TECHNICAL MEMORANDUM

January 24, 2022

To: City of Tualatin Stormwater Engineering Team
Prepared by: Daniel Scarpine, PE; Aquarius Environmental, LLC

RE: Powder Tech Inc. – 9900 SW Herman Road
Parcel #2S1 23BD-01100
AR21-016 - Development Review
Stormwater Design and Treatment

Executive Summary

The Powder Tech Inc. (Powder Tech or PTI) site, located at 9900 SW Herman Road, Washington County, Oregon, operates a stormwater management and treatment facility for stormwater from approximately 6.22 acres. The facility engaged Aquarius Environmental LLC (Aquarius) to provide technical support for the design and development of the stormwater management and treatment system beginning in 2014, which led to the final design and permitting of the stormwater management and treatment system under the architectural review permit 2015, AR95-30. As part of building expansion in 2016, PTI had Aquarius prepare a stormwater management report and associated calculations which demonstrated the stormwater management and treatment facility could manage runoff for current and future development up to the extents of the PTI parcel and the Oregon Sandblasting parcel to the north (total developed area of approximately 6.22 acres). Further the 2016 system configuration fully complies with Clean Water Services Design and Construction Standards, as permitted under EXGR16-1043.

The proposed project is for the replacement development of a storage building of approximately 7,500 sq ft. The location of the proposed building is currently impervious asphalt surfaces. In the presently proposed permit scope (AR21-016) the site's stormwater is readily managed by the existing facilities and meets the criteria of the 2019 Clean Water Services Design and Construction Standards (Chapter 4), Tualatin Municipal Code 3-5-200 thru 430 for water quality performance, water quality storm management.

This Technical memo documents the conformance of existing facilities to support development under current requirements.

Facility Description

Powder Tech is located at 9900 SW Herman Road, Washington County, Oregon.

The Powder Tech Facility comprises several buildings and a work yard for processing and coating various materials. The facility is located along Hedges Creek wetlands area. A common stormwater system manages runoff from the PTI parcel and Oregon Sandblasting to the north for a total of approximately 6.22 developed acres consisting of paved work surfaces, pervious

gravel and landscaping, and a storage yard and several buildings housing material processing equipment and staff offices. The Tualatin River, the ultimate discharge location of site stormwater is located approximately ¾ mile east-northeast of the facility.

The Site maintains an Oregon Department of Environmental Quality (DEQ) 1200-Z Industrial Stormwater General Permit (DEQ File #101270) for discharges of industrial stormwater. The 1200-Z Permit requires routine stormwater quality monitoring, regular inspections, and full implementation of a stormwater pollution control plan (SWPCP).

Proposed Project

The project proposed under review (AR21-016) is the redevelopment of existing impervious surfaces for a new building and surrounds which yields approximately 7,500 square feet of re-developed impervious surface (no net increase in total impervious surface). Roof water runoff will be conveyed via roof slope to the west and via downspouts, to the existing pavement and existing stormwater catchbasin system.

Historic Stormwater Modeling and Calculation

Numerous modeling and hydraulic design efforts have been completed for the facility over the years, under several different City of Tualatin Permit Reviews. These include:

(1) 2014 drainage assessment, detention tank installation, and advanced water quality treatment system (AR95-30)
(2) 2016 Pond decommission, paving, and stormwater treatment integration (conveyance and pumping improvements, EXGR16-1043.

A stormwater letter report was prepared, submitted, and approved by the City and Clean Water services under EXGR16-1043 (May 10, 2016, attached). This report was prepared under substantially similar design conditions to the current Clean Water Services (2019) standards and the City of Tualatin Municipal code design requirements. CWS and City of Tualatin Design Standards require that precipitation from a 0.36" 4-hour duration design storm be treated (Section 4.05.4d). As indicated in the May 2016 memo, a hydrologic analysis performed by Aquarius Environmental (AE) determined that the Water Quality Volume required by CWS was equal to approximately 60,000 gal.

The corresponding Water Quality Flow Rate was found to be less than that produced by hydrologic analysis using rainfall rates specified by the 2016 City of Portland Stormwater Management Manual (Portland SWMM). At the time, AE had designed multiple facilities conforming to City of Portland criteria with successful water quality and quantity mitigation results. (0.83"/24-hour event). The detention tank was conservatively sized at an 80,000-gallon storage capacity (Dimensions: 32' in diameter, 13'8" in height) by capturing the 0.83" 24-hour event and exceeded the CWS storage requirement.

Since it was anticipated that the various existing pervious and impervious portions of the site would be redeveloped, and numerous portions of the OSB facility are presently unimproved gravel surfaces, the 2016 Stormwater Management Report evaluated the maximum impervious surface the stormwater management facilities could manage under the Portland Water Quality Storm.

Results of modeling indicated the existing stormwater management facilities readily convey and treat up to 6.22 acres of impervious surface.

Ability of Existing Stormwater Management Facilities to Meet Current Requirements

The 2016 Stormwater Management Report indicated the existing facilities could meet the stormwater management requirements for runoff from 6.22 impervious acres. Under the proposed conditions of a new 7,500 square foot building, the stormwater from this area was previously impervious and assumed to remain impervious, such that no net change to the total impervious served by the existing stormwater management facilities. While a comprehensive site survey of all connected impervious and impervious areas is not available at this time, based on available maps and site areas, the total connected impervious is less than or equal to the modeled impervious surfaces of 6.22 acres. Further, the existing stormwater facilities have been operated successfully since 2015 without issue.

Attachments –
May 2016 Stormwater Management Letter Report

3204 Northeast 40th Ave
Portland, OR 97212
www.aquariusenv.com
503.427.8368

May 10, 2016

City of Tualatin
Building Department
18880 SW Martinazzi Ave
Tualatin, OR 97062

RE: Alternate Methods in Lieu of Stormwater Pond
Engineering Report Submittal consistent with Clean Water Services Design and Construction Standards

Oregon Sandblasting and Coating, Inc. – 10000 SW Herman Road, Tualatin, OR
1200-Z Permit: DEQ File #101270

Dear Sir or Madam,

On behalf of Oregon Sandblasting and Coating, Inc. (OSB) and Powder Tech, Inc. (PTI), this technical memo is intended to request permission to decommission the existing on-site stormwater detention/settling/storage pond (Pond). In lieu of the existing Pond, an 'Alternate Method' of treatment has been installed to treat site stormwater in accordance with National Pollutant Discharge Elimination System (NPDES) 1200-Z permit requirements. This Engineering Report (ER) details the current treatment system (Detention Tank & Electrocoagulation Treatment), demonstrates compliance with Clean Water Services (CWS) standards, and requests evaluation of the aforementioned current treatment as an Alternate Method in order to allow OSB/PTI to decommission and fill the existing Pond. See Sections below for a description of current treatment, rationale for selection of current treatment, post-installation phosphorous sample results & discussion, and Engineering Conclusions associated with OSB/PTI's request to decommission the existing Pond.

Description of Current Conditions

The OSB/PTI site currently contains a detention/settling/storage Pond in the southeast corner of the site that has historically received stormwater via overland flow, gravity flow pipes, and an unimproved ditch along the east parcel boundary. Prior to the installation of new treatment

measures, the pond has served as a detention, settling, and storage basin (i.e., decreasing the average velocity of and allowing suspended solids to settle out of solution) and is a presumptive Best Management Practice (BMP) under the CWS *Design and Construction Standards* (*Design Standards*) for detention and the removal of phosphorus.

Background for Design and Selection of Alternative Measures

The site is permitted under the Oregon Department of Environmental Quality's 1200-Z Industrial Stormwater General Permit. Ongoing monitoring indicated exceedances of the 1200-Z benchmark for effluent zinc. Site analysis indicates that the predominant speciation of zinc is dissolved; a speciation which is not readily removed by a traditional stormwater pond. Due to the zinc characterization and additional 1200-Z Tier II requirements for end-of-pipe treatment, OSB/PTI installed an alternative form of treatment. In the installed treatment train, site stormwater is routed to a pump lift station where it is transferred to a detention tank, then an Enpurion® Electrocoagulation (EC) treatment system, which outfalls to the nearby boundary ditch. In addition to treating for zinc, this system readily removes suspended solids, oil and grease, copper and phosphorus. Effluent monitoring indicates total Phosphorous removal at or above the CWS requirement of 65% reduction.

Basis for Sizing of the Detention Tank

CWS *Design Standards* require that precipitation from a 0.36" 4-hour duration design storm be treated (Section 4.05.4d). The hydrologic analysis performed by Aquarius Environmental (AE) determined that the Water Quality Volume required by CWS was equal to approximately 60,000 gal. The corresponding Water Quality Flow Rate was found to be less than that produced by hydrologic analysis using rainfall rates specified by the City of Portland *Stormwater Management Manual* (Portland *SWMM*). At similar sites in the Portland region, design based on City of Portland criteria has produced successful water quality and quantity mitigation results. The detention tank was conservatively sized at an 80,000-gallon storage capacity (Dimensions: 32' in diameter, 13'8" in height), in accordance with the Portland *SWMM*. This satisfies the CWS storage requirement and provides flow attenuation to reduce the treatment system size.

Currently, a lift pump is used to forward site stormwater to the detention tank. The lift pump is sized for a minimum pump rate of 400 gallons per minute, the peak flow rate of the water quality storm for a 6.22-acre site without detention. Installation of the detention tank has resulted in flow rate attenuation of over 80% downstream of detention to approximately 72 gpm. This reduction of the flow rate is critical in reducing treatment equipment size, maintenance, and overall affordability of a treatment system. See Appendix C (Water Quality Pond Modeling) and Appendix D (HydroCAD Output) for details.

End-of-Pipe Treatment Basis

Electrocoagulation (EC): General Summary

EC is a process that generates a coagulant by running electrical current through sacrificial steel plates. It is particularly effective for removing suspended solids from wastewater that are mineral in nature and may be colloidal in size. Several processes work concurrently to remove solids. The primary pollutant removal mechanisms are as follows:

- *Coagulation* – The direct current corrodes the metal plates slowly into the wastewater stream. The electrically charged metal ions attach onto colloidal solids in the water and form clusters of solids that will settle by gravity. The coagulation process is easier to control than chemical

wastewater treatment processes because the flocculating material is a metal plate rather than a liquid solution. Furthermore, an automated process that monitors the conductivity of the influent wastewater controls the addition of ions.

- *Floatation* – The direct electrical current splits a small fraction of the water molecules into oxygen and hydrogen gases. These gases form at the molecular level and have a very active and high surface area. The active bubbles "grab" onto coagulated masses of solids and buoy them to the surface. In most cases, the EC process develops a "float" mat of solids at the surface of the water that can be skimmed or allowed to de-aerate and settle.
- *Settling* – The flocculated solids settle to the sludge collection zone and the wastewater exits the process free of most settleable solids.
- *Filtration* – Depending on discharge requirements, settling may be followed by sand filtration to remove floc carried over from the settling tank.

Main components required in the EC pre-treatment process include:

- Electrolytic cell
- Flocculation/settling basin
- Sludge collection tank
- Effluent water tank
- Discharge metering

Rationale for Selection

Enpurion® EC Technology has demonstrated 1200-Z benchmark compliance when installed at locations with similar effluent characterization, including several facilities in both Washington and Oregon. Effluent data supplied by Enpurion indicates that a properly sized EC system will successfully treat stormwater from the OSB/PTI site runoff areas in order to achieve Permit 1200-Z benchmark levels at the sample location for Total Zinc In addition, the Enpurion® System has obtained Washington Department of Ecology Technology Assessment Protocol (TAPE) Conditional Use Level Design (CULD) approval for Advanced Treatment for heavy metals. See Appendix E (Enpurion® EC System Specifications) for site-specific details. Operations and Maintenance information can be found specifically in Section II.C of Appendix E. See Sections below for a phosphorous testing results and current treatment system performance discussion.

Ability of Proposed Treatment to Remove Phoshorus

Post-installation testing of the treatment train has demonstrated Total Phosphorous removal readily meets the CWS requirement of 65% removal. Samples were taken of both influent and effluent from the treatment system and were analyzed by Apex Labs. Analytical results are summarized in Table 1 below, see Appendix B (Laboratory Analytical Reports) for specific details.

Table 1. Stormwater Sample Results for Phosphorous Testing 2015 – 2016

Constituent		9/14/15	3/10/16	3/28/16	4/13/16	Geomean
Orthophosphate Phosphorous (mg/L)	Influent	1.46	0.0700	0.405	0.113	
	Effluent	0.326	ND (0.0200)	ND (0.0200)	ND (0.0200)	
	% Removal	77.67%	85.71%	97.53%	91.15%	
Total Phosphorous (mg/L)	Influent	1.60	0.178	0.526	0.362	
	Effluent	0.462	ND (0.100)	ND (0.100)	ND (0.100)	
	% Removal	71.13%	71.91%	90.49%	86.19%	79.47%

Engineering Conclusions & Request to Decommission Pond

Given the demonstrated effectiveness of the installed detention tank and Enpurion® treatment system as compared to CWS standards, for both water quality and flow volume, PTI/OSB is requesting permission to decommission and fill the existing Pond in the southeast corner of the site

The existing pond actually creates several water quality problems due to the fact that the tail water in the adjoining Hedges Wetland prevents the pond from operating like a true wet/dry pond.

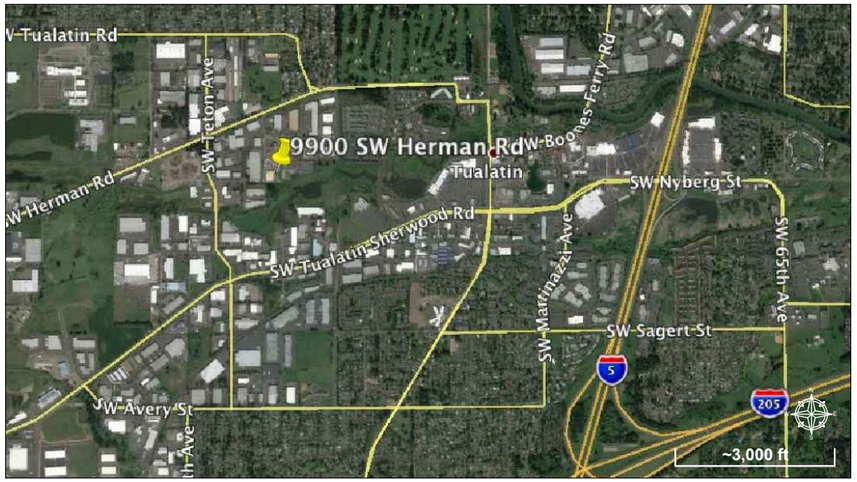
Should you have any questions about this technical memorandum you can contact me directly at 503.427.8368 or daniels@aquariusenv.com.

