

24 July 2013

Mr. Bob Williams
Oregon Department of Environmental Quality
Northwest Region Portland Office
2020 SW 4th Avenue, Suite 400
Portland OR 97201

Subject: Work Plan for Installation of TGA Monitoring Well and Pumping Plan
Cascade Troutdale Gravel Aquifer (TGA)
Fairview, Oregon
DEQ ECSI #635

Dear Bob:

Geosyntec Consultants (Geosyntec) has prepared this Work Plan on behalf of Cascade Corporation (Cascade) to describe the installation of a new groundwater monitoring well associated with the Cascade Troutdale Gravel Aquifer (TGA) remedy. This Work Plan has been prepared in response to the 3 April 2013 Oregon Department of Environmental Quality (DEQ) letter to Cascade and The Boeing Company (Boeing) regarding the *Boeing Portland, Cascade TGA Review and TSA Remedy Mound Area Well Installations*.

In that letter, DEQ requested installation of a single well in the TGA to evaluate trichloroethene (TCE) concentrations near the east end of the existing mulch biowall (biowall). The purpose of the well is to evaluate potential migration of TCE around the east end of the biowall and possibly into a sewer line/utility backfill the runs parallel to NE 201st Avenue. DEQ also proposed that Cascade consider pumping groundwater from this well to more quickly capture a larger radius of groundwater. Analytical data from the proposed monitoring well, and data obtained during pumping of the well, will be used to evaluate data gaps identified for TCE migration in the TGA near the eastern end of the biowall and along NE 201st Avenue.

The purpose of this Work Plan is to provide DEQ with details for the proposed monitoring well location(s), installation and construction specifications, and groundwater sampling and analysis. A plan is also presented herein for the planned pumping rates and duration, including pump and pipe specifications, schedule, and supporting calculations.

PROPOSED MONITORING WELL

Location

The proposed monitoring well will be located east of the existing biowall and west of the sewer line/utility backfill (Figure 1). The well was placed at a location where a radius of influence from pumping should intersect both the end of the biowall and the utility backfill. In addition, the well location was selected based on overhead and underground utility clearance.

A test pit was completed on 20 June 2013 at the eastern end of the biowall to more accurately place the well in the field relative to the biowall. The east-west trending biowall was located along the southern portion of the access road, approximately 10-feet below ground surface (bgs), and terminated approximately 10 feet west of the fence. The eastern end of the biowall was marked in the field with a stake and flagging on the fence. The biowall was surveyed by a licensed surveyor (Chase Jones & Associates) and tied into the existing site datum.

The proposed well location is outside the property line (fence); therefore, Cascade will obtain a right-of-way permit from the City of Gresham. If the right-of-way permit is not provided by the City of Gresham, or if other obstacles are present, an alternate location is shown on Figure 1. Preliminary correspondence with the City of Gresham indicates that the first-proposed location is acceptable.

Well Specifications

Drilling and monitoring well installation will be performed by an Oregon-licensed and bonded well driller using a compact roto-sonic (Sonic™) drilling rig. The rig will be equipped with a short mast because overhead power lines are adjacent to the proposed well. Drilling and well installation methods will be conducted in accordance with Oregon Water Resource Department (OWRD) regulations. Underground utilities will be located and start cards will be obtained from the OWRD prior to drilling.

The proposed well depth is approximately 20-feet bgs, targeted at the base of the TGA above confining unit 1 (CU1). Continuous core soil sampling will be performed from ground surface to the total drill depth, approximately one foot into the CU1. The cores will be lithologically logged using visual-manual methods in general accordance with the American Society for Testing and Materials (ASTM) D 2488 procedures.

The monitoring well will be constructed of 4-inch diameter, schedule 40 or 80 PVC, with a 10-foot long and 10-slot (0.01-inch) screen size. The monitoring well screen will be placed at the base of the TGA, and above CU1, approximately 10-20 feet bgs. Prior to well installation, the portion of the boring within CU1 will be backfill with hydrated bentonite chips or a bentonite grout.

Following well installation, the well will be developed by pumping and surging until low turbidity conditions are measured (<50 nephelometric turbidity units [NTUs]) or 10-well volumes have been removed.

A groundwater sample will be obtained using low flow sampling methods or a disposable bailer following well development. The groundwater sample will be submitted for analytical testing of TCE (and other VOCs) on a standard (5-day) turn-around time. Additional details regarding sampling and analysis are provided below. If TCE concentrations are higher than concentrations expected based on surrounding monitoring well data (i.e. greater than 30 micrograms per liter [$\mu\text{g/L}$]), pumping will *not* commence and additional sampling and potential additional monitoring well locations will be evaluated in consultation with DEQ and Boeing. For reference, the highest TCE detection was 15 $\mu\text{g/L}$ at Manhole 18 during the 2000 storm line sampling event (Prowell Environmental, 2000), and TCE concentrations in monitoring wells north and south of the biowall ranged from <0.5 to 12 $\mu\text{g/L}$ during the 2012 and 2013 groundwater monitoring events (Prowell Environmental, 2013). Data from nearby monitoring wells will also be used for evaluating TCE concentrations detected in the new well. Existing TGA wells are scheduled for sampling in August 2013. In addition, select TGA wells (MW-35s, MW-47a, MW-47b, MW-48a, and MW-48b) that are located close to the new well will be resampled at Day 28 of the pump test.

If TCE concentrations in the initial samples are *not* elevated (i.e. less than 30 $\mu\text{g/L}$), a pump will be placed in the well and pumped for approximately 28 days to induce a radius of influence that will intersect both the sewer line and the eastern end of the biowall. We estimate pumping for approximately 20 days to achieve the radius of influence necessary for one pore water exchange at limit of influence based on a minimum pumping rate of 1 gallon per minute (gpm). The radius of influence was calculated to be approximately 17 feet, which is sufficient to overlap the east end of the biowall and sewer/utility line backfill. However, due to uncertainties regarding the extent of capture, we propose to pump for 28 days or until 40,000 gallons have been pumped (Ref: SSPA Memorandum dated May 9, 2013, Attachment A).

