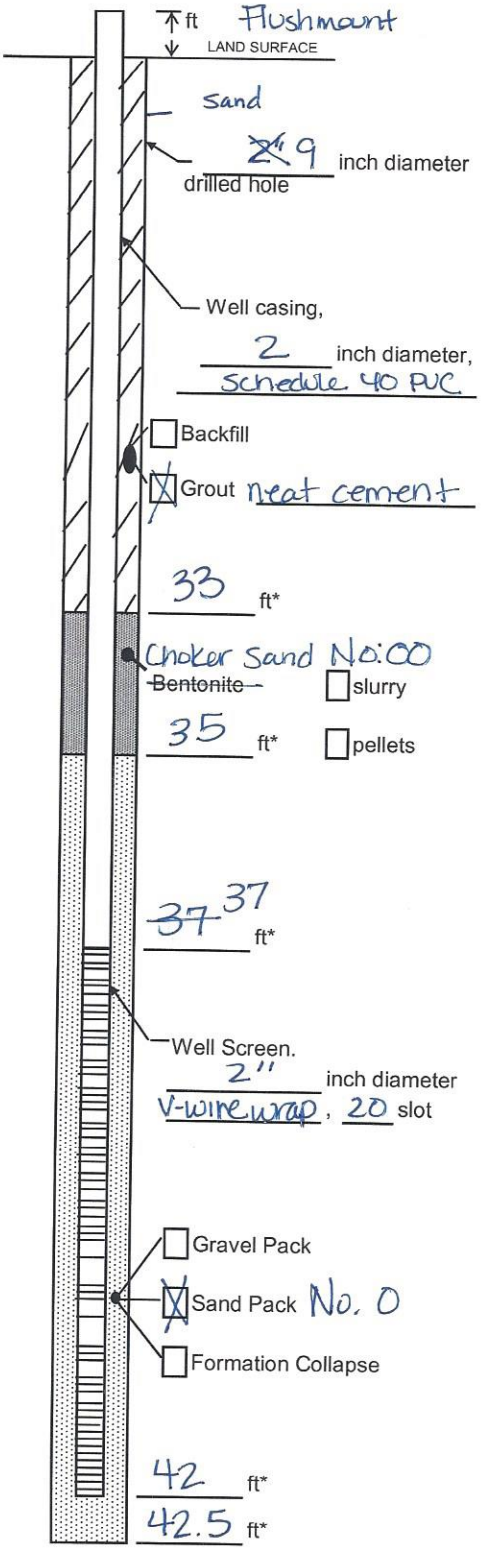
gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1359	4	~~19.5~~	19.58		7.18	0.750	16.23	17.2	ORP 187
1407	12	↓	20.41	↓	7.13	0.792	14.41	82.8	191
1412	17	2.2	20.50	41	7.08	0.802	13.97	9.89	194
More than 10 well volumes removed and turbidity <50 NTUs									
Final DTB: 41.31' below MP									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IW-32

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 5/26/15

Drilling Method HSA (6.25")

Drilling Contractor Nothnagle (Steve/Greg)

Drilling Fluid None

Development Technique(s) and Date(s)

Air lifting 6/9/15

Fluid Loss During Drilling 30 gallons

Water Removed During Development 42.5 gallons

Static Depth to Water 18.12 feet below M.P.

~~Static DTB~~ 38.96 ~~feet below M.P~~

Pumping Depth to Water 21.60 feet below M.P.

Pumping Duration 20 ~~hours~~ minutes

~~Yield~~ Pumping rate 2.1 gpm Date 6/9/15

Specific Capacity NA gpm/ft

Well Purpose Injection well

Remarks Final DTB (feet below M.P): 41.98

MP was determined prior to adding coupling/fitting

Prepared by Sizzi Ellsworth

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-32 Date 6/9/16

Static Below M.P.

Total Depth 38.96' Casing Diameter (inches) 2 Purge Method: Centrifugal ____

Water Level 18.12' Well Volume (gal) 3.33 Submersible ____

Water Column 20.84' Total Volume Purged 42.5 gallons Other Air lifting

Pump On 1545 Pump Off 1605 Developed By Kevin/Mark (Nothnagle) S. Ellsworth / M. Kiser (Arcadis)

Well Casing Volumes

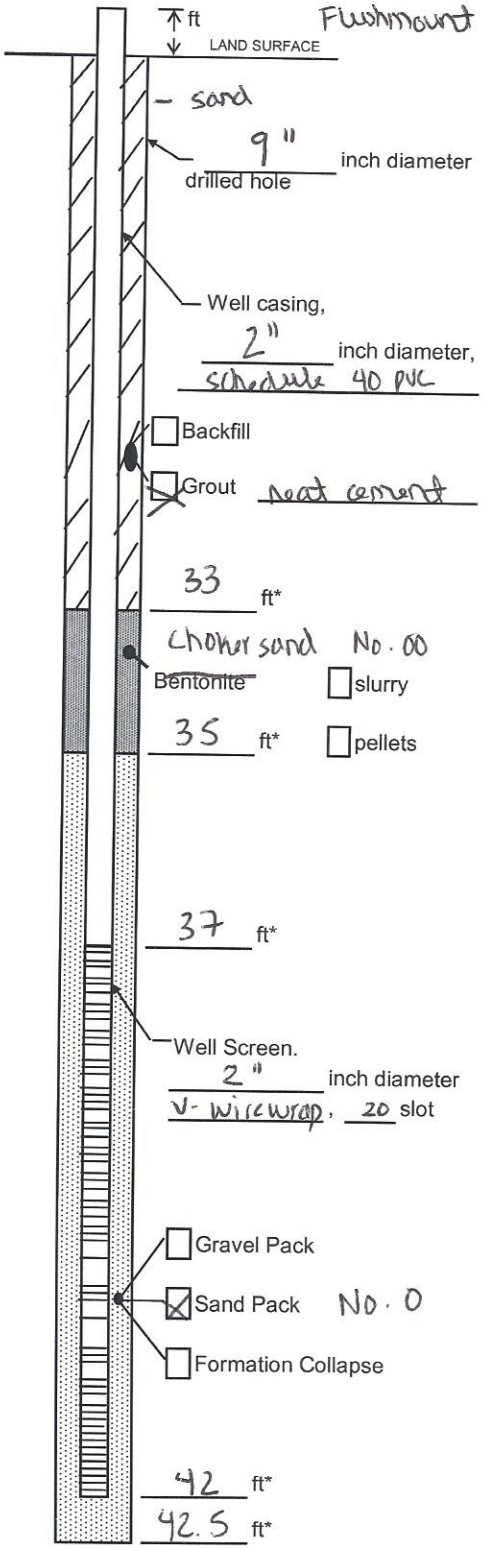
gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1551	6		21.60		7.31	1.15	14.49	45.0	ORP 161
1557	12	↓	21.80	↓	7.34	1.13	13.45	23.2	163
1602	17	2.1	21.76	42.5	7.33	1.13	12.93	8.95	163
More than 10 well volumes were removed and turbidity is <50 NTUs									
Final DTB: 41.98 Below M.P.									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project: 3800 PCE Site Well: IW-33

Town/City: Fort Drum

County: Jefferson State: NY

Permit No.:

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s): 05/26/15

Drilling Method: HSA (6.25")

Drilling Contractor: Nothnagle

Drilling Fluid: None

Development Technique(s) and Date(s)

Air lifting 6/9/15

Fluid Loss During Drilling: 40 gallons

Water Removed During Development: 42.5 gallons

Static Depth to Water (Static DTB): 18.21 feet below M.P. / 40.56 feet below M.P.

Pumping Depth to Water: 21.54 feet below M.P.

Pumping Duration: 20 ~~hours~~ minutes

~~Yield~~ pumping rate: 2.1 gpm Date: 6/9/15

Specific Capacity: NA gpm/ft

Well Purpose: Injection Well

Remarks: Final DTB (feet below M.P.) 41.68

MP was determined prior to adding coupling/fitting

Prepared by: Meghan Kiser

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-33 Date 6/9/15

Static Below M.P.

Total Depth 40.56' Casing Diameter (inches) 2 Purge Method

Water Level 18.21' Well Volume (gal) 3.58 Centrifugal ____ Submersible ____

Water Column 22.35' Total Volume Purged 42.5 gallons Other Airlifting

Pump On 1545 Pump Off 1605 Developed By Kevin/Mark (Nothnagle) S. Ellsworth/M. Kiser (Arcadis)

Well Casing Volumes

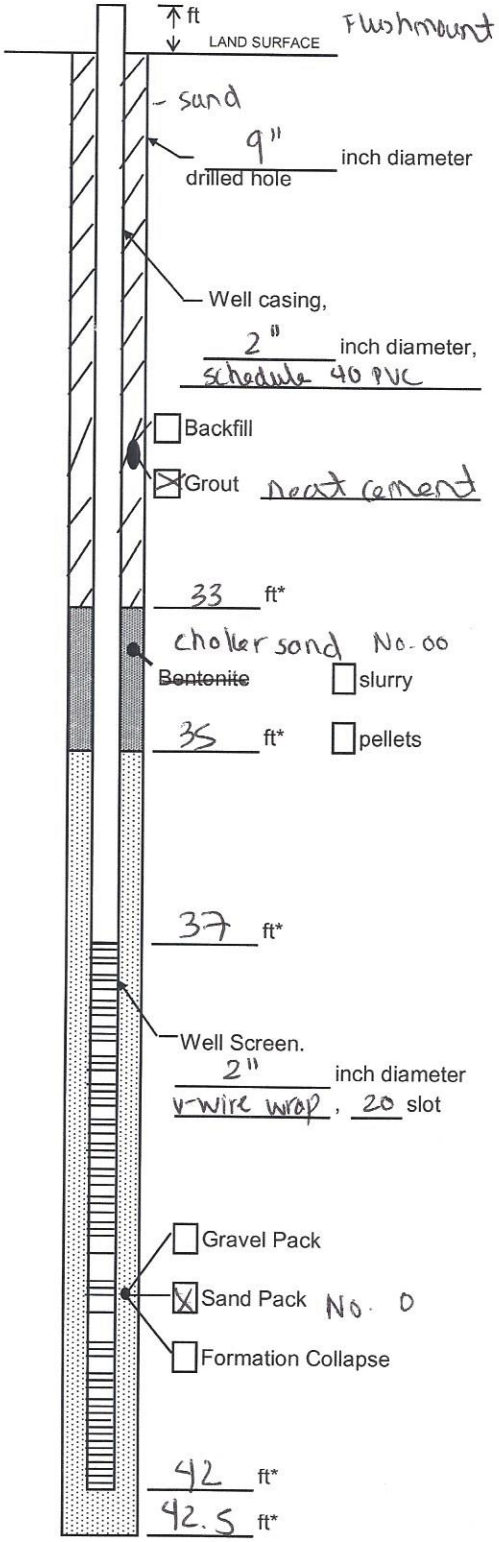
gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
1552	7	↓	21.54	↓	7.16	1.31	14.69	1,037	ORP 203
1557	12	↓	21.71	↓	7.25	1.37	13.58	28.8	204
1604	19	2.1	21.74	42.5	7.22	1.36	13.23	6.49	207
More than 10 well volumes removed and turbidity is <50 NTUs.									
Final DTB: 41.68' Below MP									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project 3800 PCE Site Well IW-34

Town/City Fort Drum

County Jefferson State NY

Permit No.

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s) 05/26/15 / 05/27/15

Drilling Method HSA (6.25")

Drilling Contractor Nothnagle

Drilling Fluid none

Development Technique(s) and Date(s)

06/04/15 venturi (air lifting)

Fluid Loss During Drilling 40 gallons

Water Removed During Development 39.5 gallons

Static Depth to Water 18.18 ~~39.30 MP~~ feet below M.P.

