DOE/RL-2013-53
Revision 2

Hanford Site Environmental Surveillance Master Sampling Schedule for Calendar Year 2016

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

U.S. DEPARTMENT OF ENERGY | Richland Operations Office

P.O. Box 550
Richland, Washington 99352

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Summary

Mission Support Alliance (MSA) conducts environmental surveillance of the Hanford Site and surrounding areas for the U.S. Department of Energy, Richland Operations Office (DOE-RL). Sampling is conducted to evaluate levels of radioactive and nonradioactive pollutants in the Hanford Site environs, as required in DOE O 436.1, Supp Rev. 0, Departmental Sustainability, and DOE O 458.1, Chg. 2, Radiation Protection of the Public and the Environment.[1,2] The environmental surveillance sampling design is described in the Hanford Site Environmental Monitoring Plan, (DOE/RL-91-50).[3]

This document contains the calendar year (CY) 2016 schedule for routine radiological surveys and collection of samples for the Environmental Surveillance Project. Each section includes a general timeline for surveys and collection of samples, sampling locations, sampling frequencies, sample types, and analyses to be performed. In some cases, samples are scheduled on a rotating basis. If a sample will not be collected during the current year, the anticipated year for collection is provided.

Environmental Surveillance Project Sampling

The Environmental Surveillance project is a multimedia environmental surveillance effort to measure the concentrations of radionuclides and chemicals in environmental media and radiological external exposure levels. The data obtained from these efforts is used to demonstrate compliance with applicable environmental quality standards and public exposure limits, and assess environmental impacts. Project personnel collect selected samples of ambient air, surface water, agricultural products, fish, wildlife, soil, vegetation, sediments, and dosimeters as well as perform radiological surveys at or near known radioactive waste sites.

A radiological pathway analysis and exposure assessment is performed annually. The results of the pathway analysis and exposure assessment, as well as a biota dose screening evaluation, serve as the bases for the design of the ES program. The surveillance design is reviewed and evaluated annually based on the above considerations and an awareness of planned waste management and environmental restoration activities.

Quality Control

Quality Control (QC) duplicate samples are used to assess sample collection process variance. A sample collection process includes collection, handling, storage, and laboratory analyses. Similar sample collection methods for similar media are considered to be the same process. Air sample QC samples are collected through the employment of collocated sampling stations at two locations. Duplicate QC samples are obtained at a frequency range of 5-10% (duplicate to parent ratio). With the exception of routine air samples, equipment blanks are collected from each type of sampling equipment used to ensure that decontamination procedures are applicable to the specific equipment types.

Laboratory split samples are a variation of field duplicate samples. The frequency and method for collection of field split samples is directed by the project plan or implementing procedure. Laboratory split samples are collected for the purpose of comparing data from different laboratories. Split samples

[1] DOE O 436.1, Supp Rev. 0. 2011. *Departmental Sustainability*. U.S. Department of Energy, Washington, D.C.

[2] DOE O 458.1, Chg. 2. 2011. *Radiation Protection of the Public and the Environment*. U.S. Department of Energy, Washington, D.C.

[3] DOE/RL-91-50, Rev. 7. 2015. *Environmental Monitoring Plan, United States Department of Energy, Richland Operations Office*. U.S. Department of Energy, Richland Operations Office, Richland, Washington.

are forwarded to separate laboratories for analysis using the same method/protocol. The data generated by field split samples is used during the data assessment process to evaluate the data from the analyses performed by the primary laboratory on samples from the same source (DOE/RL-96-68, HASQARD Volume 2, *Sampling Technical Requirements*).

Quality Control equipment blank samples are analyzed for the same analytes as are the samples being collected or as specified in the project-specific SOPs, SAP, or other work control documents (DOE/RL-96-68, HASQARD Volume 2, *Sampling Technical Requirement*s). The Environmental Surveillance project collects environmental samples that are either split or collocated with the Washington State Department of Health (DOH) and the results are compared by DOH to verify the quality of the Environmental Surveillance monitoring program.

Data Management

The Hanford Environmental Information System (HEIS) and the Automated Bar Coding of All Samples at Hanford (ABCASH) databases are used as repositories for data gathered during environmental surveillance activities at the Hanford Site. For ease in retrieving Environmental Surveillance data from the databases, the majority of the location names in this document are the location names used in these databases.

Schedule Changes

This schedule is subject to modification during the year in response to changes to Hanford Site operations, program requirements, project funding, and the nature of the observed results. Operational limitations such as weather, mechanical failures, sample availability, and other factors may also impact scheduled sampling. As a result, this document should not be considered an accurate record of samples collected during the year. The Environmental Surveillance program is a flexible environmental monitoring and sampling program that responds to changes in environmental regulations, on-site activities and conditions, as well as off-site influences (e.g., changes in agricultural products based on market interests).

This Schedule now includes two Appendices:

- Appendix A provides descriptions of changes to the Schedule from the previous year along with rationale for those changes.

- Appendix B provides media-specific sampling rationale and design.

Contents

Appendices

Figures

Acronyms and Symbols

^{129}I	iodine-129
^{137}Cs	cesium-137
^{14}C	carbon-14
^{241}Am	americium-241
^{241}Pu	plutonium-241
^{3}H	tritium
^{90}Sr	strontium-90
^{99}Tc	technetium-99
A	annually
ABCASH	Automated Bar Coding of All Samples at Hanford
ALE	Fitzner/Eberhardt Arid Lands Ecology Reserve
Alpha	gross alpha activity of a sample
Anions	major anions – generally chloride, fluoride, nitrate, nitrite, sulfate
BE	biennially (every two years)
Beta	gross beta activity of a sample
BW	biweekly (every two weeks)
Cr^{+6}	hexavalent chromium
CSB	Canister Storage Building
CSTL	Cross Site Transfer Line
DOE	U.S. Department of Energy
DOH	Washington State Department of Health
DR	Downriver
EDP	Environmental Data Point
ERDF	Environmental Restoration Disposal Facility
GEA	Gamma Energy Analysis
HEIS	Hanford Environmental Information System
Hg-CVAA	mercury by cold vapor atomic absorbance spectrometry
Hg-CVAF	total mercury in water by cold vapor atomic fluorescence
HGP	Hanford Generating Project
HRM	Hanford River Mile
HTO	tritiated water ($^{3}H^{1}H^{16}O$)
ICP-MS	major metals by inductively coupled plasma mass spectrometry – samples unfiltered unless otherwise noted
IDF	Integrated Disposal Facility
Lo ^{3}H	low-level method for the electrolytic enrichment of tritium
M	monthly
MSA	Mission Support Alliance
PFP	Plutonium Finishing Plant
PRD	Priest Rapids Dam
PSRP	Public Safety and Resource Protection

Pu-iso	isotopic plutonium (^{238}Pu, $^{239/240}$Pu)
Q	quarterly
RPH	Richland Pumphouse
SA	semiannually (twice each year)
TA	tri annual (three times a year)
TBD	To Be Determined
TE	triennially (every three years)
TLD	Thermoluminescent Dosimeter
TOC	total organic carbon
TPH	total petroleum hydrocarbons
U-iso	isotopic uranium (^{234}U, ^{235}U, ^{238}U)
VOA	volatile organic analysis
WCH	Washington Closure Hanford

Schedule by Media

In this section of the schedule, the planned sampling events are shown per media. The locations, sampling frequency, and radiochemical and chemical analyses are also provided. Maps for each sample media are included within each section of the document.

1.0 Air Surveillance

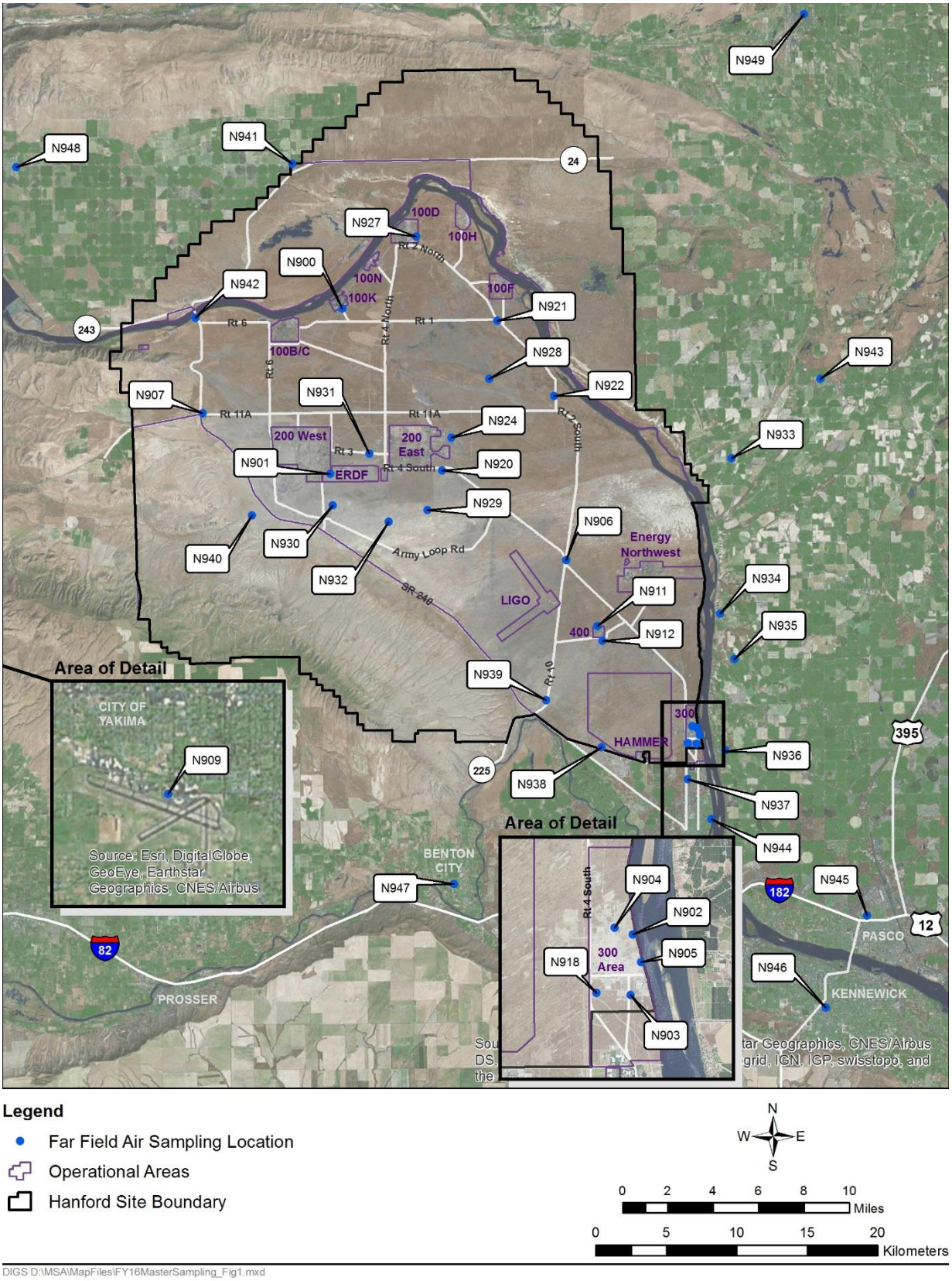
1.1 Far Field Air Monitoring

Far Field Air Monitoring		Analyses		
Air Monitoring Locations	**EDP Code**	**Bi-Weekly[a]**	**Monthly[b]**	**Semi-Annual Composite**
On-site				
100 K Area	N900	Beta, Alpha	Tritium	^{90}Sr, Pu-iso, GEA
100 D Area	N927	Beta, Alpha		^{90}Sr, Pu-iso, GEA
100 F Met Tower	N921	Beta, Alpha		^{90}Sr, Pu-iso, GEA
Hanford Townsite	N922	Beta, Alpha		^{90}Sr, Pu-iso, GEA
Gable Mountain	N928	Beta, Alpha		^{90}Sr, Pu-iso, U-iso, GEA
200 ESE	N920	Beta, Alpha	Tritium	^{90}Sr, Pu-iso, U-iso, GEA
S of 200-E	N929	Beta, Alpha		^{90}Sr, Pu-iso, U-iso, GEA
B Pond	N924	Beta, Alpha		Pu-iso, U-iso, GEA
Army Loop Camp	N930	Beta, Alpha		^{90}Sr, Pu-iso, U-iso, GEA
200 Tel. Exchange	N931	Beta, Alpha	Tritium	^{90}Sr, Pu-iso, U-iso, GEA
SW of B/C Cribs	N932	Beta, Alpha		^{90}Sr, Pu-iso, U-iso, GEA
200 W SE	N901	Beta, Alpha		Pu-iso, U-iso, GEA
300 Water Intake[c, d]	N905	Beta, Alpha	Tritium	^{90}Sr, Pu-iso, U-iso, GEA
300 South Gate[e]	N903	Beta, Alpha	Tritium	^{90}Sr, Pu-iso, U-iso, GEA
300 South West	N918	Beta, Alpha	Tritium	^{90}Sr, Pu-iso, U-iso, GEA
300 Trench	N904	Beta, Alpha	Tritium	^{90}Sr, Pu-iso, U-iso, GEA
300 NE	N902	Beta, Alpha	Tritium	^{90}Sr, Pu-iso, U-iso, GEA
400 N	N911	Beta, Alpha		^{90}Sr, Pu-iso, GEA
400 S	N912	Beta, Alpha	Tritium	^{90}Sr, Pu-iso, GEA
Wye Barricade[c, f]	N906	Beta, Alpha		Pu-iso, U-iso, GEA
Perimeter				
Ringold Met Tower	N933	Beta, Alpha	Tritium	Pu-iso, GEA
W End of Fir Road [c]	N934	Beta, Alpha	Tritium	^{90}Sr, Pu-iso, U-iso, GEA
Dogwood Met Tower	N935	Beta, Alpha	Tritium	^{90}Sr, U-iso, GEA
Byers Landing	N936	Beta, Alpha	Tritium	^{90}Sr, Pu-iso, U-iso, GEA
Battelle Complex[c, d]	N937	Beta, Alpha	Tritium	U-iso, GEA
Horn Rapids Substation	N938	Beta, Alpha		^{90}Sr, Pu-iso, GEA
Prosser Barricade[c]	N939	Beta, Alpha	Tritium	^{90}Sr, Pu-iso, GEA
Yakima Barricade[c]	N907	Beta, Alpha		^{90}Sr, Pu-iso, GEA
Rattlesnake Springs	N940	Beta, Alpha		^{90}Sr, Pu-iso, GEA
Wahluke Slope	N941	Beta, Alpha	Tritium	^{90}Sr, Pu-iso, GEA
S End Vernita Bridge	N942	Beta, Alpha		^{90}Sr, Pu-iso, GEA

Far Field Air Monitoring		Analyses		
Air Monitoring Locations	**EDP Code**	**Bi-Weekly[a]**	**Monthly[b]**	**Semi-Annual Composite**
Nearby Community				
Basin City School	N943	Beta, Alpha	Tritium	Pu-iso, U-iso, GEA
Leslie Groves-Richland	N944	Beta, Alpha	Tritium	^{90}Sr, Pu-iso, U-iso, GEA
Pasco	N945	Beta, Alpha		^{90}Sr, Pu-iso, U-iso, GEA
Kennewick-Ely Street	N946	Beta, Alpha		^{90}Sr, Pu-iso, U-iso, GEA
Benton City	N947	Beta, Alpha		GEA, Am^{241}
Mattawa	N948	Beta, Alpha		GEA
Othello	N949	Beta, Alpha		U-iso, GEA
Distant Community				
Yakima	N909	Beta, Alpha	Tritium	^{90}Sr, Pu-iso, U-iso, GEA
QC Samples				
Trip Blank	N899	Beta, Alpha		^{90}Sr, Pu-iso, U-iso, GEA, Am^{241}

(a) Particulate samples are collected every two weeks using 2-inch glass-fiber filters. These filters are analyzed then stored for the semi-annual composite.
(b) Four-week atmospheric water vapor samples for tritium analysis are collected using silica gel columns.
(c) DOH particulate air sampler also at this location.
(d) DOH tritium air sampler also at this location.
(e) Two tritium samples are collected from this location, one as a duplicate sample.
(f) Duplicate sample N981 (Near field) collected at this location.

Figure 1. Far Field Air Sampling Locations



1.2 Near Field Air Monitoring

Air Monitoring Locations	Number of Samplers	EDP Codes	Analyses		
			Bi-Weekly[a]	Monthly[b]	Semi-Annual Composite
100-K Area	6	N476, N534, N535, N575, N576[c], N578	Beta, Alpha		^{90}Sr, Pu-iso, U-iso, ^{241}Pu, ^{241}Am, GEA
200 East Area	18	N019, N158, N498, N499[c], N582, N957, N967, N968, N969, N970, N972, N973, N976, N977, N978, N984, N985, N999	Beta, Alpha		^{90}Sr, Pu-iso, U-iso, GEA
CSB (200 E Area)	2	N480, N481	Beta, Alpha		^{90}Sr, Pu-iso, U-iso, ^{241}Pu, ^{241}Am, GEA
IDF (200 E Area)	2	N532, N559	Beta, Alpha		^{90}Sr, Pu-iso, U-iso, GEA
200 West Area	17	N161, N168, N200, N304[d], N441, N442, N449, N456, N457, N956, N963, N964, N965, N966[d], N974, N987, N994	Beta, Alpha		^{90}Sr, Pu-iso, U-iso, GEA
Plutonium Finishing Plant (200 W Area)	6	N155, N165[c], N433, N554, N555, N975	Beta, Alpha		^{90}Sr, Pu-iso, U-iso, ^{241}Pu, GEA
300 Area	1	N130	Beta, Alpha	Tritium	^{90}Sr, Pu-iso, U-iso, GEA
618-10 Burial Ground[e]	4	N548[c], N549, N579, N580	Beta, Alpha		^{90}Sr, Pu-iso, U-iso, GEA
ERDF[e]	3	N482[c], N517, N518	Beta, Alpha		^{90}Sr, Pu-iso, U-iso, GEA
WYE Barricade	1	N981[c, f]	Beta, Alpha		^{90}Sr, Pu-iso, U-iso, GEA
QC Samples					
Trip Blank		N950	Beta, Alpha		^{90}Sr, Pu-iso, U-iso, GEA

(a) Particulate samples are collected using 47-mm Versapor 3000 TN W/WA filters. These filters are analyzed then stored for the semi-annual composite.
(b) Four-week atmospheric water vapor samples for tritium analysis are collected using silica gel columns.
(c) DOH particulate air sampler also at this location.
(d) Duplicate samples (N304 and N966) collected at this location
(e) Samples for WCH.
(f) Duplicate sample N906 (Far field) collected at this location.