Pumping and Water Discharge

A Grundfos RediFlo3 SQE-NE electrical submersible pump will be installed in the well. The wellhead, flow meter, and pump controls will be located in a 36-inch x 36-inch Model 4242-LA floorless concrete vault provided by Oldcastle Precast and buried at grade level. Electricity will be supplied to the vault via a combination of underground conduit, buried beneath the access road, and conduit placed above ground and connected to the Central Treatment System (CTS). The proposed vault set up and water discharge lines are shown in a schematic cross-section drawing (Figure 2).

A 1 ¼-inch polyvinyl chloride (PVC) water discharge pipe will be buried approximately 2-feet bgs from the wellhead to the opposite side of the access road near the edge of the Poplar Tree field. The PVC pipe section will run beneath the access road in a 3-inch diameter, steel containment pipe. The discharge pipe will be placed at ground level from the west side of the roadway and will extend to the CTS where water will be discharged.

Water levels will be measured weekly to evaluate drawdown in the well. In addition, water levels will also be measured weekly in adjacent monitoring wells MW-35s, MW-47a, MW-47b, MW-48a, and MW-48b to evaluate whether or not the target radius of influence has been achieved. Water levels will be measured once the pumping is completed to evaluate re-equilibration. Water levels will be measured using pressure transducers, a depth to water meter, or both.

Biofouling Prevention

Biological activity reaction tests were conducted on groundwater samples collected from existing monitoring wells MW-35s and MW-48b to test for heterotrophic aerobic bacteria (HAB) and sulfate reducing bacteria (SRB). Analytical results are provided in Attachment B.

The test results indicated the presence of highly aggressive, aerobic, slime-forming bacteria. The bacteria could biofoul the CTS air stripper, which would affect performance of the system. Based on the test results, a biodegradable, non-halogenated biocide will be fed into a temporary transfer pipe via a small metering pump prior to discharge into the CTS air stripper. The biocide drum and pump will be located inside the fenced area at the CTS. The proposed water discharge line is shown on Figure 1 and the proposed flow-through set up is shown on Figure 2.

Groundwater Sampling and Analysis

Groundwater sampling will be completed the day following pump activation and then at weekly intervals thereafter (e.g. Day 0, Day 7, Day 14, Day 21, and Day 28 and weekly thereafter if pumping continues for more than 28 days). Nearby monitoring wells to be sampled during the August sampling event include MW-35s, MW-47a, MW-47b, MW-48a, and MW-48b; these wells will again be sampled at Day 28 of the pump test.

Groundwater samples will be obtained from a sampling port installed in-line at the wellhead. Groundwater samples will be submitted to ESC Lab Sciences (ESC) for analysis of volatile organic compounds (VOCs) by EPA Method 8260.

DATA EVALUATION AND REPORTING

The weekly TCE (and VOC) data will be evaluated to determine the magnitude of TCE at and in the near vicinity of the proposed monitoring well. Results of the groundwater sampling and pumping information will be communicated in a brief letter report to DEQ.

The results of the initial sampling event will be shared with DEQ and The Boeing Company informally (via e-mail). In addition, following receipt of the weekly analytical data, DEQ and Boeing will be provided with the analytical results while the pumping test is in-progress. Once the final (Day 28) sample is obtained, Cascade will turn off the pump. However, during the course of the pumping test, Cascade will evaluate whether or not additional pumping and groundwater sampling may be necessary beyond the planned 28-day time period.

SCHEDULE

The proposed schedule is provided below, and is dependent on DEQ approval of this work plan.

Approximate Date	Task
June 19	Install test pit; survey to locate biowall
June – July	Permitting
August	Drill and complete monitoring well, develop, obtain initial groundwater sample
August	Trenching and vault install
August	Final set up and hook up to control panel
August	Begin pumping
August-September	Groundwater Sampling Events

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REFERENCES

Prowell Environmental, 2000. 201st Avenue Storm Line Migration Pathway Evaluation. 17 July 2000.

Prowell Environmental, 2013. TGA 2012 Year-End Semiannual Performance Report, July 1 through December 31, 2012. 28 February 2013.

CLOSURE

We look forward to your review and approval of this Work Plan. Please contact us at (503) 222-9518 with any questions regarding this submittal or if you need additional information.

Sincerely,

Geosyntec Consultants, Inc.



Cindy Bartlett, RG
Geologist



Brent Miller, PE
Associate Engineer

Cc: John Cushing, Cascade Corp.
Charlie Andrews, SSPA
Ken Chaput, The Boeing Co.
Eric Weber and Chris Kimmel, Landau Assoc.

Attachments:

Figure 1 – Site Location and Proposed TGA Monitoring Well Location

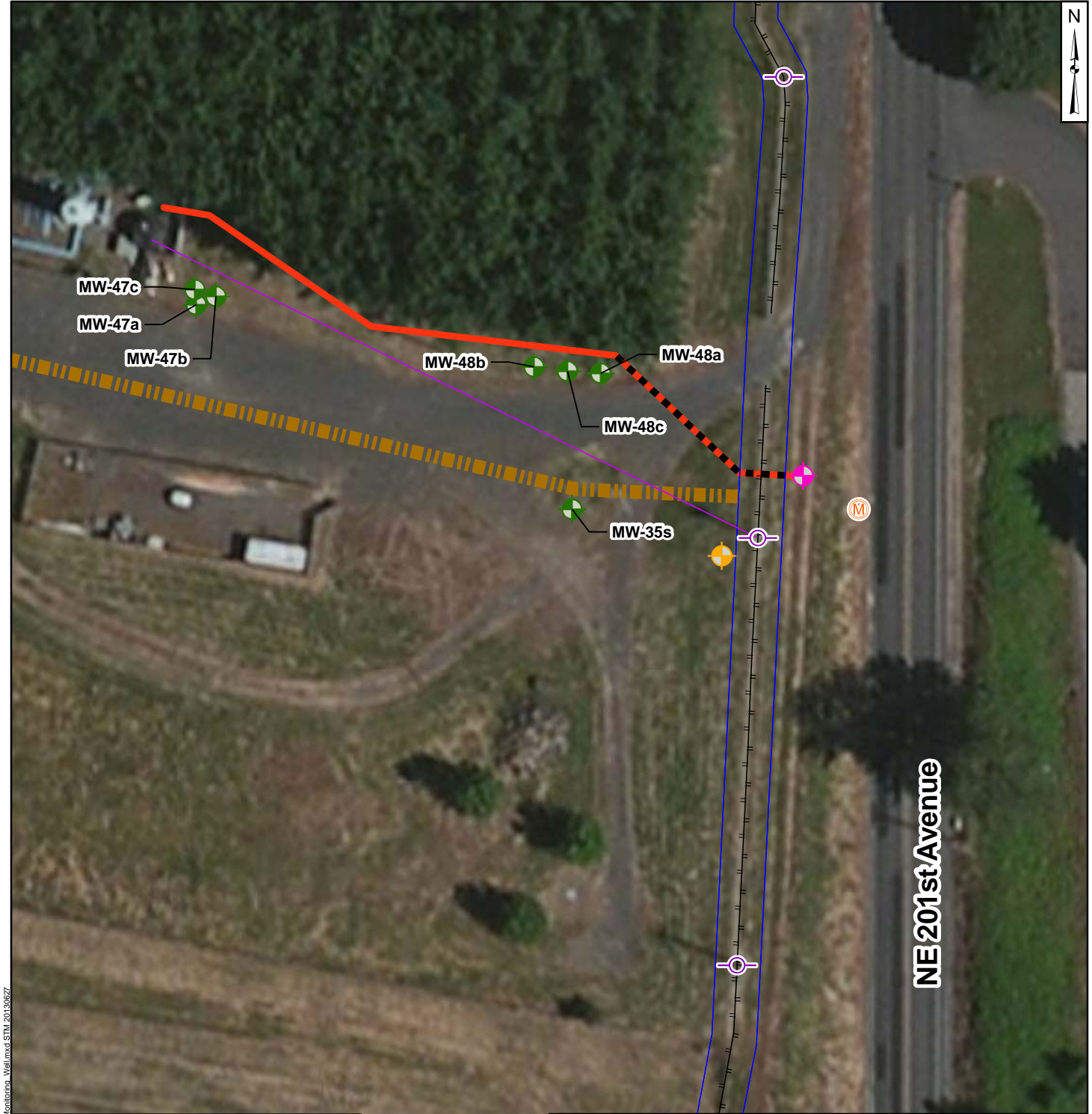
Figure 2 – Proposed New TGA Monitoring / Pumping Well Conceptual Layout; Vault Details

Attachment A – SSPA, New Cascade TGA Well dated 9 May 2013.

Attachment B – Analytix Technologies, LLC, Evaluation of Potential for Biofouling of Groundwater Remediation System dated 10 June 2013.










PNG0564G.2/Final TGA New MW WP.docx

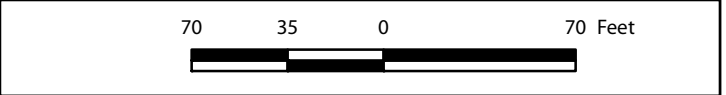
FIGURES



S:\SantaBarbara\01\1\GIS\SPN\00664 - Cascade\Projects\ER01 - Proposed New TGA Monitoring Well.mxd STM_20130827

Legend

-  Monitoring Well
-  Proposed Monitoring / Pumping Well
-  Alternative Proposed Monitoring / Pumping Well
-  Man Hole Cover
-  Power Pole
-  Above-Ground Discharge Line
-  Under-Ground Discharge Line
-  Fence and Property Line
-  Mulch Biowall
- Overhead Powerline to Central Treatment System
- Powerline



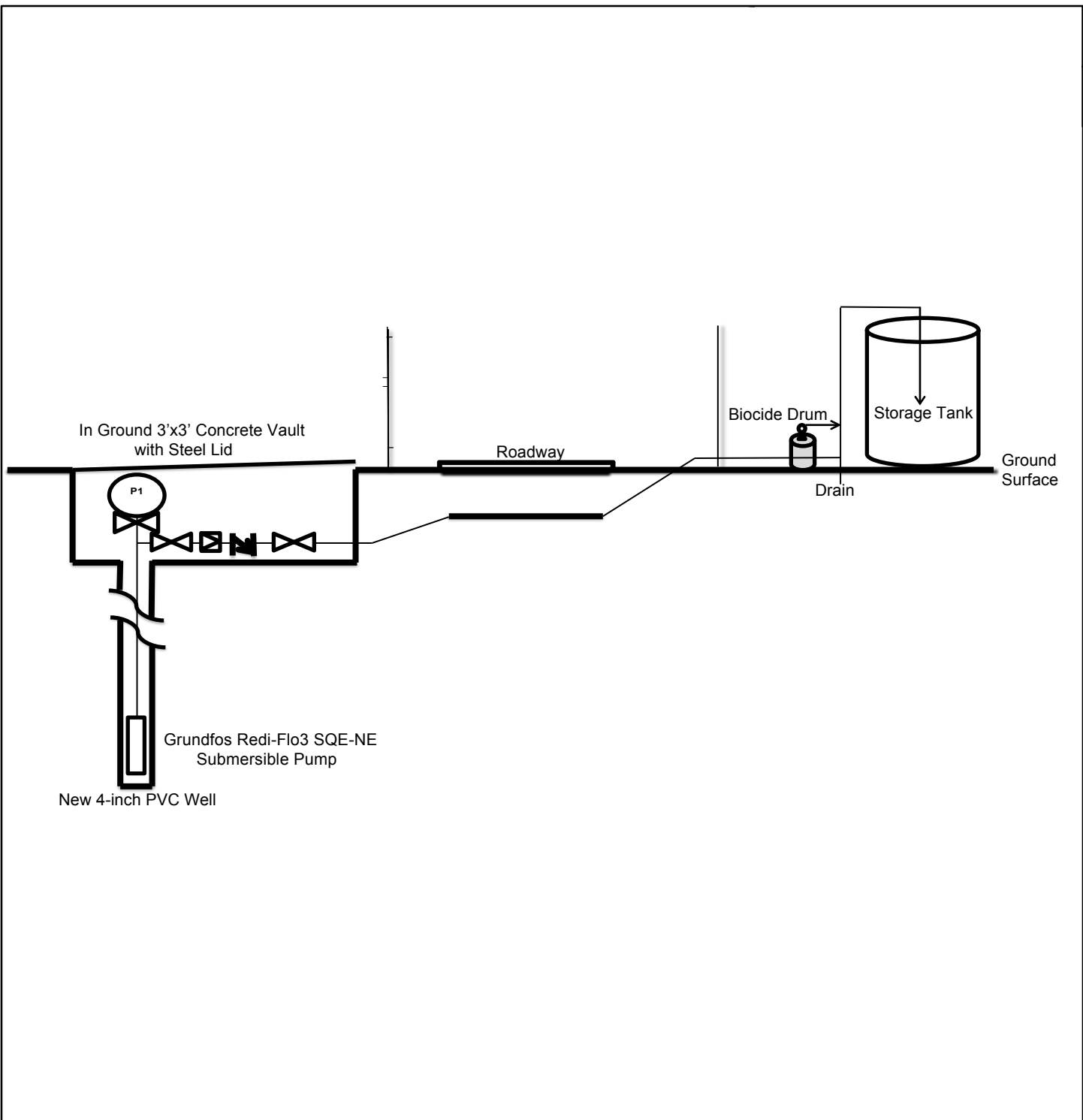
Proposed New TGA Monitoring / Pumping Well Location
 Fairview, Oregon