Pumping Depth to Water 20.31 feet below M.P. (see well dev. log)

Pumping Duration 27 ~~hours~~ minutes

~~Yield~~ pumping rate 1.46 gpm Date 06/04/15

Specific Capacity NA gpm/ft

Well Purpose Injection Well

Remarks static depth to bottom 39.30
* developed prior to adding fitting to well
MP was before coupling fitting was added
completed DTW: 18.21' below MP
completed DTB: 41.15' below MP

Prepared by Meghan Kiser

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE site Well IW-34 Date 06/04/15

static below MP

Total Depth 39.30' Casing Diameter (inches) 2

Water Level 18.18' Well Volume (gal) 3.38

Water Column 21.12' Total Volume Purged 39.5 gallons

Pump On 0941 Pump Off 1008

Purge Method: Centrifugal ____ Submersible ____ Other X air lifting

Developed By M. River (ARCADIS) Kevin (Nathnagle)

Well Casing Volumes

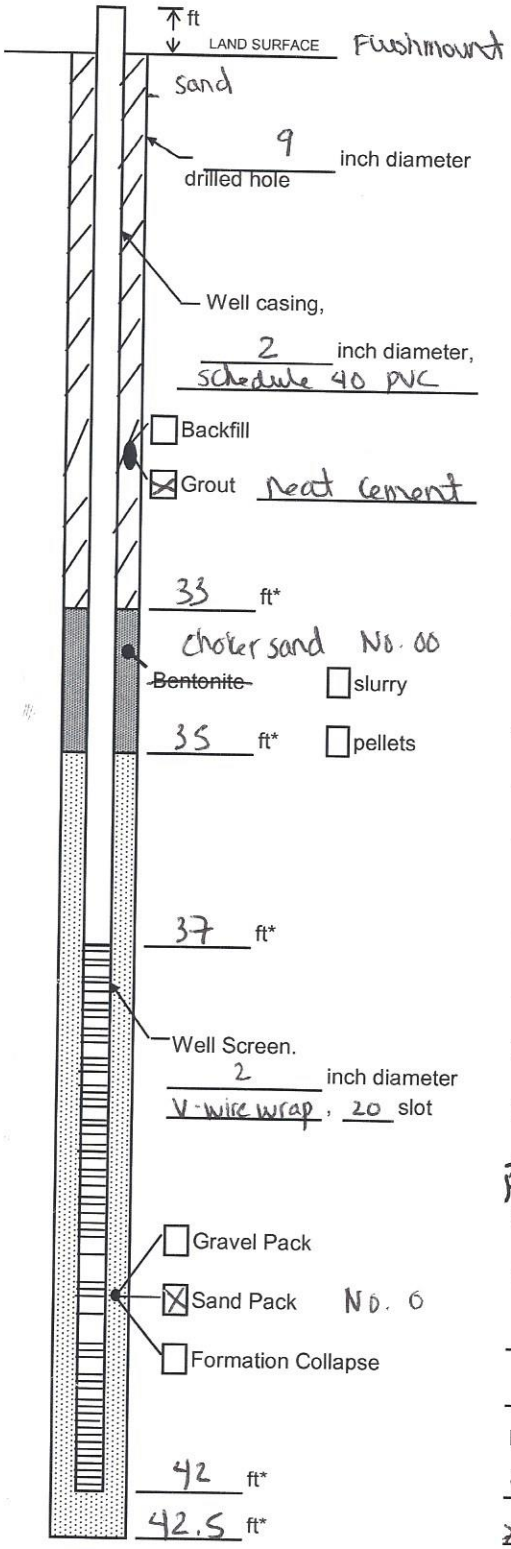
gallon/foot			
1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
0948	7	↓	21.35	↓	7.54	0.802	13.32	2434	
0953	12	↓	21.41	↓	7.44	0.807	13.01	781	
0958	17	↓	21.41	↓	7.52	0.812	12.59	94.5	
1003	22	↓	21.42	↓	7.52	0.789	13.37	40.1	
1007	26	~1.46	20.31	39.5	7.60	0.783	13.80	24.7	
More than 10 well volumes removed and turbidity < 50 NTU									
Final DTB: 41.15 feet below MP									

ARCADIS

Well Construction Log

(Unconsolidated)



Measuring Point is
Top of Well Casing
Unless Otherwise Noted.

* Depth Below Land Surface

Project: 3800 PCE Site Well: IW-35
Town/City: Fort Drum
County: Jefferson State: NY
Permit No.:

Land-Surface Elevation and Datum:

____ feet ☐ Surveyed ☐ Estimated

Installation Date(s): 05/27/15
Drilling Method: HSA (6.25")
Drilling Contractor: Nothnagle
Drilling Fluid: None

Development Technique(s) and Date(s)

06/04/15 Venturi (air lifting)

Fluid Loss During Drilling: 30 gallons
Water Removed During Development: 39.1 gallons
Static Depth to Water: 18.01 feet below M.P.
Pumping Depth to Water: 20.28 feet below M.P. (See well dev. log)
Pumping Duration: 24 ~~hours~~ minutes
~~Yield~~ pumping rate: 1.63 gpm Date: 06/04/15
Specific Capacity: NA gpm/ft
Well Purpose: Injection well

Remarks: MP was before coupling / fitting were added
Static depth to bottom: 41.30 feet
* completed prior to adding fitting to well
completed DTW: 17.98' below MP
completed DTB: 41.30' below MP

Prepared by: Meghan Kiser

ARCADIS

Monitoring Well Development Log

Project/No. 3800 PCE Site Well IW-35 Date 06/04/15

static below MP

Total Depth 41.30' Casing Diameter (inches) 2 Purge Method Centrifugal _____

Water Level 18.01' Well Volume (gal) 3.73 Submersible _____

Water Column 23.29' Total Volume Purged 39.1 gallons Other X air lifting

Pump On 0905 Pump Off 0929 Developed By Meghan Kizer (ARCADIS) Kevin (Nothnagle)

Well Casing Volumes

gallon/foot				
	1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
	1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

Time	Minutes Elapsed	Rate (gpm) ~~(mL/min)~~	DTW (ft)	Gallons Purged	pH	Specific Conductance (mS/cm)	Temp. (C) ~~(F)~~	Turbidity (NTU)	REMARKS (PID readings, color, odor, etc.)
0908	3	↓	20.12	↓	7.60	0.891	14.17	937	
0913	8		20.18		7.61	0.960	12.65	89.0	
0918	13		20.21		7.66	0.973	12.43	41.9	
0923	18		20.28		7.66	0.956	12.78	29.6	
0928	23	~1.63	20.28	~39.1	7.70	0.983	12.36	17.5	
More than 10 well volumes removed and turbidity ≤ 50 NTU									
Final DTB: 41.30 ft below MP									

APPENDIX C

Bills of Lading for Investigation-Derived Waste

ENVIRONMENTAL PRODUCTS & SERVICES OF VERMONT, INC.

24-Hour Emergency Phone Number
1-800-843-8265

Please print or type

BILL OF LADING

1. Document No. SYR11480
2. Page 1 of 1

3. Generator's Name and Mailing Address
FORT DRUM ENVIRONMENTAL DIVISION
85 FIRST STREET WEST
FORT DRUM NY 13602

Site Address
SAME

4. Generator's Phone (315) 772-6312

5. Transporter 1 Company Name
RICCELLI TRUCKING, INC.
6.

A. State Transporter's ID NY7A454
B. Transporter 1 Phone 315 701-0302

7. Transporter 2 Company Name
8.

C. State Transporter's ID
D. Transporter 2 Phone

9. Designated Facility Name and Site Address
DANC RODMAN LANDFILL
23680 NYS ROUTE 177
RODMAN NY 13682
10.

E. State Facility's ID
F. Facility's Phone 315 232-3236

GENERATOR

HM	11. Shipping Name	12. Containers No.	Type	13. Total Quantity	14. Unit Wt./Vol.
	a. NON-RCRA, NON-DOT SOLIDS, N.O.S. (TRACE TETRACHLOROETHYLENE CONTAMINATED SOIL)	001	CM		T
	b.				
	c.				
	d.				

G. Additional Descriptions for Materials Listed Above
a. APP #: SW15-24, 30 YRD ROLL-OFF
b.
c.
d. JOB #N14375, PO #33364

15. Special Handling Instructions and Additional Information
1)

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

Printed/Typed Name	Signature	Date Month	Day	Year
[handwritten name]	[signature]	6	22	15

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Date Month	Day	Year
[handwritten name]	[signature]	6	22	15

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Date Month	Day	Year

FACILITY

19. Discrepancy Indication Space

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

Printed/Typed Name	Signature	Date Month	Day	Year
Jamie Perry	[signature]	6	22	15

BILL OF LADING

ENVIRONMENTAL PRODUCTS & SERVICES OF VERMONT, INC.

24-Hour Emergency Phone Number
1-800-843-8265

Please print or type.

BILL OF LADING

1. Document No.: SYR11479
2. Page 1 of 1

3. Generator's Name and Mailing Address
FORT DRUM ENVIRONMENTAL DIVISION
85 FIRST STREET WEST
FORT DRUM NY 13602

4. Generator's Phone (315) 772-6312

Site Address: SAME

5. Transporter 1 Company Name: RICCELLI TRUCKING, INC.

6.

A. State Transporter's ID
B. Transporter 1 Phone: NYTA454 315 761-0552

7. Transporter 2 Company Name

8.

C. State Transporter's ID
D. Transporter 2 Phone

9. Designated Facility Name and Site Address
DANC RODMAN LANDFILL
23530 NYS ROUTE 177
HM RODMAN NY 13682

10.

E. State Facility's ID
F. Facility's Phone: 315 232-3236

GENERATOR

	11. Shipping Name	12. Containers No.	12. Containers Type	13. Total Quantity	14. Unit Wt./Vol.
a.	NON-RCRA, NON-DOT SOLIDS, N.O.S. (TRACE TETRACHLOROETHYLENE CONTAMINATED SOIL)	001	CM		T
b.					
c.					
d.					

G. Additional Descriptions for Materials Listed Above
a. APP #: SW15-24, 35 YRD ROLL-OFF
b.
c.
d. JOB #N14375, PO #33364

15. Special Handling Instructions and Additional Information
1)

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

Printed/Typed Name: PAUL G. ZAB
Signature:
Date: Month 6 Day 22 Year 15

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials
Printed/Typed Name: Tom Sheard
Signature:
Date: Month 6 Day 22 Year 15

18. Transporter 2 Acknowledgement of Receipt of Materials
Printed/Typed Name:
Signature:
Date: Month Day Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator; Certification of receipt of the materials covered by this bill of lading except as noted in item 19.
Printed/Typed Name:
Signature:
Date: Month 6 Day 22 Year 15

BILL OF LADING

ENVIRONMENTAL PRODUCTS & SERVICES OF VERMONT, INC.

24-Hour Emergency Phone Number
1-800-843-8265

Please print or type

BILL OF LADING

1. Document No.: SYR11476
2. Page 1 of 1

3. Generator's Name and Mailing Address
FORT DRUM ENVIRONMENTAL DIVISION
85 FIRST STREET WEST
FORT DRUM NY 13602
4. Generator's Phone (315) 772-6312

Site Address: SAME

5. Transporter 1 Company Name: RICCELLI TRUCKING, INC.
6.
A. State Transporter's ID
B. Transporter 1 Phone: 315-701-0332

7. Transporter 2 Company Name
8.
C. State Transporter's ID
D. Transporter 2 Phone

9. Designated Facility Name and Site Address
DANC RODMAN LANDFILL
23680 NYS ROUTE 177
HM RODMAN NY 13682
10.
E. State Facility's ID
F. Facility's Phone: 315 232-3236

	11. Shipping Name	12. Containers No.	Type	13. Total Quantity	14. Unit Wt./Vol.
GENERATOR	a. NON-RCRA, NON-DOT SOLIDS, N.O.S. (TRACE TETRACHLOROETHYLENE CONTAMINATED SOIL)	001	CM		T
	b.				
	c.				
	d.				

G. Additional Descriptions for Materials Listed Above
a. APP #: SW15-2430 YRD ROLL-OFF
c.
b.
d. JOB #N14375, PO #33364

15. Special Handling Instructions and Additional Information
1)

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

Printed/Typed Name	Signature	Date: Month	Day	Year
Paul G. Pang		6	22	15

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Date: Month	Day	Year
Tim Riccelli		6	22	15

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Date: Month	Day	Year

FACILITY

19. Discrepancy Indication Space

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

Printed/Typed Name	Signature	Date: Month	Day	Year
Jamie Penny	Jamie Penny	6	22	15

BILL OF LADING

ENVIRONMENTAL PRODUCTS & SERVICES OF VERMONT, INC.

24-Hour Emergency Phone Number
1-800-843-8265

Please print or type

BILL OF LADING

1. Document No. SYR11475	2. Page 1 of 1

3. Generator's Name and Mailing Address
FORT DRUM ENVIRONMENTAL DIVISION
85 FIRST STREET WEST
FORT DRUM NY 13602

4. Generator's Phone (315) 772-6012

Site Address: SAME

5. Transporter 1 Company Name: RICCELLI TRUCKING, INC.

6.

A. State Transporter's ID

B. Transporter 1 Phone NYTA434

7. Transporter 2 Company Name

8.

C. State Transporter's ID 518 781-0562

D. Transporter 2 Phone

9. Designated Facility Name and Site Address
DANC RODMAN LANDFILL
23550 NYS ROUTE 177
HM RODMAN NY 13682

10.

E. State Facility's ID

F. Facility's Phone 315 232-7226

	11. Shipping Name	12. Containers No.	Type	13. Total Quantity	14. Unit Wt./Vol.
a.	NON-RCRA, NON-DOT SOLIDS, N.O.S. (TRACE TETRACHLOROETHYLENE CONTAMINATED SOIL)	001	CM		T
b.					
c.					
d.					

GENERATOR

G. Additional Descriptions for Materials Listed Above

a. APP #: SW15-24 35 YRD ROLL-OFF

c.

b.

d. JOB #N14375, PO #33354

15. Special Handling Instructions and Additional Information

1)

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

Printed/Typed Name	Signature	Date (Month / Day / Year)
Paul C. Zaal		6 / 22 / 15

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Date (Month / Day / Year)
Joe Shepard		6 / 22 / 15

18. Transporter 2 Acknowledgement of Receipt of Materials

Printed/Typed Name	Signature	Date (Month / Day / Year)

FACILITY

19. Discrepancy Indication Space

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

Printed/Typed Name	Signature	Date (Month / Day / Year)
Jamie Perry	Jamie Perry	6 / 22 / 15

BILL OF LADING

ENVIRONMENTAL PRODUCTS & SERVICES OF VERMONT, INC.

