ECF-HANFORD-15-0019
Revision 1

Hanford Site-wide Natural Recharge Boundary Condition for Groundwater Models

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

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company

P.O. Box 1600
Richland, Washington 99352

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J. B. Fullerton
INTERA, Inc.

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APPROVED
By Lynn M. Ayers at 10:02 am, Jun 08, 2020

Release Approval Date

ENVIRONMENTAL CALCULATION COVER PAGE

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Hanford Site Composite Analysis Update

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Hanford Site-wide Natural Recharge Boundary Condition for Groundwater Models

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Brief Narrative of Experience: Jacob Fullerton's experience encompasses civil and environmental engineering, and is focused on the development and application of groundwater models using codes and platforms such as GMS, ArcMap, and GSSHA. He also brings expertise with coding web applications in multiple programming languages, including Javascript, HTML, JQuery, and Python. He has incorporated an analytic element groundwater model called TimML into a web app capable of performing general groundwater modeling tasks. Additionally, he has created an educational groundwater dewatering web app that simulates aquifer dewatering using wells and slurry trenches.

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Brief Narrative of Experience: Jose Lopez's experience focuses on collecting, analyzing, manipulating, and developing spatial data pertaining to Geographic Information Systems (GIS). He specializes in analyzing GIS data and using it to identify trends, build geodatabases, and create interactive maps to visualize data changes. He will be applying his skills to support and assist INTERA GIS Specialists with map design, GIS analysis and modeling. Jose is also proficient with ESRI ArcGIS Software, Python, Java, and Microsoft Office Applications.

ENVIRONMENTAL CALCULATION COVER PAGE (Continued)

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SECTION 2 - Completed by Preparer

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ENVIRONMENTAL CALCULATION COVER PAGE (Continued)

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SECTION 5 - Applicable if Calculation is a Risk Assessment or Uses an Environmental Model

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Calculation Approved:
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Print First and Last Name	Signature	Date
Alaa Aly	[signature]	12/19/19

Contents

Appendices

Figures

Tables

Terms

ArcGIS™	Esri ArcGIS for Desktop (Basic and Advanced)
BRMP	Biological Resources Management Plan
CA	Composite Analysis
CHPRC	CH2M HILL Plateau Remediation Company
DOE	U.S. Department of Energy
dpi	dots per inch
ECF	Environmental Calculation File
ERDF	Environmental Restoration Disposal Facility
ETC	Evapotranspiration Capillary Barrier
Esri	Environmental Systems Research Institute
GIS	Geographic Information System
HGIS	Hanford Geographic Information System
HISI	Hanford Information System Inventory
HSDB	Hanford Site Disposition Baseline
HSGW	Hanford Sitewide Groundwater
IAMIT	Interagency Management Integration Team
IDF	Integrated Disposal Facility
NRBC	natural recharge boundary condition
NRCS	Natural Resources Conservation Service
PA	Performance Assessment
PHB	Prototype Hanford Barrier
RET	Recharge Evolution Tool
SSURGO	Soil Survey Geographic Database
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
USGS	U.S. Geological Survey
WIDS	Waste Information Data System
WMA	Waste Management Area

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1 Purpose

The purpose of this environmental calculation file (ECF) is to document the development of a tool that generates temporally and spatially variable representations of natural recharge for the Hanford Site. A key feature of the recharge evolution tool (RET) is that it applies sanctioned natural recharge rates varying as a function of the condition/cover of the ground surface and soil type at different points in time. No hydrologic calculations are performed by the RET, this script works as a lookup database between spatial and temporal datasets to assign research-based recharge rates to corresponding regions throughout the Hanford Site. This work will support vadose zone and groundwater models for the Hanford Site. Although efforts will focus on generating recharge estimates for the entirety of the Hanford Site, the focus scope of this work will be the Central Plateau Area to support the Composite Analysis Vadose Zone facet. In other words, the reliability of this calculation will be greatest within the Central Plateau Area and decrease with departures from that geographic region.

