Bob Ferguson
ATTORNEY GENERAL OF WASHINGTON
Ecology Division
2425 Bristol Court SW 2nd Floor • Olympia WA 98502
PO Box 40117 • Olympia WA 98504-0117 • (360) 586-6770

March 10, 2017

Peter D. Rude, Ph.D., L.G
City of Seattle
Seattle Public Utilities
PO Box 34018
Seattle, WA 98124-4018

RE: **Gas Works Park Second Amendment to Agreed Order No. DE 2008**

Dear Mr. Rude:

Enclosed for signature is the original Second Agreed Order Amendment for Gas Works Park. Please obtain the signatures of Mami Hara of Seattle Public Utilities and Lorna Luebbe of Puget Sound Energy, each dating their signatures for March 17. Once signed, please deliver the document by noon on Friday, March 17, to Brad Petrovich at the Department of Ecology.

Thank you for your assistance with this matter.

Sincerely,

TERESA L. TRIPPEL
Legal Assistant to
CAROLINE E. CRESS
Assistant Attorney General
(360) 586-4618

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Enc.

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STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

In the Matter of Remedial Action by: **Puget Sound Energy** **City of Seattle** RE: Gas Works Park	**SECOND AMENDMENT TO AGREED ORDER** **No. DE 2008**

TO:

Puget Sound Energy
Environmental Program Services
ATTN: Lorna Luebbe, Director
P.O. Box 97034, PSE-12
Bellevue, WA 98009

City of Seattle
Seattle Public Utilities
ATTN: Mami Hara, General Manager/CEO
P.O. Box 34018
Seattle, WA 98124

I. INTRODUCTION

Agreed Order DE 2008 (Order) was entered into by the State of Washington, Department of Ecology (Ecology); Puget Sound Energy (PSE); and the City of Seattle, represented by Seattle Public Utilities (City), on March 18, 2005, to conduct a Remedial Investigation and Feasibility Study (RI/FS) per WAC 173-340-350 to address sediment contamination at the Gas Works Park site (Site). The First Amendment to the Order was entered into by Ecology, PSE, and the City on March 15, 2013, to expand the area of investigation for the RI/FS and to conduct a supplemental investigation to evaluate the upland-to-sediment pathway.

Ecology, PSE, and the City hereby stipulate to amend the Order. By this Second Amendment to the Order, Ecology authorizes the implementation of an interim action to install groundwater monitoring wells and infrastructure for a groundwater treatment system beneath the Play Area within Gas Works Park. This amendment also provides for the incorporation of the

technical memoranda submitted by GeoEngineers in August and December 2016 to serve as an interim action work plan, attached hereto as Exhibit D. Ecology believes the actions required by this amendment are in the public interest.

This Second Amendment does not attempt to recite all of the provisions of the Order. Provisions of the Order not specifically changed in this amendment remain in full force and effect.

II. JURISDICTION

This Second Amendment is issued pursuant to the authority of the Model Toxics Control Act (MTCA), RCW 70.105D.050(1).

III. AMENDMENTS

Section IV (Work to be Performed) of the Order is hereby amended to add a new subsection 8:

8. Interim Action

A. Under WAC 173-340-430, an interim action is a remedial action that is technically necessary to reduce a threat to human health or the environment by eliminating or substantially reducing one or more pathways for exposure to a hazardous substance, that corrects a problem that may become substantially worse or cost substantially more to address if the remedial action is delayed, or that is needed to provide for completion of a site hazard assessment, remedial investigation/feasibility study, or design of a cleanup action plan.

B. In conjunction with the City's 2017 Play Area renovation project, the City and PSE will conduct an interim action at the Site by installing additional groundwater monitoring wells and infrastructure for a groundwater treatment system beneath the Play Area. *See* Exhibit D (Interim Action Work Plan). Future operation of the groundwater treatment system will be conducted as a separate interim action or as part of the final remedy. Installation of the infrastructure is warranted at this time because future access to the arsenic-contaminated soil and groundwater beneath the Play Area will not be possible without disturbing the newly renovated Play Area. Based on these circumstances, Ecology has determined that an interim action is warranted under WAC 173-340-430.

C. Any party may propose an additional interim action under this Order. If the Parties are in agreement concerning the additional interim action, the Parties will formally amend this Order. If the Parties are not in agreement, Ecology reserves its authority to require additional interim action(s) under a separate order or other enforcement action under RCW 70.105D, or to undertake the interim action(s) itself.

The Order is hereby amended to add a new Exhibit D (Interim Action Work Plan), attached hereto.

Effective date of this Amendment: 4/24/17

PUGET SOUND ENERGY

3-17-17

Lorna Luebbe 3-17-17

Lorna Luebbe, Director
Environmental Program Services
P.O. Box 97034, PSE-12
Bellevue, WA 98009-9734

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

Robert Warren, Section Manager
Toxics Cleanup Program, NW Regional Office
3190 160th Ave. SE
Bellevue, WA 98008

CITY OF SEATTLE

3-17-17

AR Mami Hara, General Manager/CEO
Seattle Public Utilities
P.O. Box 34018
Seattle, WA 98124-4018

EXHIBIT D
Interim Action Work Plan

City of Seattle

PUGET SOUND ENERGY

August 18, 2016

Ching-Pi Wang, Site Manager
Washington State Department of Ecology
Northwest Regional Office
3190 - 160th Avenue SE
Bellevue, Washington 98008-5452

Subject: Play Area, Comfort Station, and East Entry Renovation Projects and Play Area Supplemental Investigation and Groundwater Treatment Infrastructure Construction
Gas Works Park Site
Seattle, Washington

Dear Ching-Pi:

Beginning in fall 2016, Seattle Parks and Recreation (SPR) will be conducting a maintenance project at Gas Works Park. Maintenance work or renovations will be completed at the Play Area, Comfort Station, and East Entry areas. Renovations will focus on replacing equipment and improving existing conditions to meet updated safety standards and Americans with Disabilities Act (ADA) requirements.

Puget Sound Energy (PSE) and the City of Seattle propose to complete a supplemental investigation as well as install the infrastructure for a groundwater treatment system beginning in early September 2016 in conjunction with the Play Area renovation. This is a time-critical action as once Play Area renovation work is completed, access to the arsenic impacted soil and groundwater beneath the Play Area will not be possible without disturbing the newly renovated Play Area.

Although these are two separate projects, we are integrating work and attaching both project descriptions to this letter to facilitate your review and approval. The following documents are attached to this letter:

- Attachment A—*Seattle Parks and Recreation Safety and ADA Renovation Summary*. This describes the maintenance project and is not considered a remedial action as it will not "identify, eliminate, or minimize any threat to human health or the environment" (173-340-200 WAC).

- Attachment B—The *Supplemental Play Area Investigation and Injection Infrastructure Construction Technical Memorandum* (Tech Memo). The Tech Memo summarizes the proposed investigation and groundwater treatment infrastructure construction scheduled to begin September 6, 2016, and includes *Sampling and Analysis Plan and Quality Assurance Project Plan Addendum No. 2*. The

Puget Sound Energy, Inc.
PSE11N
10885 N.E. 4th Street
Bellevue, WA 98004

Seattle Public Utilities
700 5th Avenue, Suite 4900
P.O. Box 34018
Seattle, WA 98124-4018

Seattle Parks and Recreation
100 Dexter Avenue North
Seattle, WA 98109

proposed work is not considered a cleanup action as it will not "eliminate, render less toxic, stabilize, contain, immobilize, isolate, treat, destroy, or remove a hazardous substance" (173-340-200 WAC). Preliminary results of ongoing arsenic treatability studies for groundwater within the Play Area and eastern shoreline indicate arsenic concentrations in groundwater can be reduced through treatment. The proposed infrastructure installation would allow future in situ treatment of arsenic in groundwater without disturbing the newly renovated Play Area. Prior to system installation, additional sampling will be conducted.

The Tech Memo describes work to be performed fall 2016. Investigation and infrastructure construction will be conducted under the current *Sampling and Analysis Plan/Quality Assurance Project Plan*, as amended to encompass this additional work. The latter phase of work—system operation—would be performed as necessary and at Ecology's discretion to treat arsenic in situ, after the Play Area renovation has been completed. Treatment could be conducted as an interim action or as part of the final cleanup action for the GWPS. The groundwater treatment system will not be operated without your approval, and we understand full public notification may be required.

We appreciate your cooperation and support of our efforts to construct a system that will allow in situ treatment of arsenic. We respectfully request your prompt review and approval to avoid delaying important renovations at the Park.

Sincerely,

John Rork
Manager - Environmental Programs & Services
Puget Sound Energy

Peter D. Rude, Ph.D. *
Strategic Advisor
Seattle Public Utilities

David Graves, AICP
Senior Planner, Planning & Development Division
Seattle Parks and Recreation
(*David Graves also signing on behalf of Peter Rude as he is on vacation)

Attachments: A. Seattle Parks and Recreation Letter—Play Area, Comfort Station, and East Entry Renovation Projects
B. Technical Memorandum—Supplemental Play Area Investigation and Injection Infrastructure Construction

cc via e-mail: Dan Baker, GeoEngineers
Sandy Smith, GeoEngineers
Chris Bailey, GeoEngineers

ATTACHMENT A
Play Area, Comfort Station, and East Entry Renovation Projects

City of Seattle

August 18, 2016

Ching-Pi Wang, Site Manager
Washington State Department of Ecology
Northwest Regional Office
3190 - 160th Avenue SE
Bellevue, Washington 98008-5452

Subject: Play Area, Comfort Station, and East Entry Renovation Projects
Gas Works Park Site
Seattle, Washington

Dear Ching-Pi:

This letter provides a description of the maintenance project that Seattle Parks and Recreation (SPR) has planned for Gas Works Park during Fall 2016 through Spring 2017. The project consists of constructing improvements to the Play Area, replacing the existing comfort station, and altering the east entrance to the Park to comply with Americans with Disabilities Act (ADA) requirements. The combined renovation project, consisting of these three elements, is currently being designed and is planned to be contracted late summer as a single construction project. Currently, construction is scheduled to begin in mid-October and is expected to continue through winter to allow the area to be re-opened in Spring of 2017.

Play Area

The play area element of the renovation project consists of general repair of Park features constructed in the 1970s, as well as installing new playground equipment. The existing play area fell into disrepair and the play features were removed over time. The play area construction activities are divided into two general components; the brick patio and the sand playground area. SPR is currently preparing a design package for contracting the play area construction. The design is nearing the 90-percent complete stage. For information purposes, the 65 percent design drawings for the play area construction are attached to this letter.

In the brick patio area, the renovation will consist of replacing the brick surface and filling a sand pit in the patio up to surrounding grade. The existing brick surface will be removed to expose the underlying surface to allow a more permanent underlayment to be installed. The round sand pit would be filled to match surrounding grade, the brick underlayment would be placed across the entire area, and the area would be re-bricked, with the bricks grouted in place.

In the current sand playground area, SPR is proposing to install new play equipment in the area of the existing playground. Generally, the construction associated with the playground will consist of the following elements; demolishing existing wooden decks structures overhanging the existing sand playground surface, grading the existing sand surface to provide a sloping base for a waterproof membrane, installing the waterproof membrane and perforated storm drain lines over the membrane to collect infiltrated rain water, placing and compacting fill

soil above the graded sand and membrane, installing new playground equipment and required foundations, and installing a poured in place rubber surface across the playground. The majority of the work will occur above grade, with disturbance of surface materials limited to grading of the playground sand (which will be left in place) and excavation to connect to the existing storm drain line in one location. Grading and limited excavation will occur above the old Gas Works materials in areas that have previously been graded and filled during the original park construction. The final grade of the playground will be higher than existing, resulting in a surface that is flush with the surrounding walkways in order to meet ADA compliance goals.

The asphalt pathway surrounding the play area requires repair of cracks, heaves and settlement in places. The pathway will be resurfaced with new asphalt to support pedestrian and maintenance vehicle traffic. No work will occur beyond the already impervious areas.

Comfort Station

The comfort station does not meet current ADA or seismic standards. SPR will demolish the existing structure and construct a new restroom facility in roughly the same location as the existing facility. A drawing presenting the layout of the proposed comfort station is attached to this letter. There is an existing pathway to the north of the comfort station that is in need of repair. Rather than repair the pathway, the comfort station will be reconstructed slightly to the north of the existing building encompassing the pathway that will be removed. Moving the comfort station to the north will afford a better ADA connection to the picnic area and improve sight lines into this area as well. Limited disturbance of surface soil will be required to construct the comfort station, but all work will occur above the old Gas Works materials in areas that have previously been graded and filled.

East Entry ADA Improvements

The east entry pathway that leads from the parking lot down to the comfort station, picnic/play barn and play area does not meet current ADA standards for access. The brick pavers will be reset by the parking lot and the access ramp will be re-built to current standards. The existing rail road ties will also be reset flush with the pathway as they are now considered a tripping hazard. Finally, the whole pathway will be repaved. The layout and components of the ADA improvement elements near the parking lot are presented in the attached drawing. As with the comfort station component, all work will occur above the old Gas Works materials in areas that have previously been graded and filled.

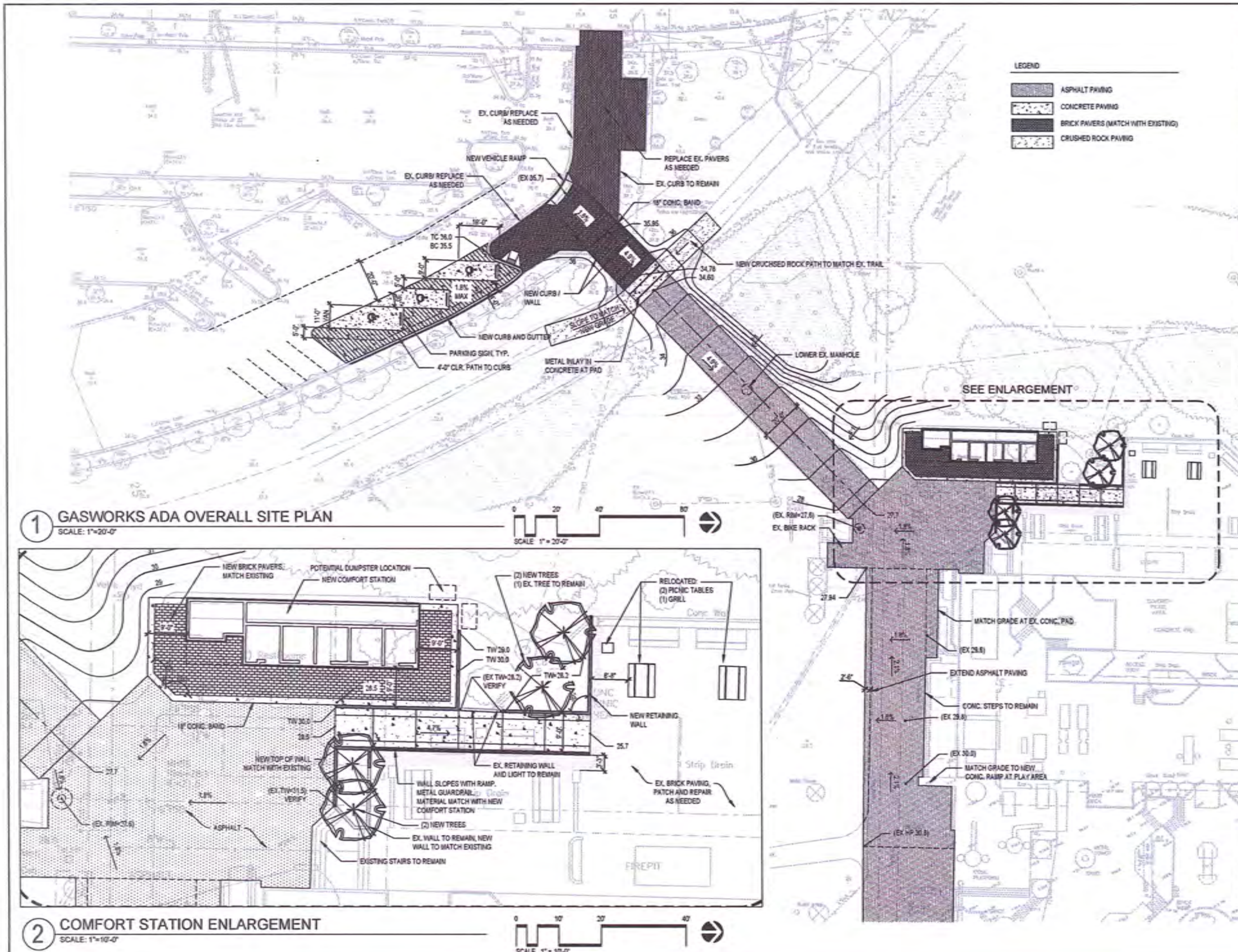
We appreciate your cooperation and support of our efforts to improve Gas Works Park.

Sincerely,

David Graves, AICP
Senior Planner, Planning & Development Division
Seattle Parks and Recreation

Attachments: Gas Works ADA (drawing dated 6/22/16)
Gas Works Park Play Area Renovation (65 percent Plan Set)

cc via e-mail: John Rork, PSE
Pete Rude, Seattle Public Utilities
Dan Baker, GeoEngineers
Sandy Smith, GeoEngineers
Chris Bailey, GeoEngineers



>>>>CAUTION - CALL 811<<<<
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WWW.CALLBEFOREYOUDIG.ORG

NOT LESS THAN 2 OR MORE THAN 10 BUSINESS DAYS PRIOR TO COMMENCING EXCAVATION OR DEMOLITION, SECURE THE SERVICES OF A COMMERCIAL UNDERGROUND UTILITIES LOCATOR SERVICE TO IDENTIFY BELOW-GROUND IMPROVEMENTS THAT MAY NOT BE INDICATED ON THE DRAWINGS. ADDITIONALLY, TO REQUEST ON-SITE UNDERGROUND UTILITY SYSTEMS LOCATES, CALL **SPR INSPECTION REQUEST LINE @ (206) 684-7034.** REFER TO SECTIONS 02100 & 02120 OF THE SPECIFICATIONS FOR INSTRUCTIONS ON HOW TO PROCEED.

NO.	REVISION – AS BUILT	DATE
3		
2		
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REVIEWED: ______ PARK ENGINEER ______ DATE

All work done in accordance with the City of Seattle Standard Plans and Specifications in effect on the date shown above, and supplemented by Special Provisions.

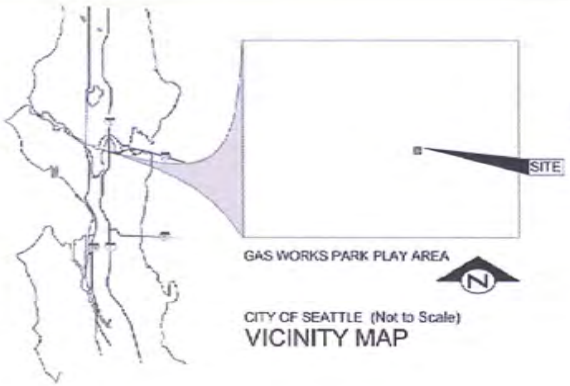
STATE OF WASHINGTON REGISTERED LANDSCAPE ARCHITECT NO. 535

Seattle Parks and Recreation

GAS WORKS ADA

DESIGNED	MH	DATE	05/22/2015
DRAWN	JC	SHEET	___ OF ___
CHECKED	MH		
ORDINANCE NO.			
CONTRACT NO.			
PW NO.			
SCALE			

Gas Works Park Play Area Renovation



CITY OF SEATTLE (Not to Scale)
VICINITY MAP

PROPERTY DESCRIPTION

Tax Parcel No.(s): A portion of King County tax parcel #

Address: 2400 N. Northlake Way, Seattle, WA

Legal Description:

Parks Contract #: PW #: 2015- Project #:

Funding Source: 2008 Parks and Green Spaces Levy

Contracting Department:
City of Seattle Department of Finance & Administrative Services
Purchasing & Contracting Services Division

Administering Department:
City of Seattle Department of Parks and Recreation, Planning & Development Division
800 Maynard Avenue South, Third Floor, Seattle, WA 98134
Contact: Jay Rood 206-733-9194

Project Design Team:
City of Seattle Department of Parks and Recreation, Planning & Development Division
800 Maynard Avenue South, Third Floor, Seattle, WA 98134
Contact: Pamela Alspaugh 206-684-7328

GENERAL NOTES

1. ALL WORK SHALL CONFORM TO THE LATEST EDITION OF THE CITY OF SEATTLE STANDARD SPECIFICATIONS AND PLANS FOR ROAD, BRIDGE AND MUNICIPAL CONSTRUCTION AND ALL APPLICABLE CODES AND REGULATIONS.

2. A COPY OF THE APPROVED CONSTRUCTION DOCUMENTS SHALL BE ON SITE WHENEVER CONSTRUCTION IS IN PROGRESS.

3. UTILITIES PER CITY OF SEATTLE (SEE SHEET 2). ALL UTILITIES SHOWN HAVE BEEN STAKED OUT BY FIELD SURVEY OR AVAILABLE RECORDS AND SHOULD BE CONSIDERED APPROXIMATE ONLY AND NOT NECESSARILY COMPLETE. IT IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR TO INDEPENDENTLY VERIFY THE ACCURACY OF ALL UTILITY LOCATIONS SHOWN AND TO FURTHER DISCOVER AND SHOW ANY OTHER UTILITIES NOT SHOWN ON THE PLANS WHICH MAY BE AFFECTED BY CONSTRUCTION.

4. THE CONTRACTOR SHALL PROVIDE AND MAINTAIN SEDIMENTATION CONTROL AND COLLECTION FACILITIES TO PREVENT ERODED SOILS FROM ENTERING THE PUBLIC DRAINAGE SYSTEM DURING EVOLUTION OF THE CONTRACT.

5. KEEP ALL ROADWAYS CLEAR AND FREE OF DEBRIS. PAVED SURFACES THAT ARE DAMAGED DURING CONSTRUCTION SHALL BE REPAIRED TO THE SATISFACTION OF THE ENGINEER AT NO COST TO THE CITY.

6. STORAGE OF MATERIALS AND EQUIPMENT WILL BE ALLOWED ONLY IN AREAS DESIGNATED FOR CONSTRUCTION OR STAGING. UNDER NO CIRCUMSTANCES ARE MATERIALS TO BE STORED IN PUBLIC USE AREAS OF THE PARK PROPERTY.

7. ALL FACILITIES SCHEDULED TO REMAIN THAT ARE DAMAGED DURING THE COURSE OF EXECUTION OF THE CONTRACT WORK SHALL BE REPLACED BY THE CONTRACTOR TO THE ENGINEER'S SPECIFICATIONS AT NO ADDED COST TO THE CITY. THESE FACILITIES MAY INCLUDE ASPHALT AND CONCRETE PAVING, FENCING, RAILINGS, IRRIGATION, VEGETATION, CURBING, BUILDING AND WORKING SURFACES.

8. THE DEMOLITION SPECIFIED MEANS THE WORK REQUIRED AS NOT INCLUDED IN THE CONTRACT.

9. CONSTRUCTION ENTRANCE AND STAGING AREA SHOWN ARE DIAGRAMATIC. CONTRACTOR SHALL COME UP WITH TRAFFIC PLAN, CONSTRUCTION ENTRANCE, AND STAGING AREA FOR APPROVAL BY THE ENGINEER PRIOR TO THE BEGINNING OF CONSTRUCTION.

SHEET INDEX

65%

APPROVED FOR ADVERTISING:
Nancy Locke
Purchasing & Contracting Services Division
Seattle, Washington _____ 20____
Signature: _____

NO.	REVISION — AS BUILT	DATE
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REVIEWED: _____ DATE: _____
PARK ENGINEER

All work done in accordance with the City of Seattle Standard Plans and Specifications in effect on the date shown above, and supplemented by Special Provisions.

STATE OF WASHINGTON
REGISTERED LANDSCAPE ARCHITECT
PAMELA K. ALSPAUGH
LICENSE NO. 641
EXPIRES ON 03/05/2017

SEATTLE PARKS AND RECREATION

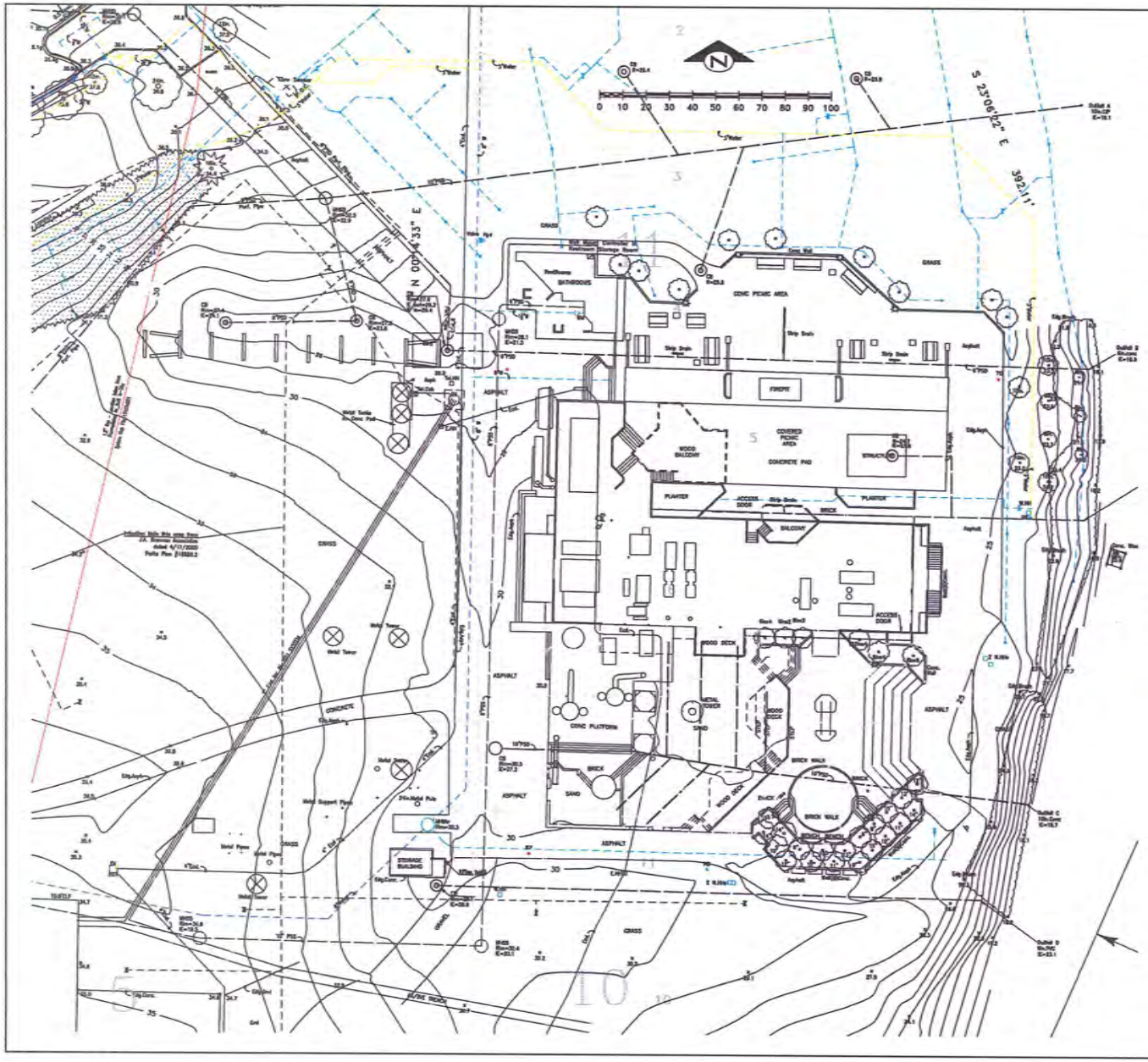
GAS WORKS PARK

PLAY AREA RENOVATION

COVER SHEET

DESIGNED PA	DATE MARCH, 2015
DRAWN PA	
CHECKED JEP	SHEET 1 OF 11
ORDINANCE NO.	1
CONTRACT NO.	
SCALE N/A	

KEY PLAN



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NO.	REVISION — AS BUILT	DATE
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REVIEWED: _____ PARK ENGINEER _____ DATE

All work done in accordance with the City of Seattle Standard Plans and Specifications in effect on the date shown above, and supplemented by Special Provisions.