Please print or type

24-Hour Emergency Phone Number
1-800-843-8265

BILL OF LADING

1. Document No. SYR11595
2. Page 1 of 1

3. Generator's Name and Mailing Address
FORT DRUM ENVIRONMENTAL DIVISION
85 FIRST STREET WEST
FORT DRUM NY 13602

4. Generator's Phone (315) 772-6312

Site Address: SAME

5. Transporter 1 Company Name: ENVIRONMENTAL PROD & SVCS OF VT, INC
6. NYR000115733

A. State Transporter's ID: 08231 VT
B. Transporter 1 Phone: 800 843-8265
C. State Transporter's ID:
D. Transporter 2 Phone:

7. Transporter 2 Company Name
8.

9. Designated Facility Name and Site Address
ENVIRONMENTAL PROD & SVCS OF VT, INC
532 STATE FAIR BLVD.
HM SYRACUSE NY 13204
10. NYR000115733

E. State Facility's ID:
F. Facility's Phone: 800 843-8265

GENERATOR

	11. Shipping Name	12. Containers No.	Type	13. Total Quantity	14. Unit Wt./Vol.
a.	NON-RCRA, NON-DOT, LIQUIDS, N.O.S. (TRACE ORGANICS CONTAMINATED WATER)	30	DM	1650	G
b.	NON-RCRA, NON-DOT SOLIDS, N.O.S. (TRACE ORGANICS CONTAMINATED SOIL)	1	DM	600	P
c.	NON-RCRA, NON-DOT SOLIDS, N.O.S. (PPE & POLYSHEETING)	1	DM	200	P
d.					

G. Additional Descriptions for Materials Listed Above

a. APP #:0715116-PPT, 30 x 55 GAL
b. APP #:0715117-DT, 1 x 55 GAL
c. APP #:0715118-DT, 1 x 55 GAL
d. JOB# N14375

15. Special Handling Instructions and Additional Information
1) 2) 3)

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

Printed/Typed Name: Paul Sayer | Signature | Date: Month 07 Day 15 Year 15

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials
Printed/Typed Name: Paul Sayer | Signature | Date: Month 07 Day 15 Year 15

18. Transporter 2 Acknowledgement of Receipt of Materials
Printed/Typed Name | Signature | Date: Month Day Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator; Certification of receipt of the materials covered by this bill of lading except as noted in item 19.
Printed/Typed Name: Robert Hussey | Signature | Date: Month 7 Day 15 Year 15

BILL OF LADING

ENVIRONMENTAL PRODUCTS & SERVICES OF VERMONT, INC.

Please print or type

24-Hour Emergency Phone Number
1-800-843-8265

BILL OF LADING

1. Document No.: SYR11599
2. Page 1 of 1

3. Generator's Name and Mailing Address
FORT DRUM ENVIRONMENTAL DIVISION
85 FIRST STREET WEST
FORT DRUM NY 13602

4. Generator's Phone (315) 772-6312

Site Address: SAME

5. Transporter 1 Company Name: ENVIRONMENTAL PROD & SVCS OF VT, INC
6. NYR000115733

A. State Transporter's ID: 28DSLVT
B. Transporter 1 Phone: 800 843-8265

7. Transporter 2 Company Name
8.

C. State Transporter's ID
D. Transporter 2 Phone

9. Designated Facility Name and Site Address
ENVIRONMENTAL PROD & SVCS OF VT, INC
632 STATE FAIR BLVD.
HM SYRACUSE NY 13204
10. NYR000115733

E. State Facility's ID
F. Facility's Phone: 800 843-8265

GENERATOR

	11. Shipping Name	12. Containers No.	Type	13. Total Quantity	14. Unit Wt./Vol.
a.	NON-RCRA, NON-DOT, LIQUIDS, N.O.S. (TRACE ORGANICS CONTAMINATED WATER)	12	DM	660	G
b.	NON-RCRA, NON-DOT SOLIDS, N.O.S. (TRACE ORGANICS CONTAMINATED SOIL)		DM	0	P
c.	NON-RCRA, NON-DOT SOLIDS, N.O.S. (PPE & POLYSHEETING)		DM	0	P
d.					

G. Additional Descriptions for Materials Listed Above

a. APP #:0715116-PFT, 12 X 55 GAL
b. ~~APP #:0715117-DT, X GAL~~
c. APP #:0715118-DT, X GAL
d. JOB# N14375

15. Special Handling Instructions and Additional Information
1) 2) 3)

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

Printed/Typed Name: Paul Zanc | Signature | Date: Month 07 Day 15 Year 15

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials
Printed/Typed Name: Chuck Spec | Signature | Date: Month 07 Day 15 Year 15

18. Transporter 2 Acknowledgement of Receipt of Materials
Printed/Typed Name | Signature | Date: Month Day Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator; Certification of receipt of the materials covered by this bill of lading except as noted in item 19.
Printed/Typed Name: Robert Helsey | Signature: Robert J Helsey | Date: Month 7 Day 15 Year 15

BILL OF LADING

APPENDIX D

Sodium Permanganate Safety Data Sheet

Section 1 Identification of the Substance/Preparation and of the Company/Undertaking

SUBSTANCE/PREPARATION NAME:	RemOx® L ISCO Reagent
PRODUCT NAME:	RemOx® L ISCO Reagent
TRADE NAME:	RemOx® L ISCO Reagent
SYNONYMS:	Permanganic acid sodium salt, sodium permanganate solution

USES OF SUBSTANCE: RemOx® L ISCO Reagent is a liquid oxidant recommended for applications that require a concentrated permanganate solution.

COMPANY NAME (Europe): CARUS EUROPE	**COMPANY ADDRESS:**	C/ Secundino Roces, 3-Planta 1ª – Oficina 14, 33428 Cayes – Llanera, Asturias - Spain
	INFORMATION:	(34) 985-785-513
	EMERGENCY TELEPHONE:	(34) 985-785-513
COMPANY NAME (US): CARUS CORPORATION	**COMPANY ADDRESS:**	315 Fifth Street Peru, IL 61354, USA
	INFORMATION:	(815) 223-1500 (815) 224-6816 (FAX) www.caruscorporation.com (Web) salesmkt@caruscorporation.com (Email)
	EMERGENCY TELEPHONE:	(800) 435 –6856 (USA) (815) 223-1500 (Other countries) (800) 424-9300 (CHEMTREC®, USA) (703) 527-3887 (CHEMTREC®, Other countries)

Section 2 Hazards Identification

GLOBAL HARMONIZED SYSTEM (GHS) OF CLASSIFICATION OF THE PREPARATION

Oxidizing liquid, Category 2
Acute toxicity, Category 4
Aquatic toxicity (acute), Category 1
Aquatic toxicity (chronic), Category 1

GHS LABEL ELEMENTS, INCLUDING PRECAUTIONARY STATEMENTS

Signal Word: DANGER
Label Codes: GHS03, GHS07, GHS09
Hazard Statements: H272, H302, H400, H410

H272 - May intensify fire, oxidizer
H302 - Harmful, if swallowed
H400 - Very toxic to aquatic life
H410 - Very toxic to aquatic life with long lasting effects

EU LABEL

HAZARD SYMBOLS: **O, Xn, N**
RISK PHRASES: **R8, R22, R50/53**
SAFETY PHRASES: **S17,S24/25, S26, S60, S61**

Section 2 Hazards Identification (contd.)

OTHER HAZARDS

EYE CONTACT
RemOx® L ISCO Reagent may cause damage to the eye.

SKIN CONTACT
Momentary contact of solution at room temperature will leave brown stains and may be irritating to some who are more sensitive. Prolonged contact is damaging to the skin.

INHALATION
Acute inhalation toxicity data are not available. However, airborne concentrations of sodium permanganate in the form of mist may cause irritation to the respiratory tract for some.

INGESTION
RemOx® L ISCO Reagent, if swallowed, may cause burns to mucous membranes of the mouth, throat, esophagus, and stomach.

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM (HMIS) RATINGS:
Health: 1 - Slight
Flammability: 0 - None
Reactivity: 0 - None
Personnel Protective Equipment: goggles face shield, apron, respirator and proper gloves.

Section 3 Composition/Information on Ingredients

HAZARDOUS COMPONENT	CAS NO.	EINECS	%	HAZARD DATA
Sodium Permanganate	10101-50-5	233-251-1	39.5-41.0	**PEL/C**5 mg Mn per m^3 of air **TLV-TWA** 0.2 mg Mn per m^3 of air

Section 4 First Aid Measures

EYES
Immediately flush eyes with large amounts of water for at least 15 minutes holding lids apart to ensure flushing of the entire surface. Do not attempt to neutralize chemically. Seek medical attention immediately. **Note to physician**: Decomposition products are alkaline. Brown stain formed is insoluble manganese dioxide.

SKIN
Immediately wash contaminated areas with water. Remove contaminated clothing and footwear. (**Caution:** Solution may ignite certain textiles). Wash clothing and decontaminate footwear before reuse. Seek medical attention if irritation is severe or persistent.

INHALATION
Remove person from contaminated area to fresh air. If breathing has stopped, resuscitate and administer oxygen if readily available. Seek medical attention immediately.

INGESTION
Never give anything by mouth to an unconscious or convulsing person. If person is conscious, give large quantities of water or milk. Seek medical attention immediately.

Section 5 Fire Fighting Measures

NFPA* HAZARD SIGNS

Health Hazard	1	=	Materials that under emergency conditions, can cause significant irritation. Materials that on the skin could cause irritation.
Flammability Hazard	0	=	Materials that will not burn under typical fire conditions, including intrinsically noncombustible materials such as concrete, stone and sand.
Instability Hazard	0	=	Materials that in themselves are normally stable, even under fire conditions.
Special Hazard	OX	=	Oxidizer

***National Fire Protection Association 704 (USA)**

FIRST RESPONDERS

Wear protective gloves, boots, goggles, and respirator. In case of fire, wear positive pressure breathing apparatus. Approach incident with caution.

FLASHPOINT

None

FLAMMABLE OR EXPLOSIVE LIMITS

Lower: Nonflammable Upper: Nonflammable

EXTINGUISHING MEDIA

Use large quantities of water. Water will turn pink to purple when in contact with sodium permanganate. Dike to contain. Do not use dry chemicals, CO_2, Halon® or foams, because they are not effective.

SPECIAL FIREFIGHTING PROCEDURES

If material is involved in fire, flood with water. Cool all affected containers with large quantities of water. Apply water from as far a distance as possible. Wear self-contained breathing apparatus and full protective clothing.

UNUSUAL FIRE AND EXPLOSION

Powerful oxidizing material. May decompose spontaneously if exposed to heat (135°C / 275°F). May be explosive in contact with certain other chemicals (Section 10). May react violently with finely divided and readily oxidizable substances. Increases burning rate of combustible material. May ignite wood and cloth.

Section 6 Accidental Release Measures

PERSONAL PRECAUTIONS

Personnel should wear protective clothing suitable for the task. Remove all ignition sources and incompatible materials before attempting clean up.

ENVIRONMENTAL PRECAUTIONS

Do not flush into sanitary sewer system or surface water. If accidental release into the environment occurs, inform the responsible authorities. Keep the product away from drains, sewers, surface and ground water and soil.

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

NOTE: Do not use paper or cloth to clean up spills. It may catch fire. Contain spill by collecting the liquid in a pit or holding behind a dam (sand or soil). Proceed with either of the following two options depending upon the size of the spill and the availability of the neutralizing agents.

Option # 1: Dilute to approximately 6% with water, and then reduce with sodium thiosulfate, a bisulfite or ferrous salt solution. The bisulfite or ferrous salt may require some dilute sulfuric acid (10% w/w) to promote reduction. Neutralize with sodium carbonate to neutral pH, if acid was used. Decant or filter and deposit sludge in approved landfill. Where permitted, the sludge may be drained into sewer with large quantities of water.

Section 6 Accidental Release Measures (contd.)

Option # 2: Absorb with inert media like diatomaceous earth or inert floor dry, collect into a drum and dispose of properly. Does not use saw dust or other incompatible media. Disposal of all materials shall be in full and strict compliance with all federal, state, and local regulations pertaining to permanganates.

To clean contaminated floors, flush with abundant quantities of water into sewer, if permitted by federal, state, and local regulations. If not, collect water and treat as described above.

Section 7 Handling and Storage

WORK/HYGIENIC PRACTICES

Wash hands thoroughly with soap and water after handling permanganate solution. Do not eat, drink or smoke when working with sodium permanganate. Wear proper protective equipment. Remove clothing if it becomes contaminated.

VENTILATION REQUIREMENTS

Provide sufficient mechanical and/or local exhaust to maintain exposure below the TLV/TWA.

CONDITIONS FOR SAFE STORAGE

Store in accordance with NFPA 430 requirements for Class II oxidizers. Protect containers from physical damage. Store in a cool, dry area in closed containers. Segregate from acids, peroxides, formaldehyde, and all combustible, organic, or easily oxidizable materials including antifreeze and hydraulic fluid.