The following three main tasks were accomplished and are defined herein:

1. Extend the spatial coverage of the soils and vegetation data to provide full coverage of baseline information within the entire area of interest.
2. Compile the available spatial data and combine the information with present-day knowledge about past events.
3. Establish a method to rank spatial data sources that systematically prioritizes the use of available information to conglomerate a sitewide estimate for recharge for the desired model year(s).

The primary goal was to develop a modular, scalable data structure capable of incorporating new/refined datasets as they become available. Such flexibility allows the utilities discussed in this ECF to be useful beyond the life of the current datasets as newer and better data collection methods supersede those currently available.

In tandem with the goal of building a persistent, scalable data structure is the ability to assimilate multiple data sources to produce sanctioned recharge estimates for the Hanford Site. The completed utility generates data-driven spatiotemporal recharge estimates as opposed to lumped regional average estimates. The finer spatiotemporal discretization provides the ability to show recharge variation at scalable levels of refinement depending on administrative/scientific needs. Although the RET will incorporate available data, it is expected that site-specific models may use the RET as a starting point and refine according to the needs of the model. These refinements may then be incorporated back into the RET as appropriate in future revisions.

2 Background

The spatiotemporal variability of the ground surface based on vegetative cover and soil conditions can alter estimated recharge by as much as 130 mm/yr. Disturbances can result in higher flux rates from the vadose zone while revegetation can subsequently reduce recharge (PNNL-14702, *Vadose Zone Hydrology Data Package for Hanford Assessments*). Modeling in the past has aimed to simulate recharge with temporally varied recharge but values largely lacked spatial variation in favor of a regional average. The goal of this work is to facilitate the estimation of recharge values at the smallest available scale over the Hanford Site as well as to provide an information infrastructure for continuous improvement of recharge estimations.

The information infrastructure proposed herein formalizes the ranking of data describing land use or surface condition in conjunction with the underlying soil to estimate recharge through time. The recharge estimates are saved as self-contained packages representing a snapshot of the conditions at the corresponding time being estimated.

New data collected were captured within the area defined by the Hanford Sitewide Groundwater (HSGW) extent (Figure 1), which generally confines the area of interest based on the boundaries of natural features in the landscape. The current process automation is not limited to this boundary, but instead will assign recharge rates to all areas that have values for the cover type, surface condition, soil type, and a corresponding recharge estimate based on the combination of the three variables mentioned.

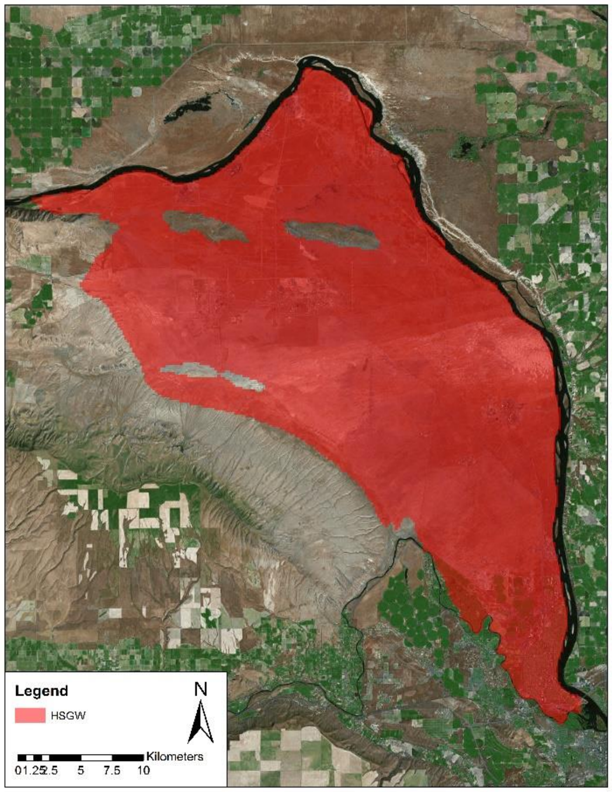

Figure 1. Extent of Suprabasalt Aquifer at the Hanford Site

3 Methodology

Key aspects for building the RET to assign recharge estimates include the following:

- Extending datasets for soils and vegetation to cover the area of interest
- Obtaining spatial data representing Hanford at different times
- Ranking datasets in order of data quality, extent, and temporal relevance
- Automating assigning recharge values

3.1 Extend the Datasets for Soils and Vegetation

Gaps in the soils and vegetation cover datasets were evaluated in the context of the HSGW. Extensions made to the soils coverage came from the Natural Resources Conservation Service (NRCS) website using the Soil Survey Geographic Database (SSURGO). Features depicted in the SSURGO database were copied into the existing soil coverage to fill the gaps within the area of interest. The vegetative cover feature class was “extended” by creating a default background value where there was no information. The default vegetative value was deliberately designed to represent pre-Hanford Site conditions (or prior to anthropogenic activity) with a mature vegetative cover without consideration for natural wildfires.

3.2 Enhance Data on Surface Condition

Surface condition or land-use definitions were produced as polygons based on survey and aerial/satellite imagery and vector data. The methodology used in generating the vector representation implemented in the recharge calculation is listed as follows:

1. Identify time periods (years) most likely to improve overall recharge estimate because of unique surface conditions. Evaluate potential time periods according to:
    a. Relative importance to recharge estimations (as either a time period representing change, or as a time period containing valuable complementary information)
    b. Extent of available data
    c. Usability of the data source, including spatial resolution and whether it is adequately available in digital, georeferenced, and orthorectified form
2. Note the reasons for choosing a given data source, including the reference data to which it will be compared if new features will be derived from it. This information will aid in decision-making during data capture in problem areas where interpretation is unclear and will also be included in the metadata of the resulting dataset.
3. For imagery that will be interpreted into new polygon features, identify a process to ensure a systematic and full-coverage review of the image, which may include use of a land grid to order the review. Other processing standards should include scheduling the review of each source by a single user for a consecutive number of days to minimize variability in data interpretation.
4. Prepare the chosen data source using the same projection as related Geographic Information System (GIS) content, and create a map document in ArcMap™ containing related data sources as needed. Create attribute domains for cover type and surface condition with the valid coded values for this dataset.
5. For features to be digitized from imagery, create a new feature class using the proper projection.
6. For features already in vector form, add new fields for “Cover_Type” and “SurfCond” to match those in the existing schema, applying the attribute domains as above. It is important that the polygon feature schemas match before the data source can be used in the automated creation of recharge in the subsequent calculations. It is ideal to name the new or derived feature classes in a way that references the data source from which it is derived.
7. Interpret the image source, using reference layers and/or comparable data sources whenever possible to maximize the similar use of new features across years and data sources. Capture (digitize) new features to represent the full local extent of a class (such as disturbed ground) detected in the image instead of digitizing only the part of the feature that has not been previously captured.
8. Assign attributes for “Cover_Type” and “SurfCond,” either as each feature is captured, or in an edit session after polygons have been digitized. Unless an additional effort is made to classify vegetation species assemblages on the ground (because comparable field control samples have been taken),

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"Cover_Type" should only be entered to help distinguish those types in bold in the interpretation. Use a combination of attribute queries to double-check that all new feature attributes are consistent and as expected.

9. Update the metadata for the feature class, paying special attention to note important process steps, interpretations, and the intended use.

10. Validate the data collected by having someone other than the digitizer review the output feature class relative to the methodology and capture notes.

3.3 Rank Data Sources

The amount of available data for the recharge calculation necessitates a formal ranking system in the likely event of two or more valid datasets coinciding in at least one location for a given time. Choosing the appropriate source in the event of overlaps should be resolved by the ranking, which will be established using the following criteria:

1. Evaluate the extent and resolution of the dataset.

   a. Coarse data should be ranked lower (given less priority) than datasets with higher resolution.

2. Accuracy of the information should also be qualitatively examined with the aim to ensure that the highest quality datasets are preserved.