Figure 2. Air Sampling Locations in the 100 K Area

Figure 3. Air Sampling Locations in the 200 East Area

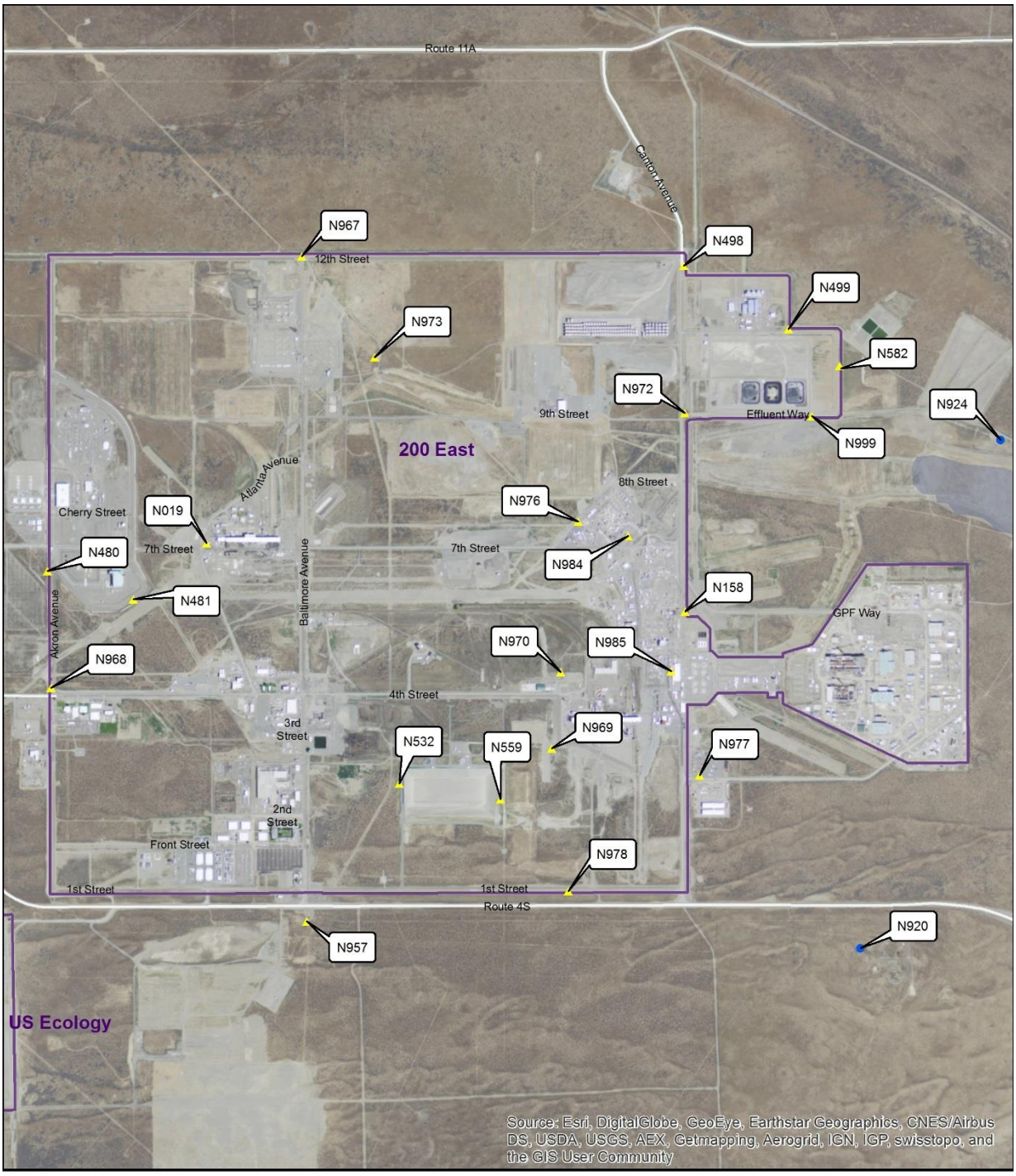


Figure 4. Air Sampling Locations in the 200 West Area

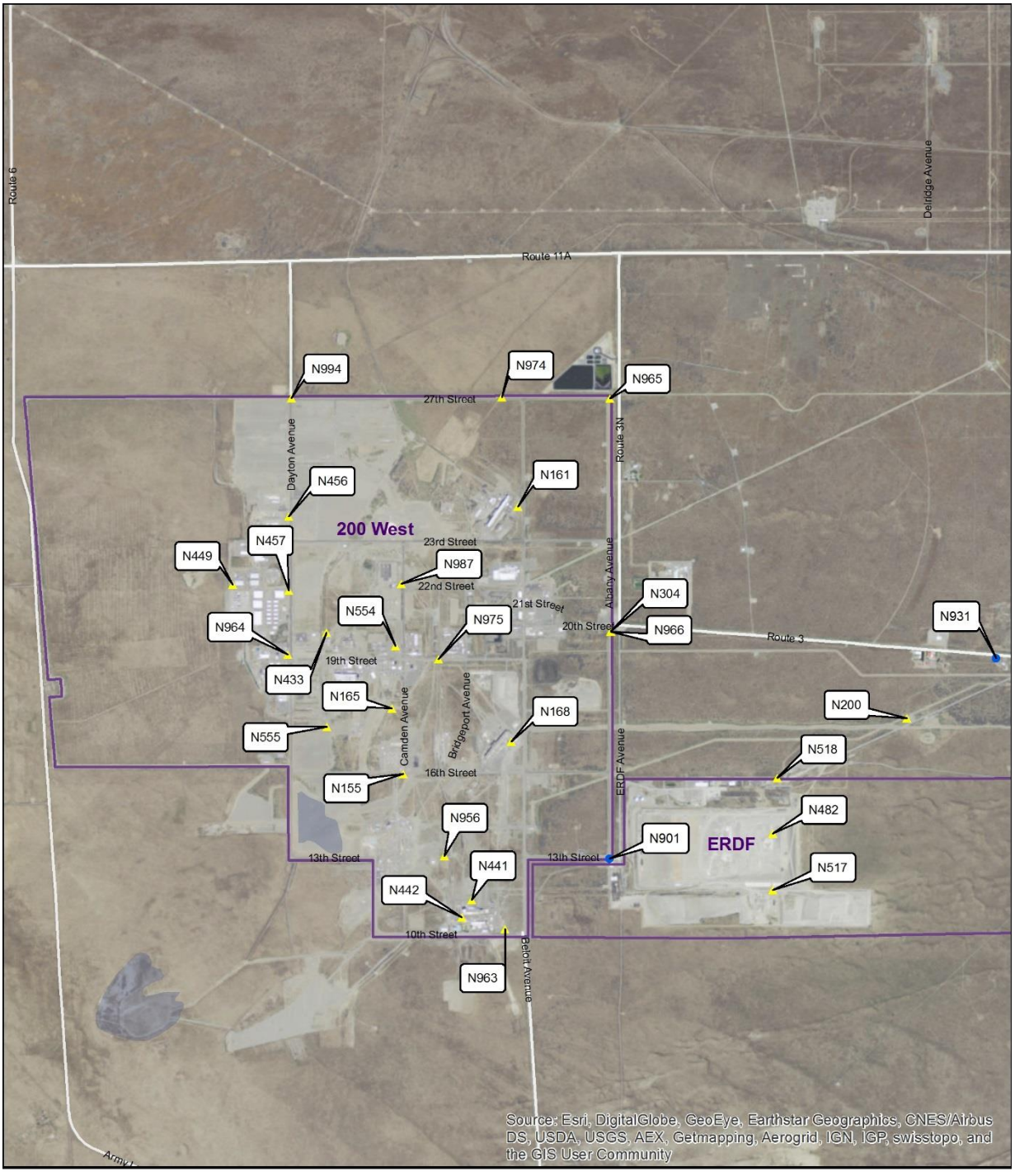


Figure 5. Air Sampling Locations in the 300 Area

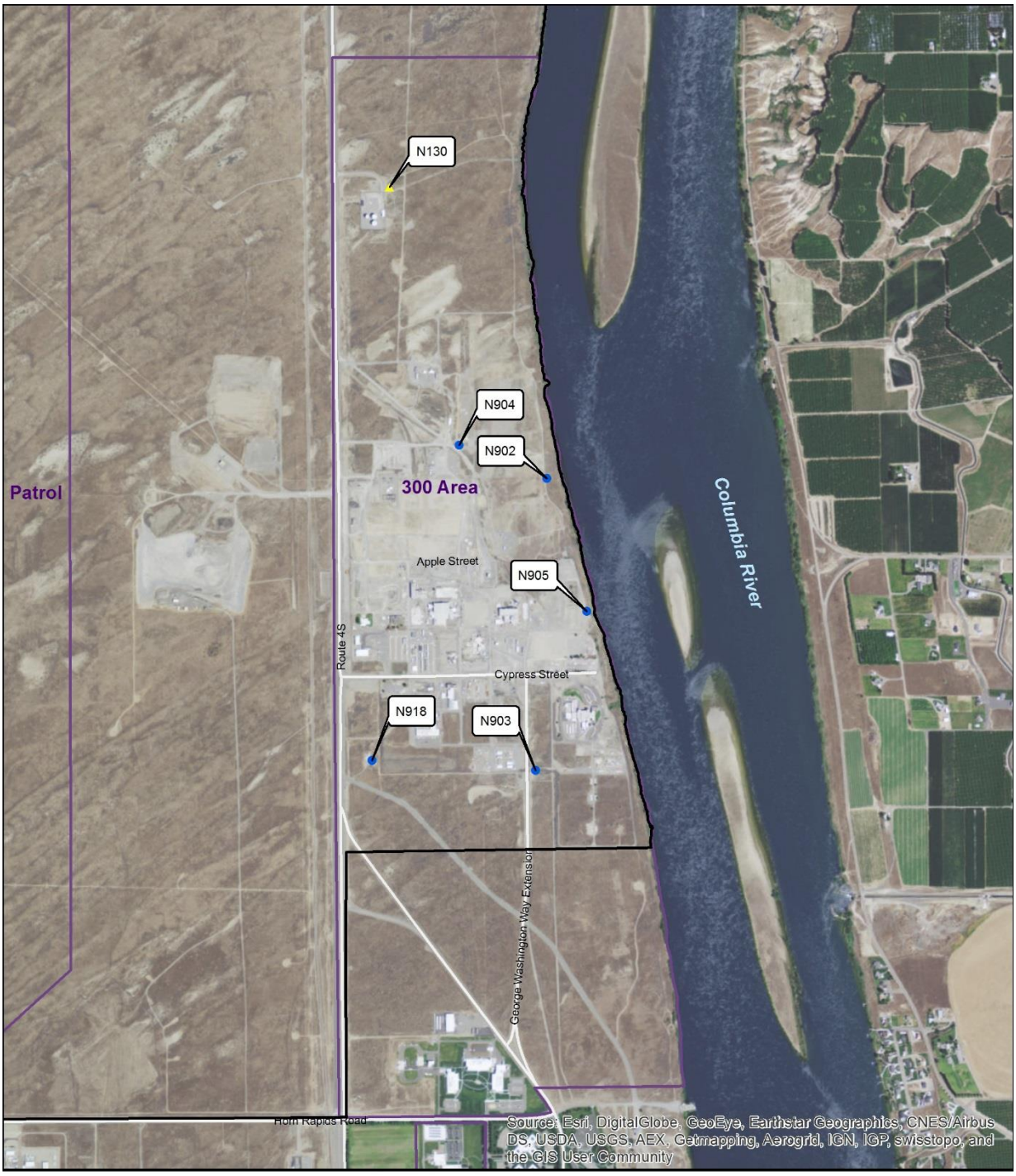
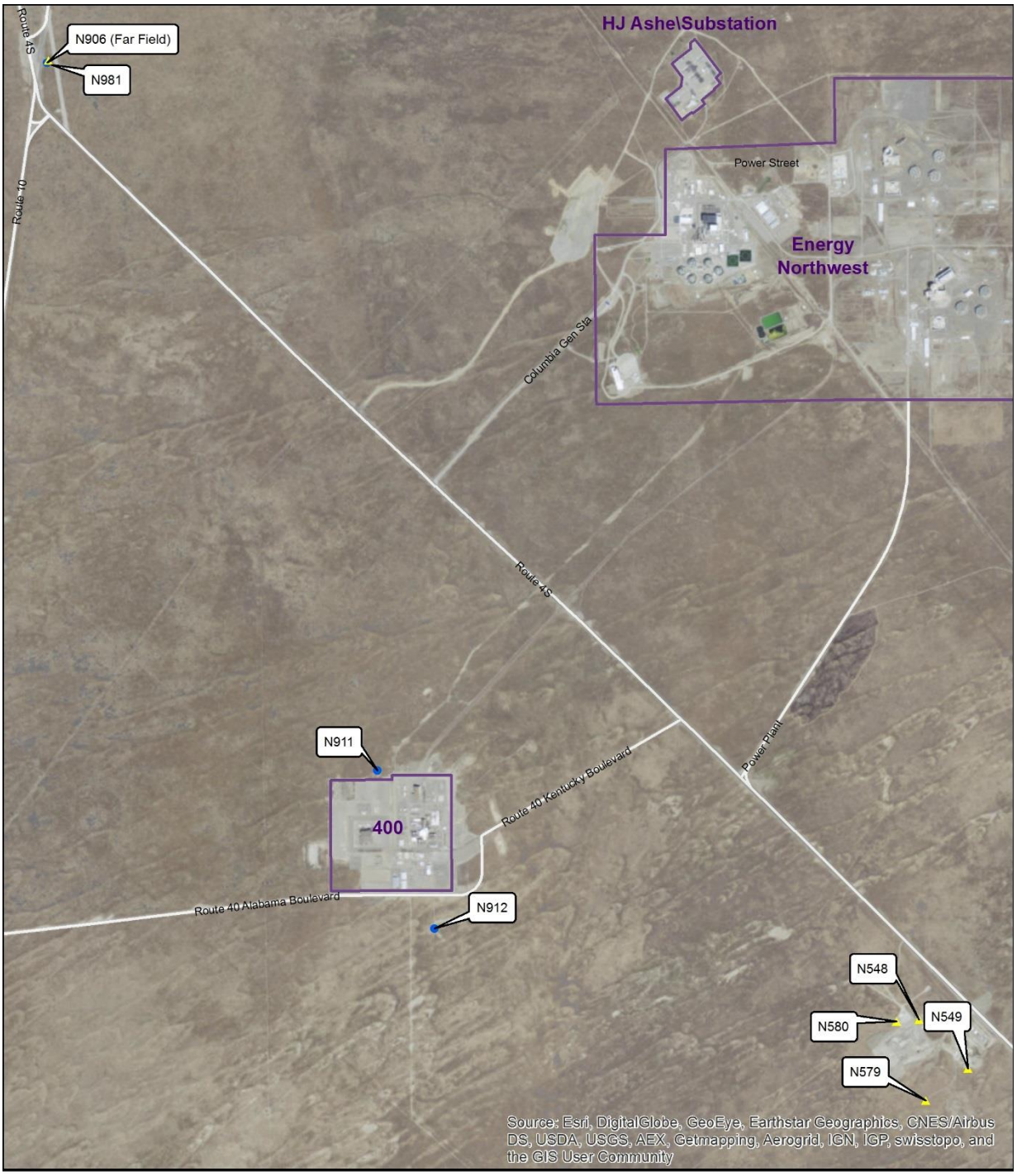


Figure 6. Air Sampling Locations at the 618-10 Burial Ground



2.0 Surface Water Surveillance

2.1 Columbia River – Continuous Sampling

Location	Sample Type	Sample Frequency	Analyses
Priest Rapids Dam	Cumulative (water)[a]	Monthly Composite[b, c, d]	Lo ^{3}H, ^{90}Sr, ^{99}Tc, U-iso
	Particulate (filter)[e]	Monthly Composite[f]	GEA, Pu-iso
	Soluble (resin)[e] Grab (water)	Monthly Composite March, May, August, November	GEA, Pu-iso Anions
Richland Pump House	Cumulative (water)[a]	Monthly Composite[c, g]	Lo ^{3}H, ^{90}Sr, ^{99}Tc, U-iso
	Particulate (filter)[e]	Monthly Composite	GEA, Pu-iso
	Soluble (resin)[e] Grab (water)	Monthly Composite March[h], May, August, November	GEA, Pu-iso Anions

(a) Sample is collected bi-weekly and composited monthly for analysis.
(b) Additional sample provided to DOH (March and September only).
(c) Laboratory duplicate sample compiled during March. Analyses for the duplicate sample will be the same as for the parent sample.
(d) Laboratory split sample compiled during September. Analyses for the split sample will be the same as for the parent sample.
(e) Sample is collected bi-weekly and composited monthly for GEA and Pu-iso analyses.
(f) Laboratory duplicate sample compiled during September. Analyses for the duplicate sample will be the same as for the parent sample.
(g) Field duplicate sample compiled during September. Analyses for the duplicate sample will be the same as for the parent sample.
(h) Laboratory duplicate and laboratory split samples collected.

2.2 Columbia River – Transects

Location	Sample Frequency	Collection Period	Analyses
Richland Pump House -1 HRM46.4 Richland Pump House -3 HRM46.4 Richland Pump House -5 HRM46.4 Richland Pump House -7 HRM46.4 Richland Pump House -9 HRM46.4	SA	March and August	GEA, Lo ^{3}H, ^{90}Sr, U-iso, Pu-iso, ^{99}Tc, Anions, ICP-MS, ICP-MS Filtered, Hg-CVAF, VOA, Cr^{+6}
Vernita-1 HRM 0.3 Vernita-2 HRM 0.3 Vernita-3 HRM 0.3 Vernita-4 HRM 0.3	SA	March[(a)] and August	GEA, Lo ^{3}H, ^{90}Sr, U-iso, Pu-iso, ^{99}Tc, Anions, ICP-MS, ICP-MS Filtered, Hg-CVAF, VOA, Cr^{+6}
100 N -1 HRM 9.5[(a, b, c)] 100 N -3 HRM 9.5[(a)] 100 N -5 HRM 9.5 100 N -7 HRM 9.5 100 N -9 HRM 9.5	A	August	GEA, Lo ^{3}H, ^{90}Sr, U-iso, Anions, ICP-MS, ICP-MS Filtered, Cr^{+6}
Hanford Townsite -1 HRM 28.7[(b, c)] Hanford Townsite -3 HRM 28.7 Hanford Townsite -5 HRM 28.7 Hanford Townsite -7 HRM 28.7 Hanford Townsite -9 HRM 28.7	A	August	GEA, Lo ^{3}H, ^{90}Sr, U-iso, Anions, ICP-MS, ICP-MS Filtered, Cr^{+6}
300 Area -1 HRM 43.1[(a)] 300 Area -3 HRM 43.1[(a)] 300 Area -5 HRM 43.1 300 Area -7 HRM 43.1 300 Area -9 HRM 43.1	A	August	GEA, Lo ^{3}H, ^{90}Sr, U-iso, Anions, ICP-MS, ICP-MS Filtered, Cr^{+6}
QC Samples			
Trip Blank at Richland Pump House[(d)]	SA	March and August	VOA
Trip Blank at Vernita[(d)]	SA	March and August	VOA
Equipment Blank	A	August	GEA, Lo ^{3}H, ^{90}Sr, U-iso, Pu-iso, ^{99}Tc, Anions, ICP-MS, ICP-MS Filtered, Hg-CVAF

(a) Additional sample provided to DOH.
(b) Duplicate sample collected. Analyses for the duplicate sample will be the same as for the parent sample.
(c) Laboratory split sample collected. Analyses for the split sample will be the same as for the parent sample.
(d) One trip blank per day.

2.3 River Bank Seeps

Location[a]	HRM[b]	Collection Period	Analyses
100-B Spring 38-3[c]	3.8	September	^{3}H, ^{90}Sr, ICP-MS, ICP-MS Filtered, Anions, Cr^{+6}
100-B Spring 39-2[d]	3.9	September	^{3}H, ^{90}Sr, ICP-MS, ICP-MS Filtered, Anions, Cr^{+6}
100-K Spring 63-1[c, d, e, f]	6.3	September	Alpha, Beta, ^{3}H, ^{90}Sr, ^{99}Tc, ^{14}C, ICP-MS, ICP-MS Filtered, Anions, VOA, Cr^{+6}
100-K Spring 68-1[c]	7.6	September	Alpha, Beta, ^{3}H, ^{90}Sr, ^{99}Tc, ^{14}C, ICP-MS, ICP-MS Filtered, Anions, VOA, Cr^{+6}
100-N Spring 89-1[c]	9.1	September	^{3}H, ^{90}Sr, ICP-MS, ICP-MS Filtered, Anions, TPH, Cr^{+6}
100-N Spring 8-13[c, d]	9.3	September	Alpha, Beta, ^{3}H, ^{90}Sr, ICP-MS, ICP-MS Filtered, Anions, Cr^{+6}
100-D Spring 110-1[d]	11	September	Alpha, Beta, ^{3}H, ^{99}Tc , U-iso, ^{90}Sr, ICP-MS, ICP-MS Filtered, Anions, Cr^{+6}
100-H Spring 145-1[f]	14.4	September	^{3}H, ^{99}Tc, ^{90}Sr, ICP-MS, ICP-MS Filtered, Anions, Cr^{+6}
100-H Spring 152-2[c]	15.2	September	Alpha, Beta, ^{3}H, ^{99}Tc, ^{90}Sr, ICP-MS, ICP-MS Filtered, Anions, Cr^{+6}
100-F Spring 187-1	18.7	September	^{3}H, ^{90}Sr, ICP-MS, ICP-MS Filtered, Anions, VOA, Cr^{+6}
100-F Spring 207-1[d, g, h]	20.7	September	^{3}H, ^{90}Sr, ICP-MS, ICP-MS Filtered, Anions, Cr^{+6}
100-F Spring 211-1	21.1	September	^{3}H, ^{90}Sr, ICP-MS, ICP-MS Filtered, Anions, Cr^{+6}
Hanford Townsite 25-4	25.4	September	Alpha, Beta, ^{3}H, ^{99}Tc, ^{90}Sr, ICP-MS, ICP-MS Filtered, Anions, VOA, Cr^{+6}
Hanford Spring 28-2	28.1	September	Alpha, Beta, ^{3}H, Anions, ^{129}I, Cr^{+6}
300 Area Spring 42-2	42.1	September	Alpha, Beta, ^{3}H, U-iso, Anions, VOA, Cr^{+6}
300 Area Spring DR 42-2[d, f]	42.4	September	Alpha, Beta, ^{3}H, U-iso, Anions, VOA, Cr^{+6}
QC Samples			
Trip Blank[i]		September	VOA
Equipment Blank		August	Alpha, Beta, ^{3}H, ^{90}Sr, ^{99}Tc , U-iso, Anions, ICP-MS, ICP-MS Filtered

(a) Sample locations may be adjusted based upon field conditions (e.g., no groundwater discharge observed at the time of sampling) or new groundwater contaminant information becomes available (e.g., change in plume concentration or plume location).
(b) HRMs are a series of signposts along the Hanford Site shoreline of the Columbia River that are roughly 1.6 km (1 mi) apart. The Vernita Bridge is HRM #0, and Ferry Street in Richland is HRM #46.
(c) Drive point sample collection available.
(d) Additional sample provided to DOH.
(e) Additional seep samples collected in January, April, and July for ^{14}C analysis. A collocated surface water sample will also be collected for ^{14}C analysis with each seep sampling event.
(f) A sediment sample will also be collected at this seep location and analyzed as specified in Table 5.1.
(g) Duplicate samples collected. Analyses for the duplicate sample will be the same as for the parent sample.
(h) Laboratory split sample collected. Analyses for the split sample will be the same as for the parent sample.
(i) One trip blank per day if VOA analysis(es) is requested.

2.4 Onsite Pond

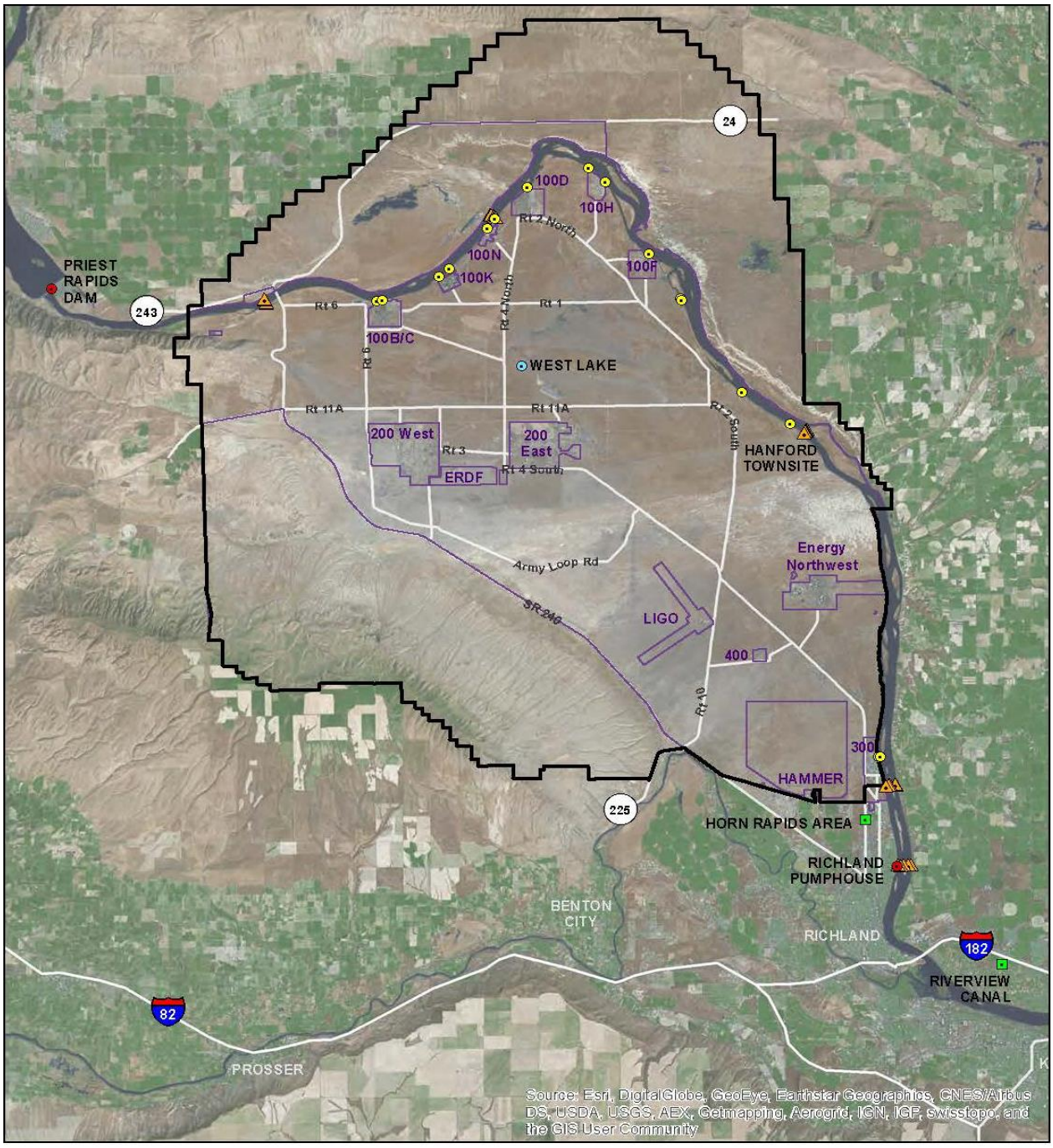
Location	Collection Period	Analyses
West Lake Seep	March	^{3}H, U-iso
West Lake Water	May, August, November	^{3}H, U-iso

2.5 Offsite Irrigation

Location	Collection Period	Analyses
Riverview Canal	May[(a)], June, July	Alpha, Beta, Lo ^{3}H, ^{90}Sr, GEA
Horn Rapids Area	May[(a)], June, July	Alpha, Beta, Lo ^{3}H, ^{90}Sr, GEA
QC Samples		
Equipment Blank	June	Alpha, Beta, Lo ^{3}H, ^{90}Sr, GEA

(a) Additional sample provided to DOH.