Sincerely,

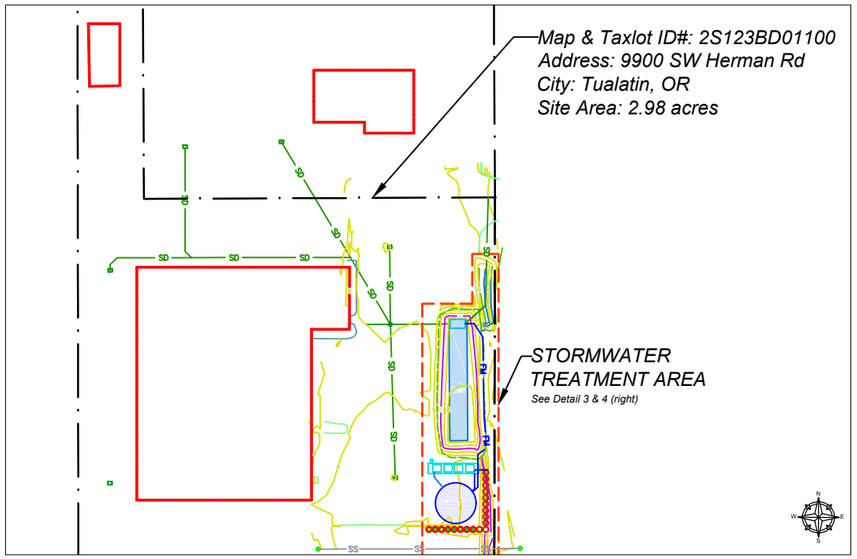
Daniel A. Scarpine, PE
Aquarius Environmental, LLC

Attachments:
Appendix A: Pond Decommission Site Plan
Appendix B: Laboratory Analytical Reports
Appendix C: Water Quality Pond Modeling
Appendix D: HydroCAD Output
Appendix E: Enpurion® EC System Specifications

Appendix A: Pond Decommission Site Plan



VICINITY MAP 1/1
AS NOTED



SITE OVERVIEW 2/1
1" = 120'

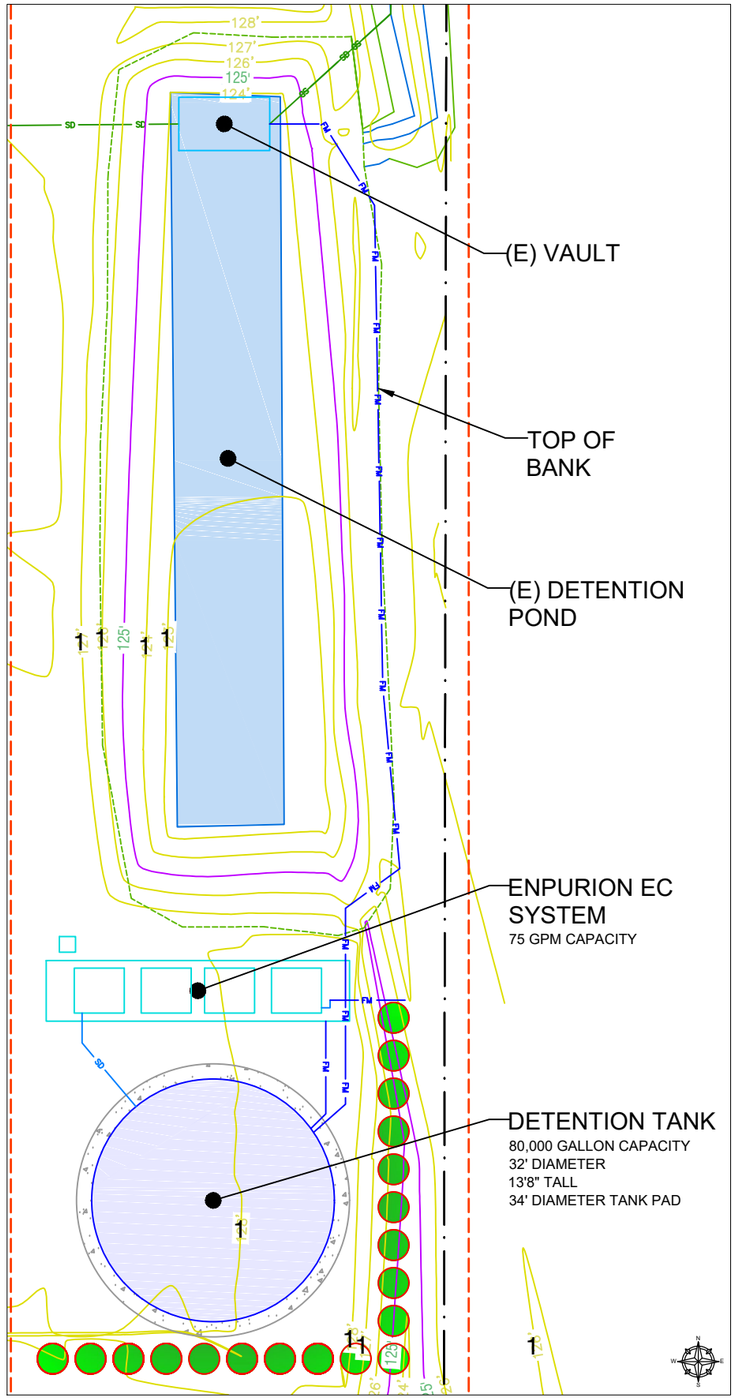
KEY

- PARCEL BOUNDARY
- BUILDING
- (E) UNDERGROUND STORM GRAVITY
- (E) FORCE MAIN
- (E) CATCH BASIN
- MAJOR CONTOUR
- MINOR CONTOUR
- TOP OF BANK
- BOTTOM OF BANK
- (E) = EXISTING (OR CURRENT)
- (P) = PROPOSED

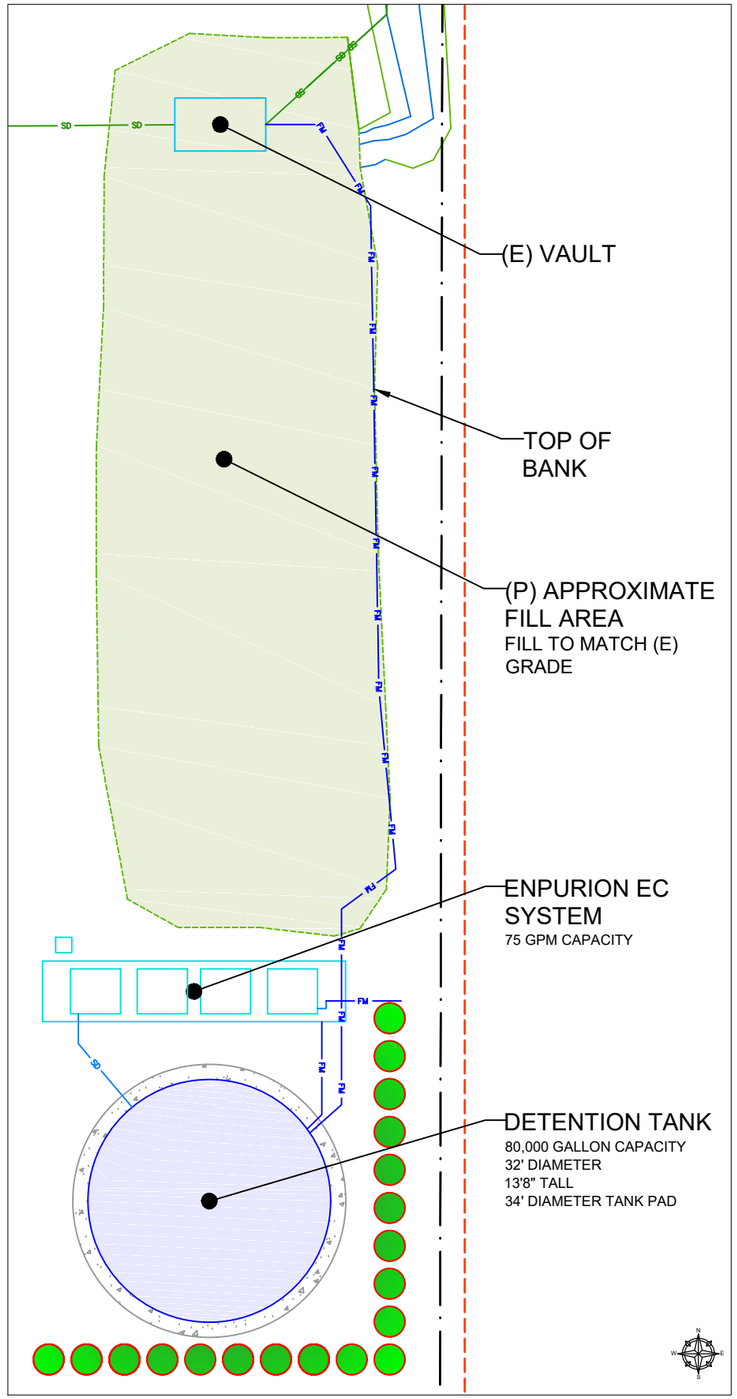
GENERAL NOTES:

1. THIS INFORMATION WAS COMPILED FROM VARIOUS RESOURCES INCLUDING FIELD MEASUREMENTS AND AERIAL PHOTOS. WHILE THIS INFORMATION IS DEEMED RELIABLE, NO GUARANTEE OF THE ACCURACY OF THIS INFORMATION IS MADE.

2. REFERENCES/BACKGROUND MAPS: GOOGLE EARTH IMAGES, WASHINGTON COUNTY PROPERTY DATA, NOTES FROM AQUARIUS ENVIRONMENTAL SITE VISIT, AND OSB/PTI PERSONNEL INTERVIEW.



(E) TREATMENT PLAN 3/1
1" = 20'



(P) TREATMENT PLAN WITH POND FILL 4/1
1" = 20'

REV	DATE	DESCRIPTION	DWN BY	DES BY	CHK BY	APP BY

DATE OF ISSUE 5/10/2016 | DWN BY DA/KRK | DES BY DS | CHK BY | APP BY

POWDER TECH INC
9900 SW HERMAN ROAD
TUALATIN, OR 97062

ALTERNATIVE METHOD PLAN

DRAWING NO. 1
PROJECT NO. 0084

Appendix B: Laboratory Analytical Reports

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

Wednesday, September 16, 2015

Daniel Scarpine
Aquarius Environmental LLC
3204 NE40th Ave
Portland, OR 97212

RE: Stormwater Sampling / Powder Tech SW 9/14/15

Enclosed are the results of analyses for work order A5I0367, which was received by the laboratory on 9/14/2015 at 3:46:00PM.

Thank you for using Apex Labs. We appreciate your business and strive to provide the highest quality services to the environmental industry.

If you have any questions concerning this report or the services we offer, please feel free to contact me by email at: BCone@apex-labs.com, or by phone at 503-718-2323.

Apex Laboratories

Brian Cone, Industrial Services Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: Powder Tech SW 9/14/15	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	09/16/15 09:58

ANALYTICAL REPORT FOR SAMPLES

SAMPLE INFORMATION

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
Stormwater In	A5I0367-01	Water	09/14/15 15:46	09/14/15 15:46
Stormwater Out	A5I0367-02	Water	09/14/15 15:46	09/14/15 15:46

Apex Laboratories

Brian Cone, Industrial Services Manager

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Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: Powder Tech SW 9/14/15	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	09/16/15 09:58

ANALYTICAL SAMPLE RESULTS

Conventional Chemistry Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
Stormwater In (A5I0367-01)			**Matrix: Water**					
Batch: 5090356								
Orthophosphate Phosphorous	**1.46**	---	0.100	mg/L	1	09/15/15 09:27	SM 4500-PE	
Batch: 5090387								
Phosphorus	**1.60**	---	0.200	"	2	09/16/15 09:31	SM 4500 P B	
Stormwater Out (A5I0367-02)			**Matrix: Water**					
Batch: 5090356								
Orthophosphate Phosphorous	**0.326**	---	0.020	mg/L	1	09/15/15 09:27	SM 4500-PE	
Batch: 5090387								
Phosphorus	**0.462**	---	0.100	"	"	09/16/15 09:31	SM 4500 P B	

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3204 NE40th Ave	Project Number: Powder Tech SW 9/14/15	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	09/16/15 09:58

QUALITY CONTROL (QC) SAMPLE RESULTS

Conventional Chemistry Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 5090356 - Method Prep: Aq								**Water**				
Blank (5090356-BLK1)					Prepared: 09/15/15 08:25		Analyzed: 09/15/15 09:27					
SM 4500-PE												
Orthophosphate Phosphorous	ND	---	0.020	mg/L	1	---	---	---	---	---	---	
LCS (5090356-BS1)					Prepared: 09/15/15 08:25		Analyzed: 09/15/15 09:27					
SM 4500-PE												
Orthophosphate Phosphorous	0.246	---	0.020	mg/L	1	0.261	---	94	85-115%	---	---	
Duplicate (5090356-DUP1)					Prepared: 09/15/15 08:25		Analyzed: 09/15/15 09:27					
QC Source Sample: Stormwater In (A5I0367-01)												
SM 4500-PE												
Orthophosphate Phosphorous	**1.48**	---	0.100	mg/L	1	---	1.46	---	---	1	20%	
Matrix Spike (5090356-MS1)					Prepared: 09/15/15 08:25		Analyzed: 09/15/15 09:27					
QC Source Sample: Stormwater In (A5I0367-01)												
SM 4500-PE												
Orthophosphate Phosphorous	2.70	---	0.101	mg/L	1	1.30	1.46	95	75-125%	---	---	
Batch 5090387 - Method Prep: Aq								**Water**				
Blank (5090387-BLK1)					Prepared: 09/16/15 06:25		Analyzed: 09/16/15 09:31					
SM 4500 P B												
Phosphorus	ND	---	0.100	mg/L	1	---	---	---	---	---	---	
LCS (5090387-BS1)					Prepared: 09/16/15 06:25		Analyzed: 09/16/15 09:31					
SM 4500 P B												
Phosphorus	0.486	---	0.100	mg/L	1	0.522	---	93	85-115%	---	---	
Duplicate (5090387-DUP1)					Prepared: 09/16/15 06:25		Analyzed: 09/16/15 09:31					
QC Source Sample: Stormwater In (A5I0367-01)												
SM 4500 P B												
Phosphorus	**1.70**	---	0.200	mg/L	2	---	1.60	---	---	6	20%	
Matrix Spike (5090387-MS1)					Prepared: 09/16/15 06:25		Analyzed: 09/16/15 09:31					

Apex Laboratories

Brian Cone, Industrial Services Manager

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Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: Powder Tech SW 9/14/15	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	09/16/15 09:58

QUALITY CONTROL (QC) SAMPLE RESULTS

Conventional Chemistry Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 5090387 - Method Prep: Aq									**Water**			
Matrix Spike (5090387-MS1)					Prepared: 09/16/15 06:25		Analyzed: 09/16/15 09:31					
QC Source Sample: Stormwater In (A5I0367-01)												
SM 4500 P B												
Phosphorus	2.21	---	0.200	mg/L	2	0.522	1.60	117	75-125%	---	---	

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SAMPLE PREPARATION INFORMATION