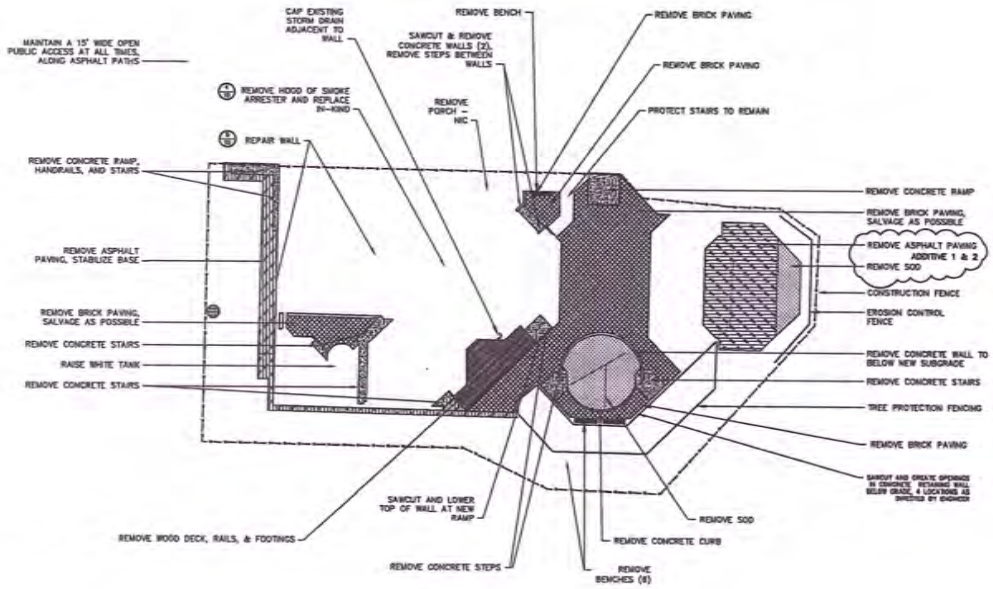
SEATTLE PARKS AND RECREATION

GAS WORKS PARK

PLAY AREA RENOVATION

EXISTING CONDITIONS

DESIGNED X	DATE MARCH 2016
DRAWN X	SHEET 2 OF 11
CHECKED X	Sht. No.
ORDINANCE NO. X	
CONTRACT NO. X	
SCALE 1" = 20'	



DEMOLITION & CSC PLAN

0 10 20 40 FT

LEGEND:

- TREE PROTECTION FENCING (4/7)
- CHAIN LINK CONSTRUCTION FENCING (6/7)
- EROSION CONTROL FENCE (4/7)
- INLET PROTECTION
- REMOVE ASPHALT
- REMOVE BRICK PAVERS
- REMOVE SOD
- REMOVE WOOD DECK
- REMOVE CONCRETE PAVING
- REMOVE BENCH

DEMOLITION NOTES:

1. SALVAGEABLE OR RE-USABLE ITEMS ENCOUNTERED IN THE FIELD BUT NOT IDENTIFIED ON THIS PLAN SHALL BE OFFERED TO THE ENGINEER FOR SALVAGE PRIOR TO DISPOSAL. IF DECLINED BY ENGINEER, ALL DEMOLISHED ITEMS SHALL BE DISPOSED OF LEGALLY OFF SITE.
2. PROTECT ALL FACILITIES NOT IDENTIFIED FOR DEMOLITION INCLUDING BUT NOT LIMITED TO: STRUCTURE, WALLS, PAVING, BURIED ELECTRICAL LINES, IRRIGATION SYSTEM, STORM SEWER LINES, TELEPHONE LINES, CATCH BASINS, TREES, FENCING, FURNITURE, ETC.
3. KEEP ALL WALKWAYS AND PARKING AREAS CLEAR AND FREE OF DEBRIS. VEGETATED AND PAVED SURFACES THAT ARE DAMAGED DURING CONSTRUCTION SHALL BE REPAIRED TO THE SATISFACTION OF THE ENGINEER AT NO COST TO THE ENGINEER.
4. DEMOLISH ONLY TO EXTENT REQUIRED TO ACCOMMODATE THE WORK OF THE CONTRACT.
5. CAREFULLY DISASSEMBLE TOP CAP FROM EX. METAL TOWER (SMOKE ARRESTOR). COORDINATE WITH FABRICATOR FOR FABRICATION AND REASSEMBLY OF NEW CAP.

CONSTRUCTION STORMWATER CONTROL NOTES:

1. THE IMPLEMENTATION OF CONSTRUCTION STORMWATER CONTROL (CSC) MEASURES AND THE CONSTRUCTION, MAINTENANCE, AND REPLACEMENT OF THESE FACILITIES IS THE RESPONSIBILITY OF THE CONTRACTOR.
2. THE CSC FACILITIES MUST BE CONSTRUCTED IN CONJUNCTION WITH ALL CONSTRUCTION ACTIVITIES AND IN SUCH A MANNER AS TO ENSURE THAT SEDIMENT LADEN WATER DOES NOT ENTER THE PUBLIC DRAINAGE SYSTEM OR FLOW OFF SITE.
3. THE CSC FACILITIES ARE THE MINIMUM REQUIREMENTS FOR ANTICIPATED SITE CONDITIONS. DURING THE CONSTRUCTION PERIOD, THESE CSC FACILITIES SHALL BE UPGRADED BY CONTRACTOR AS NEEDED FOR UNEXPECTED STORM EVENTS.
4. THE CSC FACILITIES SHALL BE INSPECTED DAILY BY THE CONTRACTOR AND MAINTAINED AS NECESSARY OR AS DIRECTED BY THE ENGINEER TO ENSURE CONTINUOUS FUNCTIONING.
5. ANY AREA STRIPPED OF VEGETATION WHERE NO FURTHER WORK IS ANTICIPATED FOR A PERIOD OF 15 DAYS SHALL BE IMMEDIATELY STABILIZED WITH APPROVED CSC METHODS SUCH AS MULCHING, EROSION BLANKETS, PLASTIC SHEETING OR AS APPROVED BY THE ENGINEER.
6. STABILIZED CONSTRUCTION ENTRANCES SHALL BE INSTALLED AT THE BEGINNING OF CONSTRUCTION AND MAINTAINED FOR THE DURATION OF THE PROJECT. ADDITIONAL MEASURES MAY BE REQUIRED TO INSURE THAT ALL PAVED AREAS ARE KEPT CLEAN FOR THE DURATION OF THE PROJECT.
7. ALL CATCH BASINS IN THE VICINITY OF CONSTRUCTION SHALL BE PROTECTED WITH FILTER FABRIC PLACED BETWEEN THE FRAME AND GRATE OR AS APPROVED. CLEAN REGULARLY. NO MORE THAN 1 INCH OF SEDIMENT WILL BE ALLOWED TO ACCUMULATE OVER FILTER FABRIC.
8. SPOILS PILES NOT USED AFTER A DAY SHALL BE COVERED WITH VISQUEEN (PLASTIC) TO KEEP SEDIMENT UNDER CONTROL.
9. CONTRACTOR SHALL NAME AND CONFIRM QUALIFICATIONS FOR THE CONTRACTOR'S CERTIFIED ON-SITE CONSTRUCTION STORMWATER CONTROL LEAD WITH 24 HOUR CALL NUMBER.

65%

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NO.	REVISION — AS BUILT	DATE
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REVIEWED: _____ PARK ENGINEER _____ DATE

All work done in accordance with the City of Seattle Standard Plans and Specifications in effect on the date above above, and supplemented by Special Provisions.

STATE OF WASHINGTON
LICENSED
LANDSCAPE ARCHITECT

PAMELA K. ALSPAUGH
LICENSE NO.441
EXPIRES ON 09/09/2017

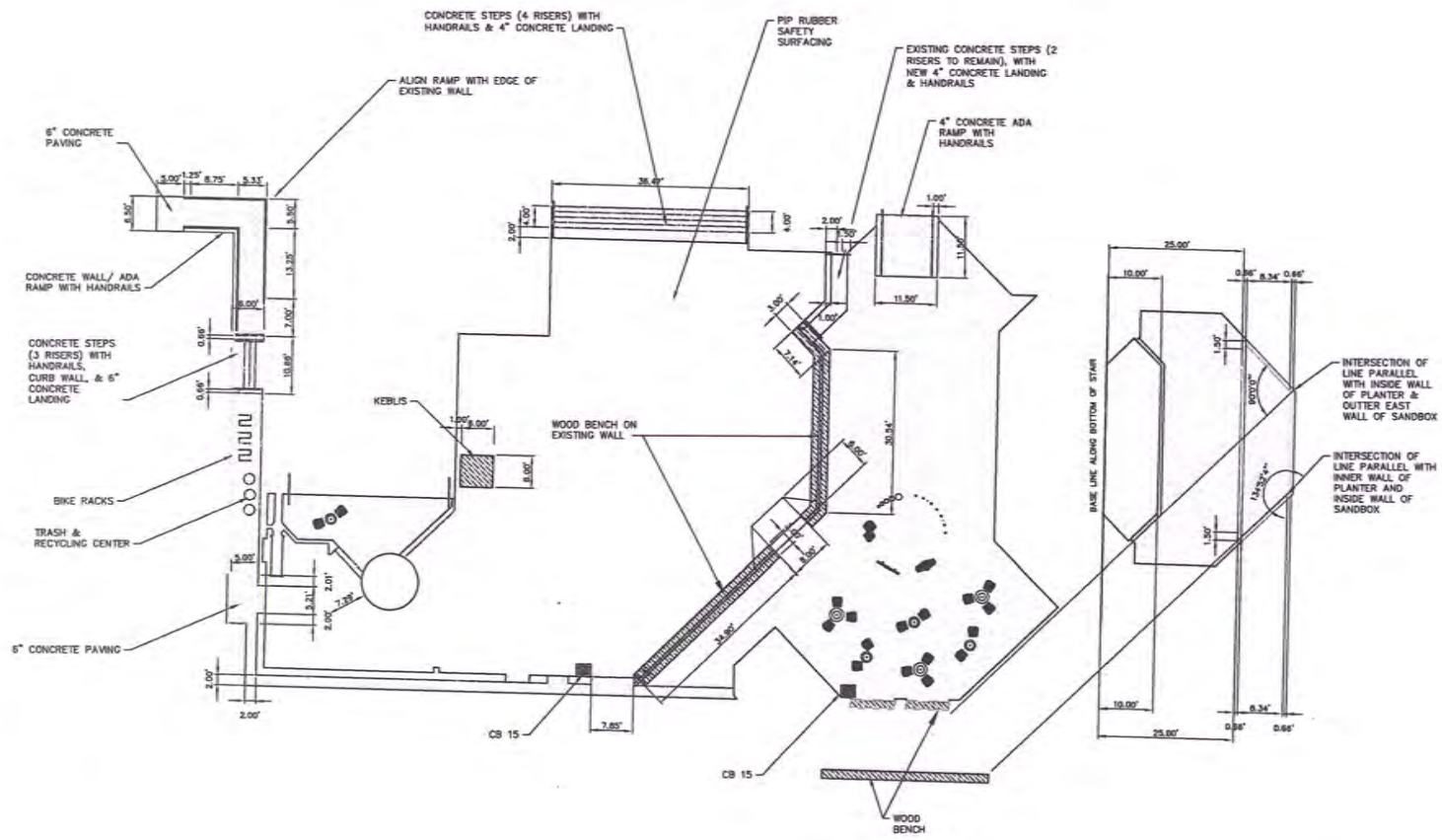
SEATTLE PARKS AND RECREATION

GAS WORKS PARK

PLAY AREA RENOVATION

DEMOLITION & CSC

DESIGNED PA	DATE MARCH 2016
DRAWN PA	
CHECKED RFR	SHEET 3 OF 11
ORDINANCE NO. X	3
CONTRACT NO. X	
SCALE 1" = 20'	



LAYOUT PLAN

65%

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LAYOUT NOTES:

1. ESTABLISH HORIZONTAL BASELINES AND OFFSET LINES PARALLEL AND PERPENDICULAR AS INDICATED FROM THE EXISTING CONTROL POINTS SET BY OWNER. VERTICAL CONTROL IS RELATIVE WITHIN THE WORKSITE. ESTABLISH SPECIFIC VERTICAL RELATIONSHIPS PRIOR TO STARTING WORK. ESTABLISH A MINIMUM OF TWO VERTICAL CONTROL POINTS AND MAINTAIN THEM THROUGHOUT THE PROJECT. THE BASELINES AND OFFSET LINES ARE TO BE ESTABLISHED AS SHOWN ON THE PLAN.

2. ALL CURVED LINES INDICATED ON THE LAYOUT SHALL BE CONTINUOUS AND WITHOUT DEVIATION. ABRUPT VERTICAL OR HORIZONTAL CHANGES ARE NOT ACCEPTABLE. STAKE CONCRETE FORMS ADEQUATELY TO PREVENT SUDDEN BENDS.

3. NOTIFY THE ENGINEER OF HORIZONTAL OR VERTICAL DISCREPANCIES IMMEDIATELY. DO NOT PROCEED WITH WORK WHICH MAY RESULT IN ACCUMULATED ERROR.

4. NOTIFY ENGINEER OF LAYOUT DISCREPANCIES WITH ELEMENTS TO REMAIN AND PROPOSED ELEMENTS. DO NOT PROCEED WITH WORK WHICH MAY RESULT IN ACCUMULATED ERROR.

5. STAKE OUT PAVING AND SITE FURNISHINGS PRIOR TO THE INSTALLATION OF THESE ITEMS. INSTALLATION MAY PROCEED AFTER SECURING APPROVAL FROM THE ENGINEER.

6. CONTRACTOR SHALL BE RESPONSIBLE FOR OFFLOADING, FINAL MOVING, LOCATION, AND STORAGE OF ALL PLAY EQUIPMENT MATERIALS AFTER DELIVERY. THE CONTRACTOR SHALL ENSURE THAT UNLOADING BY THE CARRIER IS NOT DELAYED TO AVOID EXTRA CHARGE.

7. CONTRACTOR SHALL PROVIDE SAFETY FOR STORAGE OF DELIVERED PLAY EQUIPMENT.

NO.	REVISION — AS BUILT	DATE
3		
2		
1		

REVIEWED: _____ PARK ENGINEER _____ DATE

All work done in accordance with the City of Seattle Standard Plans and Specifications in effect on the date shown above, and supplemented by Special Provisions.

STATE OF WASHINGTON
LICENSED
LANDSCAPE ARCHITECT

PAMELA K. ALSPAUGH
LICENSE NO.441
EXPIRES ON 08/30/2017

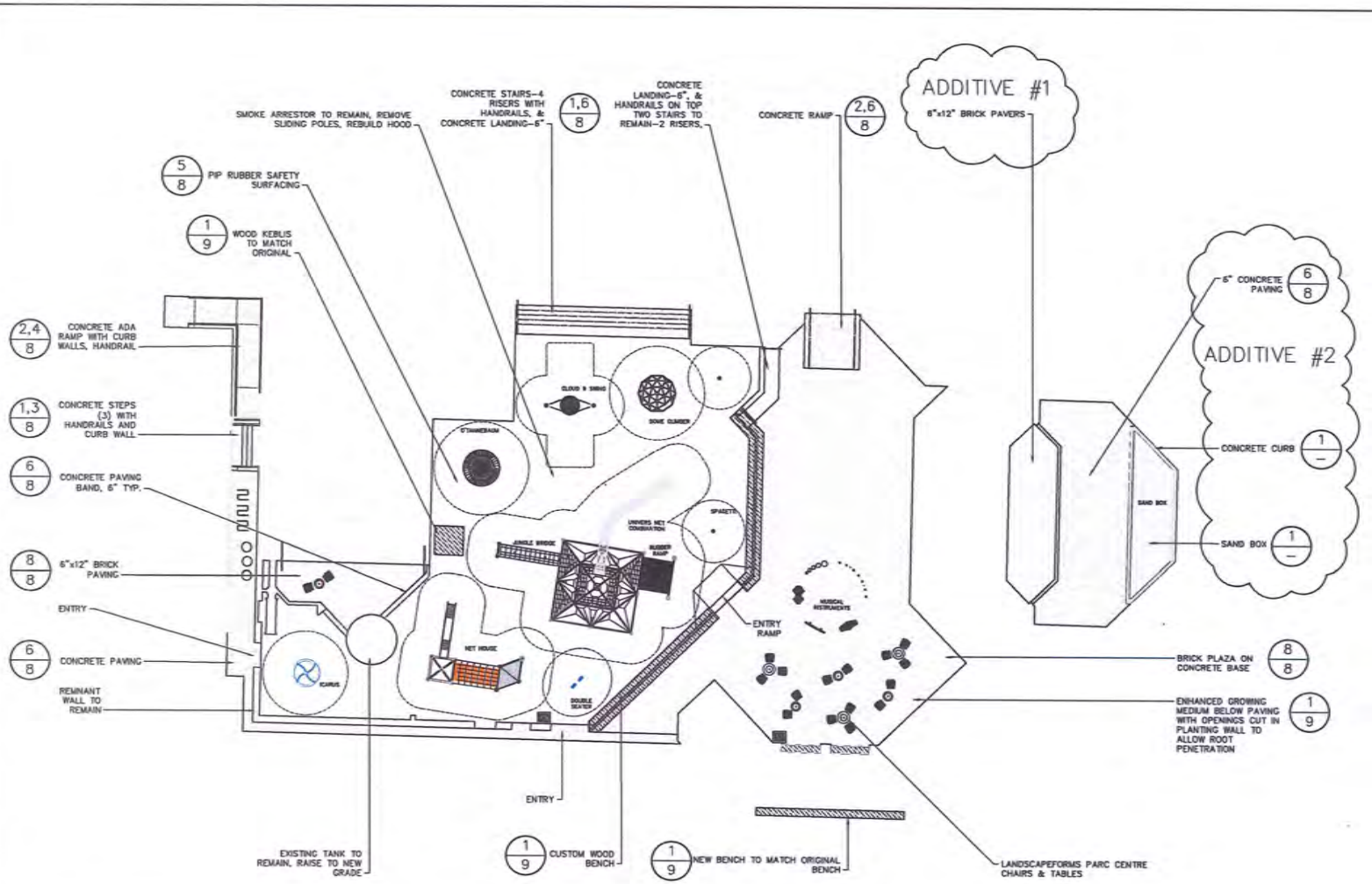
SEATTLE PARKS AND RECREATION

GAS WORKS PARK

PLAY AREA RENOVATION

LAYOUT PLAN

DESIGNED	PA	DATE	MARCH 2016
DRAWN	PA		
CHECKED	RFR	SHEET	4 OF 11
ORDINANCE NO.	X		4
CONTRACT NO.	X		
SCALE	1" = 10'		



MATERIALS PLAN

65%

>>>>CAUTION - CALL 811<<<<
UTILITY NOTIFICATION CENTER
BEFORE YOU DIGI
WWW.CALLBEFOREYOUDIG.ORG

NOT LESS THAN 2 OR MORE THAN 10 BUSINESS DAYS PRIOR TO COMMENCING EXCAVATION OR DEMOLITION, SECURE THE SERVICES OF A COMMERCIAL UNDERGROUND UTILITIES LOCATOR SERVICE TO IDENTIFY BELOW-GROUND IMPROVEMENTS THAT MAY NOT BE INDICATED ON THE DRAWINGS. ADDITIONALLY, TO REQUEST ON-SITE UNDERGROUND UTILITY SYSTEMS LOCATES, CALL SPR INSPECTION REQUEST LINE @ (206) 684-7934, REFER TO SECTIONS 02100 & 02120 OF THE SPECIFICATIONS FOR INSTRUCTIONS ON HOW TO PROCEED.

NO.	REVISION — AS BUILT	DATE
3		
2		
1		

REVIEWED:
PARK ENGINEER DATE

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STATE OF WASHINGTON
LICENSED
LANDSCAPE ARCHITECT

PAMELA K. ALSPAUGH
LICENSE NO.641
EXPIRES ON 06/09/2017

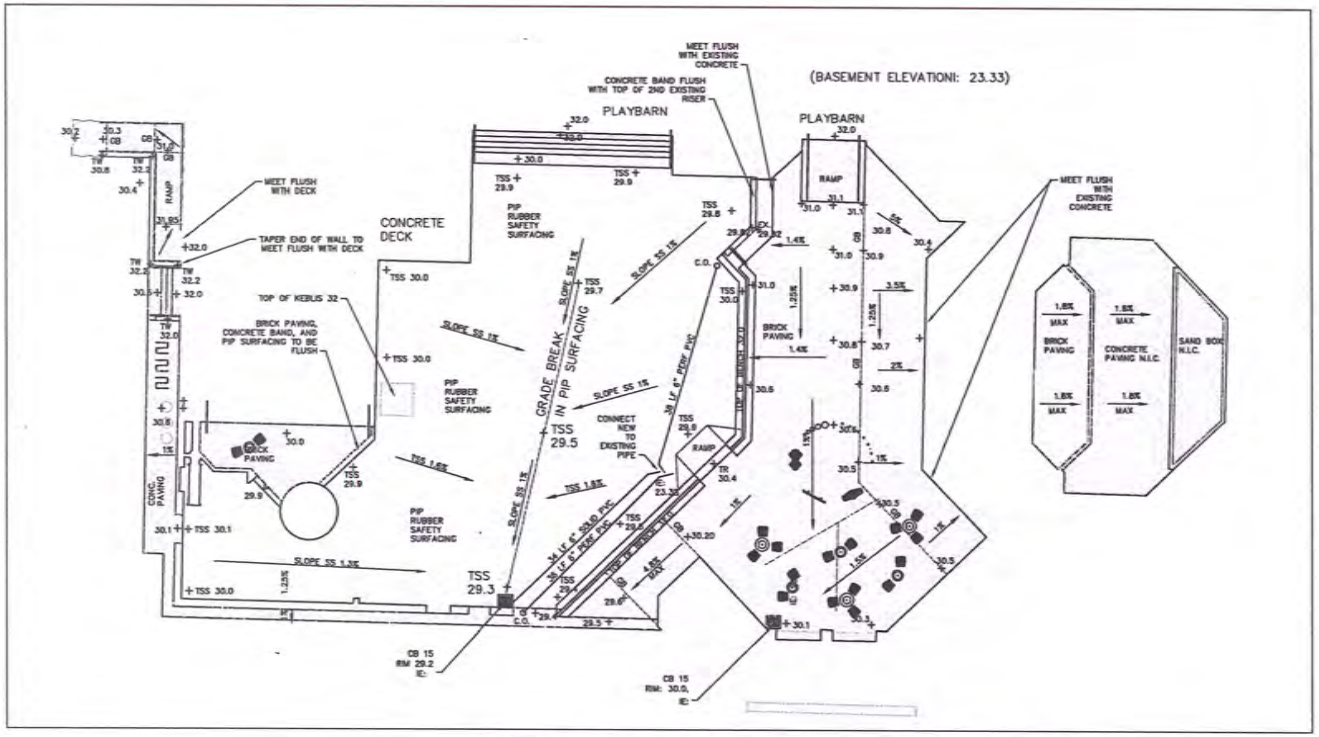
SEATTLE PARKS AND RECREATION

GAS WORKS PARK

PLAY AREA RENOVATION

MATERIALS PLAN

DESIGNED PA	DATE MARCH, 2016
DRAWN PA	
CHECKED RFR	SHEET 5 OF 11
ORDINANCE NO. X	5
CONTRACT NO. X	
SCALE 1"=10'	



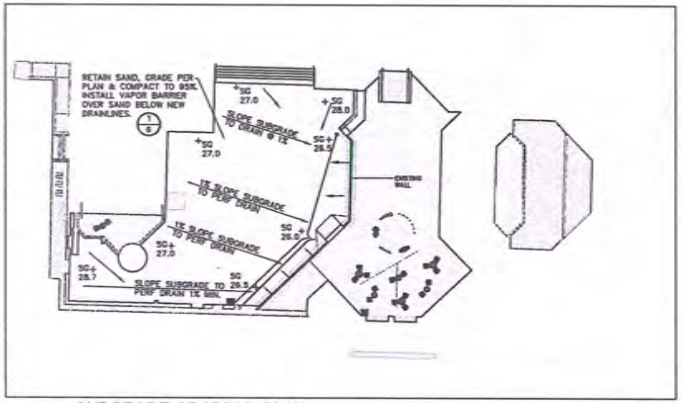
SURFACE GRADING AND DRAINAGE PLAN

0 5 10 20 FT

DRAINAGE NOTES:

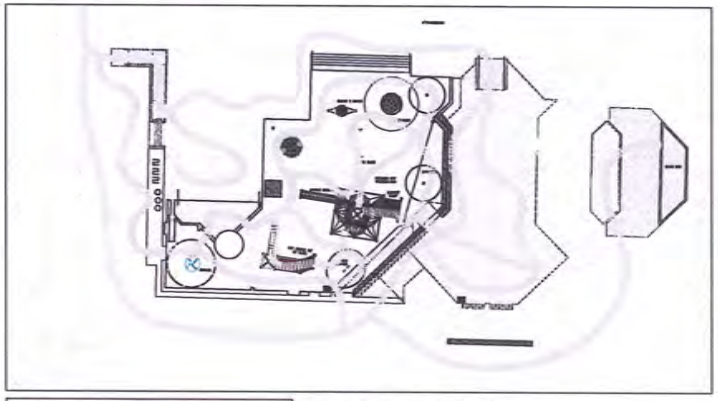
1. RELAY EXISTING SITE UTILITIES TO CLEAR OVER OR UNDER THE NEW UTILITY AS APPROVED BY THE ENGINEER.
2. WHERE A NEW PIPE CLEARS AN EXISTING OR NEW UTILITY BY 6" OR LESS, POLYETHYLENE PLASTIC FOAM SHALL BE PLACED BETWEEN THE UTILITIES AS A CUSHION PRIOR TO BACKFILLING. THE PLASTIC FOAM SHALL CONFORM TO CDS SPECIFICATIONS 9-05.14.
3. SERVICE DRAINS AND SIDE SEWERS SHALL NOT BE BACKFILLED UNTIL THE PIPE HAS BEEN INSPECTED AND APPROVED BY THE ENGINEER AND THE LOCATION AND DEPTH IS RECORDED FOR AS-BUILT DOCUMENTS.
4. CAP EXISTING PLAY AREA DRAINAGE PIPES AT INTERSECTION WITH NEW DRAIN PIPE.
5. NEW DRAINAGE TO BE LOCATED ON TOP OF VAPOR BARRIER.

