

**South Park Landfill  
Remedial Investigation/  
Feasibility Study  
June 2014 Draft**

*Draft Document – Subject to Ecology Review and  
Revision*

**This draft document is being made available for information purposes  
only.**

**It does not constitute approval by the State of Washington Department  
of Ecology**

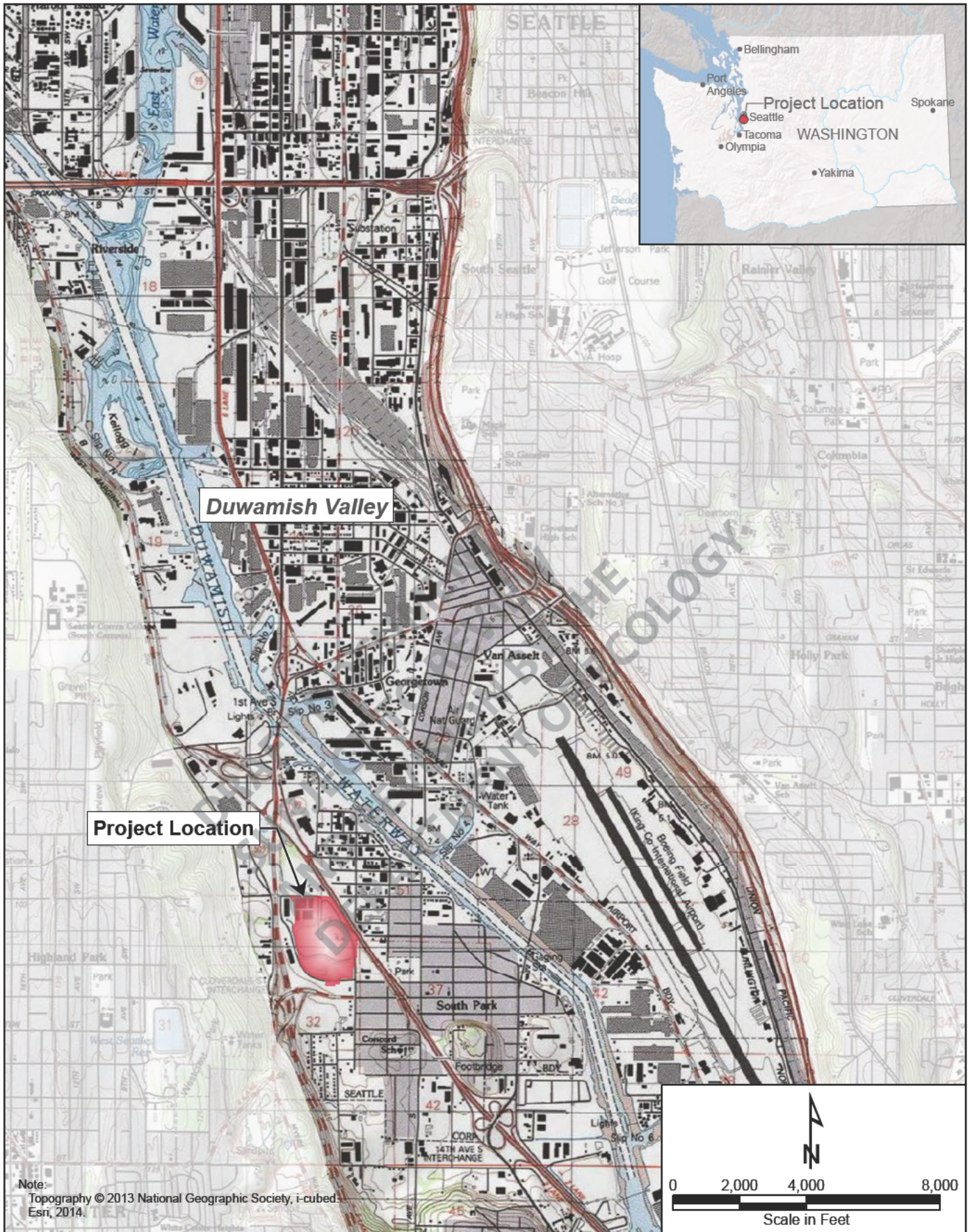
**South Park Landfill**

**Remedial Investigation/  
Feasibility Study**

**Figures**

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**Remedial Investigation/Feasibility Study**  
**South Park Landfill**  
**Seattle, Washington**

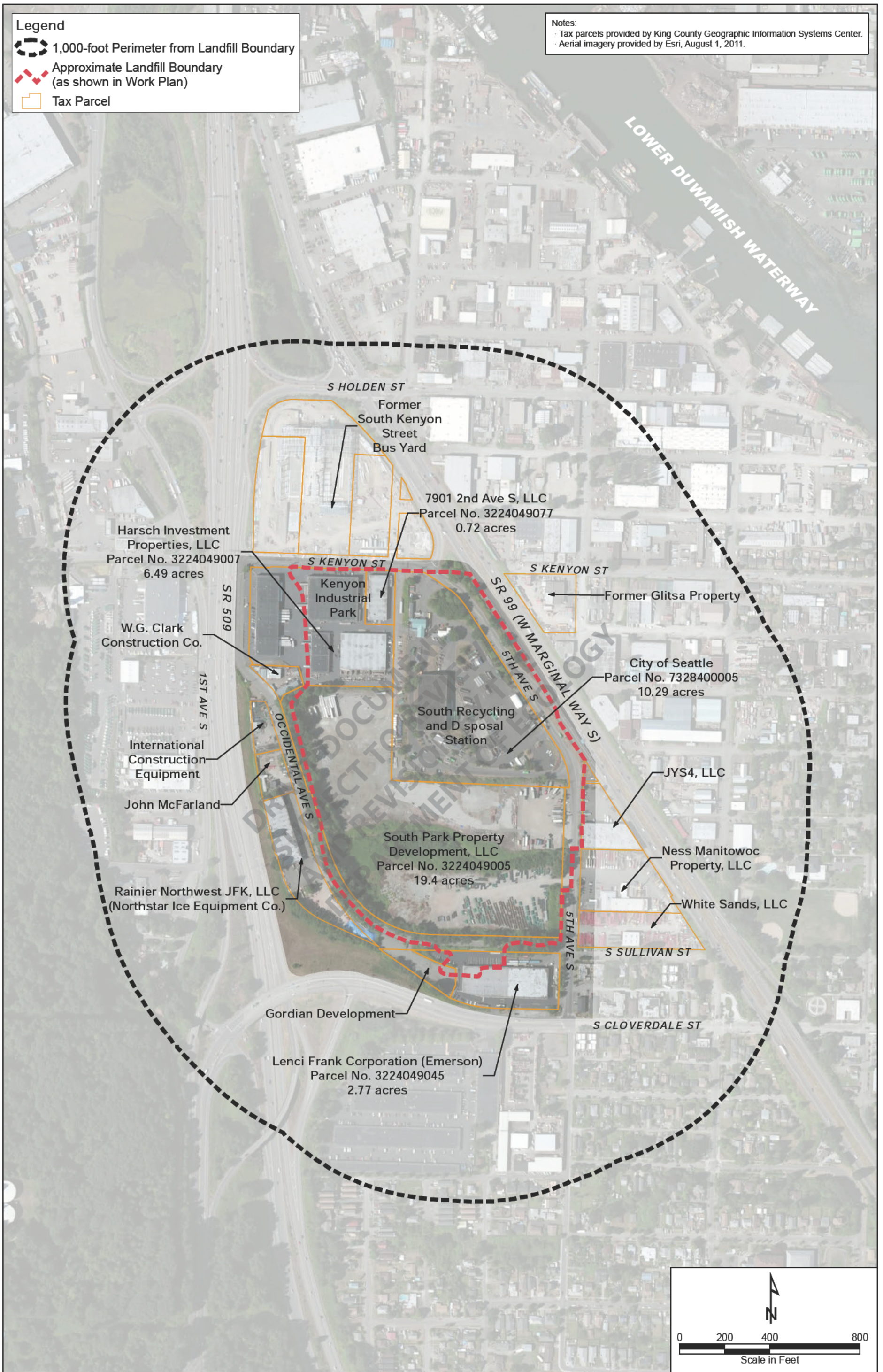
**Figure 2.1**  
**Site Location Map**

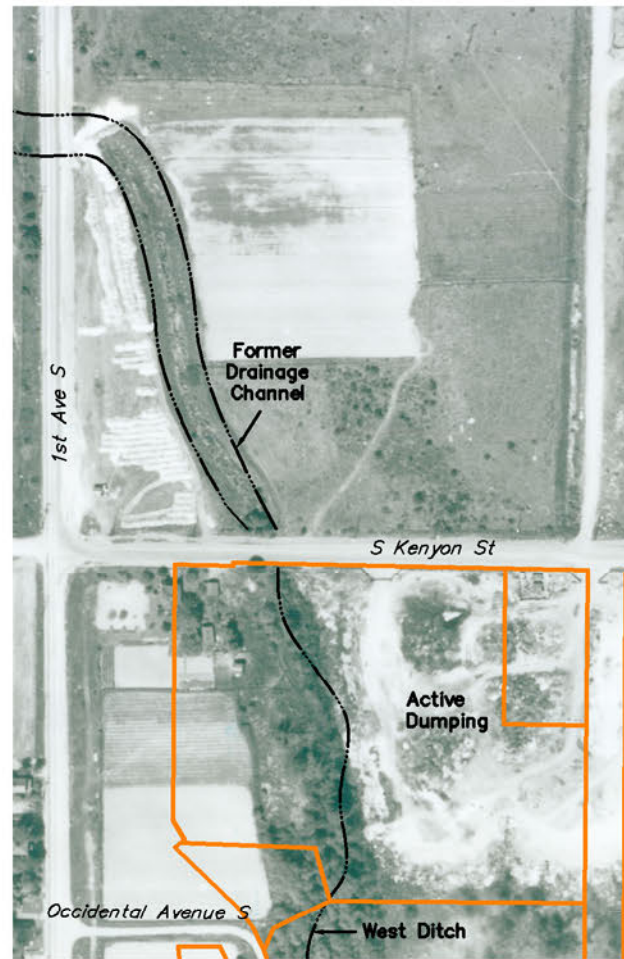
**Legend**

-  1,000-foot Perimeter from Landfill Boundary
-  Approximate Landfill Boundary (as shown in Work Plan)
-  Tax Parcel

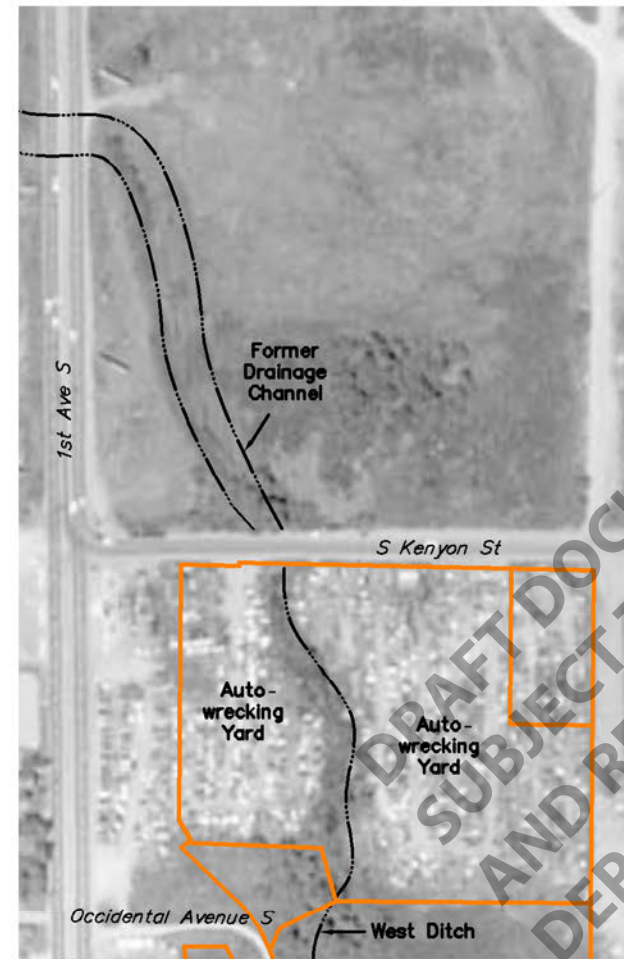
**Notes:**

- Tax parcels provided by King County Geographic Information Systems Center.
- Aerial imagery provided by Esri, August 1, 2011.

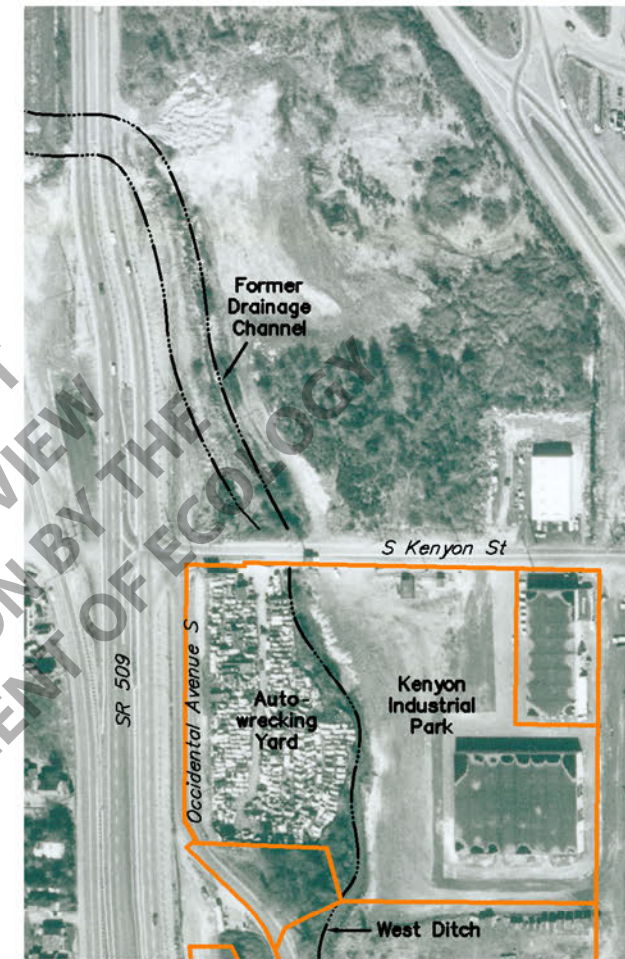




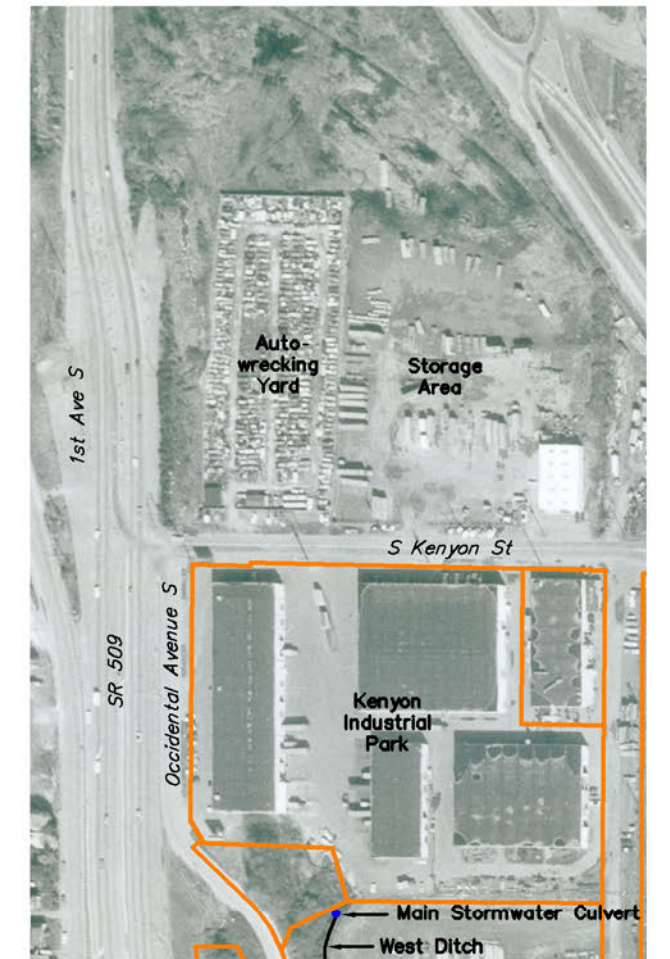
1946



1960



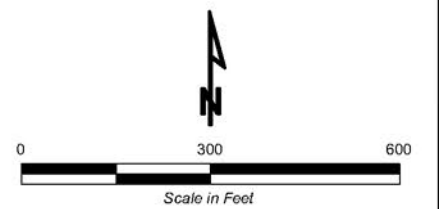
1969












1974

Tax Parcels 

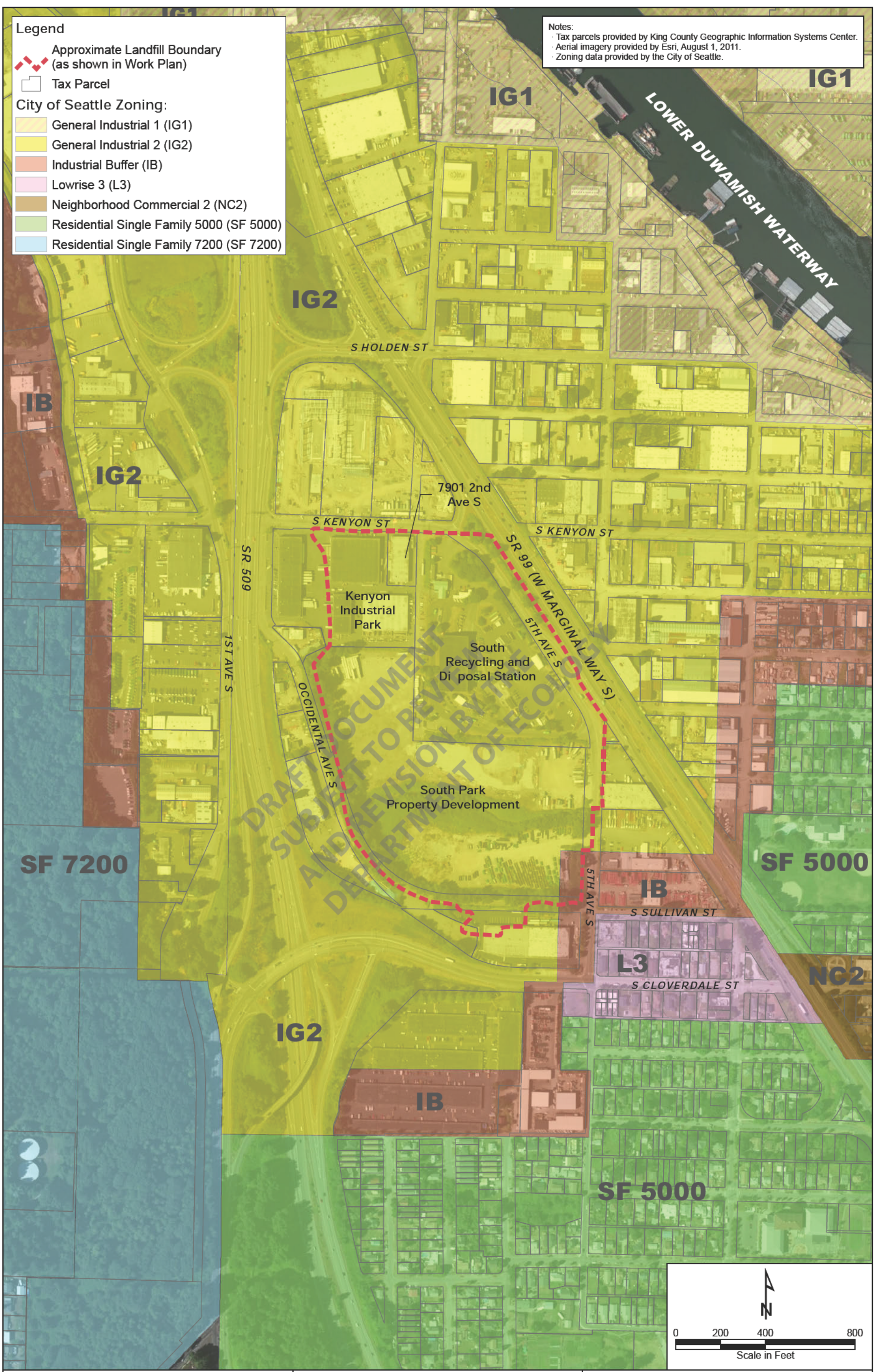
**Notes:**  
Tax Parcels provided by King County Geographic Information Systems Center.  
Aerial imagery provided by Seattle Public Utilities.



- Legend**
-  Approximate Landfill Boundary (as shown in Work Plan)
  -  Tax Parcel
  - City of Seattle Zoning:**
  -  General Industrial 1 (IG1)
  -  General Industrial 2 (IG2)
  -  Industrial Buffer (IB)
  -  Lowrise 3 (L3)
  -  Neighborhood Commercial 2 (NC2)
  -  Residential Single Family 5000 (SF 5000)
  -  Residential Single Family 7200 (SF 7200)

**Notes:**

- Tax parcels provided by King County Geographic Information Systems Center.
- Aerial imagery provided by Esri, August 1, 2011.
- Zoning data provided by the City of Seattle.





**Legend**

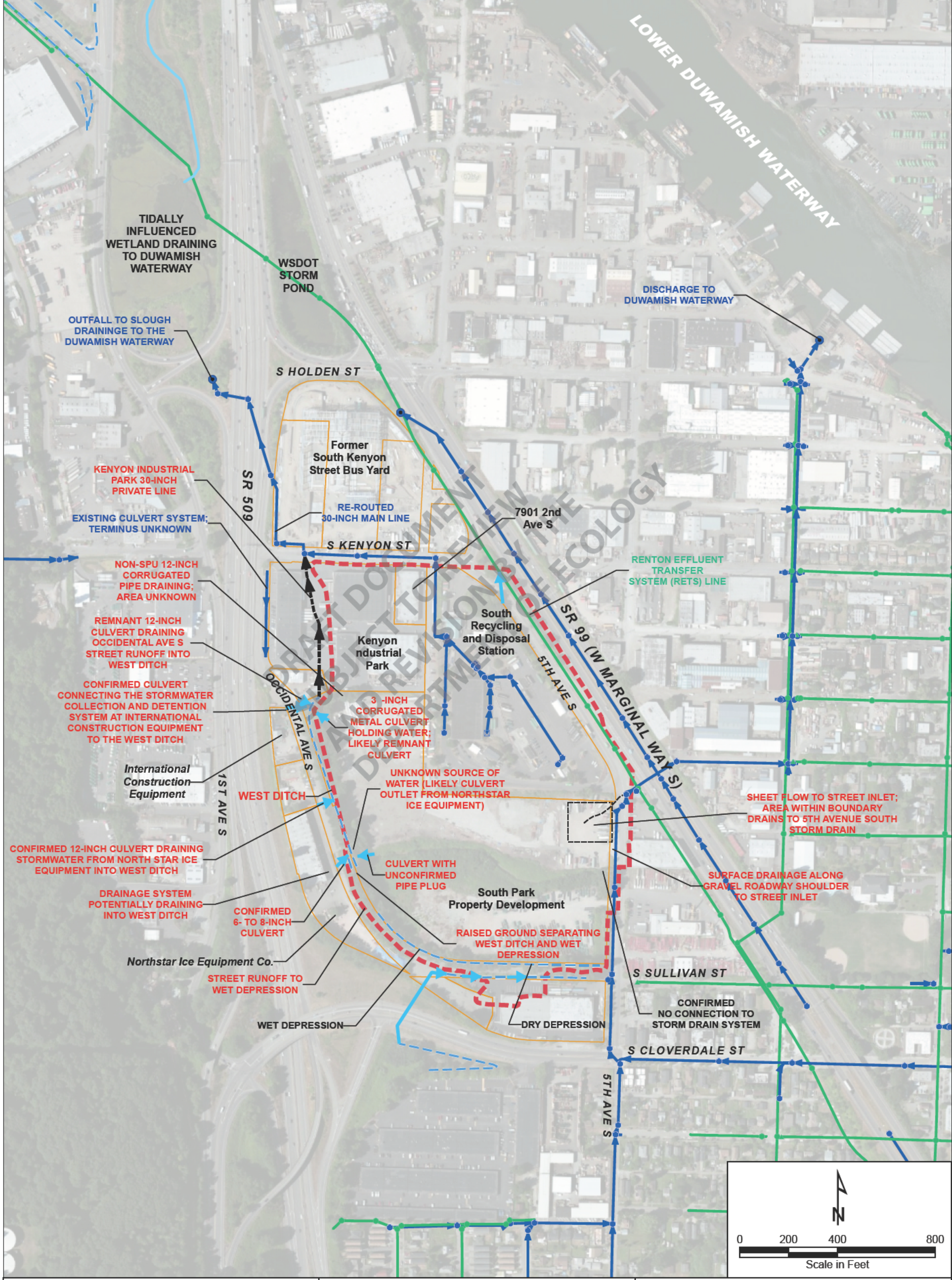
- Combined, Manhole
- ▲ Combined, Treatment Structure
- Storm, Manhole
- ⊠ Storm, Catch Basin
- Storm, Outfall
- ▭ Tax Parcel
- ▭ Approximate Landfill Boundary (as shown in Work Plan)
- Sheetflow
- Slough
- Culvert
- - - - Ditch
- Storm Main Line
- Combined Main Line

**Notes:**

- Stormwater and surface controls not associated directly with the Landfill site have been removed for clarity.
- Tax parcels provided by King County Geographic Information System Center.
- Aerial imagery provided by Esri, August 1, 2011.