Figure
1

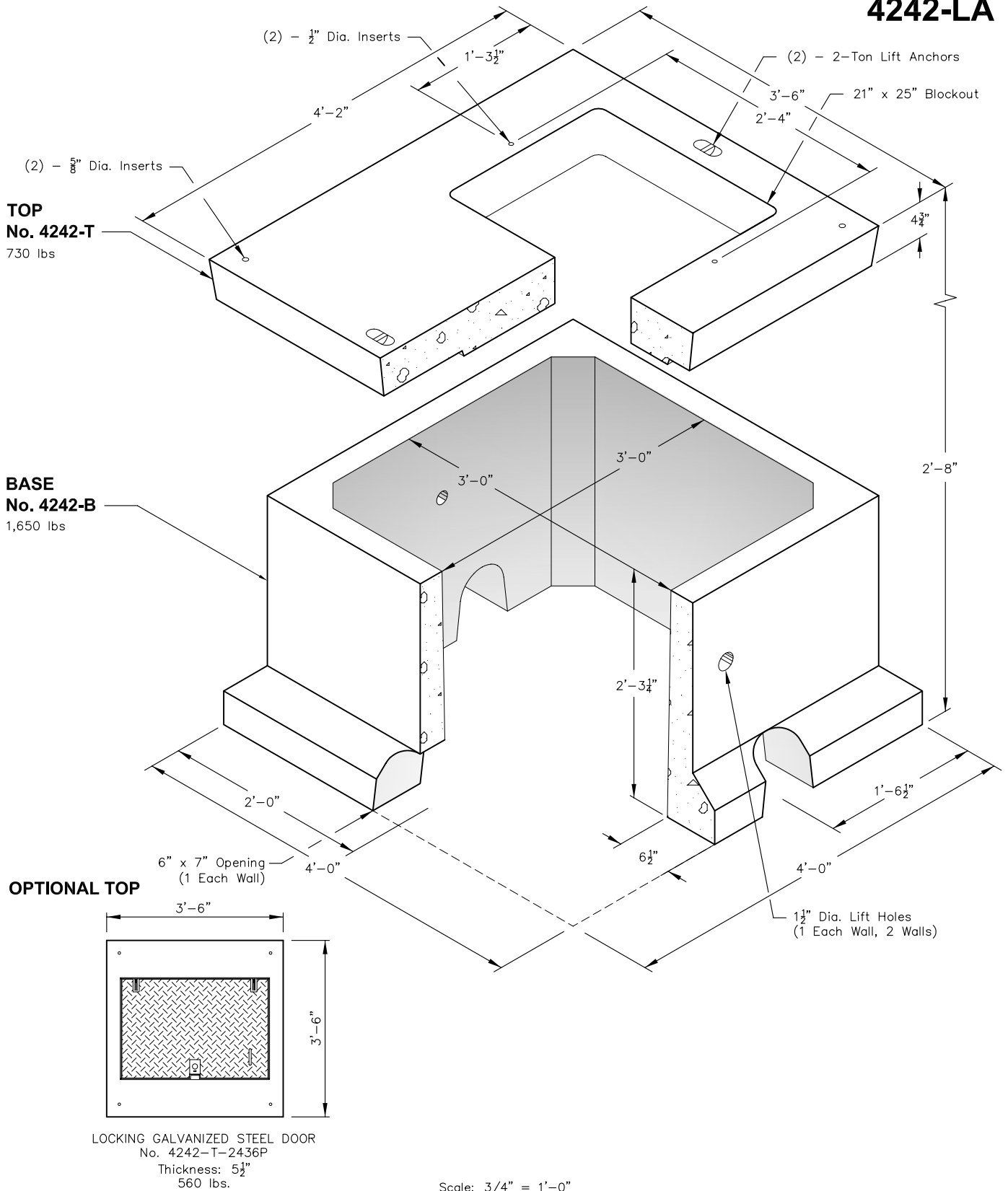
Santa Barbara


June 2013



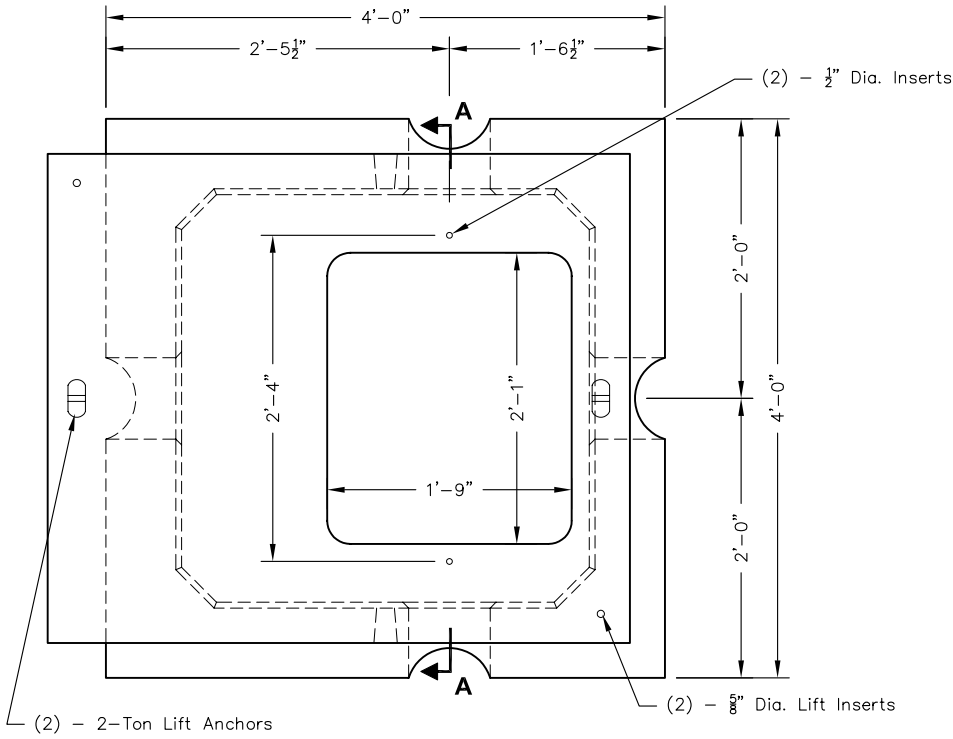
Legend  Valve  Flow Meter  Pressure Gauge  Check Valve  Fence and Property Line  3-inch Steel Containment Pipe  2-inch PVC Discharge Line	NOT TO SCALE		
	Proposed New TGA Monitoring / Pumping Well Conceptual Layout Cascade Corporation Fairview, Oregon		
	 Geosyntec consultants		Figure 2
	Seattle	June 2013	

4242-LA

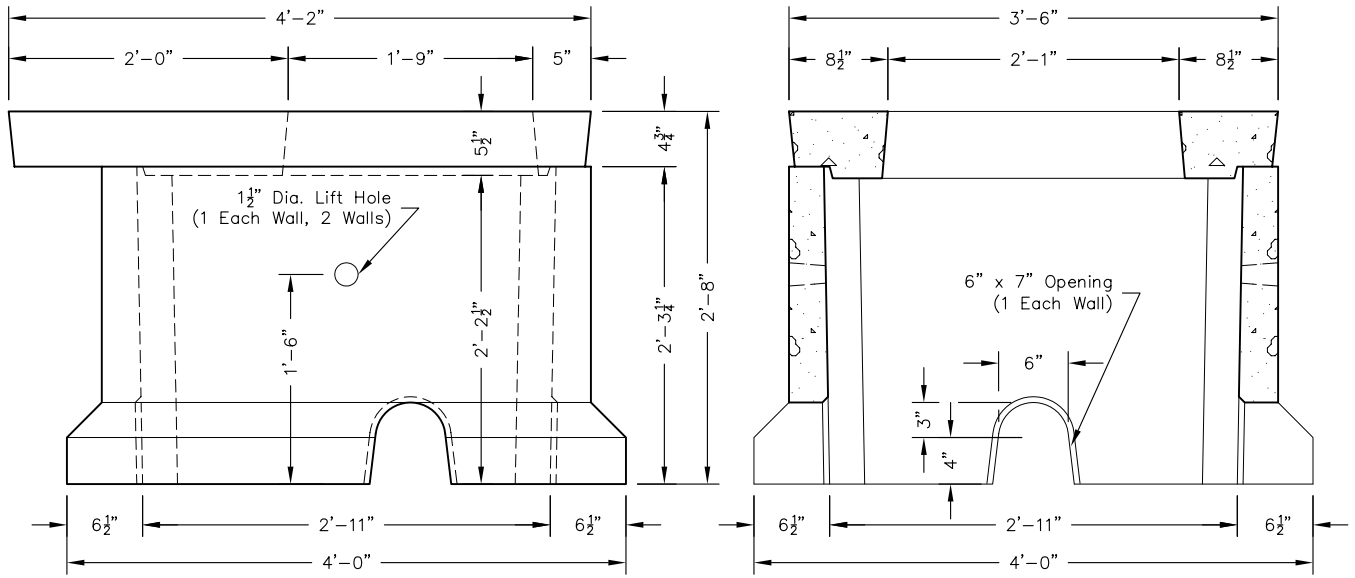


 Oldcastle Precast [®] PO Box 323, Wilsonville, Oregon 97070-0323 Tel: (503) 682-2844 Fax: (503) 682-2657	4242-LA	4242-LA 36 x 36 POWER / WATER / GAS
	File Name: 020UCP4242LA1	
	Issue Date: 2011	
oldcastleprecast.com/wilsonville		

4242-LA




PLAN VIEW



SIDE VIEW

SECTION AA

Scale: 3/4" = 1'-0"

 Oldcastle Precast [®] PO Box 323, Wilsonville, Oregon 97070-0323 Tel: (503) 682-2844 Fax: (503) 682-2657	4242-LA	4242-LA 36 x 36 POWER / WATER / GAS
	File Name: 020UCP4242LA2	
	Issue Date: 2011	
	oldcastleprecast.com/wilsonville	

ATTACHMENT A

**SSPA, 9 May 2013
New Cascade TGA Well Technical
Memorandum**



Memorandum

Date: May 9, 2013
From: Charles Andrews
To: File
Subject: **New Cascade TGA Well**

Some approximation for estimating time of pumping of a new TGA well.

Objective:

Pump well sufficiently long to intercept water at the sewer line.