65%



SUBGRADE GRADING PLAN

0 10 20 40 FT



ADA ROUTE OF TRAVEL

>>>>CAUTION - CALL 811<<<<
UTILITY NOTIFICATION CENTER
BEFORE YOU DIG!
WWW.CALLBEFOREYOUDIG.ORG

NOT LESS THAN 2 OR MORE THAN 10 BUSINESS DAYS PRIOR TO COMMENCING EXCAVATION OR DEMOLITION, SECURE THE SERVICES OF A COMMERCIAL UNDERGROUND UTILITIES LOCATOR SERVICE TO IDENTIFY BELOW-GROUND IMPROVEMENTS THAT MAY NOT BE INDICATED ON THE DRAWINGS. ADDITIONALLY, TO REQUEST ON-SITE UNDERGROUND UTILITY SYSTEMS LOCATES, CALL BPR INSPECTION REQUEST LINE @ (206) 684-7934. REFER TO SECTIONS 02100 & 02130 OF THE SPECIFICATIONS FOR INSTRUCTIONS ON HOW TO PROCEED.

GRADING NOTES:

1. DATUM PER CITY OF SEATTLE, DEPARTMENT OF PARKS AND RECREATION, BASED ON CITY OF SEATTLE DATUM (NAVD 88). LOCATE, PRESERVE, AND PROTECT VERTICAL CONTROL POINT.
2. PLAN SHOWS ALL FINISH GRADE ELEVATIONS. PROVIDE SUBGRADE ELEVATIONS AS REQUIRED BY PLANS, DETAILS, OR SPECIFICATIONS. PROVIDE APPROPRIATELY COMPACTED SUBGRADES OF NATIVE SOIL OR APPROVED FILL.
3. COORDINATE GRADING WORK WITH WORK OF OTHER TRADES, OR WORK BY OTHERS AS REQUIRED TO COMPLETE THE PROJECT.
4. IF CONTAMINATED MATERIALS ARE ENCOUNTERED DURING EXCAVATION, IMMEDIATELY NOTIFY THE ENGINEER. PROCEED WITH APPROVED DISPOSAL METHODS PER THE CONTRACT DOCUMENTS.
5. CLEAN EXCESS MATERIALS SHALL BE REMOVED FROM SITE AND HAULED TO AN APPROVED LOCATION.
6. AFTER INSTALLATION OF PIPED SUBSURFACE DRAINAGE, IMPORT SUFFICIENT MATERIALS TO ESTABLISH SUBGRADE DESIGN ELEVATIONS.

NO.	REVISION — AS BUILT	DATE
3		
2		
1		

REVIEWED: _____ PARK ENGINEER _____ DATE

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STATE OF WASHINGTON
LICENSED
LANDSCAPE ARCHITECT

PAMELA K. ALSHUSH
LICENSE NO.441
EXPIRES ON 08/06/2017

SEATTLE PARKS AND RECREATION

GAS WORKS PARK

PLAY AREA RENOVATION

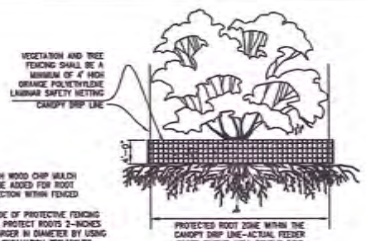
GRADING & DRAINAGE PLAN

DESIGNED	PA	DATE	MARCH 2016
DRAWN	PA		
CHECKED	RFR	SHEET	6 OF 11
ORDINANCE NO.	X		6
CONTRACT NO.	X		
SCALE	AS SHOWN		

NOTES:
1. STORM DRAIN INLETS NEED TO BE REMOVED AT THE END OF THE JOB.
2. STORM DRAIN INLETS ARE ONLY TO BE INSTALLED IN DRAINAGE DEVICES PER THE MANUFACTURER'S RECOMMENDATIONS. CATCH BASIN INSERTS ARE NOT TO BE INSTALLED IN CURB INLETS.
3. INSERTS SHALL BE INSPECTED AND MAINTAINED WHEN A 1/2 INCH RAIN ACCUMULATES WITHIN A 24 HOUR PERIOD. CLEAN AND/OR REPLACE INSERT WHEN HALF OF THE TRAP IS FILLED WITH SEDIMENTS.

PURPOSE: TO PREVENT SEDIMENT FROM ENTERING STORM DRAINAGE SYSTEMS PRIOR TO PERMANENT STABILIZATION OF THE DISTURBED AREA.

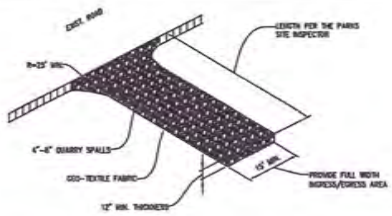
1 CATCH BASIN INSERT
NOT TO SCALE



NOTES:
1. 3-INCH WOOD CHIP MULCH MAY BE ADDED FOR ROOT PROTECTION WITHIN FENCED AREA.
2. OUTSIDE OF PROTECTIVE FENCING AREA, PROTECT ROOTS 2-INCHES OR LARGER IN DIAMETER BY USING HAND EXCAVATION TECHNIQUES.
3. MINIMIZE CONSTRUCTION ZONE: PROTECT VEGETATION OUTSIDE CONSTRUCTION ZONE BY SEGREGATING IT WITH HIGH VISIBILITY CONSTRUCTION FENCING.

SYMBOL:

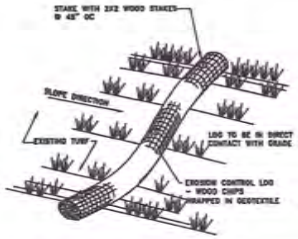
2 VEGETATION PROTECTION
NOT TO SCALE



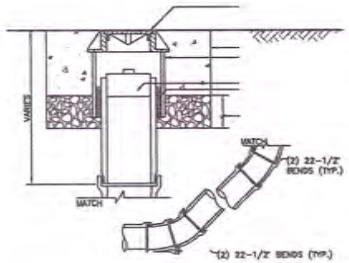
STABILIZED ACCESS SHALL BE USED IN ALL AREAS OF THE SITE WITH VEHICLE TRAFFIC AND PARKING, INCLUDING PLANTING STRIPS. OTHER MEANS OF PROVIDING STABILIZED ACCESS WILL BE CONSIDERED.

PURPOSE: TO REDUCE THE AMOUNT OF MUD, DIRT, ROCKS, ETC. TRANSPORTED ONTO PUBLIC ROADS BY MOTOR VEHICLES OR RUNOFF.

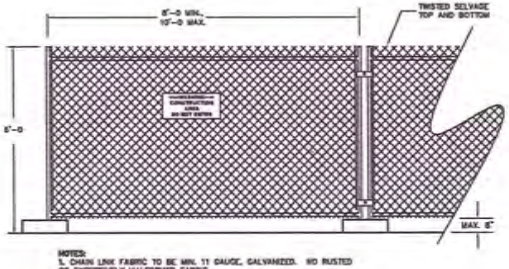
3 STABILIZED CONSTRUCTION ACCESS
NOT TO SCALE



4 EROSION CONTROL LOG
NOT TO SCALE

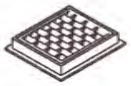


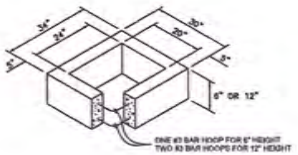
5 CLEAN OUT
NOT TO SCALE

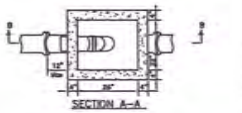


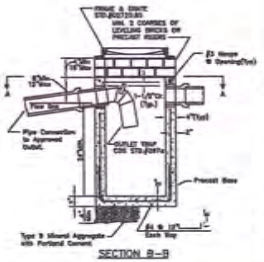
NOTES:
1. CHAIN LINK FABRIC TO BE MIN. 11 GAUGE, GALVANIZED. NO RUSTED OR EXCESSIVELY MALFORMED FABRIC.
2. FENCE BASES SHALL BE OF SUFFICIENT WEIGHT and/or SPREAD TO ADEQUATELY SUPPORT EACH PANEL.
3. PANEL-TO-PANEL CONNECTIONS SHALL BE MADE AT A MIN. TWO LOCATIONS PER CONNECTION UNLESS OTHERWISE APPROVED.
4. PROVIDE CONSTRUCTION WARNING SIGNAGE 50'O.C. ALONG FENCING INSTALLATION.

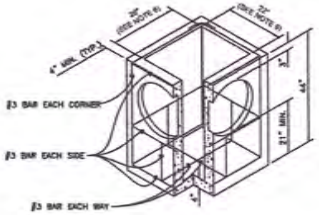
6 TEMPORARY CONSTRUCTION FENCE
NOT TO SCALE

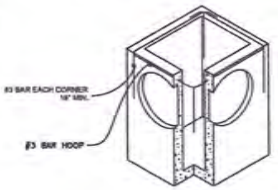










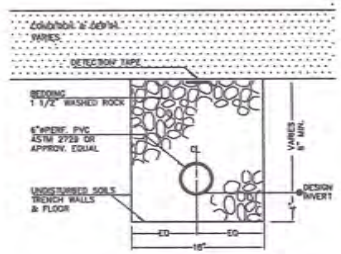


1. As acceptable alternatives to the rebar shown in the **PRECAST BASE SECTION**, fibers (placed according to the Standard Specifications), or wire mesh having a minimum area of 0.12 square inches per foot shall be used with the minimum required rebar shown in the **ALTERNATIVE PRECAST BASE SECTION**. Wire mesh shall not be placed in the knockouts.
2. The knockout diameter shall not be greater than 20". Knockouts shall have a wall thickness of 2" minimum to .5" maximum. Provide a 1.5" minimum gap between the knockout wall and the outside of the pipe. After the pipe is installed, fill the gap with joint mortar in accordance with Standard Specification 9-04.3.
3. The maximum depth from the finished grade to the lowest pipe invert shall be 5'.
4. The frame and grate may be installed with the flange up or down. The frame may be cast into the adjustment section.
5. The Precast Base Section may have a rounded floor, and the walls may be sloped at a rate of 1:24 or steeper.
6. The opening shall be measured at the top of the precast base section.
7. All pickup holes shall be grouted full after the basin has been placed.

REINFORCED OR PLAIN CONCRETE	12"
ALL METAL PIPE	15"
CPSSP® (STD. SPEC. 9-05.20)	12"
SOLID WALL PVC (STD. SPEC. 9-05.12(1))	15"
PROFILE WALL PVC (STD. SPEC. 9-05.12(2))	15"

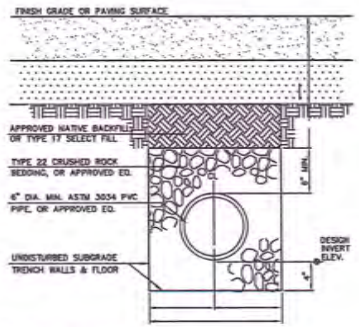
® CORRUGATED POLYETHYLENE STORM SEWER PIPE

9 CATCH BASIN - CB15
NOT TO SCALE



NOTE: DETAIL PROVIDED FOR REFERENCE ONLY. CONTRACTOR SHALL REPAIR EXISTING DRAINAGE WITH MATERIALS AND CONSTRUCTION DETAIL MATCHING TO EXISTING CONDITIONS OR WITH PROPOSED DETAILS APPROVED BY THE ENGINEER.

7 PERFORATED PIPE
NOT TO SCALE



8 SOLID PIPE
NOT TO SCALE

65%

>>>>CAUTION - CALL 811<<<<
UTILITY NOTIFICATION CENTER
BEFORE YOU DIG!
WWW.CALLBEFOREYOUDIG.ORG

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NO.	REVISION — AS BUILT	DATE
3		
2		
1		

REVIEWED:
PARK ENGINEER DATE

All work done in accordance with the City of Seattle Standard Plans and Specifications in effect on the date shown above, and supplemented by Special Provisions.

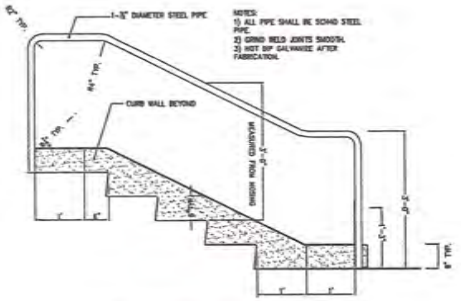
SEATTLE PARKS AND RECREATION

GAS WORKS PARK

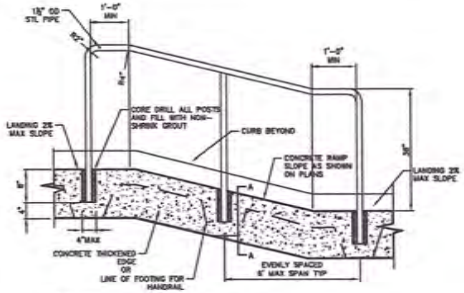
PLAY AREA RENOVATION

DETAILS - C.S.C. & DRAINAGE

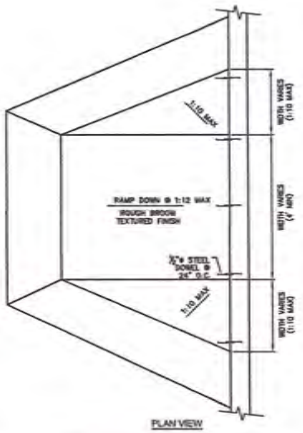
DESIGNED PA	DATE MARCH 2016
DRAWN PA	SHEET 7 OF 11
CHECKED RFR	
ORDINANCE NO.	7
CONTRACT NO.	
SCALE NOTED	

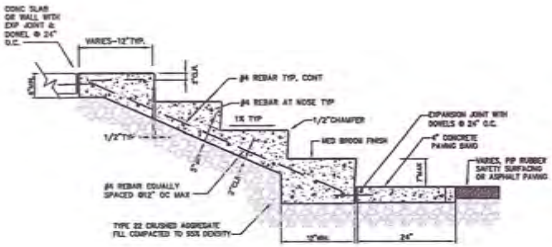


1 HANDRAIL AT STAIRS
NOT TO SCALE

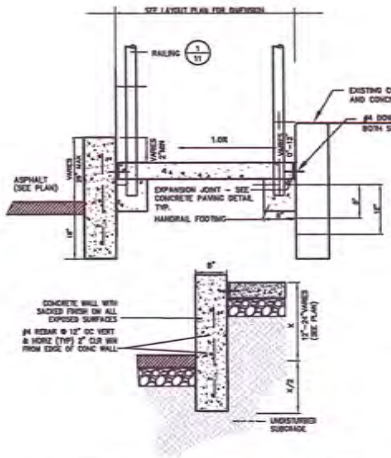


2 CONCRETE ADA RAMP WITH HANDRAIL
NOT TO SCALE

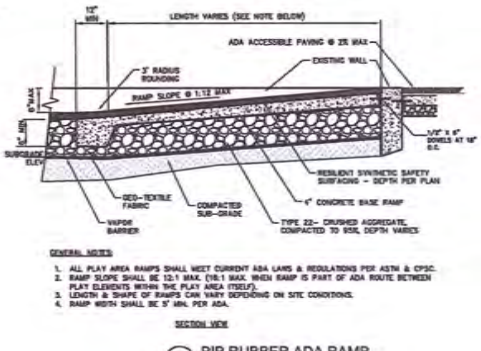




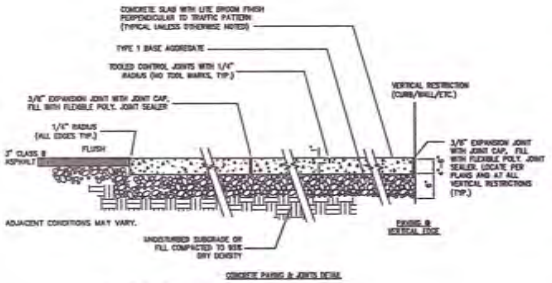
3 CONCRETE STAIRS
NOT TO SCALE



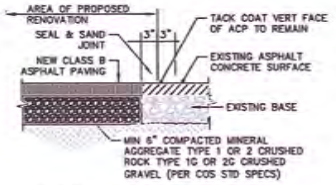
4 CONCRETE CURBS FOR RAMP AND STAIRS
NOT TO SCALE



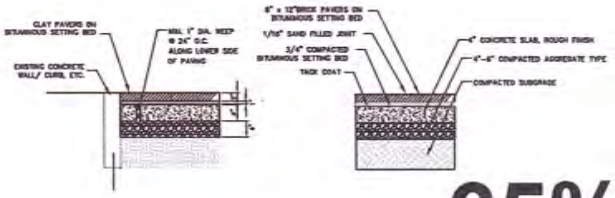
5 PIP RUBBER ADA RAMP
NOT TO SCALE



6 CONCRETE PAVING
NOT TO SCALE



7 ASPHALT PAVEMENT PATCH
NOT TO SCALE



8 BRICK PAVERS ON CONCRETE BASE
NOT TO SCALE

65%

>>>>CAUTION - CALL 811<<<<
UTILITY NOTIFICATION CENTER
BEFORE YOU DIG!
WWW.CALLBEFOREYOUDIG.ORG

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NO.	REVISION - AS BUILT	DATE
4		
3		
2		
1		

REVIEWED: _____ PARK ENGINEER _____ DATE

All work done in accordance with the City of Seattle Standard Plans and Specifications in effect on the date above above, and supplemented by Special Provisions.

STATE OF WASHINGTON
LICENSED LANDSCAPE ARCHITECT
PAMELA K. ALSPAUGH
LICENSE NO. 641
EXPIRES ON 02/09/2017

SEATTLE PARKS AND RECREATION

GAS WORKS PARK

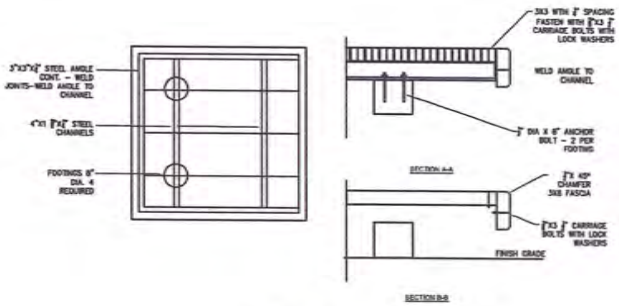
PLAY AREA RENOVATION

DETAILS - PAVING, CURBS, & HANDRAILS

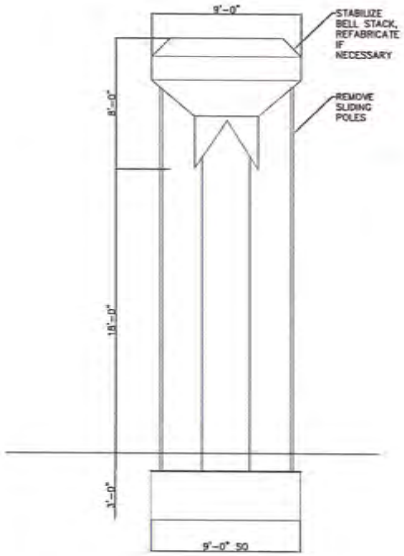
DESIGNED	PA	DATE	March, 2016
DRAWN	PA	SHEET	8 OF 11
CHECKED	RFR		
ORDINANCE NO.	124348		8
CONTRACT NO.	19		
SCALE	NOTED		

1 BENCH A
SCALE: NOT TO SCALE

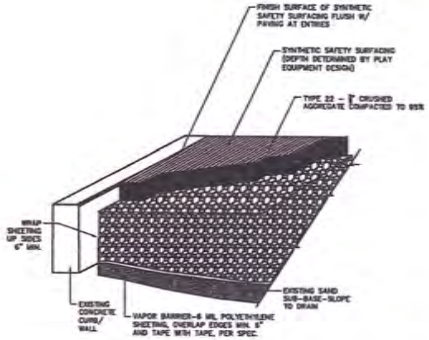
2 BENCH B
SCALE: NOT TO SCALE



3 KEBLIS
SCALE: NOT TO SCALE



4 TOWER MODIFICATIONS
SCALE: NOT TO SCALE



5 PLAY AREA SYNTHETIC P.I.P. SURFACING WITH VAPOR BARRIER
SCALE: NOT TO SCALE

>>>>CAUTION - CALL 811<<<<
UTILITY NOTIFICATION CENTER
BEFORE YOU DIG!
WWW.CALLBEFOREYOUDIG.ORG

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NO.	REVISION - AS BUILT	DATE
3		
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1		

REVIEWED:
PARK ENGINEER DATE

All work done in accordance with the City of Seattle Standard Plans and Specifications in effect on the date shown above, and supplemented by Special Provisions.

STATE OF WASHINGTON
LICENSED
LANDSCAPE ARCHITECT
PAMELA E. ALSPAUGH
LICENSE NO.441
EXPIRES ON 08/08/2017

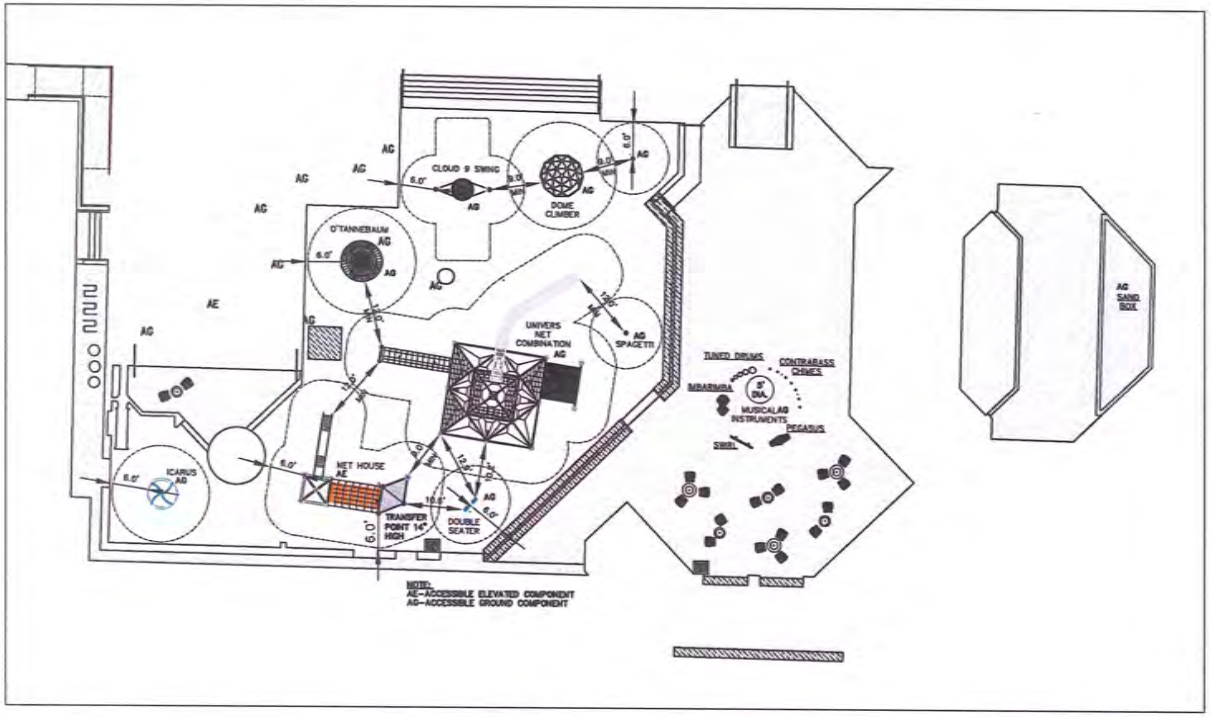
SEATTLE PARKS AND RECREATION

GAS WORKS PARK

PLAY AREA RENOVATION

DETAILS - MISCELLANEOUS

DESIGNED PA	DATE March, 2016
DRAWN PA	
CHECKED RFR	SHEET 9 OF 11
ORDINANCE NO. 124349	9
CONTRACT NO.	
SCALE NOTED	



PLAY EQUIPMENT PLAN

PLAY COMPONENTS FOR AGE 5 TO 12

	TOTAL ELEVATED PLAY COMPONENTS	0		
AE	TOTAL ELEVATED COMPONENTS ACCESSIBLE BY RAMP	0	REQUIRED	0
AE	TOTAL ELEVATED COMPONENTS ACCESSIBLE BY TRANSFER	0	REQUIRED	0
AG	TOTAL ACCESSIBLE GROUND LEVEL COMPONENTS SHOWN	19	REQUIRED	9
	TOTAL DIFFERENT TYPES OF GROUND LEVEL COMPONENTS	8	REQUIRED	0

PLAY COMPONENTS FOR AGE 2 TO 5

	TOTAL ELEVATED PLAY COMPONENTS	4		
AE	TOTAL ELEVATED COMPONENTS ACCESSIBLE BY RAMP	0	REQUIRED	0
AG	TOTAL ELEVATED COMPONENTS ACCESSIBLE BY TRANSFER	4	REQUIRED	2
	TOTAL ACCESSIBLE GROUND LEVEL COMPONENTS SHOWN	7	REQUIRED	1
	TOTAL DIFFERENT TYPES OF GROUND LEVEL COMPONENTS	3	REQUIRED	1

>>>>CAUTION - CALL 811<<<<
UTILITY NOTIFICATION CENTER
BEFORE YOU DIG!
WWW.CALLBEFOREYOUDIG.ORG

NOT LESS THAN 2 OR MORE THAN 10 BUSINESS DAYS PRIOR TO COMMENCING EXCAVATION OR DEMOLITION, SECURE THE SERVICES OF A COMMERCIAL UNDERGROUND UTILITIES LOCATOR SERVICE TO IDENTIFY BELOW-GROUND IMPROVEMENTS THAT MAY NOT BE INDICATED ON THE DRAWINGS. ADDITIONALLY, TO REQUEST ON-SITE UNDERGROUND UTILITY SYSTEMS LOCATES, CALL SPR INSPECTION REQUEST LINE @ (206) 684-7934. REFER TO SECTIONS 02100 & 02120 OF THE SPECIFICATIONS FOR INSTRUCTIONS ON HOW TO PROCEED.