SPECIFIC USES

Refer to SECTION 1.

Section 8 Exposure Controls and Personal Protection

RESPIRATORY PROTECTION

In cases where overexposure to mist may occur, the use of an approved NIOSH-MSHA mist respirator or an air supplied respirator is advised. Engineering or administrative controls should be implemented to control mist.

EYE

Face shield, goggles, or safety glasses with side shields should be worn. Provide eyewash in working area.

GLOVES

Rubber or plastic gloves should be worn.

OTHER PROTECTIVE EQUIPMENT

Chemically resistant clothing covering arms and legs, and rubber or plastic apron should be worn. **Caution:** If clothing becomes contaminated, wash off immediately. Spontaneous ignition may occur with cloth or paper.

Section 9 Physical and Chemical Properties

APPEARANCE	Dark purple solution
ODOR	Odorless
pH OF THE PREPARATION (36%-38%)	5-9
BOILING POINT/BOILING RANGE	>101°C (at 760 mm Hg)
FLASH POINT	Does not flash
FLAMMABILITY (SOLID, GAS)	Not flammable
EXPLOSIVE PROPERTIES	Explosive in contact with sulfuric acid or peroxides, or readily oxidizable substances.
OXIDIZING PROPERTIES	Strong oxidizer. May ignite wood and cloth.

Section 9 Physical and Chemical Properties (contd.)

VAPOR PRESSURE	760 mm Hg at 105°C
RELATIVE DENSITY (AT 20◦C)	1.36-1.39 at 20°C
SOLUBILITY	
WATER SOLUBILITY	Miscible in all proportions with water
PARTITION COEFFICIENT: n-OCTONAL/WATER	
VISCOSITY	
VAPOUR DENSITY	
EVAPORATION RATE	Same as water
FREEZING POINT	<-4.0 °C

Section 10 Stability and Reactivity

STABILITY
Under normal conditions, the material is stable.

CONDITIONS TO AVOID
Contact with incompatible materials or heat (135°C / 275ºF) could result in violent exothermic chemical reaction.

MATERIALS TO AVOID
Acids, peroxides, and all combustible organic or readily oxidizable materials including inorganic oxidizable materials and metal powders. With hydrochloric acid, chlorine gas is liberated.

HAZARDOUS DECOMPOSITION PRODUCTS
When involved in a fire, sodium permanganate may form corrosive fumes.

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION
Material is not known to polymerize.

Section 11 Toxicological Information

EXPOSURE SYMPTOMS DESCRIPTION

INHALATION
The product may be absorbed into the body by inhalation of the mist. Airborne concentrations of sodium permanganate in the form of mist may cause irritation to the respiratory tract for some. Major effects of exposure: *possible* respiratory disorder, cough.

INGESTION
Harmful, if swallowed. Ingestion may cause nausea, vomiting, sore throat, stomach-ache, and eventually lead to a perforation of the intestine. Liver and kidney injuries may occur.

SKIN CONTACT
Momentary contact of solution at room temperature will leave brown stains and may be irritating to some who are more sensitive. Prolonged contact is damaging to the skin.

EYE CONTACT
RemOx® L ISCO Reagent may cause damage to the eye.

Section 11 Toxicological Information (contd.)

ACUTE TOXICITY

LD50 value is not available for sodium permanganate, but is expected to be similar to that of potassium permanganate on a dry weight basis. The toxicity data for potassium permanganate (CAS# 7722-64-7) is given below:
LD 50 oral rat: 780 mg/kg male (14 days); 525 mg/kg female (14 days).
Harmful if swallowed. ALD: 10g. Ingestion may cause nausea, vomiting, sore throat, stomach-ache and eventually lead to a perforation of the intestine. Liver and kidney injuries may occur.

CHRONIC TOXICITY

No known cases of chronic poisoning due to permanganates have been reported. Prolonged exposure, usually over many years, to heavy concentrations of manganese oxides in the form of dust and fumes may lead to chronic manganese poisoning, chiefly involving the central nervous system.

CARCINOGENICITY

Sodium permanganate has not been classified as a carcinogen by ACGIH, NIOSH, OSHA, NTP, or IARC.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE

Sodium permanganate solution will cause further irritation of tissue, open wounds, burns or mucous membranes.

Section 12 Ecological Information

ECO TOXICITY

No aquatic toxicity data is available for sodium permanganate. Toxicity is expected to be similar to that of potassium permanganate. The toxicity data for potassium permanganate (CAS# 7722-64-7) is given below:

Rainbow trout, 96 hour LC_{50} for potassium permanganate:	1.8 mg/L
Bluegill sunfish, 96 hour LC_{50} for potassium permanganate:	2.3 mg/L
Milk fish (Chanos Chanos)/ 96 hour LC_{50} for potassium permanganate:	>1.4mgl

MOBILITY

Miscible in water.

PERSISTENCE AND DEGRADABILITY

Permanganate has a low estimated lifetime in the environment, being readily converted by oxidizable materials to insoluble MnO_2.

BIOACCULUMATIVE POTENTIAL

In non-reducing and non-acidic environments, MnO_2 is insoluble and has a very low bioaccumulative potential.

OTHER ADVERSE EFFECTS

Harmful to aquatic organisms.

Section 13 Disposal Considerations

WASTE DISPOSAL

Offer surplus and non-recyclable product or solutions to a licensed disposal company. Disposal of all materials shall be in full and strict compliance with all federal, state, and local regulations. Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. US EPA guidelines for the classification determination are listed in 40 CFR Parts 261.3. When it becomes a waste, sodium permanganate is considered a D001 hazardous (ignitable) waste. For disposal of sodium permanganate solutions, follow procedures in Section 6. Dispose of it in a permitted landfill. Contact Carus Corporation for additional recommendations. Packaging materials must be triple rinsed to remove all RemOx® L ISCO Reagent prior to re-cycling or disposal.

RCRA P-Series: None listed. **RCRA U-Series:** None listed.

Section 14 Transport Information

USA (Land, DOT) and Canada (TDG)	**ID Number:** UN 3214 **Proper Shipping Name:** Permanganates, inorganic, aqueous solution, n.o.s. (contains sodium permanganate) **Hazard Class:** Oxidizer **Packing Group:** II **Division:** 5.1
European Labeling in accordance Road/Rail Transport (ADR/RID)	**ID Number:** UN 3214 **ADR/RID Class:** 5.1 **Packing Group:** II **Description of Goods:** Permanganates, inorganic, aqueous solution, n.o.s. (contains sodium permanganate) **Hazard Identification No.**50
European Labeling in accordance with EC directive (Water, IMDG)	**ID Number:** UN 3214 **Proper Shipping Name:** Permanganates, inorganic, aqueous solution, n.o.s. (contains sodium permanganate) **Hazard Class:** Oxidizer **Packing Group:** II **Division:** 5.1 **Marine Pollutant**: No
European Labeling in accordance with EC directive (Air, IATA)	**ID Number:** UN 3214 **Proper Shipping Name:** Permanganates, inorganic, aqueous solution, n.o.s. (contains sodium permanganate) **Hazard Class:** Oxidizer **Packing Group:** II **Division:** 5.1

Section 15 Regulatory Information

EUROPEAN AND INTERNATIONAL REGULATIONS

MARKINGS ACCORDING TO EU GUIDELINES

The product has been classified and marked in accordance with EU directives/ordinances on hazardous materials.

CHEMICAL NAME	CAS NO.	EINECS	UN NUMBER
Sodium Permanganate	10101-50-5	233-251-1	UN 3214

LABELING INFORMATION

O

Oxidizer

Xn

Harmful

N

Dangerous to the Environment

RISK PHRASES

8	Contact with combustibles may case fire.
22	Harmful if swallowed.
50/53	Very toxic to aquatic organisms may cause long-term effects in the aquatic environment.

Section 15 Regulatory Information (contd.)

SAFETY PHRASES

17	Keep away from combustible materials.
24/25	Avoid contact with skin and eyes.
26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
60	This material and its container must be disposed of as hazardous waste.
61	Avoid releases to the environment. Refer to special instructions / Safety data sheet.

US FEDERAL REGULATIONS:

CHEMICAL INVENTORY STATUS – PART 1

Ingredient	CAS. NO.	TSCA	EC	Japan	Australia	China
Sodium permanganate	10101-50-5	Yes	Yes	Yes	Yes	Yes

CHEMICAL INVENTORY STATUS – PART 2 --- CANADA --

Ingredient	CAS. NO.	Korea	DSL	NDSL	New Zealand	PHIL
Sodium permanganate	10101-50-5	Yes	No	Yes	Yes	

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulation (CPR, Canada) and the MSDS contains all of the information required by the CPR.

FEDERAL, STATE & INTERNATIONAL REGULATIONS – PART 1

		SARA 302		SARA 313	
Ingredient	CAS. NO.	RQ	TPQ	List	Chemical Category
Sodium permanganate	10101-50-5	N/A	N/A	No	Yes (Manganese compounds)

FEDERAL, STATE & INTERNATIONAL REGULATIONS – PART 2

Ingredient	CAS. NO.	CERCLA	RCRA	TSCA 8(d)
Sodium permanganate	10101-50-5	No	D001	No

Ingredient	CAS. NO.	CWC	TSCA 12(b)	CDTA	SARA 311/312
Sodium permanganate	10101-50-5	No	No		4545 Kg

Ingredient	CAS. NO.	Acute	Chronic	Fire	Pressure	Reactivity	Pure/Liquid
Sodium permanganate	10101-50-5	Yes	Yes	Yes	No	No	Liquid

Ingredient	CAS. NO.	Australian Hazchem	WHMIS	IDL
Sodium permanganate	10101-50-5	IYE	C, D2B	No

Section 16 Other Information

ADR/RID	Agreement on Dangerous Goods by Road /Regulations Concerning the International Transport of Dangerous Goods by Rail
C	Ceiling Exposure Limit
CAS	Chemical Abstract Service
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
EINECS	Inventory of Existing Chemical Substances (European)
DOT	Department of Transportation
DSL/NDSL	The Domestic Substances and the Non-Domestic Substances List (Canada)
IARC	International Agency for Research on Cancer
IATA	International Air Transport Association

Section 16 Other Information (contd.)

IDL	Ingredient Disclosure List
IMDG	International Maritime Dangerous Goods
OSHA	Occupational Safety and Health Administration
NIOSH	National Institute for Occupational Safety and Health
NTP	National Toxicology Program
MSHA	Mine Safety and Health Administration
PEL	Permissible Exposure Limit
SARA	Superfund Amendments and Reauthorization Act
TDG	Transport Dangerous Goods (Canada)
TSCA	Toxic substances control Act
TLV-TWA	Threshold Limit Value-Time Weighted Average
UN	United Nations
WHMIS	Workplace Hazardous Materials Information System

The information contained herein is accurate to the best of our knowledge. However, data, safety standards and government regulations are subject to change and, therefore, holders and users should satisfy themselves that they are aware of all current data and regulations relevant to their particular use of product. CARUS CORPORATION DISCLAIMS ALL LIABILITY FOR RELIANCE ON THE COMPLETENESS OR ACCURACY OR THE INFORMATION INCLUDED HEREIN. CARUS CORPORATION MAKES NO WARRANTY, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTIES OF MERCHANTIABILITY OR FITNESS FOR PARTICULAR USE OR PURPOSE OF THE PRODUCT DESCRIBED HEREIN. All conditions relating to storage, handling, and use of the product are beyond the control of Carus Corporation, and shall be the sole responsibility of the holder or user of the product.

This safety data sheet was reviewed according to Annex II of the regulation of the European Parliament and European Council (EC) No. 1907/2006-REACH and 1272/2008.