**Abbreviations:**

- SPU - Seattle Public Utilities
- WSDOT - Washington State Department of Transportation



I:\GIS\Projects\COS-SPARK\MXD\RIFS\Fig 2\_06 Surface Water Drainages.mxd  
6/18/2014

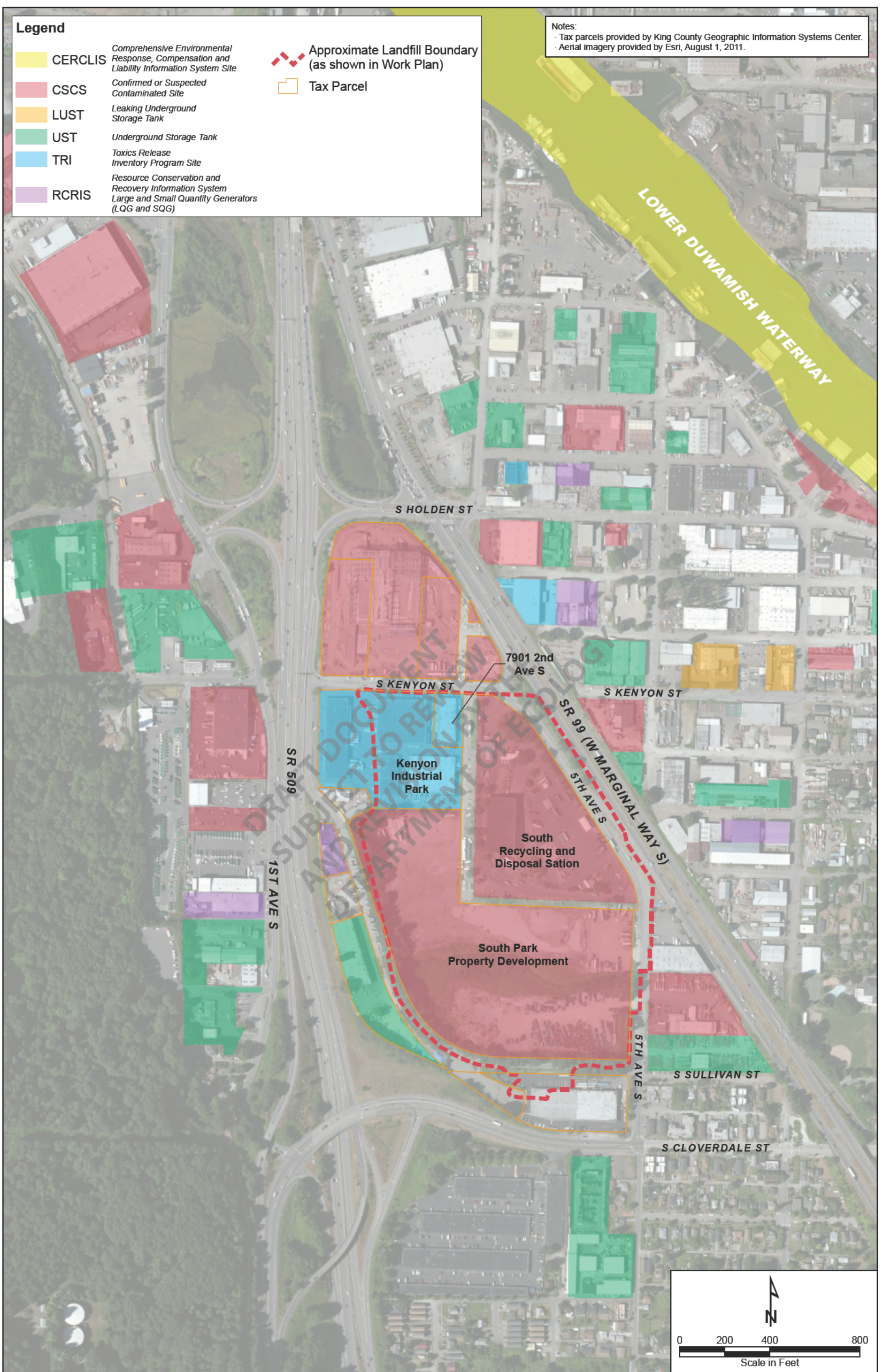


**Legend**

- CERCLIS *Comprehensive Environmental Response, Compensation and Liability Information System Site*
- CSCS *Confirmed or Suspected Contaminated Site*
- LUST *Leaking Underground Storage Tank*
- UST *Underground Storage Tank*
- TRI *Toxics Release Inventory Program Site*
- RCRIS *Resource Conservation and Recovery Information System Large and Small Quantity Generators (LQG and SQG)*

- Approximate Landfill Boundary (as shown in Work Plan)
- Tax Parcel

**Notes:**  
 - Tax parcels provided by King County Geographic Information Systems Center.  
 - Aerial imagery provided by Esri, August 1, 2011.



**Legend**

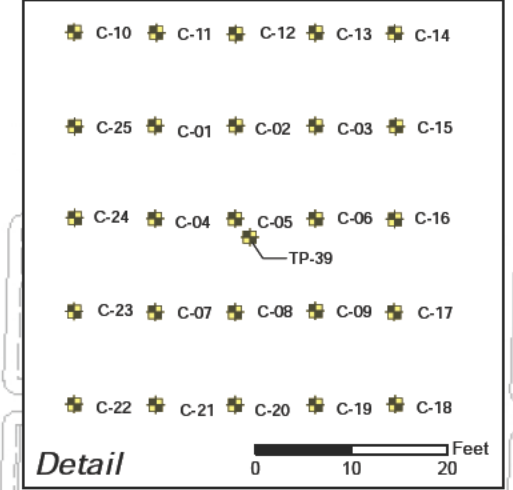
- Approximate Landfill Boundary (as shown in Work Plan)
- Monitoring Well: Lower Zone
- Monitoring Well: Upper Zone
- Decommissioned Monitoring Well
- Piezometer
- Decommissioned Piezometer
- Reconnaissance Groundwater Probe
- Gas Probe
- Reconnaissance Gas Probe
- Geotech Boring
- Soil Boring
- Surface Soil Sample Location
- Test Pit
- Surface Water Sample
- Deposited Soil Sample Location
- Tax Parcel

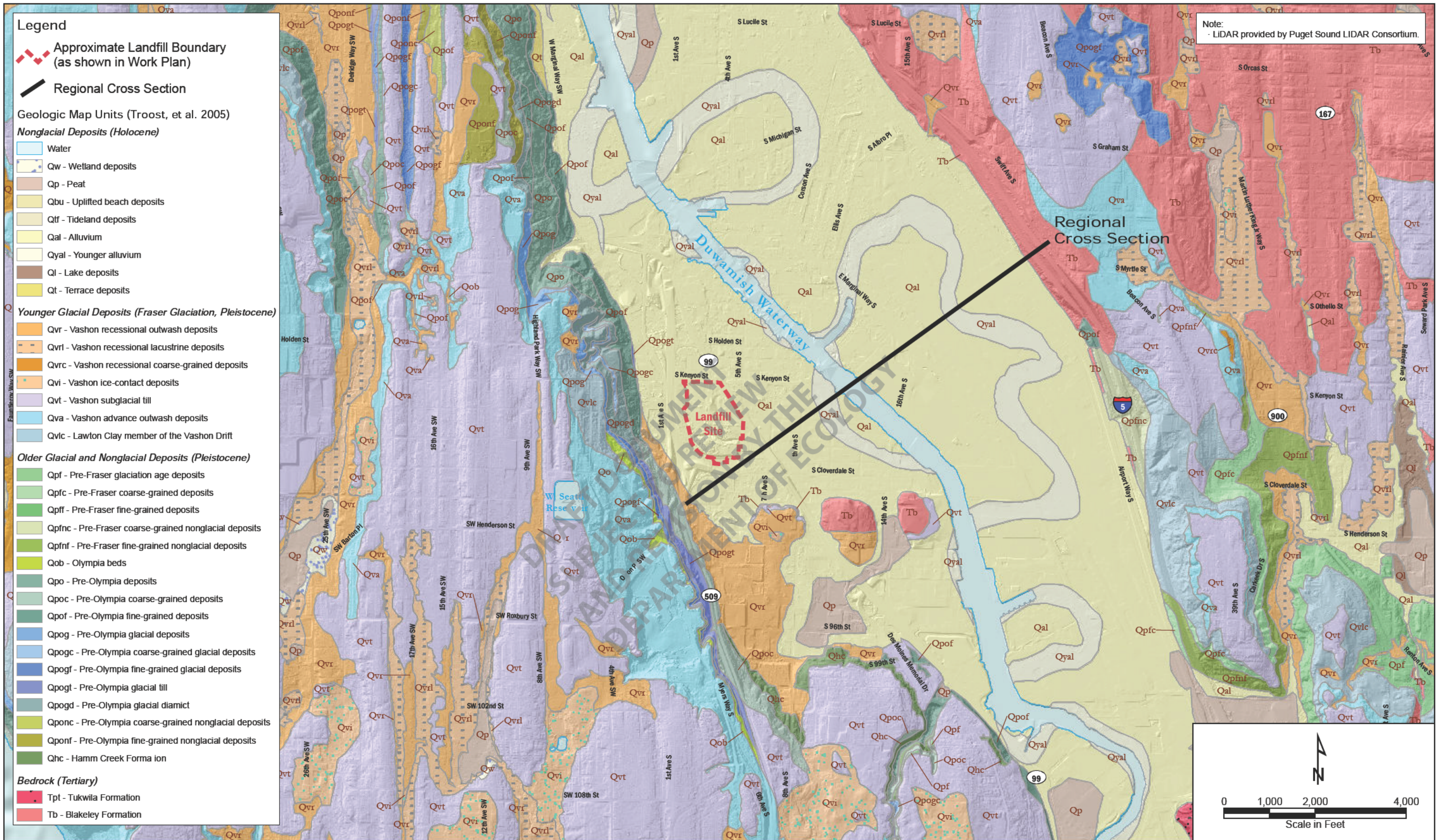
**Notes:**

- Tax parcels provided by King County Geographic Information Systems Center.
- A table summarizing the investigations in which the explorations were completed is provided in Appendix B.
- A description of the previous investigations is provided in Section 2.5 and summarized in Table 2.5.

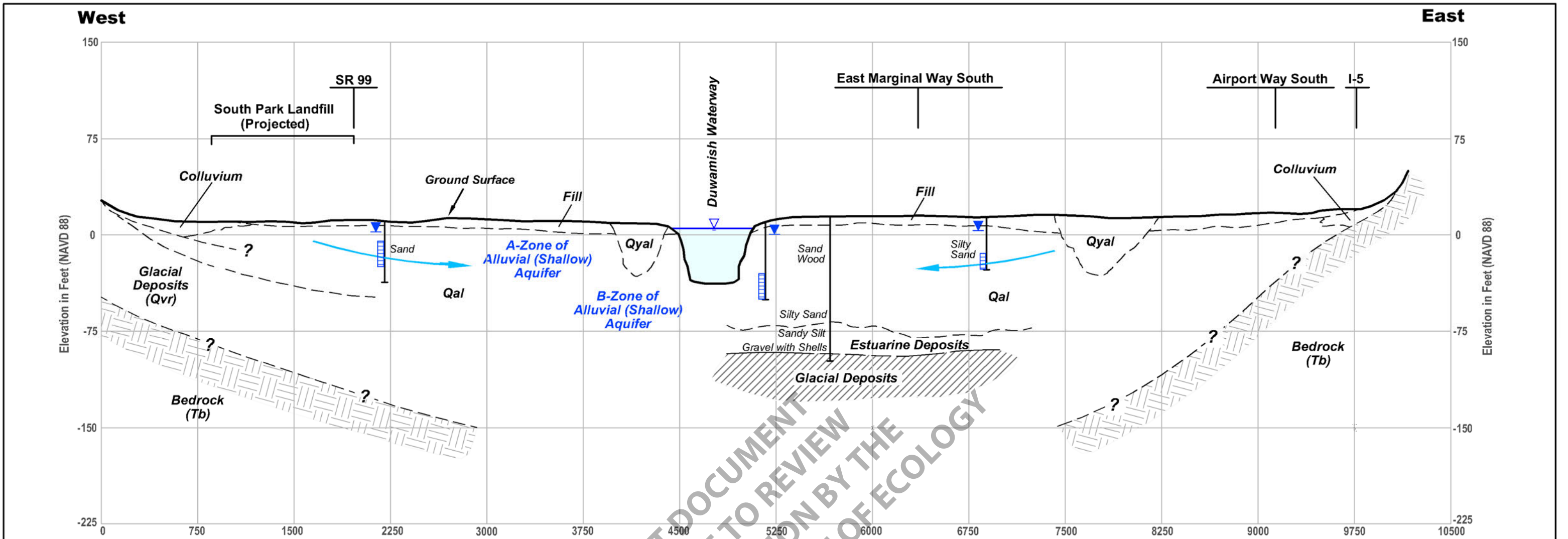
**Abbreviations:**

- KIP - Kenyon Industrial Park
- SPPD - South Park Property Development
- SRDS - South Recycling and Disposal Station





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5/11/2014



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**Legend**

**Non-glacial Deposits (Holocene)**

- Qyal** Younger Alluvium
- Qal** Alluvium

**Younger Glacial Deposits (Frasier Glaciation, Pleistocene)**

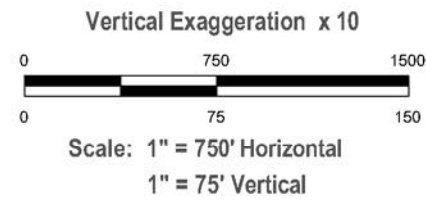
- Qvr** Vashon Recessional Outwash Deposits
- Undifferentiated Glacial Deposits

**Bedrock (Tertiary)**

- Tb** Blakeley Formation

**Well Completion Information**

- Well
- Surface Water Level
- Static Water Level
- Approximate Geologic Unit Contact
- Inferred Geologic Unit Contact
- Screen Interval
- Groundwater Flow



From the Duwamish Basin Groundwater Pathways Conceptual Model Report (Hart Crowser 1998)



Remedial Investigation/Feasibility Study  
South Park Landfill  
Seattle, Washington

Figure 3.2  
Regional Cross Section

Legend

Chapter 173-160 WAC Prohibitions:

- Landfill Boundary
- 1,000-foot Buffer
- FEMA Zone A  
(100-year flood, 1995 final)

MTCA Groundwater Quality:

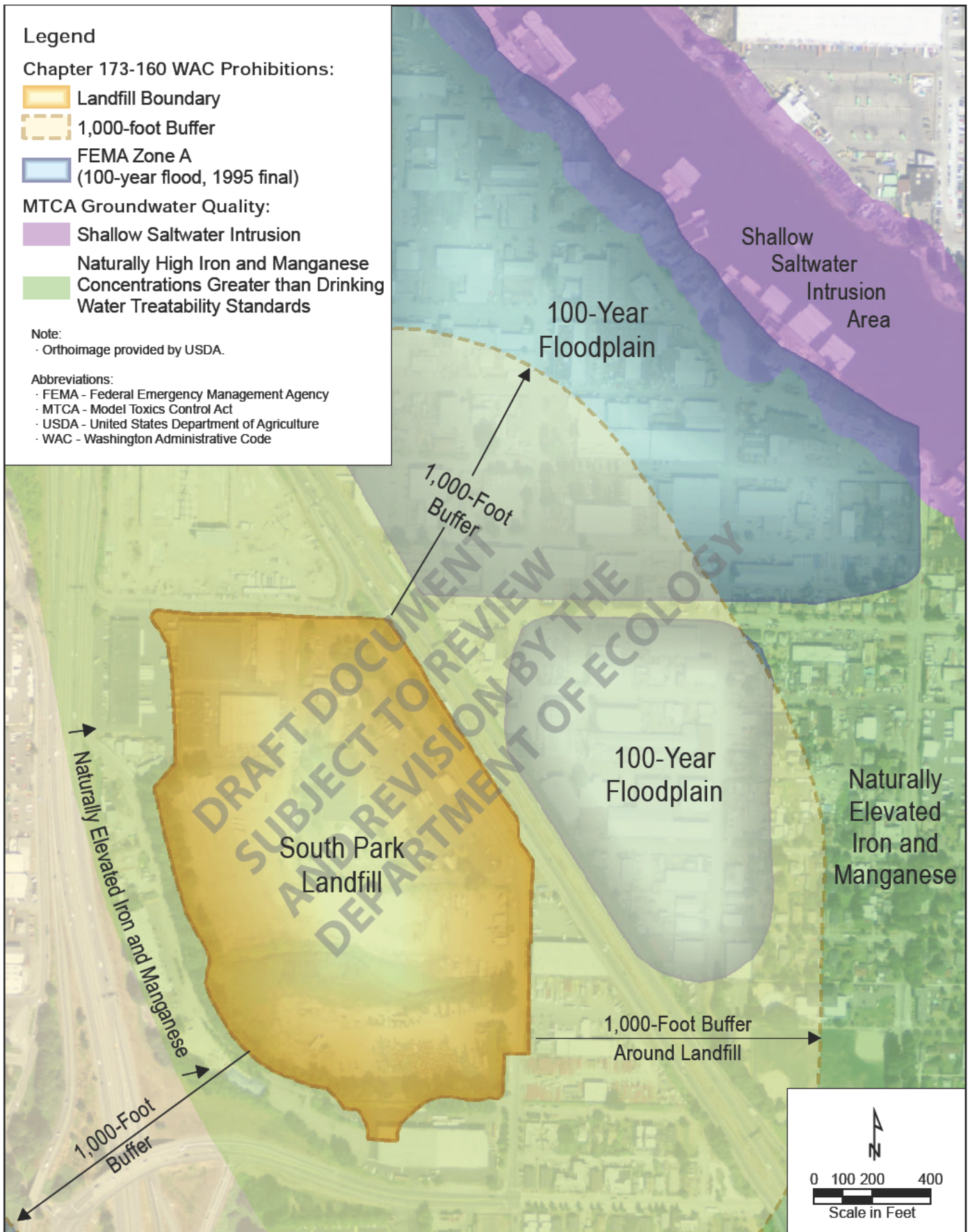
- Shallow Saltwater Intrusion
- Naturally High Iron and Manganese  
Concentrations Greater than Drinking  
Water Treatability Standards

Note:

- Orthoimage provided by USDA.

Abbreviations:

- FEMA - Federal Emergency Management Agency
- MTCA - Model Toxics Control Act
- USDA - United States Department of Agriculture
- WAC - Washington Administrative Code



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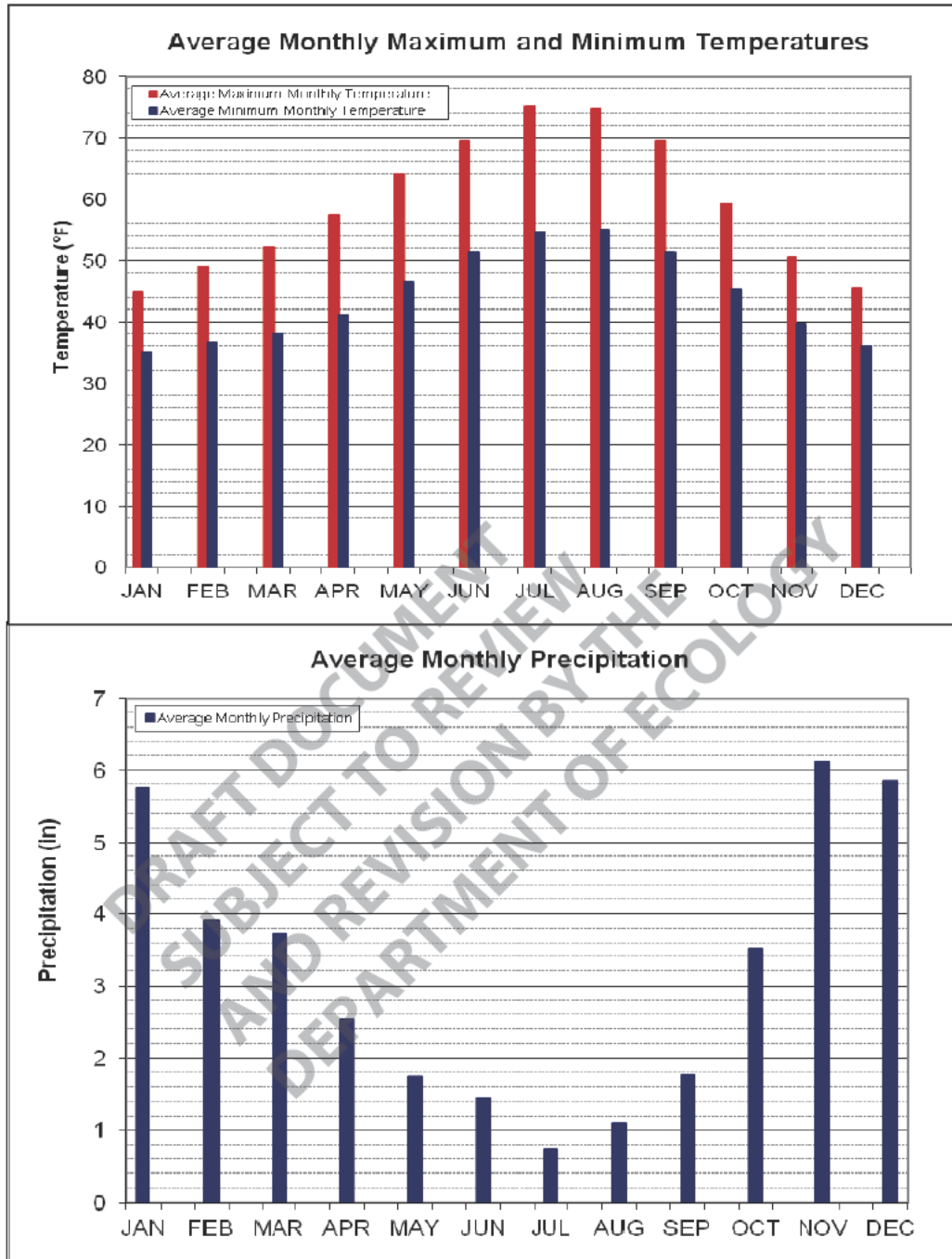
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South Park Landfill  
Seattle, Washington

Figure 3.3  
Groundwater  
Restrictions

**Figure 3.4**  
**Monthly Temperature and Precipitation Data**



**Notes:**

- Seattle monthly temperature and precipitation data from Seattle Tacoma International Airport (National Oceanic and Atmospheric Administration Station No. 457473).
- Individual months with more than 5 days of missing data were not used for either monthly or annual statistics.

**Legend**  
 Approximate Extent of Soild Waste  
 (based on Aerial Photographs provided  
 by Seattle Public Utilities; refer to Appendix A)

- 1936
- 1941
- 1946
- 1956
- 1960

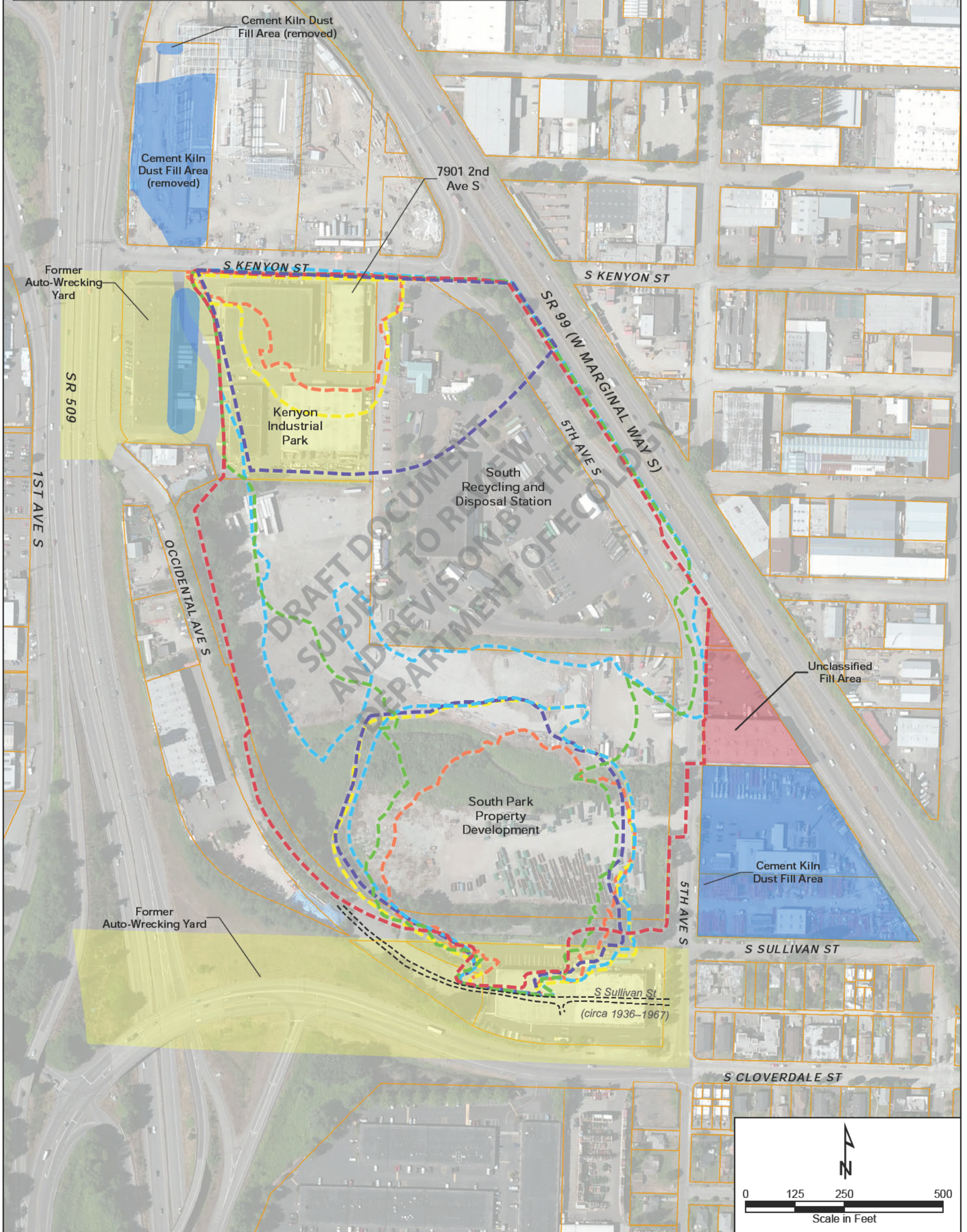
1967 - Approximate Landfill  
 Boundary (as shown in Work Plan)

Adjacent Non-Landfill Fill

- Cement Kiln Dust Fill Area
- Unclassified Fill Area
- Tax Parcel
- Former Auto-Wrecking Yard
- Former South Sullivan  
 Street Alignment

Notes:

- Tax parcels provided by King County Geographic Information Systems Center.
- Aerial imagery provided by Esri, August 1, 2011.