3. Identify the time period(s) for which each data source is valid. In some cases, the data will have strict constraints on applicability while in other cases the valid time period may be longer or shorter based on the presence or absence of other data.

   a. Where datasets overlap in time and space, document the assumptions or observations that determine which dataset to preserve over another.

3.4 Automate the Calculation of Recharge Sitewide

The complexity and extent of the recharge estimates demands a scripted approach to consistently match recharge values to each combination of cover type, surface condition, and soil type. Creating the automation script followed the general pattern described as follows:

1. Review available data sources and identify the appropriate geoprocessing steps/handlers required to define the recharge rates for a given model year using the best-available sources of information.

2. Implement the automation with a Python script using Environmental Systems Research Institute's (Esri™) ArcPy™ and GeoPandas libraries to perform the geoprocessing identified in Step 1.

   a. Other geoprocessing libraries/software may be used, the current implementation of this calculation used ArcPy and GeoPandas

3. Confirm the accuracy of the outputs.

4. Polish the code to include error handling and warning messages for exception cases and remarks documenting the purpose of key functions and variables.

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4 Assumptions and Inputs

This chapter covers the underlying assumptions made while collecting or creating the source information for recharge. Included in this discussion are subsections for spatial sources, historical data, and interpretation of inputs for estimating the surface condition and associated recharge.

4.1 Spatial Data Sources

Most data used as inputs for these calculations originated from the Hanford GIS (HGIS) production data store. Each dataset evaluated for the RET is listed in Table 1 along with the data custodian and special notes about the dataset.

Table 1. Index of Data Sources

Alias	Custodian	Notes
Past buildings	Hanford GIS team	This shapefile maintained by the GIS team at Hanford focuses primarily on buildings/facilities that were known to have existed even if they may not be present today.
Facilities	Hanford GIS team	Contains a collection of two-dimensional building footprints. Documented in EMDT-GR-0035.
Soils - 1966 soil survey	Hanford GIS team	
Barrier footprints	INTERA	Rotated minimum bounding rectangles over each site known to either receive or currently have a surface barrier in place based on the associated waste site footprint.
Waste site footprints	Hanford GIS team	Provided by M. Aye at JACOBS to J. Lopez at INTERA, Inc. on 07/26/2018 by email. EMDT-GR-0035.
HSDB	INTERA	Table is a summarized version of the "MasterList" sheet in the spreadsheet provided with CP-60254. Where applicable, disposition timeline information was superseded by CP-63386.
Soils - SSURGO	USDA	Incorporated only where the Hanford soils shapefile was lacking (Figure 3).
Vegetation - current (BRMP)	PNNL (Ecology Group)	Description provided with the feature class indicates that multiple years were included in its development, up through 2011.
Recharge lookup tables	INTERA	Derived/developed with input from the HSDB, PNL-10285 UC-2010, PNNL-14072, DOE/RL-2011-50, and AR-02612.
Model boundary	INTERA	Depicts the extents of the RET boundary, maintained by INTERA.

Note: Complete reference citations are provided in Chapter 8.

BRMP	=	biological resources management plan	PNNL	=	Pacific Northwest National Laboratory
Ecology	=	Washington State Department of Ecology	RET	=	Recharge Evolution Tool
GIS	=	geographic information system	SSURGO	=	Soil Survey Geographic Database
HSDB	=	Hanford Site Disposition Baseline	USDA	=	U.S. Department of Agriculture

4.1.1 Data Management

A file geodatabase was created to define certain default formats expected of the calculation files and to provide a single location for storing all the geospatial content related to the calculations. All data have been loaded using a common projection that has the following spatial reference:

NAD_1983_StatePlane_Washington_South_FIPS_4602
WKID: 32149 Authority: EPSG
Projection: Lambert_Conformal_Conic
False_Easting: 500000.0
False_Northing: 0.0
Central_Meridian: -120.5
Standard_Parallel_1: 45.83333333333334
Standard_Parallel_2: 47.33333333333334
Latitude_Of_Origin: 45.33333333333334
Linear Unit: Meter (1.0)