CARUS CORPORATION, 315 5TH STREET, PERU, ILLINOIS 61354, USA
CARUS EUROPE IS A DIVISION OF CARUS CORPORATION

Chithambarathanu Pillai (S.O.F.)
August 2010

RESPONSIBLE CARE®
OUR COMMITMENT TO SUSTAINABILITY

APPENDIX E

Oxidant Injection Field Logs

Daily Field Report

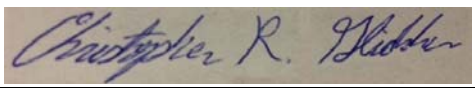
Project Name: Fort Drum
Page 1 of 2
Project Number: GP14DRUM.0001.0008C
Date 6/24/2015
Site Location: Fort Drum - Building 1885
ARCADIS Personnel: Christopher Glidden / Eli Thomas
Subcontractor(s): NA

Equipment on-site: 6,900 gal. poly tank, C185 air compressor, secondary containments, permanganate totes, injection skid including pumps , manifold and chemical hosing

Weather/Unusual Conditions: Sunny 72 degrees

Scope of Work: Todays tasks include performing clean water leak test and starting sodium permanganate injections

Time	Description of Activities
7:00	CG/ET arrive at ARCADIS/PIKA trailer to conduct daily safety meeting
7:20	CG/ET finish safety meeting and commute from trailer over 1885 site
7:30	CG/ET perform site specific tailgate and discuss todays tasks which include the following:
	- finish construction of injection skid
	- perform cleanwater leak test to determine if leaks exist
	- mix batch of permanganate and begin injection on IW-22, IW-23, IW-26, IW-28, IW-29,
	IW-30, IW-31, IW-32 IW-33, IW-34 and IW-35.
	- performance monitoring and inspection of totalizers, pressure and flow
8:50	CG/ET transfer approximately 500 gallons from hydrant into 6,900 gallon poly tank
9:20	CG/ET begin leak test. IW-27 pulled offline due to leaking flow meter
10:15	CG/ET complete leak test and find leaks in each of the six leg manifolds that run to the individual
	injections wells
10:20	CG/ET begin tightening components on skid
11:45	CG/ET put six leg manifolds back in line and begin second leak test
12:00	leak test complete and system appears ready to go
12:10	CG/ET offsite to get lunch and diesel for the compressor
13:10	CG/ET back onsite from lunch to begin transferring concentrate from tote into 6,900 gal. tank
13:40	CG/ET complete transfer of concentrate and begin filling tank with water from hydrant
	Beginning totalizers collected as well
15:20	6,900 gallon poly filled and circulation begins while CG/ET do some minor maintenance to
	concentrate pump
16:00	CG/ET begin injecting permanganate solution

Signature: 

ARCADIS

Project Name: **Fort Drum** **Page** 2 of 2

Time	Description of Activities
17:20	CG/ET begin round of performance monitoring
18:00	CG/ET complete round of performance
18:30	CG/ET shut injection skid/compressor down for the day and begin to wrap up. Final totalizer
	readings are collected and the total volume injection for the day is 2,563 gallons
18:45	CG/ET offsite

Signature: Christopher R. Stidder

Daily Field Report

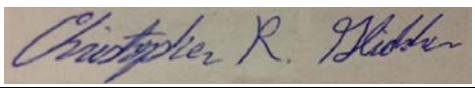
Project Name: Fort Drum
Page 1 of 2
Project Number: GP14DRUM.0001.0008C
Date 6/25/2015
Site Location: Fort Drum - Building 1885
ARCADIS Personnel: Christopher Glidden / Eli Thomas
Subcontractor(s): NA

Equipment on-site: 6,900 gal. poly tank, C185 air compressor, secondary containments, permanganate totes, injection skid including pumps , manifold and chemical hosing

Weather/Unusual Conditions: Sunny 72 degrees

Scope of Work: Todays tasks include continuation of sodium permanganate injection, performance monitoring, collecting field data inlcuding totalizers, pressure and flow rates

Time	Description of Activities
7:00	CG/ET arrive at ARCADIS/PIKA trailer to conduct daily safety meeting
7:20	CG/ET finish safety meeting and commute from trailer over 1885 site
7:30	CG/ET perform site specific tailgate and discuss todays tasks which include the following:
	- making minor adjustments to injection skid operation procedures
	- continue injecting half batch of solution in 6,900 gallon tank
	- mix batch 2 of permanganate and continue injection on IW-22, IW-23, IW-26, IW-28, IW-29,
	IW-30, IW-31, IW-32 IW-33, IW-34 and IW-35
	- performance monitoring and inspection of totalizers, pressure and flow
8:30	CG/ET start up injection after circulating solution that sat overnight
9:55	CG/ET complete injection of batch 1. CG begins transferring contents of tote 2 into 6,900 gallon
	poly tank
10:30	concentrate transferred over to the 6,900 gallon poly
10:40	CG/ET begin transfer of water from hydrant to 6,900 gallon tank
11:45	transfer of water complete. CG/ET offsite to get lunch and stop at hardware store for injection
	supplies
13:20	CG/ET back onsite and begin circulating solution
13:50	CG/ET begin injecting batch 2
14:28	CG/ET perform round of performance monitoring
17:11	CG/ET perform additional round of performance monitoring
17:45	CG/ET finish batch 2 and begin clean up for the day
18:15	7,607 gallons of solution injected over the course of the day
	CG/ET offsite

Signature: 

Daily Field Report

Project Name: Fort Drum | **Page** 1 of 1

Project Number: GP14DRUM.0001.0008C | **Date** 6/26/2015

Site Location: Fort Drum - Building 1885

ARCADIS Personnel: Christopher Glidden / Eli Thomas

Subcontractor(s): NA

Equipment on-site: 6,900 gal. poly tank, C185 air compressor, secondary containments, permanganate totes, injection skid including pumps , manifold and chemical hosing

Weather/Unusual Conditions: Sunny 72 degrees

Scope of Work: Todays tasks include continuation of sodium permanganate injection, performance monitoring, collecting field data inlcuding totalizers, pressure and flow rates

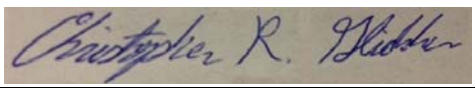
Time	Description of Activities
7:00	CG/ET arrive at ARCADIS/PIKA trailer to conduct daily safety meeting
7:20	CG/ET finish safety meeting and commute from trailer over 1885 site
7:30	CG/ET perform site specific tailgate and discuss todays tasks which include the following:
	- making minor adjustments to injection skid operation procedures
	- mix batch 3 of permanganate and continue injection on IW-22, IW-23, IW-26, IW-28, IW-29,
	IW-30, IW-31, IW-32 IW-33, IW-34 and IW-35
	- performance monitoring and inspection of totalizers, pressure and flow
8:00	CG/ET begin transferring concentrate from the tote to the 6,900 gallon poly tank
8:30	concentrate transfer is complete
8:35	CG/ET begin transferring water from the hydrant to the 6,900 gallon tank
9:20	water transfer complete. CG/ET circulate solution in 6,900 gallon tank
9:30	CG/ET begin injection batch 3
10:46	CG/ET round of performance monitoring on IMW-3, IMW-5, IMW-6, PCERI-25S and PCERI-25I
11:45	CG/ET shut down skid as batch 3 injection is complete
13:40	CG/ET prepare batch 4 and begin circulating solution
14:00	CG/ET begin injecting batch 4
16:05	CG/ET stop injecting batch 4 and begin cleaning up for the weekend
16:30	CG/ET offsite

Signature: Christopher R. Glidden

Daily Field Report

Project Name:	**Fort Drum**	**Page**	1 of 1
Project Number:	**GP14DRUM.0001.0008C**	**Date**	**6/30/2015**
Site Location:	**Fort Drum - Building 1885**		
ARCADIS Personnel:	**Christopher Glidden / Eli Thomas**		
Subcontractor(s):	**NA**		
Equipment on-site:	**6,900 gal. poly tank, C185 air compressor, secondary containments, permanganate totes, injection skid including pumps , manifold and chemical hosing**		
Weather/Unusual Conditions:	**Rain 58 degrees**		
Scope of Work:	**Todays tasks include continuation of sodium permanganate injection, performance monitoring, collecting field data inlcuding totalizers, pressure and flow rates**		

Time	Description of Activities
7:00	CG/ET arrive at ARCADIS/PIKA trailer to conduct daily safety meeting
7:15	CG/ET finish safety meeting and commute from trailer over 1885 site
7:30	CG/ET perform site specific tailgate and discuss todays tasks which include the following:
	- making minor adjustments to injection skid operation procedures
	- circulate remainder of batch 4 permanganate solution and continue injection on IW-22, IW-23,
	IW-26, IW-28, IW-29, IW-30, IW-31, IW-32 IW-33, IW-34 and IW-35
	- performance monitoring and inspection of totalizers, pressure and flow
7:45	CG/ET add water to 6,900 gallon tank and circulate solution left from 6/26 operation
8:20	CG/ET begin injecting remainder of batch 4
10:24	CG/ET begin round of performance monitoring at IMW-3, IMW-5, IMW-6, PCERI-25S, PCERI-25I
11:00	Batch 4 injection complete. CT/E begin transferring concentrate into 6,900 gallon tank
11:25	concentrate transfer complete. CG/ET begin filling tank with water from hydrant
12:25	CG/ET complete preparation of batch 5. offsite for lunch
13:25	CG/ET back onsite and begin circulating mixture prior to starting injection
14:00	CG/ET start injecting batch 5
17:05	CG/ET complete injection of batch 5
17:15	Final totalizer readings taken for the day and prep for switch over to second transect of wells
18:05	CG/ET offsite

Signature: 

Daily Field Report

Project Name: Fort Drum | **Page** 1 of 2

Project Number: GP14DRUM.0001.0008C | **Date** 7/1/2015

Site Location: Fort Drum - Building 1885

ARCADIS Personnel: Christopher Glidden / Eli Thomas

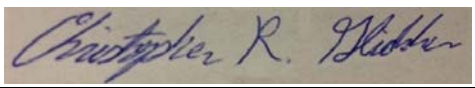
Subcontractor(s): NA

Equipment on-site: 6,900 gal. poly tank, C185 air compressor, secondary containments, permanganate totes, injection skid including pumps , manifold and chemical hosing

Weather/Unusual Conditions: Rain 60 degrees

Scope of Work: Todays tasks include continuation of sodium permanganate injection, performance monitoring, collecting field data inlcuding totalizers, pressure and flow rates

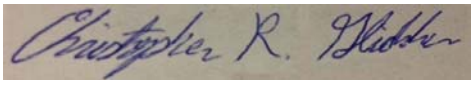
Time	Description of Activities
7:00	CG/ET arrive at ARCADIS/PIKA trailer to conduct daily safety meeting
7:15	CG/ET finish safety meeting and commute from trailer over 1885 site
7:30	CG/ET perform site specific tailgate and discuss todays tasks which include the following:
	- making minor adjustments to injection skid operation procedures
	- complete final batch (#6), flush lines and begin switchover to transect #2 consisting of;
	IW-12, IW-13, IW-14, IW-15, IW-16, IW-17, IW-18, IW-19, IW-20, IW-21, IW-24 and IW-25
	- performance monitoring and inspection of totalizers, pressure and flow
7:40	CG/ET offsite to get diesel and allow rain to subside
8:00	CG/ET back onsite and begin prepping to mix batch 6
8:20	CG/ET begin transferring comcentrate into 6,900 gallon tank
8:55	CG/ET complete concentrate transfer and begin adding water from hydrant
10:00	CG/ET complete the water transfer and begin circulating solution
10:15	ET begins round of performance monitoring
10:27	CG/ET begin injecting with the plan to shut down wells when totalizer reach limit for proposed
	volume
12:02	CG/ET shut down for lunch. IW-33 and IW-31 shutdown during timeframe as target volumes have
	been reach
13:13	CG/ET back onsite and continue injecting batch 6
15:11	CG/ET begin another round of performance monitoring on IMW-3, IMW-5, IMW-6, PCERI-25S and
	PCERI-25I
15:32	CG shuts down injection skid as batch 6 injection is complete
15:40	CG begins transferrring ~250 gallons of water in small storage tank for system flush

Signature: 

ARCADIS

Project Name: **Fort Drum** **Page** 2 of 2

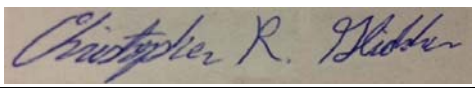
Time	Description of Activities
15:47	CG begins flushing system for breakdown and move to transect #2
16:00	CG begins moving wellhead manifolds and injection lines over the new injections wells as follows;
	IW-12, IW-13, IW-14, IW-15, IW-16, IW-17, IW-18, IW19, IW-20, IW-21, IW-24 and IW-25
18:00	Switchover is complete and start totalizers recorded. Batch 7 preparred during switchover
18:20	CG/ET offsite

Signature: 

Daily Field Report

Project Name:	**Fort Drum**	**Page**	1 of 1
Project Number:	**GP14DRUM.0001.0008C**	**Date**	**7/2/2015**
Site Location:	**Fort Drum - Building 1885**		
ARCADIS Personnel:	**Christopher Glidden / Eli Thomas**		
Subcontractor(s):	**NA**		
Equipment on-site:	**6,900 gal. poly tank, C185 air compressor, secondary containments, permanganate totes, injection skid including pumps , manifold and chemical hosing**		
Weather/Unusual Conditions:	**Rain 60 degrees**		
Scope of Work:	**Todays tasks include continuation of sodium permanganate injection, performance monitoring, collecting field data inlcuding totalizers, pressure and flow rates**		

Time	Description of Activities
7:00	CG/ET arrive at ARCADIS/PIKA trailer to conduct daily safety meeting
7:20	CG/ET finishing safety meeting and commute from trailer over 1885 site
7:30	CG/ET perform site specific tailgate and discuss todays tasks which include the following:
	- making minor adjustments to injection skid operation procedures
	- start injecting batch 7 into new transect of wells which include the following wells;
	IW-12, IW-13, IW-14, IW-15, IW-16, IW-17, IW-18, IW-19, IW-20, IW-21, IW-24 and IW-25
	- performance monitoring and inspection of totalizers, pressure and flow
8:00	CG/ET circulating batch 7 and complete final preparations before starting injection
8:25	CG/ET begin injecting batch 7 on new set of wells
8:40	CG/ET dialing in manifolds to achieve good flow with minimal pressure
11:55	CG/ET complete injection of batch 7 and second transect of wells. Offsite for lunch and diesel
12:55	CG/ET back onsite and begin preparring batch 8
13:45	CG/ET complete batch preparation and begin injecting batch 8
14:02	CG/ET begin round of performance monitoring on IMW-3, IMW-5, IMW-6, PCERI-25S and PCERI-25I
16:00	CG/ET stop injection and flush ~100 gallons of water through skid for the weekend
16:20	CG/ET finishing cleaning up for weekend break
16:25	CG/ET offsite