**Legend**

**Exploration Type:**

(symbol shape)

- ▲ Gas Probe
- ▲ Reconnaissance Gas Probe
- Geotech Boring
- Deposited Soil Sample
- ⊕ Test Pit
- ⊕ Monitoring Well
- ⊕ Reconnaissance Groundwater Probe
- Solid Waste Probe

**Material Type:**

(symbol color)

- Native Material
- Solid Waste
- Unclassified Fill
- Cement Kiln Dust

- ⋯ Revised Landfill Boundary (based on RI/FS)
- ⋯ Approximate Landfill Boundary (as shown in Work Plan)
- Tax Parcel

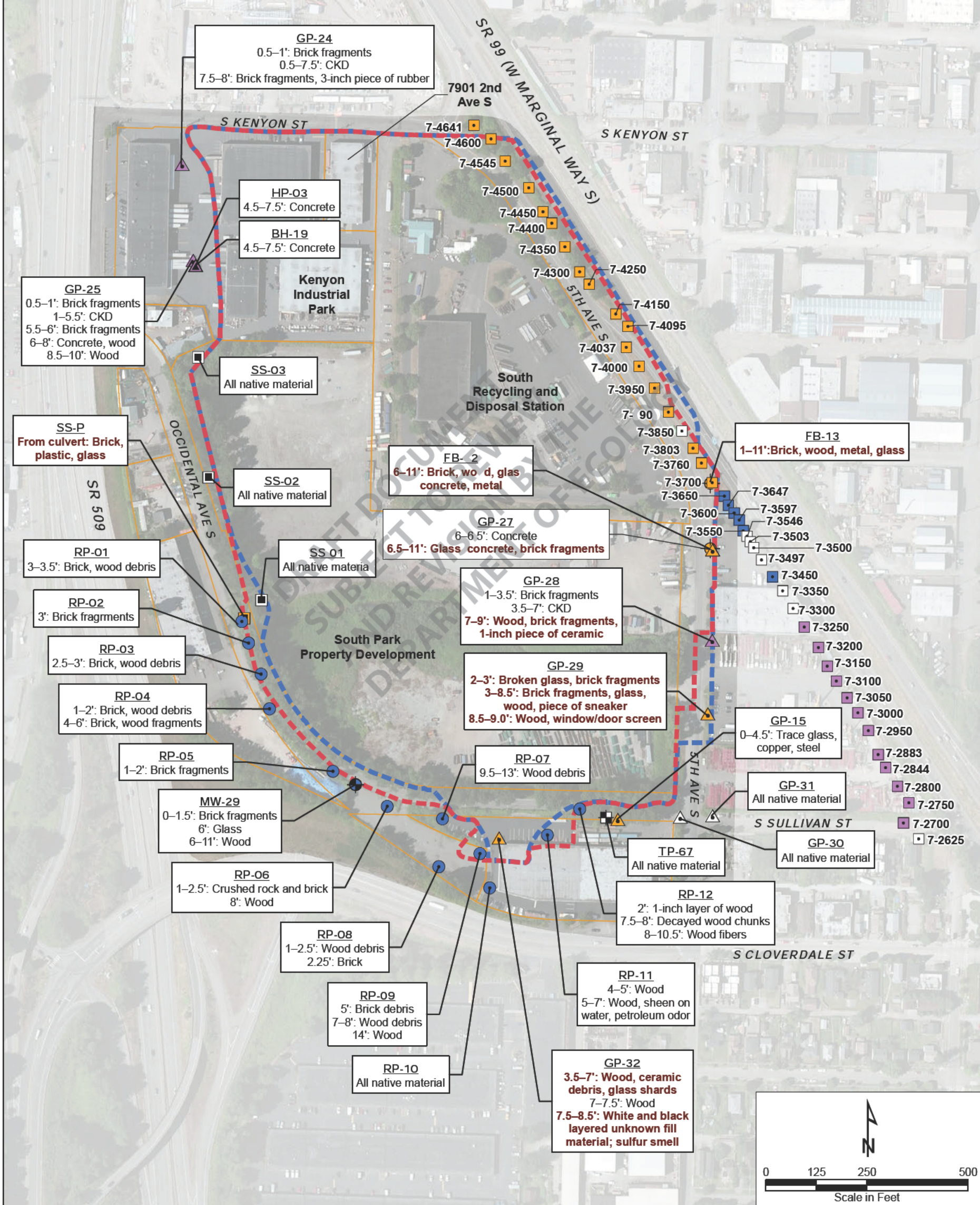
**BROWN, BOLD TEXT** in exploration label indicates solid waste material.

**Notes:**

- Tax parcels provided by King County Geographic Information Systems Center.
- Aerial imagery provided by Esri, August 1, 2011.

**Abbreviations**

- CKD - Cement kiln dust
- RI/FS - Remedial Investigation/Feasibility Study





**Legend**



- Decision Unit 1 Sampling Location
- Decision Unit 2 Sampling Location
- Decision Unit 3 Sampling Location
- Revised Landfill Boundary (based on RI/FS)
- Decision Unit 1
- Decision Unit 2
- Decision Unit 3
- Tax Parcel

**Note:**  
 - Tax parcels provided by King County Geographic Information Systems Center.

**Abbreviation:**  
 - RI/FS - Remedial Investigation/Feasibility Study



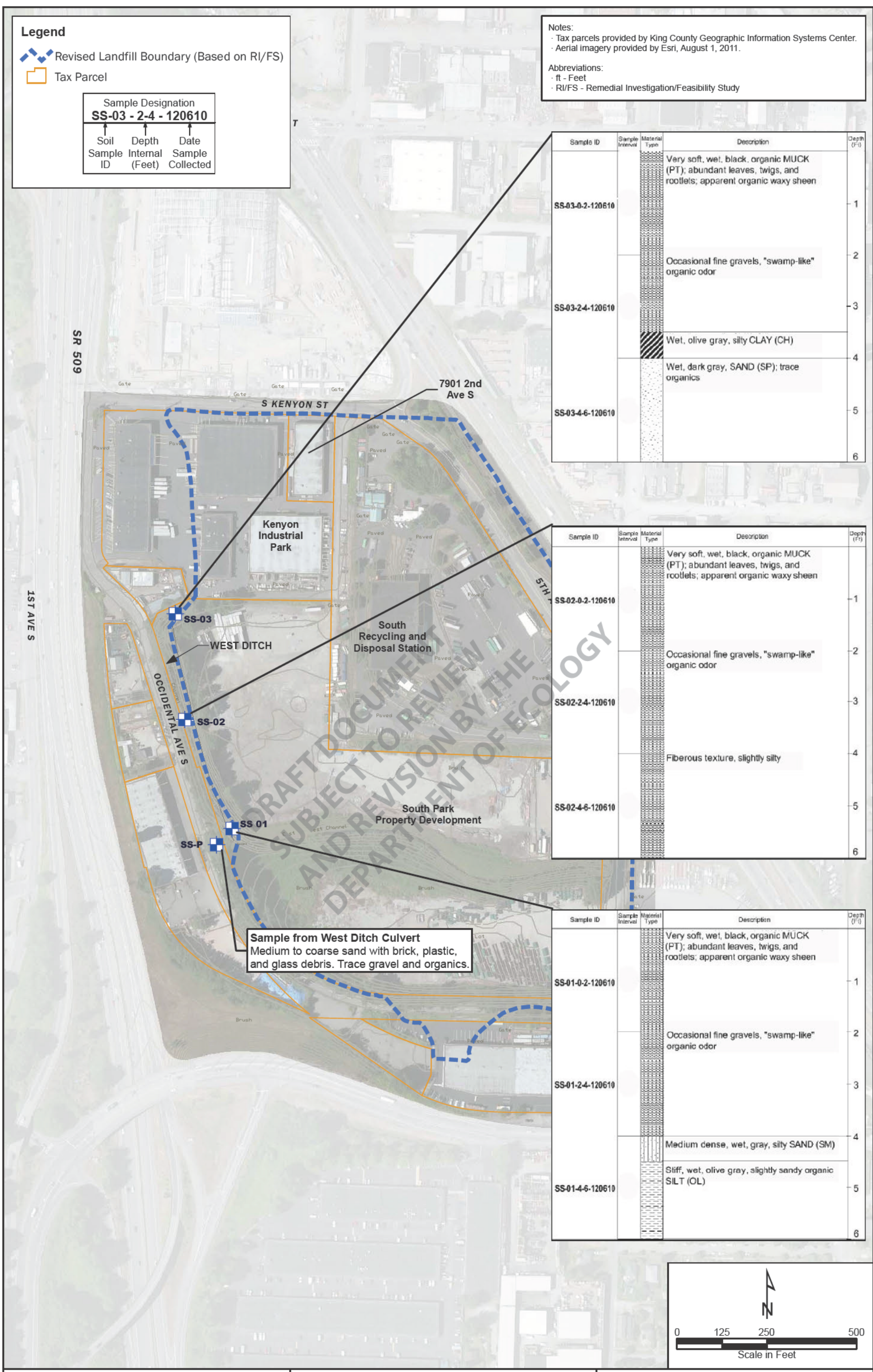
**Legend**

-  Revised Landfill Boundary (Based on RI/FS)
-  Tax Parcel





Sample Designation		
<b>SS-03</b>	<b>- 2-4 -</b>	<b>120610</b>
Soil Sample ID	Depth Internal (Feet)	Date Sample Collected




**Notes:**  
 - Tax parcels provided by King County Geographic Information Systems Center.  
 - Aerial imagery provided by Esri, August 1, 2011.





**Abbreviations:**  
 - ft - Feet  
 - RI/FS - Remedial Investigation/Feasibility Study

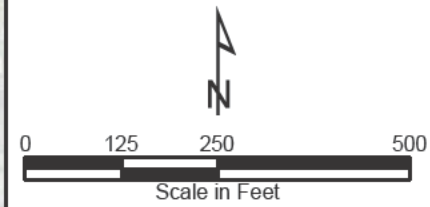


**Sample from West Ditch Culvert**  
 Medium to coarse sand with brick, plastic, and glass debris. Trace gravel and organics.

Sample ID	Sample Interval	Material Type	Description	Depth (Ft)
SS-03-0-2-120610	0-2		Very soft, wet, black, organic MUCK (PT); abundant leaves, twigs, and rootlets; apparent organic waxy sheen	1
SS-03-2-4-120610	2-4		Occasional fine gravels, "swamp-like" organic odor	2-3
SS-03-4-6-120610	4-6		Wet, olive gray, silty CLAY (CH)	4
SS-03-4-6-120610	4-6		Wet, dark gray, SAND (SP); trace organics	5
				6

Sample ID	Sample Interval	Material Type	Description	Depth (Ft)
SS-02-0-2-120610	0-2		Very soft, wet, black, organic MUCK (PT); abundant leaves, twigs, and rootlets; apparent organic waxy sheen	1
SS-02-2-4-120610	2-4		Occasional fine gravels, "swamp-like" organic odor	2-3
SS-02-4-6-120610	4-6		Fibrous texture, slightly silty	4
				5
				6

Sample ID	Sample Interval	Material Type	Description	Depth (Ft)
SS-01-0-2-120610	0-2		Very soft, wet, black, organic MUCK (PT); abundant leaves, twigs, and rootlets; apparent organic waxy sheen	1
SS-01-2-4-120610	2-4		Occasional fine gravels, "swamp-like" organic odor	2-3
SS-01-4-6-120610	4-6		Medium dense, wet, gray, silty SAND (SM)	4
SS-01-4-6-120610	4-6		Stiff, wet, olive gray, slightly sandy organic SILT (OL)	5
				6



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 6/18/2014

**Legend**

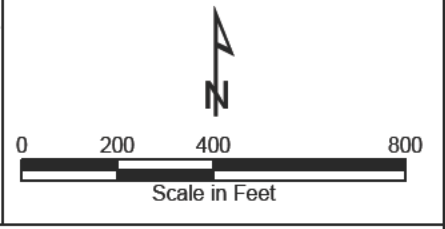
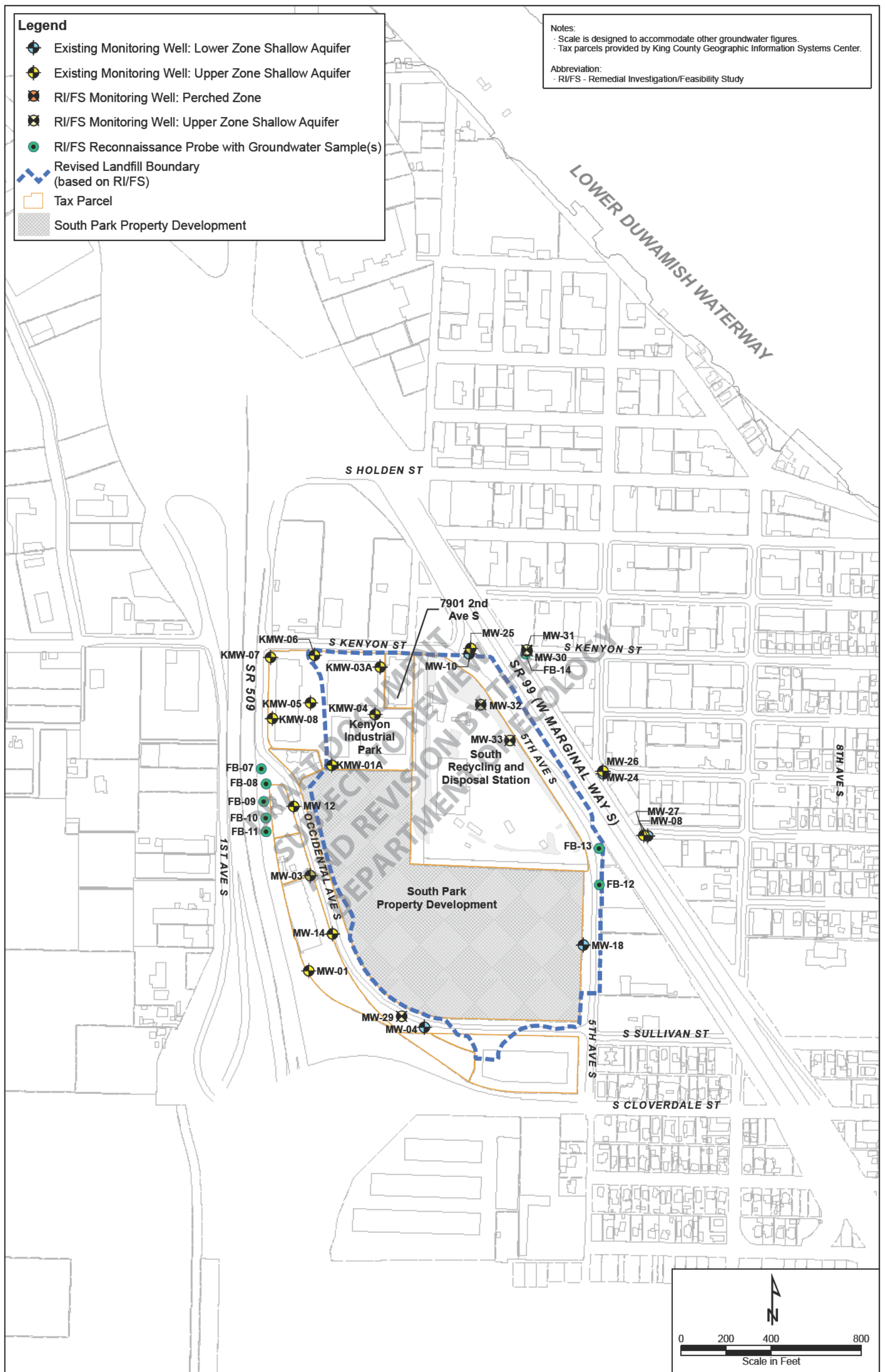
-  Existing Monitoring Well: Lower Zone Shallow Aquifer
-  Existing Monitoring Well: Upper Zone Shallow Aquifer
-  RI/FS Monitoring Well: Perched Zone
-  RI/FS Monitoring Well: Upper Zone Shallow Aquifer
-  RI/FS Reconnaissance Probe with Groundwater Sample(s)
-  Revised Landfill Boundary (based on RI/FS)
-  Tax Parcel
-  South Park Property Development

**Notes:**






- Scale is designed to accommodate other groundwater figures.
- Tax parcels provided by King County Geographic Information Systems Center.

**Abbreviation:**

- RI/FS - Remedial Investigation/Feasibility Study



**Legend**

-  Cross Section Data Point
-  Revised Landfill Boundary (based on RI/FS)
-  Cross Section
-  Tax Parcel
-  South Park Property Development

**Notes:**  
- Tax parcels provided by King County Geographic Information Systems Center.  
- For cross section purposes, only monitoring wells and soil borings within 200 feet of the cross sections were used and are shown on this figure. The locations of the historical explorations are presented on Figure 2.8 and the groundwater monitoring wells and reconnaissance probes sampled during this RI/FS are presented on Figure 5.1.

**Abbreviation:**  
- RI/FS - Remedial Investigation/Feasibility Study

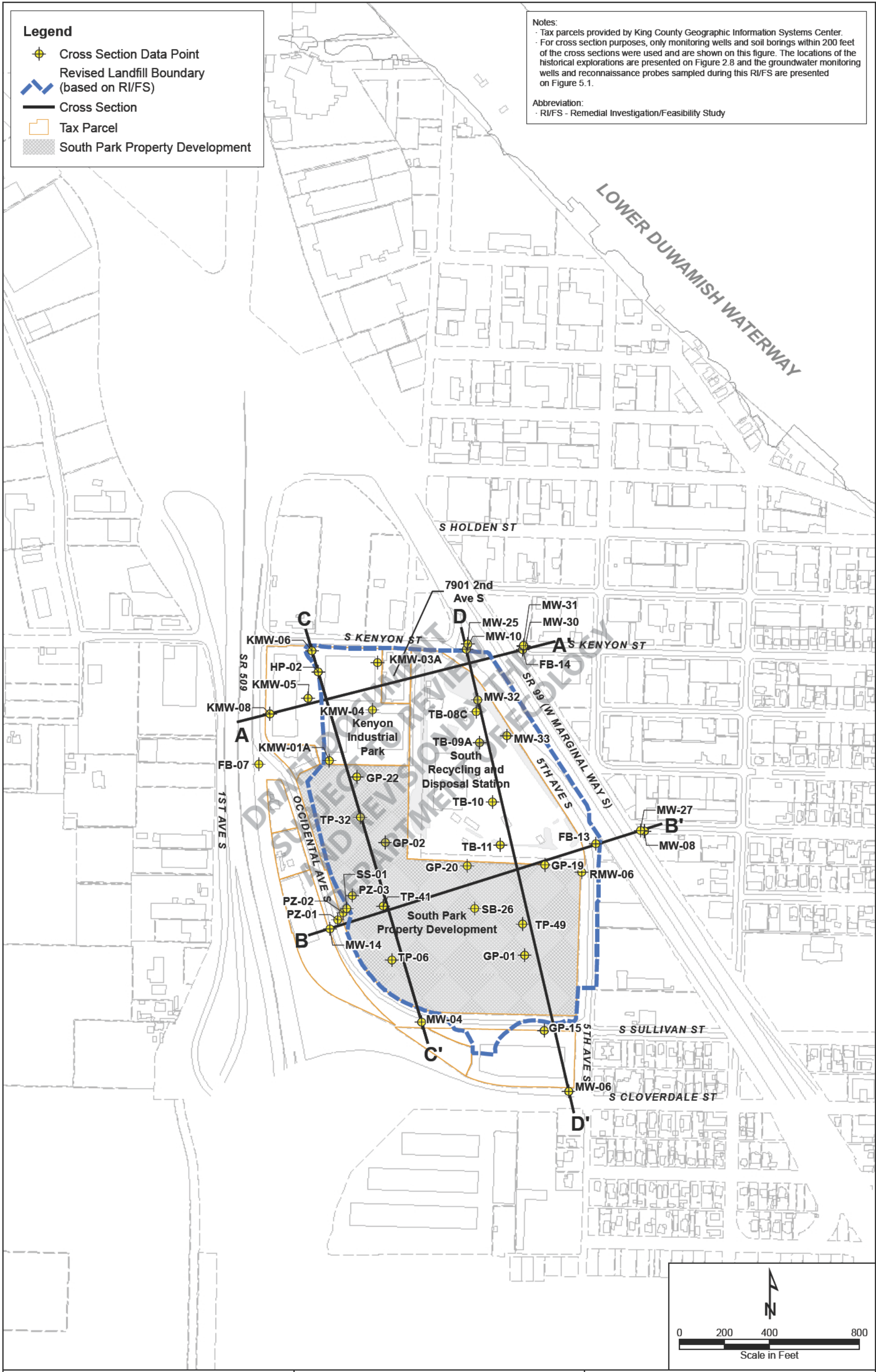
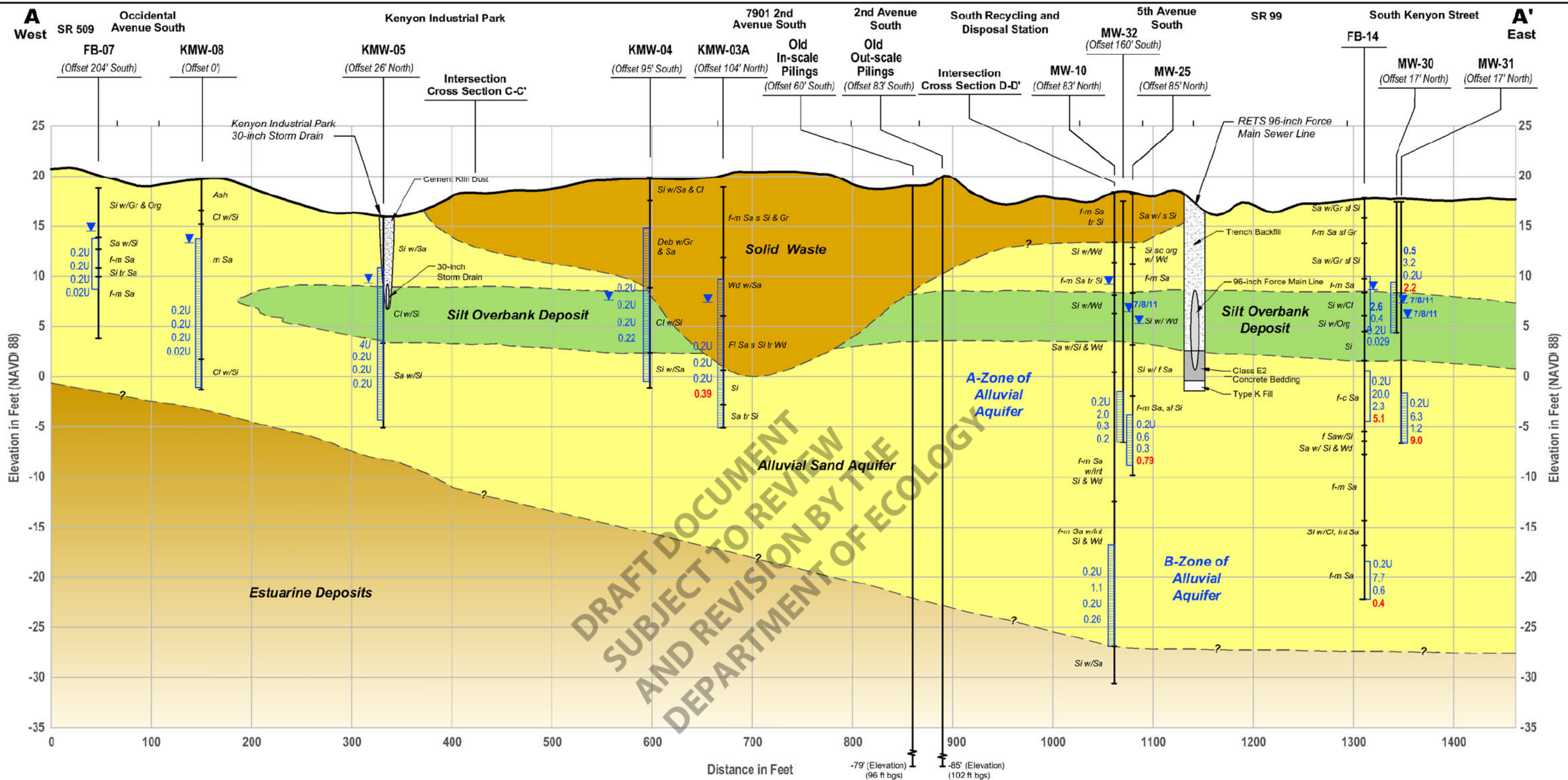


Figure 5.2  
Cross Section Location Map

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6/17/2014



**Notes:**

**BOLD, RED TEXT** indicates exceedance of cleanup levels.  
 ITALICS indicate that the reporting limit is greater than the cleanup level.  
 Qualifier "U" = The analyte was not detected at the reported concentration.  
 Cleanup level: Trichloroethylene (TCE) = 5.0 µg/L, cis-1,2-dichloroethene (cis-DCE) = 16 µg/L, trans-1,2-dichloroethene (trans-DCE) = 160 µg/L, vinyl chloride = 0.29 µg/L.  
 bgs - Below Ground Surface  
 ft - Feet  
 NAVD 88 - North American Vertical Datum of 1988  
 RETS - Renton Effluent Transfer System

**Legend**

- Static Water Level (January or March 2011)
- Approximate Ground Surface
- Approximate Geologic Unit Contact
- Inferred Geologic Unit Contact

**Groundwater Data**

Data from 2011 RI Event

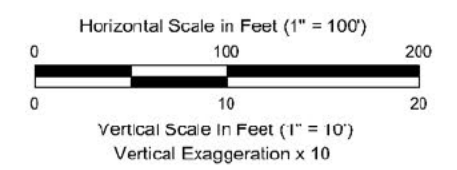
TCE Concentration in µg/L	0.2U
cis-DCE Concentration in µg/L	0.6
trans-DCE Concentration in µg/L	0.3
Vinyl Chloride Concentration in µg/L	0.4

Monitoring Well Screen

Temporary Groundwater Collection Screen

**Soil Description**

- |               |                   |
|---------------|-------------------|
| Cl = Clay     | f = fine          |
| Sa = Sand     | m = medium        |
| Si = Silt     | c = course        |
| Gr = Gravel   | w/ = with         |
| Org = Organic | s = some          |
| Wd = Wood     | & = and           |
| Deb = Debris  | sc = scattered    |
| FI = Fill     | sl = slightly     |
|               | tr = trace        |
|               | int = interbedded |



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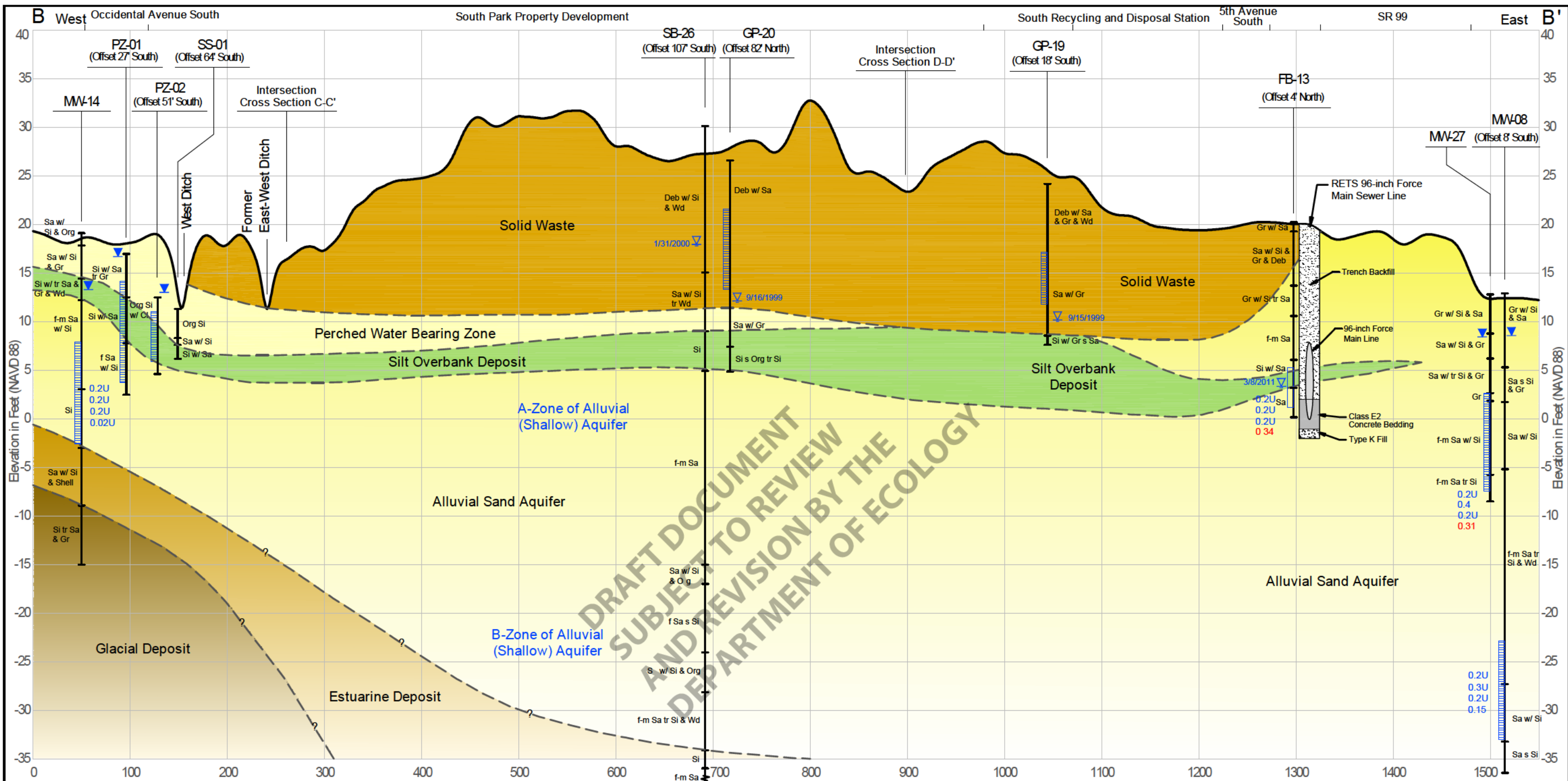
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**BHC**  
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Remedial Investigation/Feasibility Study  
 South Park Landfill  
 Seattle, Washington