Conventional Chemistry Parameters

Prep: Method Prep: Aq

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
Batch: 5090356							
A5I0367-01	Water	SM 4500-PE	09/14/15 15:46	09/15/15 08:25	5mL/25mL	25mL/25mL	5.00
A5I0367-02	Water	SM 4500-PE	09/14/15 15:46	09/15/15 08:25	25mL/25mL	25mL/25mL	1.00
Batch: 5090387							
A5I0367-01	Water	SM 4500 P B	09/14/15 15:46	09/16/15 06:25	25mL/50mL	25mL/50mL	1.00
A5I0367-02	Water	SM 4500 P B	09/14/15 15:46	09/16/15 06:25	25mL/50mL	25mL/50mL	1.00

Apex Laboratories

Brian L Cone

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Notes and Definitions

Qualifiers:

Notes and Conventions:

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis. Results listed as 'wet' or without 'dry'designation are not dry weight corrected.
RPD	Relative Percent Difference
MDL	If MDL is not listed, data has been evaluated to the Method Reporting Limit only.
WMSC	Water Miscible Solvent Correction has been applied to Results and MRLs for volatiles soil samples per EPA 8000C.
Batch QC	Unless specifically requested, this report contains only results for Batch QC derived from client samples included in this report. All analyses were performed with the appropriate Batch QC (including Sample Duplicates, Matrix Spikes and/or Matrix Spike Duplicates) in order to meet or exceed method and regulatory requirements. Any exceptions to this will be qualified in this report. Complete Batch QC results are available upon request. In cases where there is insufficient sample provided for Sample Duplicates and/or Matrix Spikes, a Lab Control Sample Duplicate (LCS Dup) is analyzed to demonstrate accuracy and precision of the extraction and analysis.
Blank Policy	Apex assesses blank data for potential high bias down to a level equal to ½ the method reporting limit (MRL), except for conventional chemistry and HCID analyses which are assessed only to the MRL. Sample results flagged with a B or B-02 qualifier are potentially biased high if they are less than ten times the level found in the blank for inorganic analyses or less than five times the level found in the blank for organic analyses. For accurate comparison of volatile results to the level found in the blank; water sample results should be divided by the dilution factor, and soil sample results should be divided by 1/50 of the sample dilution to account for the sample prep factor. Results qualified as reported below the MRL may include a potential high bias if associated with a B or B-02 qualified blank. B and B-02 qualifications are not applied to J qualified results reported below the MRL.
---	QC results are not applicable. For example, % Recoveries for Blanks and Duplicates, % RPD for Blanks, Blank Spikes and Matrix Spikes, etc.
***	Used to indicate a possible discrepancy with the Sample and Sample Duplicate results when the %RPD is not available. In this case, either the Sample or the Sample Duplicate has a reportable result for this analyte, while the other is Non Detect (ND).

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Brian Cone, Industrial Services Manager

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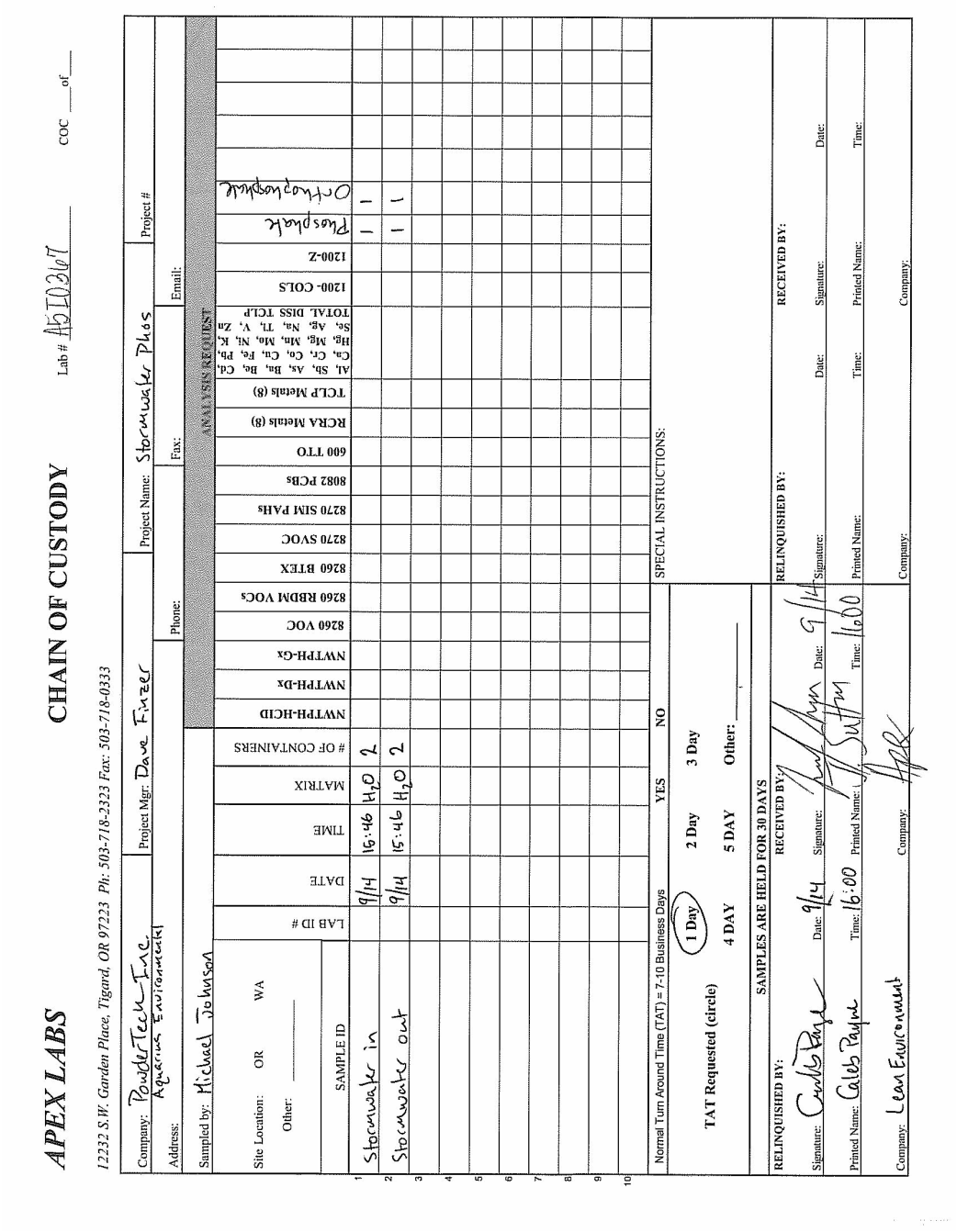
3204 NE40th Ave	Project Number: Powder Tech SW 9/14/15	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	09/16/15 09:58



APEX LABS — **CHAIN OF CUSTODY** — Lab # 459038 — COC ___ of ___

12232 S.W. Garden Place, Tigard, OR 97223 Ph: 503-718-2323 Fax: 503-718-0333

Company: PowderTech Inc. | Project Mgr: Dave Fixter | Project Name: Stormwater Phos | Project #
Address: Aquarius Environmental | Phone: | Fax: | Email:
Sampled by: Michael Johnson

Site Location: OR WA
Other: _____

	SAMPLE ID	LAB ID #	DATE	TIME	MATRIX	# OF CONTAINERS	NWTPH-HCID	NWTPH-Dx	NWTPH-Gx	8260 VOC	8260 RBDM VOCs	8260 BTEX	8270 SVOC	8270 SIM PAHs	8082 PCBs	600 TTO	RCRA Metals (8)	TCLP Metals (8)	Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Hg, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, V, Zn TOTAL DISS TCLP	1200- COLS	1200-Z	Phosphate	Orthophosphate				
1	Stormwater in		9/14	16:46	H_2O	2																1	1			
2	Stormwater out		9/14	15:46	H_2O	2																1	1			
3																										
4																										
5																										
6																										
7																										
8																										
9																										
10																										

Normal Turn Around Time (TAT) = 7-10 Business Days — YES — NO — SPECIAL INSTRUCTIONS:

TAT Requested (circle): 1 Day — 2 Day — 3 Day — 4 DAY — 5 DAY — Other: _____

SAMPLES ARE HELD FOR 30 DAYS

RELINQUISHED BY: Caleb Payne — Date: 9/14 — Time: 16:00
RECEIVED BY: Signature: — Printed Name: — Company: Lean Environmental

RELINQUISHED BY: Signature: — Printed Name: — Company:
RECEIVED BY: Signature: — Printed Name: Jeff Sutton — Company: — Date: 9/14 — Time: 16:00

RELINQUISHED BY: Signature: — Printed Name: — Company:
RECEIVED BY: Signature: — Printed Name: — Company: — Date: — Time:

Apex Laboratories

Brian L Cone

Brian Cone, Industrial Services Manager

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

Friday, March 18, 2016

Daniel Scarpine
Aquarius Environmental LLC
3204 NE40th Ave
Portland, OR 97212

RE: Stormwater Sampling / 3/10/16

Enclosed are the results of analyses for work order A6C0402, which was received by the laboratory on 3/10/2016 at 12:30:00PM.

Thank you for using Apex Labs. We appreciate your business and strive to provide the highest quality services to the environmental industry.

If you have any questions concerning this report or the services we offer, please feel free to contact me by email at: BCone@apex-labs.com, or by phone at 503-718-2323.

Apex Laboratories

Brian Cone, Industrial Services Manager

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Apex Labs

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Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: 3/10/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	03/18/16 15:10

ANALYTICAL REPORT FOR SAMPLES

SAMPLE INFORMATION

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
Vault-Influent	A6C0402-01	Water	03/10/16 11:15	03/10/16 12:30
Tank-Effluent	A6C0402-02	Water	03/10/16 11:20	03/10/16 12:30

Apex Laboratories

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Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: 3/10/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	03/18/16 15:10

ANALYTICAL SAMPLE RESULTS

Conventional Chemistry Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
Vault-Influent (A6C0402-01)			**Matrix: Water**					
Batch: 6030356								
Phosphorus	**0.178**	---	0.100	mg/L	1	03/11/16 15:59	SM 4500 P B	
Batch: 6030378								
Orthophosphate Phosphorous	**0.0700**	---	0.0200	"	"	"	SM 4500-PE	
Tank-Effluent (A6C0402-02)			**Matrix: Water**					
Batch: 6030356								
Phosphorus	ND	---	0.100	mg/L	1	03/11/16 15:59	SM 4500 P B	
Batch: 6030378								
Orthophosphate Phosphorous	ND	---	0.0200	"	"	"	SM 4500-PE	

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503-718-0333 Fax

Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: 3/10/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	03/18/16 15:10

Weck Laboratories, Inc

ANALYTICAL SAMPLE RESULTS (Subcontracted)

Conventional Chemistry/Physical Parameters by APHA/EPA/ASTM Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
Vault-Influent (A6C0402-01)			**Matrix: Water**		**Batch: W6C0950**			
Batch: W6C0950								
TKN	**0.12**	---	0.10	mg/l	1	03/17/16 14:23	EPA 351.2	
Tank-Effluent (A6C0402-02)			**Matrix: Water**		**Batch: W6C0611**			
Batch: W6C0611								
TKN	**0.12**	---	0.10	mg/l	1	03/15/16 16:29	EPA 351.2	

Apex Laboratories

Brian Cone, Industrial Services Manager

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Apex Labs

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Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: 3/10/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	03/18/16 15:10

QUALITY CONTROL (QC) SAMPLE RESULTS

Conventional Chemistry Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 6030356 - Method Prep: Aq									Water			
Blank (6030356-BLK1)					Prepared: 03/11/16 09:14		Analyzed: 03/11/16 15:59					
SM 4500 P B												
Phosphorus	ND	---	0.100	mg/L	1	---	---	---	---	---	---	
LCS (6030356-BS1)					Prepared: 03/11/16 09:14		Analyzed: 03/11/16 15:59					
SM 4500 P B												
Phosphorus	1.26	---	0.100	mg/L	1	1.30	---	96	85-115%	---	---	
Batch 6030378 - Method Prep: Aq									Water			
Blank (6030378-BLK1)					Prepared: 03/11/16 13:05		Analyzed: 03/11/16 15:59					
SM 4500-PE												
Orthophosphate Phosphorous	ND	---	0.0200	mg/L	1	---	---	---	---	---	---	
LCS (6030378-BS1)					Prepared: 03/11/16 13:05		Analyzed: 03/11/16 15:59					
SM 4500-PE												
Orthophosphate Phosphorous	0.294	---	0.0200	mg/L	1	0.326	---	90	85-115%	---	---	
Duplicate (6030378-DUP1)					Prepared: 03/11/16 13:05		Analyzed: 03/11/16 15:59					
QC Source Sample: Tank-Effluent (A6C0402-02)												
SM 4500-PE												
Orthophosphate Phosphorous	ND	---	0.0200	mg/L	1	---	ND	---	---	---	20%	
Matrix Spike (6030378-MS1)					Prepared: 03/11/16 13:05		Analyzed: 03/11/16 15:59					
QC Source Sample: Tank-Effluent (A6C0402-02)												
SM 4500-PE												
Orthophosphate Phosphorous	0.308	---	0.0202	mg/L	1	0.326	ND	94	75-125%	---	---	

Apex Laboratories

Brian Cone, Industrial Services Manager

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503-718-2323 Phone
503-718-0333 Fax

Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: 3/10/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	03/18/16 15:10

Weck Laboratories, Inc

QUALITY CONTROL (QC) SAMPLE RESULTS

Conventional Chemistry/Physical Parameters by APHA/EPA/ASTM Methods

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch W6C0611 - General Preparation							**Water**					
Blank (W6C0611-BLK1)					Prepared: 03/10/16 09:42		Analyzed: 03/15/16 16:29					
EPA 351.2												
TKN	ND	---	0.10	mg/l	1	---	---	---	---	---	---	
Blank (W6C0611-BLK2)					Prepared: 03/10/16 09:42		Analyzed: 03/15/16 16:29					
EPA 351.2												
TKN	ND	---	0.10	mg/l	1	---	---	---	---	---	---	
LCS (W6C0611-BS1)					Prepared: 03/10/16 09:42		Analyzed: 03/15/16 16:29					
EPA 351.2												
TKN	1.01	---	0.10	mg/l	1	1.00	---	101	90-110%	---	---	
LCS (W6C0611-BS2)					Prepared: 03/10/16 09:42		Analyzed: 03/15/16 16:29					
EPA 351.2												
TKN	0.987	---	0.10	mg/l	1	1.00	---	99	90-110%	---	---	

Apex Laboratories

Brian Cone, Industrial Services Manager

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Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: 3/10/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	03/18/16 15:10

Weck Laboratories, Inc

QUALITY CONTROL (QC) SAMPLE RESULTS

Conventional Chemistry/Physical Parameters by APHA/EPA/ASTM Methods

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch W6C0950 - General Preparation									**Water**			
Blank (W6C0950-BLK1)					Prepared: 03/15/16 18:26		Analyzed: 03/17/16 14:23					
EPA 351.2												
TKN	ND	---	0.10	mg/l	1	---	---	---	---	---	---	
LCS (W6C0950-BS1)					Prepared: 03/15/16 18:26		Analyzed: 03/17/16 14:23					
EPA 351.2												
TKN	0.935	---	0.10	mg/l	1	1.00	---	93	90-110%	---	---	