NO.	REVISION -- AS BUILT	DATE
3		
2		
1		

REVIEWED: _____ PARK ENGINEER _____ DATE

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STATE OF WASHINGTON
LICENSED
LANDSCAPE ARCHITECT

PAMELA K. ALSPAUGH
LICENSE NO.441
EXPIRES ON 08/09/2017

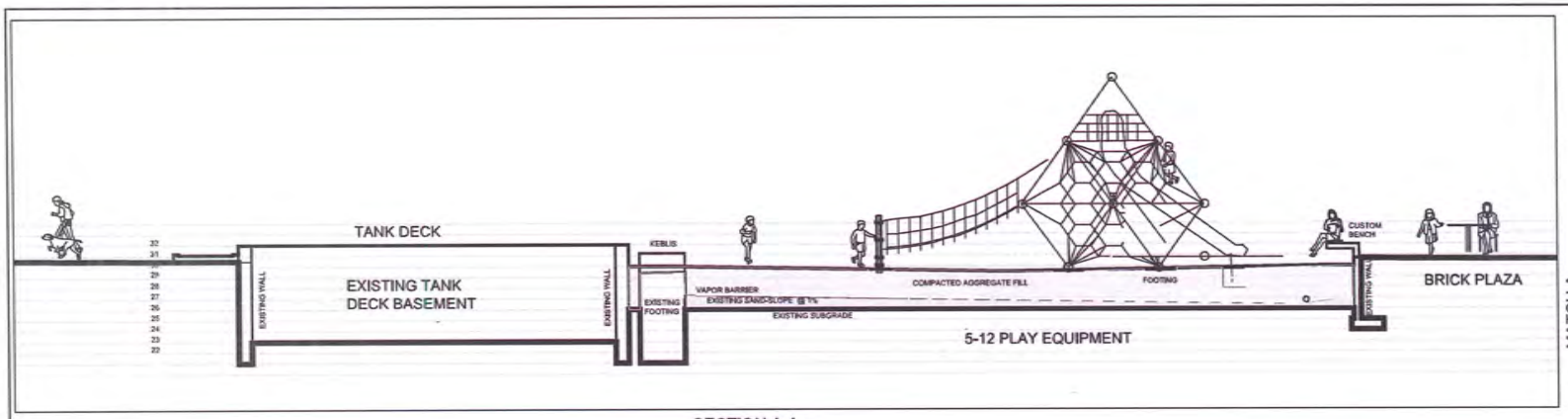
SEATTLE PARKS AND RECREATION

GAS WORKS PARK

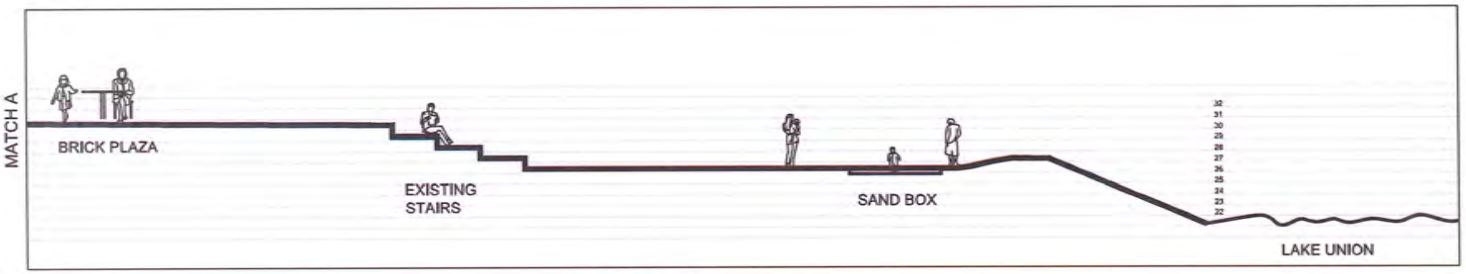
PLAY AREA RENOVATION

PLAN EQUIPMENT PLAN

DESIGNED PA	DATE MARCH, 2016
DRAWN PA	
CHECKED RFR	SHEET 10 OF 11
ORDINANCE NO. X	10
CONTRACT NO. X	
SCALE 1"=20'	



SECTION A-A



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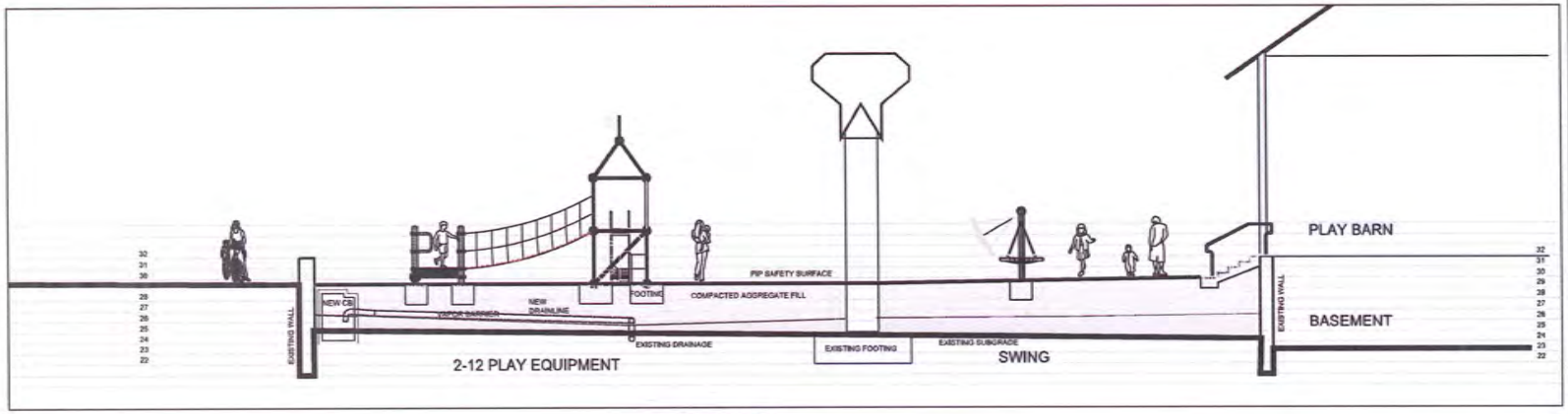

SECTION B-B

>>>>CAUTION - CALL 811<<<<
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NO.	REVISION – AS BUILT	DATE
3		
2		
1		

REVIEWED:
PARK ENGINEER DATE

All work done in accordance with the City of Seattle Standard Plans and Specifications in effect on the date shown above, and supplemented by Special Provisions.

STATE OF WASHINGTON
LICENSED
LANDSCAPE ARCHITECT

PAMELA K. ALSPAUGH
LICENSE NO.441
EXPIRES ON 03/06/2017

SEATTLE PARKS AND RECREATION

65%

GAS WORKS PARK

PLAY AREA RENOVATION

CROSS SECTIONS

DESIGNED	PA	DATE	MARCH 2016
DRAWN	PA	SHEET	6 OF 11
CHECKED	RFR		11
ORDINANCE NO.	X		
CONTRACT NO.	X		
SCALE	AS SHOWN		

ATTACHMENT B
Supplemental Play Area Investigation and Treatment Infrastructure Construction
Agency Review Draft

GeoEngineers

Plaza 600 Building, 600 Stewart Street, Suite 1700, Seattle, Washington 98101, Telephone: 206.728.2674, Fax: 206.728.2732 www.geoengineers.com

Technical Memorandum

To:	Ching-Pi Wang Site Manager Washington State Department of Ecology
From:	Dan Baker, Sandy Smith and Chris Bailey
Date:	August 18, 2016
File:	0186-846-01
Subject:	Supplemental Play Area Investigation and Treatment Infrastructure Construction

The supplemental Play Area investigation and treatment infrastructure construction summarized in this technical memorandum is being implemented in conjunction with park renovations and needs to be completed before substantial construction begins within the Play Area footprint. Work will be conducted under a modification of the March 18, 2005, Agreed Order DE 2008 between Puget Sound Energy (PSE), the City of Seattle (City), and the Washington State Department of Ecology (Ecology) for the Gas Works Park Sediment Site. If appropriate, the treatment system would be operated following completion of the renovation project as an interim action or as part of the final remedy for the Gas Works Park Site.

Background

In 2013, Agreed Order DE 2008 was amended to include upland properties in the area of investigation in order to evaluate the upland to sediment pathway. Ecology approved the Supplemental Investigation Work Plan (GeoEngineers, 2013) on March 13, 2013. During the supplemental investigation (SI), elevated concentrations of arsenic were measured in soil and groundwater samples collected from beneath the Play Area and eastern shoreline. In response to these findings, the 2014 Play Area investigation (PAI) was conducted to evaluate the nature and extent of arsenic in soil and groundwater (e.g., speciation), arsenic groundwater geochemistry and arsenic leaching from soil to groundwater. Ecology approved the 2014 PAI and work was conducted in accordance with the 2013 sampling and analysis plan (SAP) and quality assurance project plan (QAPP) amended to meet the specific objectives of the 2014 PAI (GeoEngineers, 2014). The results of the 2014 PAI are presented in Appendix Y of the Agency Review Draft Remedial Investigation and Feasibility Study Report (ARD RI/FS) (GeoEngineers, 2016) and geochemical evaluation of arsenic is presented in Appendix Z of the ARD RI/FS. The geochemical evaluation found that elevated concentrations of arsenic in soil reflect precipitation of arsenic sulfides within the soil matrix and elevated arsenic concentrations in groundwater are related to local geochemical conditions that stabilize thioarsenate species in groundwater.

Purpose and Objectives

Although fate and transport evaluation indicates the groundwater to sediment pathway is incomplete, PSE and the City plan to install treatment infrastructure in conjunction with the Play Area renovation project. The purpose of installing treatment infrastructure is to provide a subsurface injection and monitoring network that may be used to treat arsenic detected in groundwater beneath the Play Area. Prior to installing treatment infrastructure, investigation will be performed primarily to characterize dissolved arsenic concentrations. Treatment infrastructure needs to be installed before completion of the Play Area renovation so that, if investigation and treatability results indicate treatment would be beneficial, arsenic can be treated in situ without disturbing the newly renovated Play Area.

The work will consist of the following elements:

- Investigation.
  - Priority direct push borings, grab groundwater sampling, soil sampling and analytical testing. Investigation objectives include:
    - Delineate extent of elevated dissolved arsenic concentrations beneath the Play Area (both areal extent and depth).
    - Characterize upgradient groundwater geochemistry (e.g., sulfide concentration).
    - Characterize arsenic impacts at the shoreline to identify appropriate locations to monitor potential pathway to sediment.
  - Contingent direct push borings, grab groundwater sampling, soil sampling, and analytical testing.
  - Hydraulic profile testing to evaluate the hydraulic parameters.
- Injection infrastructure installation. Using information obtained during the investigation, the injection system layout will be designed to provide adequate vertical and lateral coverage of elevated dissolved arsenic concentrations. Injection wells will be installed and associated infrastructure including piping and an access vault will be constructed.
- Monitoring well installation, well development and baseline groundwater sampling, Monitoring wells will be installed to monitor the treatment system performance over time.

Field work will be performed according to methods presented in the Ecology approved 2013 Supplemental Investigation Work Plan (GeoEngineers, 2013), approved SAP-QAPP Addendum No. 1 (GeoEngineers, 2014), and SAP-QAPP Addendum No. 2 (Attachment 1).

Treatment Approach

As summarized in the ARD RI, the former Thylox process area is a likely source of arsenic impacts found in soil, groundwater and sediment near this historical facility (GeoEngineers, 2016). Planned investigations and groundwater treatment infrastructure installation are focused in this area.

The preliminary results of ongoing treatability studies for groundwater indicate that elevated arsenic concentrations in groundwater can likely be reduced by applying iron-containing amendments that act to decrease the soluble arsenic fraction in groundwater. The iron-containing amendments work by reducing the groundwater pH and sulfide concentrations, which results in arsenic sequestration within the soil matrix. Two injectable amendments, ferrous sulfate ($FeSO^4$) and ferric chloride ($FeCl^3$), are being evaluated for direct injection into saturated material beneath the Play Area.

Supplemental Investigation Elements

The SAP-QAPP Addendum No. 2 presents details on the proposed investigation. Priority borings will be advanced using direct push drilling methods. Secondary, or contingent, locations may be explored to refine the lateral and vertical extent of arsenic impacts and inform the understanding of the soil and groundwater conditions. The proposed investigation locations are presented in Figure 1 of the SAP/QAPP Addendum No. 2.

Groundwater samples collected will be submitted to the lab on an expedited turn-around-time and/or a mobile lab will be used.

A Hydraulic Profiling Tool (HPT) will be used to evaluate the hydraulic parameters for the injection infrastructure. The HPT uses two sensors: a pressure transducer to record dynamic pore pressure and an electrical conductivity (EC) sensor to provide information on lithology. The pressure transducer measures the response of the soil to injection of water as it is advanced through the soil column.

Treatment System Infrastructure

The SAP-QAPP Addendum No. 2 also presents details on the conceptual injection system infrastructure. Subsurface infrastructure will be installed to facilitate potential in situ treatment of arsenic-impacted groundwater including:

- Injection wells,
- Conveyance piping,
- Access vault, and
- Performance monitoring wells.

The conceptual treatment layout is illustrated on Figure 2 of SAP/QAPP Addendum No. 2. The location and spacing of treatment wells will be further evaluated based on the results of this investigation and ongoing groundwater treatability studies.

Schedule

The supplemental Play Area explorations and treatment infrastructure construction schedule will conform to Seattle Parks and Recreation's (SPR's) construction schedule. Play Area renovations are anticipated to begin in October. As a result, Play Area investigation and infrastructure construction activities are planned to begin in early September and be completed before SPR's construction begins. Schedule is contingent on approval of these proposed activities. Prompt approval is needed to allow this proposed work to be completed before Park renovations begin.

References

GeoEngineers, Inc. 2013. *Supplemental Investigation Work Plan, Gas Works Park Sediment Site, Seattle, Washington*, February 25, 2013.

GeoEngineers, Inc. 2014. *Sampling and Analysis Plan and Quality Assurance Project Plan Addendum 1, Supplemental Upland Investigation (Play Area Investigation), Gas Works Park Site, Seattle, Washington*, December 5, 2014.

GeoEngineers, Inc. 2016. *Agency Review Draft, Site-wide Remedial Investigation/Feasibility Study, Gas Works Park Site, Seattle, Washington*, March 1, 2016.

ATTACHMENT 1
Sampling and Analysis Plan and Quality Assurance Project Plan Addendum No. 2
Agency Review Draft

Sampling and Analysis Plan and
Quality Assurance Project Plan
Addendum No. 2
Agency Review Draft

2016 Supplemental Play Area Investigation
Gas Works Park Site
Seattle, Washington

for
Puget Sound Energy

August 18, 2016

GeoEngineers

Plaza 600 Building
600 Stewart Street, Suite 1700
Seattle, Washington 98101
206.728.2674

Sampling and Analysis Plan and Quality Assurance Project Plan Addendum No. 2

Agency Review Draft

2016 Supplemental Play Area Investigation Gas Works Park Site Seattle, Washington

File No. 0186-846-01

August 18, 2016

Prepared for:

Puget Sound Energy
P.O. Box 90868, PSE 11-N
Bellevue, Washington 98009-0868

Attention: John Rork

Prepared by:

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Claudia De La Via
Environmental Engineer

_____

Dan Baker, LG, LHG
Principal

CDV:DMB:leh

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APPENDICES

1.0 INTRODUCTION

This document is the second addendum to the sampling and analysis plan (SAP) and quality assurance project plan (QAPP) for the Gas Works Park Site (GWPS) Supplemental Investigation in Seattle, Washington. This SAP and QAPP Addendum No. 2 outlines additional sampling and testing activities proposed for the Play Area at GWPS and proposed infrastructure construction.

Elevated concentrations of arsenic were detected in soil and groundwater samples collected from beneath the Play Area during the 2013 supplemental upland investigation (GeoEngineers, 2013). Information obtained during the first supplemental investigation in 2014 was used to refine the understanding of the nature and extent of arsenic in this area. The results of the 2014 supplemental investigation were presented in the Remedial Investigation Report (RI; GeoEngineers, 2016, Appendix Y). Planned sampling activities, summarized in this second addendum, will supplement existing data and previous environmental investigations.

The work described in this addendum will be conducted under the March 2013 Work Plan (GeoEngineers, 2013) which was approved by Washington State Department of Ecology (Ecology) on March 11, 2013. The Work Plan described an environmental investigation designed to meet the data needs for completing the RI. Data collected in that investigation were summarized in the Agency Review Draft Site-Wide Remedial Investigation Report (GeoEngineers, 2016).

1.1. Purpose and Approach

The additional investigation and installation of remediation infrastructure in the Play Area is proposed at this time is to complete these activities while the Seattle Parks and Recreation (SPR) has the Play Area closed off to the public and prior to completion of the Play Area renovation project. SPR plans to complete the renovation project during fall/winter 2016. Collecting soil and groundwater data prior to completing the renovation project will allow the sampling to be performed using standard methods and without damaging Play Area features to be installed during the renovation. The planned remediation infrastructure will allow soil and groundwater under the Play Area to be treated using in situ methods in the future after the renovation project is complete, after which installation of remediation infrastructure would disturb the completed Play Area features.

Results from this supplemental Play Area investigation will be used to refine the extent of arsenic-impacted groundwater beneath the Play Area and inform the lateral and vertical placement of injection infrastructure and monitoring wells for possible future treatment. Treatment infrastructure needs to be installed prior to renovation as the Play Area will have limited accessibility after renovation is completed. Investigation objectives include:

- Delineate extent of elevated dissolved arsenic concentrations beneath the Play Area to determine treatment area and depth.
- Characterize upgradient groundwater geochemistry (e.g., sulfide concentration) to inform the design of the injection program.
- Characterize arsenic impacts at the shoreline to design treatment system and appropriate locations to monitor potential pathway to sediment.

The Supplemental Play Area investigation will be conducted in accordance with this SAP and QAPP Addendum No. 2. More details are provided in the 2013 SAP and QAPP, included as appendices to the 2013 Work Plan.

1.2. Work Flow

The work will consist of the following elements.

- Priority direct push borings, grab groundwater sampling, and soil sampling
- Contingent direct push borings, grab groundwater sampling, and soil sampling
- Hydraulic profile testing to evaluate the hydraulic parameters for the injection infrastructure
- Injection infrastructure installation
- Monitoring well installation, well development and baseline groundwater sampling

Proposed direct push investigation locations are illustrated on Figure 1. A summary of the proposed groundwater investigation is presented in Table 1. A direct push drill rig will be used to install soil borings and temporary wells (priority and contingent locations), and injection wells. A sonic rig will be used for installing the monitoring wells.

Priority direct push borings PAI-13 to PAI-21 will be drilled and sampled first (Table 2). Field screening with an x-ray fluorescence (XRF) analyzer will provide real-time approximate total arsenic soil concentrations. In each of the borings, temporary polyvinyl chloride (PVC) well screens will be set in the Fill and/or Outwash units to allow groundwater grab sampling. Groundwater grab samples may be field screened on site using a colorimetric test kit to estimate dissolved arsenic concentrations. Alternatively, a mobile laboratory may be used on site to provide quick-turn around arsenic analyses. Groundwater grab samples will also be collected and submitted to an off-site analytical laboratory for analysis as described in Table 3.

The results obtained from the priority direct push borings will be used to evaluate whether to follow with contingent locations. Conditions triggering contingent explorations are presented in Table 1. Procedures for completing the contingent borings will be the same as those for priority borings. Field screening and analysis of groundwater samples from these borings will be used to evaluate the lateral and vertical extent of arsenic impacts in groundwater.

At least one grab groundwater sample will be collected from each priority and contingent direct push location. At borings where Fill and Outwash groundwater samples are proposed at the same exploration, only one boring drive will be required. Discrete groundwater samples will be collected using dual tube system and clean single use ¾-inch diameter PVC. Although the number, location, and depths of groundwater samples will be determined during the investigation, the following considerations are provided for planning purposes:

- It is anticipated that all of the priority borings used to evaluate the extent of arsenic in groundwater will be completed first. Exceptions may include the following:
  - Areas that are difficult to access (i.e. sand pits)—if initial results indicate additional groundwater vertical delineation is merited, a "twin" boring may be drilled.

- If Fill groundwater sampling is proposed and the water table is below the Fill unit, an Outwash groundwater sample will be collected instead. Groundwater sampling will be conducted at the base of Fill and/or Outwash units, estimated in Table 2. The well screens will be set in either geologic unit (Fill or Outwash) and are not to overlap geologic units.

- An air sparging/soil vapor extraction system including a near-surface geomembrane cover is present south of the Play Area (Figure 1). If elevated arsenic concentrations in soil or groundwater are encountered at PAI-13 and/or PAI-22, (southern-most borings) that would prompt contingent borings farther south. These locations will be advanced according to the Construction Completion Report (ThermoRetec, 2001).

The results obtained from the priority and contingent direct push samples results will be used to finalize the injection infrastructure layout and performance monitoring well locations. A conceptual layout for these components is presented on Figure 2. Based on the direct push soil and groundwater sample results and interpreted extent of arsenic under the Play Area, the number and locations of the proposed injection wells will be adjusted. The new monitoring wells proposed for the Play Area are intended to evaluate performance of future remediation using the injection wells. Therefore, the locations for the proposed monitoring wells will be adjusted based on the final layout of the injection wells. Baseline groundwater sampling would be conducted from the new monitoring wells and existing wells MW-36S and MW-36D.

2.0 FIELD SAMPLING AND TESTING METHODS

This section focuses on field screening, sampling, and laboratory testing methods that are not contained in the 2013 SAP and QAPP and 2014 Addendum No. 1 or that deviate from the methods described therein.

2.1. Soil Investigation

Soil boring cores will be field screened for nonaqueous phase liquid (NAPL) and arsenic impacts. Discrete soil samples will be collected for chemical analysis in accordance to Table 3. Estimated boring depths are presented in Table 2 but are subject to change based on the observed conditions in the field.

2.2. Groundwater Investigation

Grab groundwater samples will be collected from all direct push locations. Temporary well screens constructed of clean ¾-inch diameter PVC will be inserted into the boring. Screen intervals will be determined in the field and will generally target either the Fill or Outwash units, estimated screen intervals are presented in Table 2 but are subject to change based on the observed conditions in the field. The wells will be allowed to sit for a period of time before purging using a peristaltic pump. Low-flow purging will be conducted and field measurements will be collected using a water quality instrument such as a Horiba U-22. Groundwater being purged will be tested for turbidity, dissolved oxygen, pH, specific conductivity, and oxidation-reduction potential. Samples will be collected once turbidity readings are low enough and field parameters are relatively stable. Target "low turbidity" will be less than 5 nephelometric turbidity units (NTU), however samples may be collected if three well volumes have been removed and parameters generally vary by less than 10 percent on three

consecutive measurements. The PVC screens will be pulled and disposed of after sampling, and the borings will be grouted.

Groundwater chemical analysis will focus on data needed for evaluation of in situ treatment of arsenic in the Play Area; total and dissolved arsenic and iron, sulfide, and chemical oxygen demand.

2.3. Laboratory Analytical Methods

The analytical methods to be used for sample analysis, as well as details regarding containers, sample preservatives, and sample holding times, are listed in Table 4.

Table 5 lists the field quality control (QC) samples to be collected during this investigation. Field QC samples will consist of equipment rinsate blanks, trip blanks, and field duplicates, and will be documented in field reports. As discussed in the 2013 QAPP, field QC samples will be used to evaluate the effectiveness of equipment decontamination procedures, potential cross-contamination of samples during transport to the laboratory, reproducibility of laboratory results, and sample heterogeneity.

2.4. Hydraulic Testing

Hydraulic profile testing will be conducted to evaluate the hydraulic parameters for the injection infrastructure. A Hydraulic Profiling Tool (HPT) will be used. Additional hydraulic tests, such as slug tests or soil core testing, may be performed.

The HPT provides continuous, real-time profiles of soil hydraulic properties. HPT measures estimated lithology and estimated porosity. The HPT consists of two sensors: a sensitive downhole pressure transducer to record dynamic pore pressure and an electrical conductivity (EC) sensor to provide information on lithology. The pressure transducer measures the response of the soil to injection of water as it is advanced through the soil column. The higher the pressure response on the data logs, the lower the soil permeability; inversely, the lower the pressure response on the data logs, the higher the soil permeability. The EC sensor provides information regarding the soil type by measuring the EC of the soil, which provides an indication of the general soil particle size. Data output from the HPT include EC, pressure, and flow rate. The proposed location(s) for hydraulic profiling will be determined based on the direct push results. Appendix B presents the standard operating procedure (SOP) for the GeoProbe HPT system.