Figure 5.3  
 Cross Section A-A'



**Notes:**

**BOLD, RED TEXT** indicates exceedance of cleanup levels.  
 ITALICS indicate that the reporting limit is greater than the cleanup level.  
 Qualifier "U" = The analyte was not detected at the reported concentration.  
 Cleanup level: Trichloroethylene (TCE) = 5.0 µg/L, cis-1,2-dichloroethene (cis-DCE) = 16 µg/L, trans-1,2-dichloroethene (trans-DCE) = 160 µg/L, vinyl chloride = 0.29 µg/L.  
 bgs - Below Ground Surface  
 ft - Feet  
 NAVD 88 - North American Vertical Datum of 1988  
 RETS - Renton Effluent Transfer System

**Legend**

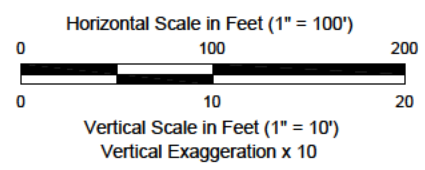
- At Time of Drilling Water Level
- Static Water Level (January or March 2011)
- Approximate Ground Surface
- Approximate Geologic Unit Contact
- Inferred Geologic Unit Contact

**Groundwater Data**

Monitoring Well Screen	TCE Concentration in µg/L	cis-DCE Concentration in µg/L	trans-DCE Concentration in µg/L	Vinyl Chloride Concentration in µg/L
SB-26 (Offset 107' South)	0.2U	0.4	0.6	0.3
GP-20 (Offset 82' North)	9/16/1999			
GP-19 (Offset 18' South)	9/15/1999			
FB-13 (Offset 4' North)	3/8/2011	0.2U	0.2U	0.34
MV-08 (Offset 8' South)		0.2U	0.4	0.2U
MV-27 (Offset 8' South)		0.2U	0.15	

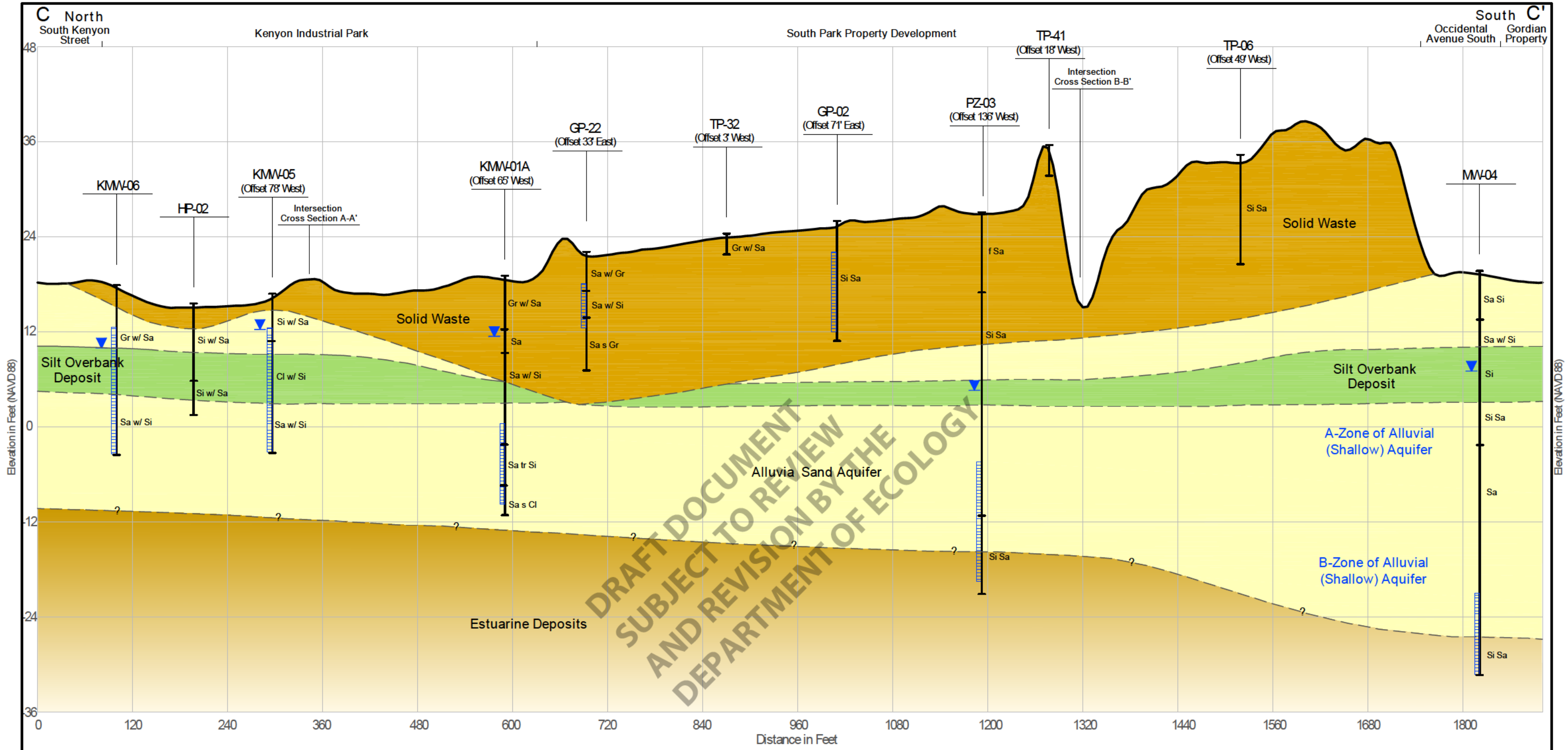
**Soil Description**

- Cl = Clay
- Sa = Sand
- Si = Silt
- Gr = Gravel
- Org = Organic
- Wd = Wood
- Fl = Fill
- Shell = Shell Fragments
- f = fine
- m = medium
- c = course
- w/ = with
- s = some
- & = and
- sc = scattered
- sl = slightly
- tr = trace
- int = interbedded



Remedial Investigation/ Feasibility Study  
 South Park Landfill  
 Seattle, Washington

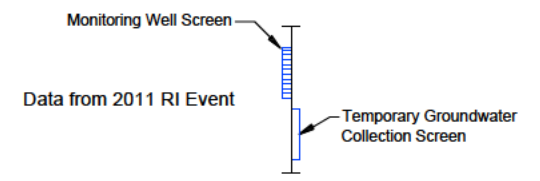
Figure 5.4  
 Cross Section B-B'



**Legend**

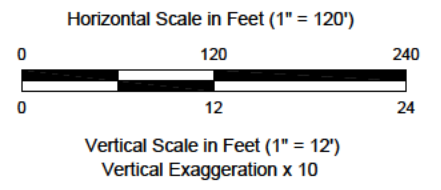
- Static Water Level (January or March 2011)
- Approximate Ground Surface
- Approximate Geologic Unit Contact
- Inferred Geologic Unit Contact

**Groundwater Data**



**Soil Description**

- |               |                   |
|---------------|-------------------|
| Cl = Clay     | f = fine          |
| Sa = Sand     | m = medium        |
| Si = Silt     | c = coarse        |
| Gr = Gravel   | w/ = with         |
| Org = Organic | s = some          |
| Wd = Wood     | & = and           |
| Deb = Debris  | sc = scattered    |
| Fl = Fill     | sl = slightly     |
|               | tr = trace        |
|               | int = interbedded |

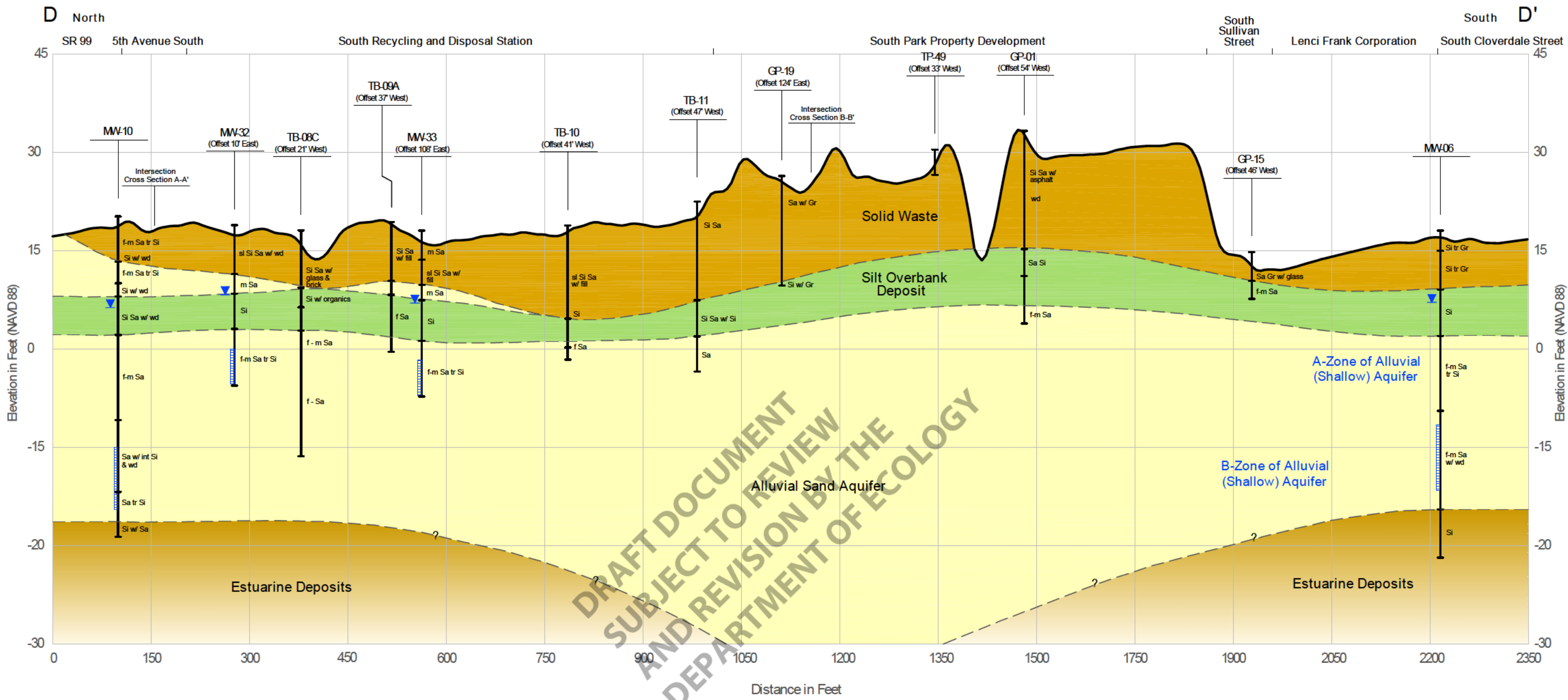


NAVD 88 - North American Vertical Datum of 1988



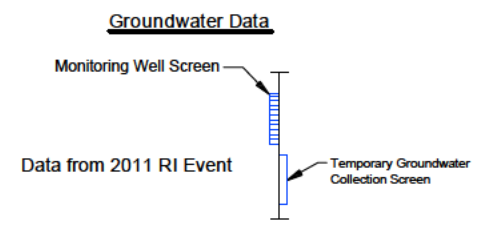
Remedial Investigation/ Feasibility Study  
 South Park Landfill  
 Seattle, Washington

Figure 5.5  
 Cross Section C-C'



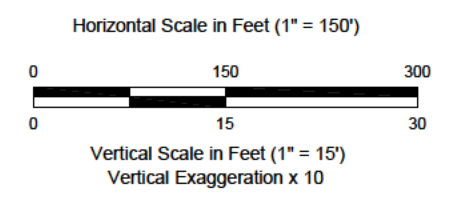
**Legend**

- Static Water Level (January or March 2011)
- Approximate Ground Surface
- Approximate Geologic Unit Contact
- Inferred Geologic Unit Contact



**Soil Description**

Cl = Clay	f = fine
Sa = Sand	m = medium
Si = Silt	c = coarse
Gr = Gravel	w/ = w/ h
Org = Organic	s = some
Wd = Wood	& = and
Deb = Debris	sc = scattered
Fl = Fill	sl = slightly
	tr = trace
	int = interbedded



NAVD 88 - North American Vertical Datum of 1988

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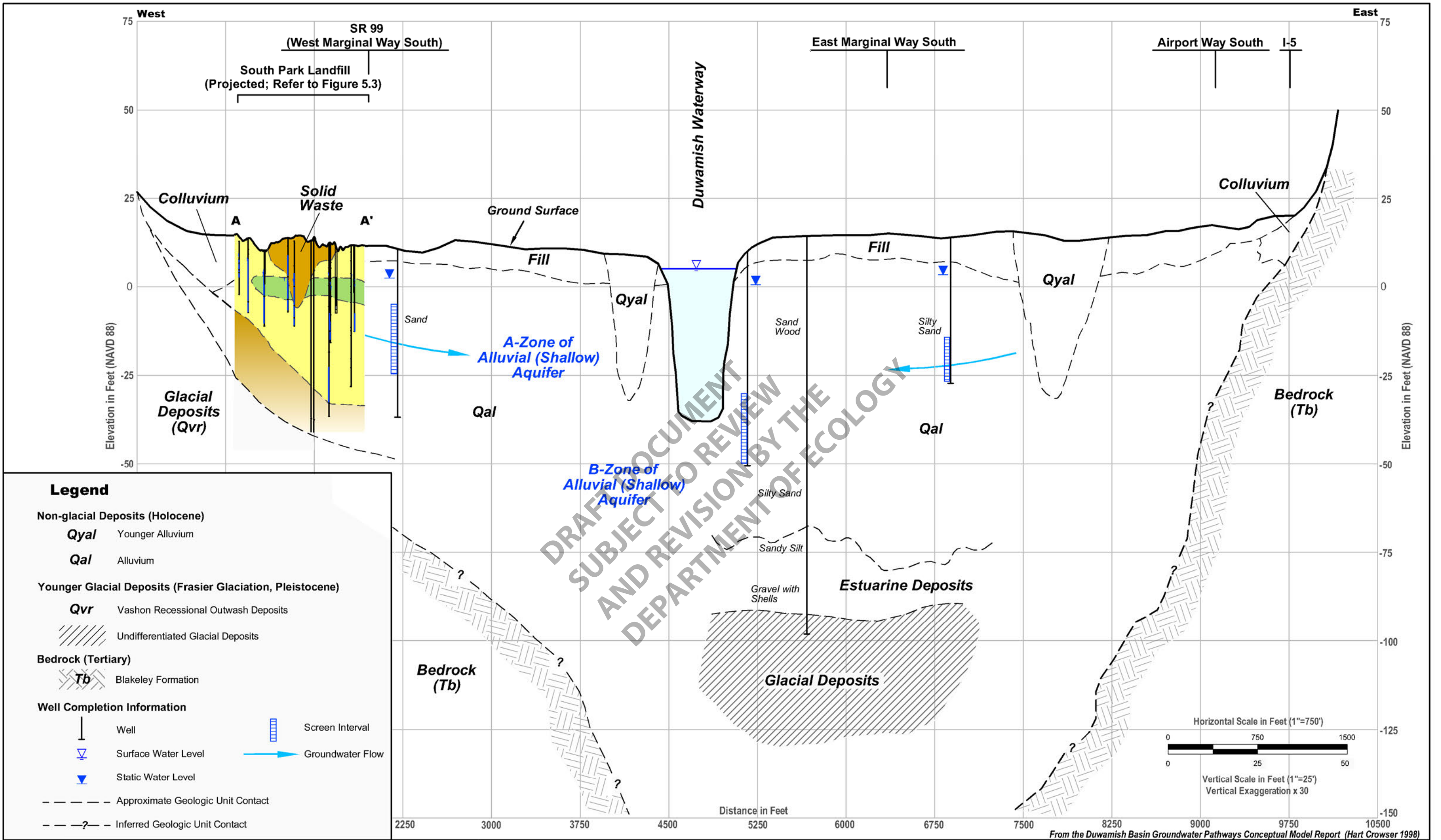
**BHC** CONSULTANTS

**HERRERA** CONSULTANTS

Remedial Investigation/ Feasibility Study  
South Park Landfill  
Seattle, Washington

Figure 5.6  
Cross Section D-D'





Remedial Investigation/Feasibility Study  
South Park Landfill  
Seattle, Washington

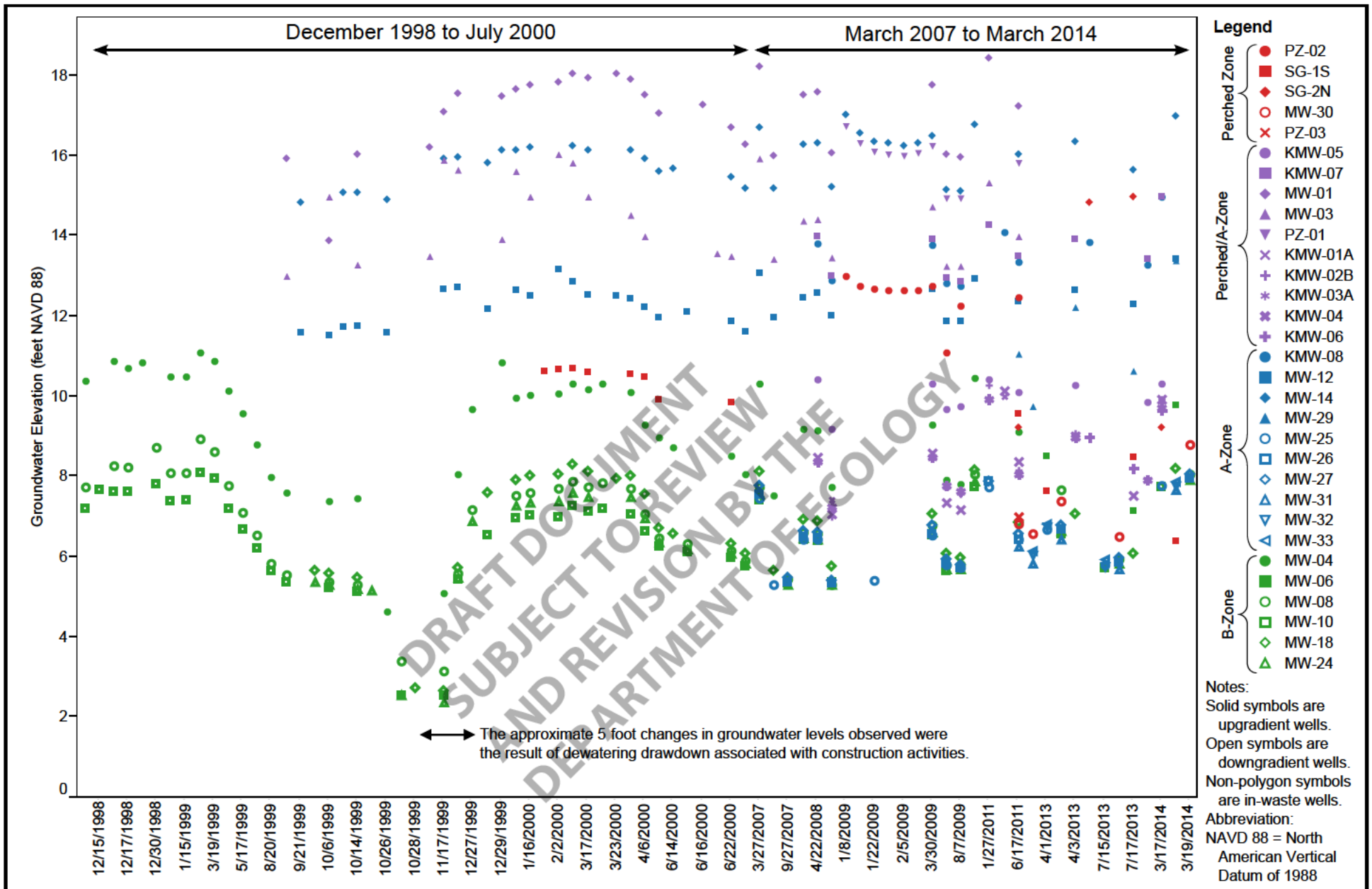
Figure 5.7  
Cross Section A-A' Projected  
onto the Regional Cross Section

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CONSULTING

3IC  
CONSULTANTS

HERRERA  
ENVIRONMENTAL  
CONSULTANTS



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strategy • science • engineering



**Remedial Investigation/Feasibility Study  
South Park Landfill  
Seattle, Washington**

**Figure 5.8  
Groundwater Hydrographs—  
Shallow Aquifer**

**Legend**

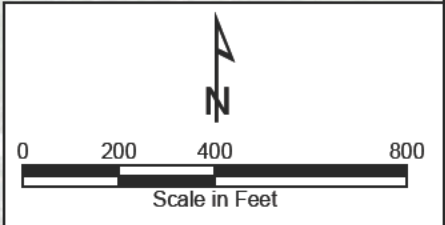
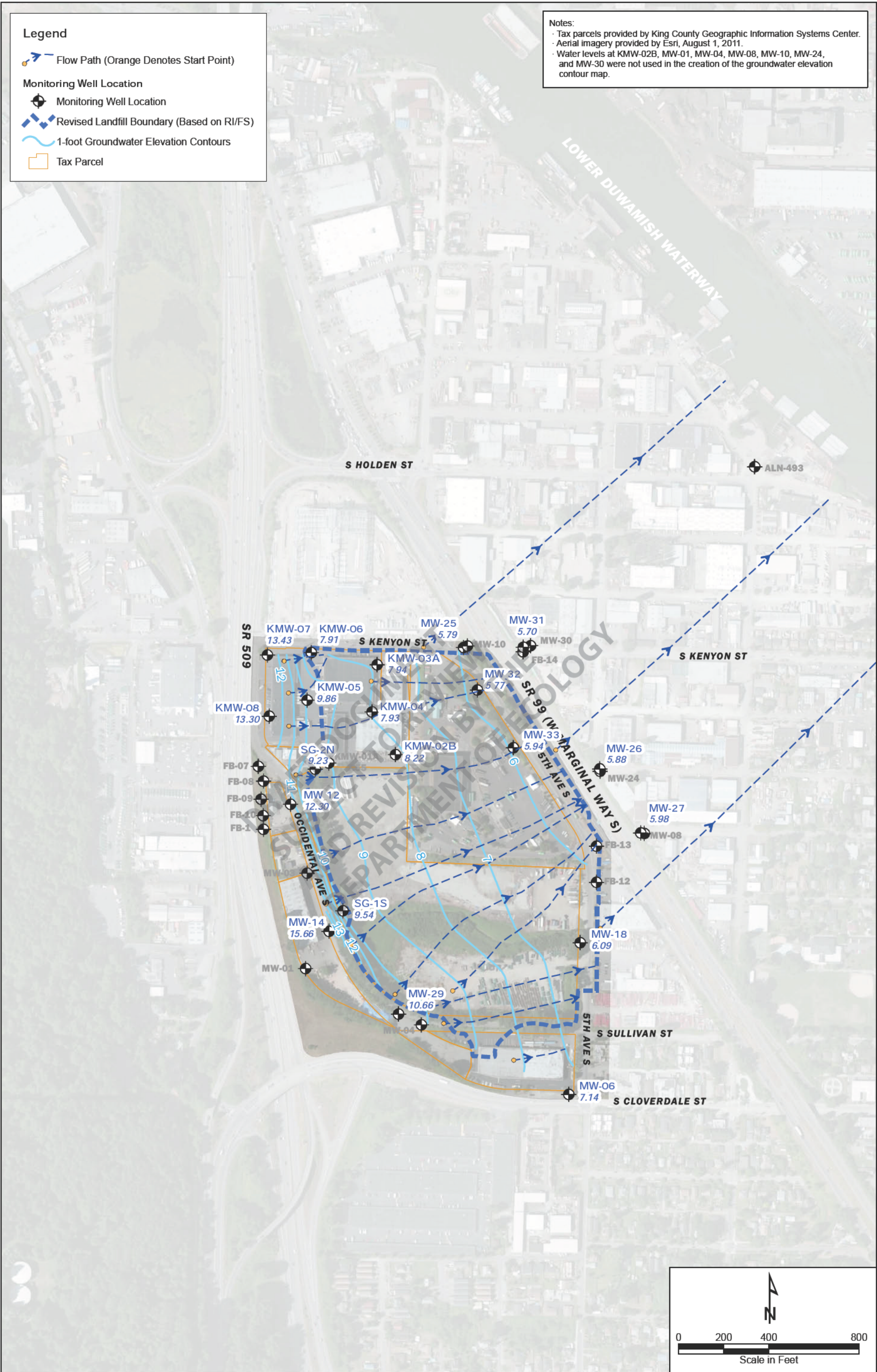
Flow Path (Orange Denotes Start Point)

**Monitoring Well Location**







- Monitoring Well Location
- Revised Landfill Boundary (Based on RI/FS)
- 1-foot Groundwater Elevation Contours
- Tax Parcel

**Notes:**

- Tax parcels provided by King County Geographic Information Systems Center.
- Aerial imagery provided by Esri, August 1, 2011.
- Water levels at KMW-02B, MW-01, MW-04, MW-08, MW-10, MW-24, and MW-30 were not used in the creation of the groundwater elevation contour map.