Geographic Coordinate System: GCS_North_American_1983
Angular Unit: Degree (0.0174532925199433)
Prime Meridian: Greenwich (0.0)
Datum: D_North_American_1983
Spheroid: GRS_1980
Semimajor Axis: 6378137.0
Semiminor Axis: 6356752.314140356
Inverse Flattening: 298.257222101

4.1.2 USGS Black and White Aerial Photography

The HGIS contains digital image files of aerial photography collected by the U.S. Geological Survey (USGS) in 1943. The original images had been scanned previously at either 600 or 1,200 dpi and merged into a mosaic to cover most of the Hanford Site. The mosaic consists mostly of higher-resolution scans (1,200 dpi), at least in the irrigated areas, while other parts of the mosaic were captured at 600 dpi. Though the 600-dpi data are too coarse to define vegetation cover per se, the images are considered legible enough to distinguish important features (vegetated versus disturbed land cover).

4.1.3 Soils

Most of the soils used in this calculation originate from the HGIS (Soils.shp), which contains soil types for which recharge rates have been published previously. However, there are some areas of the model domain not covered by the current soils classification for Hanford, so in these areas the data gaps will be filled by the U.S. Department of Agriculture NRCS SSURGO data available from http://www.nrcs.usda.gov/wps/portal/nrcs/surveylist/soils/survey/state/?stateId=WA. When navigating through the data portal, select the data for the "Benton County Area" (Figure 2), which will take you to a map where the user can interactively select data for download. A figure representing how the SSURGO data was added to complement the HGIS soil dataset is shown in Figure 3.

www.nrcs.usda.gov/wps/portal/nrcs/surveylist/soils/survey/state/?stateId=WA

Soil survey name (Click links for online surveys.)	Date	Archived PDF online	Web Soil Survey (generated from official soil data)
Benton County Area	1971	Yes	No
Benton County Area ★	current	No	Yes
Benton County	1919	Yes	No