Figure 7. Surface Water Sampling Locations



3.0 Biota

3.1 Food and Farm Products

3.1.1 Milk

Location	Frequency	Collection Period	Analyses
East Wahluke Area[a]	Q	Feb., May, Aug., and Nov.	Lo ^{3}H, ^{90}Sr, GEA
Sagemoor Composite[a]	Q	Feb., May[b, c], Aug., and Nov.	Lo ^{3}H, ^{90}Sr, GEA
Sunnyside Area	Q	Feb., May, Aug., and Nov.	Lo ^{3}H, ^{90}Sr, GEA
QC Samples			
Equipment Blank		Feb	Lo ^{3}H, ^{90}Sr, GEA

(a) Sample composited from multiple dairies in each area.
(b) Duplicate sample collected. Analyses for the duplicate sample will be the same as for the parent sample.
(c) Laboratory split sample collected. Analyses for the split sample will be the same as for the parent sample.

3.1.2 Alfalfa/ Hay

Location	Frequency	Collection Period	Analyses
Sagemoor Area	BE (2017)	May	^{90}Sr, GEA
Riverview Area[a]	BE (2017)	May	^{90}Sr, GEA
Sunnyside Area	BE (2017)	May	^{90}Sr, GEA
Horn Rapids Area[a]	BE (2017)	May	^{90}Sr, GEA

(a) Additional sample provided to DOH.

3.1.3 Vegetables

Location[a]	Frequency	Collection Period	Analyses
Leafy Vegetables			
Riverview Area[b]	A	June	^{90}Sr, GEA, ^{14}C
Sunnyside Area	A	June	^{90}Sr, GEA, ^{14}C
East Wahluke Area[b, c, d]	A	June	^{90}Sr, GEA, ^{14}C
Sagemoor Area[b]	A	June	^{90}Sr, GEA, ^{14}C
Potatoes			
Riverview Area[b, c, d]	A	August	^{90}Sr, GEA
Sunnyside Area	A	August	^{90}Sr, GEA
East Wahluke Area[b]	A	August	^{90}Sr, GEA
Sagemoor Area[b]	TE (2018)	August	^{90}Sr, GEA
Horn Rapids Area[b]	BE (2017)	August	^{90}Sr, GEA
Corn[e]			
Riverview Area[b]	A	July	^{90}Sr, GEA, ^{14}C
Sunnyside Area[b]	A	July	^{90}Sr, GEA, ^{14}C
East Wahluke Area[b]	A	July	^{90}Sr, GEA, ^{14}C
Sagemoor Area[b]	A	July	^{90}Sr, GEA, ^{14}C

(a) Two samples collected within each area; one is analyzed and one is archived.
(b) Additional sample provided to DOH.
(c) Duplicate sample collected. Analyses for the duplicate sample will be the same as for the parent sample.
(d) Laboratory split sample collected. Analyses for the split sample will be the same as for the parent sample.
(e) Four samples collected within each area (kernels and vegetation); Two are analyzed and two are archived.

3.1.4 Fruits

Location[a]	Frequency	Collection Period	Analyses
Tomatoes			
Riverview Area	A	August	^{90}Sr, ^{3}H, GEA
Sunnyside Area	A	August	^{90}Sr, ^{3}H, GEA
Cherries			
Riverview Area[b, c]	TE (2017)	June	^{90}Sr, GEA
Sagemoor Area[d]	TE (2017)	June	^{90}Sr, GEA
Sunnyside Area[d]	TE (2017)	June	^{90}Sr, GEA
Ringold Area[d]	TE (2017)	June	^{90}Sr, GEA
East Wahluke Area[d]	TE (2017)	June	^{90}Sr, GEA
Apples			
Mattawa Area[b, c, d]	TE (2018)	September	^{90}Sr, GEA
Riverview Area[d]	TE (2018)	September	^{90}Sr, GEA
Sagemoor Area[d]	TE (2018)	September	^{90}Sr, GEA
Sunnyside Area	TE (2018)	September	^{90}Sr, GEA
Apricots			
Riverview Area[d]	TE (2016)	June	^{90}Sr, GEA
Sunnyside Area[d]	TE (2016)	June	^{90}Sr, GEA
East Wahluke Area[b, c]	TE (2016)	June	^{90}Sr, GEA
Sagemoor Area[d]	TE (2016)	June	^{90}Sr, GEA
Melons			
Riverview Area[d]	A	July	^{90}Sr, GEA,^{14}C
Sunnyside Area[d]	A	July	^{90}Sr, GEA,^{14}C
East Wahluke Area	A	July	^{90}Sr, GEA,^{14}C
Sagemoor Area[d]	A	July	^{90}Sr, GEA,^{14}C

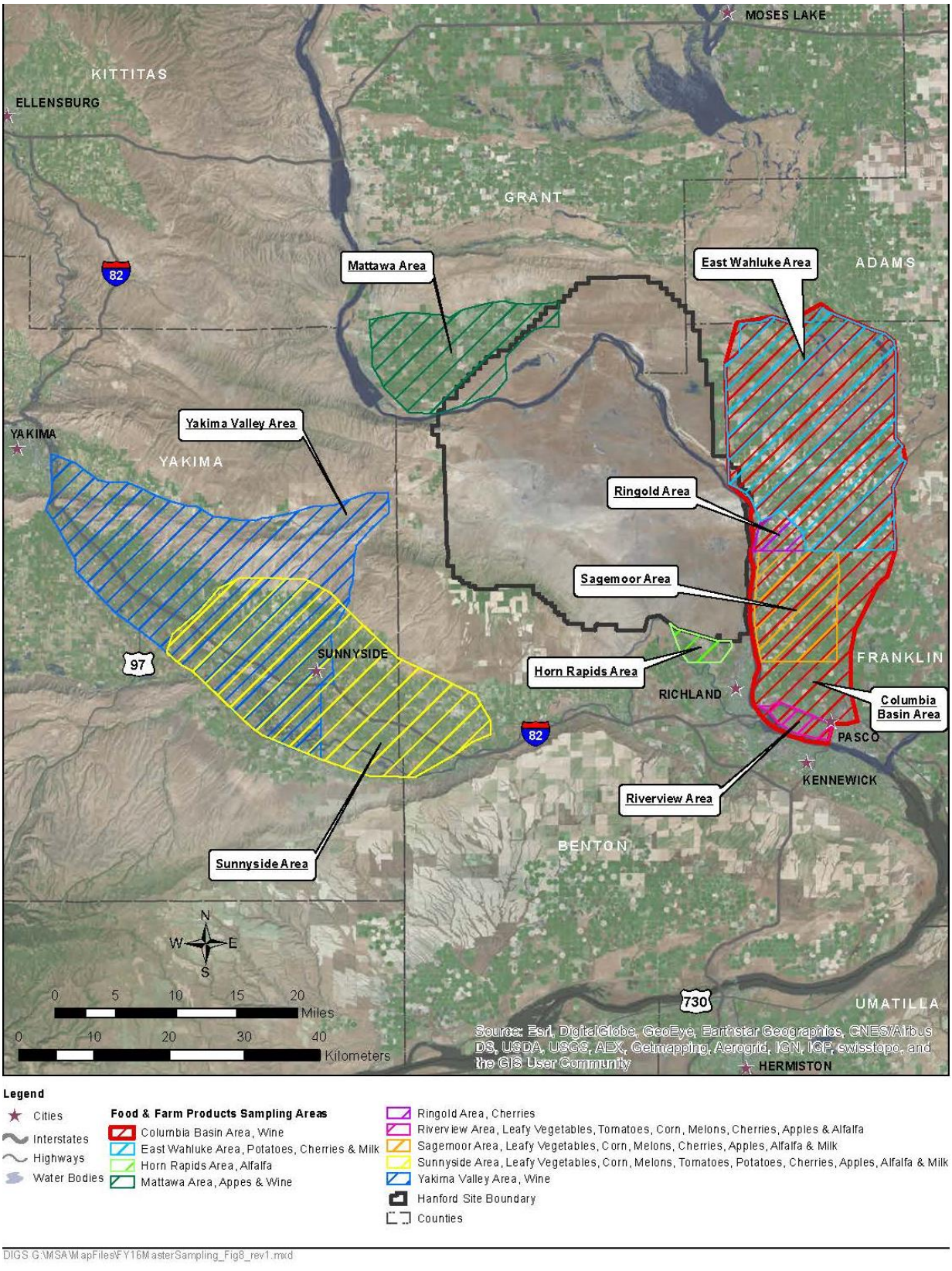
(a) Two samples collected within each area; one is analyzed and one is archived.
(b) Duplicate sample collected. Analyses for the duplicate sample will be the same as for the parent sample.
(c) Laboratory split sample collected. Analyses for the split sample will be the same as for the parent sample.
(d) Additional sample provided to DOH.

3.1.5 Wine

Location[a]	Frequency	Collection Period	Analyses
Columbia Basin[b, c, d]	A	December	Lo ^{3}H, GEA
Yakima Valley[b]	A	December	Lo ^{3}H, GEA
Mattawa Area[b]	A	December	Lo ^{3}H, GEA

(a) Two samples each of red and white wine collected within each area; one is analyzed and one is archived.
(b) Additional sample provided to DOH.
(c) Duplicate sample collected. Analyses for the duplicate sample will be the same as for the parent sample.
(d) Laboratory split sample collected. Analyses for the split sample will be the same as for the parent sample.

Figure 8. Food and Farm Products Sampling Locations



3.2 Wildlife

3.2.1 Fish

Location	Sample Item	Number of Samples	Frequency	Collection Period	Analyses
Bass[a, b]					
100 Areas	Fillet	3	BE (2016)	July	GEA
	Fillet (Composite)	1	BE (2016)	July	GEA, U-iso, Pu-iso, ICP-MS, Hg-CVAA, ^{90}Sr, ^{3}H
	Carcass	3	BE (2016)	July	^{90}Sr
Hanford Townsite to 300 Area	Fillet	3	BE (2016)	July	GEA
	Fillet (Composite)	1	BE (2016)	July	GEA, U-iso, Pu-iso, ICP-MS, Hg-CVAA, ^{90}Sr, ^{3}H
	Carcass	3	BE (2016)	July	^{90}Sr
Reference[d]	Fillet	3	BE (2016)	July	GEA
	Fillet (Composite)	1	BE (2016)	July	GEA, U-iso, Pu-iso, ICP-MS, Hg-CVAA, ^{90}Sr, ^{3}H
	Carcass	3	BE (2016)	July	^{90}Sr
Carp[a, b]					
100 Areas[c]	Fillet (composite)	3	BE (2016)	June	GEA, U-iso, Pu-iso, ICP-MS, Hg-CVAA, ^{90}Sr, ^{3}H
	Carcass	3	BE (2016)	June	^{90}Sr
Hanford Townsite to 300 Area [c]	Fillet (composite)	3	BE (2016)	June	GEA, U-iso, Pu-iso, ICP-MS, Hg-CVAA, ^{90}Sr, ^{3}H
	Carcass	3	BE (2016)	June	^{90}Sr
Reference[d]	Fillet (composite)	3	BE (2016)	June	GEA, U-iso, Pu-iso, ICP-MS, Hg-CVAA, ^{90}Sr, ^{3}H
	Carcass	3	BE (2016)	June	^{90}Sr
Whitefish[a, b]					
100 Areas[c]	Fillet	3	BE (2017)	October	GEA
	Fillet (Composite)	1	BE (2017)	October	GEA, U-iso, Pu-iso, ICP-MS, Hg-CVAA, ^{90}Sr, ^{3}H
	Carcass	3	BE (2017)	October	^{90}Sr
Reference[d]	Fillet	3	BE (2017)	October	GEA
	Fillet (Composite)	1	BE (2017)	October	GEA, U-iso, Pu-iso, ICP-MS, Hg-CVAA, ^{90}Sr, ^{3}H
	Carcass	3	BE (2017)	October	^{90}Sr
Walleye[a, b]					
100 Areas[c]	Fillet (composite)	3	BE (2017)	June	GEA, U-iso, Pu-iso, ICP-MS, Hg-CVAA, ^{90}Sr, ^{3}H
	Carcass	3	BE (2017)	June	^{90}Sr
Hanford Townsite to 300 Area [c]	Fillet (composite)	3	BE (2017)	June	GEA, U-iso, Pu-iso, ICP-MS, Hg-CVAA, ^{90}Sr, ^{3}H
	Carcass	3	BE (2017)	June	^{90}Sr
Reference[d]	Fillet (composite)	3	BE (2017)	June	GEA, U-iso, Pu-iso, ICP-MS, Hg-CVAA, ^{90}Sr, ^{3}H
	Carcass	3	BE (2017)	June	^{90}Sr

(a) Attempt to collect one duplicate fillet or carcass sample from any one of the listed locations. Analyses for the duplicate sample will be the same as for the parent sample.
(b) Attempt to collect one laboratory split sample from any of the listed locations. Analyses for the split sample will be the same as for the parent sample.
(c) Fish sample mass provided to DOH: 1kg preferred; 100g minimum.
(d) Reference location is Priest Rapids/ Wanapum Pools.

3.2.2 Birds

Location	Sample Item	Number of Samples	Frequency	Collection Period	Analyses
Upland Game Birds[a, b, c]					
100 Areas[d]	Muscle	3	BE (2016)	September	GEA
	Bone	3	BE (2016)	September	^{90}Sr
Hanford Townsite to 300 Area [d]	Muscle	3	BE (2016)	September	GEA
	Bone	3	BE (2016)	September	^{90}Sr
Reference	Muscle	3	BE (2016)	September	GEA
	Bone	3	BE (2016)	September	^{90}Sr
Waterfowl[b, c]					
100 Areas	Muscle	3	BE (2017)	July	GEA
	Bone	3	BE (2017)	July	^{90}Sr
Hanford Townsite to 300 Area	Muscle	3	BE (2017)	July	GEA
	Bone	3	BE (2017)	July	^{90}Sr
Reference	Muscle	3	BE (2017)	July	GEA
	Bone	3	BE (2017)	July	^{90}Sr

(a) Pheasants preferred; chukar or quail acceptable if pheasants are unavailable.
(b) Attempt to collect one duplicate muscle or bone sample from any one of the listed locations. Analyses for the duplicate sample will be the same as for the parent sample.
(c) Attempt to collect one laboratory split sample from any of the listed locations. Analyses for the split sample will be the same as for the parent sample.
(d) Bird sample mass provided to DOH: 1kg preferred; 100g minimum.

3.2.3 Mammals

Location	Sample Item	Number of Samples	Frequency	Collection Period	Analyses
Deer/Elk[a, b]					
Road Strike at Onsite Locations[c]	Muscle	≤10	BE (2016)	As Available	GEA
	Bone	≤10	BE (2016)	As Available	^{90}Sr
	Liver	≤10	BE (2016)	As Available	GEA, Pu-iso, ICP-MS, Hg-CVAA
Reference[d]	Muscle	1	BE (2016)	As Available	GEA
	Bone	1	BE (2016)	As Available	^{90}Sr
	Liver	1	BE (2016)	As Available	GEA, Pu-iso, ICP-MS, Hg-CVAA
Cottontail Rabbits[a, b]					
300 Area[e]	Muscle	3	BE (2017)	Feb. – March	GEA
	Bone	3	BE (2017)	Feb. – March	^{90}Sr
Reference	Muscle	3	BE (2017)	March – April	GEA
	Bone	3	BE (2017)	March – April	^{90}Sr

(a) Attempt to collect one duplicate muscle or bone sample from any one of the listed locations. Analyses for the duplicate sample will be the same as for the parent sample.
(b) Attempt to collect one laboratory split sample from any of the listed locations. Analyses for the split sample will be the same as for the parent sample.
(c) Additional sample (elk preferred) provided to DOH.
(d) The reference sample is obtained from DOH.
(e) Additional whole rabbit sample provided to DOH.

Figure 9. Bass and Carp Sampling Locations

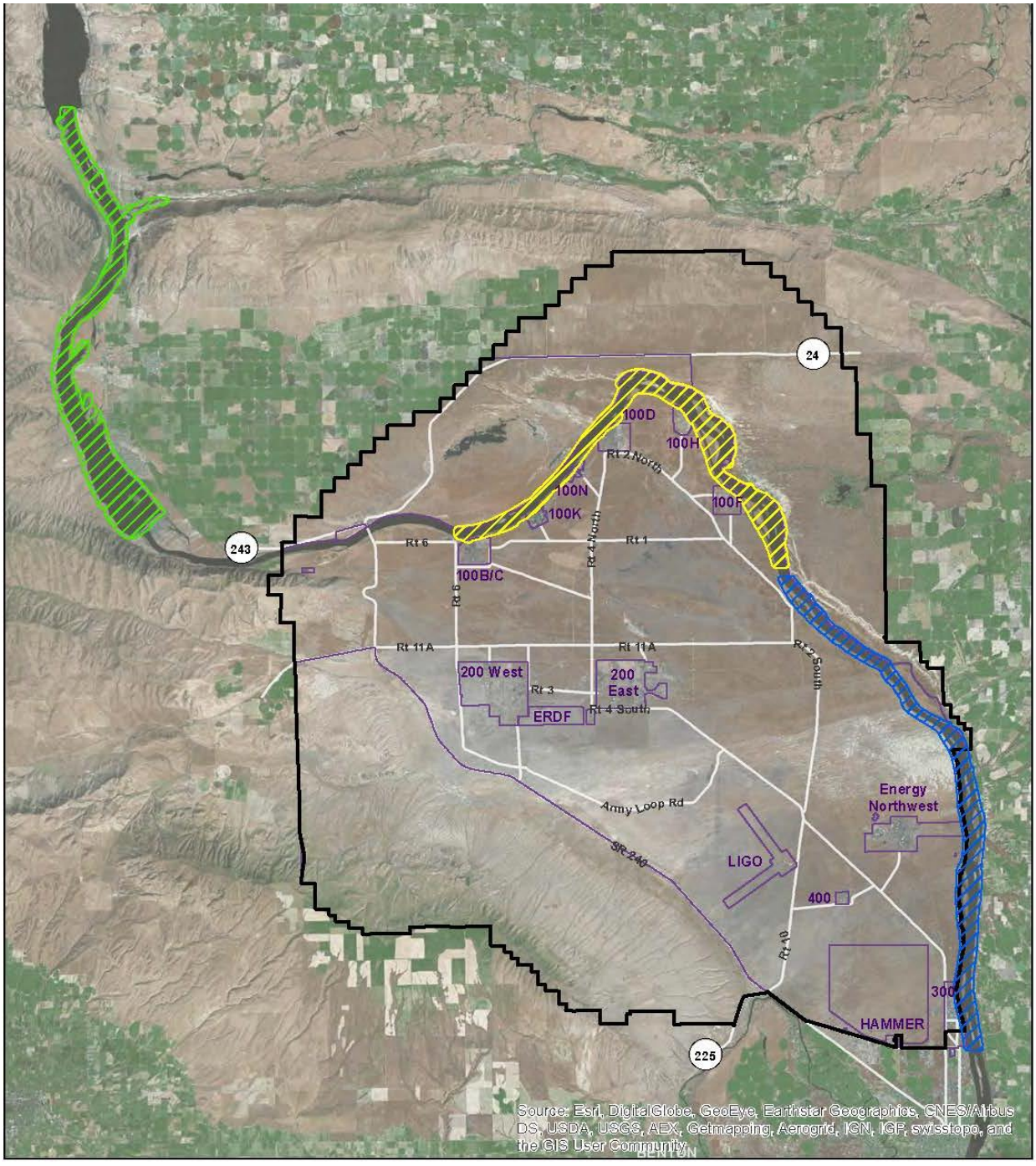
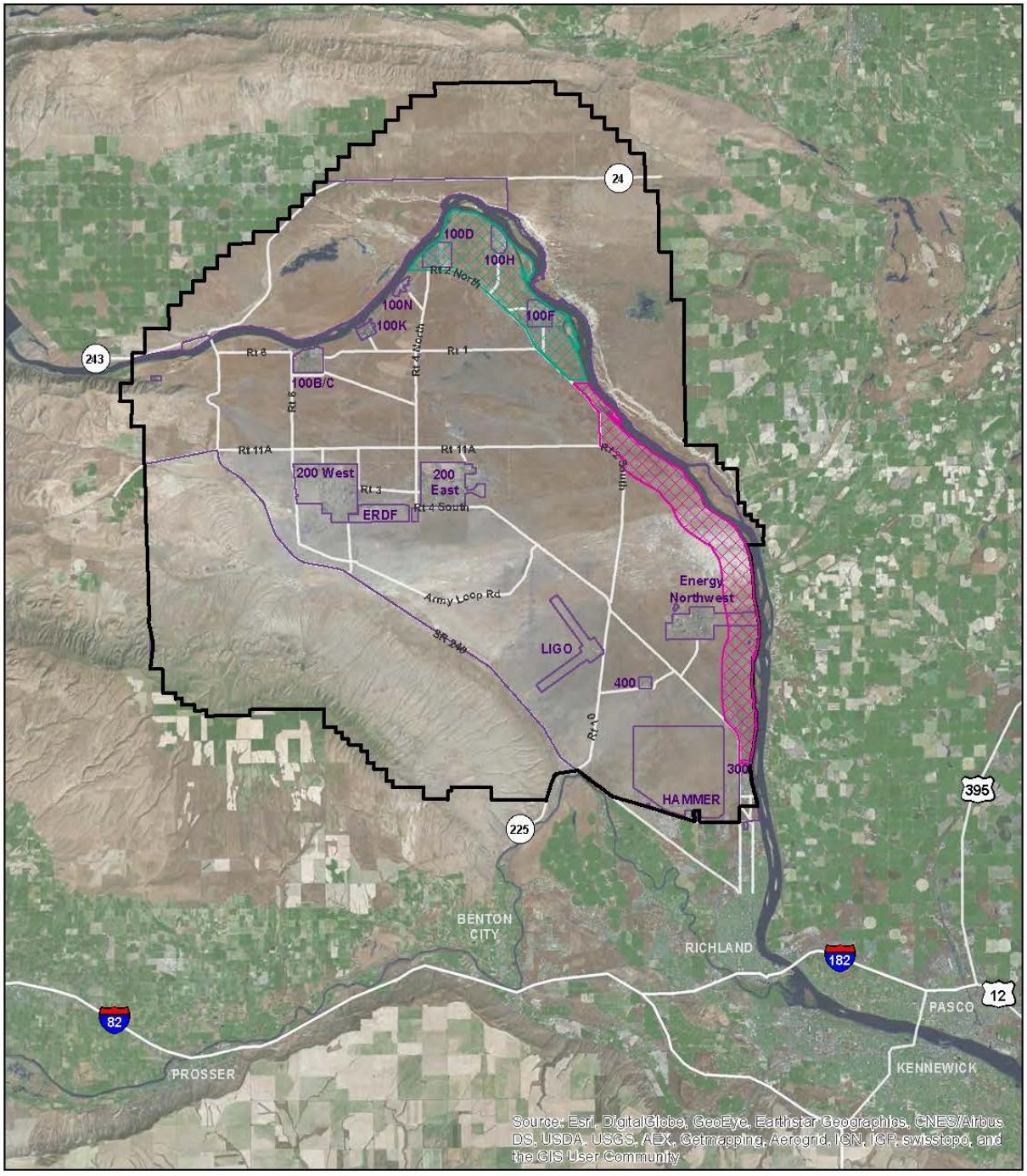