Parameter Values

Transmissivity (T) – 38 to 86 ft²/day (see Feb 24, 2012 semi-annual report)

Hydraulic Gradient (i): ~0.043 based on Feb 2013 data, ~0.03 based on August 2012 data
(based on head difference between B-6 and MW-35s)

Saturated Thickness: ~7 feet in August 2012, 12 feet in February 2013

Porosity: 0.35 (assumed)

Calculations

Flow rate of well --- estimate Q/s (specific capacity) as T/240 (rule of thumb)

$Q/s = 38/240 = 0.16$ gpm/ft of drawdown – assume 6' of drawdown, Q ~ 1 gpm
(use T that gives smallest value of specific capacity)

Distance from well to edge of capture zone in direction perpendicular to flow [distance = $Q/(4*T*i)$ -- use parameters values that give smallest width]

$$\text{Distance} = 192 \text{ ft}^3/\text{day} / (4*70 \text{ ft}^2/\text{day}*0.04) = 17 \text{ feet}$$



To: File
Date: May 9, 2013
Page: 2

Time of pumping to capture outward from well for 17'

Use approximation that flow is radial, volume of water within 17' of well is:

$$\text{Volume} = 17^2 \text{ feet} * 12 \text{ feet [saturated thickness]} * 0.35 \text{ [porosity]} * 3.14 = 3811 \text{ ft}^3$$

At pumping rate of 1 gpm (192 ft³/day), 20 days to remove 3,811 ft³

(note this is a rough approximation)

ATTACHMENT B

**Analytix Technologies, LLC, 10 June 2013
Evaluation of Potential for Biofouling of
Groundwater Remediation System**

Cascade Corporation, Fairview OR

Evaluation of Potential for Biofouling of Groundwater Remediation System

Wells MW-48B & MW-35S

Final Report Prepared For:

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Prepared By:

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281.286.7562

June 10, 2013

Introduction:

Biological fouling is a common problem in municipal, industrial, environmental, and oil & gas -field water treatment systems. Excessive, uncontrolled growth of bacteria and slime (biofilm) impacts the performance of water treatment system by plugging piping, equipment and extraction/reinjection wells. Microbially induced corrosion (MIC) could also be expected in presence of acid producing bacteria, such as SRB.

Water samples, collected from MW-48B and MW-35S were received on 6-4-2013 and evaluated for presence of heterotrophic aerobic bacteria (HAB) and sulfate reducing bacteria (SRB) using BART (biological activity reaction test) bioassay testers developed by Droycon Bioconcepts Inc. of Canada.

Background on BART Tester:

BART testers contain nutrients in the base of a cylindrical plastic column fitted with a floating ball. The ball restricts the amount of oxygen entering the water column so that aerobic organisms grow around the ball and anaerobic organisms grow deep down in the water column. By changing the nutrients in the base of the column different organisms can be encouraged to grow. BART determines presence and activity levels. The time taken for a color change (reaction) to occur gives a measure of the population size and activity. A color change occurs in the BART tube as a result of the oxygen gradient diffusing from the bottom upward. The change of color indicates a presence of bacteria within that sample. The usual duration of the tests is 1 to 9 days. There is no practical need to continue a tests if aggressive reaction is observed during the first few days.

HOW THE BART™ TEST WORKS

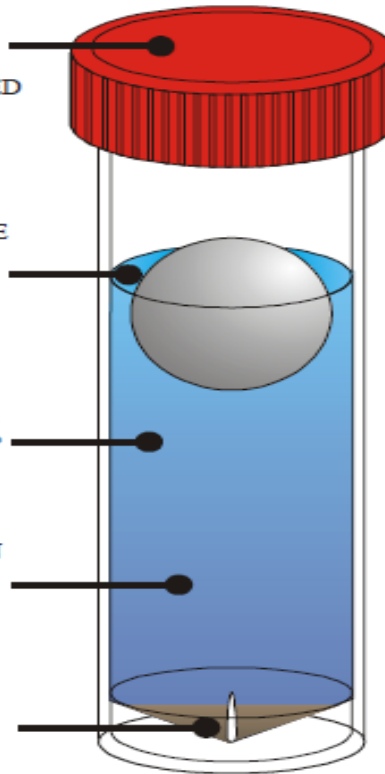
THE SCREW CAP SHOULD BE TIGHTENED ON THE BART TUBE SO THAT CASUAL LEAKAGE CAN BE PREVENTED IN THE CASE OF THE TUBE.

AEROBIC GROWTH OF BACTERIA WILL OCCUR AT THE SURFACE OF THE SAMPLE BETWEEN THE BART-BALL AND THE WALL OF THE BART™ TUBE.

FIFTEEN mL OF WATER SAMPLE IS USED TO BRING THE BART- BALL UP TO THE CORRECT LEVEL. NUTRIENTS WILL GRADUALLY DIFFUSE UP THE WATER COLUMN TO SUPPORT THIS BACTERIAL GROWTH.

ONCE THE OXYGEN HAS BEEN USED BY THE AEROBES, THIS ZONE BECOMES FREE OF OXYGEN AND ANAEROBIC GROWTH WILL DOMINATE.

NUTRIENT MEDIUM FOR GROWTH IS PROVIDED AS A STERILE DRIED PELLET ON THE FLOOR OF THE TUBE. DO NOT SHAKE.



BIOASSAY TEST RESULTS:

Annotated daily bioassay test results are shown on the following pages.

CASCADE MW-35S



06/04/2013

Sulfate Reducing Bacteria, SRB

Heterotrophic Aerobic Bacteria, HAB

CASCADE MW-48B



06/04/2013

Sulfate Reducing Bacteria, SRB

Heterotrophic Aerobic Bacteria, HAB

Figure 1.0 - Bioassay Test Results, Starting Day (Day 0)