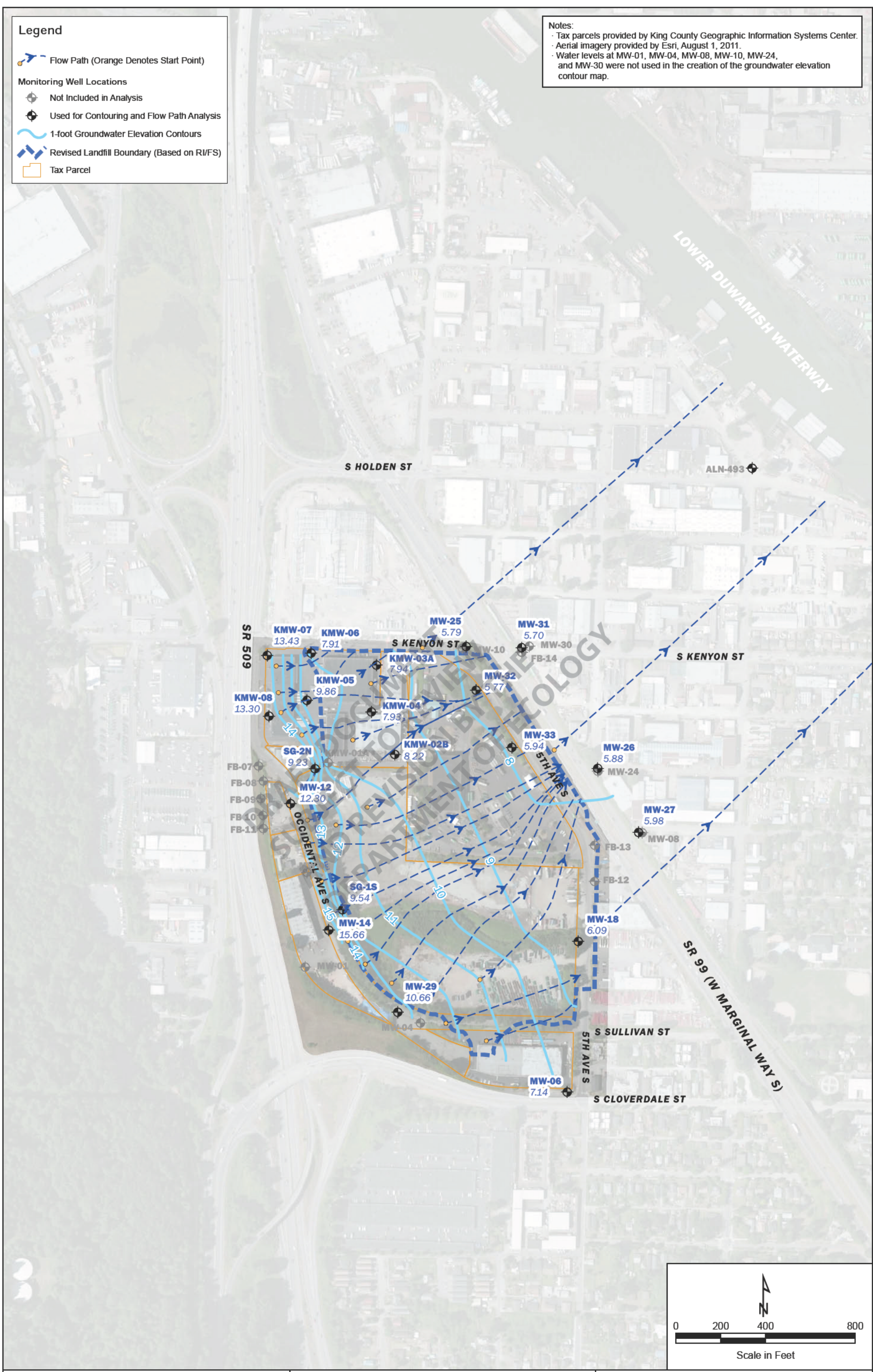


**Legend**

-  Flow Path (Orange Denotes Start Point)
- Monitoring Well Locations**
-  Not Included in Analysis
-  Used for Contouring and Flow Path Analysis
-  1-foot Groundwater Elevation Contours
-  Revised Landfill Boundary (Based on R/IFS)
-  Tax Parcel

**Notes:**

- Tax parcels provided by King County Geographic Information Systems Center.
- Aerial imagery provided by Esri, August 1, 2011.
- Water levels at MW-01, MW-04, MW-08, MW-10, MW-24, and MW-30 were not used in the creation of the groundwater elevation contour map.



I:\GIS\Projects\COS-SPARK\MXD\RIFS\Fig 5\_9B Groundwater Elevation Contour Map Mar 2014.mxd  
5/29/2014

**Legend**

- Revised Landfill Boundary (based on RI/FS)
  - Tax Parcel
  - 1,000-foot Perimeter from Landfill Boundary
- Benzene  
 TPH-Gas  
 TPH-Diesel + Oil

**Location Labels:**

- KMW-07**  
@ 5-20 feet (ft)  
(Jan-2011)  
TPH-G: 0.25U  
TPH-D/O: 0.1U  
Benz: 0.2U
- Well ID
- Well Screen Depth Interval
- Sample Month/Year
- TPH-Gasoline Concentration in mg/L
- TPH-Diesel + Oil Concentration in mg/L
- Benzene Concentration in µg/L

Color	Description	Benzene	TPH-Gasoline	TPH-Diesel+Oil
	Not measured			
	Less than CUL	< 5 µg/L	< 0.8 mg/L	< 0.5 mg/L
	Between the CUL and 2 times the CUL	Between 5 and 10 µg/L	Between 0.8 and 1.6 mg/L	Between 0.5 and 1.0 mg/L
	Greater than 2 times the CUL	> 10 µg/L	> 1.6 mg/L	> 1.0 mg/L

**Notes:**

- Tax parcels provided by King County Geographic Information Systems Center.
- Trend plots represent benzene concentrations for locations KMW-05 and MW-25 for sampling events through March 2014.
- Benzene results for FB-14 are based on Ecology split samples.
- **BOLD, RED TEXT** indicates exceedance of CUL.

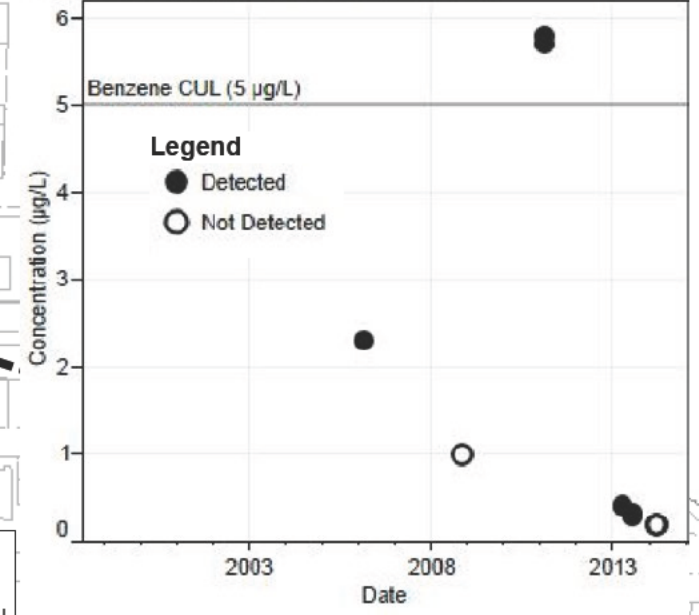
**Abbreviations:**

- Benz - Benzene
- CUL - Cleanup level
- Ecology - Washington Department of Ecology
- ft - Feet
- µg/L - Micrograms per liter
- mg/L - Milligrams per liter
- RI/FS - Remedial Investigation/Feasibility Study
- TPH-D/O - Total petroleum hydrocarbon - Diesel- and oil-range
- TPH-G - Total petroleum hydrocarbon - Gasoline-range

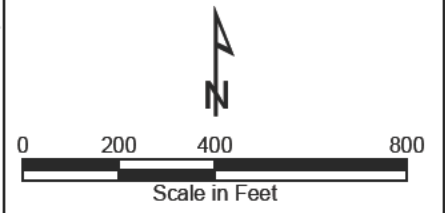
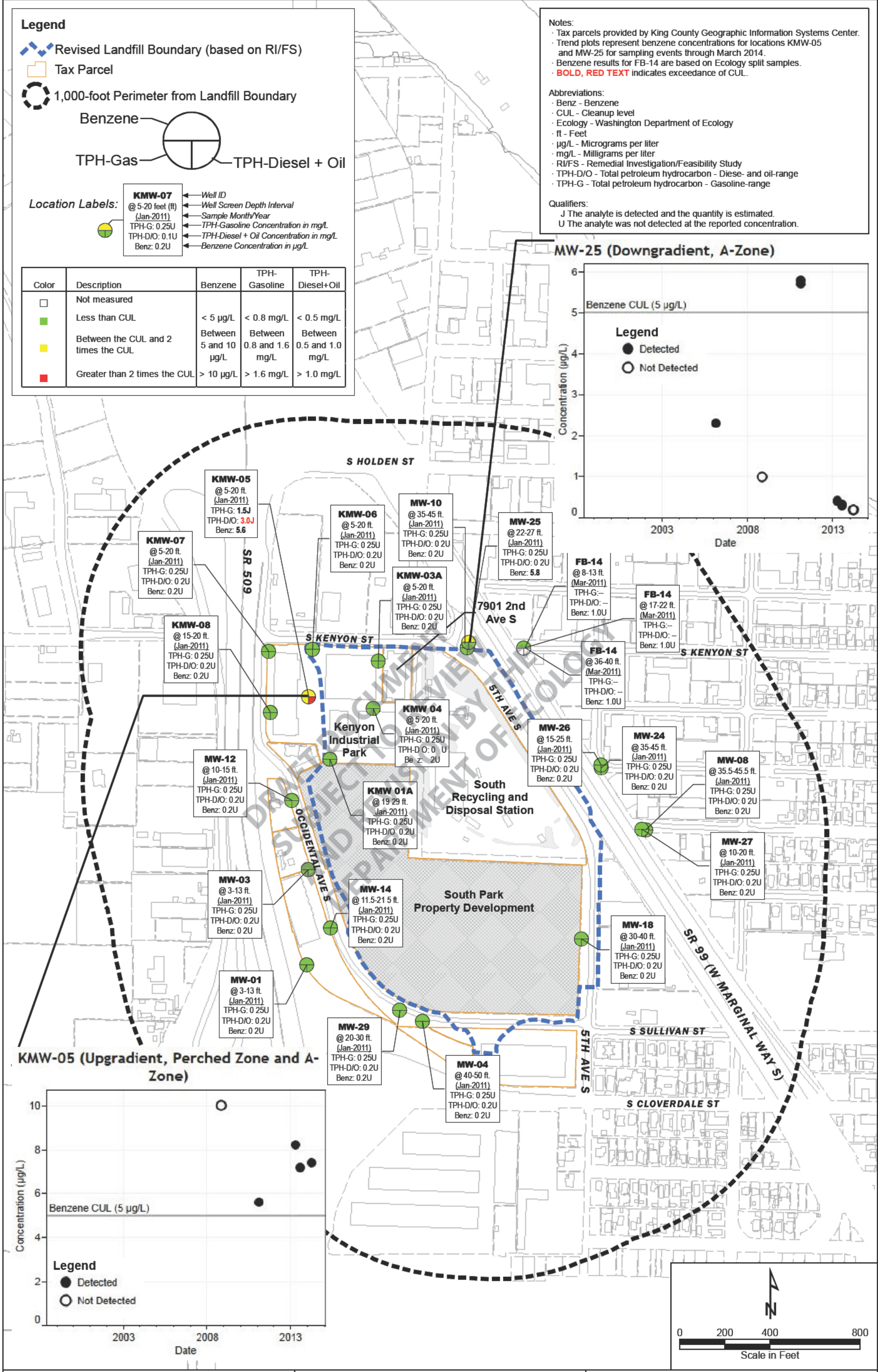
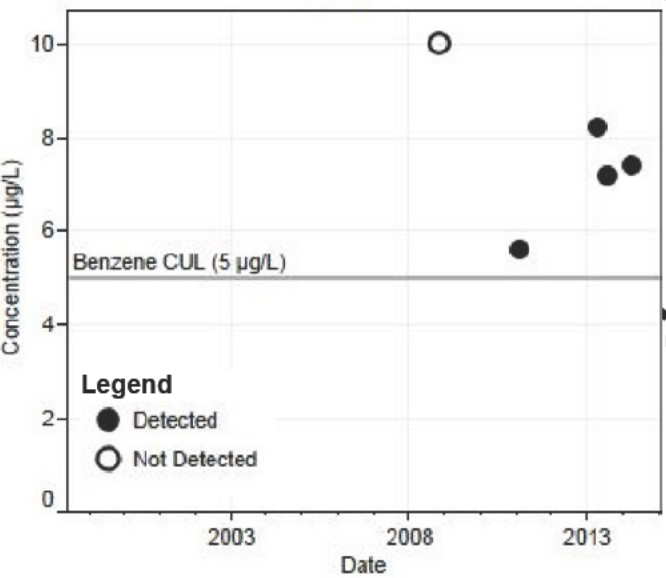
**Qualifiers:**

- J The analyte is detected and the quantity is estimated.
- U The analyte was not detected at the reported concentration.

**MW-25 (Downgradient, A-Zone)**



**KMW-05 (Upgradient, Perched Zone and A-Zone)**



I:\GIS\Projects\COS-SPARKMXD\RI\FS\Fig 5\_10 GW TPH and Benzene.mxd  
6/24/2014

**Legend**

- Flow Path (Orange Denotes Start Point)
- Revised Landfill Boundary (based on RI/FS)
- Tax Parcel
- 1,000-foot Perimeter from Landfill Boundary

**Location Labels:**

**MW-30** ← Well ID  
 @ 8-13 feet (ft) ← Well Screen Depth Interval  
 (Jul-2011) ← Sample Month/Year  
 TCE: 0.5 ← Trichloroethene Concentration in µg/L  
 cis-DCE: 3.2 ← cis-1,2-Dichloroethene Concentration in µg/L  
 VC: 2.2 ← Vinyl Chloride Concentration in µg/L

Color	Description	TCE	cis-DCE	VC
	Not measured			
	Greater than CUL in a non-detect sample	> 5 µg/L	> 16 µg/L	> 0.29 µg/L
	Less than CUL	< 5 µg/L	< 16 µg/L	< 0.29 µg/L
	Between the CUL and 2 times the CUL	Between 5 and 10 µg/L	Between 16 and 32 µg/L	Between 0.29 and 1.45 µg/L
	Greater than 2 times the CUL; Greater than 5 times the CUL for VC	> 10 µg/L	> 32 µg/L	> 1.45 µg/L

**Notes:**

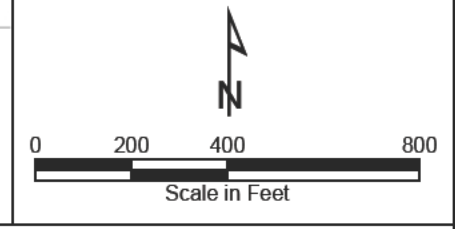
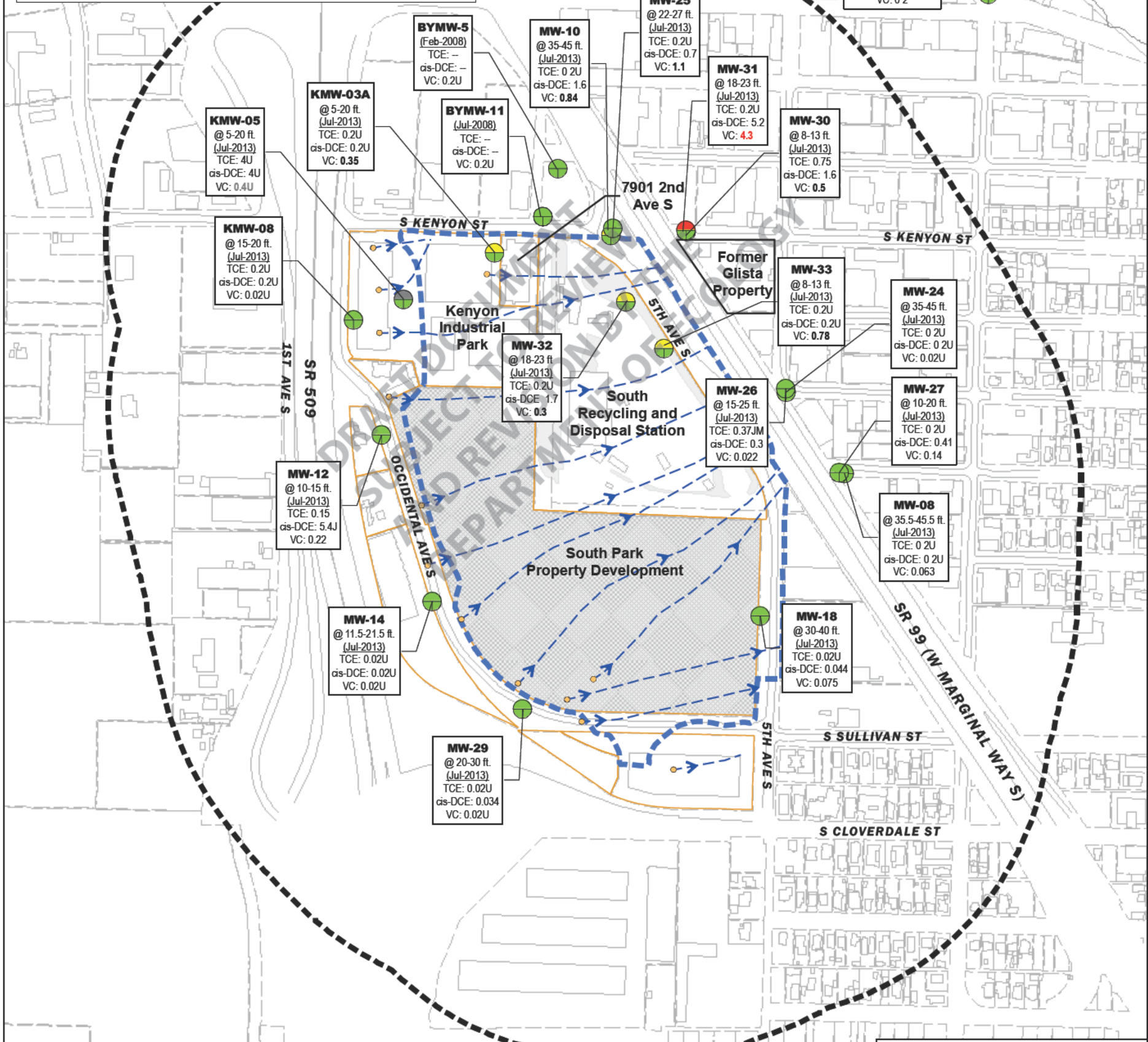
- Tax parcels provided by King County Geographic Information Systems Center.
- **BOLD, GRAY TEXT** indicates exceedance of CUL in a non-detect sample.
- **BOLD, RED TEXT** indicates exceedance of CUL.

**Abbreviations:**

- cis-DCE - cis-1,2-Dichloroethene
- CUL - Cleanup level
- DCE - Dichloroethene
- µg/L - Micrograms per liter
- RI/FS - Remedial Investigation/Feasibility Study
- TCE - Trichloroethene
- VC - Vinyl chloride

**Qualifiers:**

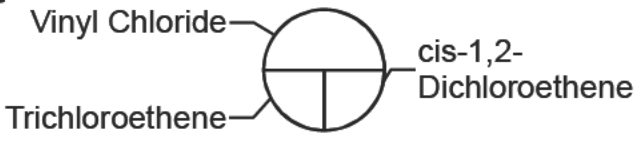
- J The analyte is detected and the quantity is estimated.
- JM The analyte is detected with low spectral match parameters, and the quantity is estimated when less than the reporting limit.
- U The analyte was not detected at the reported concentration.



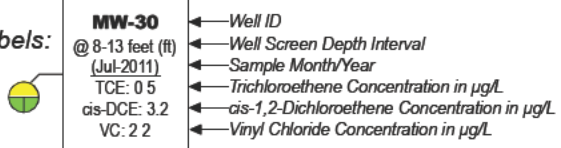
I:\GIS\Projects\COS-SPARK\MXD\RI\FS\Fig 5\_11A GW Chlorinated Ethenes.mxd  
 6/24/2014

**Legend**

- Flow Path (Orange Denotes Start Point)
- Revised Landfill Boundary (based on RI/FS)
- Tax Parcel
- 1,000-foot Perimeter from Landfill Boundary



**Location Labels:**

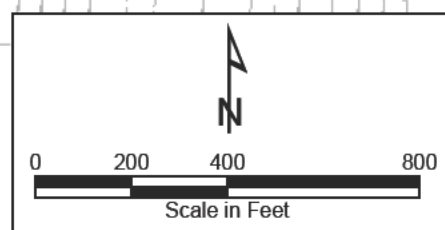
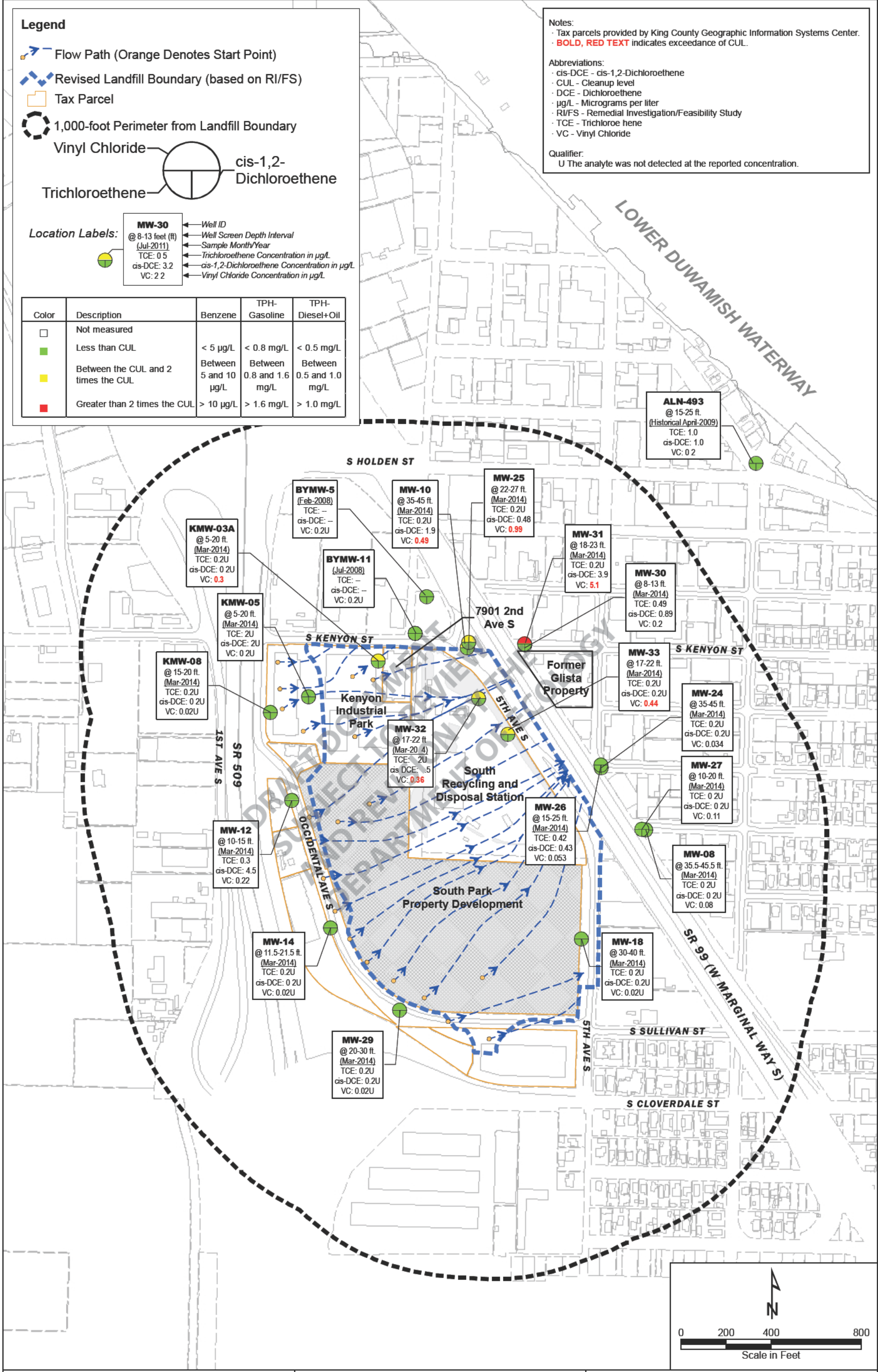


**Notes:**  
 - Tax parcels provided by King County Geographic Information Systems Center.  
 - **BOLD, RED TEXT** indicates exceedance of CUL.

**Abbreviations:**  
 - cis-DCE - cis-1,2-Dichloroethene  
 - CUL - Cleanup level  
 - DCE - Dichloroethene  
 - µg/L - Micrograms per liter  
 - RI/FS - Remedial Investigation/Feasibility Study  
 - TCE - Trichloroethene  
 - VC - Vinyl Chloride

**Qualifier:**  
 U The analyte was not detected at the reported concentration.

Color	Description	Benzene	TPH-Gasoline	TPH-Diesel+Oil
□	Not measured			
■	Less than CUL	< 5 µg/L	< 0.8 mg/L	< 0.5 mg/L
■	Between the CUL and 2 times the CUL	Between 5 and 10 µg/L	Between 0.8 and 1.6 mg/L	Between 0.5 and 1.0 mg/L
■	Greater than 2 times the CUL	> 10 µg/L	> 1.6 mg/L	> 1.0 mg/L



I:\GIS\Projects\COS-SPARK\MXD\IRIFS\Fig 5\_11B GW Chlorinated Ethenes.mxd  
 6/26/2014

**Legend**

- Revised Landfill Boundary (based on RI/FS)
- Tax Parcel
- 1,000-foot Perimeter from Landfill Boundary

**Total Arsenic**

**Dissolved Arsenic**

**Location Labels:**

Well ID  
 Well Screen Depth Interval  
 Sample Month/Year  
 Total Arsenic Concentration in µg/L  
 Dissolved Arsenic Concentration in µg/L  
 pH  
 Turbidity in Nephelometric Turbidity Units (NTU)

Color	Description	Arsenic
	Not measured	
	Less than background-based CUL	< 5 µg/L
	Between the background-based CUL and 2 times the CUL	Between 5 and 10 µg/L
	Greater than 2 times the CUL	> 10 µg/L

**Notes:**

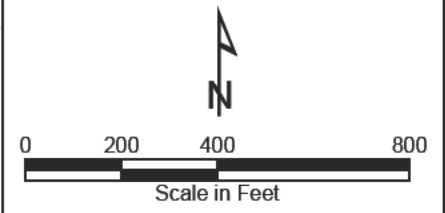
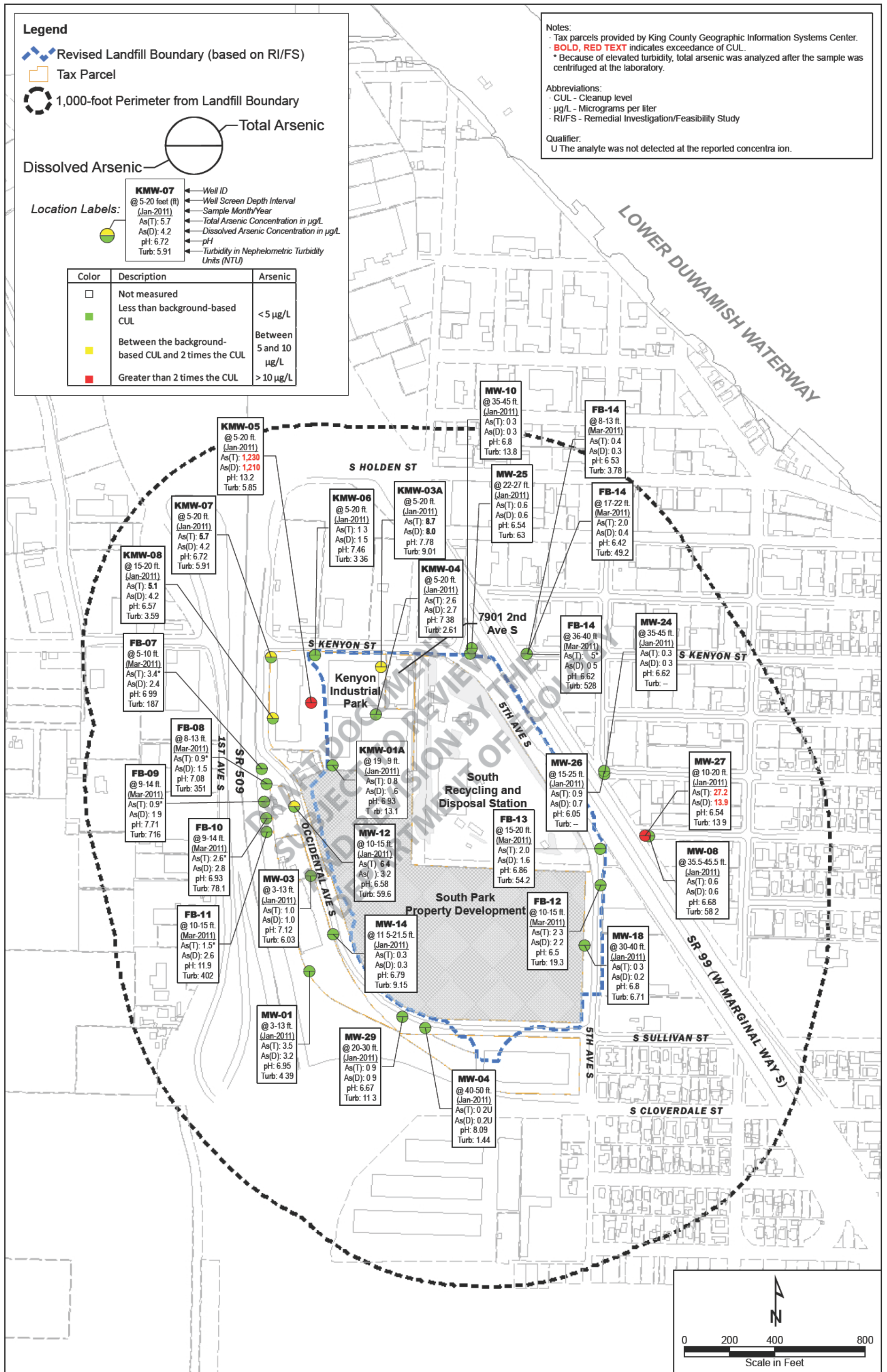
- Tax parcels provided by King County Geographic Information Systems Center.
- **BOLD, RED TEXT** indicates exceedance of CUL.
- \* Because of elevated turbidity, total arsenic was analyzed after the sample was centrifuged at the laboratory.