Figure 10. Upland Game Sampling Locations



4.0 Soil and Vegetation

4.1 Far Field Soil Monitoring

Sample Location	EDP Code	Collection Period[a]	Analyses
N end Vernita Bridge	D424	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
Wahluke Slope	D425	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
Berg Ranch	D426	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
Ringold	D427	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
W end Fir Road	D428	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
Taylor Flats No. 2	D429	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
Sagemoor Farms	D430[b, c], D493[b]	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso, ^{241}Am
Byers Landing	D431	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
Benton City	D433	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
Sunnyside	D434	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso, ^{241}Am
McNary Dam	D435	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
Walla Walla	D436	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
Washtucna	D437	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
Toppenish	D438	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
George	D439[d], D490[d]	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
Othello	D440[d], D491[d]	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
WanaPum	D441[d], D492[d]	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso

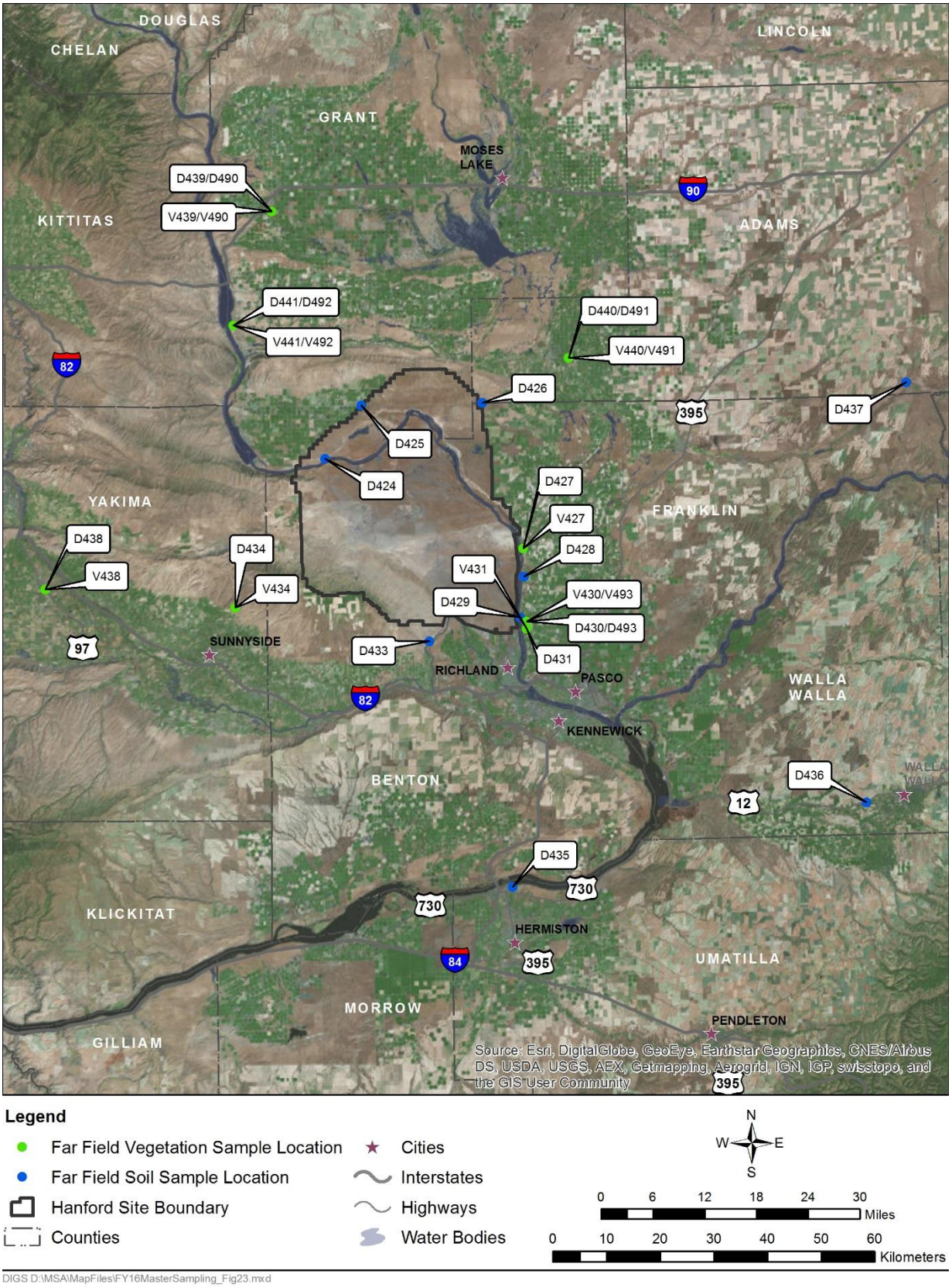
a) Samples are collected approximately every 3-5 years.
b) Duplicate samples (D430 & D493) collected at this location.
c) Laboratory split sample collected. Analyses for the split sample will be the same as for the parent sample.
d) Additional samples (D490, D491, D492) provided to DOH.

4.2 Far Field Vegetation Monitoring

Sample Location	EDP Code	Collection Period[a]	Analyses
Ringold	V427	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
Sagemoor Farms	V430[b, c], D493[b]	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
Byers Landing	V431	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
Sunnyside	V434	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
Toppenish	V438	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
George	V439[d], V490[d]	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
Othello	V440[d], V491[d]	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso
WanaPum	V441[d], V492[d]	June (2018)	GEA, ^{90}Sr, U-iso, Pu-iso

a) Samples are collected approximately every 3-5 years.
b) Duplicate samples (V430 & V493) collected at this location.
c) Laboratory split sample collected. Analyses for the split sample will be the same as for the parent sample.
d) Additional samples (V490, V491, V492) provided to DOH.

Figure 11. Far Field Soil and Vegetation Sampling Locations



4.3 Near Field Soil Monitoring

Location	EDP Codes	Collection Period	Analyses
100-N Area[a]	D156[b], D158, D183	TBD	^{90}Sr, Pu-iso, U-iso, GEA
200 East Area	D054, D058, D060, D062, D064, D066[b], D072[c, d], D076, D078, D112[c]	May	^{90}Sr, Pu-iso, U-iso, GEA
200 ETF (200 E Area) [e]	D457, D458, D459, D460	TBD	^{90}Sr, Pu-iso, U-iso, GEA
Trench 94 (200 E Area) [f]	D458, D460, D461, D462	TBD	^{90}Sr, Pu-iso, U-iso, GEA
200 West Area	D002, D006, D008, D010, D012, D016, D020[b], D022, D024, D026, D028[c, d], D032, D034, D036, D038, D040, D042, D044, D046, D050, D052, D142[c]	May	^{90}Sr, Pu-iso, U-iso, GEA
ERDF at N482 (200 W Area) [g]	D146[b]	May	^{90}Sr, Pu-iso, U-iso, GEA
300 Area	D120[c, d], D121, 123[b, c, d], D125, D126, D132[c], D140[c], D207	May	^{90}Sr, Pu-iso, U-iso, GEA
400 Area	D130	May	^{90}Sr, Pu-iso, U-iso, GEA
600 Area	D004, D030, D048, D074[c, d], D080, D082, D084, D086, D088[b], D090, D092[c, d], D094, D096, D098, D100, D102, D104, D106, D108, D110, D114[c], D144[c]	May	^{90}Sr, Pu-iso, U-iso, GEA
QC Samples			
Equipment Blank		May	^{90}Sr, Pu-iso, U-iso, GEA

(a) Samples for WCH. TBD = to be scheduled by WCH.
(b) Additional sample provided to DOH.
(c) Duplicate samples (D072 & D112, D028 & D142, D120 & D132, D123 & D140, D074 & D144, D092 & D114) collected at this location.
(d) Laboratory split sample collected. Analyses for the split sample will be the same as for the parent sample.
(e) Samples for WRPS. Only three of the four locations will be sampled depending on wind rose analysis. TBD = to be scheduled by WRPS.
(f) Samples for CHPRC. Only three of the four locations will be sampled depending on wind rose analysis. TBD = to be scheduled by CHPRC.
(g) ERDF soil sample is collected every year. Sample for WCH.