Apex Laboratories

Brian Cone, Industrial Services Manager

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Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: 3/10/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	03/18/16 15:10

SAMPLE PREPARATION INFORMATION

Conventional Chemistry Parameters

Prep: Method Prep: Aq

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
Batch: 6030356							
A6C0402-01	Water	SM 4500 P B	03/10/16 11:15	03/11/16 09:14	25mL/50mL	25mL/50mL	1.00
A6C0402-02	Water	SM 4500 P B	03/10/16 11:20	03/11/16 09:14	25mL/50mL	25mL/50mL	1.00
Batch: 6030378							
A6C0402-01	Water	SM 4500-PE	03/10/16 11:15	03/11/16 13:05	25mL/25mL	25mL/25mL	1.00
A6C0402-02	Water	SM 4500-PE	03/10/16 11:20	03/11/16 13:05	25mL/25mL	25mL/25mL	1.00

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Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: 3/10/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	03/18/16 15:10

Weck Laboratories, Inc

SAMPLE PREPARATION INFORMATION

Conventional Chemistry/Physical Parameters by APHA/EPA/ASTM Methods

Prep: General Preparation

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
Batch: W6C0611							
A6C0402-02	Water	EPA 351.2	03/10/16 11:20	03/10/16 11:42	20ml/20ml	20ml/20ml	NA
Batch: W6C0950							
A6C0402-01	Water	EPA 351.2	03/10/16 11:15	03/15/16 18:26	20ml/20ml	20ml/20ml	NA

Apex Laboratories

Brian Cone, Industrial Services Manager

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Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: 3/10/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	03/18/16 15:10

Notes and Definitions

Qualifiers:

Notes and Conventions:

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis. Results listed as 'wet' or without 'dry'designation are not dry weight corrected.
RPD	Relative Percent Difference
MDL	If MDL is not listed, data has been evaluated to the Method Reporting Limit only.
WMSC	Water Miscible Solvent Correction has been applied to Results and MRLs for volatiles soil samples per EPA 8000C.
Batch QC	Unless specifically requested, this report contains only results for Batch QC derived from client samples included in this report. All analyses were performed with the appropriate Batch QC (including Sample Duplicates, Matrix Spikes and/or Matrix Spike Duplicates) in order to meet or exceed method and regulatory requirements. Any exceptions to this will be qualified in this report. Complete Batch QC results are available upon request. In cases where there is insufficient sample provided for Sample Duplicates and/or Matrix Spikes, a Lab Control Sample Duplicate (LCS Dup) is analyzed to demonstrate accuracy and precision of the extraction and analysis.
Blank Policy	Apex assesses blank data for potential high bias down to a level equal to ½ the method reporting limit (MRL), except for conventional chemistry and HCID analyses which are assessed only to the MRL. Sample results flagged with a B or B-02 qualifier are potentially biased high if they are less than ten times the level found in the blank for inorganic analyses or less than five times the level found in the blank for organic analyses. For accurate comparison of volatile results to the level found in the blank; water sample results should be divided by the dilution factor, and soil sample results should be divided by 1/50 of the sample dilution to account for the sample prep factor. Results qualified as reported below the MRL may include a potential high bias if associated with a B or B-02 qualified blank. B and B-02 qualifications are not applied to J qualified results reported below the MRL.
---	QC results are not applicable. For example, % Recoveries for Blanks and Duplicates, % RPD for Blanks, Blank Spikes and Matrix Spikes, etc.
***	Used to indicate a possible discrepancy with the Sample and Sample Duplicate results when the %RPD is not available. In this case, either the Sample or the Sample Duplicate has a reportable result for this analyte, while the other is Non Detect (ND).

Apex Laboratories

Brian Cone, Industrial Services Manager

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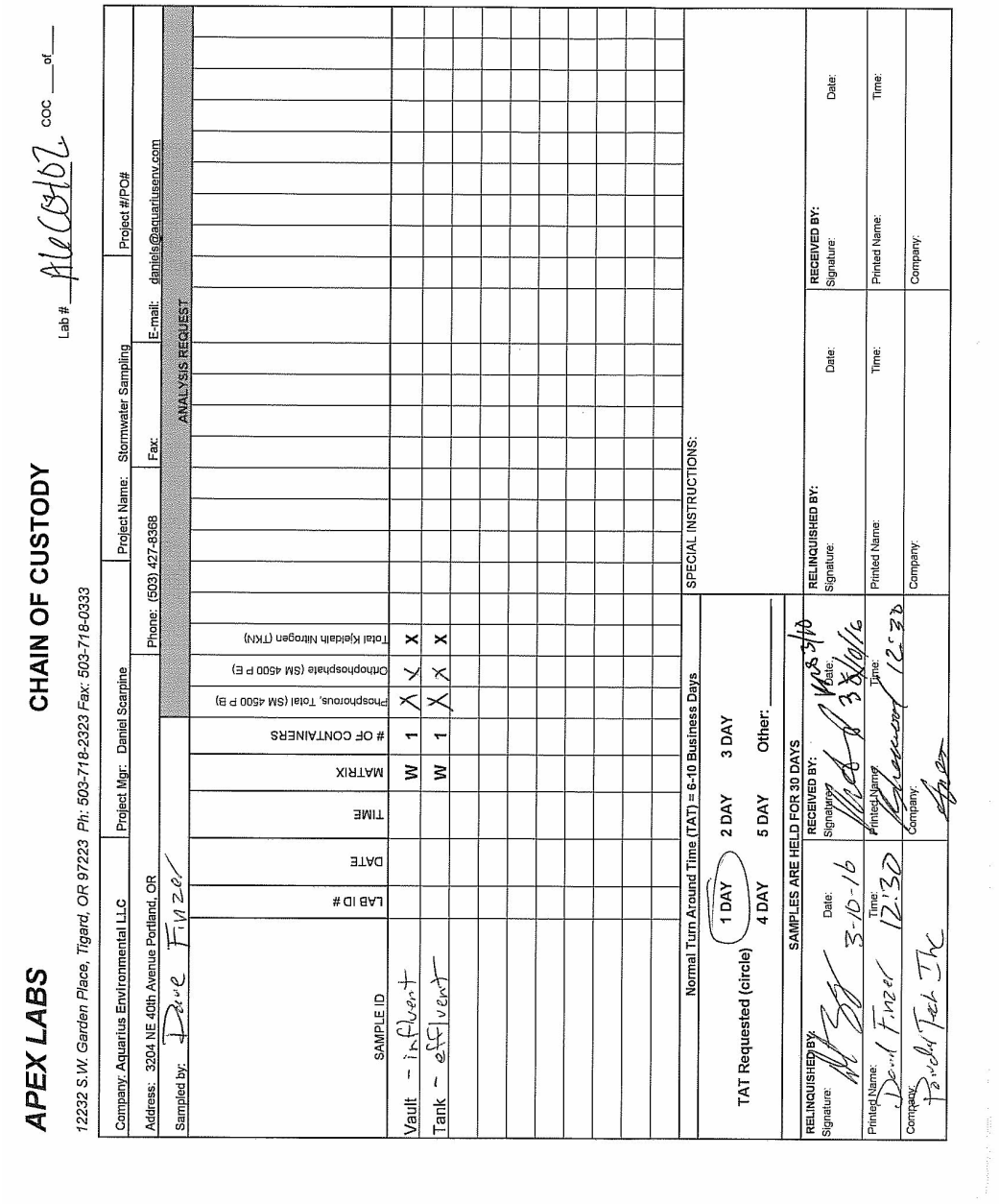
Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: 3/10/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	03/18/16 15:10



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Brian Cone, Industrial Services Manager

Apex Labs

12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

Thursday, March 31, 2016

Daniel Scarpine
Aquarius Environmental LLC
3204 NE40th Ave
Portland, OR 97212

RE: Stormwater Sampling / 3/28/16

Enclosed are the results of analyses for work order A6C1007, which was received by the laboratory on 3/28/2016 at 12:56:00PM.

Thank you for using Apex Labs. We appreciate your business and strive to provide the highest quality services to the environmental industry.

If you have any questions concerning this report or the services we offer, please feel free to contact me by email at: BCone@apex-labs.com, or by phone at 503-718-2323.

Apex Laboratories

Brian Cone, Industrial Services Manager

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Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: 3/28/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	03/31/16 16:45

ANALYTICAL REPORT FOR SAMPLES

SAMPLE INFORMATION

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
Vault-Influent	A6C1007-01	Water	03/28/16 12:00	03/28/16 12:56
Tank-Effluent	A6C1007-02	Water	03/28/16 11:55	03/28/16 12:56

Apex Laboratories

Brian Cone, Industrial Services Manager

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Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: 3/28/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	03/31/16 16:45

ANALYTICAL SAMPLE RESULTS

Conventional Chemistry Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
Vault-Influent (A6C1007-01)			**Matrix: Water**					
Batch: 6030942								
Orthophosphate Phosphorous	**0.405**	---	0.0200	mg/L	1	03/29/16 15:58	SM 4500-PE	
Batch: 6030999								
Phosphorus	**0.526**	---	0.100	"	"	03/31/16 15:12	SM 4500 P B	
Tank-Effluent (A6C1007-02)			**Matrix: Water**					
Batch: 6030942								
Orthophosphate Phosphorous	ND	---	0.0200	mg/L	1	03/29/16 15:58	SM 4500-PE	
Batch: 6030999								
Phosphorus	ND	---	0.100	"	"	03/31/16 15:12	SM 4500 P B	

Apex Laboratories

Brian Cone, Industrial Services Manager

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Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: 3/28/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	03/31/16 16:45

QUALITY CONTROL (QC) SAMPLE RESULTS

Conventional Chemistry Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 6030942 - Method Prep: Aq								**Water**				
Blank (6030942-BLK1)					Prepared: 03/29/16 15:21		Analyzed: 03/29/16 15:58					
SM 4500-PE												
Orthophosphate Phosphorous	ND	---	0.0200	mg/L	1	---	---	---	---	---	---	
LCS (6030942-BS1)					Prepared: 03/29/16 15:21		Analyzed: 03/29/16 15:58					
SM 4500-PE												
Orthophosphate Phosphorous	0.261	---	0.0200	mg/L	1	0.261	---	100	85-115%	---	---	
Duplicate (6030942-DUP1)					Prepared: 03/29/16 15:21		Analyzed: 03/29/16 15:58					
QC Source Sample: Tank-Effluent (A6C1007-02)												
SM 4500-PE												
Orthophosphate Phosphorous	ND	---	0.0200	mg/L	1	---	0.0120	---	---	***	20%	
Matrix Spike (6030942-MS1)					Prepared: 03/29/16 15:21		Analyzed: 03/29/16 15:58					
QC Source Sample: Tank-Effluent (A6C1007-02)												
SM 4500-PE												
Orthophosphate Phosphorous	0.260	---	0.0202	mg/L	1	0.261	0.0120	95	75-125%	---	---	
Batch 6030999 - Method Prep: Aq								**Water**				
Blank (6030999-BLK1)					Prepared: 03/31/16 07:51		Analyzed: 03/31/16 15:12					
SM 4500 P B												
Phosphorus	ND	---	0.100	mg/L	1	---	---	---	---	---	---	
LCS (6030999-BS1)					Prepared: 03/31/16 07:51		Analyzed: 03/31/16 15:12					
SM 4500 P B												
Phosphorus	0.490	---	0.100	mg/L	1	0.522	---	94	85-115%	---	---	

Apex Laboratories

Brian Cone, Industrial Services Manager

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Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: 3/28/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	03/31/16 16:45

SAMPLE PREPARATION INFORMATION

Conventional Chemistry Parameters

Prep: Method Prep: Aq

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
Batch: 6030942							
A6C1007-01	Water	SM 4500-PE	03/28/16 12:00	03/29/16 15:21	25mL/25mL	25mL/25mL	1.00
A6C1007-02	Water	SM 4500-PE	03/28/16 11:55	03/29/16 15:21	25mL/25mL	25mL/25mL	1.00
Batch: 6030999							
A6C1007-01	Water	SM 4500 P B	03/28/16 12:00	03/31/16 07:51	25mL/50mL	25mL/50mL	1.00
A6C1007-02	Water	SM 4500 P B	03/28/16 11:55	03/31/16 07:51	25mL/50mL	25mL/50mL	1.00

Apex Laboratories

Brian Cone, Industrial Services Manager

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Tigard, OR 97223
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503-718-0333 Fax

Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: 3/28/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	03/31/16 16:45

Notes and Definitions

Qualifiers:

Notes and Conventions:

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis. Results listed as 'wet' or without 'dry'designation are not dry weight corrected.
RPD	Relative Percent Difference
MDL	If MDL is not listed, data has been evaluated to the Method Reporting Limit only.
WMSC	Water Miscible Solvent Correction has been applied to Results and MRLs for volatiles soil samples per EPA 8000C.
Batch QC	Unless specifically requested, this report contains only results for Batch QC derived from client samples included in this report. All analyses were performed with the appropriate Batch QC (including Sample Duplicates, Matrix Spikes and/or Matrix Spike Duplicates) in order to meet or exceed method and regulatory requirements. Any exceptions to this will be qualified in this report. Complete Batch QC results are available upon request. In cases where there is insufficient sample provided for Sample Duplicates and/or Matrix Spikes, a Lab Control Sample Duplicate (LCS Dup) is analyzed to demonstrate accuracy and precision of the extraction and analysis.
Blank Policy	Apex assesses blank data for potential high bias down to a level equal to ½ the method reporting limit (MRL), except for conventional chemistry and HCID analyses which are assessed only to the MRL. Sample results flagged with a B or B-02 qualifier are potentially biased high if they are less than ten times the level found in the blank for inorganic analyses or less than five times the level found in the blank for organic analyses. For accurate comparison of volatile results to the level found in the blank; water sample results should be divided by the dilution factor, and soil sample results should be divided by 1/50 of the sample dilution to account for the sample prep factor. Results qualified as reported below the MRL may include a potential high bias if associated with a B or B-02 qualified blank. B and B-02 qualifications are not applied to J qualified results reported below the MRL.
---	QC results are not applicable. For example, % Recoveries for Blanks and Duplicates, % RPD for Blanks, Blank Spikes and Matrix Spikes, etc.
***	Used to indicate a possible discrepancy with the Sample and Sample Duplicate results when the %RPD is not available. In this case, either the Sample or the Sample Duplicate has a reportable result for this analyte, while the other is Non Detect (ND).