Figure 2. SSURGO Soils Data

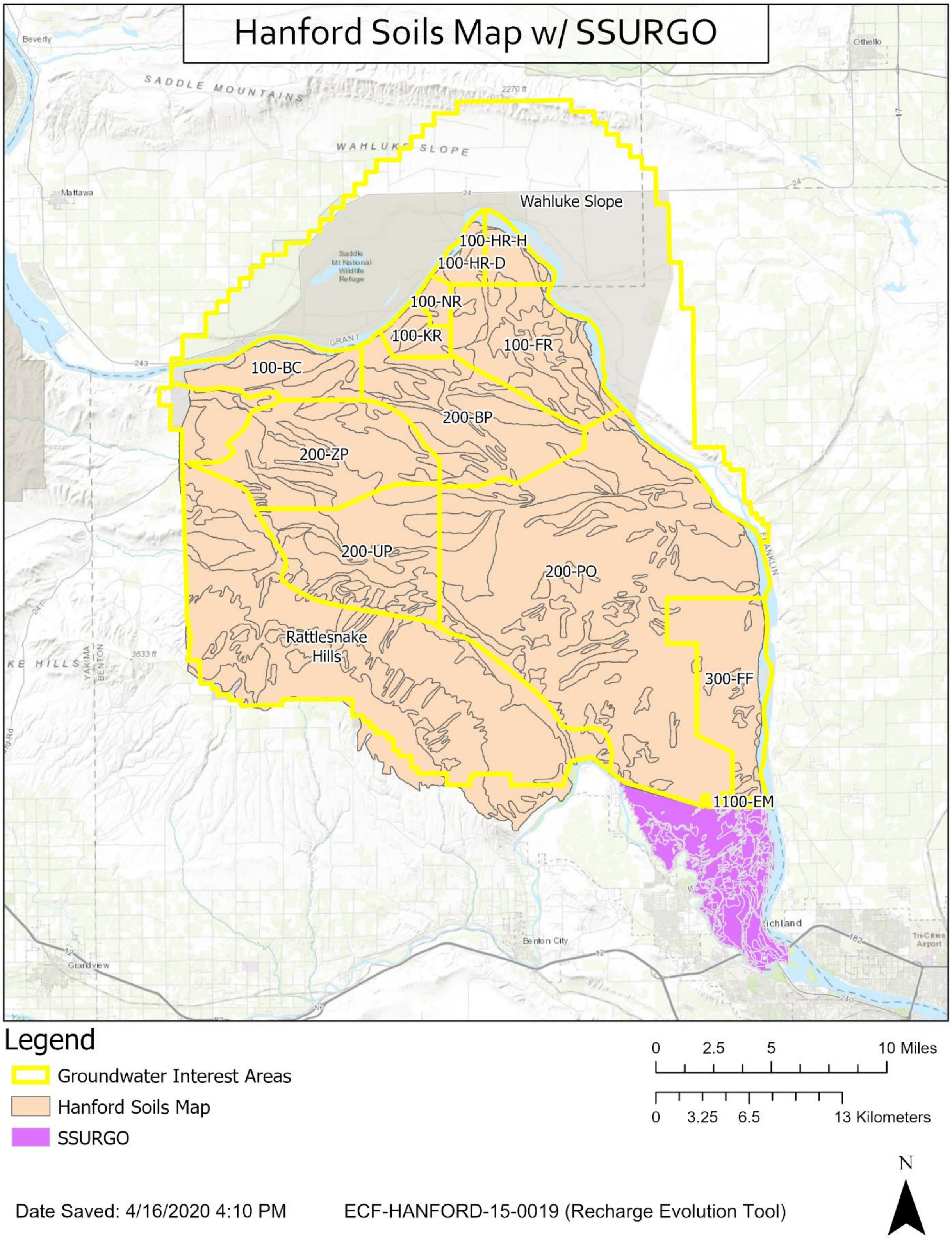


Figure 3. Addition of SSURGO Soils Data to Hanford Soils Dataset

The SSURGO database contains information about soil as collected by the National Cooperative Soil Survey over the course of a century. The mapping is intended for natural resource planning and management by landowners, townships, and counties. The maps are linked in the database to information about the component soils and their properties for each map unit. Each map unit may contain one to three major components and some minor components. The map units are typically named for the major components. SSURGO soil types were associated to the existing Hanford Site soils classification (see "Recharge Type" in Table 2) to apply the recharge rates previously established for the Hanford soils.

Table 2. Reference Index of Soil Types to Corresponding Recharge Type (Based on Literature Published for Hanford Site Soils) as Applied in this Calculation

Abbreviation	Recharge Type	Description	Source
BbA	Ba	Burbank loamy fine sand, 0% to 2% slopes	SSURGO
BbC	Ba	Burbank loamy fine sand, 0% to 15% slopes	SSURGO
BbD	Ba	Burbank loamy fine sand, 2% to 15% slopes	SSURGO
BlA	Ba	Burbank loamy fine sand, gravelly substratum, 0% to 2% slopes	SSURGO
BlD	Ba	Burbank loamy fine sand, gravelly substratum, 2% to 15% slopes	SSURGO
Ba	Ba	Burbank loamy sand: Coarse soil underlain by gravel. Gravel content: 20 to 80 vol%. Surface layer thickness: 40 cm.	HGIS
D	D	Dune sand: Represents miscellaneous materials of sand sized particles transported by wind. Can be both shifting and/or stabilized. No soil horizons have developed.	HGIS
Eb	Eb	Ephrata stony loam: Medium textured soil underlain by gravel. Occurs on glacial hummocky ridges. Areas between hummocks contain 1 m size boulders.	HGIS
FeA	El	Finley fine sandy loam, 0% to 2% slopes	SSURGO
FeB	El	Finley fine sandy loam, 2% to 5% slopes	SSURGO
FeD	El	Finley fine sandy loam, 5% to 15% slopes	SSURGO
FfE	El	Finley stony fine sandy loam, 0% to 30% slopes	SSURGO
FnA	El	Finley fine sandy loam, moderately deep, 0% to 2% slopes	SSURGO
FnB	El	Finley fine sandy loam, moderately deep, 2% to 5% slopes	SSURGO
UmB	El	Umapine silt loam, 0% to 5% slopes	SSURGO
El	El	Ephrata sandy loam: Medium textured soil underlain by gravelly material. The topography is generally level.	HGIS
HeA	He	Hezel loamy fine sand, 0% to 2% slopes	SSURGO
He	He	Hezel sand: Laminated and strongly calcareous, usually encountered within 60 cm of the surface. The surface soil was formed in eolian sands that covered lacustrine sediments.	HGIS
Kf	Kf	Koehler sand: Developed in an eolian mantle. Differs from the other sands in that it overlies a lime-silica cemented layer. The subsoil is calcareous and is at approximately 40 cm.	HGIS
Ki	Ki	Kiona silt loam: Occupies steep slopes and ridges. The soil contains basalt fragments both in the surface and subsoil. Basalt rock outcrops are present.	HGIS