**Abbreviations:**

- CUL - Cleanup level
- µg/L - Micrograms per liter
- RI/FS - Remedial Investigation/Feasibility Study

**Qualifier:**

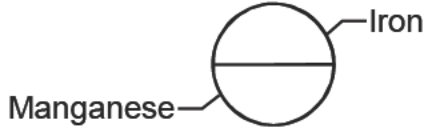
U The analyte was not detected at the reported concentration.





**Legend**

- Revised Landfill Boundary (based on RI/FS)
- Tax Parcel
- 1,000-foot Perimeter from Landfill Boundary



**Location Labels:**

- MW-30**  
@ 8-13 feet (ft)  
(Jul-2011)  
Fe (T/D): 0.5  
Mn (T/D): 3.2
- ← Well ID
- ← Well Screen Depth Interval
- ← Sample Month/Year
- ← Total and Dissolved Iron Concentration in mg/L
- ← Total and Dissolved Manganese Concentration in mg/L

Color	Description	Fe Values	Mn Values
	Not measured		
	Less than background-based criteria	≤ 27 mg/L	≤ 2.1 mg/L
	Between the background-based criteria and two times the criteria	Between 27 and 54 mg/L	Between 2.1 and 4.2 mg/L
	Greater than 2 times the background-based criteria	> 54 mg/L	> 4.2 mg/L

**Note:**

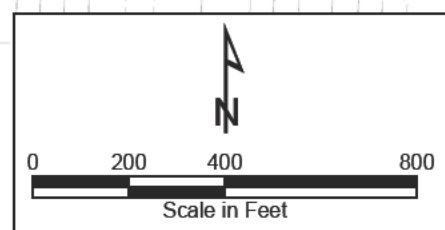
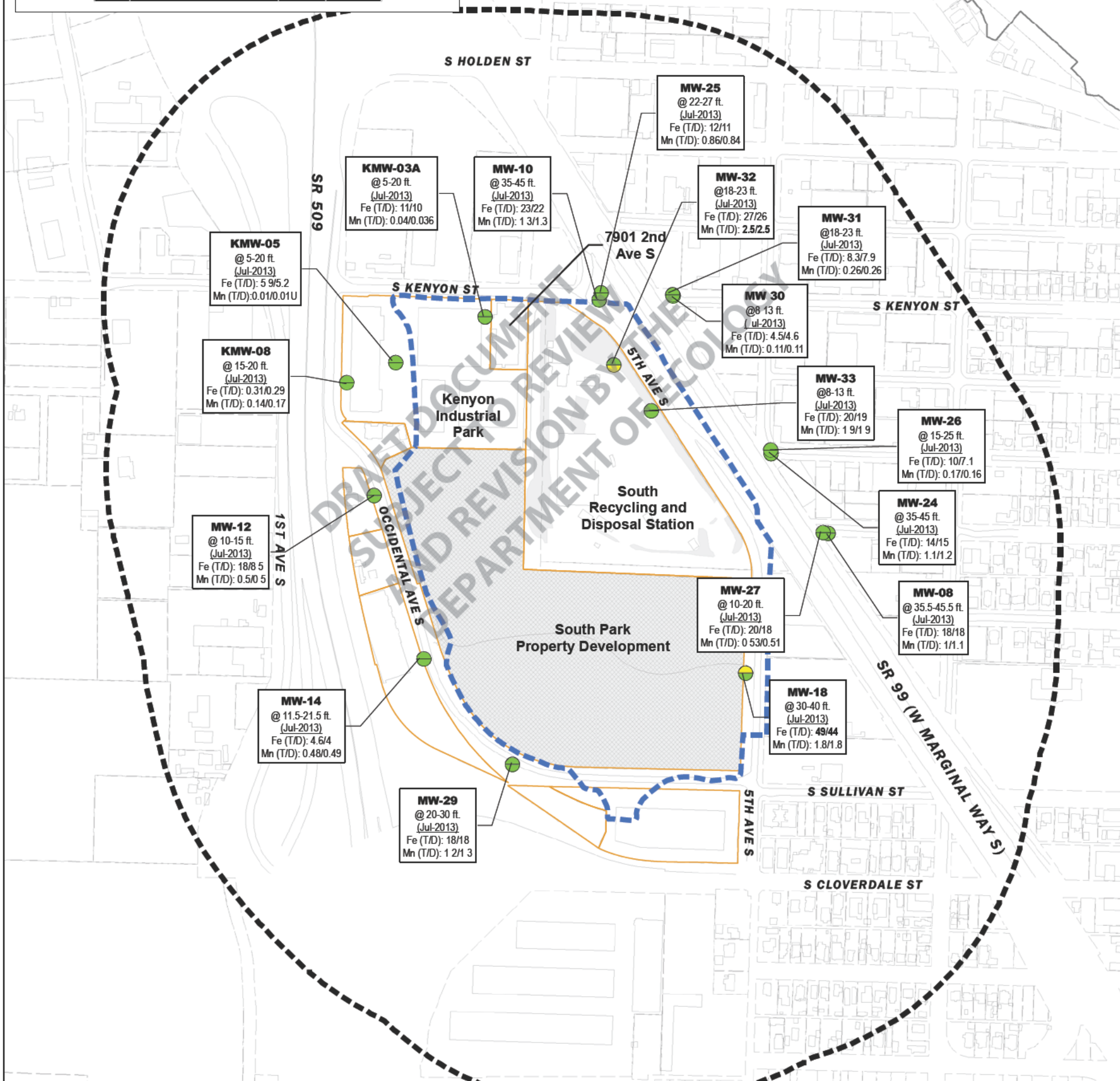
· Tax parcels provided by King County Geographic Information Systems Center.

**Abbreviations:**

- ft - Feet
- mg/L - Milligrams per liter
- RI/FS - Remedial Investigation/Feasibility Study

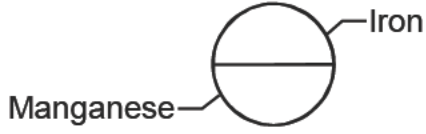
**Qualifier:**

U The analyte was not detected at the reported concentration.



**Legend**

- Revised Landfill Boundary (based on RI/FS)
- Tax Parcel
- 1,000-foot Perimeter from Landfill Boundary



**Location Labels:**

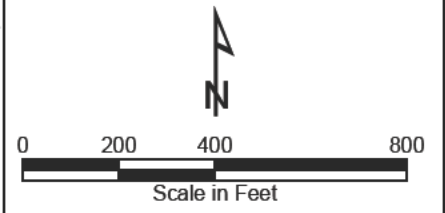
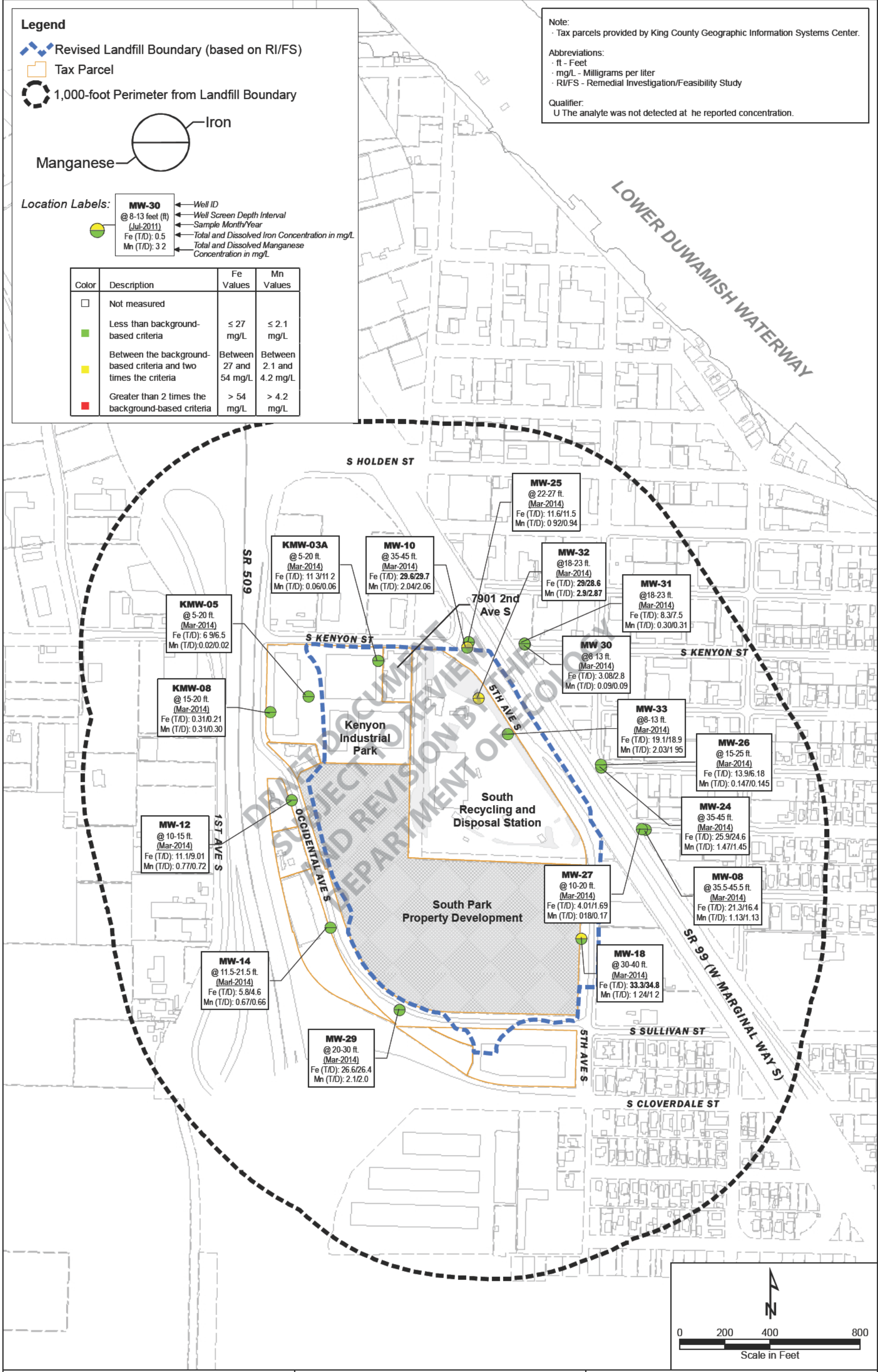
- Well ID
- Well Screen Depth Interval
- Sample Month/Year
- Total and Dissolved Iron Concentration in mg/L
- Total and Dissolved Manganese Concentration in mg/L

Color	Description	Fe Values	Mn Values
	Not measured		
	Less than background-based criteria	≤ 27 mg/L	≤ 2.1 mg/L
	Between the background-based criteria and two times the criteria	Between 27 and 54 mg/L	Between 2.1 and 4.2 mg/L
	Greater than 2 times the background-based criteria	> 54 mg/L	> 4.2 mg/L

**Note:**  
 - Tax parcels provided by King County Geographic Information Systems Center.

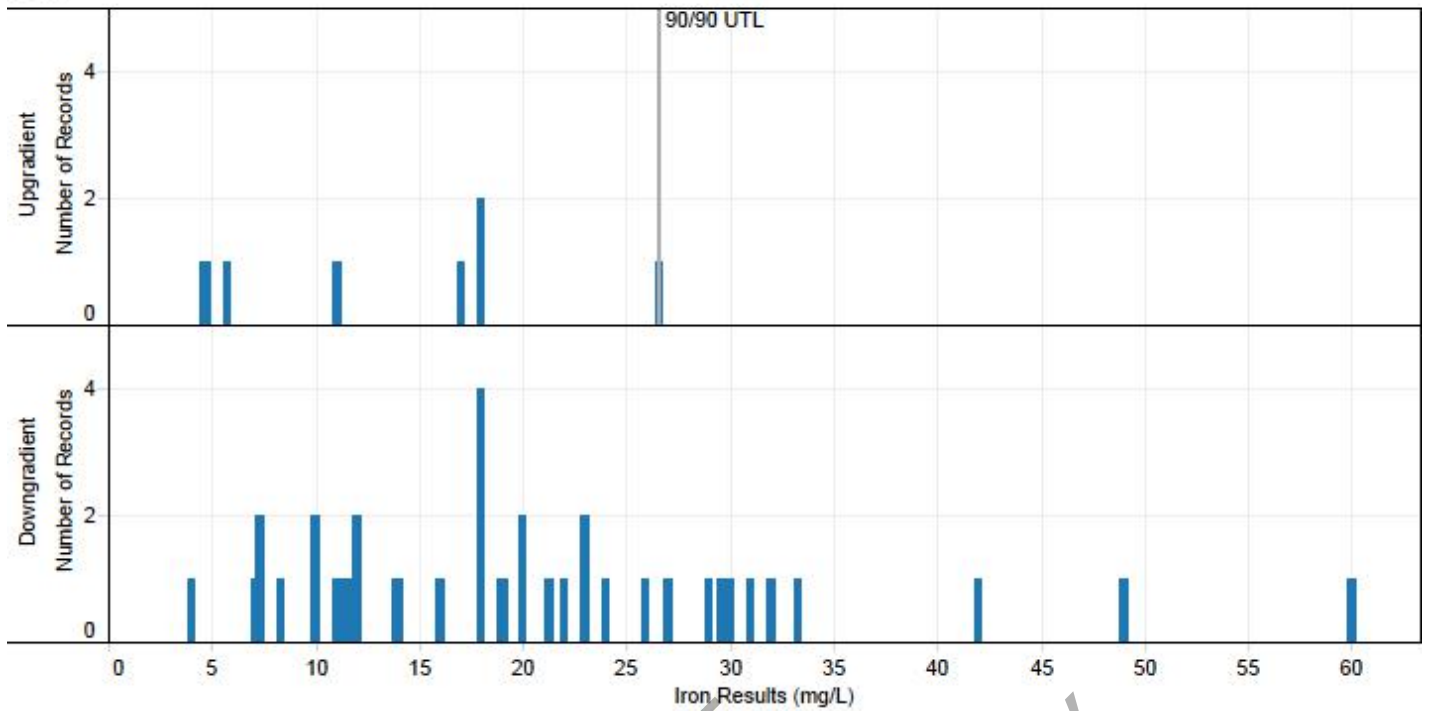
**Abbreviations:**  
 - ft - Feet  
 - mg/L - Milligrams per liter  
 - RI/FS - Remedial Investigation/Feasibility Study

**Qualifier:**  
 U The analyte was not detected at the reported concentration.

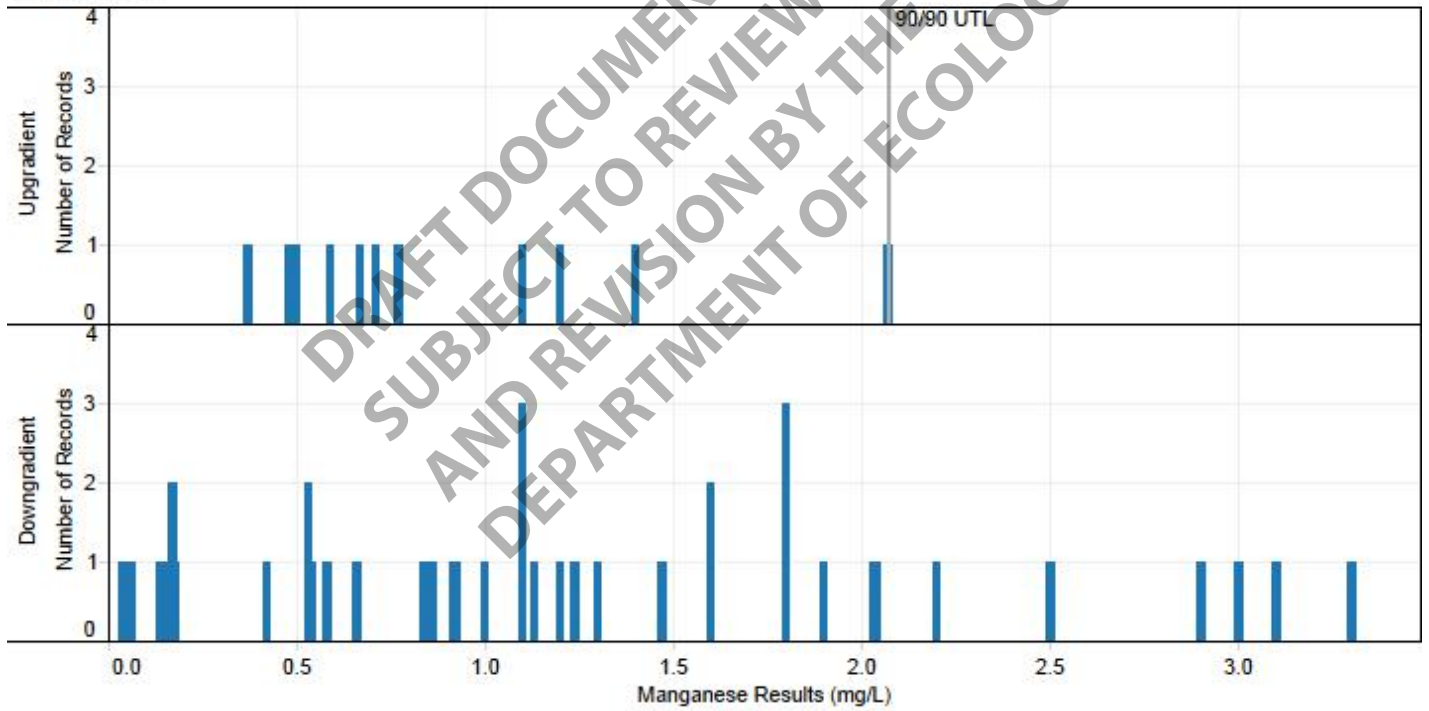


H:\GIS\Projects\COS-SPARK\MXD\RI\FS\Fig 5\_13B GW Iron and Mang.mxd  
 6/24/2014

### Iron



### Manganese



Abbreviations:

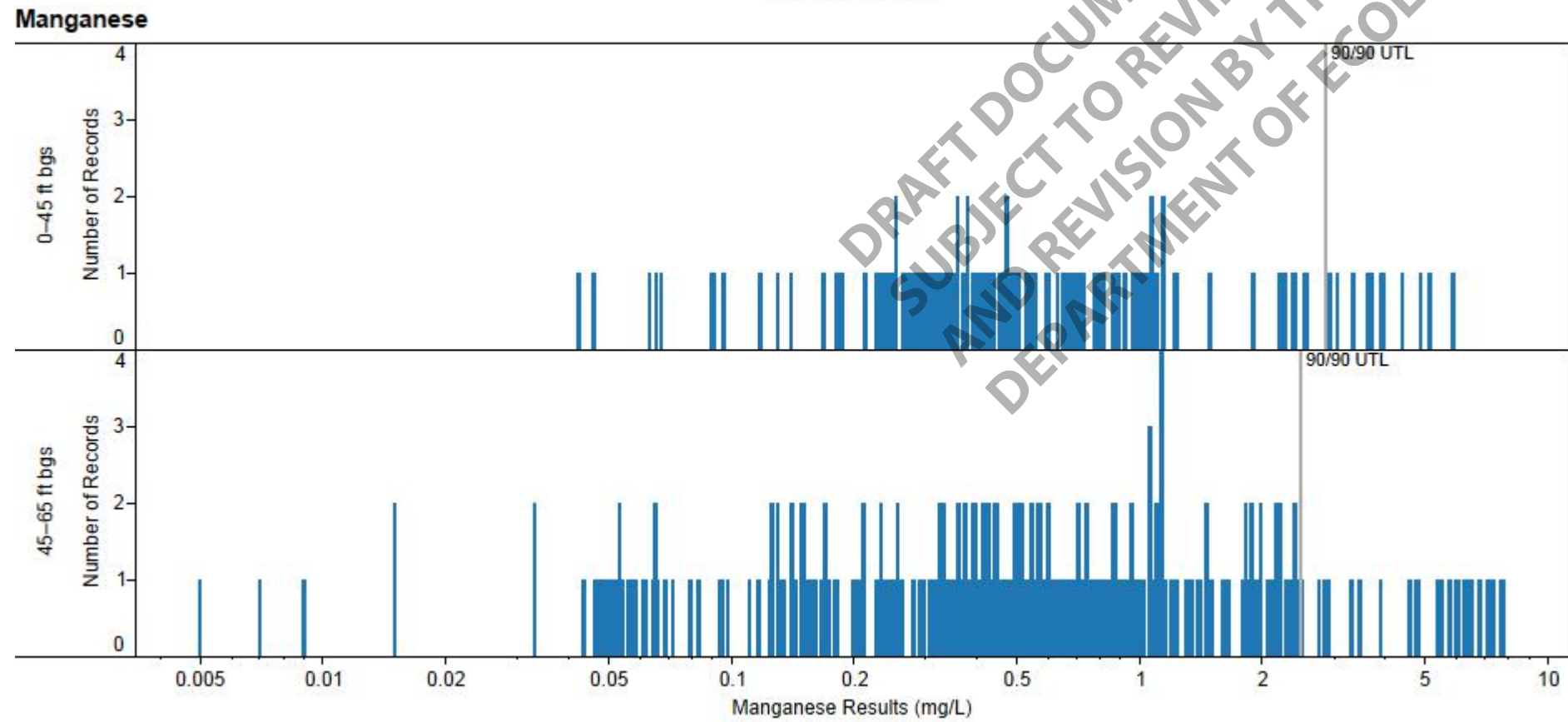
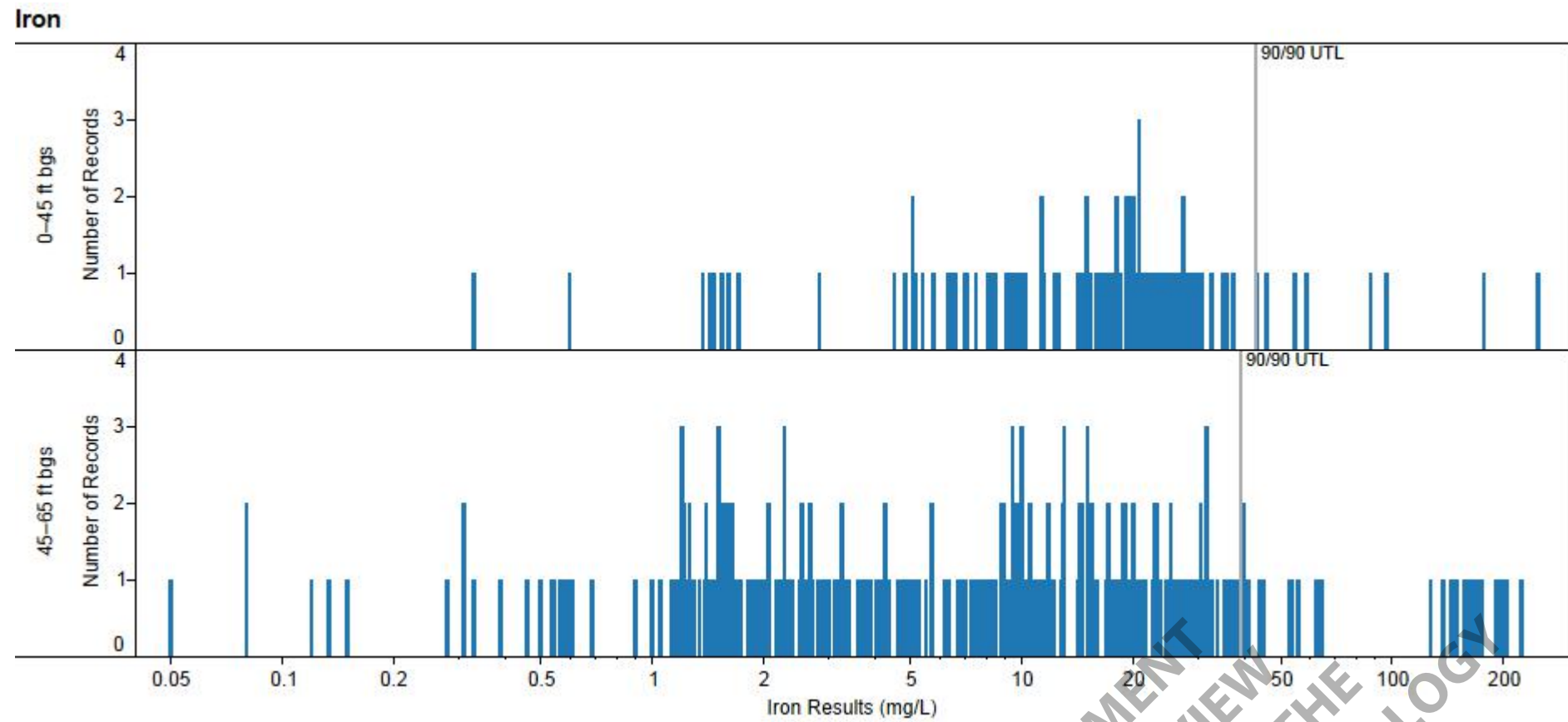
mg/L = Milligrams per liter

90/90 UTL = 90<sup>th</sup> percentile of the 90 percent upper tolerance limit

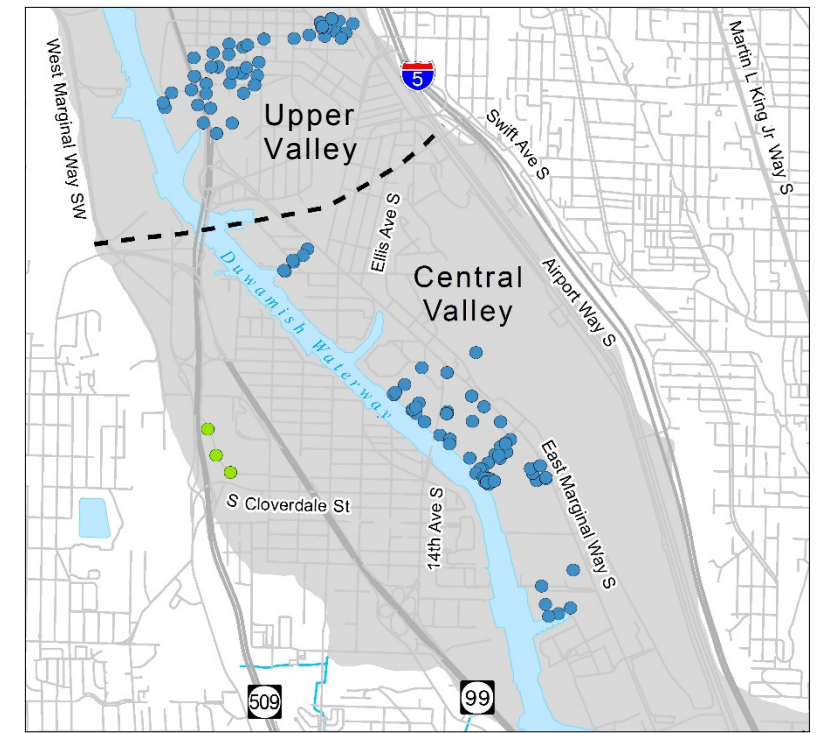


## Remedial Investigation/Feasibility Study South Park Landfill Seattle, Washington

Figure 5.14  
Site-Specific Total  
Iron and Manganese  
in Groundwater  
Multiple Events  
2011–2014



Map shows location of groundwater wells where iron data are available. Data used are primarily from depths deeper than 40 feet bgs where contamination is too low to affect iron concentrations. Green wells are background locations within the South Park Landfill site.