3.0 INFRASTRUCTURE INSTALLATION

This section describes the remediation infrastructure proposed to be installed prior to the construction of the SPR Play Area renovation project. This infrastructure will be constructed prior to the renovation construction in a manner that will allow future treatment of arsenic impacted groundwater without damaging Play Area facilities once constructed. The installation of the remediation infrastructure would be completed while the Play Area is closed for construction of the renovation project, but prior to the City initiating the construction. The infrastructure will be permanently installed under the renovated Play Area, and will consist of injection wells and piping and performance monitoring wells.

3.1. Injection System Details

The injection system infrastructure planned for construction prior to completion of the Play Area renovation will consist of a series of vertical injection wells located in an elongated grid network across the Play Area footprint. The injection wells will be completed below the anticipated final Play Area grade and will be plumbed to individual dedicated conveyance pipes for injection. The conveyance pipes for the wells will be trenched and plumbed to a remote vault outside the footprint of the Play Area to allow injections to be performed from outside the renovated Play Area. The conceptual layout of the injection wells is shown on Figure 2.

The injection wells will be permanent wells, screened across the intended vertical treatment profile, estimated to be approximately 10-feet to 15-feet below ground surface but to be determined based on the investigation results as described above. The injection wells will be constructed using direct-push methods to install permanent pre-packed well casings and screens where possible. Where proposed well locations will intercept subsurface obstructions, sonic well drilling methods will be used. The layout of the wells shown on Figure 2 is conceptual, but representative of the estimated spacing in the longitudinal and lateral directions relative to groundwater flow. Results from the investigation described above will be considered and the well spacing will be adjusted as necessary.

The injection wells will be completed below the proposed final grade of the Play Area surface, without surface completions or vaults at each well location. The well casing will be directly plumbed to a 1 inch PVC or polyethylene lateral conveyance line that will be placed in an excavated shallow trench. The conveyance lines for multiple wells will be bundled to the extent possible to reduce trenching. The conveyance lines will be terminated in a sub-grade utility vault located outside the Play Area footprint, but in an accessible location to allow future access for injection. Each conveyance line will be terminated with a shut-off valve and quick-connect fitting to allow easy connection to injection equipment in the future.

3.2. Monitoring Wells

Four to six monitoring wells will be installed to evaluate the injection system. Exact locations and screen intervals will be adjusted based on the results of the above investigation activities. The objectives of the new monitoring wells are to monitor groundwater conditions within, downgradient, and upgradient of the remediation performed at the constructed injection wells. Groundwater monitoring wells installed within and downgradient of the area of injection wells will be used to evaluate distribution of injected reagent as well as the results of reaction of the reagent and reduction of arsenic. Upgradient groundwater monitoring wells will evaluate the contaminant concentration, as well as the concentration of geochemical parameters that affect the treatment, in groundwater entering the treatment area. Figure 2 shows the approximate areas where the wells would be installed. Monitoring well installation will be conducted according to the 2013 SAP. The performance well objectives are:

- Background monitoring well, upgradient of impacted zone. On either side of the concrete platform depending on investigation results.
- Performance monitoring well, downgradient of 1st injection lateral.
- Performance monitoring well, downgradient of 2nd injection lateral.

- Performance monitoring well, downgradient of entire injection system. Upgradient of MW-36S.

A baseline groundwater sampling event will be performed to evaluate current arsenic conditions prior to treatment. Groundwater samples will be collected from the new monitoring wells, as well as nearby existing monitoring wells MW-36S and MW-36D. The sampling methodology and proposed chemical analyses for the baseline groundwater monitoring is listed in Table 1. Groundwater monitoring to be performed following future treatments will be designed based on the selected reagents and will be described in a separate plan outlining the details of the future in situ treatment.

4.0 REFERENCES

ThermoRetec, 2001. Construction Completion Report, Gas Works Park Site, Seattle, Washington.

GeoEngineers, Inc. 2013. Final Supplemental Investigation Work Plan, Gas Works Park Site, Seattle, Washington.

GeoEngineers, Inc. 2014. Final Supplemental Investigation Work Plan, Gas Works Park Site, Seattle, Washington.

GeoEngineers, Inc. March 1, 2016. Agency Review Draft Site-Wide Remedial Investigation Feasibility Study Report, Gas Works Park Site, Seattle, Washington.

Table 1

Proposed Groundwater Investigation

Gas Works Park Site - SAP/QAPP Addendum No. 2
Seattle, Washington

Exploration Type	Exploration ID[1]	Groundwater Sampling Objective				Geologic Unit
		Upgradient Groundwater	Shoreline Extent	Lateral Extent of Dissolved Arsenic	Vertical Extent of Dissolved Arsenic	
Primary Borings	PAI-13		X	X	X	Outwash GW
	PAI-14		X		X	Outwash GW
	PAI-15			X	X	Fill GW Outwash GW
	PAI-16			X	X	Fill GW Outwash GW
	PAI-17			X	X	Fill GW Outwash GW
	PAI-18			X	X	Fill GW Outwash GW
	PAI-19			X	X	Fill GW (Outwash GW contingent on PAI-17 and/or 18)
	PAI-20	X		X	X	Fill GW (Outwash GW contingent on PAI-18)
	PAI-21			X	X	Fill GW (Outwash GW contingent on PAI-13 and/or 16)
	PAI-22			X	X	Fill GW (Outwash GW contingent on PAI-13 and/or 16)
Contingent Borings	If PAI-13 or PAI-16 are elevated, move South of PAI-16 and West of PAI-13			X	X	Fill GW Outwash GW
	If PAI-14 is elevated, move North		X			Fill GW Outwash GW
	If PAI-19 is elevated, move Northwest			X	X	Fill GW Outwash GW
	If PAI-20 is elevated, move West	X		X		Fill GW
	If contingent PAI-20 is elevated, continue moving West	X		X	X	Fill GW
	if PAI-21 is elevated, move West			X	X	Fill GW Outwash GW

Notes:

1. Investigation locations are shown on Figure 1.

GW = groundwater

X = priority investigation

X = contingent investigation

Table 2

Estimated Exploration Depths

Gas Works Park Site - SAP/QAPP Addendum No. 2
Seattle, Washington

Proposed Exploration Type	Exploration ID	Boring Method	Estimated Surface Elevation (ft. USACE)	Estimated Base of Fill (ft. USACE)	Estimated Base of Outwash (ft. USACE)	Estimated Groundwater Elevation (ft. USACE)	Estimated Boring Depth (feet bgs)	Estimated Base of Sample Interval (feet bgs)
Priority Borings	PAI-13	Direct Push	27	9	5	18 / Fill	22	22
	PAI-14		29	2	-4	20 / Fill	33	33
	PAI-15		30	7	-4	18 / Fill	34	34
	PAI-16		30	7	-4	18 / Fill	34	34
	PAI-17		33	16	4	19 / Fill	29	17 and 29
	PAI-18		34	18	5	20 / Fill	29	16 and 29
	PAI-19		30	17	2	15 /Qvr	13	13
	PAI-20		30	17	2	17 /Qvr	28	13 and 28
	PAI-21							
	PAI-22		33	20	9	21 / Fill	13	13
Contingent Borings	If PAI-13 or PAI-16 are elevated, move Southwest		33	20	9	21 / Fill	13	13
	If PAI-14 is elevated, move North		28	7	0	19 / Fill	28	21 and 28
	If PAI-19 is elevated, move Northwest							
	If PAI-20 is elevated, move West		30	17	2	17 /Qvr	28	13
	If contingent PAI-20 is elevated, continue moving West		35	21	10	25 / Fill	14	14
	if PAI-21 is elevated, move West							

Notes:

1. Investigation locations are shown on Figure 1.

GW = groundwater
Qvr = Vashon Recessional Outwash

Table 3

Proposed Analysis

Gas Works Park Site - SAP/QAPP Addendum No. 2
Seattle, Washington

Exploration Type	Soil		Groundwater			
	Chemical Oxygen Demand	Grain Size	Arsenic	Total Iron	Sulfide	Chemical Oxygen Demand
			Field Filtered			
	5220D-97	PSEP 1986 or ASTM-Mod	EPA 200.8	SW6010	SM 4500-S2-D	410.4
Borings	X	X	X	X	X	X
Monitoring Wells	X	X	X	X	X	X

Table 4

Test Methods, Sample Containers, Preservatives and Holding Times

Gas Works Park Site - SAP/QAPP Addendum No. 2

Seattle, Washington

Analysis	Method	Minimum Sample Size		Sample Containers		Sample Preservatives		Sample Holding Times[1]	
		Soil	Water	Soil	Water	Soil	Water	Soil	Water
Arsenic	EPA 200.8 (water)	–	500 mL	–	500 mL HDPE	–	Cool ≤6 °C, HNO_3 to pH < 2 (Dissolved metals preserved after filtration)	–	180 days to digestion, 180 days to analysis
Total Iron	SW6010 (water)								
Sulfide	SM 4500-S2-D (water)	–	500 mL	–	500 mL HDPE	–	Cool ≤6 °C, Zinc Acetate and NaOH, pH > 9	–	7 days
Chemical Oxygen Demand	410.04 (soil) 5220D-97 (water)	50 g	250 mL	4 oz. glass widemouth with Teflon-lined lid	250 mL amber glass with Teflon-lined lid	Cool ≤6 °C	Cool ≤6 °C, H_2SO_4 to pH < 2	28 days	28 days
Grain Size	PSEP 1986 or ASTM-Mod (soil)	300 g	–	16-oz HDPE or Ziploc	–		–		–

Notes:

1. Holding times are based on elapsed time from date of sample collection.

g = gram
HDPE = High density polyethylene
HNO_3 = nitric acid
H_2SO_4 = Sulfuric acid
mL = milliliter
NaOH = Sodium hydroxide
oz. = ounce

Table 5

Quality Control Sample Types and Minimum Frequency

Gas Works Park Site - SAP/QAPP Addendum No. 2

Seattle, Washington

Parameter	Field QC Samples			Laboratory QC Samples			
	Field Duplicates	Trip Blanks	Equipment Rinsate Blanks	Method Blanks	Blank Spike, LCS or OPR	MS/MSD	Lab Duplicates
Arsenic	1 per 20 primary soil samples	NA	1	1 per batch*	1 per batch*	1 MS only per batch*	1 per batch*
Total Iron							
Sulfide							
Chemical Oxygen Demand							

Notes:

*An analytical batch is defined as a group of samples taken through a preparation procedure and sharing a method blank, LCS, and MS/MSD (or MS and lab duplicate). No more than 20 field samples are contained in one batch.

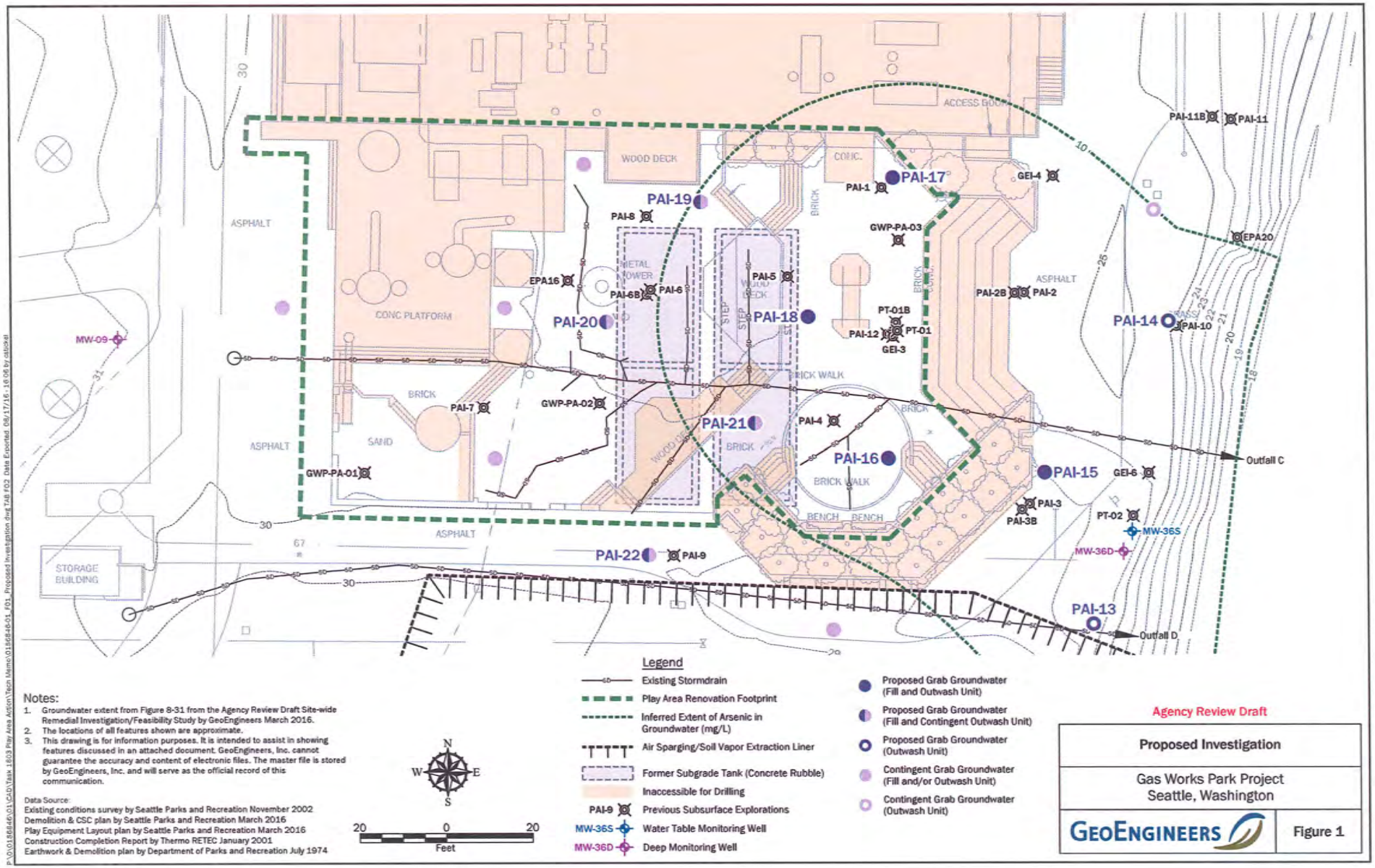
LCS = Laboratory control sample

MS = Matrix spike

MSD = Matrix spike duplicate

NA = Not applicable

OPR = Ongoing precision and recovery



Notes:

1. Groundwater extent from Figure 8-31 from the Agency Review Draft Site-wide Remedial Investigation/Feasibility Study by GeoEngineers March 2016.
2. The locations of all features shown are approximate.
3. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source:
Existing conditions survey by Seattle Parks and Recreation November 2002
Demolition & CSC plan by Seattle Parks and Recreation March 2016
Play Equipment Layout plan by Seattle Parks and Recreation March 2016
Construction Completion Report by Thermo RETEC January 2001
Earthwork & Demolition plan by Department of Parks and Recreation July 1974

N W E S

20 0 20
Feet

Legend

- Existing Stormdrain
- Play Area Renovation Footprint
- Inferred Extent of Arsenic in Groundwater (mg/L)
- Air Sparging/Soil Vapor Extraction Liner
- Former Subgrade Tank (Concrete Rubble)
- Inaccessible for Drilling
- PAI-9 Previous Subsurface Explorations
- MW-36S Water Table Monitoring Well
- MW-36D Deep Monitoring Well
- Proposed Grab Groundwater (Fill and Outwash Unit)
- Proposed Grab Groundwater (Fill and Contingent Outwash Unit)
- Proposed Grab Groundwater (Outwash Unit)
- Contingent Grab Groundwater (Fill and/or Outwash Unit)
- Contingent Grab Groundwater (Outwash Unit)

Agency Review Draft

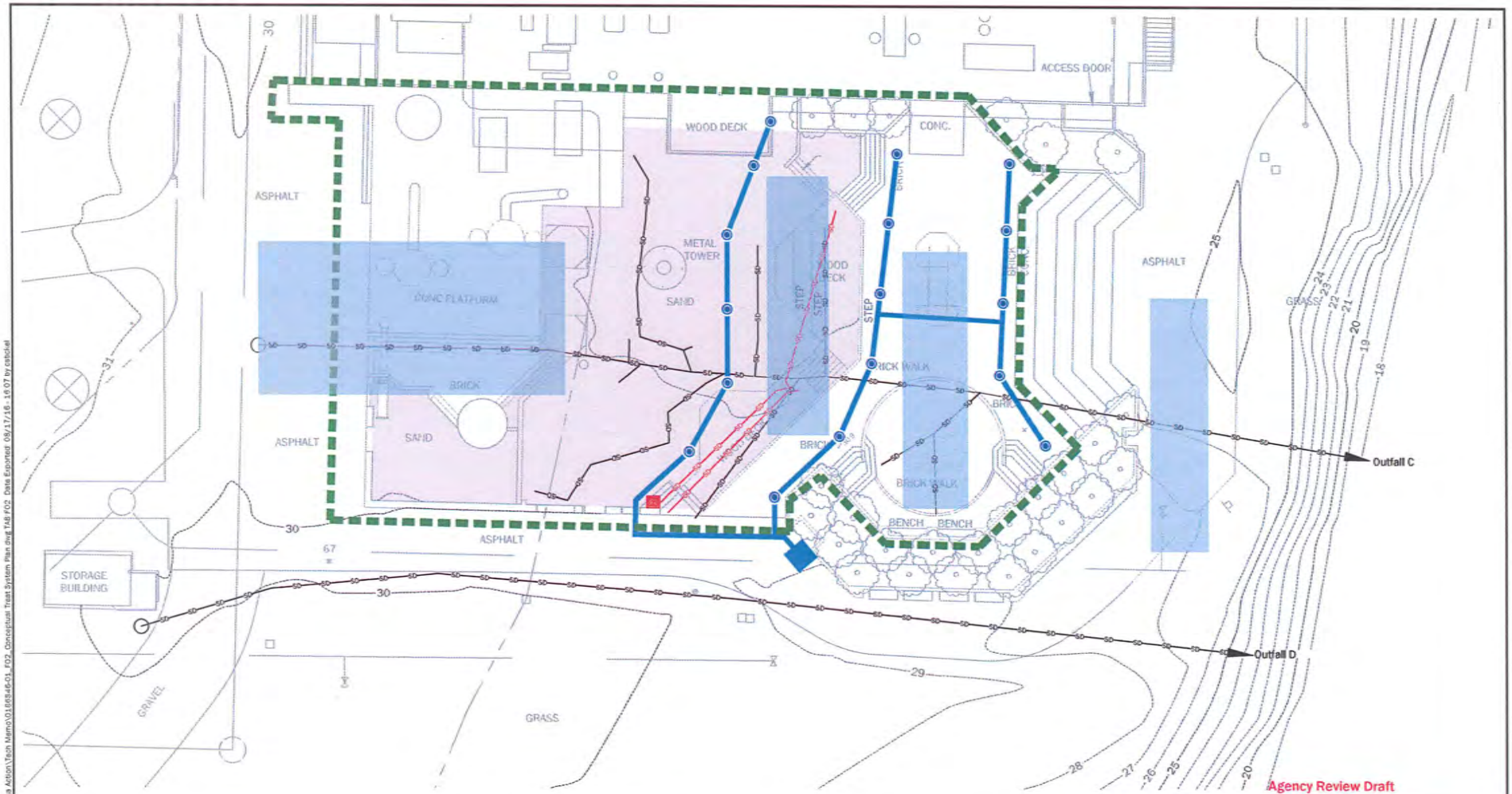
Proposed Investigation

Gas Works Park Project
Seattle, Washington

GeoEngineers

Figure 1

P:\0\018684e6\01\CAD\Task 1803 Play Area Action\Tech Memo\018684e6-01_F01_Proposed Investigation.dwg TAB F02 Data Exported 08/17/16 - 16:06 by catickal


ACCESS DOOR
WOOD DECK
CONC.
ASPHALT
METAL TOWER
SAND
CONC. PLATFORM
BRICK
STEP
BRICK WALK
BENCH
ASPHALT
GRASS
Outfall C
Outfall D
STORAGE BUILDING
GRAVEL
GRASS
Agency Review Draft
Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
Data Source:
Existing Conditions survey by Seattle Parks and Recreation November 2002. Materials Plan by Seattle Parks and Recreation March 2016
N
W
E
S
20 0 20
Feet
Legend
Existing Stormdrain
Play Area Renovation Footprint
Planned Stormdrain and Catch Basin
Planned Surface Poured in Place Rubber
Conceptual Treatment System Layout
Injection Well Location
Trenched Injection Pipe and System Vault
Performance Monitoring Well Area
Conceptual Treatment System Layout
Gas Works Park Project
Seattle, Washington
GeoEngineers
Figure 2

APPENDIX A
Health and Safety Plan
(reserved)

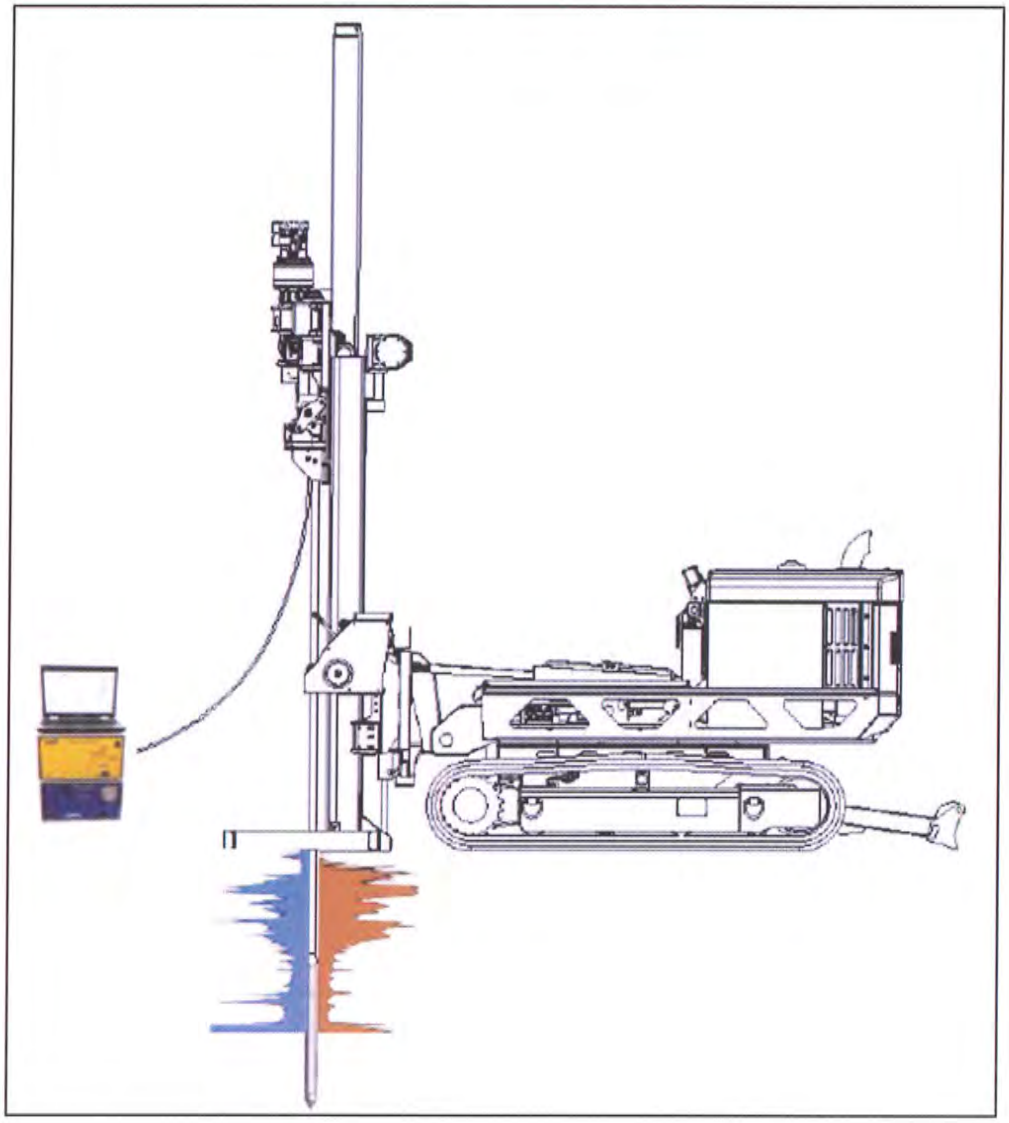
APPENDIX B
Hydraulic Profiling Tool
Standard Operating Procedure

Geoprobe® Hydraulic Profiling Tool (HPT) System

Standard Operating Procedure

Technical Bulletin No. MK3137

Prepared: January 2015



1.0 Objective

This document serves as the standard operating procedure for the Geoprobe® Hydraulic Profiling Tool (HPT) system. In this procedure, the HPT system is used to measure the pressure response of soil to injected water for identifying potential flow paths and to assist with characterization of soil type.

2.0 Background

2.1 Definitions

Geoprobe®*: A brand of high quality, hydraulically-powered machines that utilize both static force and percussion to advance sampling and logging tools into the subsurface. The Geoprobe® brand name refers to both machines and tools manufactured by Geoprobe Systems®, Salina, Kansas. Geoprobe® tools are used to perform soil core and soil gas sampling, groundwater sampling and testing, electrical conductivity and contaminant logging, grouting, and materials injection.

**Geoprobe® and Geoprobe Systems® are registered trademarks of Kejr, Inc., Salina, Kansas.*

Hydraulic Profiling Tool (HPT) System: A system manufactured by Geoprobe Systems® to evaluate the hydraulic behavior of subsurface soil. The tool is advanced through the subsurface at a constant rate while water is injected through a screen on the side of the probe. An in-line pressure sensor measures the pressure response of the soil to water injection. The pressure response identifies the relative ability of a soil to transmit water. Both pressure and flow rate are logged versus depth.

2.2 Introduction

The HPT system has been developed by Geoprobe Systems® for the geohydrologic characterization of soils. The HPT probe and logging system is able to quickly provide logs that are easily interpreted. HPT logs are used to indicate hydraulic conductivity, EC, hydrostatic profile, and areas of EC/permeability anomalies.

The HPT system is designed to evaluate the hydraulic behavior of unconsolidated materials. As the probe is pushed or hammered at 2cm/s, clean water is pumped through a screen on the side of the HPT probe at a low flow rate, usually less than 300mL/min. Injection pressure, which is monitored and plotted with depth, is an indication of the hydraulic properties of the soil. That is, a low pressure response would indicate a relatively large grain size, and the ability to easily transmit water. Conversely, a high HPT pressure response would indicate a relatively small grain size and the lack of ability to transmit water.