Apex Laboratories

Brian Cone, Industrial Services Manager

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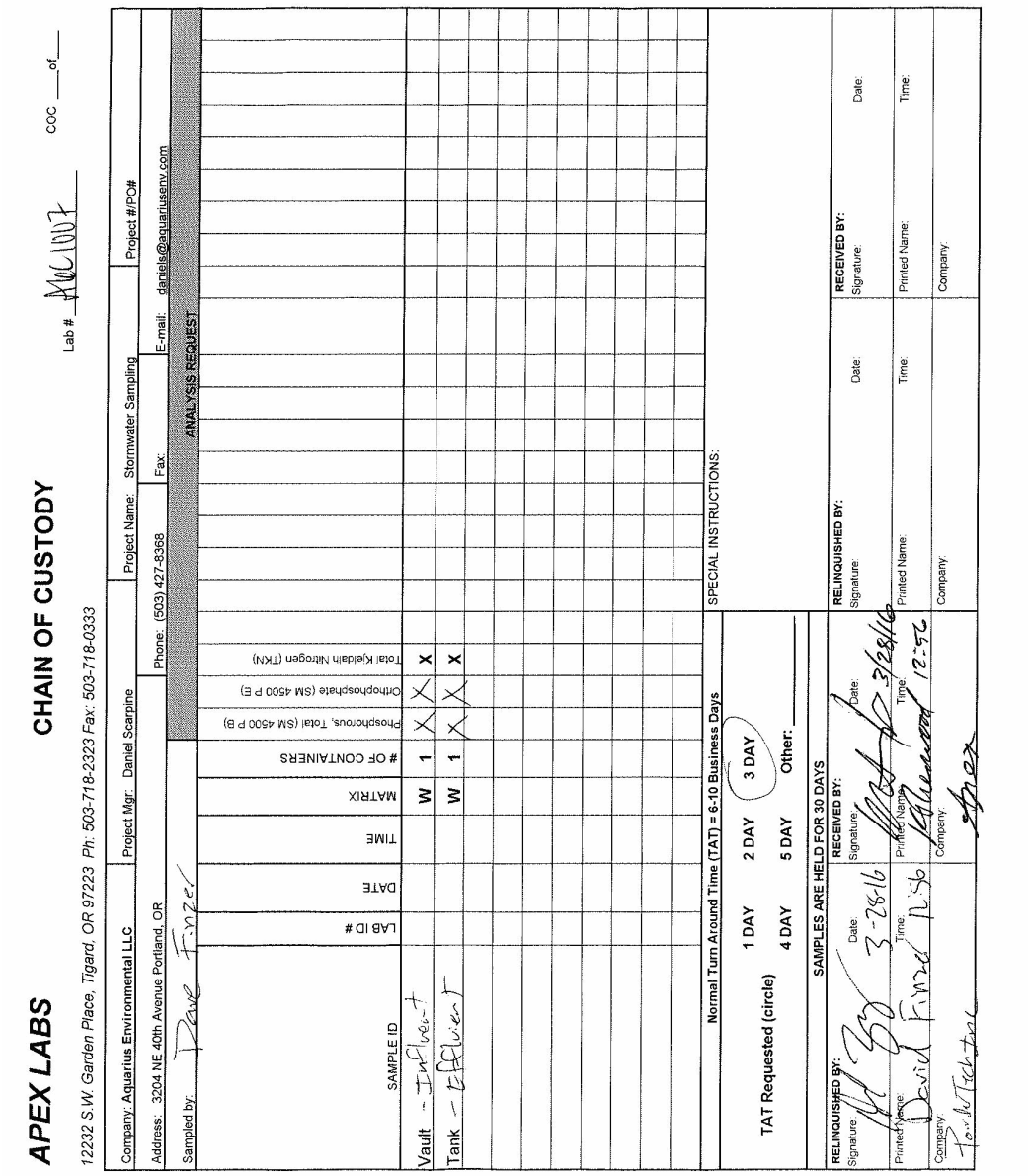
12232 S.W. Garden Place
Tigard, OR 97223
503-718-2323 Phone
503-718-0333 Fax

Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: 3/28/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	03/31/16 16:45



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Brian L Cone

Brian Cone, Industrial Services Manager

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503-718-2323 Phone
503-718-0333 Fax

Tuesday, April 26, 2016

Daniel Scarpine
Aquarius Environmental LLC
3204 NE40th Ave
Portland, OR 97212

RE: Stormwater Sampling / Phos 4/13/16

Enclosed are the results of analyses for work order A6D0372, which was received by the laboratory on 4/13/2016 at 10:32:00AM.

Thank you for using Apex Labs. We appreciate your business and strive to provide the highest quality services to the environmental industry.

If you have any questions concerning this report or the services we offer, please feel free to contact me by email at: BCone@apex-labs.com, or by phone at 503-718-2323.

Apex Laboratories

Brian Cone, Industrial Services Manager

Apex Labs

12232 S.W. Garden Place
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503-718-2323 Phone
503-718-0333 Fax

Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: Phos 4/13/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	04/26/16 10:49

ANALYTICAL REPORT FOR SAMPLES

SAMPLE INFORMATION

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
Vault-Influent	A6D0372-01	Water	04/13/16 10:00	04/13/16 10:32
Tank-Effluent	A6D0372-02	Water	04/13/16 10:10	04/13/16 10:32

Apex Laboratories

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Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: Phos 4/13/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	04/26/16 10:49

ANALYTICAL SAMPLE RESULTS

Conventional Chemistry Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
Vault-Influent (A6D0372-01)			**Matrix: Water**					
Batch: 6040357								
Orthophosphate Phosphorous	**0.113**	---	0.0200	mg/L	1	04/13/16 17:47	SM 4500-PE	
Batch: 6040475								
Phosphorus	**0.362**	---	0.100	"	"	04/18/16 19:39	SM 4500 P B	
Tank-Effluent (A6D0372-02)			**Matrix: Water**					
Batch: 6040357								
Orthophosphate Phosphorous	ND	---	0.0200	mg/L	1	04/13/16 17:47	SM 4500-PE	
Batch: 6040475								
Phosphorus	ND	---	0.100	"	"	04/18/16 19:39	SM 4500 P B	

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Brian Cone, Industrial Services Manager

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Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: Phos 4/13/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	04/26/16 10:49

Weck Laboratories, Inc

ANALYTICAL SAMPLE RESULTS (Subcontracted)

Conventional Chemistry/Physical Parameters by APHA/EPA/ASTM Methods

Analyte	Result	MDL	Reporting Limit	Units	Dilution	Date Analyzed	Method	Notes
Vault-Influent (A6D0372-01)			**Matrix: Water**		**Batch: W6D0728**			
Batch: W6D0728								
TKN	**4.3**	---	0.10	mg/l	1	04/21/16 18:08	EPA 351.2	
Tank-Effluent (A6D0372-02)			**Matrix: Water**		**Batch: W6D0728**			
Batch: W6D0728								
TKN	**0.55**	---	0.10	mg/l	1	04/21/16 18:08	EPA 351.2	

Apex Laboratories

Brian Cone, Industrial Services Manager

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503-718-0333 Fax

Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: Phos 4/13/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	04/26/16 10:49

QUALITY CONTROL (QC) SAMPLE RESULTS

Conventional Chemistry Parameters

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 6040357 - Method Prep: Aq									Water			
Blank (6040357-BLK1)					Prepared: 04/13/16 14:51		Analyzed: 04/13/16 17:47					
SM 4500-PE												
Orthophosphate Phosphorous	ND	---	0.0200	mg/L	1	---	---	---	---	---	---	
LCS (6040357-BS1)					Prepared: 04/13/16 14:51		Analyzed: 04/13/16 17:47					
SM 4500-PE												
Orthophosphate Phosphorous	0.275	---	0.0200	mg/L	1	0.261	---	105	85-115%	---	---	
Batch 6040475 - Method Prep: Aq									Water			
Blank (6040475-BLK1)					Prepared: 04/18/16 09:43		Analyzed: 04/18/16 19:39					
SM 4500 P B												
Phosphorus	ND	---	0.100	mg/L	1	---	---	---	---	---	---	
LCS (6040475-BS1)					Prepared: 04/18/16 09:43		Analyzed: 04/18/16 19:39					
SM 4500 P B												
Phosphorus	1.24	---	0.100	mg/L	1	1.30	---	95	85-115%	---	---	

Apex Laboratories

Brian Cone, Industrial Services Manager

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Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: Phos 4/13/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	04/26/16 10:49

Weck Laboratories, Inc

QUALITY CONTROL (QC) SAMPLE RESULTS

Conventional Chemistry/Physical Parameters by APHA/EPA/ASTM Methods

Analyte	Result	MDL	Reporting Limit	Units	Dil.	Spike Amount	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch W6D0728 - General Preparation							**Water**					
Blank (W6D0728-BLK1)					Prepared: 04/14/16 09:46 Analyzed: 04/21/16 18:08							
EPA 351.2												
TKN	ND	---	0.10	mg/l	1	---	---	---	---	---	---	
LCS (W6D0728-BS1)					Prepared: 04/14/16 09:46 Analyzed: 04/21/16 18:08							
EPA 351.2												
TKN	1.08	---	0.10	mg/l	1	1.00	---	108	90-110%	---	---	

Apex Laboratories

Brian Cone, Industrial Services Manager

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Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: Phos 4/13/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	04/26/16 10:49

SAMPLE PREPARATION INFORMATION

Conventional Chemistry Parameters

Prep: Method Prep: Aq

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
Batch: 6040357							
A6D0372-01	Water	SM 4500-PE	04/13/16 10:00	04/13/16 14:51	25mL/25mL	25mL/25mL	1.00
A6D0372-02	Water	SM 4500-PE	04/13/16 10:10	04/13/16 14:51	25mL/25mL	25mL/25mL	1.00
Batch: 6040475							
A6D0372-01	Water	SM 4500 P B	04/13/16 10:00	04/18/16 09:43	25mL/50mL	25mL/50mL	1.00
A6D0372-02	Water	SM 4500 P B	04/13/16 10:10	04/18/16 09:43	25mL/50mL	25mL/50mL	1.00

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Aquarius Environmental LLC	Project: **Stormwater Sampling**	
3204 NE40th Ave	Project Number: Phos 4/13/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	04/26/16 10:49

Weck Laboratories, Inc

SAMPLE PREPARATION INFORMATION

Conventional Chemistry/Physical Parameters by APHA/EPA/ASTM Methods

Prep: General Preparation

Lab Number	Matrix	Method	Sampled	Prepared	Sample Initial/Final	Default Initial/Final	RL Prep Factor
Batch: W6D0728							
A6D0372-01	Water	EPA 351.2	04/13/16 10:00	04/14/16 16:13	20ml/20ml	20ml/20ml	NA
A6D0372-02	Water	EPA 351.2	04/13/16 10:10	04/14/16 16:13	20ml/20ml	20ml/20ml	NA

Apex Laboratories

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3204 NE40th Ave	Project Number: Phos 4/13/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	04/26/16 10:49

Notes and Definitions

Qualifiers:

Notes and Conventions:

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis. Results listed as 'wet' or without 'dry'designation are not dry weight corrected.
RPD	Relative Percent Difference
MDL	If MDL is not listed, data has been evaluated to the Method Reporting Limit only.
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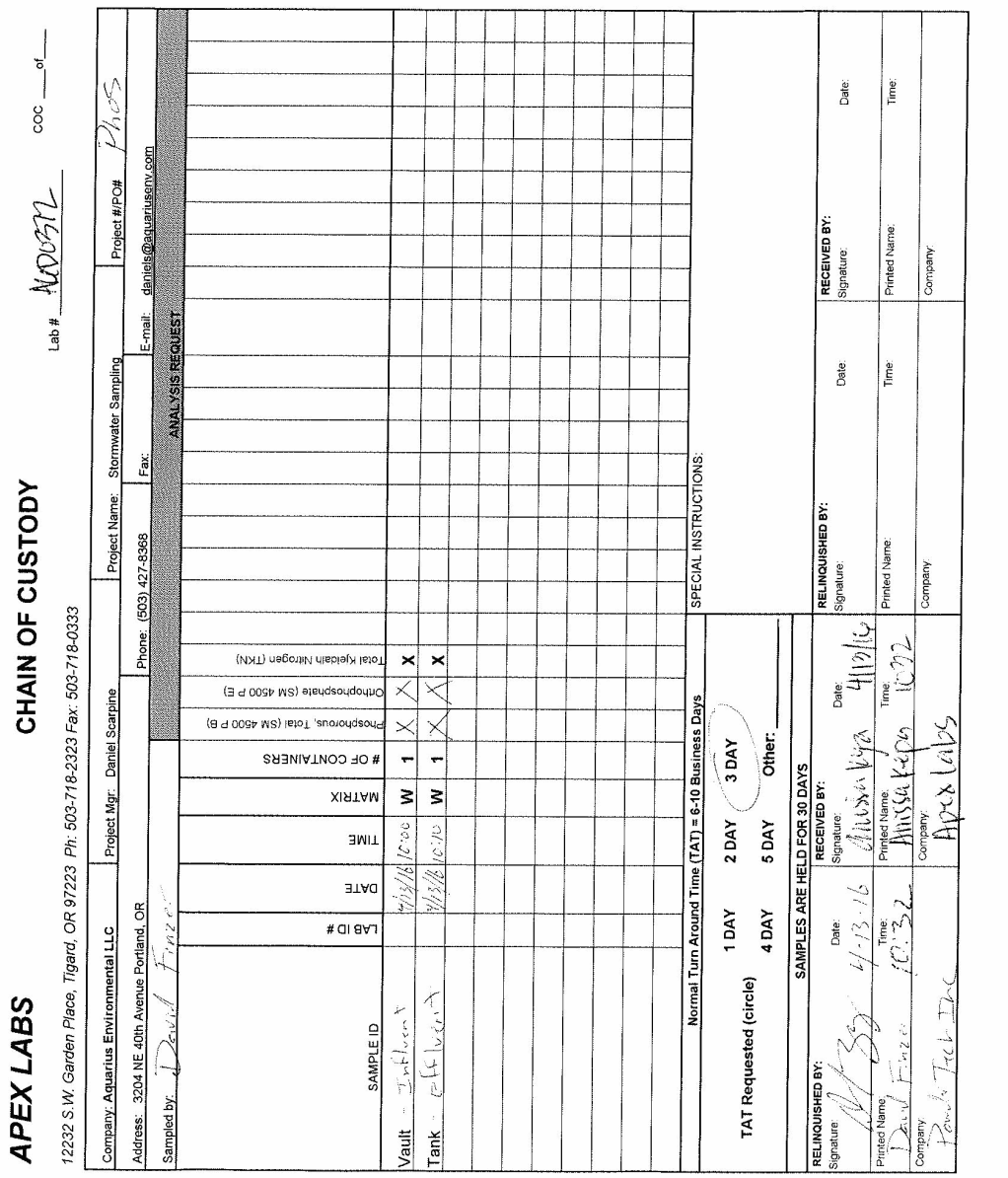
3204 NE40th Ave	Project Number: Phos 4/13/16	**Reported:**
Portland, OR 97212	Project Manager: Daniel Scarpine	04/26/16 10:49



Apex Laboratories

Brian L Cone

Brian Cone, Industrial Services Manager

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Appendix C: Water Quality Pond Modeling

TECHNICAL MEMORANDUM
Prepared by: Daniel Scarpine, PE, Aquarius Environmental, LLC
RE: PTI-OSB Tualatin, OR – Water Quality Pond modeling

Modeling Summary

Hydrologic runoff modeling for Powder Tech. Inc. and Oregon Sand Blast (PTI-OSB) at 9900 & 10000 SW Herman Road, Tualatin, OR was performed by Aquarius Environmental, LLC (AE) using the Santa Barbara Urban Hydrograph (SBUH) method and the Clean Water Services method for determining water quality volume. Conveyance flow rates were calculated using precipitation rates prescribed by 2008 The City of Portland Stormwater Manual (Manual) using HYDROCAD flow modeling software.