Notes:  
 High iron and manganese concentrations exist throughout the Duwamish Valley at all depths in the aquifer. When known, data excluded samples that had been impacted by contaminant releases.

Abbreviations:  
 ft bgs = Feet below ground surface  
 mg/L = Milligrams per liter  
 90/90 UTL = 90<sup>th</sup> percentile of the 90 percent upper tolerance limit



**South Park Landfill  
 Remedial Investigation/Feasibility Study  
 South Park Landfill  
 Seattle, Washington**

**Figure 5.15  
 Total Iron and Manganese Concentrations in the Duwamish Valley  
 Aquifer**

**Legend**

**Well Locations:**

- A-Zone Monitoring Well
- Perched Zone & A-Zone Monitoring Well
- B-Zone Monitoring Well
- Perched Zone Monitoring Well

Revised Landfill Boundary (based on RI/FS)

Tax Parcel

1,000-foot Perimeter from Landfill Boundary

**Well Labels:**

<p><b>MW-10</b> @ 35-45 feet (ft) DO: 0.65 ORP: <b>-121.9</b> Nit: <b>0.05U</b> Sulf: 176 Meth: 51 Eth: <b>18.2</b></p>	<p>← Well ID ← Well Screen Depth Interval ← Dissolved Oxygen in mg/L ← Oxidation Reduction Potential in mV ← Nitrate as Nitrogen in mg/L ← Sulfate in mg/L ← Methane in µg/L ← Ethane in µg/L</p>
---	---

*BLUE ITALICS* indicate favorable conditions for natural attenuation of hydrocarbon fuels or chlorinated solvents (values from USEPA/600/R-98/128 1998):

- Dissolved Oxygen: less than 0.5 mg/L
- Oxidation Reduction Potential: less than 50 mV
- Nitrate as Nitrogen: less than 1 mg/L
- Sulfate: less than 20 mg/L
- Methane: greater than 500 µg/L
- Ethane: greater than 10 µg/L

**Notes:**

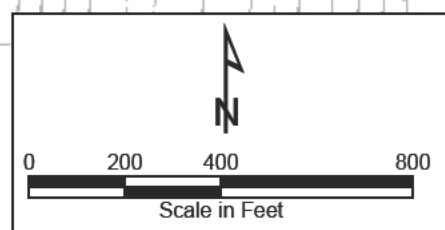
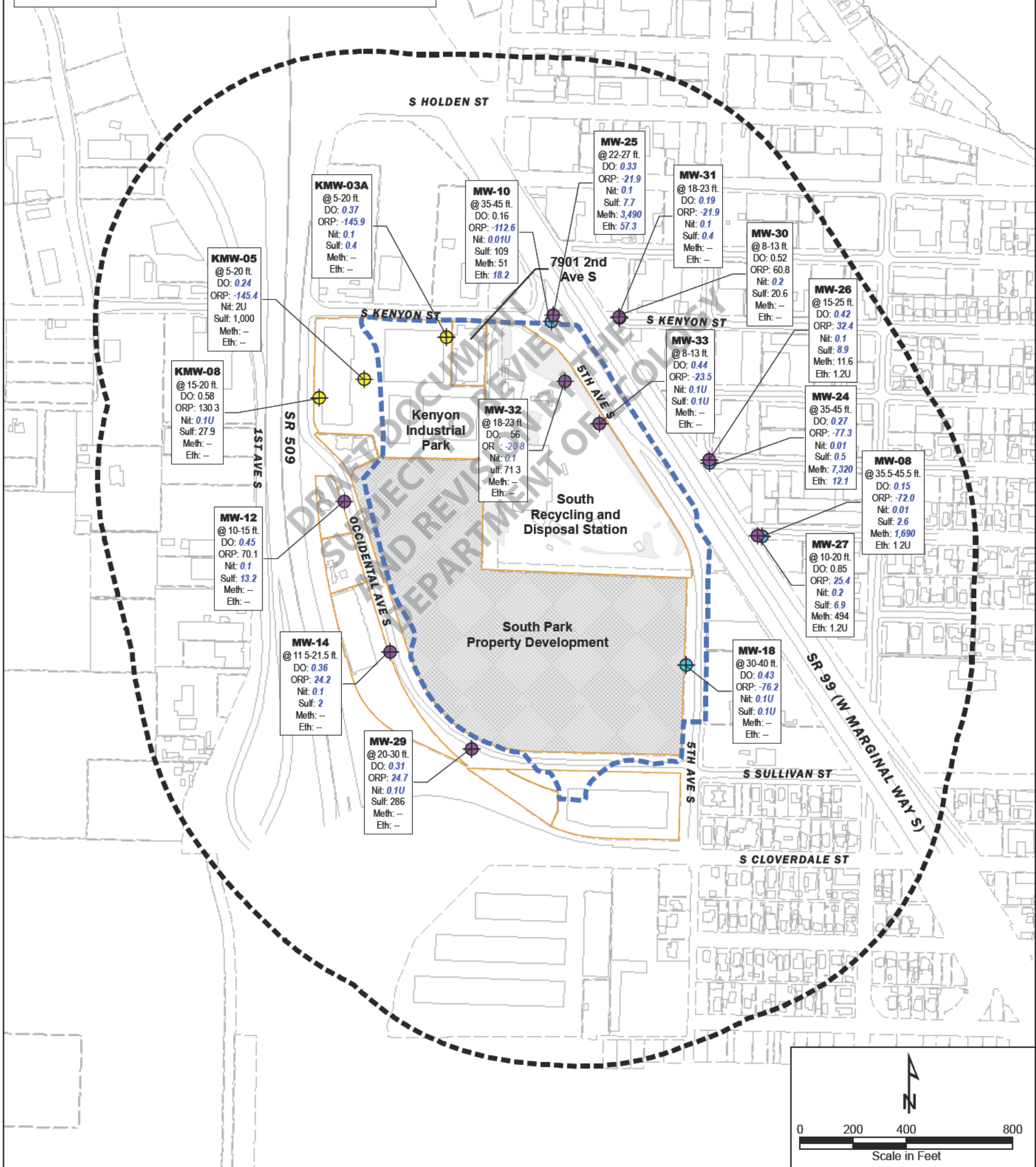
- Tax parcels provided by King County Geographic Information Systems Center.
- Only well locations sampled for natural attenuation parameters are illustrated.
- Attenuation parameters are from March 2014 sampling event except methane and ethane, which were not analyzed for after 2011.

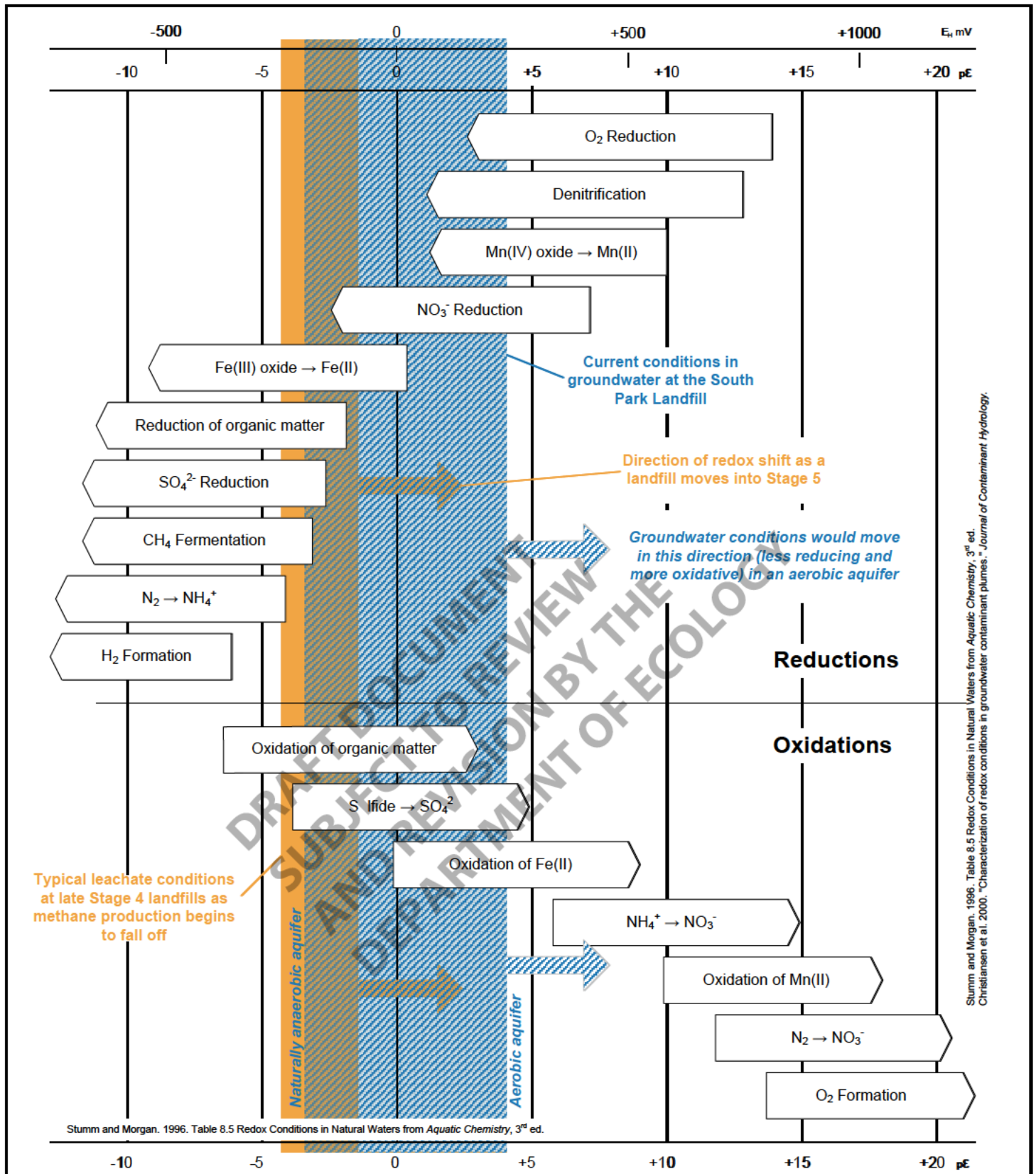
**Abbreviations:**

- µg/L - Micrograms per liter
- mg/L - Milligrams per liter
- mV - Millivolts
- USEPA - United States Environmental Protection Agency
- RI/FS - Remedial Investigation/Feasibility Study

**Qualifier:**

- U The analyte was not detected at the reported concentration.





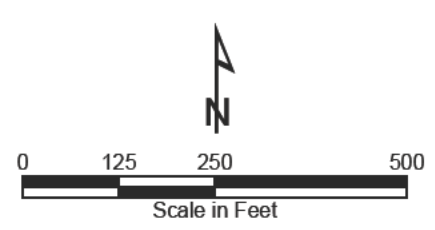
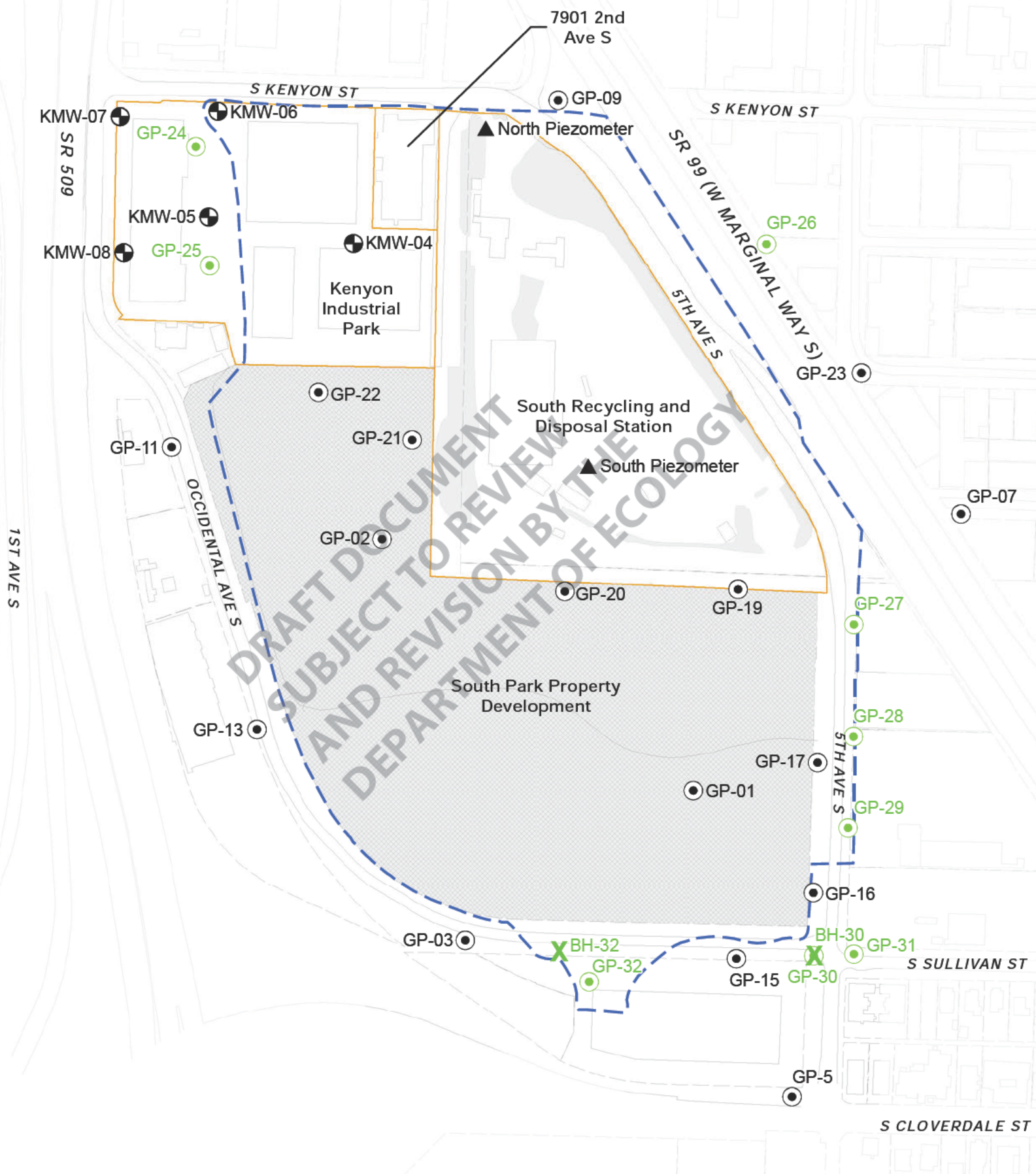
Stumm and Morgan, 1996. Table 8.5 Redox Conditions in Natural Waters from Aquatic Chemistry, 3<sup>rd</sup> ed.  
Christiansen et al., 2000. "Characterization of redox conditions in groundwater contaminant plumes." Journal of Contaminant Hydrology.

<p><b>FLOYD   SNIDER</b> strategy • science • engineering</p> <p><b>Aspect</b> CONSULTING</p> <p><b>HERREPA</b> CONSULTANTS</p>	<p><b>Remedial Investigation/Feasibility Study</b> <b>South Park Landfill</b> <b>Seattle, Washington</b></p>	<p><b>Figure 5.17</b> <b>Redox Conditions in</b> <b>Natural Waters</b></p>
---	--	--

**Legend**

- GP-01 ● Gas Probe
- KMW-04 ● Monitoring Well
- ▲ Piezometer
- BH-32 X Barhole Monitoring Location
- GP-27 ● Gas Probe Installed in 2011 for RI/FS
- Revised Landfill Boundary (based on RI/FS)
- Tax Parcel
- South Park Property Development

Note:  
 - Tax parcels provided by King County Geographic Information Systems Center.  
 Abbreviation:  
 - RI/FS - Remedial Investigation/Feasibility Study



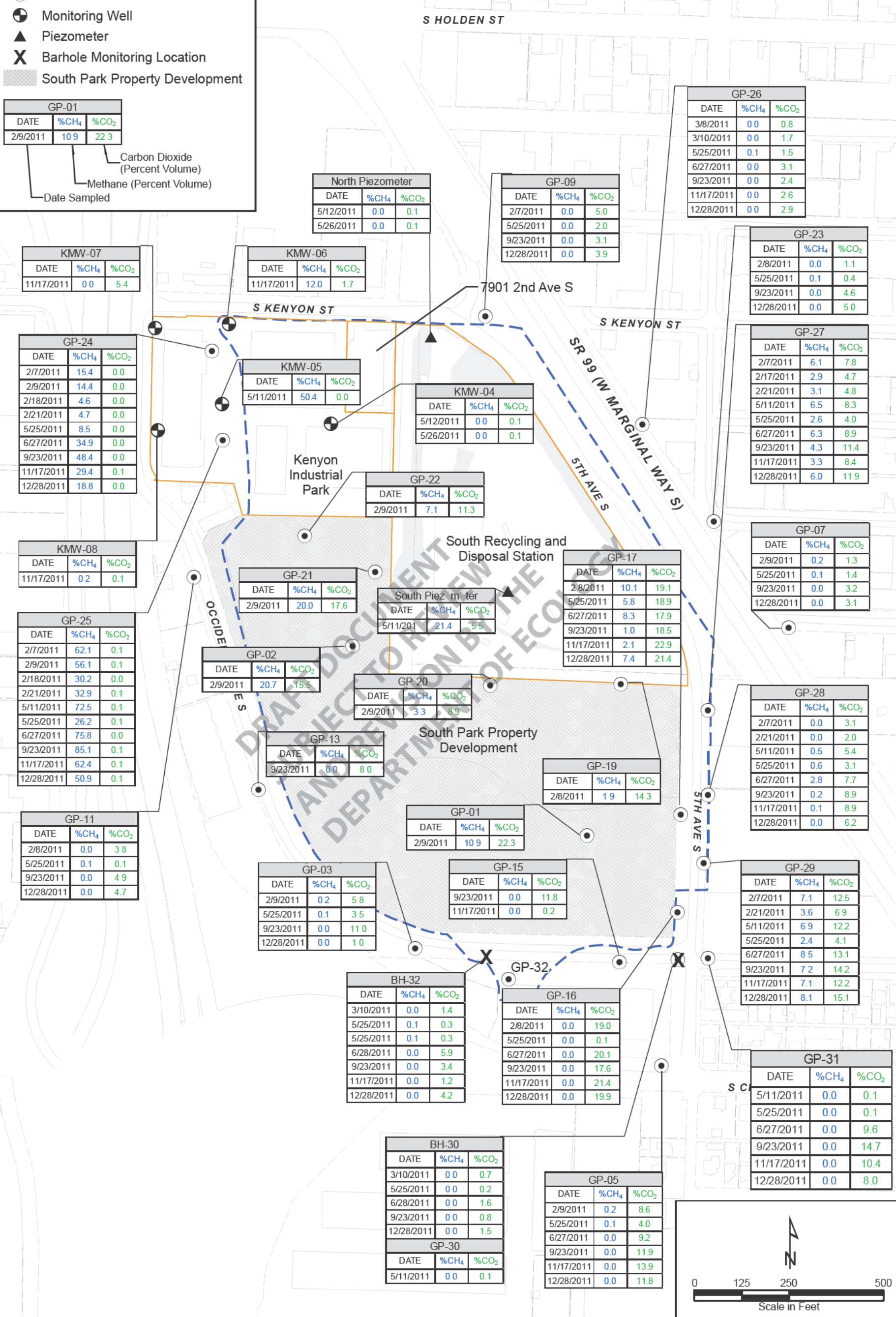
**Legend**

- Revised Landfill Boundary (based on RI/FS)
- Tax Parcel
- Gas Probe
- Monitoring Well
- Piezometer
- Barhole Monitoring Location
- South Park Property Development

GP-01		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/9/2011	10.9	22.3

Carbon Dioxide (Percent Volume)  
Methane (Percent Volume)  
Date Sampled

Note:  
- Tax parcels provided by King County Geographic Information Systems Center.  
Abbreviation:  
- RI/FS - Remedial Investigation/Feasibility Study



North Piezometer		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
5/12/2011	0.0	0.1
5/26/2011	0.0	0.1

GP-09		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/7/2011	0.0	5.0
5/25/2011	0.0	2.0
9/23/2011	0.0	3.1
12/28/2011	0.0	3.9

GP-26		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
3/8/2011	0.0	0.8
3/10/2011	0.0	1.7
5/25/2011	0.1	1.5
6/27/2011	0.0	3.1
9/23/2011	0.0	2.4
11/17/2011	0.0	2.6
12/28/2011	0.0	2.9

KMW-07		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
11/17/2011	0.0	5.4

KMW-06		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
11/17/2011	12.0	1.7

GP-23		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/8/2011	0.0	1.1
5/25/2011	0.1	0.4
9/23/2011	0.0	4.6
12/28/2011	0.0	5.0

GP-24		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/7/2011	15.4	0.0
2/9/2011	14.4	0.0
2/18/2011	4.6	0.0
2/21/2011	4.7	0.0
5/25/2011	8.5	0.0
6/27/2011	34.9	0.0
9/23/2011	48.4	0.0
11/17/2011	29.4	0.1
12/28/2011	18.8	0.0

KMW-05		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
5/11/2011	50.4	0.0

KMW-04		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
5/12/2011	0.0	0.1
5/26/2011	0.0	0.1

GP-27		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/7/2011	6.1	7.8
2/17/2011	2.9	4.7
2/21/2011	3.1	4.8
5/11/2011	6.5	8.3
5/25/2011	2.6	4.0
6/27/2011	6.3	8.9
9/23/2011	4.3	11.4
11/17/2011	3.3	8.4
12/28/2011	6.0	11.9

GP-22		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/9/2011	7.1	11.3

GP-17		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/8/2011	10.1	19.1
5/25/2011	5.8	18.9
6/27/2011	8.3	17.9
9/23/2011	1.0	18.5
11/17/2011	2.1	22.9
12/28/2011	7.4	21.4

GP-07		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/9/2011	0.2	1.3
5/25/2011	0.1	1.4
9/23/2011	0.0	3.2
12/28/2011	0.0	3.1

KMW-08		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
11/17/2011	0.2	0.1

GP-21		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/9/2011	20.0	17.6

South Piezometer		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
5/11/2011	21.4	5.5

GP-28		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/7/2011	0.0	3.1
2/21/2011	0.0	2.0
5/11/2011	0.5	5.4
5/25/2011	0.6	3.1
6/27/2011	2.8	7.7
9/23/2011	0.2	8.9
11/17/2011	0.1	8.9
12/28/2011	0.0	6.2

GP-25		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/7/2011	62.1	0.1
2/9/2011	56.1	0.1
2/18/2011	30.2	0.0
2/21/2011	32.9	0.1
5/11/2011	72.5	0.1
5/25/2011	26.2	0.1
6/27/2011	75.8	0.0
9/23/2011	85.1	0.1
11/17/2011	62.4	0.1
12/28/2011	50.9	0.1

GP-02		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/9/2011	20.7	15.5

GP-20		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/9/2011	3.3	8.9

GP-29		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/7/2011	7.1	12.5
2/21/2011	3.6	6.9
5/11/2011	6.9	12.2
5/25/2011	2.4	4.1
6/27/2011	8.5	13.1
9/23/2011	7.2	14.2
11/17/2011	7.1	12.2
12/28/2011	8.1	15.1

GP-11		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/8/2011	0.0	3.8
5/25/2011	0.1	0.1
9/23/2011	0.0	4.9
12/28/2011	0.0	4.7

GP-13		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
9/23/2011	0.0	8.0

GP-19		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/8/2011	1.9	14.3

GP-03		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/9/2011	0.2	5.8
5/25/2011	0.1	3.5
9/23/2011	0.0	11.0
12/28/2011	0.0	1.0

GP-01		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/9/2011	10.9	22.3

GP-15		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
9/23/2011	0.0	11.8
11/17/2011	0.0	0.2

BH-32		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
3/10/2011	0.0	1.4
5/25/2011	0.1	0.3
5/25/2011	0.1	0.3
6/28/2011	0.0	5.9
9/23/2011	0.0	3.4
11/17/2011	0.0	1.2
12/28/2011	0.0	4.2