An electrical conductivity measurement array is built into the HPT probe. This allows the user to collect soil electrical conductivity (EC) data for lithologic interpretation. In general, the higher the electrical conductivity value, the smaller the grain size, and vice versa. However, other factors can affect EC, such as mineralogy and pore water chemistry (brines, extreme pH, contaminants). In contrast, HPT pressure response is independent of these chemical and mineralogical factors.

There are four primary components of the HPT system: the probe assembly, trunkline, HPT Flow Controller (K6300 Series), and Field Instrument (FI6000 series). These primary components are shown in Figure 2.1.

The probe assembly consists of the HPT probe and connection section. This assembly houses the downhole HPT pressure transducer, water and electrical connections, and the probe body with the injection screen and electrical conductivity array.

Injecting water at a constant rate is integral to system operation. The HPT Flow Module houses the pump and associated hand crank mechanism used for adjusting the output flow of the HPT pump. The flow module also contains the HPT flow measurement and injection line pressure transducers. HPT flow can be adjusted from approximately 50 to 500ml/min. The HPT pump is a positive displacement pumping device with minimal decrease in flow over the HPT operating pressure range. The flow module is equipped with an internal bypass that is factory set to open and return flow to the supply reservoir at a pressure of 120psi. When the soil resistance to water injection becomes sufficiently great, the HPT Flow Module bypass will open, returning some or all of the pumped flow to the supply reservoir. The flow meter only measures flow leaving the module to the HPT probe. The HPT Flow Module is connected to the Field Instrument via a data cable.

Water and power are transmitted from the controller to the probe assembly via the HPT trunkline. The probe rods must be pre-strung with the trunkline before advancing the probe.

Data collection occurs in real time by connecting the controller to the field instrument. The field instrument collects, stores and displays transducer pressure, flow rate and electrical conductivity, line pressure, probe rate, and diagnostic parameters, with depth via the field laptop.

Since the HPT pressure response is analogous to the soil's ability to transmit water (and therefore the to the soil's dominant grain size), the HPT system can be used to identify potential contaminant migration pathways. Similarly, it can help identify zones for remedial material injection or provide qualitative guidance on how difficult injection may be in different zones of the formation.

The HPT system may be used to direct other investigation methods, such as soil and groundwater sampling and slug testing. HPT pressure response and EC data can help target zones of geologic and hydraulic interest, minimizing the number of soil and groundwater samples required to adequately develop a site conceptual model. When hydraulic conductivity values are required, the

HPT system can also help the user identify zones to slug test, as well as the length of the screen required to adequately test the zone.

The HPT system also can be used to collect static water pressure data at discrete intervals during the logging process. These static pressure data can be used to calculate static water levels or to create a hydrostatic profile for the log.

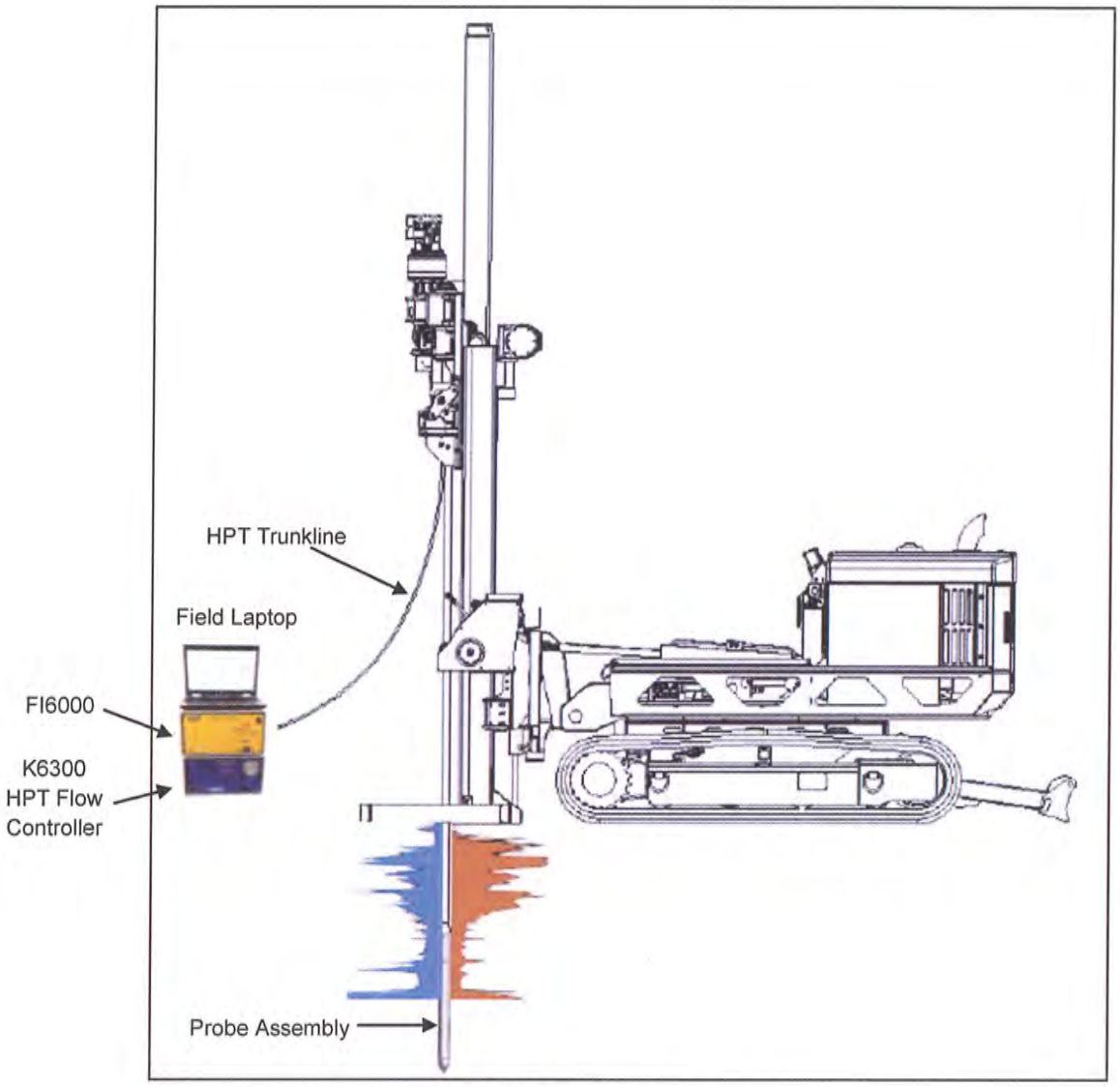


Figure 2.1: HPT Components

3.0 Tools and Equipment

The following equipment is required to perform and record an HPT log using a Geoprobe® 66- or 78-Series Direct Push Machine. Refer to Appendix I for identification of the specified parts.

Basic HPT System Components	Quantity	Material Number
Field Instrument, 120V (Model FI6000)	-1-	213940
Field Instrument, 220V (Model FI6003)	*	213941
HPT Acquisition Software	-1-	214128
HPT Flow Module, 120V (Model K6300)	-1-	214091
HPT Flow Module, 220V (Model K6303)	*	214093
HPT Probe, 1.75 inch	-1-	215667
MIP/HPT Connection Tube	-1-	206304
MIP/HPT Adapter 1.5 Pin x LB Box	-1-	203794
MIP/HPT Adapter 1.75ML Pin x LB Box	**	220966
HPT Probe, 2.25 inch	**	214097
2.25 Connection Tube	**	219455
2.25 Inch Water Seal Drive Head	**	212089
2.75 Inch Water Seal Drive Head	**	209796
HPT Reference Tube 1.75 in HPT Probe	-1-	212689
HPT Reference Tube 2.25 in HPT Probe	**	211762
HPT Trunkline 150 ft.	-1-	214095
HPT Trunkline 200 ft.	(optional)	214096
HPT Service Kit	-1-	205599
HPT Test Load	-1-	206552
EC Probe Test Jig	-1-	214237
EC Test Load	-1-	*208075*
EC Bypass Cable	-1-	204025
Stringpot, 100-inch	-1-	214227
Stringpot Cordset, 65-feet (19.8 m)	-1-	202884

*Use in place of 120V components if desired.

**Use in place of 1.75 inch probe and components if desired.

4.0 HPT Assembly

Refer to Appendix I

Threading the Rods

- Protect the end of the trunkline to be threaded through the rods with electrical tape or shrink tubing.
- Probe rods must alternate directions prior to threading the trunkline.
- The end of the HPT trunkline with chrome connectors is the downhole or probe end.
- The probe end of the trunkline will always enter the male end and exit the female end of the probe rods.
- The instrument end (no chrome connectors) will always enter the female end and exit the male end of the probe rods.
- After the trunkline is through the probe rods make sure the downhole end is threaded through the male end of the drive head and connection tube prior to connecting to the probe.
- The trunkline is now ready to connect to the instrument and HPT pressure sensor and probe.

5.0 Field Operation

5.1 Instrument Setup

1. Connect the HPT Controller (K6300), Field Instrument (FI6000) and laptop (Fig. 5.1) to an appropriate power source.

2. Connect the FI6000 to the K6300 using the 62-pin serial cable inserted into the acquisition port of each instrument.

3. Secure the EC wires into the Green terminal block connector and insert into the FI6000. The wires match to the EC dipoles in the following top down order when the probe tip is on the ground – white, black, yellow and blue (Fig 5.2).

4. Secure the HPT sensor wires to the appropriate inputs on the green terminal block connector and connect to the rear of the K6300. The top down order of the wires which is listed on the back of the instrument is: brown, orange, red and reserved (open).

Figure 5.1: HPT Instrument Setup

5. Insert the nylon water line tubing from the trunkline into the water output connector on the back of the K6300.

6. Connect the HPT water supply hose into the input port on the rear of the K6300 and insert the filtered end of the supply line into a water supply tank. The bypass line connects to the bypass port and will follow the supply line back to the supply tank.

7. Connect the USB cable between the USB interface port on the rear of the FI6000 to USB input on the field laptop computer.

Figure 5.2: EC Wire Connections

8. A stringpot is required to measure depth. Bolt the stringpot onto the machine and the stringpot onto the bracket. Connect the plastic connector end of the stringpot cable to the "Stringpot" connector on the back of the Field Instrument and the metal connector to the stringpot. Pull the stringpot cable and attach to the stringpot piston weight which should be mounted to the probe machine foot and pull the keeper pin so the weight is free to move.

5.2 Starting the Software

1. Make sure the FI6000 and K6300 are connected together with the 62 pin cable, powered on and connected to the computer by the USB cable for the software to load properly.

2. Start the DI Acquisition Software which should open in HPT mode.

3. Select "Start New Log". The software will request log information and have you browse for a storage location and create and save a file name for the log (Fig. 5.3).

4. Select "Next". If the software has been run before it will show a list of previous settings including Probe Type, EC Configuration, Stringpot length, rod length and HPT Transducer. If any of these have changed or you are unsure select "No" but if they are all the same select "yes". If you select "No" the software will have you select the proper settings after the EC Load Test, if you selected "Yes" the selection of these settings will be bypassed.

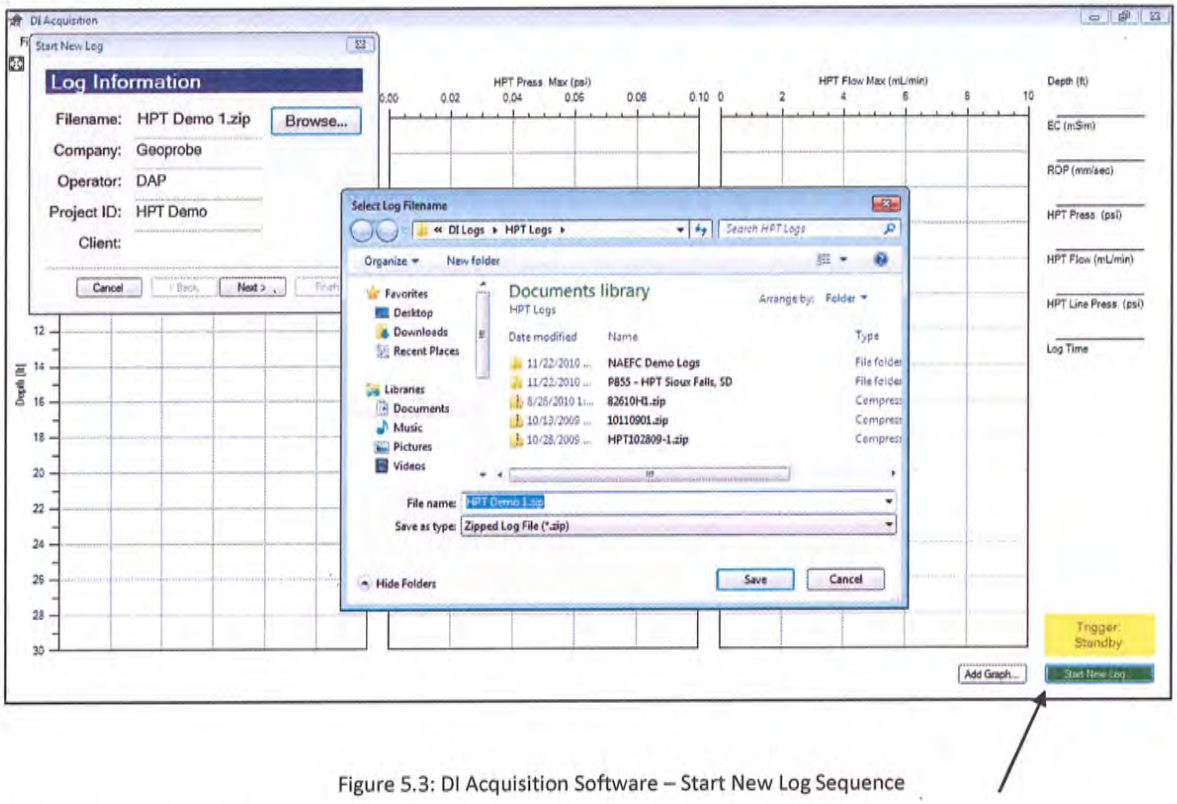


Figure 5.3: DI Acquisition Software – Start New Log Sequence

5.3 QA Testing the EC and HPT Systems

Both the EC and HPT components must be tested before and after each log. This is required to ensure that the equipment is working properly and capable of generating good data before and after the log.

A. Electrical Conductivity Load Test

1. Secure the EC 3 position test load connector (208075) to the test input jack on the back of the Field Instrument.

2. Secure the EC Probe Test Jig into the input on the EC 3 position test load.

3. Clean and dry the EC dipoles as well as several inches of the probe body above the pins.

4. Place the EC Test Jig (214237) so that the four springs on the test jig touch the four dipoles of the Wenner EC array (Fig. 5.4). Make sure the trunkline and test jig wires go in the same direction. The other spring on the test jig will ground the probe body above the Wenner array. Make sure the springs are pulled out far enough to make a solid contact on the dipoles.

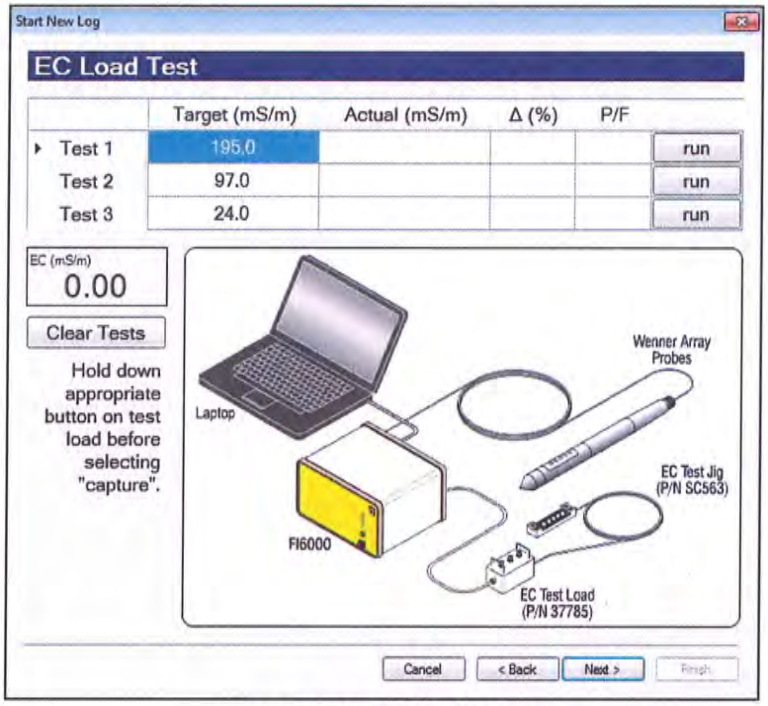


Figure 5.4: EC Load Test Screen

5. When you get to the EC Load Test Screen and the EC test load and test jig are in place on the probe press down on the test 1 button on the test load and select "run" of Test 1 (Fig. 5.4). After 5 seconds the actual value will acquire and will pass if within 10% of the target value. Continue on with Test 2 and 3.

6. If any of the EC load tests fail do not pass within the allowed 10% acceptance range you can make adjustments on the test jig and rerun the test by just re-clicking the "run" button for an individual test.

7. If the tests continue to fail, select "Next" and the software will conduct the "EC Troubleshooting Tests." The Instrument Calibration Tests (Fig. 5.5) checks of the calibration within the FI6000. If these are far out of range it will influence the EC Test load values and will need to return to Geoprobe® for repair. The "Probe Continuity and Isolation Tests" confirm each of the wires is a complete circuit and is fully isolated from one another. If a probe continuity test fails just outside the target range of <8ohms this is typically a contact issue with the test jig and the dipoles. If the continuity is in the thousands of ohms this is a break in the EC wire circuit – either in the probe, the trunkline or the connection between them.

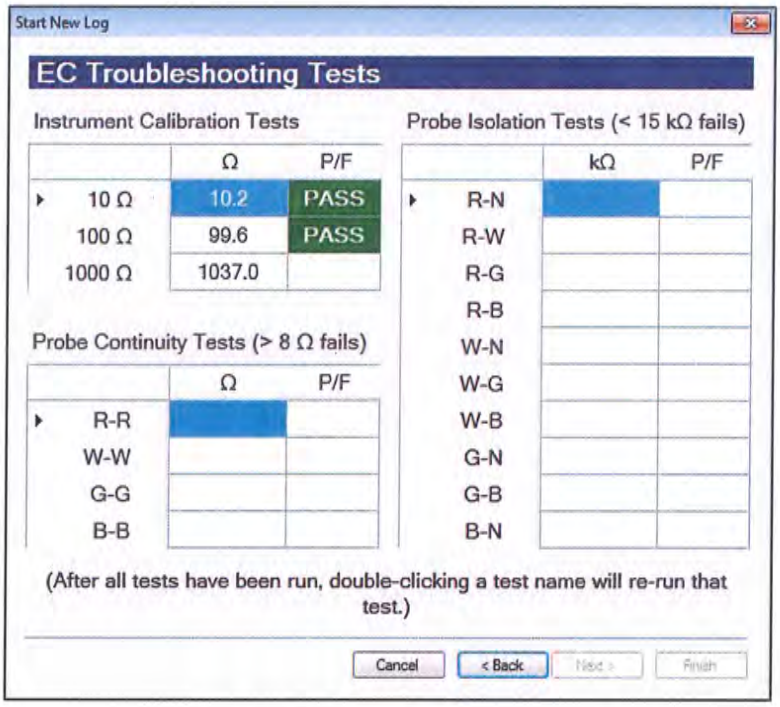


Figure 5.5: EC Troubleshooting Test Screen

8. When these tests are complete select next. In the next screen, the software will provide an EC option, if one is available. The EC Load Test will only work if EC can be operated in Wenner array meaning all of the EC wires in the continuity test pass with results <8ohms on the individual circuits. EC can be operated and collect good data in one of the dipole areas: top, middle or bottom dipole. If the R-R test fails but the others pass the software will provide the option in the next screen to run either middle dipole or bottom dipole arrays. If R-R and G-G are both an incomplete circuit then no EC array is available to run and a new probe must be connected or the problem fixed. In the Wenner configuration it requires 2 adjacent dipoles to operate in dipole mode. If an EC array is chosen and run in this last manner then all of the EC information collected will be bad data.

B. HPT Reference Testing

Reference testing is done to ensure that the HPT pressure sensor is in working order and to evaluate the condition of the HPT injection screen. The HPT reference test calculates atmospheric pressure which is required to obtain static water level readings and to determine the estimated K values for the log in our post log processing software the DI Viewer.

Reference Test Procedure

1. Connect a clean water source to the HPT controller and turn on the pump.

2. Allow water to flow through the system long enough so that no air remains in the trunkline or probe (air in the system can cause inaccurate flow and pressure measurements).

3. Insert the probe into the HPT reference tube and allow the water to flow out the valve adjusting the flow rate to between 250-300ml/min (Fig. 5.5). Ensure that the reference tube is close to vertical.

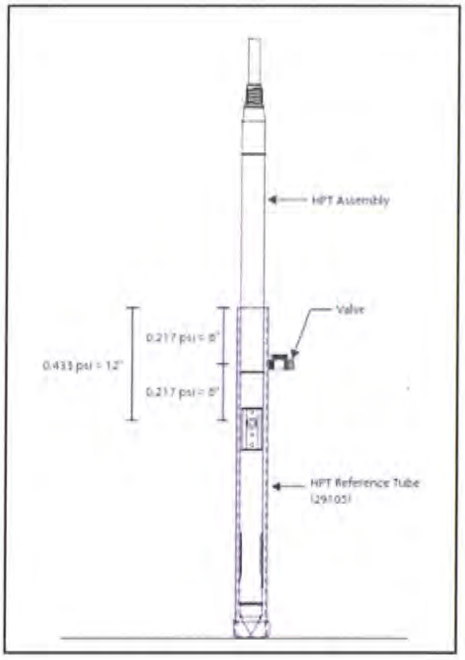


Figure 5.5: HPT Reference Test Setup

4. With a stable pressure reading and the water flowing out of the valve select "capture" - bottom with flow (Fig. 5.6)

5. Close the valve and allow the water to overflow the top of the tube. When the pressure stabilizes select "capture" - top with flow.

6. Shut off the water flow. When the pressure stabilizes select "capture" - top flow = 0.

7. Open the valve and allow the water to drain out. When the pressure stabilizes select "capture" - bottom flow = 0.

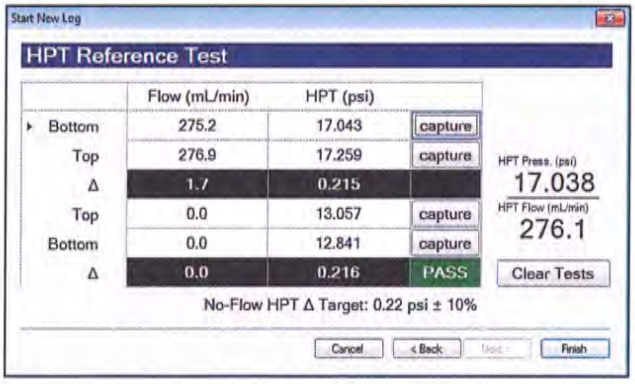


Figure 5.6: HPT Reference Test Screen

The HPT reference test reading flow = 0 is the true test of the condition of the pressure sensor and is the only sensor test to have a pass/fail reading on it. Ideally, the pressure difference between the top and bottom values will be 0.22psi (1.52kPa). Typical pressure readings of the sensor will be in the 12-15psi (83-104kPa) range.

5.4 Running an HPT Log

1. Place the rod wiper on the ground over the probing location and install the drive cushion in place of the anvil of the probing machine.

2. Place the probe tip in the center of the rod wiper, and place the slotted drive cap on top of the HPT probe.

3. Start the HPT water flow. **Note**: It is important that there is always water flowing when the probe is advanced to avoid soil particles from moving through the screen and causing problems with the pressure readings or causing a blockage behind the screen.

4. Adjust the probe so that it is vertical and advance the probe until the HPT screen is at the ground surface.

5. Click the trigger button in the lower right hand corner of computer screen. (The Trigger label will flash and the background will change from yellow to green).

9. Advance the probe at a rate of 2cm/s. If necessary, feather the hammer to maintain this advance rate.

10. Perform a dissipation test (Section 5.4) in a zone of higher permeability indicated by lower HPT pressure.

11. After completing the log, press the trigger button again and select "Stop Log".

12. Pull the rod string using either the rod grip pull system or a slotted pull cap. Run a post-log EC test and HPT response test (Section 5.2).

5.5 Performing a Dissipation Test

At least one dissipation test must be performed in order to calculate the static water level and estimated K readings from the log. Dissipation tests need to be performed below the water table and are best in zones of high permeability where the injection pressure can dissipate off quickly once the flow is shut off.

1. Stop in a zone of higher permeability which is indicated by lower HPT inject pressure.

2. Switch the DI Acquisition display view from the depth screen to the time screen by pressing the F10 key (F9 and F10 toggle between the depth and time screen of the acquisition software).

3. The screen will be grayed out which means that the data up to that point has not been saved. Select "Start Dissipation Test" which will turn the screen from gray to a white background indicating that you are now saving the time data.

4. Now shut the pump switch off and when the line pressure reaches zero, turn the flow valve off.

5. The HPT Pressure will begin to drop (dissipate the hydrostatic increase) and allow it to stabilize so very little visible drop in pressure is seen. When the pressure has fully dissipated turn the flow valve and the pump switch back on. When the flow and pressure are reestablished select "End Dissipation test."

6. Select F9 to return to the depth screen and advancing the tool into the ground.

   Note: Performing a dissipation test in zones of higher permeability may only take 30 seconds or so but if the HPT pressure was higher to start with it may take a long time up to several hours to dissipate off to equilibrium. This is why targeting the most permeable zone to perform the dissipation tests is most desirable.