CASCADE MW-35S



Sulfate Reducing Bacteria, SRB
No Reaction

Heterotrophic Aerobic Bacteria, HAB
No Reaction

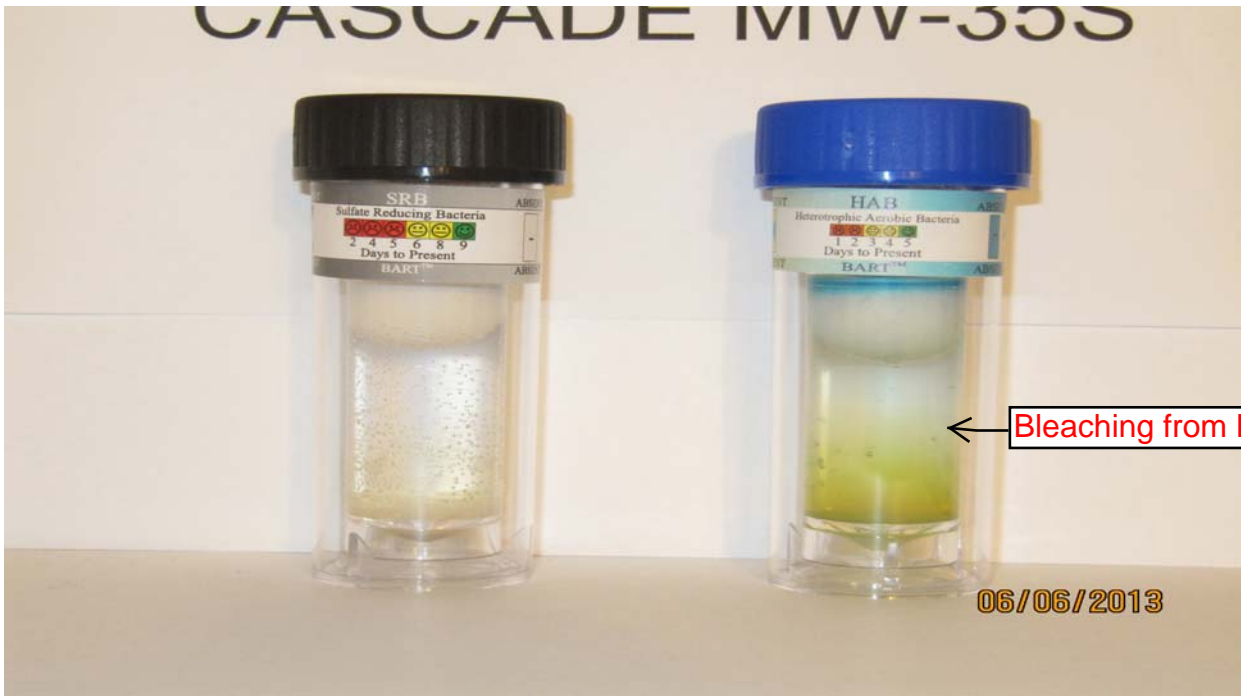
CASCADE MW-48B



Sulfate Reducing Bacteria, SRB
No Reaction

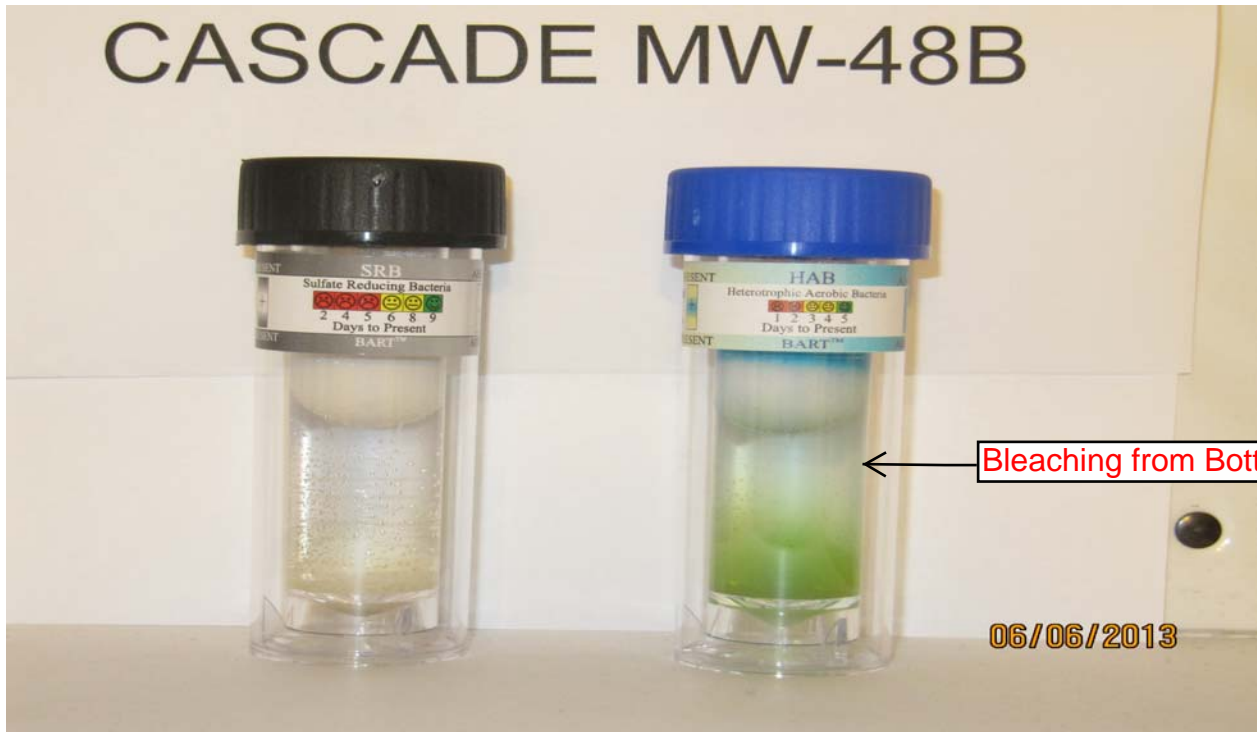
Heterotrophic Aerobic Bacteria, HAB
No Reaction

Figure 2.0 - Bioassay Test Results, Day 1



Sulfate Reducing Bacteria, SRB
No Reaction

Heterotrophic Aerobic Bacteria, HAB
Bleaching from Bottom Up
Highly Aggressive Aerobic Bacteria
approx population: 500,000 cfu/ml



Sulfate Reducing Bacteria, SRB
No Reaction

Heterotrophic Aerobic Bacteria, HAB
Bleaching from Bottom Up
Highly Aggressive Aerobic Bacteria
approx population: 500,000 cfu/ml