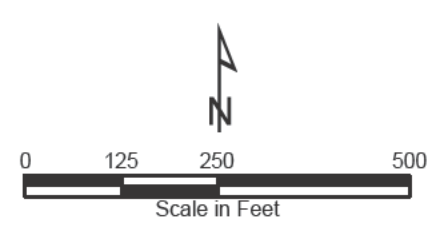
GP-16		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/8/2011	0.0	19.0
5/25/2011	0.0	0.1
6/27/2011	0.0	20.1
9/23/2011	0.0	17.6
11/17/2011	0.0	21.4
12/28/2011	0.0	19.9

GP-31		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
5/11/2011	0.0	0.1
5/25/2011	0.0	0.1
6/27/2011	0.0	9.6
9/23/2011	0.0	14.7
11/17/2011	0.0	10.4
12/28/2011	0.0	8.0

BH-30		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
3/10/2011	0.0	0.7
5/25/2011	0.0	0.2
6/28/2011	0.0	1.6
9/23/2011	0.0	0.8
12/28/2011	0.0	1.5

GP-05		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
2/9/2011	0.2	8.6
5/25/2011	0.1	4.0
6/27/2011	0.0	9.2
9/23/2011	0.0	11.9
11/17/2011	0.0	13.9
12/28/2011	0.0	11.8

GP-30		
DATE	%CH <sub>4</sub>	%CO <sub>2</sub>
5/11/2011	0.0	0.1

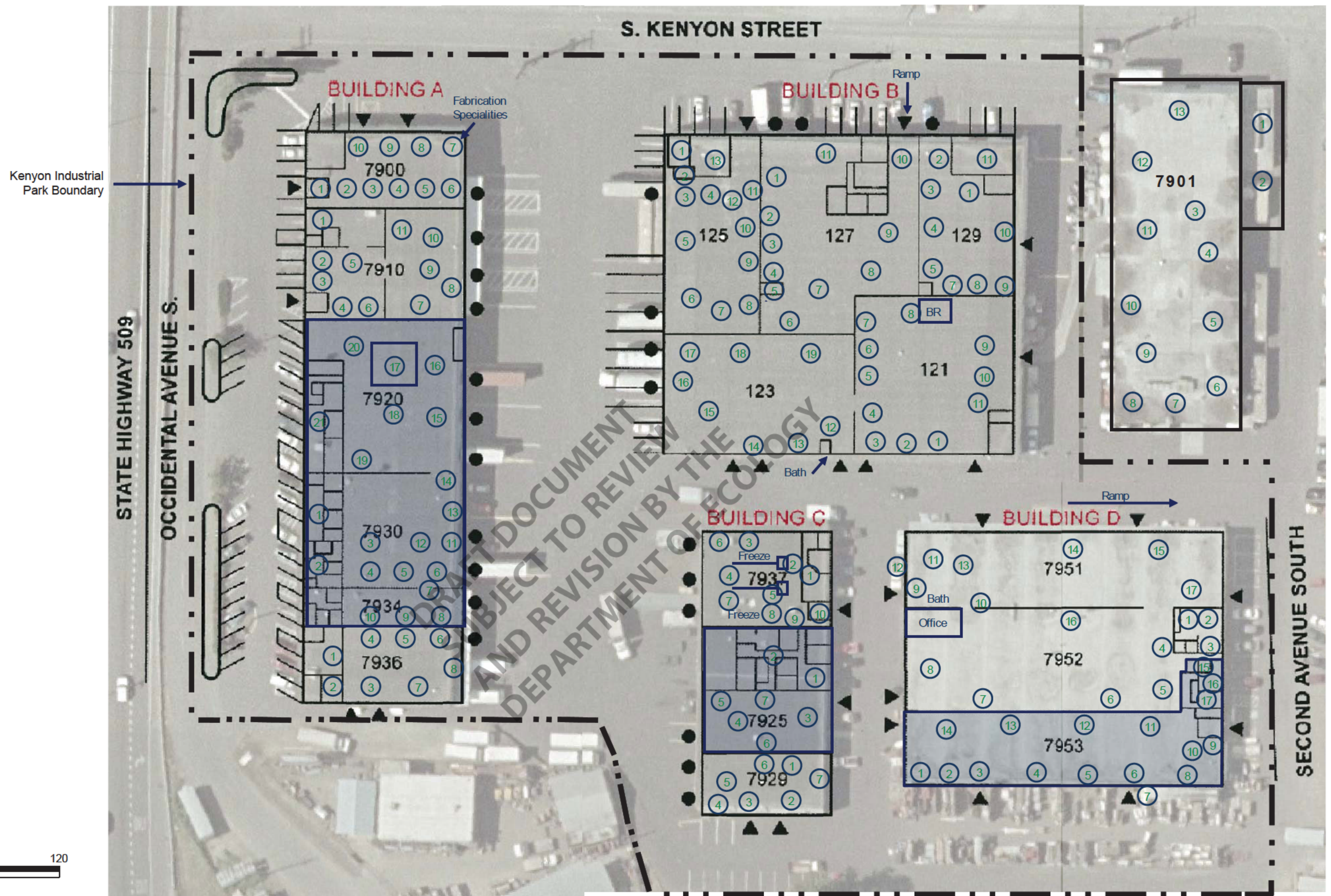


I:\GIS\Projects\COS-SPARK\MXD\RI\FS\Fig 6\_02 Landfill Gas Probe Monitoring Results.mxd  
5/29/2014



**Legend**

- Dock High Overhead Door
- ▲ Roll-up Door
- ② Monitoring Location

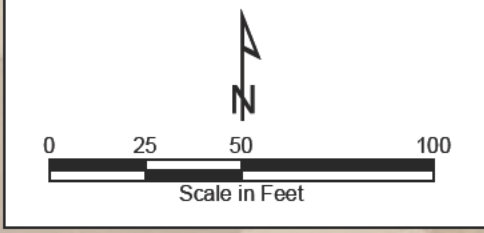


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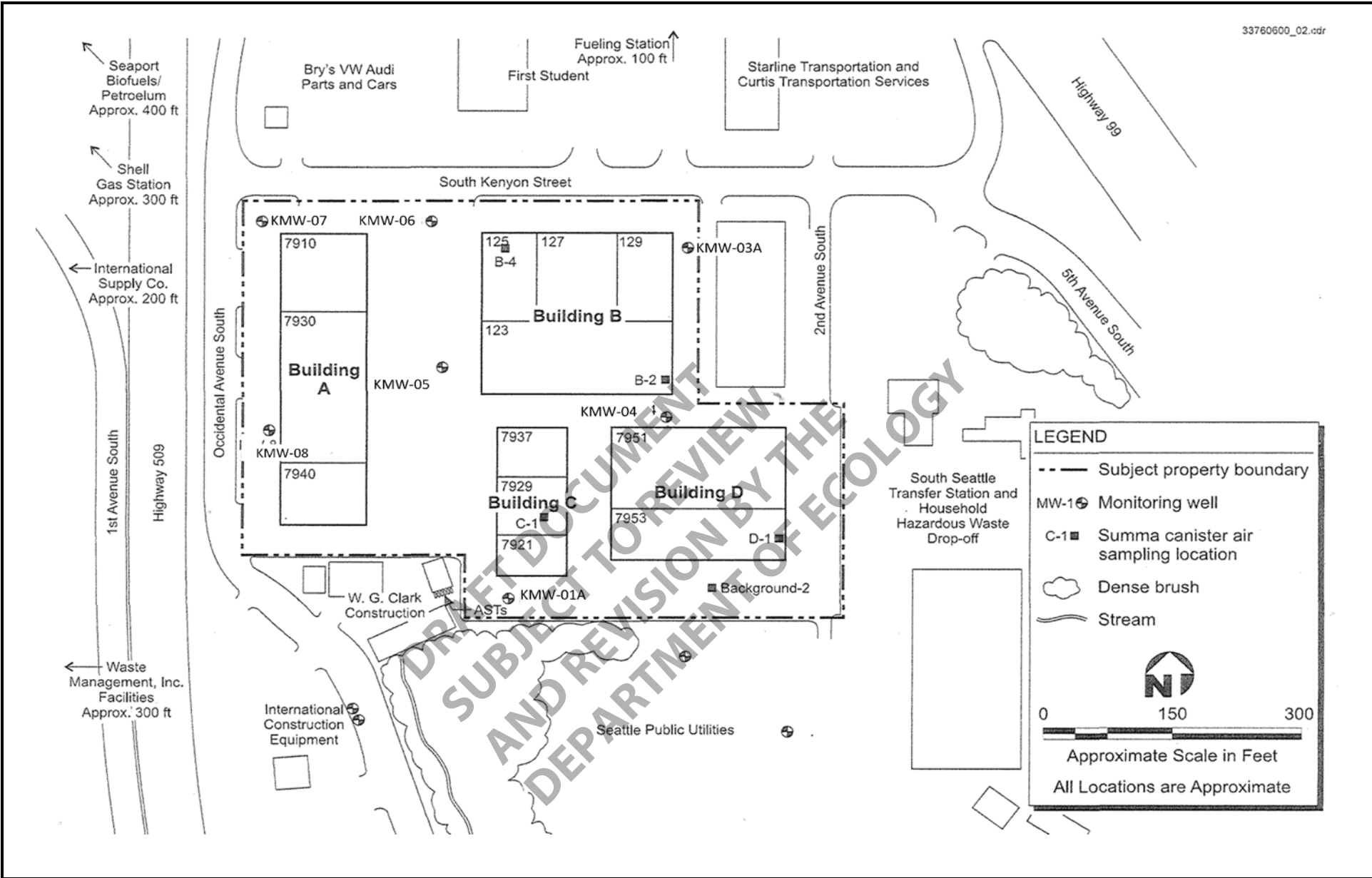
**Legend**  
 ⑧ Monitoring Location

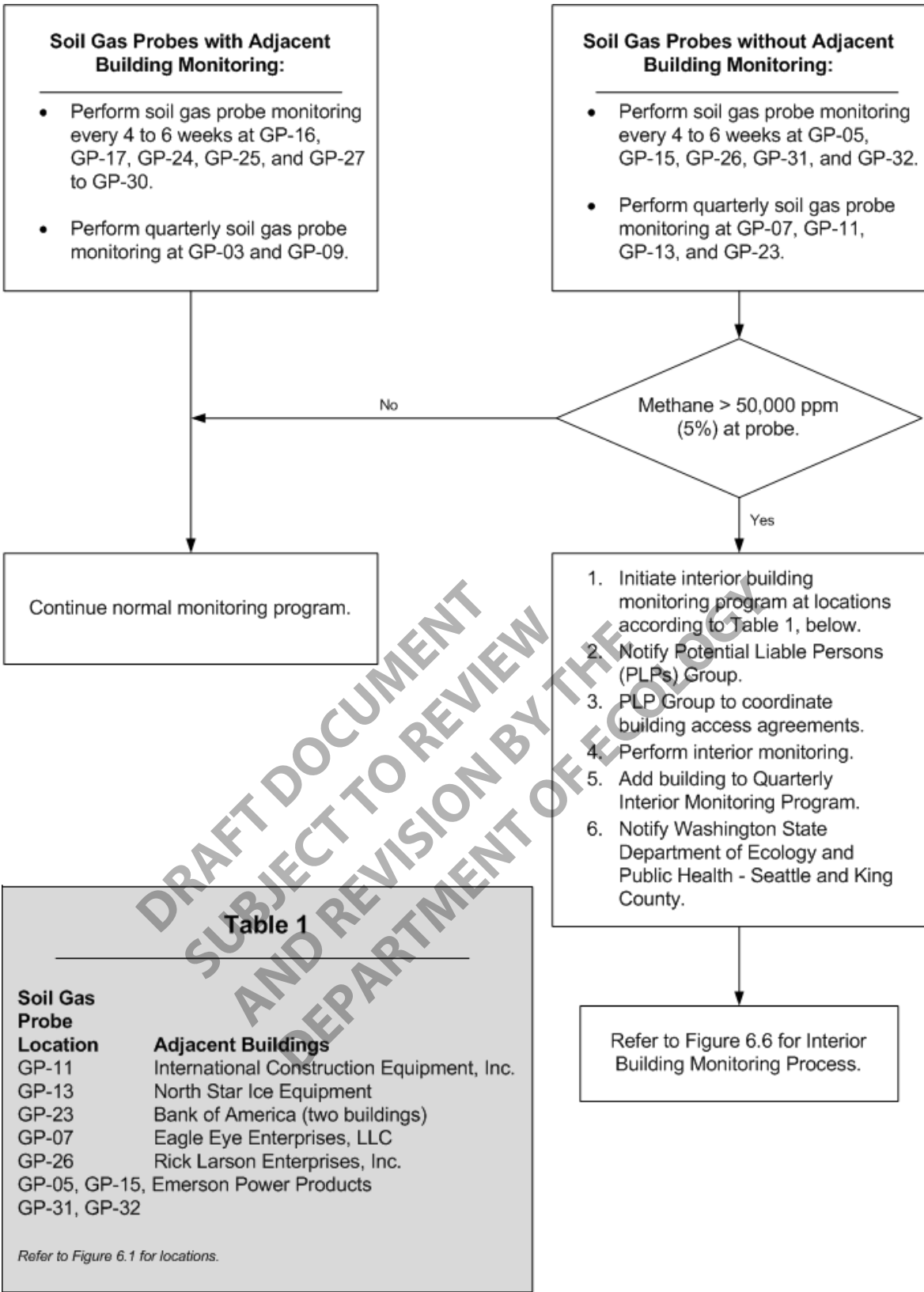
**Notes:**  
 - Aerial imagery from King County 2007.



**Remedial Investigation/Feasibility Study  
 South Park Landfill  
 Seattle, Washington**

**Figure 6.3B  
 Indoor Air Landfill Gas Monitoring Locations—  
 8230 and 8250 5th Avenue South**





**Table 1**

Soil Gas Probe Location	Adjacent Buildings
GP-11	International Construction Equipment, Inc.
GP-13	North Star Ice Equipment
GP-23	Bank of America (two buildings)
GP-07	Eagle Eye Enterprises, LLC
GP-26	Rick Larson Enterprises, Inc.
GP-05, GP-15, GP-31, GP-32	Emerson Power Products

*Refer to Figure 6.1 for locations.*

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AND REVISION BY THE  
DEPARTMENT OF ECOLOGY

Perform quarterly interior building monitoring at 8230 and 8250 5<sup>th</sup> Avenue South, plus additional buildings identified by soil gas probe monitoring as necessary (refer to Figure 6.5).

Methane detected.

Yes

> 100 ppm and  
< 12,500 ppm  
(1.25%) methane

No

Yes

≥ 12,500 ppm  
(1.25%) methane

1. Identify the source.
2. Notify Potential Liable Persons (PLPs) Group and develop response actions.
3. PLP Group to notify building owner.
4. PLP Group to notify Washington State Department of Ecology and Public Health - Seattle and King County.
5. Document monitoring results.

1. Field person will notify tenants to evacuate building and call 911 to report the need for a building evacuation.
2. Identify the source.
3. PLP Group to notify building owner.
4. PLP Group to notify Washington State Department of Ecology and Public Health - Seattle and King County.
5. Document monitoring results.

Continue normal monitoring program.

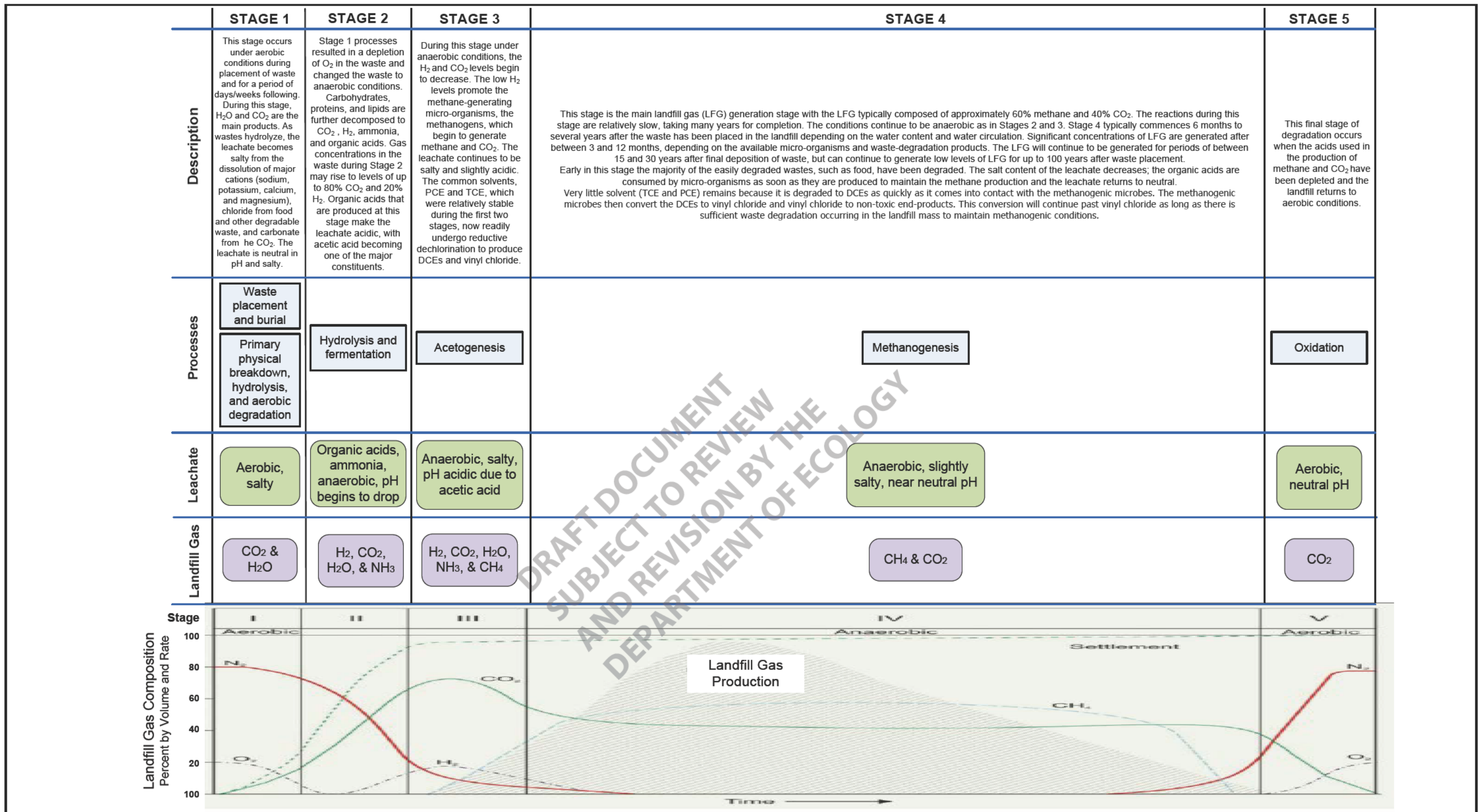
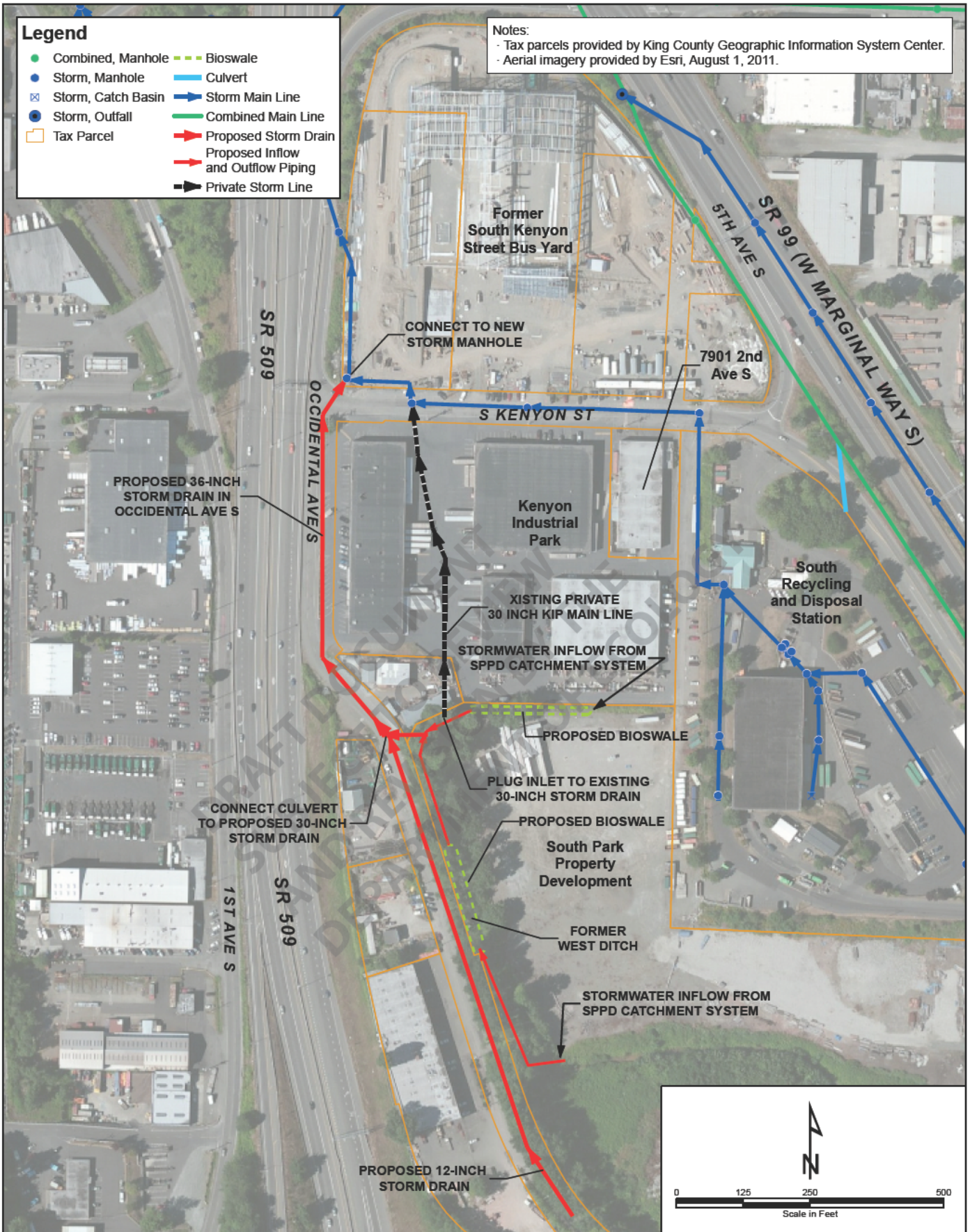


Figure: Changes in the Production and Composition of Landfill Gas with Time (based on Farquhar and Rovers 1973 with additions from USEPA 2011).



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ENVIRONMENTAL  
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**Remedial Investigation/Feasibility Study  
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Figure 13.1  
Proposed Storm  
Drain in Public  
Right-of-Way

**Legend**

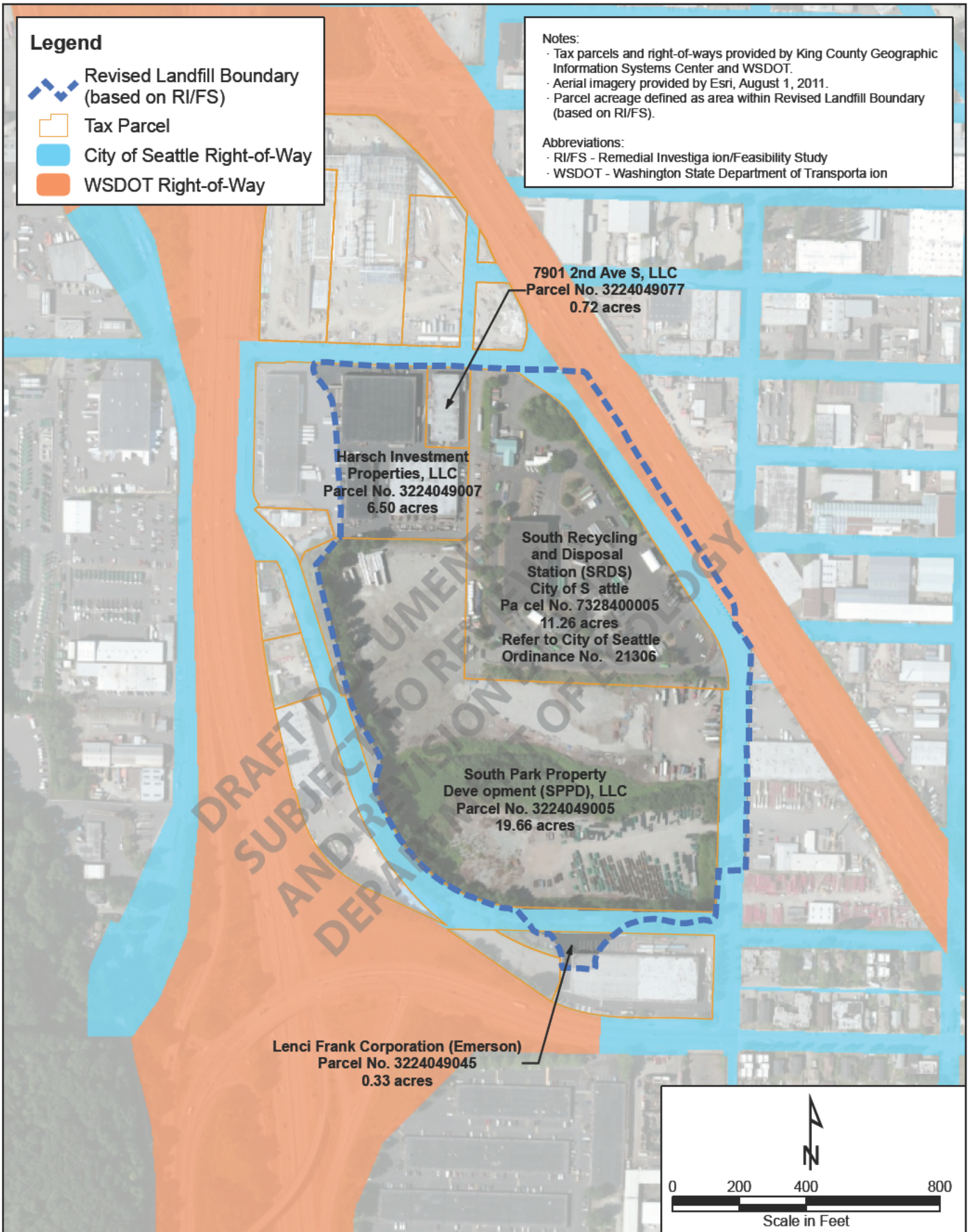
-  Revised Landfill Boundary (based on RI/FS)
-  Tax Parcel
-  City of Seattle Right-of-Way
-  WSDOT Right-of-Way

**Notes:**

- Tax parcels and right-of-ways provided by King County Geographic Information Systems Center and WSDOT.
- Aerial imagery provided by Esri, August 1, 2011.
- Parcel acreage defined as area within Revised Landfill Boundary (based on RI/FS).

**Abbreviations:**

- RI/FS - Remedial Investigation/Feasibility Study
- WSDOT - Washington State Department of Transportation



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**Remedial Investigation/Feasibility Study**  
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Figure 16.1  
Environmental  
Covenant Parcels