6.0 HPT Log and Interpretation

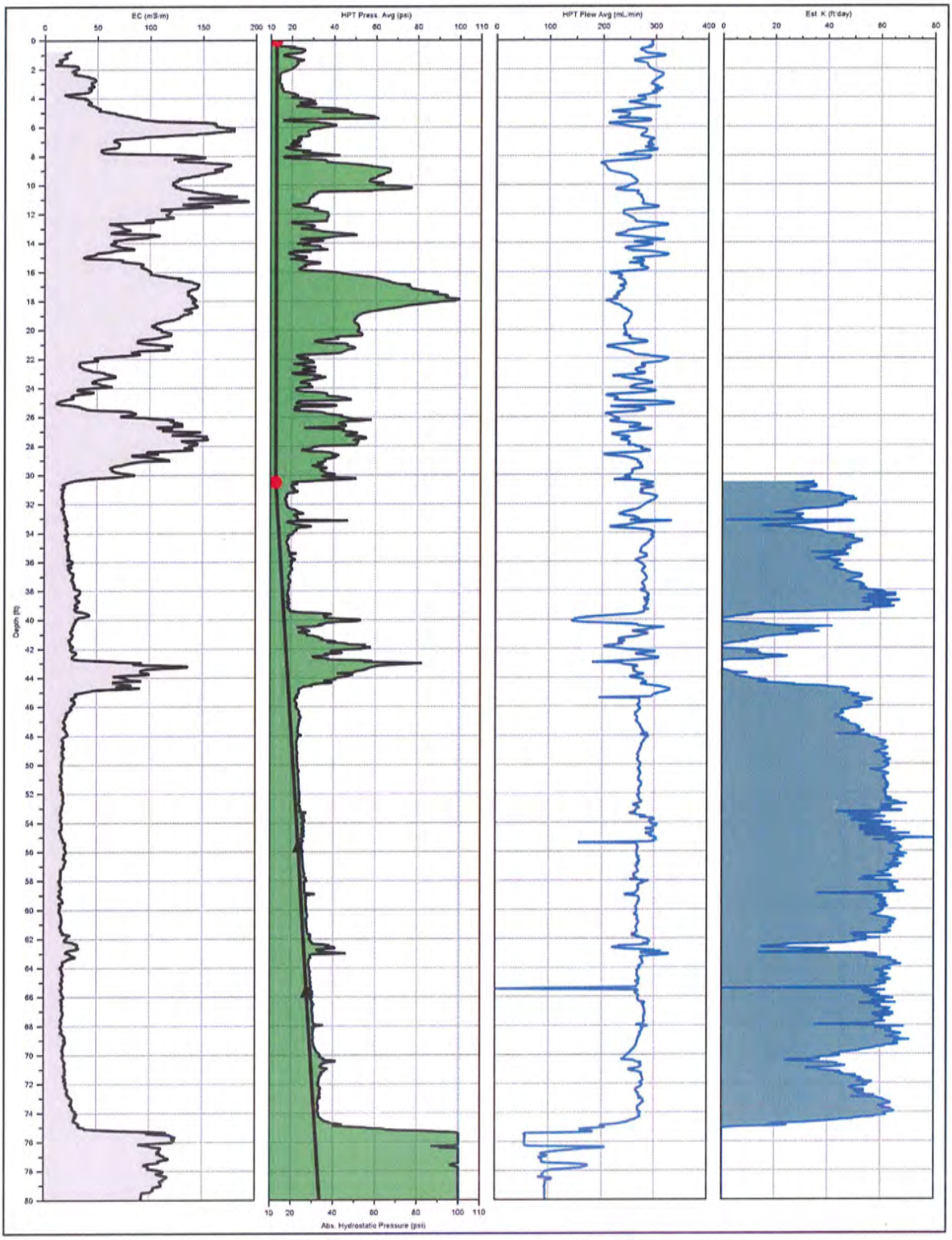


Figure 6.1: HPT Log file showing (left to right):
Electrical Conductivity (EC), HPT Injection Pressure with Hydrostatic Profile, HPT Flow, and Estimated K

A typical HPT log is shown in figure 6.1, which consists of both the HPT pressure response and electrical conductivity. In general, both HPT pressure and EC values increase with decreasing grain size, and decrease with increasing grain size. The log in Figure 6.1 shows good consistency between EC and HPT pressure for the majority of the log. It is only between 32'-42'bgs that we see some divergence of the graphs with higher HPT pressure while the EC readings remained low. This can happen for reasons such as poor mineralogy of the soil. Refusal was encountered in a shale layer beginning at 75'bgs and it can be noted that as we enter this layer the HPT flow gets suppressed as the pressure reaches a maximum value of 100psi (690kPa). The second graph of the log shows the hydrostatic profile on the secondary series of the graph. The hydrostatic profile has 2 black triangles which indicate where dissipation tests were run and used to calculate the profile. The red circle indicates the calculated water table based upon where the hydrostatic profile intersects atmospheric pressure. The fourth graph is the estimate K or groundwater flow graph. This is calculated based upon HPT pressure and HPT flow relationships. Less permeable soil will have less groundwater flow.

It is fairly common to see zones where EC readings and HPT pressure contradict one another. In cases where EC readings are low and HPT pressure trends higher as in the log in Figure 6.1 the following are possible reasons:

- Poor mineralogy of the soil particles resulting in silt and clay soils with very low EC readings. This is seen in many locations along the east coast of the United States.
- Silts intermixed with sand particles.
- Weathered bedrock may have low EC but would have low permeability.

Where we have cases of higher EC and lower HPT pressure typically is due to an ionic influence in the soil or groundwater. These higher EC readings can range from very slight to higher than typical soil readings. Very high EC readings can occur when the probe contacts metallic objects in the soil which will ground them out and typically will cause hard sharp spikes in the EC data.

- Chloride or other ionic contaminant (sea water, injection materials)
- Sea Water intrusion
- Wire, metal objects or Slag

In cases where HPT and EC do not confirm one another it is important to take confirmation soil and/or groundwater samples to help understand the difference between the two graphs.

7.0 Troubleshooting

7.1 Using the HPT Controller Test Load

The HPT Controller Test Load (206552) is included with the HPT Controller to help troubleshoot the HPT pressure sensor, trunkline, and controller. If there is a major problem with the HPT pressure sensor or the system wiring the system will not read anywhere close to atmospheric pressure with the probe at the surface. Commonly if the HPT sensor has broken the software will read either a maximum or minimum value which would be 100psi or 0psi (690kPa or 0kPa). If there is damaged wiring or nothing is connected to the controller the system typically reads 50psi (345kPa).

Figure 7.1: HPT Test Load (206552)

To use the test load, set up the system as previously described. Turn on both the field instrument and HPT controller and start the HPT software. Plug the green wire connector of the test load into the HPT sensor connector on the back of the HPT controller. If the pressure sensor value reads between 25-35psi (172 – 241kPa) the controller is able to properly read pressures so the problem is in the trunkline or the HPT sensor. If HPT controller has not moved from what it was reading or is way out from the expected value of the load test the HPT controller may require servicing. Contact Geoprobe Systems® for service.

Next, connect the HPT sensor wires of the trunkline to the controller with the green connector and then connect the chrome connector side of the test load to the female chrome connector on the downhole end of the trunkline in place of the pressure sensor. Again, the pressure value displayed on the field instrument should read between 25-35psi (172 – 241kPa) and should be the same as what was seen with the load test connected into the controller. If the load test read the expect value 25-35psi (172 – 241kPa) at both locations then both the trunkline and the controller are working properly and the problem is in the HPT sensor. If the test load read the expected value at the controller but not at the end of the trunkline, the trunkline may be defective and should be replaced. Before restringing another HPT trunkline, first connect the new trunkline sensor wires into the HPT controller and the downhole end into the test load. If the system now reads in the expected test load range the original trunkline needs replacing.

Finally, connect the pressure sensor to the trunkline. If it reads atmospheric pressure, approximately 12-15psi (83-104kPa), then the pressure transducer is functioning properly. However, if it does not, replace the sensor with a new one and re-check the pressure reading. Be sure to enter the new sensor calibration values into the software prior to starting the new log. Additional pressure sensors may be purchased from Geoprobe®.

7.2 Common Problems

Problem: The pressure transducer is connected to the trunkline, but the software is reporting a reading of ~ 50psi (345kPa).
Solution: Make sure all trunkline wires are secured to the green terminal blocks and plugged in to the back of the HPT controller and sensor chrome connectors are secure. Check components using the HPT Controller Test Load (Section 7.1).

Problem: The pressure transducer is connected to the trunkline, but the software is reporting a reading of 100psi or 0psi (690kPa or 0kPa).
Solution: Make sure all of the connections are good and recheck the pressure reading. If still bad connect a new HPT pressure sensor onto the trunkline and see if it reads atmospheric pressure. If not check all the components using the HPT Controller Test Load (Section 7.1).

Problem: The pressure with flow values keep drifting when water is flowing out the port or over the top of the reference tube.
Solution 1: If the trunkline was just connected and flow was just started air may still be in the lines. Allow the water to continue to flow through system which will purge out the remaining air. When it appears that most of the air is out of the lines press your thumb over the injection screen for a few seconds to help drive out any remaining air from the trunkline.
Solution 2: There may be debris behind the screen. Remove the HPT screen with the membrane wrench and turn the water flow on, use a small screwdriver to scrap out any debris in the screen socket as well as any that might be behind the screen. Replace the screen and retry the reference test with flow.
Solution 3: If the with flow pressure values continue to not settle down and provide close to the expected difference for a 6" water column then the problem may be inside the HPT control box. When you remove the cover of the HPT controller there will be a brass filter located on the left side when viewing from the front of the instrument (Fig 7.2). Particulates and precipitates can collect inside this filter causing problems with HPT pressure stability. Remove this filter and open up using appropriate wrenches. The filter can be easily cleaned by rinsing water over the screen. Reassemble and return to its proper location inside the control box. Resume reference testing the system.

Figure 7.2: Location of Inline Filter in K6300 and buildup of particulates in filter.

Problem: Atmospheric pressure values are way off from normal (12-15psi (83-104kPa)) after installing a new HPT sensor.
Solution: Check the calibration values that were entered into the software to ensure that they are correct.

Problem: Winterizing the HPT system for subfreezing work or air transport.
Solution: Pump RV antifreeze through the HPT pump and bypass pathway which can be done by blocking off the inject line. The trunkline can either be purge free of water by the pump or with an air compressor. NOTE: Never purge the HPT Controller of water using an air compressor this will damage sensor components in the controller.

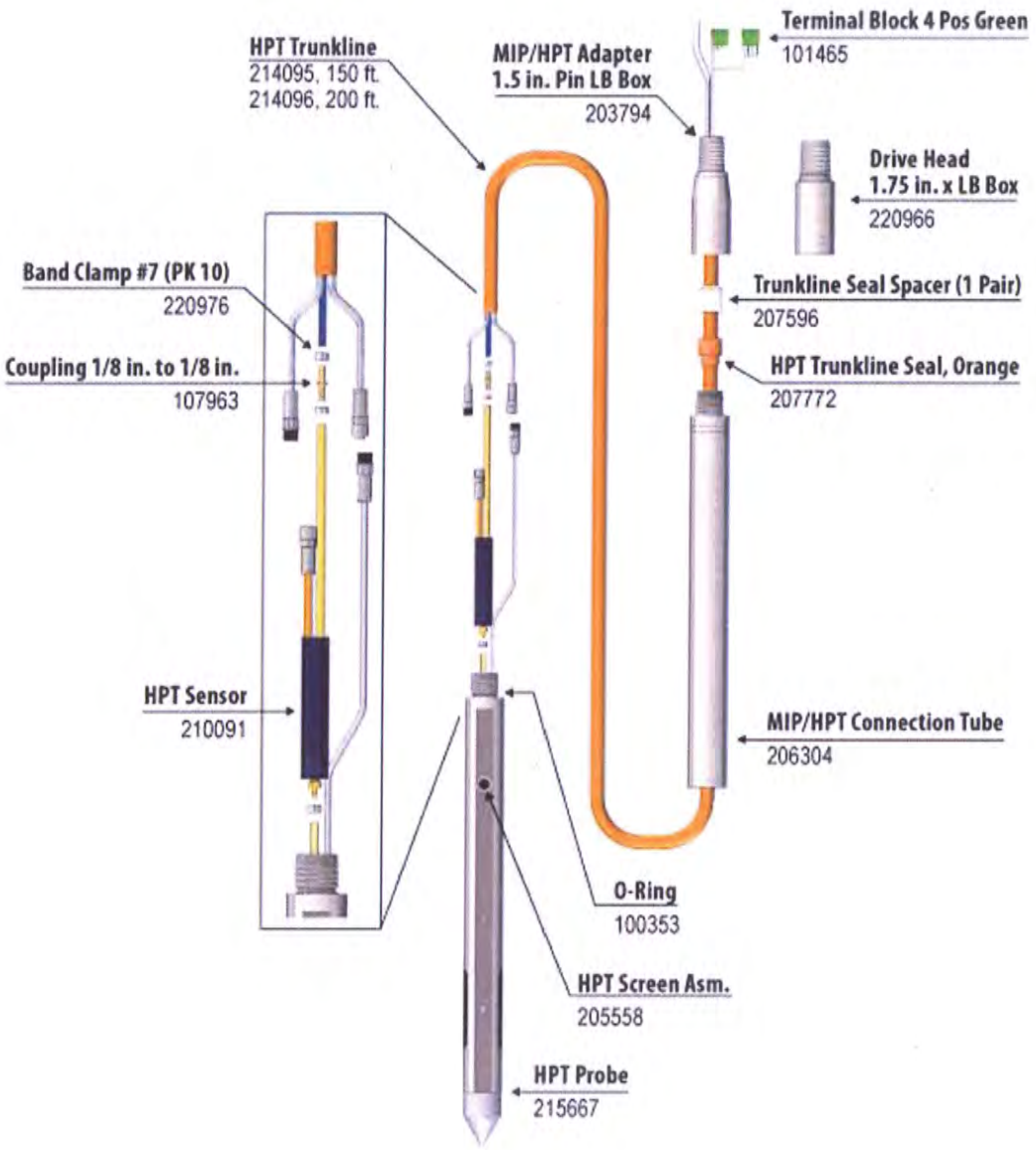
Problem: HPT flow sensor reading 0ml/min
Solution: If the flow sensor reads 0 or some other stabile number that does not correspond to actual water flow out the controller likely the flow sensor has been damaged. The flow sensor is very susceptible to damage from freezing. To repair the HPT flow sensor contact Geoprobe-DI technical support.

Problem: EC won't pass the QA tests.
Solution: Check the trunkline to probe EC connections ensuring they are tight. Run the troubleshooting tests (Section 5.3A), test EC on a new probe. If multiple probes and trunklines do not pass EC isolate the FI6000 instrument using the EC bypass cable (204025). The bypass cable is a six inch long cable that connects between the Test input and the EC probe connections on the back of the FI6000. Once connected start an EC or HPT log and fail the EC test load tests on purpose and run the EC troubleshooting tests (Figure 5.5). If the EC calibration or the EC continuity readings fail there could be an issue in the FI6000. In this case contact Geoprobe-DI technical support. If all of the troubleshooting tests pass then the problem is not in the instrument but in the trunkline, probe or their connections.

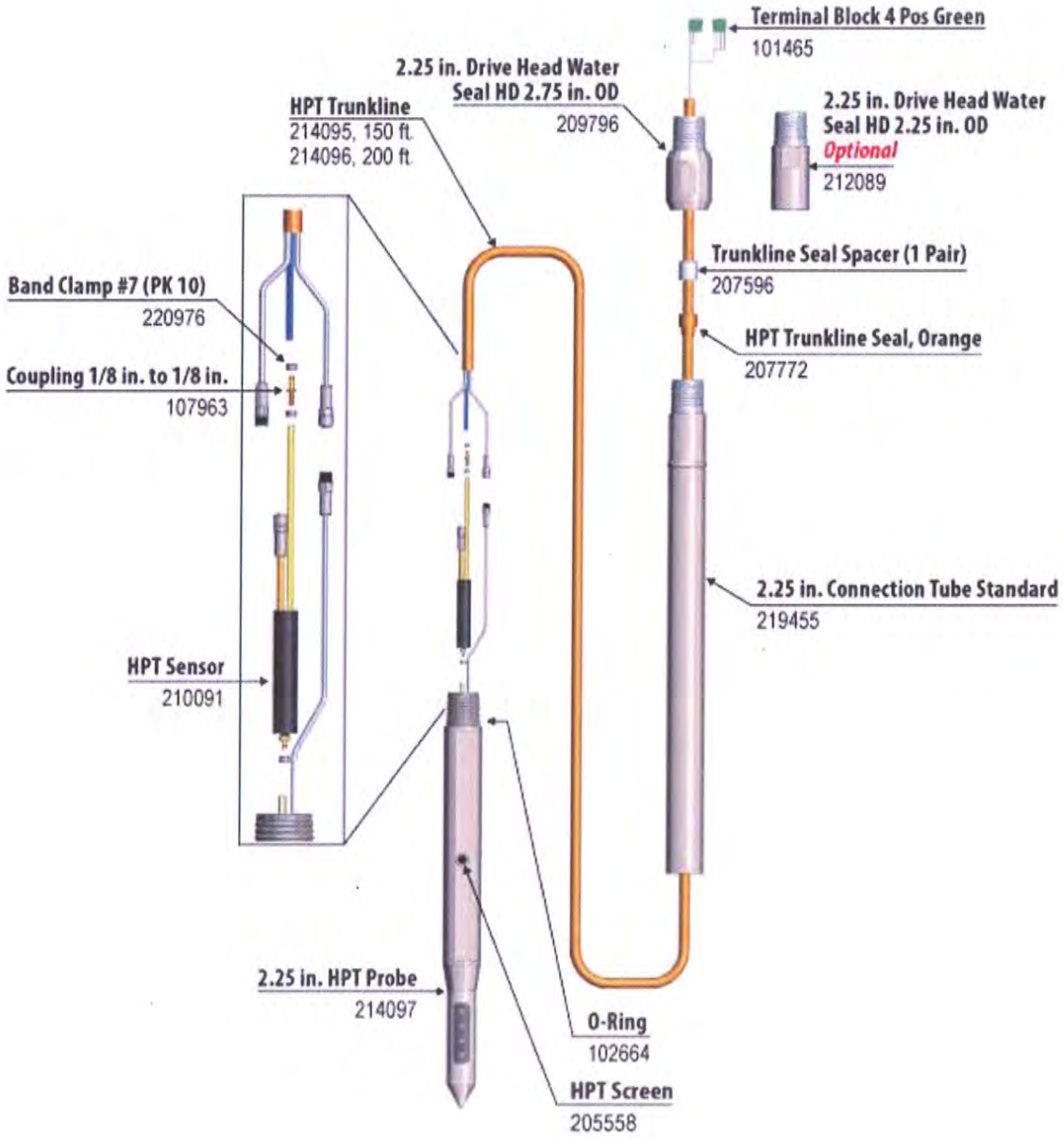
APPENDIX I

HPT Tool Configurations

HPT – K6050 (1.5 in / 1.75 in. system)



HPT – K8050 (2.25 in. system)



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Technical Memorandum

To:	Ching-Pi Wang Site Manager Washington State Department of Ecology
From:	Claudia De La Via and Dan Baker
Date:	December 19, 2016
File:	0186-846-01
Subject:	Gas Works Park Site Play Area Injection Infrastructure Groundwater Monitoring Well Network

Gas Works Park Site (GWPS) Play Area injection infrastructure installation is being planned in conjunction with Seattle Parks and Recreation (SPR) renovations at the Gas Works Park Play Area. Infrastructure installation is planned before substantial renovation begins within the Play Area footprint. The proposed Play Area injection infrastructure was described in the August 18, 2016, *Technical Memorandum*[1] (Tech Memo). This memorandum was prepared on behalf of Puget Sound Energy (PSE) and the City of Seattle (City), and presents the layout of the injection infrastructure and the location of monitoring wells proposed to evaluate system performance, and monitor groundwater conditions upgradient and downgradient of the system.

BACKGROUND

SPR will be conducting a maintenance project at Gas Works Park. Maintenance work or renovations will be completed in the Play Area, Comfort Station, and East Entry areas. PSE and the City propose to install injection infrastructure for testing and possible future groundwater treatment in conjunction with the Play Area renovation. This is a time-critical action as once Play Area renovation work is completed, access to the arsenic impacted soil and groundwater beneath the Play Area will not be possible without disturbing the newly renovated Play Area. The Tech Memo described supplemental investigation activities intended to refine the characterization of dissolved arsenic impacts to groundwater in the Play Area and inform the design of the injection infrastructure. The field work and analyses for the supplemental investigation were completed during September and October 2016, in accordance with the Sampling and Analysis Plan and Quality Assurance Project Plan Addendum No. 2, included as Attachment 1 of the Tech Memo. A summary of the general findings of the investigation is presented below. A Supplemental Investigation Data Report summarizing the investigation activities will be provided to Washington State Department of Ecology (Ecology).

Ecology's August 31, 2016, letter approving supplemental investigation and infrastructure installation requested the opportunity to review proposed monitoring well locations once they have been determined. Proposed monitoring well locations were provided to Ecology in a draft version of this memo on November 30, 2016. Ecology provided comments on December 5, 2016. GeoEngineers, Inc. (GeoEngineers) discussed monitoring well location revisions with Ecology and revised well locations were verified in the field with Ecology on December 14, 2016.

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[1] *Supplemental Play Area Investigation and Treatment Infrastructure Construction*, GeoEngineers, August 18, 2016.

PLAY AREA INVESTIGATION FINDINGS

The supplemental Play Area investigations in 2014 and 2016 involved soil and/or groundwater sampling at borings in more than 30 locations to characterize arsenic concentrations in soil and dissolved arsenic concentrations in groundwater, as well as characterize geochemical conditions that may impact possible future treatment of groundwater (e.g., pH, iron and sulfide concentrations). Borings were completed using direct-push drilling methods where possible. In locations where direct-push methods were unable to achieve the planned sample depth, sonic drilling methods were used to complete the planned borings. Figure 1 presents the locations of the soil borings.

Temporary pre-packed well screens were installed in soil borings to allow collection of grab groundwater samples. Groundwater samples were collected from the saturated fill and outwash units and analyzed for dissolved arsenic, dissolved iron, sulfide, and chemical oxygen demand (COD). In addition, field measurements of pH, dissolved oxygen, specific conductance and turbidity were collected during the supplemental investigation. Figure 2 presents the dissolved arsenic concentrations in fill groundwater samples. Dissolved arsenic concentrations detected in fill groundwater samples collected during the 2016 supplemental investigation ranged from 140 micrograms per liter (µg/L) to 10,500 µg/L. Figure 3 presents the dissolved arsenic concentrations in outwash groundwater samples. Dissolved arsenic concentrations detected in outwash groundwater samples collected during the 2016 supplemental investigation ranged from 39 µg/L to 23,400 µg/L. Non-aqueous phase liquid (NAPL) was observed in borings; NAPL was known to be present in the area from previous investigations (see Figures 8-8 and 8-9 in *Agency Review Draft Remedial Investigation/Feasibility Study Volume I: Remedial Investigation Report*). Additional details of the groundwater sample analyses will be provided to Ecology in a forthcoming data summary report.

The Play Area supplemental investigation included five hydraulic profiling tool (HPT) borings to estimate hydraulic conductivity in fill and outwash soil. HPT borings and resulting hydraulic conductivity estimates were used to support the flow analysis for reagent injection and design of the injection infrastructure layout. The HPT boring locations are presented on Figure 1.

INJECTION AND GROUNDWATER MONITORING WELL NETWORK LAYOUT

Based on the results of analysis of groundwater chemistry data, HPT data, and geology observed at the soil borings, the layout of the reagent injection well system presented in the Tech Memo was refined, and a monitoring well network was developed to allow sampling to evaluate the performance of possible future in-situ treatment. The anticipated injection well system includes 22 injection wells screened in the fill unit and 13 injection wells screened in the outwash unit. The injection wells will be connected below grade to conveyance piping trenched to utility vaults located outside the Play Area footprint to allow injection from outside the Play Area after the Play Area renovation is complete. Figures 4 and 5 present the anticipated layout of the injection well system.

To evaluate the performance of the reagent injection, fifteen new monitoring wells will be installed. The proposed monitoring well network is presented on Figure 4 with the fill dissolved arsenic extent and Figure 5 with the outwash dissolved arsenic extent. Rationale for each well is presented in Table 1. The proposed monitoring wells will be installed using hollow-stem auger or sonic drilling methods, depending on the presence of subsurface debris that may inhibit hollow-stem auger drilling. Monitoring wells will be completed with 2-inch

diameter polyvinyl chloride (PVC) well casing and screen with flush-mount monuments, similar to other wells installed at the GWPS. Well installation will be consistent with the Sampling and Analysis Plan (Appendix A) of the March 13, 2013, *Supplemental Investigation Work Plan*. The 15 new monitoring wells in combination with two existing wells (MW-36S and MW-36D) (Table 1) will provide a 17-well monitoring network consisting of:

- Nine performance monitoring wells located within the expected area of influence of possible future in-situ treatment (six wells screened in the fill unit and three wells screened in the outwash unit),
- Two upgradient monitoring wells (one well screened in the fill unit and one well screened in the outwash unit), and
- Six downgradient monitoring wells near the shoreline (two wells screened in the fill unit and four wells screened in the outwash unit).

NEXT STEPS

Completion of the injection infrastructure is a time-critical action as, once Play Area renovation work is completed, access to the arsenic impacted groundwater beneath the Play Area will not be possible without disturbing the newly renovated Play Area. Installation of the injection infrastructure and monitoring well network is expected to start in January 2017 and anticipated to take approximately 6 weeks. Monitoring wells will be installed following injection well installation. After injection infrastructure and monitoring well installation are complete, an Interim Action Work Plan (work plan) will be prepared to present operating procedures including the selected reagent, and the proposed monitoring plan to evaluate system performance. The work plan will include a proposed schedule for reagent injection and monitoring and will specify analyses and analytical methods for groundwater monitoring. The work plan will be submitted to Ecology for approval before system operation begins.