Signature: 

Daily Field Report

Project Name: Fort Drum | **Page** 1 of 1

Project Number: GP14DRUM.0001.0008C | **Date** 7/6/2015

Site Location: Fort Drum - Building 1885

ARCADIS Personnel: Christopher Glidden / Eli Thomas

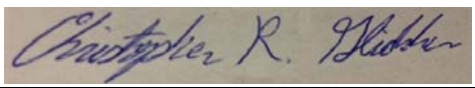
Subcontractor(s): NA

Equipment on-site: 6,900 gal. poly tank, C185 air compressor, secondary containments, permanganate totes, injection skid including pumps , manifold and chemical hosing

Weather/Unusual Conditions: Rain 60 degrees

Scope of Work: Todays tasks include continuation of sodium permanganate injection, performance monitoring, collecting field data inlcuding totalizers, pressure and flow rates

Time	Description of Activities
7:00	CG/ET arrive at ARCADIS/PIKA trailer to conduct daily safety meeting
7:20	CG/ET finishing safety meeting and commute from trailer over 1885 site
7:30	CG/ET perform site specific tailgate and discuss todays tasks which include the following:
	- making minor adjustments to injection skid operation procedures
	- continue injecting batch 8 into second transect which include the following wells;
	IW-12, IW-13, IW-14, IW-15, IW-16, IW-17, IW-18, IW-19, IW-20, IW-21, IW-24 and IW-25
	- performance monitoring and inspection of totalizers, pressure and flow
7:40	Start injecting remainder of Batch 8
8:00	Batch 8 injection complete. Start transfer of concentrate and water into 6,900 gallon tank
8:40	Concentrate and water added to tank. CG/ET circulate solution
8:55	Start injection of batch 9 on IW-12, IW-13, IW-14, IW-15, IW-16, IW-17, IW-18, IW-19, IW-20, IW-21
	IW-24, IW-25
11:10	CG/ET start round of performance monitoring at IMW-3, IMW-5, IMW-6, PCERI-25S and PCERI-25I
11:35	Batch 9 injection is complete. CG/ET begin transfer of concentrate and water in 6,900 gallon tank
12:25	Batch 10 transferred and mixed. CG/ET offsite for lunch and to get a power washer
13:25	CG/ET back onsite and start injecting Batch 10
13:40	CG/ET begin cleaning poly totes with power washer
16:05	Batch 10 injection complete. CG/ET start concentrate/water transfer into 6,900 poly ank
17:00	CG/ET complete transfer and mixture of Batch 11 and start injecting
17:20	CG/ET start second round of performance monitoring
18:05	CG/ET shutdown injection skid, take final totalizers, and cleanup from days activities
18:20	CG/ET offsite

Signature: 

Daily Field Report

Project Name: Fort Drum | **Page** 1 of 1

Project Number: GP14DRUM.0001.0008C | **Date** 7/7/2015

Site Location: Fort Drum - Building 1885

ARCADIS Personnel: Christopher Glidden / Eli Thomas

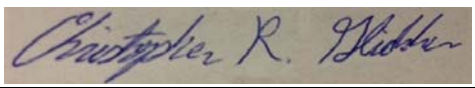
Subcontractor(s): NA

Equipment on-site: 6,900 gal. poly tank, C185 air compressor, secondary containments, permanganate totes, injection skid including pumps , manifold and chemical hosing

Weather/Unusual Conditions: Rain 60 degrees

Scope of Work: Todays tasks include continuation of sodium permanganate injection, performance monitoring, collecting field data inlcuding totalizers, pressure and flow rates

Time	Description of Activities
7:00	CG/ET arrive at ARCADIS/PIKA trailer to conduct daily safety meeting
7:20	CG/ET finishing safety meeting and commute from trailer over 1885 site
7:30	CG/ET perform site specific tailgate and discuss todays tasks which include the following:
	- making minor adjustments to injection skid operation procedures
	- continue injecting batch 11 into second transect which include the following wells;
	IW-12, IW-13, IW-14, IW-16, IW-17, IW-18, IW-19, IW-20, IW-21, IW-24 and IW-25
	- switch over to IW-9, IW-10 and IW-11 as injection wells in transect two reach target volumes
	- performance monitoring and inspection of totalizers, pressure and flow
7:35	CG/ET start up skid and continue injecting batch 11
9:45	Batch 11 injection is complete. Concentrate and water transfer start for Batch 12
10:25	Start of injection performance monitoring round
10:45	Injection resumes with Batch 12
12:15	Injection stopped for lunch and to get diesel for the compressor
13:30	CG/ET back onsite. Injection resumes.
16:40	CG/ET stop injection for the day and begin to clean up.
	- IW-9, IW-10 and IW-11 started during the day
	- Injection at IW-13, IW-14, IW-18, IW-19, IW-20, IW-21, IW-24 and IW-25 complete
17:15	CG/ET offsite for the day

Signature: 

ARCADIS

Daily Field Report

Project Name:	Fort Drum	**Page**	1 of 1
Project Number:	GP14DRUM.0001.0008C	**Date**	7/8/2015
Site Location:	Fort Drum - Building 1885		
ARCADIS Personnel:	Christopher Glidden / Eli Thomas		
Subcontractor(s):	NA		
Equipment on-site:	6,900 gal. poly tank, C185 air compressor, secondary containments, permanganate totes, injection skid including pumps , manifold and chemical hosing		
Weather/Unusual Conditions:	Rain 60 degrees		
Scope of Work:	Todays tasks include continuation of sodium permanganate injection, performance monitoring, collecting field data inlcuding totalizers, pressure and flow rates		

Time	Description of Activities
7:00	CG/ET arrive at ARCADIS/PIKA trailer to conduct daily safety meeting
7:20	CG/ET finishing safety meeting and commute from trailer over 1885 site
7:30	CG/ET perform site specific tailgate and discuss todays tasks which include the following:
	- making minor adjustments to injection skid operation procedures
	- continue injecting batch 12 into second/third transect which include the following wells;
	IW-9, IW-10, IW-11, IW-12, IW-16 and IW-17.
	- performance monitoring and inspection of totalizers, pressure and flow
7:45	Start injection with remainder of batch 12
8:12	Batch 12 injection complete. CG/ET begin transfer of concentrate and water
9:25	Batch 13 transfer and mixture complete
9:30	Start injection of batch 13
10:00	CG/ET begin round of performance monitoring
12:00	CG/ET stop for lunch and to get diesel or compressor
13:00	CG/ET back onsite and resume injection of batch 13
15:35	Injection of batch 13 is complete. CG/ET begin transferring concentrate and water
16:45	CG/ET finish batch 14 preparation and begin injecting
16:55	CG/ET begin round of performance monitoring
18:43	CG/ET shut down injection for the day with roughly 4,000 gallons od solution remaining
18:45	CG/ET offsite for the day
	- Injection on IW-10, IW-11, IW-12 and IW-17 complete
	- Setup of injection leg to IW-1 through IW-6 complete

Signature: Christopher R. Glidden

Daily Field Report

Project Name: Fort Drum
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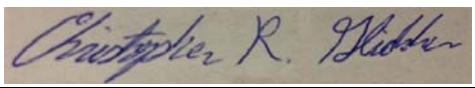
Project Number: GP14DRUM.0001.0008C
Date 7/9/2015
Site Location: Fort Drum - Building 1885
ARCADIS Personnel: Eli Thomas
Subcontractor(s): NA

Equipment on-site: 6,900 gal. poly tank, C185 air compressor, secondary containments, permanganate totes, injection skid including pumps , manifold and chemical hosing

Weather/Unusual Conditions: Rain 60 degrees

Scope of Work: Todays tasks include continuation of sodium permanganate injection, performance monitoring, collecting field data inlcuding totalizers, pressure and flow rates

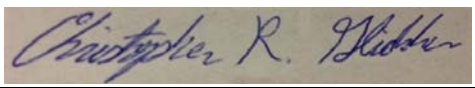
Time	Description of Activities
7:00	ET arrive at ARCADIS/PIKA trailer to conduct daily safety meeting
7:20	ET finish safety meeting and commute from trailer over 1885 site
7:30	ET perform site specific tailgate and discuss todays tasks which include the following:
	- making minor adjustments to injection skid operation procedures
	- continue injecting batch 14 into second/third transect which include the following wells;
	IW-8, IW-9 and IW-16
	- performance monitoring and inspection of totalizers, pressure and flow
8:53	ET begins round of performance monitoring
10:00	Injection of batch 14 continues on IW-8, IW-9 and IW-16
12:00	ET offsite for lunch
13:00	ET back onsite to continue injection
14:03	ET begins second round of performance monitoring
15:35	Injection on IW-8, IW-9 and IW-16 is complete. ET begins cleaning up for the day
16:00	ET offsite

Signature: 

Daily Field Report

Project Name:	**Fort Drum**	**Page**	1 of 1
Project Number:	**GP14DRUM.0001.0008C**	**Date**	**7/10/2015**
Site Location:	**Fort Drum - Building 1885**		
ARCADIS Personnel:	**Christopher Glidden / Eli Thomas**		
Subcontractor(s):	**NA**		
Equipment on-site:	**6,900 gal. poly tank, C185 air compressor, secondary containments, permanganate totes, injection skid including pumps , manifold and chemical hosing**		
Weather/Unusual Conditions:	**Rain 60 degrees**		
Scope of Work:	**Todays tasks include continuation of sodium permanganate injection, performance monitoring, collecting field data inlcuding totalizers, pressure and flow rates**		

Time	Description of Activities
7:00	CG/ET arrive at ARCADIS/PIKA trailer to conduct daily safety meeting
7:20	CG/ET finishsafety meeting and commute from trailer over 1885 site
7:30	CG/ET perform site specific tailgate and discuss todays tasks which include the following:
	- making minor adjustments to injection skid operation procedures
	- mix and inject batch 15 into third transect which include the following wells;
	IW-1, IW-2, IW-3, IW-4, IW-5 and IW-6
	- performance monitoring and inspection of totalizers, pressure and flow
7:50	CG/ET begin transferring concentrate and water into 6,900 gallon poly tank
9:30	CG/ET complete transfer and begin circulating while inspecting new leg to IW-1 through IW-6
9:50	CG/ET begin injection of batch 15
10:25	CG/ET being round of performance monitoring
12:00	CG/ET shut down skid for the day and begin cleaning up for the weekend
12:15	CG/ET offsite for the day

Signature: 

Daily Field Report

Project Name: Fort Drum | **Page** 1 of 1

Project Number: GP14DRUM.0001.0008C | **Date** 7/13/2015

Site Location: Fort Drum - Building 1885

ARCADIS Personnel: Christopher Glidden / Eli Thomas

Subcontractor(s): NA

Equipment on-site: 6,900 gal. poly tank, C185 air compressor, secondary containments, permanganate totes, injection skid including pumps , manifold and chemical hosing

Weather/Unusual Conditions: Rain 60 degrees

Scope of Work: Todays tasks include continuation of sodium permanganate injection, performance monitoring, collecting field data inlcuding totalizers, pressure and flow rates

Time	Description of Activities
7:00	CG arrive at ARCADIS/PIKA trailer to conduct daily safety meeting
7:20	CG finish safety meeting and commute from trailer over 1885 site
7:30	CG perform site specific tailgate:
	- making minor adjustments to injection skid operation procedures
	- inject batch 15 into third transect under gravity conditions which include the following wells;
	IW-1, IW-2, IW-3, IW-4, IW-5 and IW-6 until Eli arrives onsite
	- performance monitoring and inspection of totalizers, pressure and flow
7:45	CG begins gravity injection of batch 15 to IW-1 through IW-6
8:00	CG begins cleaning out totes so Slack Chemical can take them offsite
12:15	CG offsite for lunch and to get nuetralizing supplies
13:35	CG back onsite to continue injecting on IW-1 through IW-6
14:15	ET arrives onsite. CG/ET begin injecting under pumping conditions
15:35	Injection of batch 15 complete. CG/ET begin preparing batch 16
16:45	CG/ET complete preparation of batch 16 and begin injecting
17:15	CG/ET begin round of performance monitoring
18:05	CG/ET shut down skid for the day and begin cleaning up
18:20	CG/ET offsite
	- Injection at IW-6 complete. IW-7 injection started today

Signature: Christopher R. Glidden

Daily Field Report

Project Name: Fort Drum | **Page** 1 of 1

Project Number: GP14DRUM.0001.0008C | **Date** 7/14/2015

Site Location: Fort Drum - Building 1885

ARCADIS Personnel: Christopher Glidden / Eli Thomas

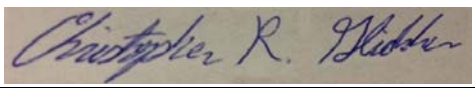
Subcontractor(s): NA

Equipment on-site: 6,900 gal. poly tank, C185 air compressor, secondary containments, permanganate totes, injection skid including pumps , manifold and chemical hosing