Table 2. Reference Index of Soil Types to Corresponding Recharge Type (Based on Literature Published for Hanford Site Soils) as Applied in this Calculation

Abbreviation	Recharge Type	Description	Source
Ls	Ls	Lickskillet silt loam: Occupies ridge tops. Contains basalt fragments 30 cm in diameter and larger. Numerous basalt fragments are present throughout the profile. Many areas of stony silt loam and shallow lithosols may be mapped.	HGIS
PaA	P	Pasco fine sandy loam, 0% to 2% slopes	SSURGO
PcA	P	Pasco silt loam, 0% to 2% slopes	SSURGO
P	P	Pasco silt loam: Very poorly drained soil formed in recent alluvial material. The subsoil is variable consisting of stratified layers. Limited in areal extent and located in low areas near the Columbia River.	HGIS
EsA	Qu	Esquatzel fine sandy loam, 0% to 2% slopes.	SSURGO
Qu	Qu	Esquatzel silt loam: Formed in recent alluvium derived from loess and lake sediments. The color and texture are stratified. Associated with the Ritzville and Warden soils.	HGIS
QuA	Qy	Quincy loamy sand, 0% to 2% slopes	SSURGO
QuD	Qy	Quincy loamy sand, 2% to 15% slopes	SSURGO
QuE	Qy	Quincy loamy sand, 0 to 30 percent	SSURGO
Qy	Qy	Quincy sand: Very extensive. Developed under grass, sagebrush, and hopsage in coarse sandy alluvium mantled by eolian sands. Relief includes hummocky terraces and dune like ridges. Active dunes are present.	HGIS
PITS	Qy	Pits	SSURGO
W	Qy	Water	SSURGO
XX	Qy	Not coded (use Rupert Sand)	HGIS
Rp	Rp	Quincy sand (was Rupert Sand, Rp)	HGIS
Ri	Ri	Ritzville silt loam: Developed on Rattlesnake Hills under bunch grass from eolian sands mixed with minor amounts of volcanic ash. Depth range: 50 cm - 1 m.	HGIS
Rh	Rv	Riverwash	SSURGO
Rv	Rv	Riverwash: Occur in wet, periodically flooded areas of sand gravel and boulders which make up islands in and adjacent to the Columbia River.	HGIS
ScA	Sc	Scooteney silt loam, 0% to 2% slopes	SSURGO
SdA	Sc	Scooteney silt loam, gravelly subsoil, 0% to 2% slopes	SSURGO
Sc	Sc	Scootney stony silt loam: Developed along the north slope of Rattlesnake Hills, confined to areas where draws and fan shaped areas open onto the plain. The soils are often severely eroded with exposed basalt boulders and other rocks.	HGIS
WdAB	Wa	Warden silt loam, 0% to 5% slopes	SSURGO
WdB	Wa	Warden silt loam, 2% to 5% slopes	SSURGO

Table 2. Reference Index of Soil Types to Corresponding Recharge Type (Based on Literature Published for Hanford Site Soils) as Applied in this Calculation