Figure 12. Near Field Soil Sampling Locations in the 100-N Area

Figure 13. Near Field Soil Sampling Location in the 200 East Area

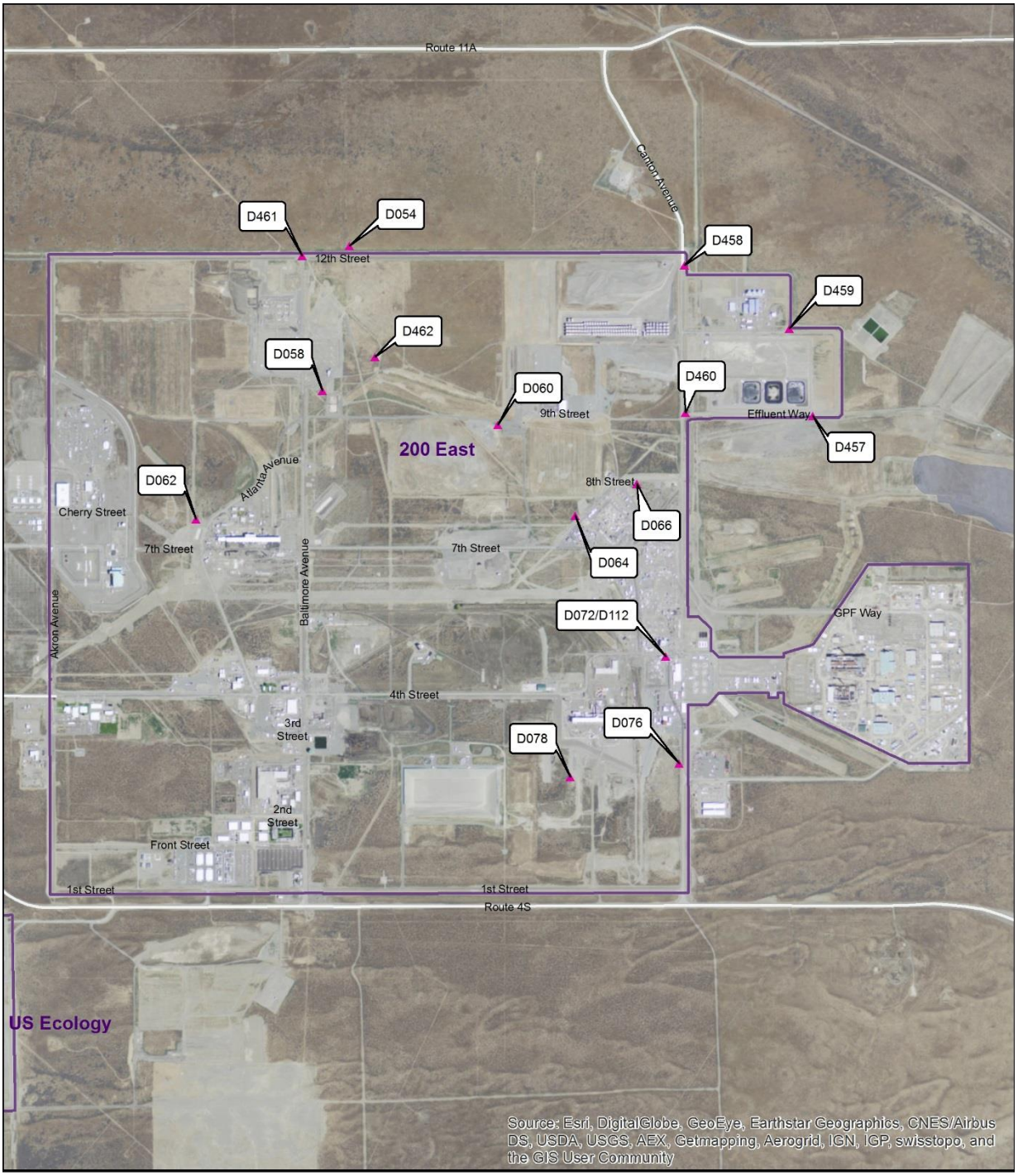


Figure 14. Near Field Soil Sampling Locations in the 200 West Area

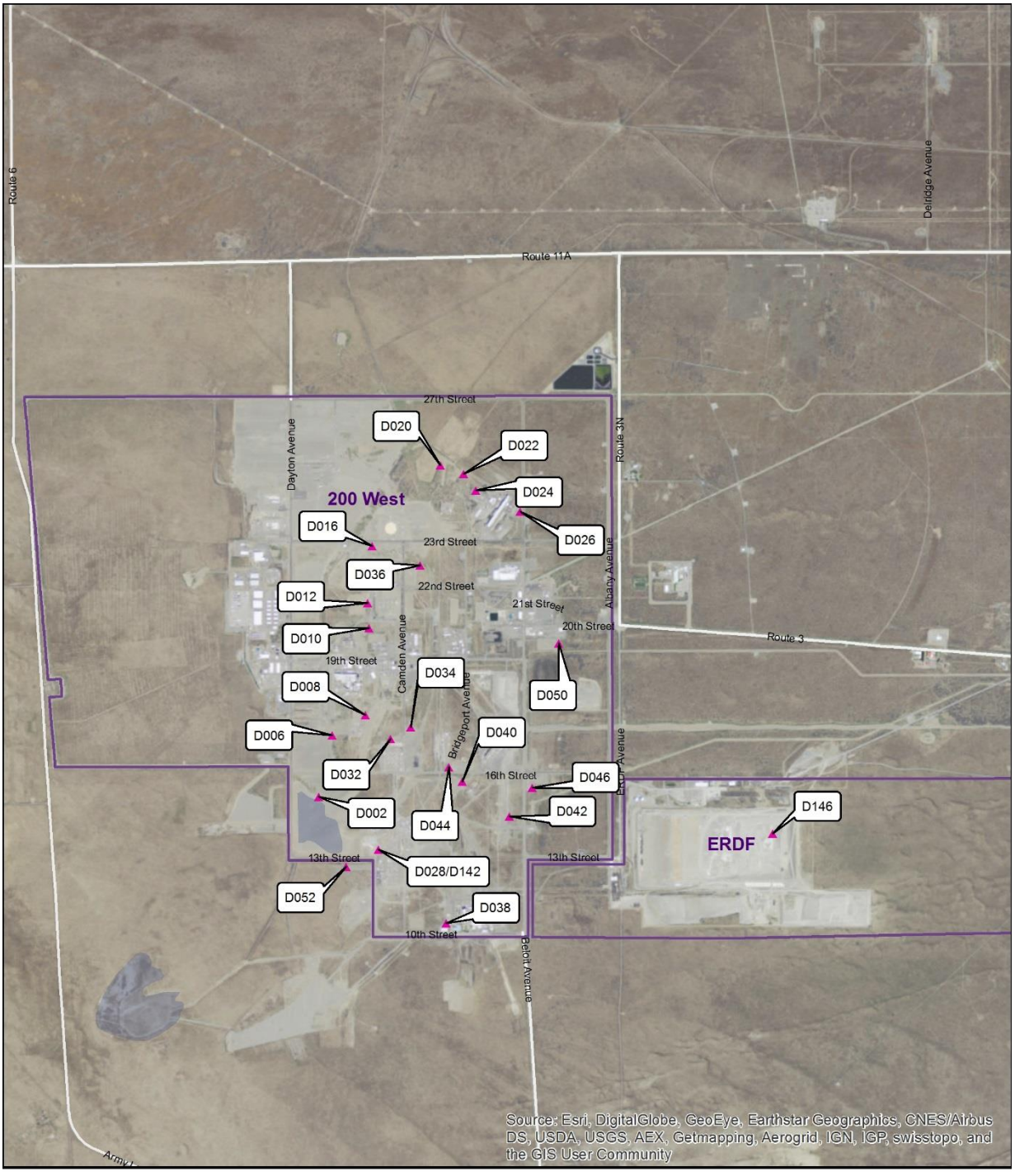


Figure 15. Near Field Soil Sampling Locations in the 300 Area

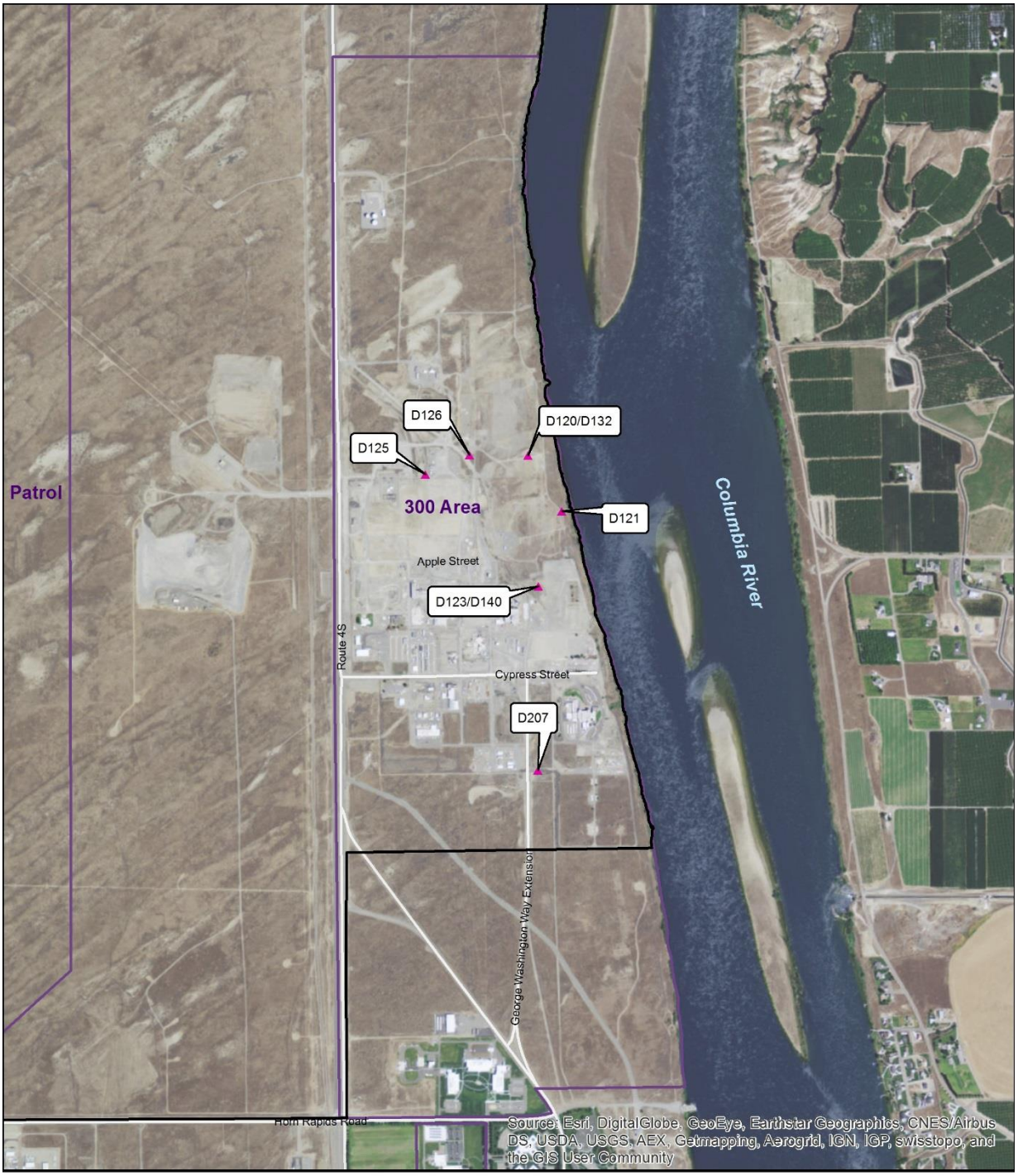


Figure 16. Near Field Soil Sampling Locations in the 400 Area

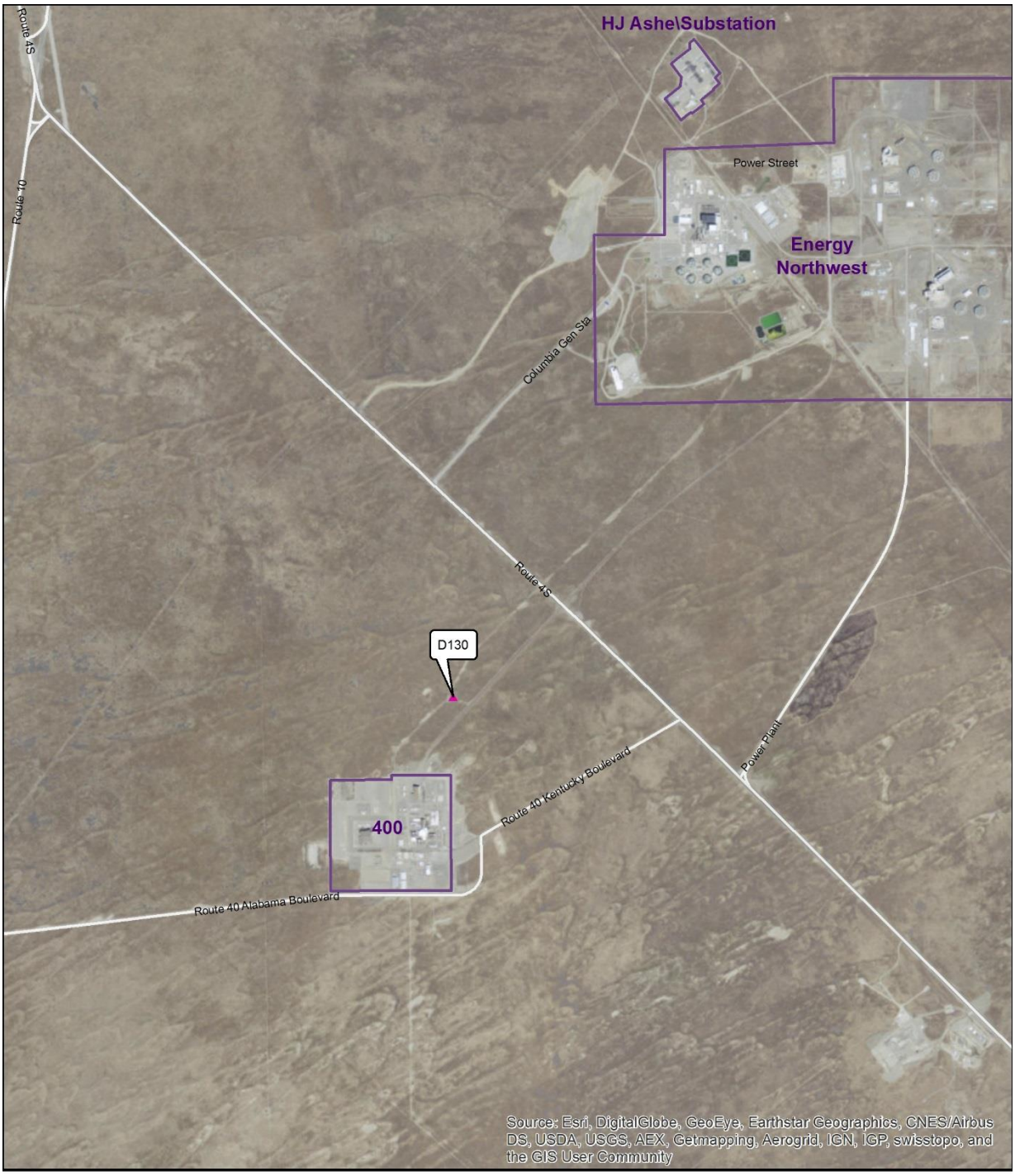
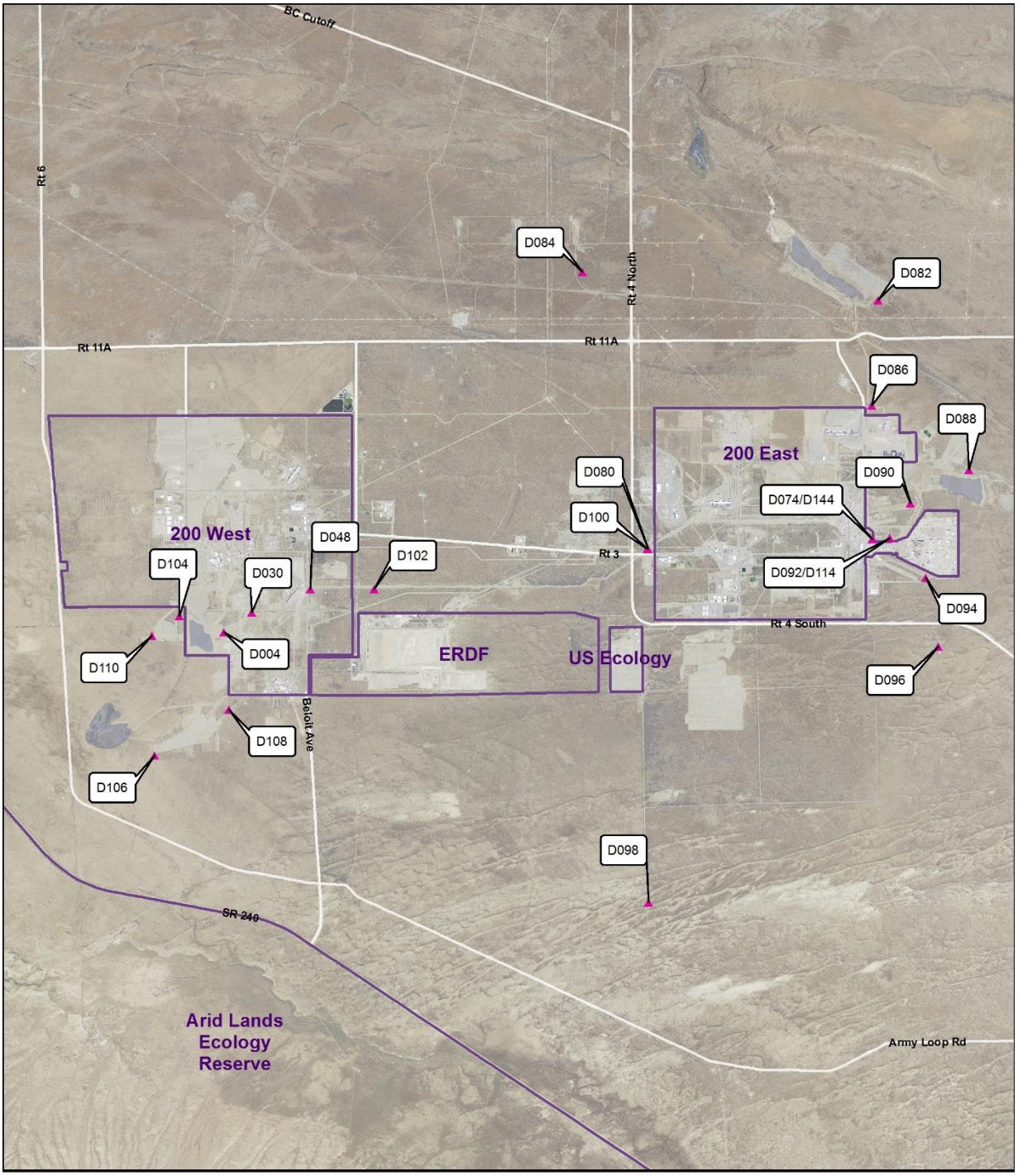


Figure 17. Near Field Soil Sampling Locations in the 600 Area



4.4 Near Field Vegetation Monitoring

Location	EDP Codes	Collection Period	Analyses
100-N Area	Y719[a], Y724	May	^{90}Sr, Pu-Iso, U-Iso, GEA
200 East Area	V054, V058, V060, V062, V064, V066[a], V072, V076, V078,	May	^{90}Sr, Pu-Iso, U-Iso, GEA
200 West Area	V002, V006, V010, V012, V016, V020[a], V022, V024, V026, V028[b, c], V032[b, c], V034, V036, V040, V042, V044, V046, V050, V052, V140[b], V112[b]	May	^{90}Sr, Pu-Iso, U-Iso, GEA
300 Area	V123[a, b, c], V132[b]	May	^{90}Sr, Pu-Iso, U-Iso, GEA
400 Area	V130	May	^{90}Sr, Pu-Iso, U-Iso, GEA
600 Area	V004, V030, V048, V080, V082, V084, V086, V088[a], V090, V092, V094, V096[b, c], V098, V100, V102, V104, V106, V108, V110, V114[b]	May	^{90}Sr, Pu-Iso, U-Iso, GEA
QC Samples			
Equipment Blank		May	^{90}Sr, Pu-Iso, U-Iso, GEA

(a) Additional sample provided to DOH.
(b) Duplicate samples (V028 & V140, V032 & V112, V123 & V132, V096 & V114) collected at this location.
(c) Laboratory split sample collected. Analyses for the split sample will be the same as for the parent sample.