Attachments:

Figure 1. Site Plan

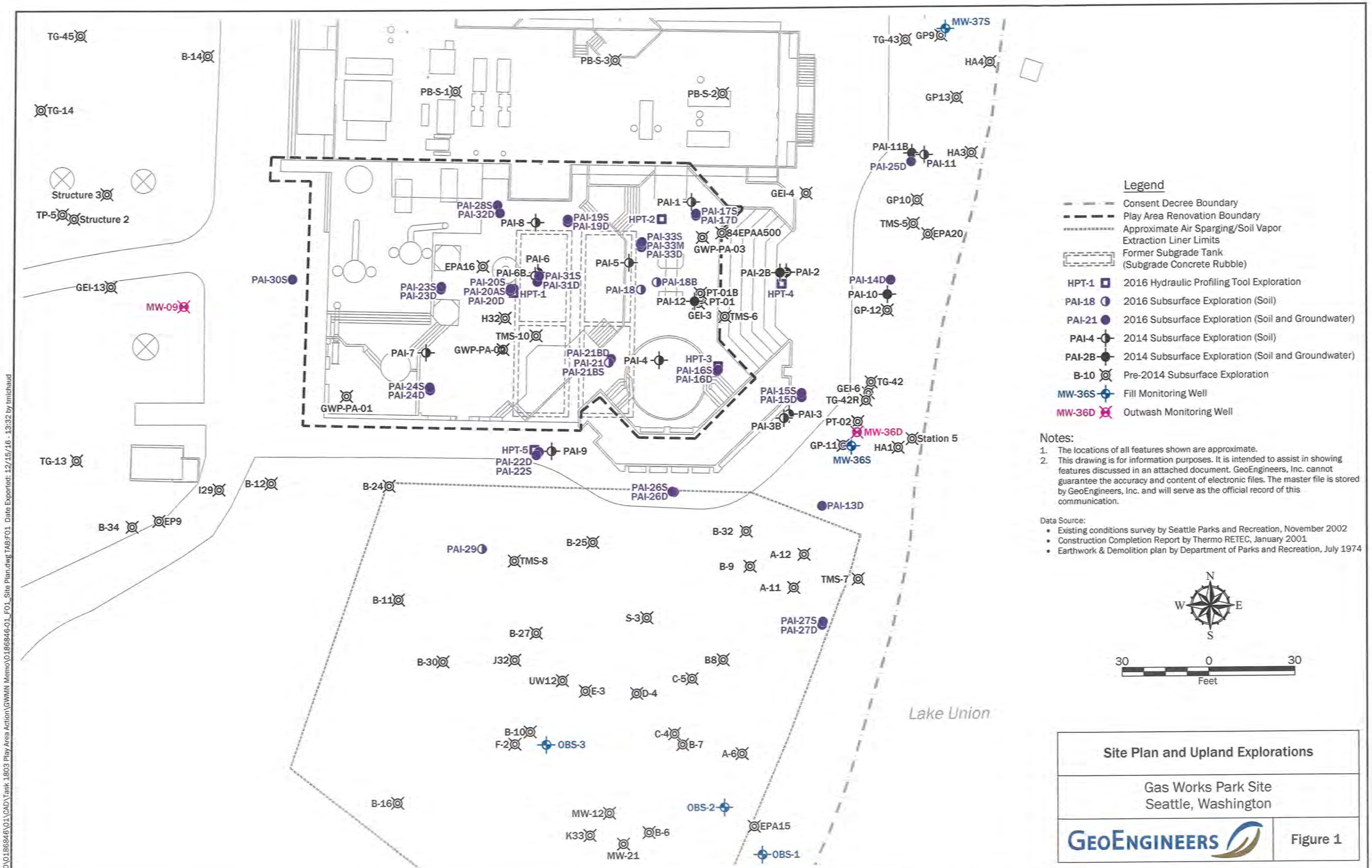
Figure 2. Fill Dissolved Arsenic

Figure 3. Outwash Dissolved Arsenic

Figure 4. Proposed Injection Infrastructure and Monitoring Well Network—Fill Dissolved Arsenic

Figure 5. Proposed Injection Infrastructure and Monitoring Well Network—Outwash Dissolved Arsenic

Table 1. Proposed Play Area Groundwater Monitoring Network



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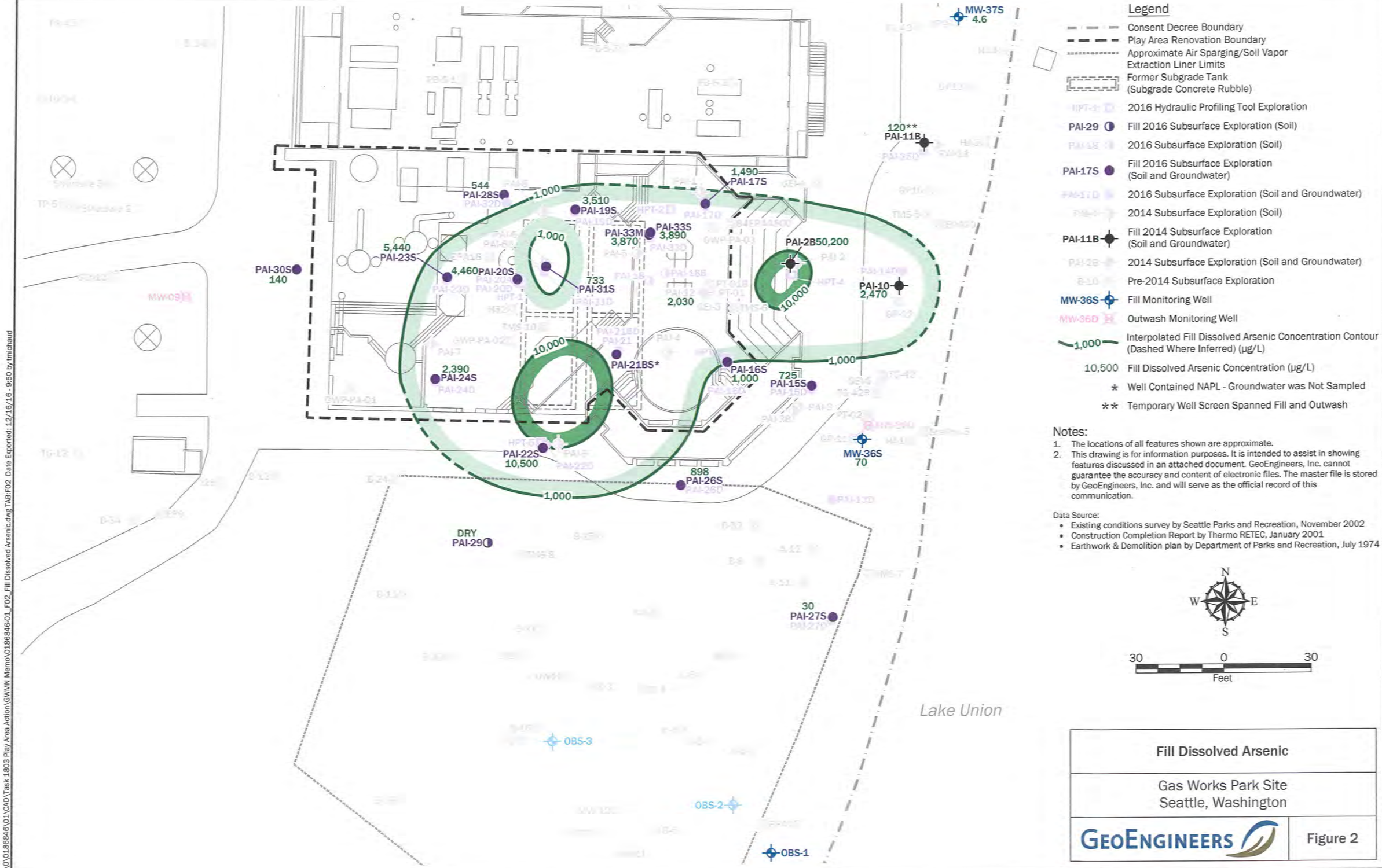

Legend

- Consent Decree Boundary
- Play Area Renovation Boundary
- Approximate Air Sparging/Soil Vapor Extraction Liner Limits
- Former Subgrade Tank (Subgrade Concrete Rubble)
- 2016 Hydraulic Profiling Tool Exploration
- PAI-29 — Fill 2016 Subsurface Exploration (Soil)
- 2016 Subsurface Exploration (Soil)
- PAI-17S — Fill 2016 Subsurface Exploration (Soil and Groundwater)
- 2016 Subsurface Exploration (Soil and Groundwater)
- 2014 Subsurface Exploration (Soil)
- PAI-11B — Fill 2014 Subsurface Exploration (Soil and Groundwater)
- 2014 Subsurface Exploration (Soil and Groundwater)
- Pre-2014 Subsurface Exploration
- MW-36S — Fill Monitoring Well
- MW-36D — Outwash Monitoring Well
- 1,000 — Interpolated Fill Dissolved Arsenic Concentration Contour (Dashed Where Inferred) (µg/L)
- 10,500 — Fill Dissolved Arsenic Concentration (µg/L)
- * Well Contained NAPL - Groundwater was Not Sampled
- ** Temporary Well Screen Spanned Fill and Outwash

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source:

- Existing conditions survey by Seattle Parks and Recreation, November 2002
- Construction Completion Report by Thermo RETEC, January 2001
- Earthwork & Demolition plan by Department of Parks and Recreation, July 1974

N W E S

30 0 30
Feet

Fill Dissolved Arsenic

Gas Works Park Site
Seattle, Washington

GeoEngineers | Figure 2

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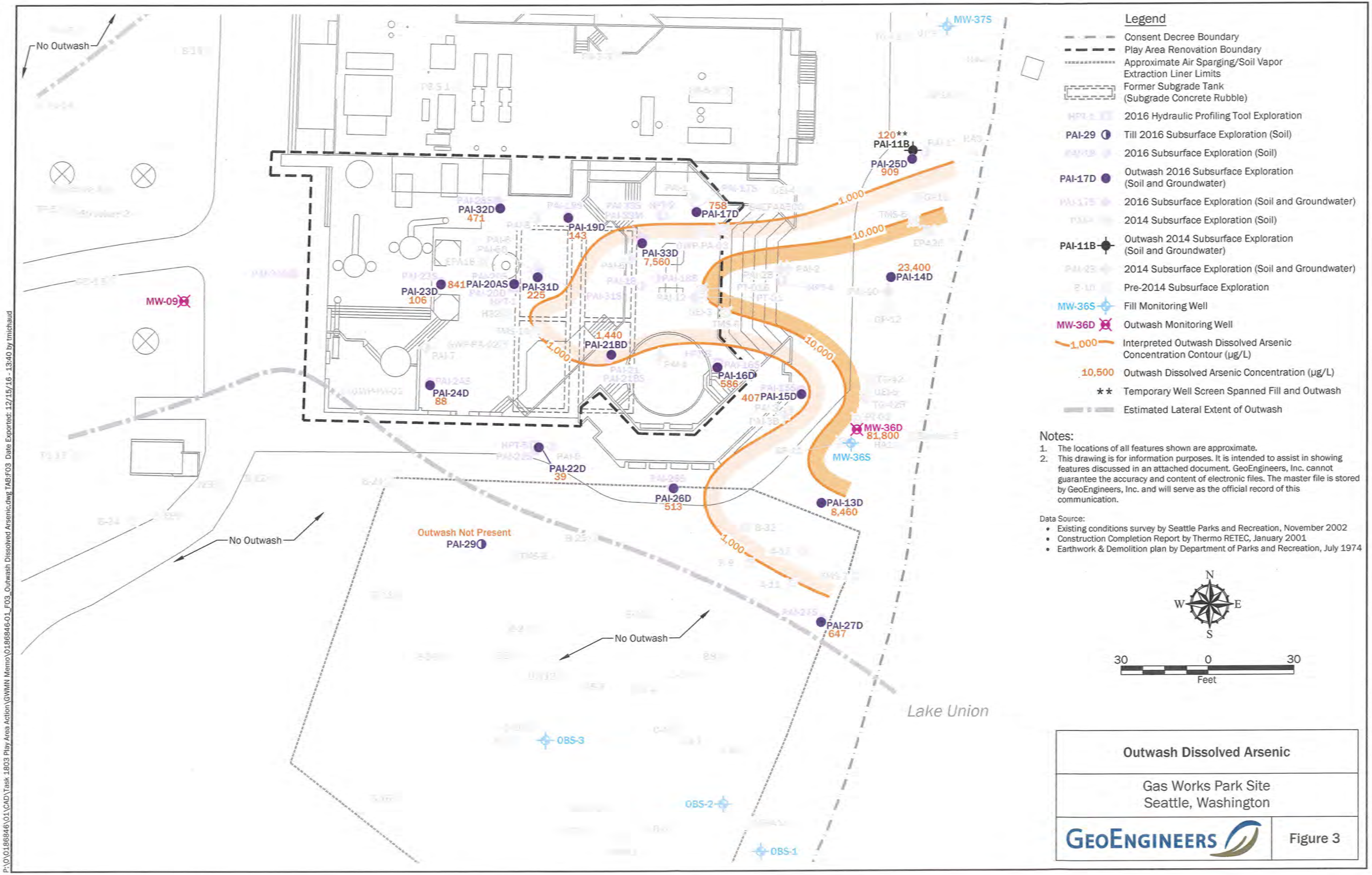

Legend

- Consent Decree Boundary
- Play Area Renovation Boundary
- Approximate Air Sparging/Soil Vapor Extraction Liner Limits
- Former Subgrade Tank (Subgrade Concrete Rubble)
- 2016 Hydraulic Profiling Tool Exploration
- PAI-29 — Till 2016 Subsurface Exploration (Soil)
- 2016 Subsurface Exploration (Soil)
- PAI-17D — Outwash 2016 Subsurface Exploration (Soil and Groundwater)
- 2016 Subsurface Exploration (Soil and Groundwater)
- 2014 Subsurface Exploration (Soil)
- PAI-11B — Outwash 2014 Subsurface Exploration (Soil and Groundwater)
- 2014 Subsurface Exploration (Soil and Groundwater)
- Pre-2014 Subsurface Exploration
- MW-36S — Fill Monitoring Well
- MW-36D — Outwash Monitoring Well
- 1,000 — Interpreted Outwash Dissolved Arsenic Concentration Contour (µg/L)
- 10,500 — Outwash Dissolved Arsenic Concentration (µg/L)
- ** — Temporary Well Screen Spanned Fill and Outwash
- Estimated Lateral Extent of Outwash

Notes:

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- Earthwork & Demolition plan by Department of Parks and Recreation, July 1974

N W E S

30 0 30
Feet

Outwash Dissolved Arsenic

Gas Works Park Site
Seattle, Washington

GeoEngineers

Figure 3

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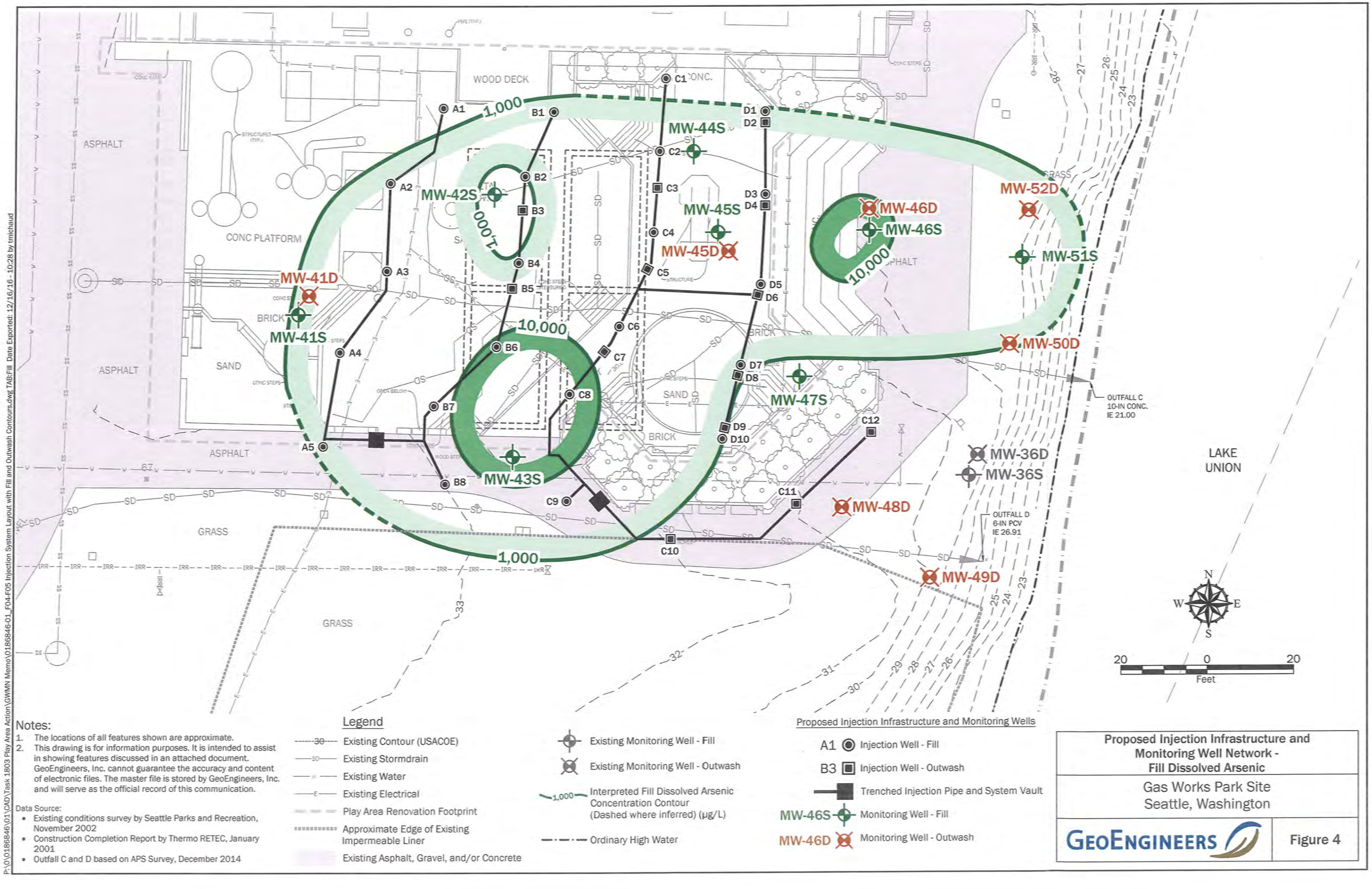

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Data Source:

- Existing conditions survey by Seattle Parks and Recreation, November 2002
- Construction Completion Report by Thermo RETEC, January 2001
- Outfall C and D based on APS Survey, December 2014

Legend

- 30 — Existing Contour (USACOE)
- SD — Existing Stormdrain
- W — Existing Water
- E — Existing Electrical
- Play Area Renovation Footprint
- Approximate Edge of Existing Impermeable Liner
- Existing Asphalt, Gravel, and/or Concrete
- Existing Monitoring Well - Fill
- Existing Monitoring Well - Outwash
- 1,000 — Interpreted Fill Dissolved Arsenic Concentration Contour (Dashed where inferred) (µg/L)
- Ordinary High Water

Proposed Injection Infrastructure and Monitoring Wells

- A1 — Injection Well - Fill
- B3 — Injection Well - Outwash
- Trenched Injection Pipe and System Vault
- MW-46S — Monitoring Well - Fill
- MW-46D — Monitoring Well - Outwash

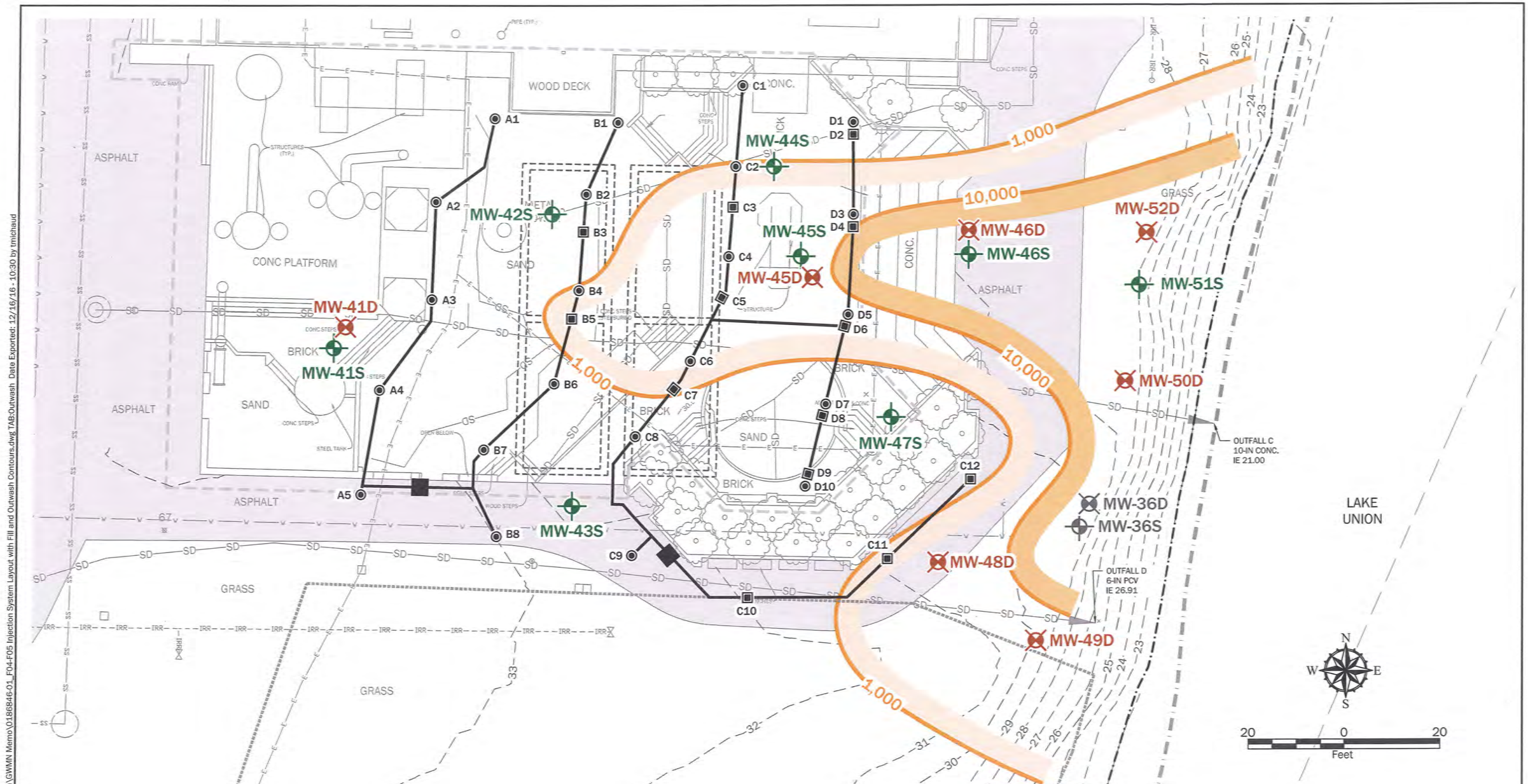
Proposed Injection Infrastructure and Monitoring Well Network - Fill Dissolved Arsenic

Gas Works Park Site
Seattle, Washington

GeoEngineers

Figure 4

P:\0\0186846\01\CAD\Task 1803 Play Area Action\GWMN Memo\0186846-01_F04-F05 Injection System Layout with Fill and Outwash Contours.dwg TAB:Fill Date Exported: 12/16/16 - 10:28 by tmichaud



Notes:

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2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source:

- Existing conditions survey by Seattle Parks and Recreation, November 2002
- Construction Completion Report by Thermo RETEC, January 2001
- Outfall C and D based on APS Survey, December 2014

Legend

- Existing Contour (NAVD88)
- Existing Stormdrain
- Existing Water
- Existing Electrical
- Play Area Renovation Footprint
- Approximate Edge of Existing Impermeable Liner
- Existing Asphalt, Gravel, and/or Concrete
- Existing Monitoring Well - Fill
- Existing Monitoring Well - Outwash
- Interpreted Outwash Dissolved Arsenic Concentration Contour (µg/L)
- Ordinary High Water

Proposed Injection Infrastructure and Monitoring Wells

- A1 Injection Well - Fill
- B3 Injection Well - Outwash
- Trenched Injection Pipe and System Vault
- MW-46S Monitoring Well - Fill
- MW-46D Monitoring Well - Outwash

Proposed Injection Infrastructure and Monitoring Well Network - Outwash Dissolved Arsenic

Gas Works Park Site
Seattle, Washington

GeoEngineers

Figure 5

P:\0\0186846\01\CAD\Task 1803 Play Area Action\GWMN Memo\0186846-01_F04-F05 Injection System Layout with Fill and Outwash Contours.dwg TAB:Outwash Date Exported: 12/16/16 - 10:30 by tmichaud

Table 1

Proposed Play Area Groundwater Monitoring Network

Gas Works Park Site
Seattle, Washington

No.	Well ID	Unit	Type	Purpose/Rationale
1	MW-36S	Fill	Downgradient	Part of existing shoreline network to monitor groundwater quality downgradient of Play Area injection system. Sampling optional.
2	MW-36D	Outwash	Downgradient	Part of existing shoreline network to monitor groundwater quality downgradient of Play Area injection system.
3	MW-41S	Fill	Upgradient	Characterize groundwater entering the treatment area. Upgradient of injection wells to avoid treatment effects.
4	MW-41D	Outwash	Upgradient	Characterize groundwater entering the treatment area. Upgradient of injection wells to avoid treatment effects.
5	MW-42S	Fill	Performance	Monitor groundwater within treatment area downgradient of injection lateral A.
6	MW-43S	Fill	Performance	Monitor groundwater within treatment area downgradient of injection lateral B.
7	MW-44S	Fill	Performance	Monitor groundwater within treatment area downgradient of injection lateral C – closer to injection well.
8	MW-45S	Fill	Performance	Monitor groundwater within treatment area downgradient of injection lateral C – farther from injection well.
9	MW-45D	Outwash	Performance	Monitor groundwater within treatment area downgradient of injection lateral C.
10	MW-46S	Fill	Performance	Monitor groundwater near downgradient edge of treatment area along plume centerline (higher concentration area).
11	MW-46D	Outwash	Performance	Monitor groundwater near downgradient edge of treatment area along plume centerline.
12	MW-47S	Fill	Performance	Monitor groundwater within treatment area downgradient of injection lateral D south of plume centerline (lower concentration area).
13	MW-48D	Outwash	Performance	Monitor groundwater within treatment area downgradient of injection laterals C and D.
14	MW-49D	Outwash	Downgradient	Part of shoreline network to monitor groundwater quality downgradient of Play Area injection system – southern well.
15	MW-50D	Outwash	Downgradient	Part of shoreline network to monitor groundwater quality downgradient of Play Area injection system – central well.
16	MW-51S	Fill	Downgradient	Part of shoreline network to monitor groundwater quality downgradient of Play Area injection system and centerline of plume.
17	MW-52D	Outwash	Downgradient	Part of shoreline network to monitor groundwater quality downgradient of Play Area injection system – northern well.

Notes:

1. Monitoring well locations are shown on Figure 4 and 5.