Weather/Unusual Conditions: Rain 60 degrees

Scope of Work: Todays tasks include continuation of sodium permanganate injection, performance monitoring, collecting field data inlcuding totalizers, pressure and flow rates

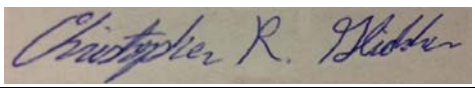
Time	Description of Activities
7:00	CG/ET arrive at ARCADIS/PIKA trailer to conduct daily safety meeting
7:20	CG/ET finish safety meeting and commute from trailer over 1885 site
7:30	CG/ET perform site specific tailgate and discuss todays tasks which include the following:
	- making minor adjustments to injection skid operation procedures
	- continue injecting batch 16 into third transect which include the following wells;
	IW-1, IW-2, IW-3, IW-4, IW-5 and IW-7
	- performance monitoring and inspection of totalizers, pressure and flow
7:45	CG/ET continue injecting batch 16 in IW-1 through 5 and IW-7
11:30	CG/ET complete batch 16 and do some housekeeping
12:00	CG/ET offsite for lunch and diesel
13:05	CG/ET back onsite and begin transferring concentrate and water for batch 17
14:05	CG/ET begin round of performance monitoring while tank fills
15:25	CG/ET complete preparation of batch 17 and begin injection
17:10	CG/ET stop injection for the day and begin cleaning up
17:20	CG/ET offsite for lunch and diesel
	- Injection on IW-5 and IW-7 complete

Signature: 

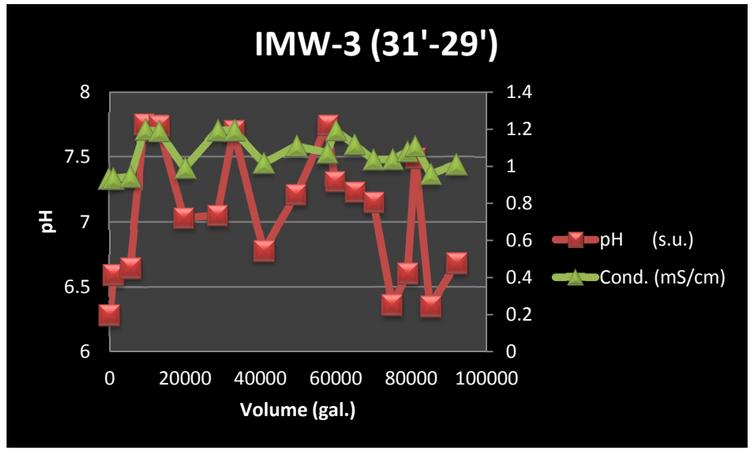
Daily Field Report

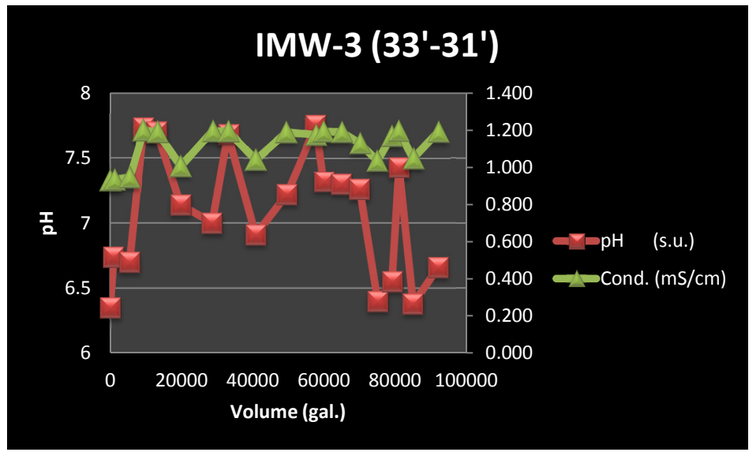
Project Name:	**Fort Drum**	**Page**	1 of 1
Project Number:	**GP14DRUM.0001.0008C**	**Date**	**7/15/2015**
Site Location:	**Fort Drum - Building 1885**		
ARCADIS Personnel:	**Christopher Glidden / Eli Thomas**		
Subcontractor(s):	**NA**		
Equipment on-site:	**6,900 gal. poly tank, C185 air compressor, secondary containments, permanganate totes, injection skid including pumps , manifold and chemical hosing**		
Weather/Unusual Conditions:	**Rain 60 degrees**		
Scope of Work:	**Todays tasks include continuation of sodium permanganate injection, performance monitoring, collecting field data inlcuding totalizers, pressure and flow rates**		

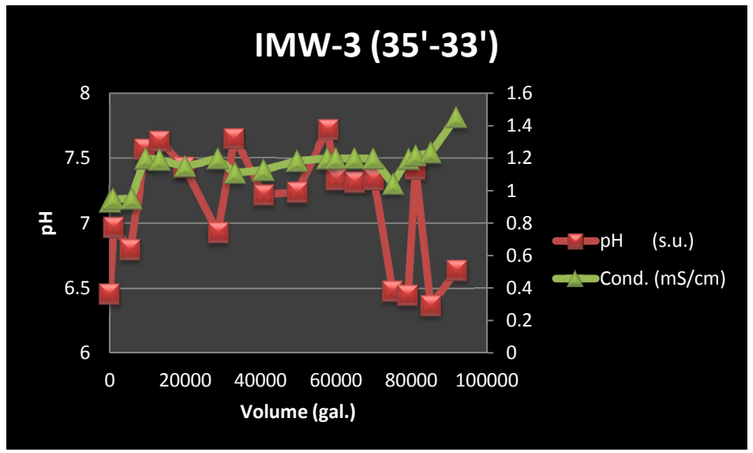
Time	Description of Activities
7:00	CG/ET arrive at ARCADIS/PIKA trailer to conduct daily safety meeting
7:20	CG/ET finish safety meeting and commute from trailer over 1885 site
7:30	CG/ET perform site specific tailgate and discuss todays tasks which include the following:
	- making minor adjustments to injection skid operation procedures
	- continue injecting batch 16 into third transect which include the following wells;
	IW-1, IW-2, IW-3 and IW-4
	- performance monitoring and inspection of totalizers, pressure and flow
	- performance system rinse and breakdown
7:35	CG/ET continue injecting batch 17 on IW-1 through IW-4
8:30	CG/ET begin breaking down concentrate containments
11:35	CG/ET complete the rest of batch 17 and begin flushing water through the lines
12:15	CG/ET offsite for lunch and diesel for air compressor
13:15	CG/ET back onsite and continue flush of the system
14:15	CG/ET begin breaking system components down and cleaning containment
15:00	CG/ET continue with breakdown and start loading truck to bring equipment over to 2140 building
16:50	CG/ET run load of equipment over to 2140 location
17:30	CG/ET back onsite and continue loading equipment that is going back to Manchester, CT
18:15	CG/ET complete the truck loadings and secure the remaining equipment for the night. ET coming back in the a.m. to clean up remaining equipment.
18:25	CG/ET offsite for the day

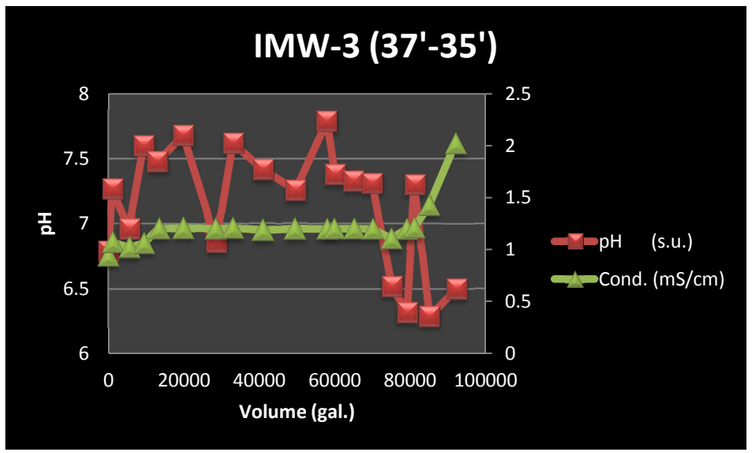
Signature: 

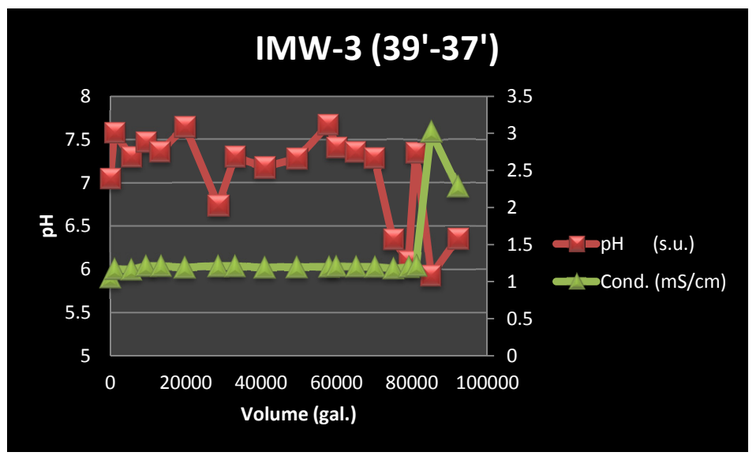
IMW-3
pH and Conductivity Measurements
Fort Drum IRP - 3800 Area PCE Site



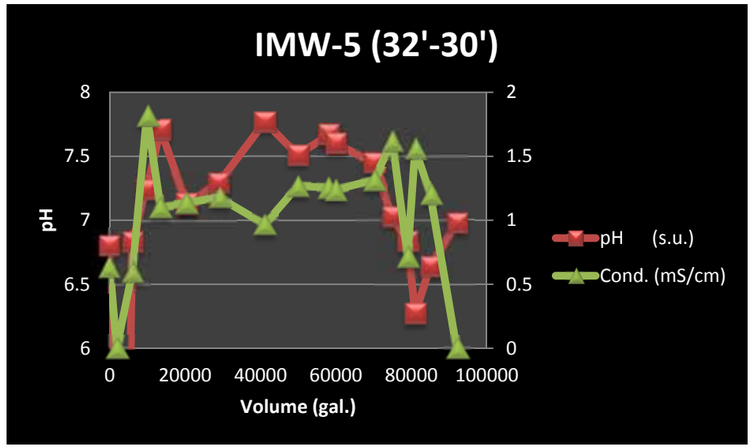


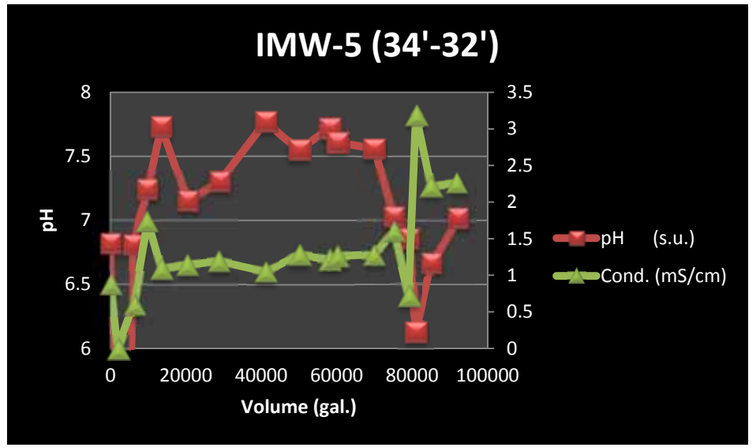


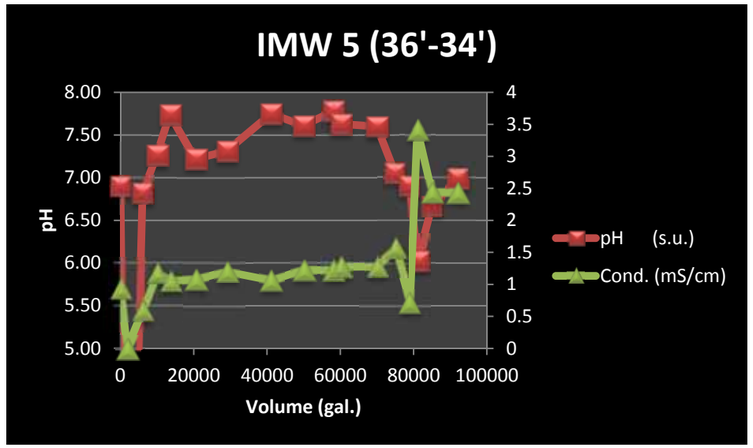


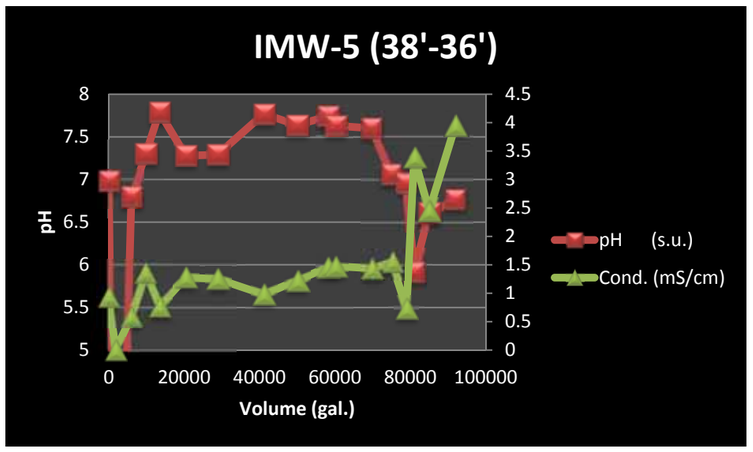


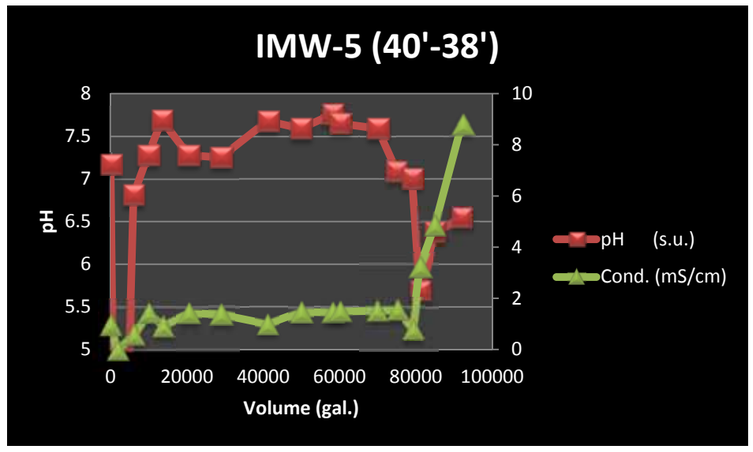
IMW-5
pH and Conductivity Measurements
Fort Drum IRP - 3800 Area PCE Site