Figure 18. Near Field Vegetation Sampling Locations in the 100 N Area

Figure 19. Near Field Vegetation Sampling Locations in the 200 East Area

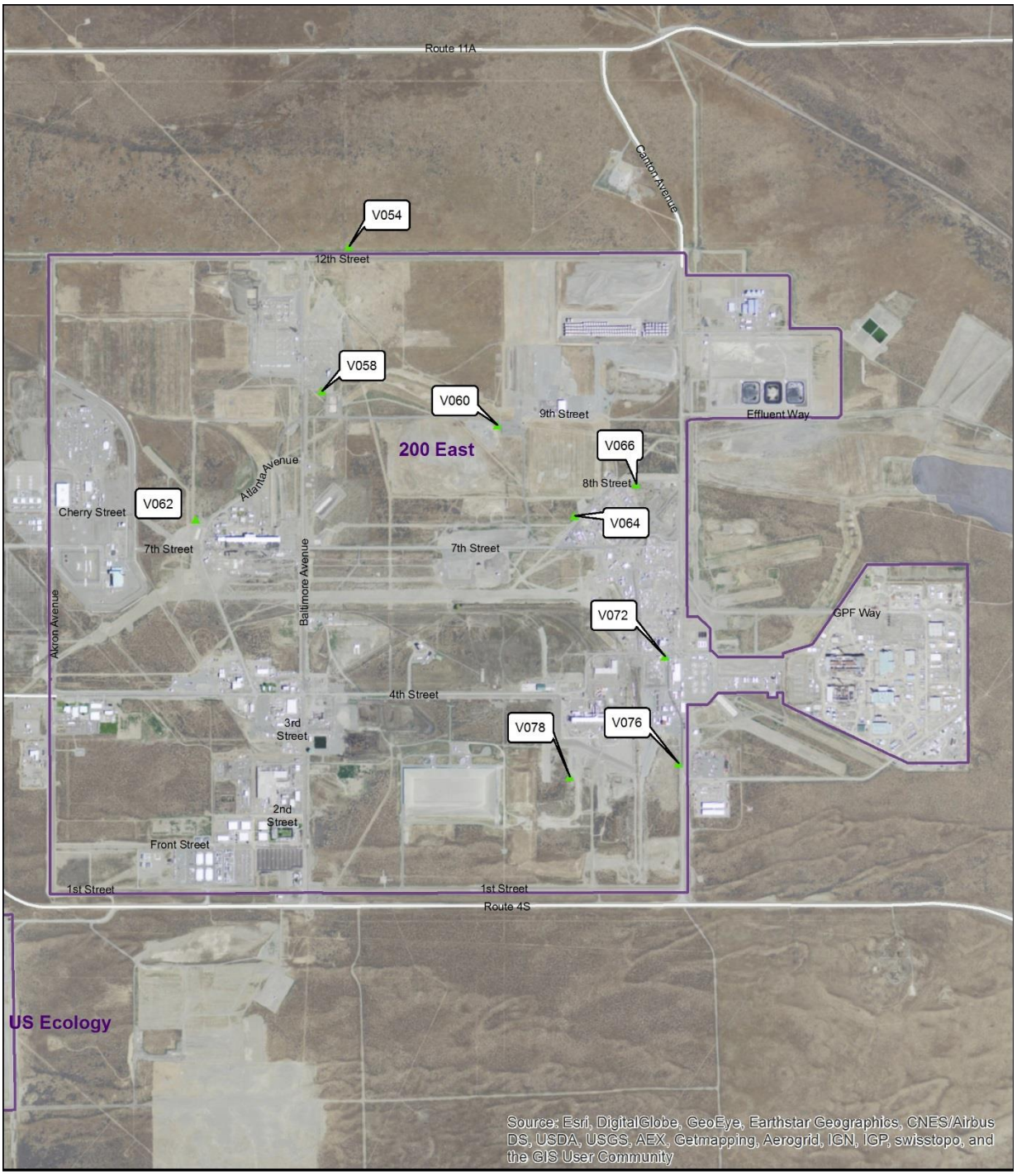


Figure 20. Near Field Vegetation Sampling Locations in the 200 West Area

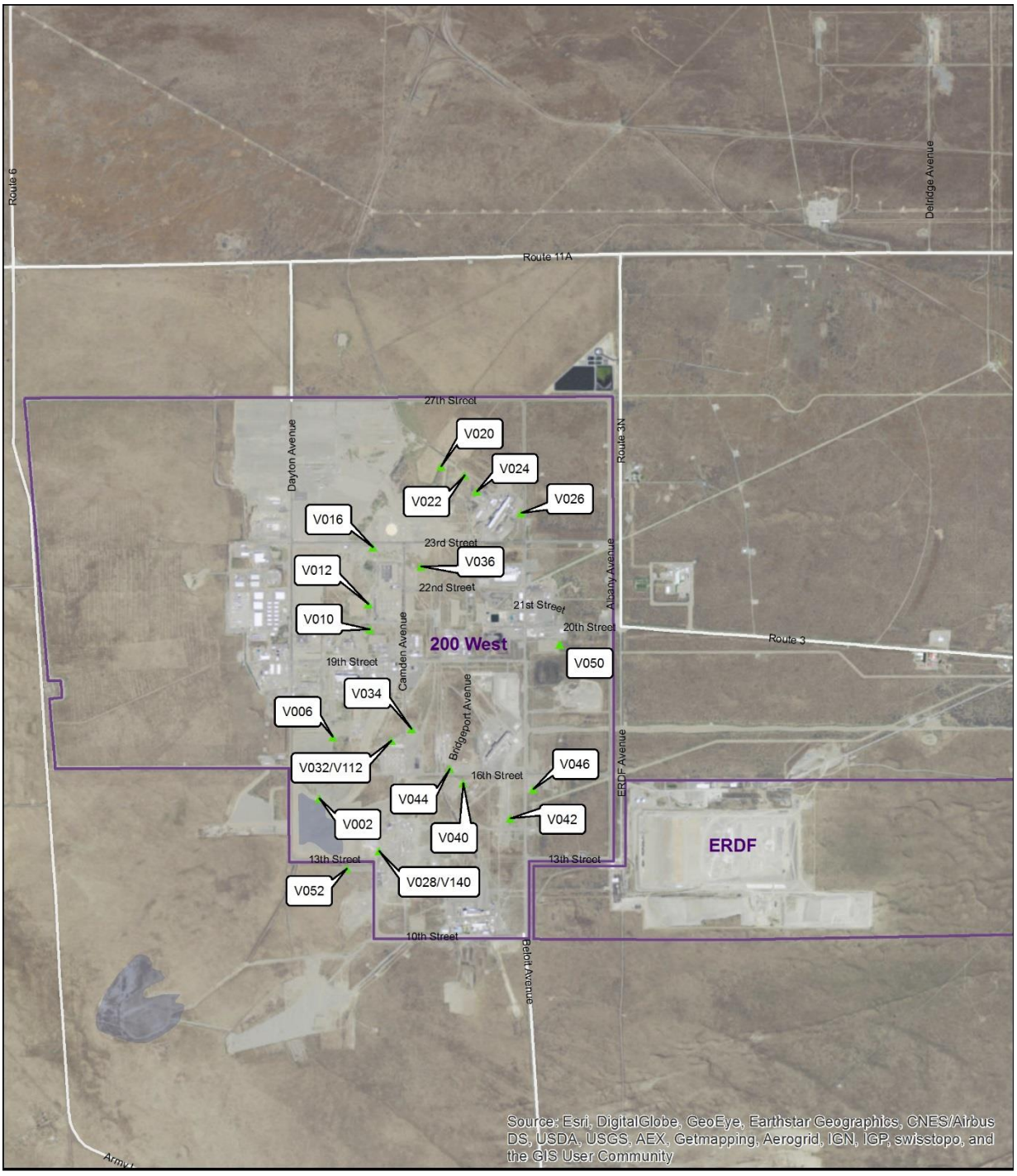


Figure 21. Near Field Vegetation Sampling Locations in the 300 Area

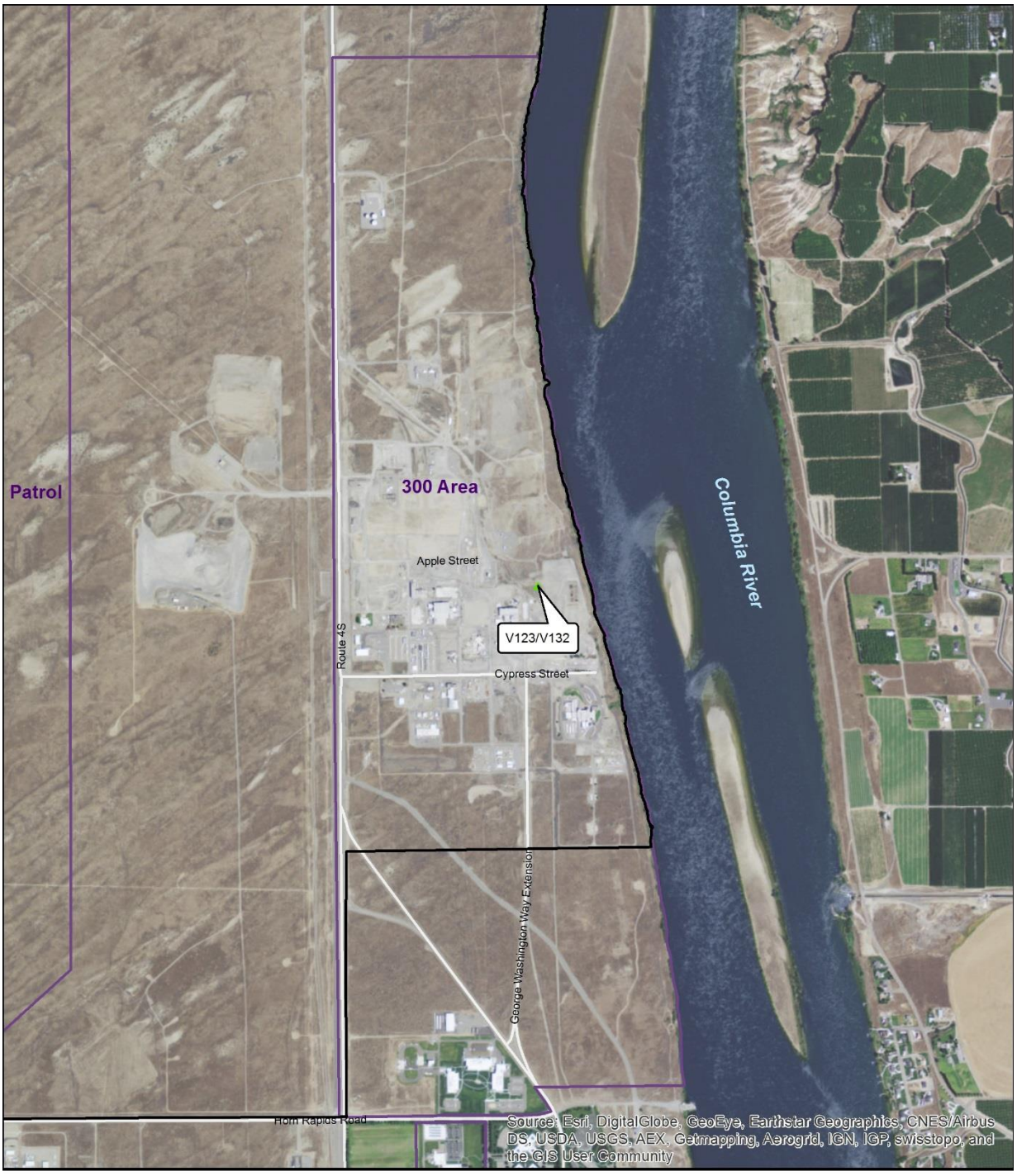


Figure 22. Near Field Vegetation Sampling Locations in the 400 Area

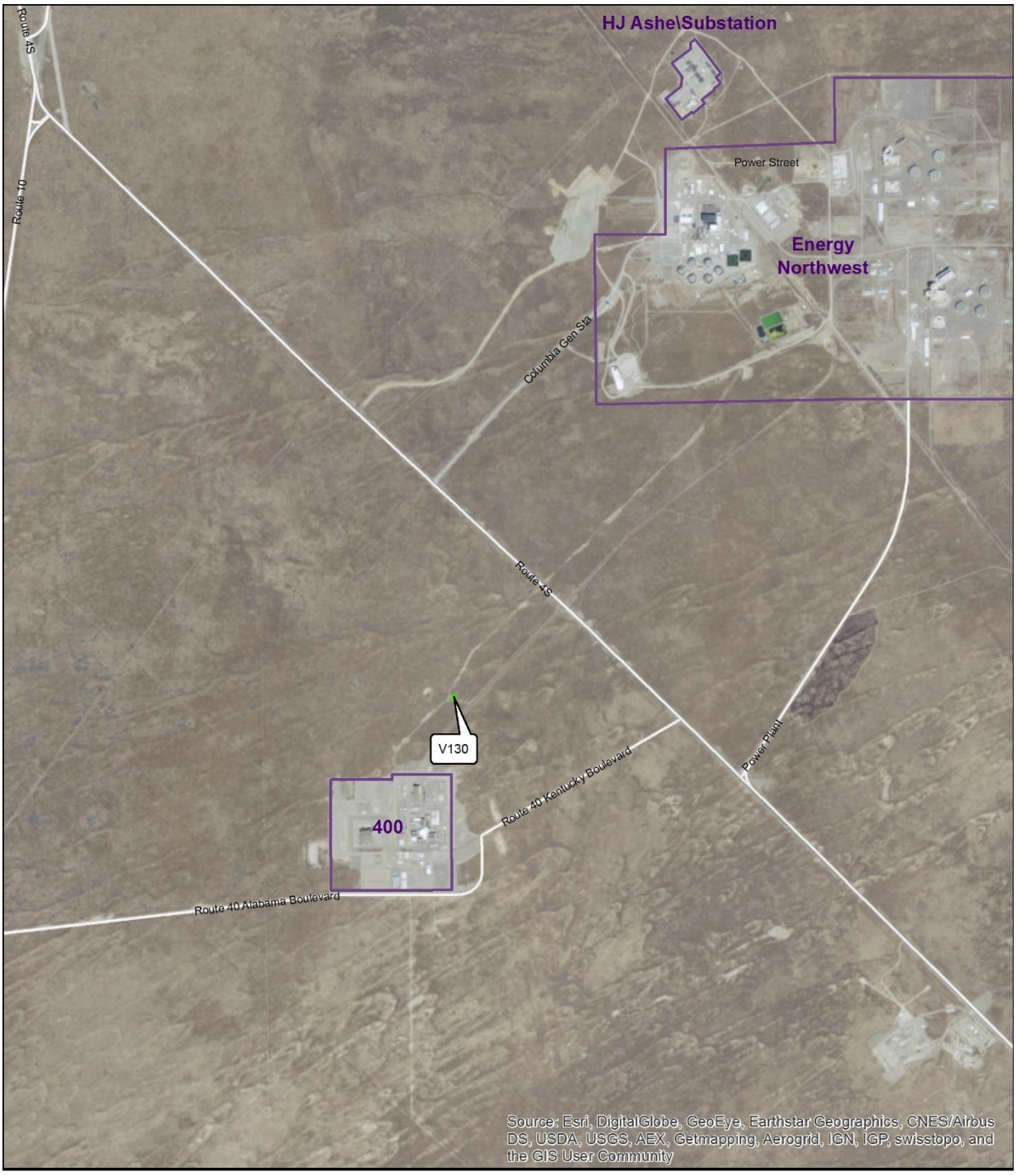
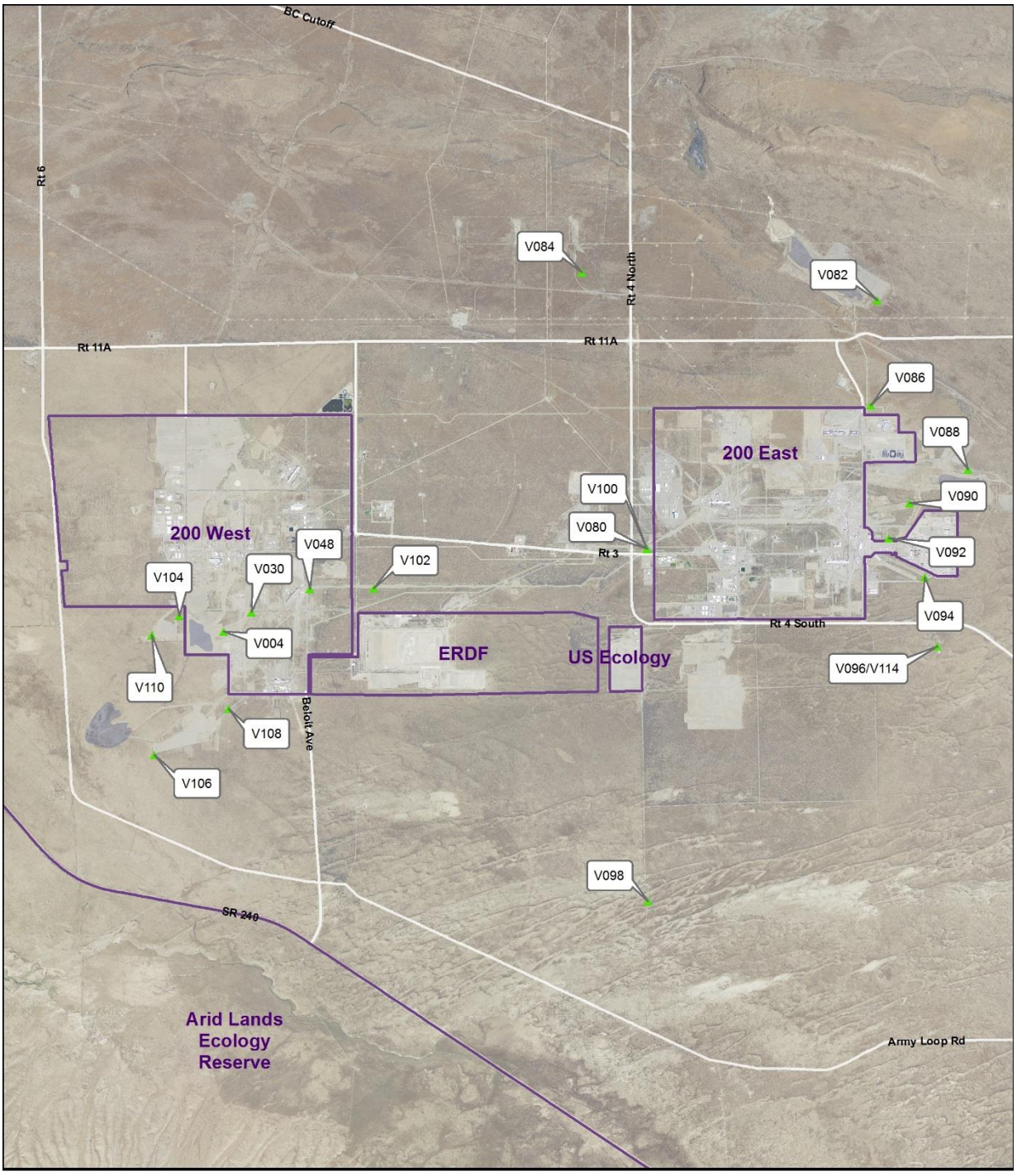


Figure 23. Near Field Vegetation Sampling Locations in the 600 Area



Legend

- Near Field Vegetation Sampling Location
- Operational Areas

N
W E
S

0 1 2 Miles

0 0.8 1.6 2.4 3.2 4 Kilometers

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5.0 Sediment

5.1 Columbia River

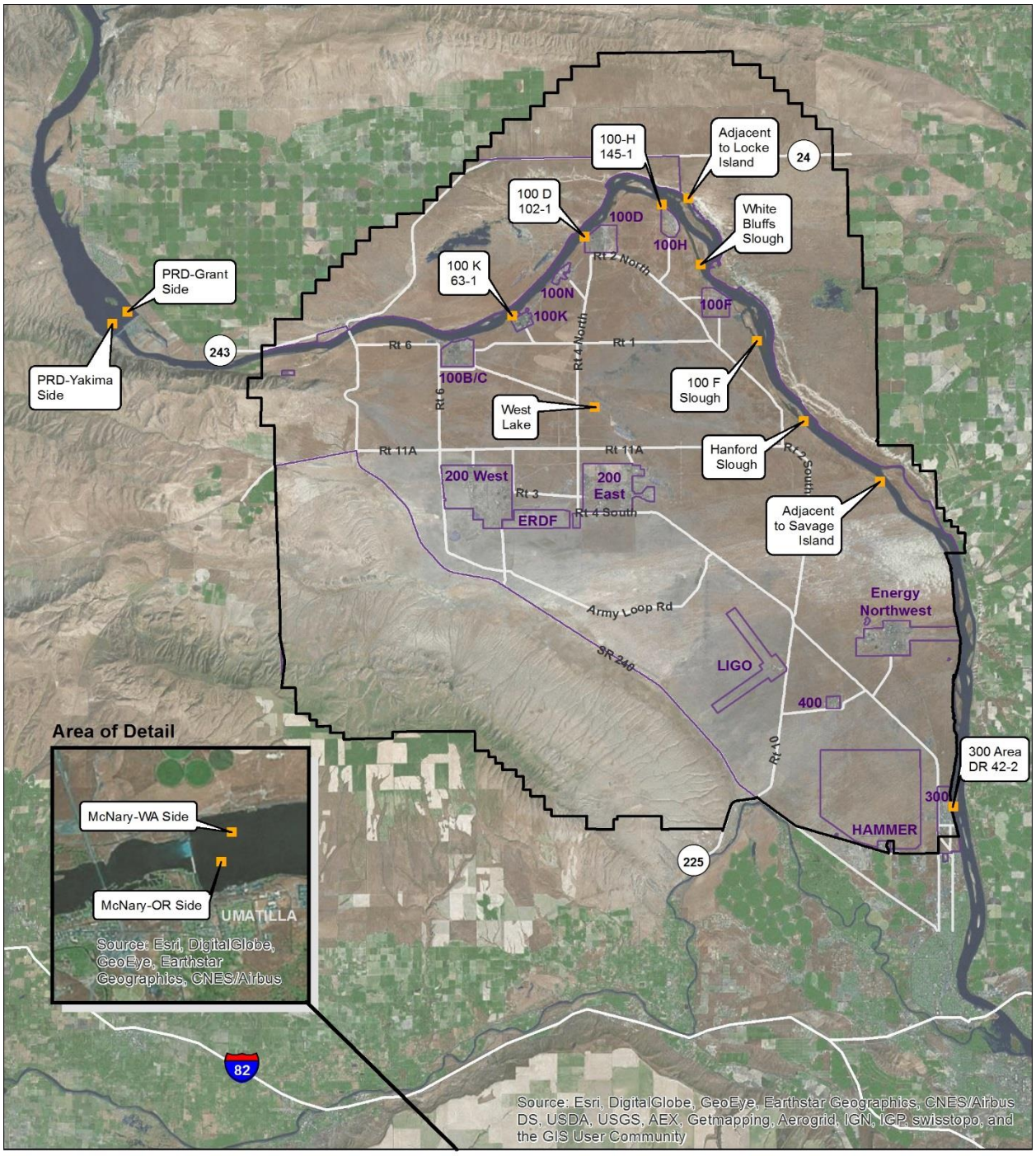
Location	Collection Period	Analyses
McNary Dam - Oregon Side[a]	October	GEA, ^{90}Sr, U-iso, Pu-iso, Anions, Cr^{+6}, ICP-MS, Hg-CVAA, TOC
McNary Dam - Washington Side[a]	October	GEA, ^{90}Sr, U-iso, Pu-iso, Anions, Cr^{+6}, ICP-MS, Hg-CVAA, TOC
Priest Rapids Dam - Grant Side[a]	October	GEA, ^{90}Sr, U-iso, Pu-iso, Anions, Cr^{+6}, ICP-MS, Hg-CVAA, TOC
Priest Rapids Dam - Yakima Side[a]	October	GEA, ^{90}Sr, U-iso, Pu-iso, Anions, Cr^{+6}, ICP-MS, Hg-CVAA, TOC
100-D Spring 102-1[b, c, d]	October	GEA, ^{90}Sr, U-iso, Pu-iso, Anions, Cr^{+6}, ICP-MS, Hg-CVAA, TOC
100-K Spring 63-1[a]	September	GEA, ^{90}Sr, U-iso, Pu-iso, Anions, Cr^{+6}, ICP-MS, Hg-CVAA, TOC, ^{14}C
100-H Spring 145-1[a, d]	September	GEA, ^{90}Sr, U-iso, Pu-iso, Anions, Cr^{+6}, ICP-MS, Hg-CVAA, TOC
Adjacent to Locke Island	October	GEA, ^{90}Sr, U-iso, Pu-iso, Anions, Cr^{+6}, ICP-MS, Hg-CVAA
White Bluffs Slough[a]	October	GEA, ^{90}Sr, U-iso, Pu-iso, Anions, Cr^{+6}, ICP-MS, Hg-CVAA, TOC
100-F Slough	October	GEA, ^{90}Sr, U-iso, Pu-iso, Anions, Cr^{+6}, ICP-MS, Hg-CVAA, TOC
Hanford Slough	October	GEA, ^{90}Sr, U-iso, Pu-iso, Anions, Cr^{+6}, ICP-MS, Hg-CVAA, TOC
300 Area DR 42-2[a, d]	September	GEA, ^{90}Sr, U-iso, Pu-iso, Anions, Cr^{+6}, ICP-MS, Hg-CVAA, TOC
Adjacent to Savage Island	October	GEA, ^{90}Sr, U-iso, Pu-iso, Anions, Cr^{+6}, ICP-MS, Hg-CVAA
QC Samples		
Equipment Blank	October	GEA, ^{90}Sr, U-iso, Pu-iso, Anions, Cr^{+6}, ICP-MS, Hg-CVAA, TOC

(a) Additional sample provided to DOH.
(b) Duplicate sample collected. Analyses for the duplicate sample will be the same as for the parent sample.
(c) Laboratory split sample collected. Analyses for the split sample will be the same as for the parent sample.
(d) Located at seep sampling location. Will be sampled at the same time as seep collections.

5.2 Onsite Pond

Location	Collection Period	Analyses
West Lake	March, May, August, November	GEA, ^{90}Sr, U-iso, ^{99}Tc, Alpha, Beta

Figure 24. Sediment Sampling Locations



6.0 Thermoluminescent Dosimeter

Area	Number of Locations	Frequency[a]	EDP Codes
On-Site			
100-K	18	Q	T218, T219, T220, T221, T222, T223, T224, T225, T226, T227, T228, T347, T348, T349, T350, T376, T377, T378
100-N	1	Q	T246
200 E	45	Q	T259, T260, T261, T262, T263, T264, T266, T267, T268, T269, T270, T271, T272, T273, T274, T275, T276, T277, T278, T279, T280, T281, T282, T283, T284, T285, T286, T287, T288, T289, T290, T291, T292, T293, T294, T295, T296, T297, T298, T299, T300, T375, T265, T382, T383
200 W	28	Q	T301, T302, T303, T304, T305, T306, T307, T308, T309, T310, T311, T312, T313, T314, T315, T316, T317, T318, T319, T320, T322, T324, T351, T352, T353, T321, T325, T323
300 Area	14	Q	T326, T327, T328, T329, T330, T331, T332, T333, T334, T335, T336, T337, T338, T339
400 Area	7	Q	T340, T341, T342, T343, T344, T345, T346
618-10[b]	4	Q	T379, T380, T381, T374
Off-Site			
Ringold	1	Q	T384
W End of Fir Road	1	Q	T385
Dogwood Met Tower	1	Q	T386

(a) TLDs are exchanged quarterly in March, June, September and December.
(b) Samples for WCH.