Results indicate that with the present pond configuration, a water quality flow (treatment rate) of approximately 400 gpm is required. Proposed improvements to install an above-ground storage volume to 80,000 gallons will reduce required water quality flow to approximately 72 gpm.

Details of our analysis are as follows.

Modeling Methodology

Existing conditions of the site and pond were established by analyzing aerial imagery and historic drawings provided by PTI-OSB[1]. Conflicting details in the drawings we resolved by field as-built measurements of the pond.

The complete site is comprised of approximately 6.85 acres. Analysis of site land types and runoff directions indicates areas with vegetation on the perimeter of the site a gravel area near the north end of the site were determined to not convey via the pond outfall. The area excluded was a relatively small portion of the site, see the modeling inputs below for details.

The following model inputs were used:

- Total Site Area - 6.85 acres
  - Contributing Impervious Area – 6.22 acres (Used in computing water quality flow and CWS water quality volume)
- Impervious CN – 98
- Time of concentration – 15 minutes
- Existing pond dimensions:
  - Bottom width – 22 ft
  - Bottom length – 80 ft
  - Side Slope - 1:1
  - Depth – 5 ft

[1] Sisul Engineering "Utility Improvements", "Grading & Erosion Control" Worth Technical Services "Grading and Erosion Control"

- Proposed Detention Facility dimensions:
  - Min. 80,000 gallon volume
  - Bottom width – 22 ft
  - Bottom length – 73.75 ft
  - Side Slope - 1:1
  - Depth – 5 ft

The HydroCAD model computed runoff from the site and routed it through a detention facility with 80,000 gallons of storage volume, which represents the proposed 80,000 gallon storage tank. In this simulation, the detention facility significantly attenuated the water quality flow rate produced by the industrial area. Details are listed in Table 1 below.

Table 1: Model Results Summary

Scenario	Water quality flow (Qwq)		Detention Volume
	cfs	gpm	gal
Existing - No Storage	0.89	399.4	0
Proposed - DetentionTank	0.16	71.8	80,000

The unmodified water quality flow rate with no detention was determined to be approximately 400 gpm, but by including proposed detention, that rate drops to approximately 72 gpm. This reduction of over 80% of the flow rate is critical in reducing treatment equipment size, maintenance, and overall affordability of treatment alternatives.

The Clean Water Services' water quality volume and flow rate were calculated according to the method described in Section 4.05.6 of the Design and Construction Standards. In order to determine the quantity of water requiring treatment, one computes the Water Quality Volume as shown below.

$$\text{Water Quality Volume (WQV) } [\text{ft}^3]:$$

$$WQV = \frac{0.36[in]Area[ft^2]}{12[in/ft]}$$

The Water Quality Flow rate is calculated by dividing the WQV by the time duration of the storm producing the WQV as shown below.

$$\text{Water Quality Flow (WQF) [cfs]:}$$

$$WQF = \frac{WQV[ft^3]}{(4[hr])(60[\text{min}/hr])(60[\text{sec}/\text{min}])}$$

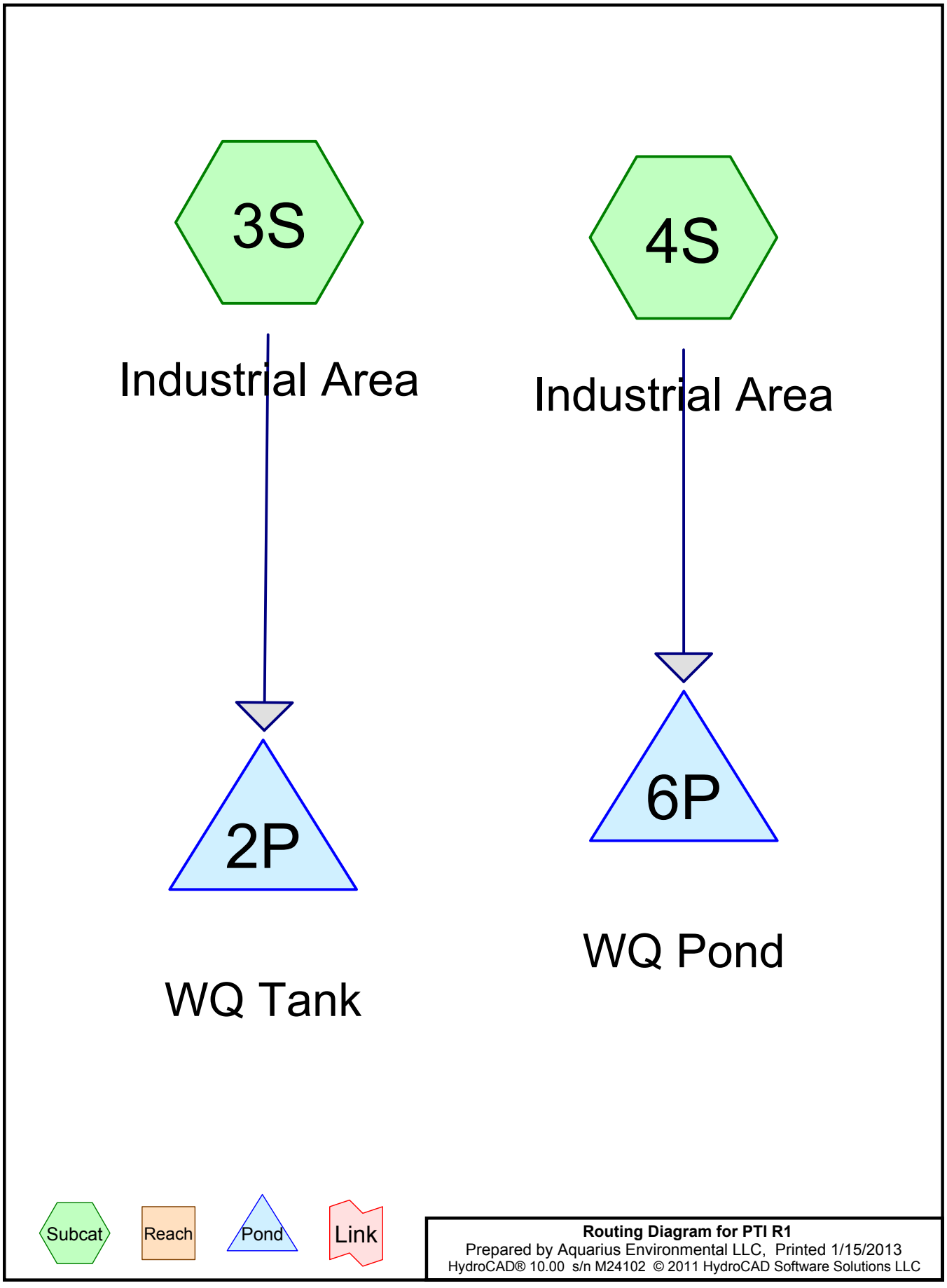
This straightforward method results in calculated values that are lower than those calculated by the 2008 City of Portland Stormwater Management Manual method (SBUH). The results of the Clean Water Services calculations are shown in table 2 below.

Table 2: Clean Water Services Calculations Results

Water Quality Volume (Qwv)		Water Quality Treatment Rate (Qwq)	
ft^3	gal	ft^3/s	gpm
8,128	60,800	0.56	253.33

In order to be conservative in the design of the water treatment facility and storage structures, AE compared the unmodified water quality flow rates, and used modeling results from the City of Portland scenario (Qwq = 400 gpm) rather than the Clean Water Services results (Qwq = 253 gpm). The proposed tank provides the storage volume required by Clean Water Services water quality volume calculations and accomplishes the desirable flow rate attenuation of the water quality flow to 72 gpm.

Appendix D: HydroCAD Output



Routing Diagram for PTI R1
Prepared by Aquarius Environmental LLC, Printed 1/15/2013

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
12.440	98	(3S, 4S)
12.440	**98**	**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	12.440	12.440		3S, 4S
0.000	**0.000**	**0.000**	**0.000**	**12.440**	**12.440**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 3S: Industrial Area Runoff Area=6.220 ac 100.00% Impervious Runoff Depth>0.62"
Tc=15.0 min CN=0/98 Runoff=0.89 cfs 0.323 af

Subcatchment 4S: Industrial Area Runoff Area=6.220 ac 100.00% Impervious Runoff Depth>0.62"
Tc=15.0 min CN=0/98 Runoff=0.89 cfs 0.323 af

Pond 2P: WQ Tank Peak Elev=123.55' Storage=0.218 af Inflow=0.89 cfs 0.323 af
Outflow=0.16 cfs 0.106 af

Pond 6P: WQ Pond Peak Elev=123.55' Storage=0.235 af Inflow=0.89 cfs 0.323 af
Outflow=0.15 cfs 0.089 af

Total Runoff Area = 12.440 ac Runoff Volume = 0.646 af Average Runoff Depth = 0.62"
0.00% Pervious = 0.000 ac 100.00% Impervious = 12.440 ac

Summary for Subcatchment 3S: Industrial Area

Runoff = 0.89 cfs @ 8.00 hrs, Volume= 0.323 af, Depth> 0.62"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 1 City WQ Storm 0.83/24 Rainfall=0.83"

	Area (ac)	CN	Description
*	6.220	98	
	6.220	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Summary for Subcatchment 4S: Industrial Area

Runoff = 0.89 cfs @ 8.00 hrs, Volume= 0.323 af, Depth> 0.62"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 1 City WQ Storm 0.83/24 Rainfall=0.83"

	Area (ac)	CN	Description
*	6.220	98	
	6.220	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Summary for Pond 2P: WQ Tank

Inflow Area = 6.220 ac,100.00% Impervious, Inflow Depth > 0.62" for 1 City WQ Storm 0.83/24 event
Inflow = 0.89 cfs @ 8.00 hrs, Volume= 0.323 af
Outflow = 0.16 cfs @ 15.03 hrs, Volume= 0.106 af, Atten= 82%, Lag= 421.4 min
Primary = 0.16 cfs @ 15.03 hrs, Volume= 0.106 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 123.55' @ 15.03 hrs Surf.Area= 0.059 ac Storage= 0.218 af

Plug-Flow detention time= 703.0 min calculated for 0.106 af (33% of inflow)
Center-of-Mass det. time= 394.7 min (1,125.2 - 730.5)

Volume	Invert	Avail.Storage	Storage Description
#1	119.00'	0.245 af	**22.00'W x 73.75'L x 5.00'H Prismatoid Z=1.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	123.50'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50

Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.16 cfs @ 15.03 hrs HW=123.55' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 0.16 cfs @ 0.59 fps)

Summary for Pond 6P: WQ Pond

Inflow Area = 6.220 ac,100.00% Impervious, Inflow Depth > 0.62" for 1 City WQ Storm 0.83/24 event
Inflow = 0.89 cfs @ 8.00 hrs, Volume= 0.323 af
Outflow = 0.15 cfs @ 16.41 hrs, Volume= 0.089 af, Atten= 83%, Lag= 504.3 min
Primary = 0.15 cfs @ 16.41 hrs, Volume= 0.089 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 123.55' @ 16.41 hrs Surf.Area= 0.064 ac Storage= 0.235 af

Plug-Flow detention time= 762.6 min calculated for 0.089 af (27% of inflow)
Center-of-Mass det. time= 439.2 min (1,169.7 - 730.5)

Volume	Invert	Avail.Storage	Storage Description
#1	119.00'	0.264 af	**22.00'W x 80.00'L x 5.00'H Prismatoid Z=1.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	123.50'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.15 cfs @ 16.41 hrs HW=123.55' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 0.15 cfs @ 0.58 fps)

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 3S: Industrial Area Runoff Area=6.220 ac 100.00% Impervious Runoff Depth=0.19"
Tc=15.0 min CN=0/98 Runoff=0.73 cfs 0.101 af

Subcatchment 4S: Industrial Area Runoff Area=6.220 ac 100.00% Impervious Runoff Depth=0.19"
Tc=15.0 min CN=0/98 Runoff=0.73 cfs 0.101 af

Pond 2P: WQ Tank Peak Elev=121.37' Storage=0.101 af Inflow=0.73 cfs 0.101 af
Outflow=0.00 cfs 0.000 af

Pond 6P: WQ Pond Peak Elev=121.21' Storage=0.101 af Inflow=0.73 cfs 0.101 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 12.440 ac Runoff Volume = 0.202 af Average Runoff Depth = 0.19"
0.00% Pervious = 0.000 ac 100.00% Impervious = 12.440 ac

Summary for Subcatchment 3S: Industrial Area

Runoff = 0.73 cfs @ 1.47 hrs, Volume= 0.101 af, Depth= 0.19"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 4.00 hrs 1 CWS WQ Storm 0.36/4 Rainfall=0.36"

	Area (ac)	CN	Description
*	6.220	98	
	6.220	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Summary for Subcatchment 4S: Industrial Area

Runoff = 0.73 cfs @ 1.47 hrs, Volume= 0.101 af, Depth= 0.19"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 4.00 hrs 1 CWS WQ Storm 0.36/4 Rainfall=0.36"

	Area (ac)	CN	Description
*	6.220	98	
	6.220	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Summary for Pond 2P: WQ Tank

Inflow Area = 6.220 ac,100.00% Impervious, Inflow Depth = 0.19" for 1 CWS WQ Storm 0.36/4 event
Inflow = 0.73 cfs @ 1.47 hrs, Volume= 0.101 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 121.37' @ 11.60 hrs Surf.Area= 0.048 ac Storage= 0.101 af

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	119.00'	0.245 af	**22.00'W x 73.75'L x 5.00'H Prismatoid Z=1.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	123.50'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50

Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=119.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 6P: WQ Pond

Inflow Area = 6.220 ac,100.00% Impervious, Inflow Depth = 0.19" for 1 CWS WQ Storm 0.36/4 event
Inflow = 0.73 cfs @ 1.47 hrs, Volume= 0.101 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 121.21' @ 11.45 hrs Surf.Area= 0.051 ac Storage= 0.101 af

Plug-Flow detention time= (not calculated: initial storage excedes outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	119.00'	0.264 af	**22.00'W x 80.00'L x 5.00'H Prismatoid Z=1.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	123.50'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=119.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 3S: Industrial Area Runoff Area=6.220 ac 100.00% Impervious Runoff Depth>2.65"
Tc=15.0 min CN=0/98 Runoff=3.72 cfs 1.376 af

Subcatchment 4S: Industrial Area Runoff Area=6.220 ac 100.00% Impervious Runoff Depth>2.65"
Tc=15.0 min CN=0/98 Runoff=3.72 cfs 1.376 af

Pond 2P: WQ Tank Peak Elev=123.93' Storage=0.241 af Inflow=3.72 cfs 1.376 af
Outflow=3.66 cfs 1.156 af