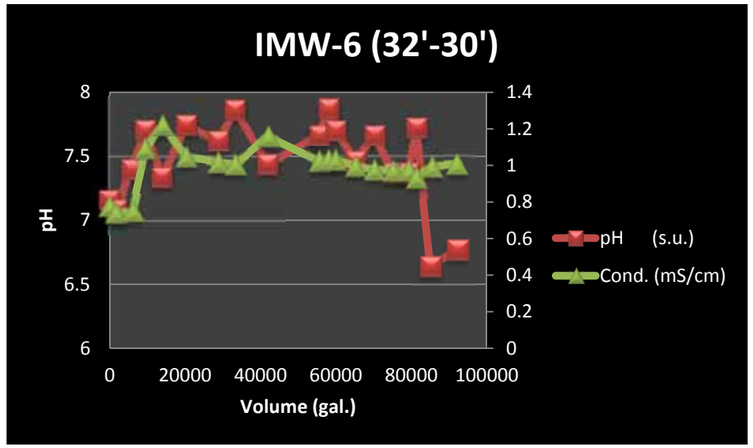


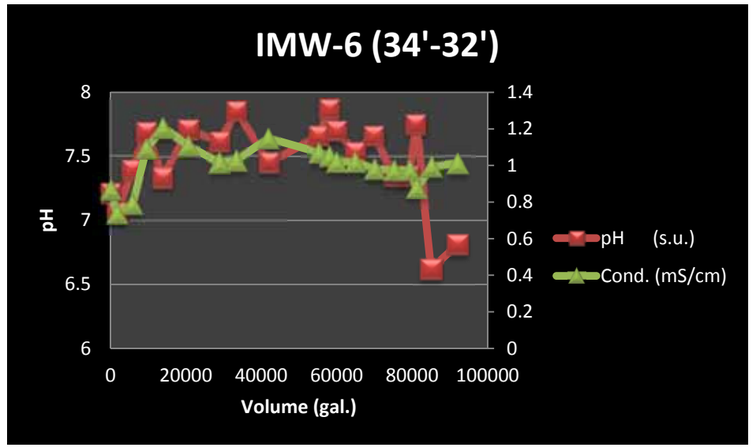


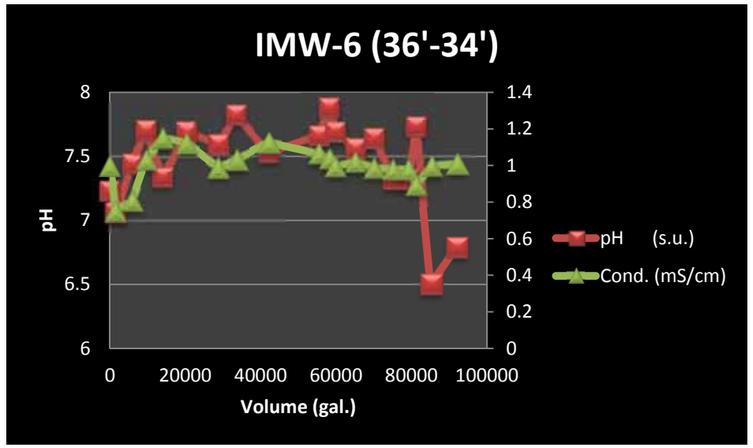


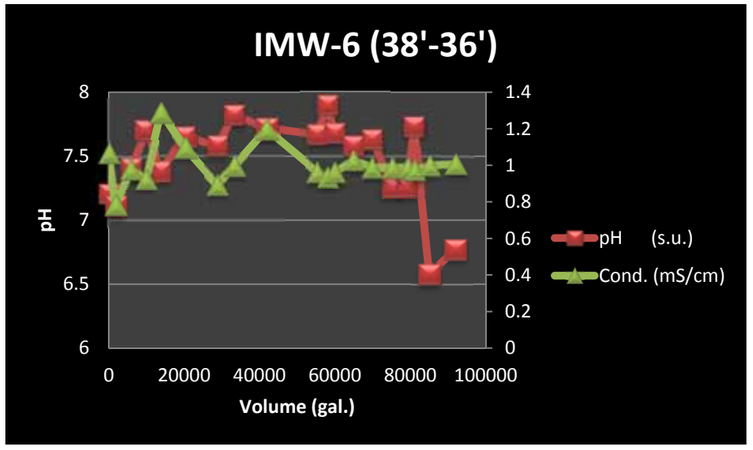


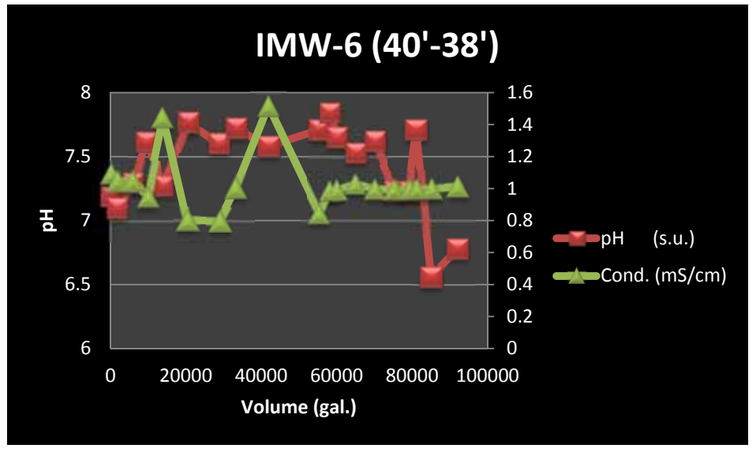
IMW-6
pH and Conductivity Measurements
Fort Drum IRP - 3800 Area PCE Site



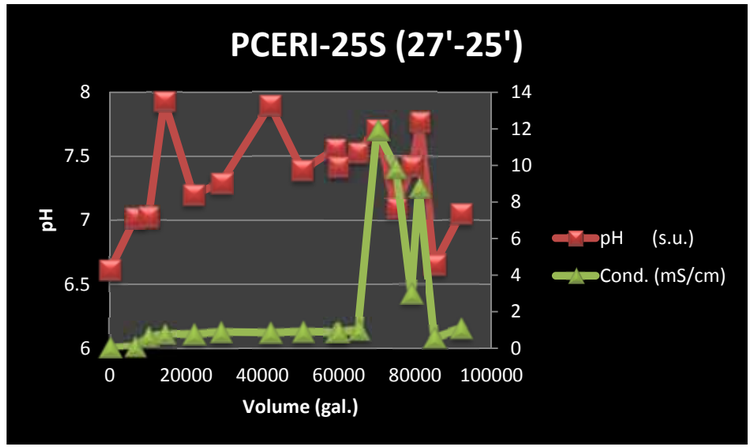


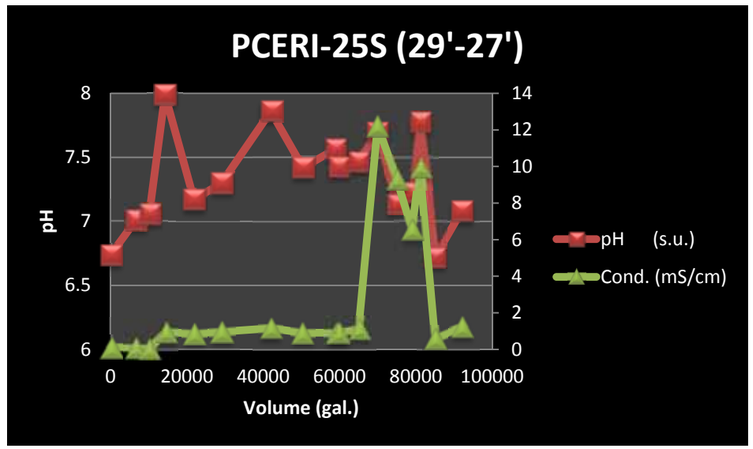


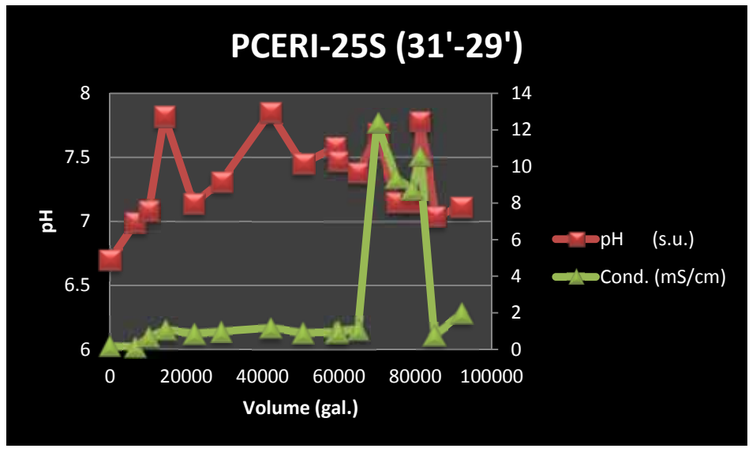


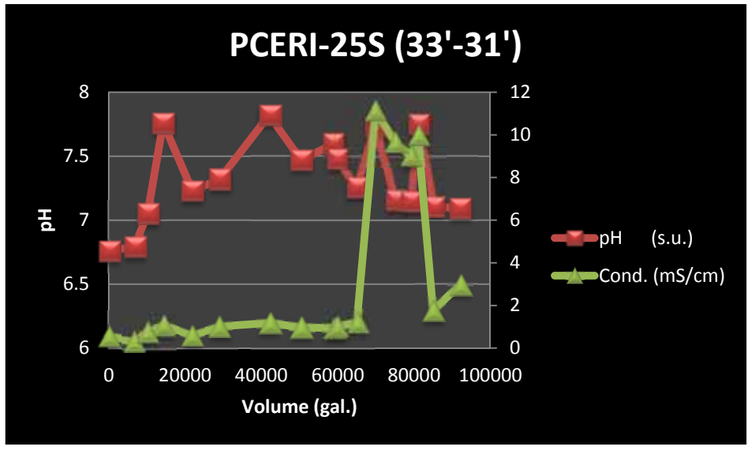


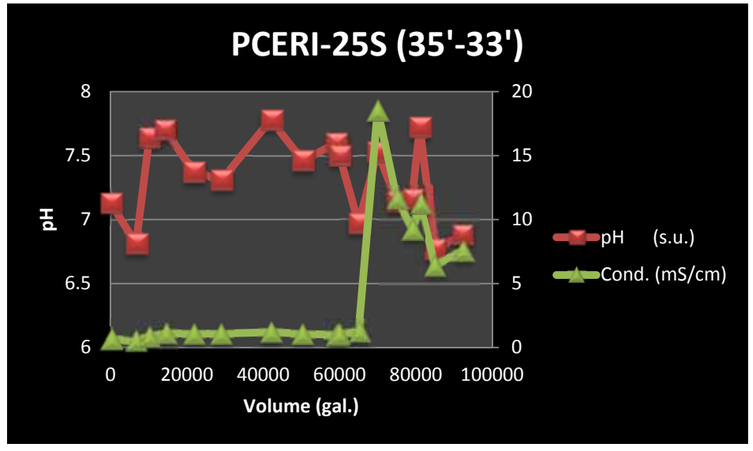
PCERI-25S
pH and Conductivity Measurements
Fort Drum IRP - 3800 Area PCE Site











PCERI-25I
pH and Conductivity Measurements
Fort Drum IRP - 3800 Area PCE Site