Figure 25. Thermoluminescent Dosimeter Locations in the 100-K Area

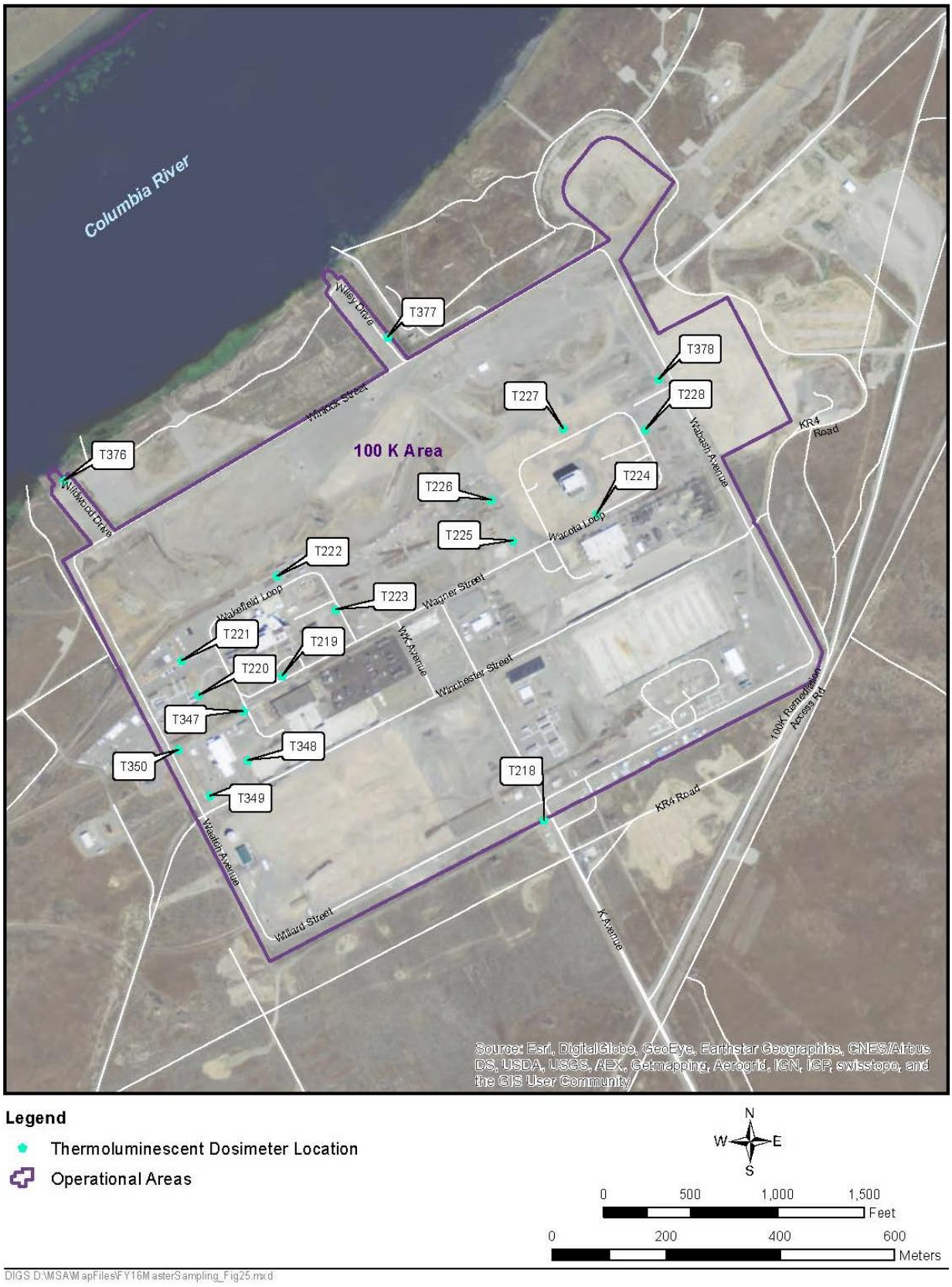


Figure 26. Thermoluminescent Dosimeter Location in the 100-N Area

Figure 27. Thermoluminescent Dosimeter Locations in the 200 East Area

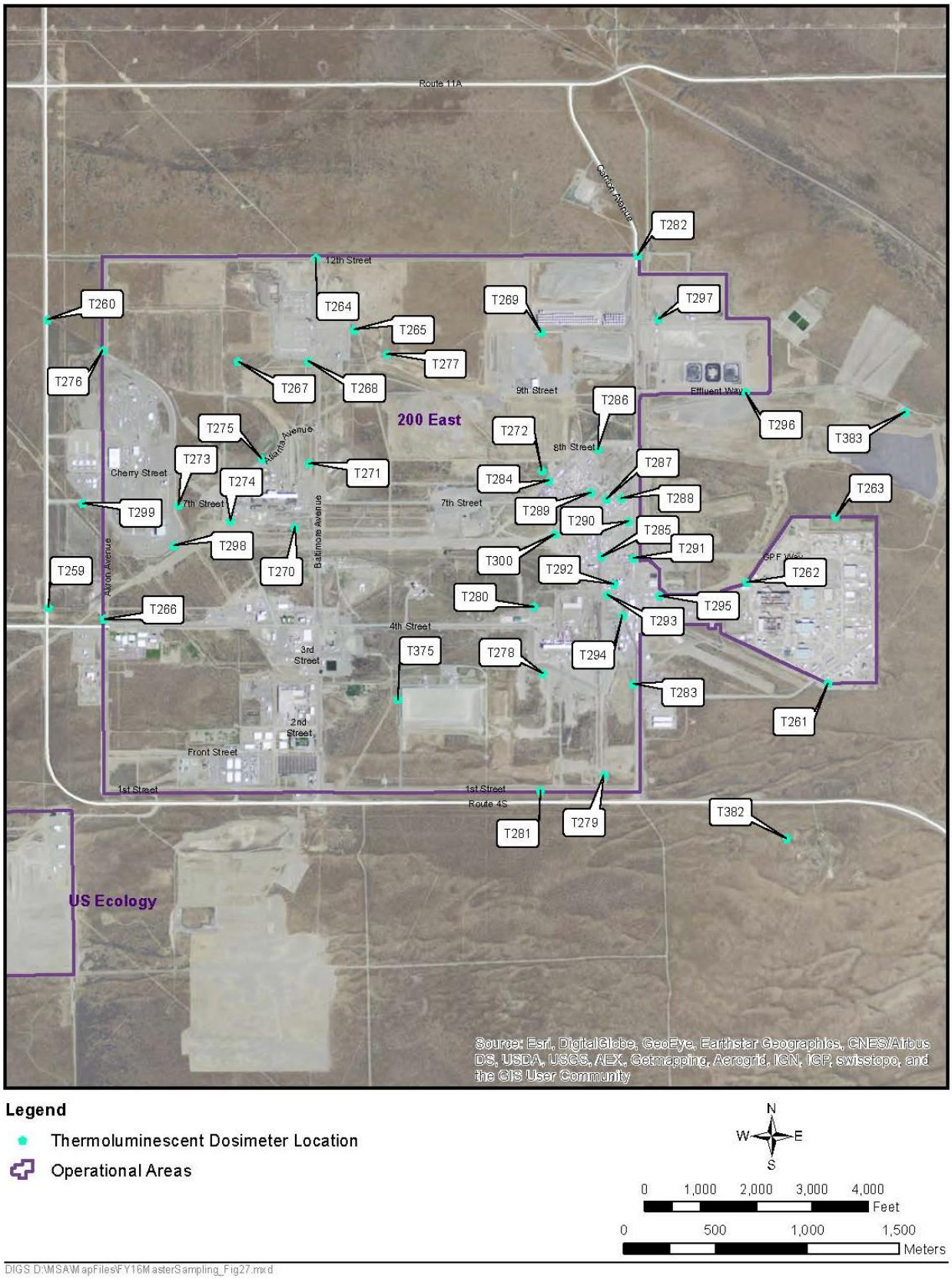


Figure 28. Thermoluminescent Dosimeter Location in the 200 West Area

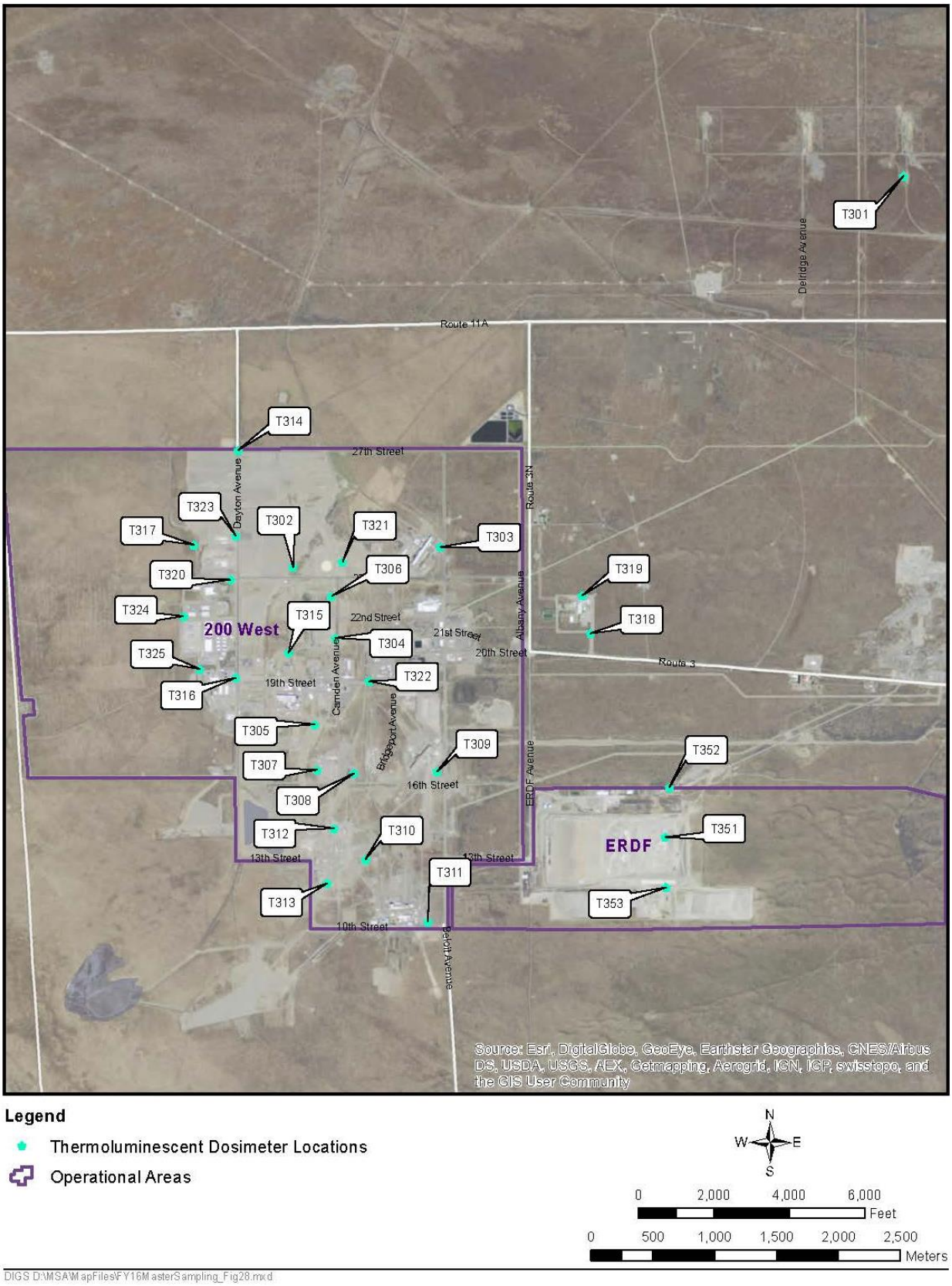


Figure 29. Thermoluminescent Dosimeter Locations in the 300 Area

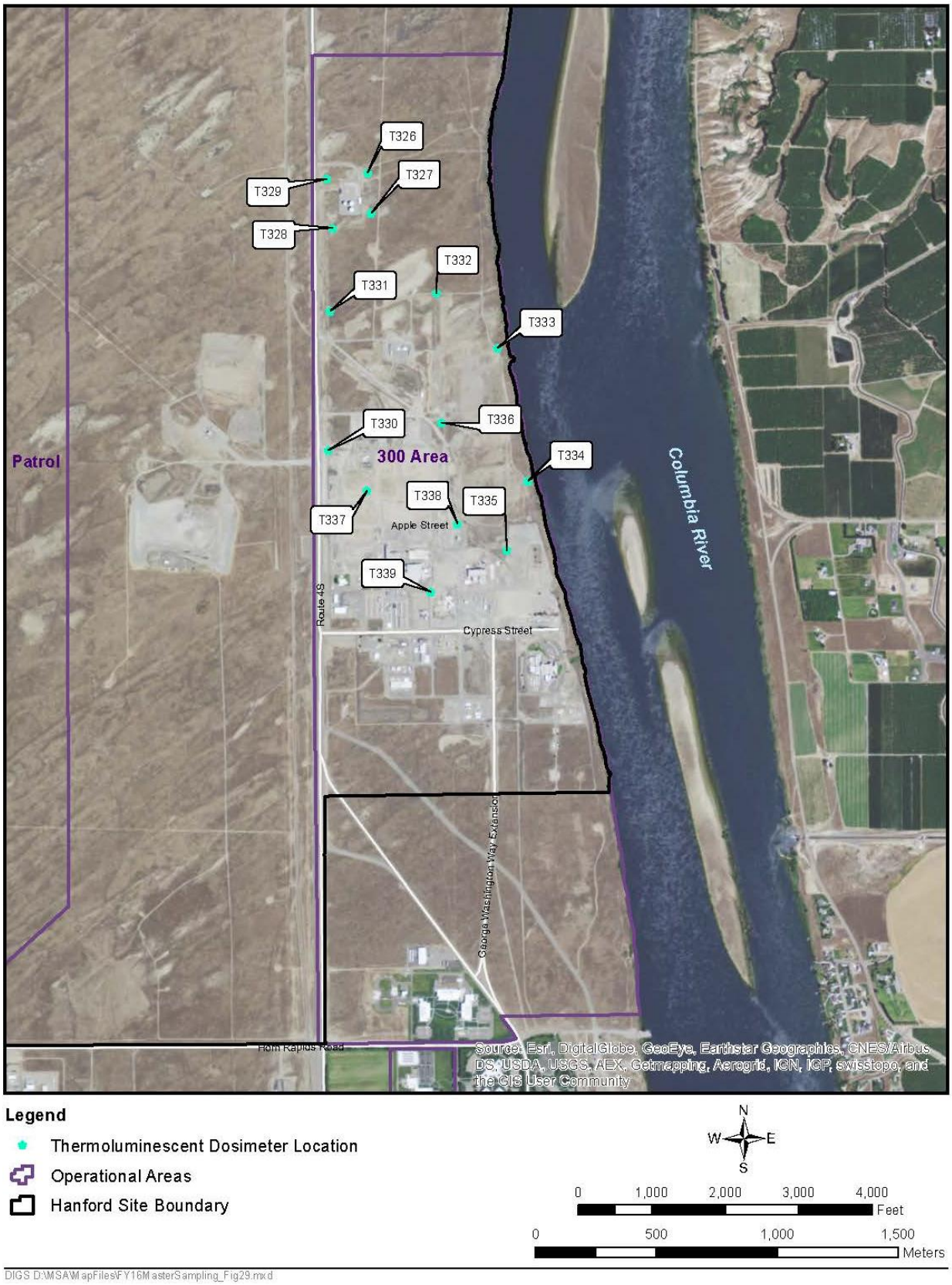


Figure 30. Thermoluminescent Dosimeter Locations in the 400 Area and 618-10 Burial Ground

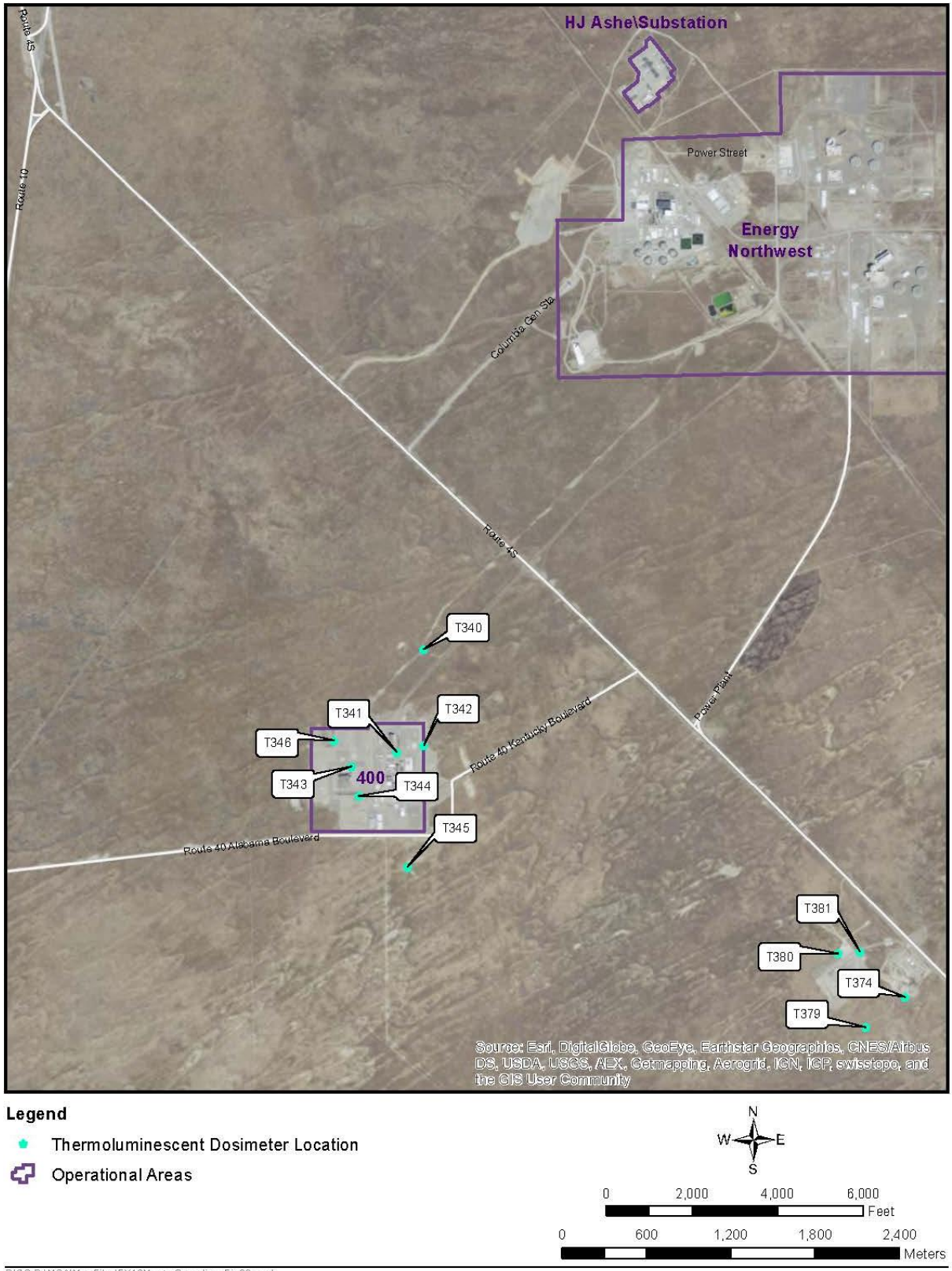
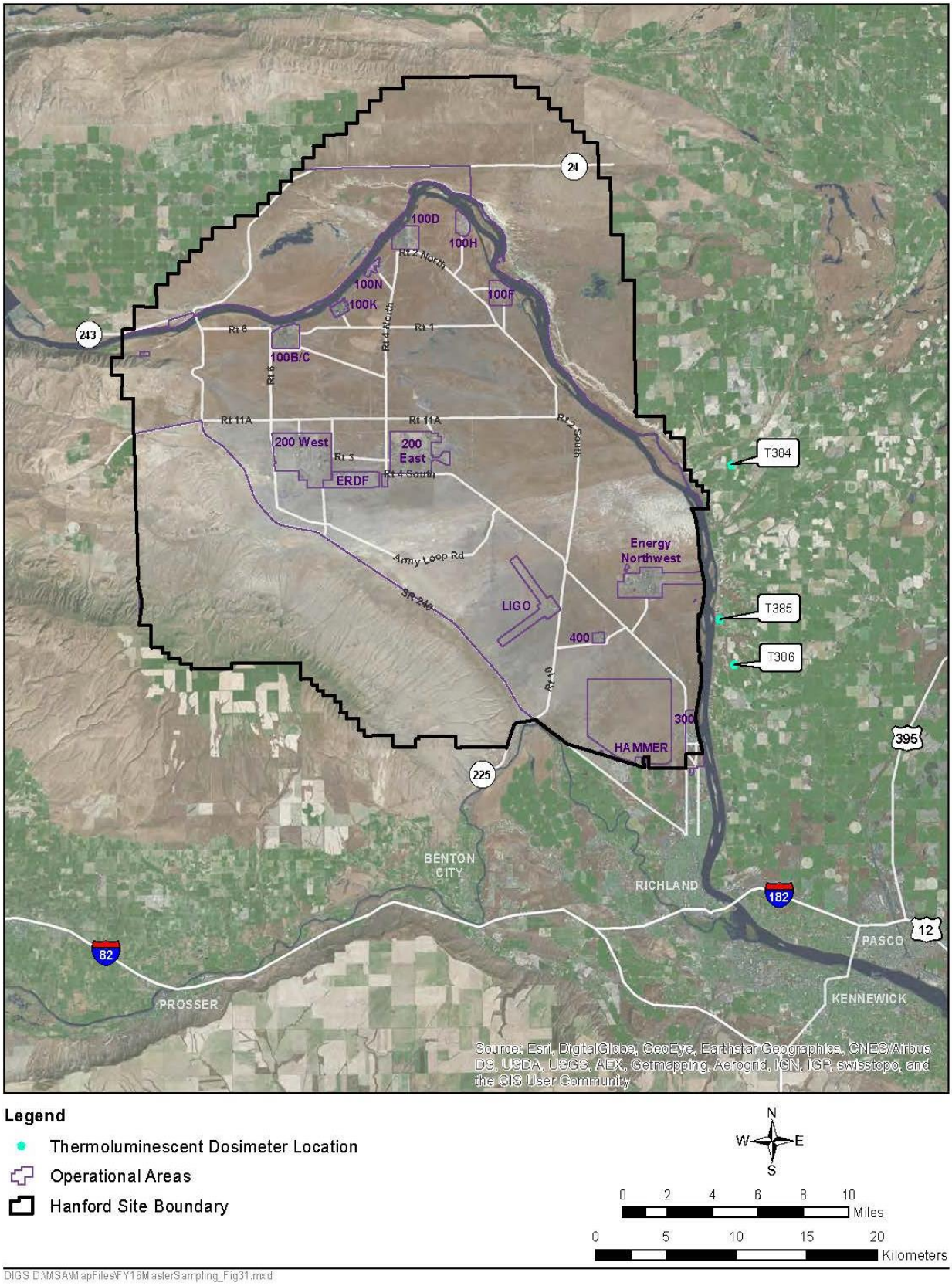


Figure 31. Thermoluminescent Dosimeter Off-Site Locations



7.0 Radiological Surveys

7.1 Weekly Inspections

Location
2724-WB RMA

7.2 Annual Radiological Surveys

Location	Survey Period
241-S/SX/SY tank farm perimeters (including 200-W-54 and 216-SX-2)	January
218-E-12B outside perimeter	January
241-B tank farm perimeter	January
241-C tank farm perimeter (including posted CA South of 7th street)	February
242-A, 241-A, AN, AX, AY, & AZ tank farm perimeters	February
241-BX/BY tank farm perimeters (including 216-BY-201 tank)	February
218-E-12A outside perimeter	February
241-U (including 200-W-91 and 200-W-95) tank farm perimeters	February
241-TX/TY tank farm perimeters	March
218-W-4A perimeter	March
200-E-109 perimeter	March
218-E-10 outside perimeter	March
241-T tank farm perimeter	April
2025E and 200-E-17 perimeter	April
600-214 Perimeter	April
Tumbleweed surveys inside and outside of the Northeast corners of 200-E and 200-W perimeter fences	April
200/600 Areas Emergency Plots	November
Haul routes (As identified by PSRP)	TBD

Appendix A Master Sampling Schedule changes for Calendar Year 2016

1.0 Air Surveillance

1.2 Near Field Air Monitoring

- Retired one CERCLA station at 300 D4 project: N557 due to completion of clean-up activities by WCH.
- Added tritium sampling capability at station N130 (300 TEDF) to provide "upwind" location to support 300 Area monitoring. This addition is based on recommendations made in recent report: *Independent Review of the Hanford Environmental Surveillance Air Monitoring Program*, conducted by Integrated Science Solutions, Inc. team.
- Added new permanent station N582 at 200 ETF/LERF in response to DOH NOC requirements.
- In support of upcoming D&D project at the Plutonium Finishing Plant (200 West Area), added Pu-241 (known contaminant for this facility) analysis for six stations listed in DOH Notice of Construction: N155, N165, N433, N554, N555 & N975.

2.0 Surface Water Surveillance

2.1 Columbia River – Continuous Sampling

- Added quarterly grab sample collections to the Priest Rapids Dam and Richland Pumphouse locations. These will be analyzed for anions only in an effort to help discern non-Hanford contaminant sources in irrigation water.

2.2 Columbia River – Transects

- Added hexavalent chromium, having a hold time of 24 hours for water samples, will be added to the analytical list for the 2016 transect sampling. A local laboratory will be contracted to perform this analysis in order to meet the holding time requirement. Hexavalent chromium is a contaminant of potential ecological concern (DOE/RL-2007-21) and has been added to the analytical list to provide contaminant specific data for comparison to the 10 ug/L EPA surface water quality standard and to provide analytical consistency and comparability with the groundwater monitoring program. Transect locations are positioned in conjunction with known contaminant plumes that are located on the Hanford Site.

2.3 River Bank Seeps

- Added hexavalent chromium, having a hold time of 24 hours for water samples, will be added to the analytical list for the 2016 seep sampling. A local laboratory will be contracted to perform this analysis in order to meet the holding time requirement. Hexavalent chromium is a contaminant of potential ecological concern (DOE/RL-2007-21) and has been added to the analytical list to provide contaminant specific data for comparison to the 10 ug/L EPA surface

water quality standard and to provide analytical consistency and comparability with the groundwater monitoring program.

- A seep (100-F Spring 187-1) will be added to the sampling schedule to support evaluation of contaminant discharges to the Columbia River at the shoreline near the 105-F Reactor. Historical information indicates the 100-F Spring 187-1 seep was sampled in 1991, 1999, 2012, 2013, and 2015 (by another contractor); however, it has not been sampled as part of the Environmental Surveillance Program. Groundwater contaminants at 100-F are nitrate, trichloroethene, hexavalent chromium, and strontium-90. Samples collected from the 100-F Spring 187-1 will include analyses of those contaminants along with others that may have entered the Columbia River via shoreline seep or groundwater. The 2014 *Record of Decision Hanford 100 Area Superfund Site 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, 100-IU-6 Operable Unit* identifies Monitored Natural Attenuation (MNA) for the contaminated groundwater until groundwater cleanup levels are achieved. Sampling this seep will provide information concerning potential contaminated surface water discharges to the Columbia River at the 100-F Reactor shoreline. This will also confirm the method of MNA as an effective remediation methodology that is contained in the ROD as well as confirm that other contaminant exposure pathways (e.g., direct biological exposure and/or bioaccumulation) are mitigated or eliminated.

2.4 Onsite Pond

- Changed the collection of West Lake water to quarterly as a result of elevated uranium concentrations resulting in additional RESRAD Biota Tier 2 Model input requirements. Additional sampling opportunities may be introduced as a result of these elevated concentrations of uranium including sampling for biota exposure/bioaccumulation (on-site and downwind) as well as downwind sampling locations of soil and biota due to potential airborne transport and redeposition of uranium.

3.0 Biota

3.1 Food and Farm Products

3.1.4 Fruits

- Removed the collection of Concord grapes due to lack of table grape production and overall increase of wine grapes grown in the collection areas.

- Added the collection of apricots due to availability and consumption of stone fruits by humans in the lower Yakima Valley and greater Columbia Basin areas.

3.1.5 Wine

- Sampling frequency increased from biennially to annually due to increased market interest and lack of local production of table (Concord) grapes.

3.2 Wildlife

3.2.1 Fish

- Walleye has been added into the 2016 schedule for initial collection in 2017. Walleye are a highly popular sport fish, considered a highly appetizing white-fleshed fish. As with bass, many local tournaments occur each year for this species. Sampling locations will be located in the 100 Areas, Hanford Townsite to 300 Area and a Reference area. These areas match other fish species sampled and provide the best opportunity to capture fish living near groundwater plumes entering the Columbia River.
- Sampling frequency for carp has been changed from triennially to biennially for a more adequate representation of fish used locally for human consumption by some cultures.

3.2.2 Birds

- Hanford Townsite to 300 Area collection location has been added to upland game bird sampling to provide proximity to the historical operation areas and proximity to the general public (and known habitat areas).

4.0 Soil and Vegetation

4.1 Far Field Soil Monitoring

- No offsite soil sampling is scheduled in 2016. Offsite sampling is used for long-term trend analysis and is not used in dose model calculations. Sampling frequency is every 3 to 5 years and was last conducted in 2015.

4.2 Far Field Vegetation Monitoring

- No offsite vegetation sampling is scheduled in 2016. Offsite sampling is used for long-term trend analysis and is not used in dose model calculations. Sampling frequency is every 3 to 5 years and was last conducted in 2015.

4.3 Near Field Soil Monitoring

- Includes the 200/600 Area even numbered sample locations that are collected only during even numbered years.
- Removed five (5) monitoring locations due to lack of soil availability
    - D014 (216-W-14 Ditch, SW)
    - D018 (207-T Basin SW)
    - D056 (BY Tank Farm, East)
    - D068 (216-A-40 Basin)
    - D070 (AZ Tank Farm, West)

4.4 Near Field Vegetation Monitoring

- Includes the 200/600 Area even numbered sample locations that are collected only during even numbered years.