Pond 6P: WQ Pond Peak Elev=123.93' Storage=0.260 af Inflow=3.72 cfs 1.376 af
Outflow=3.65 cfs 1.138 af

Total Runoff Area = 12.440 ac Runoff Volume = 2.752 af Average Runoff Depth = 2.65"
0.00% Pervious = 0.000 ac 100.00% Impervious = 12.440 ac

Summary for Subcatchment 3S: Industrial Area

Runoff = 3.72 cfs @ 8.00 hrs, Volume= 1.376 af, Depth> 2.65"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5year 2.90/24 Rainfall=2.90"

	Area (ac)	CN	Description
*	6.220	98	
	6.220	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Summary for Subcatchment 4S: Industrial Area

Runoff = 3.72 cfs @ 8.00 hrs, Volume= 1.376 af, Depth> 2.65"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 5year 2.90/24 Rainfall=2.90"

	Area (ac)	CN	Description
*	6.220	98	
	6.220	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Summary for Pond 2P: WQ Tank

Inflow Area = 6.220 ac,100.00% Impervious, Inflow Depth > 2.65" for 5year 2.90/24 event
Inflow = 3.72 cfs @ 8.00 hrs, Volume= 1.376 af
Outflow = 3.66 cfs @ 8.04 hrs, Volume= 1.156 af, Atten= 2%, Lag= 2.8 min
Primary = 3.66 cfs @ 8.04 hrs, Volume= 1.156 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 123.93' @ 8.04 hrs Surf.Area= 0.061 ac Storage= 0.241 af

Plug-Flow detention time= 188.9 min calculated for 1.153 af (84% of inflow)
Center-of-Mass det. time= 81.1 min (756.3 - 675.2)

Volume	Invert	Avail.Storage	Storage Description
#1	119.00'	0.245 af	**22.00'W x 73.75'L x 5.00'H Prismatoid Z=1.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	123.50'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50

Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=3.65 cfs @ 8.04 hrs HW=123.93' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 3.65 cfs @ 1.71 fps)

Summary for Pond 6P: WQ Pond

Inflow Area = 6.220 ac,100.00% Impervious, Inflow Depth > 2.65" for 5year 2.90/24 event
Inflow = 3.72 cfs @ 8.00 hrs, Volume= 1.376 af
Outflow = 3.65 cfs @ 8.05 hrs, Volume= 1.138 af, Atten= 2%, Lag= 3.0 min
Primary = 3.65 cfs @ 8.05 hrs, Volume= 1.138 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 123.93' @ 8.05 hrs Surf.Area= 0.066 ac Storage= 0.260 af

Plug-Flow detention time= 202.2 min calculated for 1.136 af (83% of inflow)
Center-of-Mass det. time= 87.0 min (762.1 - 675.2)

Volume	Invert	Avail.Storage	Storage Description
#1	119.00'	0.264 af	**22.00'W x 80.00'L x 5.00'H Prismatoid Z=1.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	123.50'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=3.64 cfs @ 8.05 hrs HW=123.93' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 3.64 cfs @ 1.71 fps)

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 3S: Industrial Area Runoff Area=6.220 ac 100.00% Impervious Runoff Depth>3.15"
Tc=15.0 min CN=0/98 Runoff=4.39 cfs 1.633 af

Subcatchment 4S: Industrial Area Runoff Area=6.220 ac 100.00% Impervious Runoff Depth>3.15"
Tc=15.0 min CN=0/98 Runoff=4.39 cfs 1.633 af

Pond 2P: WQ Tank Peak Elev=123.98' Storage=0.244 af Inflow=4.39 cfs 1.633 af
Outflow=4.32 cfs 1.412 af

Pond 6P: WQ Pond Peak Elev=123.98' Storage=0.263 af Inflow=4.39 cfs 1.633 af
Outflow=4.31 cfs 1.395 af

Total Runoff Area = 12.440 ac Runoff Volume = 3.266 af Average Runoff Depth = 3.15"
0.00% Pervious = 0.000 ac 100.00% Impervious = 12.440 ac

Summary for Subcatchment 3S: Industrial Area

Runoff = 4.39 cfs @ 8.00 hrs, Volume= 1.633 af, Depth> 3.15"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10year 3.4/24 Rainfall=3.40"

	Area (ac)	CN	Description
*	6.220	98	
	6.220	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Summary for Subcatchment 4S: Industrial Area

Runoff = 4.39 cfs @ 8.00 hrs, Volume= 1.633 af, Depth> 3.15"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10year 3.4/24 Rainfall=3.40"

	Area (ac)	CN	Description
*	6.220	98	
	6.220	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Summary for Pond 2P: WQ Tank

Inflow Area = 6.220 ac,100.00% Impervious, Inflow Depth > 3.15" for 10year 3.4/24 event
Inflow = 4.39 cfs @ 8.00 hrs, Volume= 1.633 af
Outflow = 4.32 cfs @ 8.04 hrs, Volume= 1.412 af, Atten= 2%, Lag= 2.7 min
Primary = 4.32 cfs @ 8.04 hrs, Volume= 1.412 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 123.98' @ 8.04 hrs Surf.Area= 0.061 ac Storage= 0.244 af

Plug-Flow detention time= 164.0 min calculated for 1.412 af (86% of inflow)
Center-of-Mass det. time= 70.6 min (741.4 - 670.8)

Volume	Invert	Avail.Storage	Storage Description
#1	119.00'	0.245 af	**22.00'W x 73.75'L x 5.00'H Prismatoid Z=1.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	123.50'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50

Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=4.31 cfs @ 8.04 hrs HW=123.98' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 4.31 cfs @ 1.80 fps)

Summary for Pond 6P: WQ Pond

Inflow Area = 6.220 ac,100.00% Impervious, Inflow Depth > 3.15" for 10year 3.4/24 event
Inflow = 4.39 cfs @ 8.00 hrs, Volume= 1.633 af
Outflow = 4.31 cfs @ 8.04 hrs, Volume= 1.395 af, Atten= 2%, Lag= 2.9 min
Primary = 4.31 cfs @ 8.04 hrs, Volume= 1.395 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 123.98' @ 8.04 hrs Surf.Area= 0.066 ac Storage= 0.263 af

Plug-Flow detention time= 175.7 min calculated for 1.395 af (85% of inflow)
Center-of-Mass det. time= 75.7 min (746.4 - 670.8)

Volume	Invert	Avail.Storage	Storage Description
#1	119.00'	0.264 af	**22.00'W x 80.00'L x 5.00'H Prismatoid Z=1.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	123.50'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=4.30 cfs @ 8.04 hrs HW=123.98' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 4.30 cfs @ 1.80 fps)

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 3S: Industrial Area Runoff Area=6.220 ac 100.00% Impervious Runoff Depth>3.65"
Tc=15.0 min CN=0/98 Runoff=5.06 cfs 1.890 af

Subcatchment 4S: Industrial Area Runoff Area=6.220 ac 100.00% Impervious Runoff Depth>3.65"
Tc=15.0 min CN=0/98 Runoff=5.06 cfs 1.890 af

Pond 2P: WQ Tank Peak Elev=124.04' Storage=0.245 af Inflow=5.06 cfs 1.890 af
Outflow=5.17 cfs 1.669 af

Pond 6P: WQ Pond Peak Elev=124.04' Storage=0.264 af Inflow=5.06 cfs 1.890 af
Outflow=5.13 cfs 1.651 af

Total Runoff Area = 12.440 ac Runoff Volume = 3.780 af Average Runoff Depth = 3.65"
0.00% Pervious = 0.000 ac 100.00% Impervious = 12.440 ac

Summary for Subcatchment 3S: Industrial Area

Runoff = 5.06 cfs @ 8.00 hrs, Volume= 1.890 af, Depth> 3.65"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25year 3.9/24 Rainfall=3.90"

	Area (ac)	CN	Description
*	6.220	98	
	6.220	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Summary for Subcatchment 4S: Industrial Area

Runoff = 5.06 cfs @ 8.00 hrs, Volume= 1.890 af, Depth> 3.65"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25year 3.9/24 Rainfall=3.90"

	Area (ac)	CN	Description
*	6.220	98	
	6.220	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Summary for Pond 2P: WQ Tank

Inflow Area = 6.220 ac,100.00% Impervious, Inflow Depth > 3.65" for 25year 3.9/24 event
Inflow = 5.06 cfs @ 8.00 hrs, Volume= 1.890 af
Outflow = 5.17 cfs @ 7.95 hrs, Volume= 1.669 af, Atten= 0%, Lag= 0.0 min
Primary = 5.17 cfs @ 7.95 hrs, Volume= 1.669 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 124.04' @ 7.95 hrs Surf.Area= 0.062 ac Storage= 0.245 af

Plug-Flow detention time= 144.7 min calculated for 1.665 af (88% of inflow)
Center-of-Mass det. time= 62.7 min (730.1 - 667.3)

Volume	Invert	Avail.Storage	Storage Description
#1	119.00'	0.245 af	**22.00'W x 73.75'L x 5.00'H Prismatoid Z=1.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	123.50'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50

Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=5.17 cfs @ 7.95 hrs HW=124.04' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 5.17 cfs @ 1.92 fps)

Summary for Pond 6P: WQ Pond

Inflow Area = 6.220 ac,100.00% Impervious, Inflow Depth > 3.65" for 25year 3.9/24 event
Inflow = 5.06 cfs @ 8.00 hrs, Volume= 1.890 af
Outflow = 5.13 cfs @ 7.95 hrs, Volume= 1.651 af, Atten= 0%, Lag= 0.0 min
Primary = 5.13 cfs @ 7.95 hrs, Volume= 1.651 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 124.04' @ 7.95 hrs Surf.Area= 0.066 ac Storage= 0.264 af

Plug-Flow detention time= 155.1 min calculated for 1.648 af (87% of inflow)
Center-of-Mass det. time= 67.2 min (734.6 - 667.3)

Volume	Invert	Avail.Storage	Storage Description
#1	119.00'	0.264 af	**22.00'W x 80.00'L x 5.00'H Prismatoid Z=1.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	123.50'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=5.13 cfs @ 7.95 hrs HW=124.04' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 5.13 cfs @ 1.91 fps)

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 3S: Industrial Area Runoff Area=6.220 ac 100.00% Impervious Runoff Depth>4.14"
Tc=15.0 min CN=0/98 Runoff=5.73 cfs 2.148 af

Subcatchment 4S: Industrial Area Runoff Area=6.220 ac 100.00% Impervious Runoff Depth>4.14"
Tc=15.0 min CN=0/98 Runoff=5.73 cfs 2.148 af

Pond 2P: WQ Tank Peak Elev=124.09' Storage=0.245 af Inflow=5.73 cfs 2.148 af
Outflow=5.90 cfs 1.926 af

Pond 6P: WQ Pond Peak Elev=124.08' Storage=0.264 af Inflow=5.73 cfs 2.148 af
Outflow=5.84 cfs 1.908 af

Total Runoff Area = 12.440 ac Runoff Volume = 4.295 af Average Runoff Depth = 4.14"
0.00% Pervious = 0.000 ac 100.00% Impervious = 12.440 ac

Summary for Subcatchment 3S: Industrial Area

Runoff = 5.73 cfs @ 8.00 hrs, Volume= 2.148 af, Depth> 4.14"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 year 4.4/24 Rainfall=4.40"

	Area (ac)	CN	Description
*	6.220	98	
	6.220	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Summary for Subcatchment 4S: Industrial Area

Runoff = 5.73 cfs @ 8.00 hrs, Volume= 2.148 af, Depth> 4.14"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 year 4.4/24 Rainfall=4.40"

	Area (ac)	CN	Description
*	6.220	98	
	6.220	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Summary for Pond 2P: WQ Tank

Inflow Area = 6.220 ac,100.00% Impervious, Inflow Depth > 4.14" for 100 year 4.4/24 event
Inflow = 5.73 cfs @ 8.00 hrs, Volume= 2.148 af
Outflow = 5.90 cfs @ 7.96 hrs, Volume= 1.926 af, Atten= 0%, Lag= 0.0 min
Primary = 5.90 cfs @ 7.96 hrs, Volume= 1.926 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 124.09' @ 7.96 hrs Surf.Area= 0.062 ac Storage= 0.245 af

Plug-Flow detention time= 129.8 min calculated for 1.922 af (89% of inflow)
Center-of-Mass det. time= 56.5 min (721.1 - 664.6)

Volume	Invert	Avail.Storage	Storage Description
#1	119.00'	0.245 af	**22.00'W x 73.75'L x 5.00'H Prismatoid Z=1.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	123.50'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50

Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=5.84 cfs @ 7.96 hrs HW=124.09' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 5.84 cfs @ 2.00 fps)

Summary for Pond 6P: WQ Pond

Inflow Area = 6.220 ac,100.00% Impervious, Inflow Depth > 4.14" for 100 year 4.4/24 event
Inflow = 5.73 cfs @ 8.00 hrs, Volume= 2.148 af
Outflow = 5.84 cfs @ 7.96 hrs, Volume= 1.908 af, Atten= 0%, Lag= 0.0 min
Primary = 5.84 cfs @ 7.96 hrs, Volume= 1.908 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 124.08' @ 7.96 hrs Surf.Area= 0.066 ac Storage= 0.264 af

Plug-Flow detention time= 139.5 min calculated for 1.908 af (89% of inflow)
Center-of-Mass det. time= 60.6 min (725.2 - 664.6)

Volume	Invert	Avail.Storage	Storage Description
#1	119.00'	0.264 af	**22.00'W x 80.00'L x 5.00'H Prismatoid Z=1.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	123.50'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=5.78 cfs @ 7.96 hrs HW=124.08' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 5.78 cfs @ 1.99 fps)

Appendix E: Enpurion® EC System Specifications

SPECIFICATION AND SCOPE OF WORK

Stormwater Treatment System

December 12, 2014

Powder Tech Inc
9900 South Herman Road
Tualatin, OR 99062

Prepared by:

Michael Johnson, PE
Lean Environment Inc
michael@lean-e.com
(425) 922-9141

DATE: December 12, 2014

TO: Joe Lang, Owner / Powder Tech Inc & Oregon Sand Blasting

FROM: Michael Johnson, LEI / Enpurion

SUBJECT: Specification and Scope of Work – Powder Tech Inc Stormwater Treatment

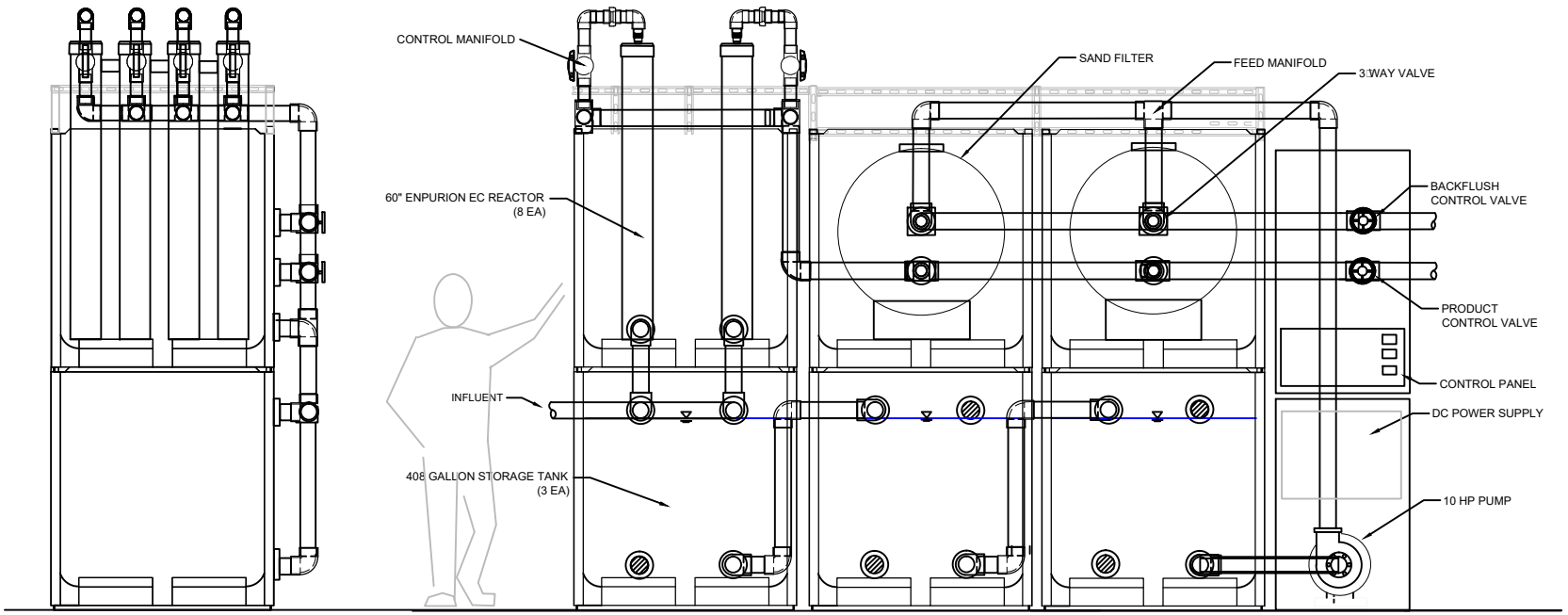
The following document is a basis under which the Enpurion Stormwater Treatment System will be specified and final proposal developed for Powder Tech Inc of Tualatin Oregon. Once accepted, the final proposal will be used to establish final pricing, and establish the standards under which the system is constructed, installed and commissioned.

The purpose of the enclosed document is:

1) Define the system performance requirements
2) Delineate specific tasks in the process
3) Identify roles and responsibilities for each task
4) Determine the approximate order of execution
5) Specify critical elements of the final bid package and proposal

The document is subject to change and revision up to the acceptance of the final proposal, at which time formal contract language will be included, and final terms and conditions specified.

We are grateful for your thoughtful consideration and timely response.



END ELEVATION

FRONT ELEVATION VIEW

SHEET
1 OF 1

MARK	DESCRIPTION OF REVISIONS	DRAWN AM
		CHK'D MBJ
		APP'D MBJ
1		DATE 9/30/14

enpurion
A Lean Environment Company

4500 A 15□ STREET EAST
TACOMA, WA 98424
(253) 922 8823 □(425) 922 9141

ENPURION COMPACT EC□100

STORMWATER TREATMENT
ELEVATION VIEW

SHEET
1 OF 1

CONTENTS

I. BACKGROUND

Powder Tech Inc (Customer) is seeking to implement Tier II treatment to the stormwater outfalls at the Tualatin Oregon site. Full scale studies of comparable facilities performed by Lean Environment Inc (LEI) have demonstrated the efficacy of the Enpurion® electrocoagulation (EC) treatment technologies for meeting benchmarks at those locations. This Specification and Scope of Work (Specification) is presented to define the roles and responsibilities, approximate sequence, procedures and coordination on specific tasks. A more detailed work plan will follow pending the review, option selection and acceptance of the Specification. Each element in the Specification is subject to change until execution of final agreement and purchase order.

The system proposed is based upon a proven electrocoagulation technology utilizing a proprietary Enpurion® EC reactor. The site has significant issues in terms of the level of ionic pollutants (zinc) and suspended particles. Performance of systems installed with similar site conditions has demonstrated perfect compliance using Enpurion EC technology. Data indicate that the system as specified will successfully treat the site stormwater to achieve benchmarks, and do so in an economical and sustainable manner.

II. BASIS OF DESIGN

A. Hydraulic Capacity

A design flow rate of 75 GPM has been defined by Aquarius Environmental and Powder Tech Inc management as the capacity requirement for design.

B. Performance Characteristics

The system will be designed to meet Oregon Department of Environmental Quality Industrial Stormwater Discharge 1200-Z Permit for the parameters in Table 1. Note that no provision for treatment of BOD or fecal coliform is included in this design. Additional features are available for purchase to provide for treatment of these pollutants at additional cost.

Parameter	Benchmark
1. Total Copper	0.020 mg/l
2. Total Lead	0.040 mg/l
3. Total Zinc	0.120 mg/l
4. Total Suspended Solids	100 mg/l
5. pH	5.5 – 9.0 SU
6. Total Oil and Grease	10 mg/l
7. Total Iron	1.0 mg/l
8. Total Aluminum	0.750 mg/l

TABLE 1 – BENCHMARK LIMITS

C. Operation and Maintenance

The system shall have the following *operational* characteristics:

1. The system shall be capable of basic operation without operator intervention. Periodic and normal maintenance activities will be required, and may include back-flush. These will be defined in Section III.D – OPTIONS.

2. The system shall operate without the use of chemicals as defined by 29 CFR 1910. Articles are specifically excluded from this definition.

3. The system shall be maintainable by workers reasonably skilled in basic mechanical, piping or related trades. With the exception of training provided by LEI/Enpurion, no highly specialized training shall be necessary to conduct regularly scheduled maintenance.

4. The system shall use no more than 100 Ampere of 480V three-phase power. No other forms of energy are required.

5. No aspect of the system shall be designed for continuous human occupancy.

6. Other than outfall and those contained in the system, additional utilities will not be required at the work site.

III. ROLES AND RESPONSIBILITIES

A. Engineering Specifications and Design

1. Powder Tech will determine the construction envelope inside of which the entire system shall be constructed and operate. The envelope must be larger than the minimum footprint specified in sections III.B – III.D.

2. Powder Tech Inc will provide for survey and elevations at the site, and make results available to LEI personnel preferably in both paper and electronic formats. Alternatively, LEI may

3. Powder Tech will provide for a compacted level surface on which the treatment system will reside. Powder Tech will retain responsibility for structural integrity and management thereof.

4. LEI / Enpurion shall provide the physical design, drawings, specifications and operating parameters for the above-ground components for the stormwater treatment system, including external piping.

5. Third parties shall provide as-built drawings for all elements not provided by LEI.

B. Customer-Supplied Components

The system shall employ existing stormwater infrastructure and Powder Tech Inc will provide additional system elements described below:

1. Powder Tech will provide for all stormwater conveyances to deliver the stormwater to be treated to a single location.

2. Powder Tech will provide a pump transfer of all stormwater to be treated into the treatment system at a rate no greater than 110% of the stated design flow defined in Section II.A.

3. An open channel surface conveyance or outfall pipe with minimum diameter of 8” shall be provided at a specified location near the treatment system. If the outfall is a

subsurface conveyance, the outfall shall be comprised of a catch basin with not less than 24" of pipe riser exposed, or an alternative equivalent structure. A schematic drawing of the preferred embodiment of the outfall will be provided with final proposal.

4. Electrical service shall be provided by customer to an electrical disconnect providing a minimum of 100 AMP of 480 Volt three-phase power. Power shall be provided in a single electrical disconnect.

5. Customer will not require any form of electronic data collection, telemetry, remote monitoring or operation of the system. Electronic data management is available for additional costs. See SECTION D.

C. Enpurion® / LEI – Supplied Components

The major system components provided as part of the Enpurion EC (SEE FIGURE 1) process are as follows:

1. Eight (8) Enpurion EC Reactors, approximately six feet in working height and comprised of inner pressure tube, outer shell, anode, cathode, dielectric, internal wiring and connectors.

2. All required mechanical appurtenances, armature, chassis and brackets for mounting Enpurion EC reactors, pipe chases, etc. associate with water, power and air conveyances on the above ground equipment.

3. Electrical bus bars for connecting DC current to treatment reactors, and electrical conductors from bus bars to DC power supply.

4. DC Power Supply will be provided capable of producing a minimum of 200 continuous Ampere at 24V to be delivered to the reactors and automatically actuated when sand filter pumps are running.

5. A series rectangular reactor tanks comprised of polypropylene walls and flat bottom with the following characteristics:

    a. Tanks are structurally capable of safely holding a minimum of 1200 gallons with adequate freeboard to prevent overtopping.

b. Necessary inlet and outlet flanges and fittings to provide for reasonably continuous operation of treatment system without operator intervention.

c. System is to provide for reasonable access to reactor topsides for visual inspection and maintenance of tank contents. No external ladders and stairs are provided.

d. Tank is to be equipped with mounting brackets for pipe and electrical chases, armature for reactor mounting, and appurtenances.

6. A prefabricated enclosure containing main electrical panel (item III.E.9), pumps (Item III.E.7), DC power supply (Item III.E.4), relays and/or PLC) and freeze protection circuits as indicated.

7. Two or more pumps capable of delivering 150 GPM at 35 PSI to the sand filters, actuated by float switches contained in the process tank. The preliminary specification is for 5 HP centrifugal pumps, which maybe submersible, depending on site and influent conditions.

8. Two float switches or a pressure transducer indicating high level and low level, configured for indicating level to latching relays that turn on pumps and DC power to the reactors, such that the reactors are energized only when the pumps to the sand filter are running.

9. Electrical control panel(s) providing for automated operation of reactors, pumps, level switches and optional backflush operations. SEE SECTION D for description of backflush operating options.

10. A built-to-order series of sand filter (See FIGURE 1) specified and designed by Enpurion specifically for the Powder Tech Inc application, including gravel media, ASTM standard sand, and/or other selected media for filter operation.

11. Backflush control valve, feed pressure control valve and two (2) product control valves to regulate flow in low and high flow conditions. Low flow and backflush valves may be operated manually, or mechanically actuated based on tank level. (SEE SECTION D.)

D. Customer Defined Backflush Operation and Automation Options

The Client shall define the degree of automation, as the system may be operated under several levels of automation for backflush operations. The options are described below.

1. *Manual backflush* of sand filters is accomplished by an operator flushing the system at least daily during storm events to ensure the filters are not blinded. The system is fitted with two or more pressure relief valves to ensure that the sand filters do not exceed design pressure of 50 psig. Operators are to backflush the system in the event that the pressure relief valves are engaged, or on a schedule determined by flow rates and site conditions.

2. *Semi-Automatic backflush* occurs based on run time of the system, such that the system back-flushes the sand filter at a fixed interval as determined by the operator.

3. *Fully-automated backflush* occurs at a fixed interval AND if a differential pressure across the sand filter manifold exceeds a minimum threshold pressure drop, typically 10-15 PSIG.

IV. SEQUENCE AND COORDINATION (Basis for Gantt Chart)

A. Preliminary scope of work reviewed, updated and finalized. (POWDER TECH, LEI, AQUARIUS)

B. Final Scope and Design Approval (Powder Tech / AQUARIUS)

C. Final Proposal and Agreement provided to Powder Tech Inc (LEI)

D. PO issued and prepayment check submitted (POWDER TECH INC)

E. Engineering Tier II Checklist per DEQ (AQUARIUS)

F. Final Project management package, Gantt Chart, 3rd party design begins (LEI/AQUARIUS)

G. Site survey, Conveyance and Pad Construction (POWDER TECH / AQUARIUS)

H. Off-site construction, fabrication and assemble Enpurion (LEI)

I. Electrical, subsurface, final construction (POWDER TECH)

J. Deliver and install Enpurion System (LEI)

K. System Commissioning, Start-up and Sampling (LEI)

L. Acceptance and Final Payment (POWDER TECH – March 2015)

V. ENGINEERING AND PROJECT MANAGEMENT ROLES

Enpurion / LEI will assume key roles in the engineering and project management for the above-ground components of the system. These efforts and associated costs will be included as part of the price for the treatment system. It is assumed that Aquarius Environmental will support the on-site work and real-property improvements under the direction of Mr. Lang. Powder Tech Inc acknowledges the considerable efforts undertaken in conceptual design, site visits, vendor coordination, assembly, logistics and project management. Powder Tech or designee will provide for the third-party management, coordination, field supervision, and support engineering related to the construction and site improvements for the system. The value of these services shall be reflected in the final proposal.

Powder Tech Inc Management (Mr. Lang) will assume responsibility for all Real-Property and subsurface improvements to the site prior to installation.

VI. CONTRACTUAL AND BUSINESS ASPECTS

1. Final Proposal: Following concurrence and agreement on the scope of work, roles and responsibilities, and deliverables, LEI will provide Powder Tech Inc with a final proposal and contractual terms.

2. Payment Terms: The financial terms of the agreement will require a minimum of 50% down payment on acceptance and issuance of Purchase Order (PO), and final 50% payment *on delivery* of the system.

3. Liability Coverage: LEI / Enpurion agrees to provide a minimum of $2 million in liability coverage, including $1 million in environmental liability insurance, errors and omissions coverage and general liability terms.

4. Change Orders: Following acceptance of final proposal and terms, changes to the system, its components, configuration or operational will be charged on a time-and-material basis, with charges to customer and project commensurate with prevailing wages, professional rates and equipment rates for the time, services and materials actually provided.

5. Collaboration and Confidentiality: It is understood that LEI and Powder Tech Inc will work together to the extent necessary for a timely and cost-effective completion of the project. The spirit of cooperation includes Powder Tech's recognition that LEI / Enpurion brings substantial, valuable and irreplaceable intellectual property to the process, including research and development, testing and consultation, the value of which shall be included in part with the value of the project. It is LEI's intent to provide a cost-effective option to the client in terms of purchase and operations, with the best available technical expertise and support. Powder Tech may become aware of proprietary and trade secret information in the course of this agreement. Powder Tech Inc and its personnel will refrain from disclosure of such information to the public or to other private entities unless otherwise required by law.

6. Additional Engineering Services: Lean Environment / Enpurion is available to provide Oregon Department of Environmental Quality (DEQ) Tier II checklist and related regulatory documentation to Powder Tech Inc at additional cost using an Oregon-Licensed Engineer of Record.

CONCLUSIONS

Lean Environment / Enpurion® looks forward to provision of superior quality and timely implementation of the stormwater treatment system and the project elements described herein. This Specification and Scope of Work is intended to clarify roles, compel detailed consideration and minimize the potential for conflict and misunderstanding. While misunderstandings may happen, all parties working to the common goal will ensure the best result with the least wasted effort.

On concurrence, LEI will proceed in preparation of final proposal including provision of plans and specifications, including relevant process and instrumentation diagrams. We are grateful for your consideration.