Figure 3.0 – Bioassay Test Results, Day 2

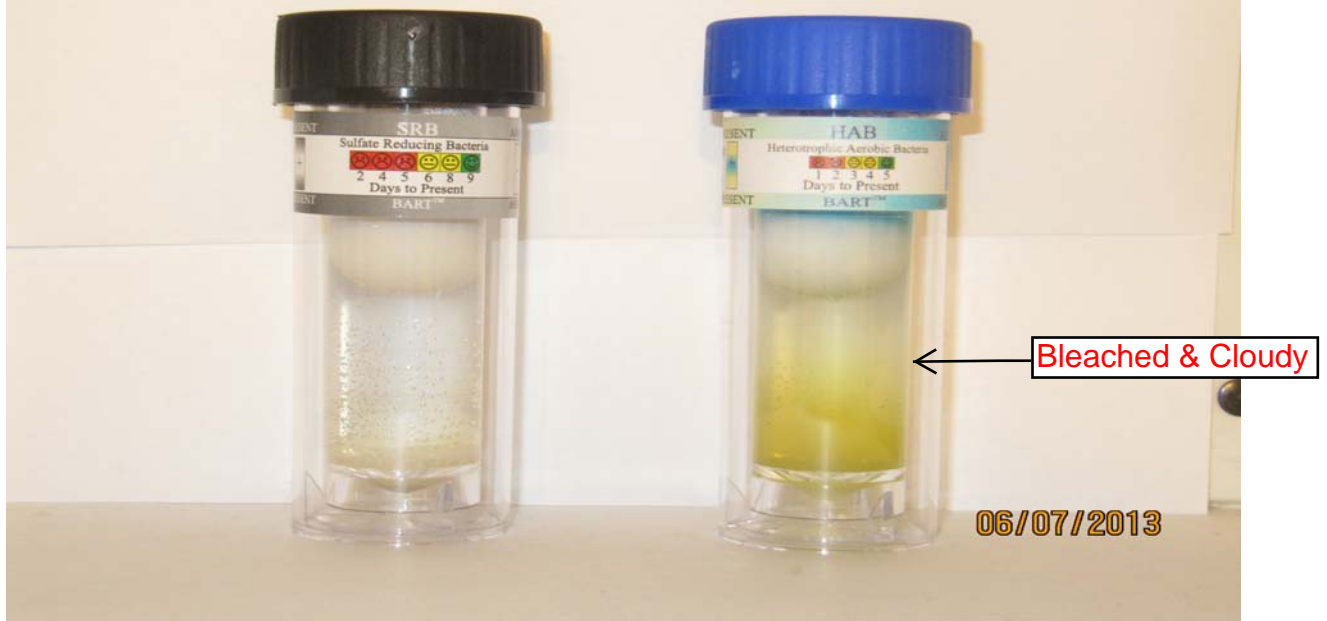
CASCADE MW-35S



Sulfate Reducing Bacteria, SRB
Base becoming Black,
Solution Becoming Cloudy
Anaerobic Bacteria

Heterotrophic Aerobic Bacteria, HAB
Bleached from Bottom Up, Cloudy
Highly Aggressive Aerobic Bacteria
approx population: 500,000 cfu/ml

CASCADE MW-48B



Sulfate Reducing Bacteria, SRB
No Reaction

Heterotrophic Aerobic Bacteria, HAB
Bleached from Bottom Up
Highly Aggressive Aerobic Bacteria
approx population: 500,000 cfu/mL

Figure 4.0 – Bioassay Test Results, Day 3



Sulfate Reducing Bacteria, SRB
Black Base, Solution Cloudy
Aggressive Anaerobic SRB
approx population: 18,000 cfu/mL

Heterotrophic Aerobic Bacteria, HAB
Bleached from Bottom Up, Cloudy
Highly Aggressive Aerobic Bacteria
approx population: 500,000 cfu/mL



Sulfate Reducing Bacteria, SRB
No Reaction

Heterotrophic Aerobic Bacteria, HAB
Bleached from Bottom Up, Cloudy
Highly Aggressive Aerobic Bacteria
approx population: 500,000 cfu/mL

Figure 5.0 – Bioassay Test Results, Day 4

CASCADE MW-35S



Sulfate Reducing Bacteria, SRB
Black Base, Solution Cloudy
Aggressive Anaerobic SRB
approx population: 18,000 cfu/mL

Heterotrophic Aerobic Bacteria, HAB
Bleached from Bottom Up, Cloudy
Highly Aggressive Aerobic Bacteria
approx population: 500,000 cfu/mL

CASCADE MW-48B



Sulfate Reducing Bacteria, SRB
No Reaction

Heterotrophic Aerobic Bacteria, HAB
Bleached from Bottom Up, Cloudy
Highly Aggressive Aerobic Bacteria
approx population 500,000 cfu/mL

Figure 6.0 – Bioassay Test Results, Day 5

CASCADE MW-35S



Sulfate Reducing Bacteria, SRB
Black Base, Solution Cloudy
Aggressive Anaerobic SRB
approx population: 18,000 cfu/mL

Heterotrophic Aerobic Bacteria, HAB
Bleached from Bottom Up, Cloudy
Highly Aggressive Aerobic Bacteria
approx population: 500,000 cfu/mL

CASCADE MW-48B



Sulfate Reducing Bacteria, SRB
Solution Becoming Cloudy
Anaerobic Bacteria Present
approximate population: 1200 cfu/mL

Heterotrophic Aerobic Bacteria, HAB
Bleached from Bottom Up, Cloudy Solution
Highly Aggressive Aerobic Bacteria
approx population 500,000 cfu/mL

Figure 7.0 – Bioassay Test Results, Day 6

Conclusions:

Treatment System Issues:

Biofouling:

The bioassay test results indicate presence of highly aggressive aerobic slime-forming bacteria (HAB) in both wells MW-48B and MW-35S within two days of starting the bioassay tests. Highly aggressive anaerobic SRB bacteria are detected in well MW-35S sample within 3 days of starting the bioassay tests.

Glue-like slime and bacteria extracted from or near these wells will gradually foul the treatment system, affecting system O&M and performance. The influent water should be pretreated continuously or intermittently with a biocide to control bacteria / slime growth.

The choice of biocide depends on the design, operation, and discharge permit conditions of the remediation system.

Organic biodegradable non-halogenated biocides are preferred if the system effluent is polished by liquid phase activated carbon prior to discharge to surface water or reinjection wells. The choice of biocide becomes less restricted if the system effluent is discharged to POTW.