- Removed seven (7) monitoring locations due to lack of perennial vegetation availability
    - V008 (216-Z-19 Ditch)
    - V014 (216-W-14 Ditch, SW)
    - V018 (207-T Basin SW)
    - V056 (BY Tank Farm, East)
    - V068 (216-A-40 Basin)
    - V070 (AZ Tank Farm, West)
    - V074 (AP Tank Farm, NE)

5.0 Sediment

5.1 Columbia River

- Added sediment collections at 300 Area DR 42-2 and 100-H Spring 145-1. Sediment samples will be collected concurrently with co-located seep water samples at three seep locations in 2016 (100-K Spring 63-1, 100-H Spring 145-1, and 300 Area DR 42-2). The results of this sampling provide co-located sediment and water concentration data that will be used to develop site-specific solid/solution distribution coefficients (Kd) for use in biota dose modeling, as specified (DOE-STD-1153-2002). Locations correspond to Hanford Site down-gradient areas where known groundwater contaminant plumes are entering and/or have entered the Columbia River.

5.2 Onsite Pond

- Changed the collection of West Lake water to quarterly as a result of elevated uranium concentrations resulting in additional RESRAD Biota Tier 2 Model input requirements. Additional sampling opportunities may be introduced as a result of these elevated concentrations of uranium including sampling for biota exposure/bioaccumulation (on-site and downwind) as well as downwind sampling locations of soil and biota due to potential airborne transport and redeposition of uranium.

6.0 Thermoluminescent Dosimeter

- Added five (5) monitoring locations in concert with anticipated ambient air monitoring for WTP:
    - Onsite station N920 (200 ESE)
    - Onsite station N924 (B Pond)

- Offsite station N933 (Ringold Met Tower)
- Offsite station N934 (W. End of Fir Rd.)
- Offsite station N935 (Dogwood Met Tower)

[Will pursue authorization from DOH to retire 5 TLD locations north of the 300 Area at the recently removed 300 TEDF site]

7.0 Radiological Surveys

7.2 Annual Radiological Surveys

- As a result of reviewing near field contamination control incidents in the previous year and in the last 5 and 10 years for sites with the greatest number of events, an annual radiological survey at the 242 A Evaporator has been added to the 2016 schedule and 241-ER-251 Diversion box perimeter surveys have been removed.

Appendix B Sampling Rationale

1.0 Ambient Air Monitoring

Atmospheric releases of radioactive materials from Hanford Site facilities and operations to the surrounding region are potential sources of exposure to humans. Radioactive constituents in air are monitored at Hanford Site facilities and projects, at Hanford Site locations away from facilities, and offsite around the site perimeter as well as in nearby and distant communities.

Air sampling at/near facilities/projects is conducted to assure compliance with predetermined regulatory limits (i.e., EPA concentration values (40 CFR 61, Appendix E, Table 2, per *#FF-01 License*) and to detect airborne radiological contaminants resulting from site operations.

Ambient air monitoring is a recommended practice per section 6.0 of DOE handbook DOE-HDBK-1216-2015, *Environmental Radiological Effluent Monitoring and Environmental Surveillance*.

Air sampling at Perimeter, Nearby Community and Distant Community locations is conducted to provide analytical data that is used to support radiological dose modeling to the public via the air pathway using CAP88 dose model.

Data collected from locations on and around the Hanford Site is also compared to concentrations measured at upwind locations assumed to be uninfluenced by Hanford Site operations to provide an evaluation of the impact of radionuclide air emissions from the Hanford Site on surrounding ambient air.

Airborne particle samples are collected biweekly at each location and combined into semiannual composite samples.

Atmospheric water vapor samples are collected for tritium analysis by continuously drawing air through multi-column samplers containing adsorbent silica gel. The water-vapor samples are exchanged every 4 weeks.

2.0 Surface Water Surveillance

2.1 Columbia River Continuous Water

Liquid effluent discharges related to historical Hanford operations are known to enter the Columbia River through shoreline, surface water discharge of groundwater at certain locations along the site shoreline from the 100-B/C Area downstream to the 300 Area. The impact of these discharges is evaluated as the difference between near-shore river water radionuclide concentrations downstream of the Hanford Site (monthly samples collected at the Richland Pumphouse) and upstream samples collected below the Priest Rapids Dam. Some radionuclides are measured in both filtered samples (in solution) and in samples that capture suspended particulates (adhered to resin).

Radionuclides of interest are selected for analyses based on the following criteria:

- Their presence in historical effluent discharges from Hanford Site facilities or in contaminants found in groundwater underlying the Hanford Site near the Columbia River

- Their importance in determining water quality, and in determining compliance with applicable water quality standards.

- Their importance in key pathway-specific exposure dose assumption calculations based on 95th percentile of drinking water ingestion rate of 3.1 L/day for 350 days/year (EPA/600/R-09/052F, Table ES-1).

Constituents of interest in Columbia River water samples collected at Priest Rapids Dam and the city of Richland included gamma-emitting radionuclides, tritium, strontium-90, technetium-99, uranium-234, uranium-235, plutonium-238, uranium-238, and plutonium-239/240.

2.2 Columbia River Transects

Transect sampling (i.e., a series of samples collected along a line across the Columbia River) was initiated because of findings of a special study conducted in the late 1980s (PNL-8531, *Columbia River Monitoring: Distribution of Tritium in Columbia River Water at the Richland Pumphouse*). The study concluded that, under certain flow conditions, contaminants entering the Columbia River from the Hanford Site are not completely mixed when sampled at routine monitoring stations located downriver. Incomplete mixing results in a conservative bias in the data generated using the routine, single-point sampling system at the city of Richland drinking water intake. Transect sampling allows cross-river concentration profiles to be determined to provide information over a larger portion of the Hanford Site shoreline where the highest contaminant concentrations of concern would be expected.

Columbia River transect water samples are analyzed for radionuclides, metals, and inorganic and organic contaminants. These analyses are selected for following reviews of existing surface-water and groundwater data, various RI/FS work plans, and preliminary Hanford Site risk assessments (DOE/RL-92-67, *Final Remedial Investigation/Feasibility Study-Environmental Assessment Report for the 1100-EM-1 Operable Unit, Hanford*; WCH-380, *Field Summary Report for Remedial Investigation of Hanford Site Releases to the Columbia River, Hanford Site, Washington*). Metals analyses included both unfiltered and filtered samples.

2.3 River Bank Seeps

Groundwater beneath the Hanford Site discharges on the shoreline surface of the Columbia River via seeps and subaqueous (below the riverbed) groundwater up-welling. Groundwater provides a means for transporting Hanford Site-associated contaminants into the Columbia River. Routine monitoring of selected Columbia River seeps was initiated in 1988. The objectives of seep sampling are multi-fold and include: the locations and levels of contaminants entering the river, confirm or negate the MNA and pump and treat (for groundwater) are effective remediation strategies proposed in various CERCLA ROD's; evaluation of the nature and extent of potential ecological and human exposures and bioaccumulation; and provides assistance in discerning whether public and biological access needs to be restricted (e.g., institutional controls such as fencing, sign postings, etc.). Samples are collected at least annually during low river level periods (fall) when dilution by river water is minimal and relatively higher contaminant concentrations are expected.

It is important to know the inventory of contaminants and the various locations that these known contaminants are entering the Columbia River along the Hanford Reach shoreline in order to (DOE/RL-91-50):

- Assure that protection of human health and the environment are maintained both on and off the Hanford Site.

- Assess the impact of Hanford Site operations on Columbia River water quality.
- Identify significant changes in contaminant concentrations (radiological and chemical) in surface water.
- To assess potential sources of new contaminants or whether various remediation strategies are or have been effective.
- Characterize contaminants in the surface water environment and discern whether there are any human health or biological risk associated with these contaminants.
- Determine the status of the site's compliance with applicable with regulatory-driven water quality standards and criteria.
- Provide assurance to the public that Hanford-derived contaminant exposure risks associated with use of the Columbia River are continually monitored and evaluated.

The following contaminants are present in groundwater that discharges to the river (DOE/RL-2015-07):

- 100 BC: hexavalent chromium, strontium-90, tritium
- 100-K: hexavalent chromium, carbon-14, tritium, strontium-90, nitrate, trichloroethene
- 100-N: strontium-90, petroleum hydrocarbons, nitrate, tritium
- 100-D: hexavalent chromium, strontium-90, nitrate
- 100-H: hexavalent chromium, strontium-90, nitrate
- 100-F: nitrate, hexavalent chromium, strontium-90, and trichloroethene
- 300 Area: uranium, trichloroethene

Sample locations and analytes of interest for riverbank springs/seeps are selected based on findings of previous investigations, review of contaminant concentrations observed in nearby groundwater monitoring wells, and results of preliminary risk assessments. Several seep locations (e.g., F Area Slough) are targeted for sampling because they are easily accessible and highly used by wildlife.

The results of the seep sampling are trended and data are used to determine radiological dose to humans, aquatic, riparian, and terrestrial biota. The contaminant concentrations in seeps are greater than those observed in the river water and have the potential for higher contaminant concentration level exposures due to mixing and subsequent dilution. Therefore, the dose assessment results using these discrete areas of elevated concentrations are conservative and are protective relative to the potential for impacts on populations of biota in and adjacent to the Columbia River.

2.4 Onsite Pond

The West Lake pond is accessible to migratory waterfowl, deer, and other riparian wildlife, creating a potential biological pathway for the dispersion of contaminants. West Lake, the only naturally occurring pond on the Hanford Site, is located north of the 200-East Area. West Lake has not received direct effluent discharges from Hanford Site facilities. The water level in West Lake fluctuates due to precipitation and changing water table elevations. The lake changes from standing water in winter and spring to dry or nearly dry in summer and fall. The water level and size of the lake has been decreasing over the past several years due to reduced wastewater discharge. Historic discharges of billions of gallons of process water into nearby cribs, ditches, and ponds created groundwater mounding beneath West Lake which, in recent years, is slowly receding. Radionuclides are chosen for analysis based on their presence in local groundwater and sediment and on their potential to contribute to the overall radiation dose to biota that frequent the ponds.

2.5 Offsite Irrigation

The consumption of food products irrigated with Columbia River water downstream of the Hanford site has been identified as one of the primary pathways contributing to the potential dose to the hypothetical Maximally Exposed Individual (MEI) and any other member of the public. Irrigation water samples are collected 3 times per year to cover variations in harvest periods.

3.0 Biota Sampling

3.1 Food and Farm Products

3.1.1 Milk, 3.1.2 Alfalfa/ Hay, 3.1.3 Vegetables, 3.1.4 Fruits, and 3.1.5 Wine

Food and farm products are collected at locations near the Hanford Site. These products are used to determine pathway-specific exposure assumptions by way of annual dose calculations. Sample locations include:

- Generally downwind (east and southeast) of the Hanford Site where airborne emissions or contaminated dust from the site potentially would be deposited.
- Generally upwind of and distant from the Hanford Site to provide information about reference (background) contaminant levels.
- Farms irrigated with water taken from the Columbia River downstream of the Hanford Site.

Results of sample analyses are used to document contaminant trends and to assess the amounts of Hanford Site-origin contaminants in food and farm products by comparing:

- Analytical results obtained from similar samples collected from the same regions over long periods of time.
- Analytical results from samples collected at downwind locations to results obtained from generally upwind or distant locations.

- Analytical results from samples collected in areas irrigated with water withdrawn from the Columbia River downstream of the Hanford Site to analytical results from samples obtained from locations irrigated with water from other regional sources.

3.2 Wildlife

3.2.1 Fish, 3.2.2 Birds, & 3.2.3 Mammals

Fish and wildlife, on and off the Hanford Site, are valued natural and recreational resources. Fish from the Hanford Reach may be caught and consumed by anglers, and wildlife residing onsite (elk, deer, rabbits, upland game birds, and waterfowl) may move offsite and be harvested by the public for consumption. It is important, therefore, that consumable fish and wildlife on and near the site be sampled to monitor levels of potential contaminants. Reference samples of fish and wildlife are collected from distant locations that have not been exposed to Hanford contaminants and compared to samples collected on and near the site.

The objectives of fish and wildlife surveillance include:

- Verifying that radiological exposure and dose to consumers of fish and wildlife remain quantifiable as required by DOE-HDBK-1216-2015.

- Providing assurance to consumers of fish and wildlife collected near the Hanford Site that the degree of contamination caused by site operations and cleanup activities is known and documented in publicly available reports (e.g., the annual Hanford Site Environmental Report).

- Monitoring the occurrence and accumulation of long-lived radionuclides and trace metals in fish and wildlife tissues.

- Evaluating radionuclide concentrations and associated exposure to key wildlife near onsite operational areas to determine the degree of risk to biological resources.

Fish and wildlife species on and around the Hanford Site are sampled based on their likelihood of exposure to contaminants, potential for accumulating contaminants, and potential for moving off the site and being consumed by humans (i.e., hunters or anglers). Consideration is given to species that may be consumed by various cultures. Fish and wildlife species selected for sampling are found in sufficient abundance to ensure sampling will not affect population stability. Specific biota are selected based on their significance to human dose.

- Aquatic biota – Whitefish historically have been sampled because of their value to recreational fishing and their habitat selection and diet of salmonid eggs. Additionally both smallmouth and largemouth bass have a high recreational value in the area including local tournaments for these sport fish. Carp have been historically collected for their foodstuff value to some cultures and the primarily demersal activities nearest to any potential deposits of benthic contamination. Walleye has been added into the 2016 schedule for initial collection in 2017. Walleye are a highly popular sport fish, considered a highly appetizing white-fleshed fish. As with bass, many

local tournaments occur each year for this species. For human dose assessment purposes, two sample types are obtained: edible muscle and remaining carcass not including the internal organs or skin.

- Terrestrial biota – Terrestrial biota are collected to monitor contaminant concentrations of Hanford Site-sourced radionuclides. Mammal Species collected include mountain cottontail rabbits and mule deer/elk. Rabbits are collected at the 300 area due to the proximity to the general public with the relatively small home range of the animals. Elk and mule deer have been collected by opportunistic takes as a result of vehicle strikes in recent years. Bird species collected include waterfowl, primarily young Canada Goose, and upland game birds, usually California Quail but may include Ring-necked Pheasant or Chukar. Canada goose and California Quail are common game species hunted by the general public and Hanford Site birds may be represented in hunted populations. Muscle and bone are collected. Samples from terrestrial wildlife generally include muscle and bone tissue for all species with deer/elk including the addition liver samples. Deer or elk livers may often be consumed by the general public as a foodstuff.

Fish and wildlife samples are analyzed for 1) radionuclides, and in some cases chemicals, that are found in Hanford Site effluent and emissions, 2) radionuclides that contribute to doses associated with various potential human and biota exposure pathways, and 3) radionuclides and chemicals that are of concern to DOE, the public, American Indian Tribes, activist groups, environmental organizations, public officials, and regulatory agencies. Fish and wildlife samples are analyzed for strontium-90, which accumulates in bones, and gamma emitters, specifically cesium-137, which accumulates in muscle tissues. When sampled, livers are analyzed for metals, and some fish are analyzed for mercury.

Fish and wildlife are collected annually from Hanford Reach locations; with species collected in alternating years (biennially). Reference samples are collected during the same year. Wildlife populations undergo natural fluctuations, and routinely scheduled species are not always abundant or easily collected. When this occurs scheduling changes or species substitutions may be considered. The current level of sampling is consistent with meeting DOE concerns for public assurance about contamination levels in fish and game in the region and concerns about contaminants in the Columbia River. Due to the variable nature of these collections and the locomotion of the animals themselves most wildlife will be collected in areas classified as 100 Areas extending from the 100B/C area to south of the 100F area and the Hanford Townsite to the 300 Area. These locations are used as they provide the nearest proximity to the historical operation areas and proximity to the general public.

Reference samples of fish and wildlife are collected at locations upwind or upstream of, or distant from, the Hanford Site.

4.0 Soil and Vegetation Sampling

Radiological monitoring of soil and vegetation is conducted at a variety of locations: onsite near facilities and operations, onsite away from facilities and operations (Hanford Site), and offsite at perimeter and distant locations and in nearby communities. Contaminant concentration data are used for the following:

- Determine the effectiveness of effluent monitoring and controls within facilities

- Assess the adequacy of containment at waste disposal sites

- Detect and monitor unusual conditions
- Provide long-term radionuclide contamination trends in soil at undisturbed locations.

Soil provides an integrating sample medium that can account for contaminants released to the atmosphere either directly (gaseous effluent) or indirectly (resuspension/deposition), or through liquid effluents released to a stream that is subsequently used for irrigation.

Vegetation provides an integrating sample medium that can account for contaminants released to the atmosphere either directly (gaseous effluent) or indirectly (resuspension/deposition), through liquid effluents released to a stream that is subsequently used for irrigation, or from uptake of contaminants via their root system.

4.1 Far Field Soil Monitoring & 4.2 Far Field Vegetation Monitoring

Offsite soil and native vegetation sampling is designed to monitor atmospheric deposition of contaminants not influenced by agricultural activities. Offsite samples are collected every 3 to 5 years to evaluate long-term trends (per DOE-HDBK-1216-2015).

4.3 Near Field Soil Monitoring and 4.4 Near Field Vegetation Monitoring

Onsite soil and vegetation sampling is conducted annually and is required by Department Of Health as a qualitative indicator of the environmental monitoring program (#FF-01 License, section 5.1.2) and is a recommended practice per the DOE handbook DOE-HDBK-1216-2015, *Environmental Radiological Effluent Monitoring and Environmental Surveillance*.

In the 200/600 Areas, as a cost savings measure, sample locations are alternated between even and odd numbered years, aligning with even-vs-odd numbered sample locations.

5.0 Sediment Sampling

5.1 Columbia River

During peak operating years at the Hanford Site, large amounts of effluents associated with reactor operations were discharged to the Columbia River. Some constituents in these effluents may have become associated with particulate matter that accumulated in riverbed sediment, particularly in slack-water areas and in the reservoirs behind the dams located downstream of the Hanford Site. The majority of short-lived radioactive constituents have decayed away, but some longer-lived radionuclides, such as isotopes of cesium, plutonium, strontium, and uranium are still detectable. Fluctuations in the river flow from the operations of upriver hydroelectric dams, annual spring high river flows, and occasional floods have resulted in re-suspension, relocation, and subsequent re-deposition of sediment. Upper-layer sediment in the Columbia River downstream of the Hanford Site contains low concentrations of radionuclides, metals of Hanford Site origin, and radionuclides from worldwide atmospheric fallout, as well as metals and other nonradioactive contaminants from mining and agricultural activities (*Simultaneously Extracted Metals/Acid-Volatile Sulfide and Total Metals in Surface Sediment from the Hanford Reach of the Columbia River and the Lower Snake River* [PNNL-13417], *Summary of Radiological Monitoring of Columbia and Snake River*

Sediment, 1988 through 2004 [PNNL-16990]). Periodic sediment sampling confirms that concentrations are low, and that no significant changes in concentrations have occurred. The accumulation of radioactive materials in sediment can lead to human exposure from ingestion of aquatic organisms associated with the sediment or sediment re-suspension into drinking water supplies. Sediment with accumulated radioactive materials can be an external radiation source, irradiating people who are fishing, wading, swimming, sunbathing, or participating in other recreational activities associated with the river or shoreline (*Environmental Radiological Effluent Monitoring and Environmental Surveillance* [DOE-HDBK-1216-2015]). Sediment contaminant concentrations are also used to model potential pathway exposures to riparian (e.g., raccoon, coyote) and aquatic receptors (e.g., fish, benthic organisms) and to establish DOE guidelines for organisms within the Hanford Reach.

5.2 Onsite Pond

The West Lake pond is accessible to migratory waterfowl, deer, and other riparian wildlife, creating a potential biological pathway for the dispersion of residual, historic contaminants. West Lake, the only naturally occurring pond on the Hanford Site, is located north of the 200-East Area. West Lake has not received direct effluent discharges from Hanford Site facilities. The water level in West Lake fluctuates due to precipitation and changing water table elevations. The lake changes from standing water in winter and spring to dry or nearly dry in summer and fall. The water level and size of the lake has been decreasing over the past several years due to reduced wastewater discharge. Historic discharges of billions of gallons of process water into nearby cribs, ditches, and ponds created groundwater mounding beneath West Lake which, in recent years, is slowly receding. The West Lake sediment is analyzed for gross alpha, gross beta, cesium-137, strontium-90, uranium-234, uranium-235, uranium-238, and other gamma-emitting radionuclides. Radionuclides are chosen for analysis based on their presence in local groundwater and sediment and on their potential to contribute to the overall radiation dose to biota that frequent the ponds.

6.0 Thermoluminescent Dosimeter

External radiation is monitored at the Hanford Site in relative proximity to known or potential radiation sources. Sources of external radiation include waste materials associated with the historical production of plutonium for defense; residual nuclear inventories in former production and processing facilities; radioactive waste handling, storage, and disposal activities; waste cleanup and remediation activities; atmospheric fallout from historical nuclear weapons testing; and natural sources such as cosmic radiation.

The Harshaw thermoluminescent dosimeter (TLD) system is used to measure external radiation on the Hanford Site. This system includes the Harshaw 8800-series dosimeter and the Harshaw 8800 reader. The Harshaw 8800-series environmental dosimeter consists of two TLD-700 chips and two TLD-200 chips and provides both shallow- and deep-dose measurement capabilities using filters in the dosimeter. Data obtained from the two TLD-700 chips are used to determine the average total environmental dose at each location. The two TLD-200 chips are included to determine doses in the event of a radiological emergency and are not used in calculating average total environmental dose.

TLD monitoring is required by DOH as a qualitative indicator of the near-field environmental monitoring program (#FF-01 License, section 5.1.2) and is a recommended practice per section 6.0 of DOE handbook DOE-HDBK-1216-2015, *Environmental Radiological Effluent Monitoring and Environmental Surveillance*.

7.0 Radiological Surveys

7.1 Weekly Inspections and 7.2 Annual Radiological Surveys

Radiation surveys with portable instruments are conducted at active and inactive waste disposal sites and the surrounding terrain to monitor and detect contamination and to provide a coarse screening for external radiation fields. The types of areas surveyed included underground radioactive material areas, contamination areas, soil contamination areas, high-contamination areas, roads, and fence lines.

Radiological surveys are required by Department Of Health as a qualitative indicator of the environmental monitoring program (#FF-01 License, section 5.1.2) and are a recommended practice per section 6.0 of DOE handbook DOE-HDBK-1216-2015, *Environmental Radiological Effluent Monitoring and Environmental Surveillance*.