Abbreviation	Recharge Type	Description	Source
Wa	Wa	Warden silt loam: Characteristic of dry climate where evapotranspiration exceeds precipitation. The subsoil becomes strongly calcareous at 60 cm and calcium carbonate layers are common. Granitic boulders are common.	HGIS

HGIS = Hanford Geographic Information System
SSURGO = Soil Survey Geographic Database

4.1.4 Vegetation Classification

The surface condition for most of the Hanford Site will be the natural vegetative cover, which is defined in a GIS polygon feature class referenced by the Biological Resources Management Plan, or BRMP, documented in DOE/RL-96-32, *Hanford Site Biological Resources Management Plan*. This dataset includes areas throughout the site that have evidence of fire scarring and anthropogenic activity.

In the absence of data on the natural vegetation cover prior to 2011, data from the BRMP are phased in over time. Prior to any known disturbance within a feature of the BRMP feature class ("disturbance" meaning any known change to the vegetation cover), a default coverage assuming pre-Hanford Site conditions is used. When a known disturbance or event intersects with a BRMP feature, the vegetative cover from the BRMP is applied. Vegetative cover during and after 2011 is taken directly from the BRMP (where available) with no other substitutions to the dataset.

The vegetative classes in the BRMP were applied only within the Central Plateau Area, coincident with the modeling areas discussed in Section 4.1.9. Pre-Hanford Site conditions were applied outside of the Central Plateau Area.

4.1.5 Waste Sites (*ehsit*) and Facilities (*bggenxs*, *bggensit*)

The ehsit, bggenexs, bggensit data sources represent all of the known point, line, and polygon features that make up mapped waste sites, facilities, and buildings at the U.S. Department of Energy's (DOE) Hanford Site. These features can include both known and suspected features, which means that there may be features in these datasets that do not correspond to features in the Disposition Baseline (described below). The mapped locations provide a starting point for remediation planning and field activities and are also used during excavation and drilling activities to identify potential conditions at the work site.

As more information is acquired through the declassification of documents and photos, newly identified drawings, and field work associated with remediation planning, the mapped location is modified to account for the updated information. The automation script provided by this calculation is designed to incorporate new information as it becomes available.

When present (in time), waste sites and structures are given a default cover and surface condition of “bare” and “disturbed sand,” respectively, which corresponds to a rate of 63 mm/yr. The exceptions to this rule are tank farms and lined landfills (e.g., the Integrated Disposal Facility (IDF) described in EMDT-RE-0019, “Performance Assessment Results for Inclusion in Composite Analysis: Integrated Disposal Facility,”[1] which is provided in Appendix A of this ECF). Tank farms receive a cover and surface condition of “bare” and “disturbed gravel,” respectively, corresponding with a rate of 100 mm/yr. Lined landfills are assigned a cover and surface condition of “Lined Landfill” and “Barrier/MinRchrg,” respectively, corresponding with a rate of 0 mm/yr.

4.1.6 Modifications to Spatial Data Sources

Spatial data sources including the BRMP, waste sites, facilities, and barriers were edited to improve the accuracy of the recharge estimates and facilitate data incorporation into numerical models. All modifications made to the spatial datasets will be described in turn.

4.1.6.1 BRMP Edits

The BRMP dataset utilized a coarsely defined set of polygons that did not align with observations from 2011 aerial imagery (Figure 4). Within the Central Plateau region where anthropogenic activities are likely to have altered surface condition, edits were made to the BRMP shapefile to bring it into conformity with the aerial imagery. Outside of the Central Plateau Area the BRMP was modified to match a 25 m buffer of known sites outside of the Central Plateau Area (Figure 5). A 25 m buffer was used to capture disturbances associated with waste sites and buildings and activities associated with maintenance of those facilities outside of the Central Plateau Area.

[1] Electronic Model Data Transmittals are data-tracking numbers for imported and verified data used in modeling.

Figure 4. Example of the Original BRMP Alignment and Modifications Implemented in RET Calculation (see circled)

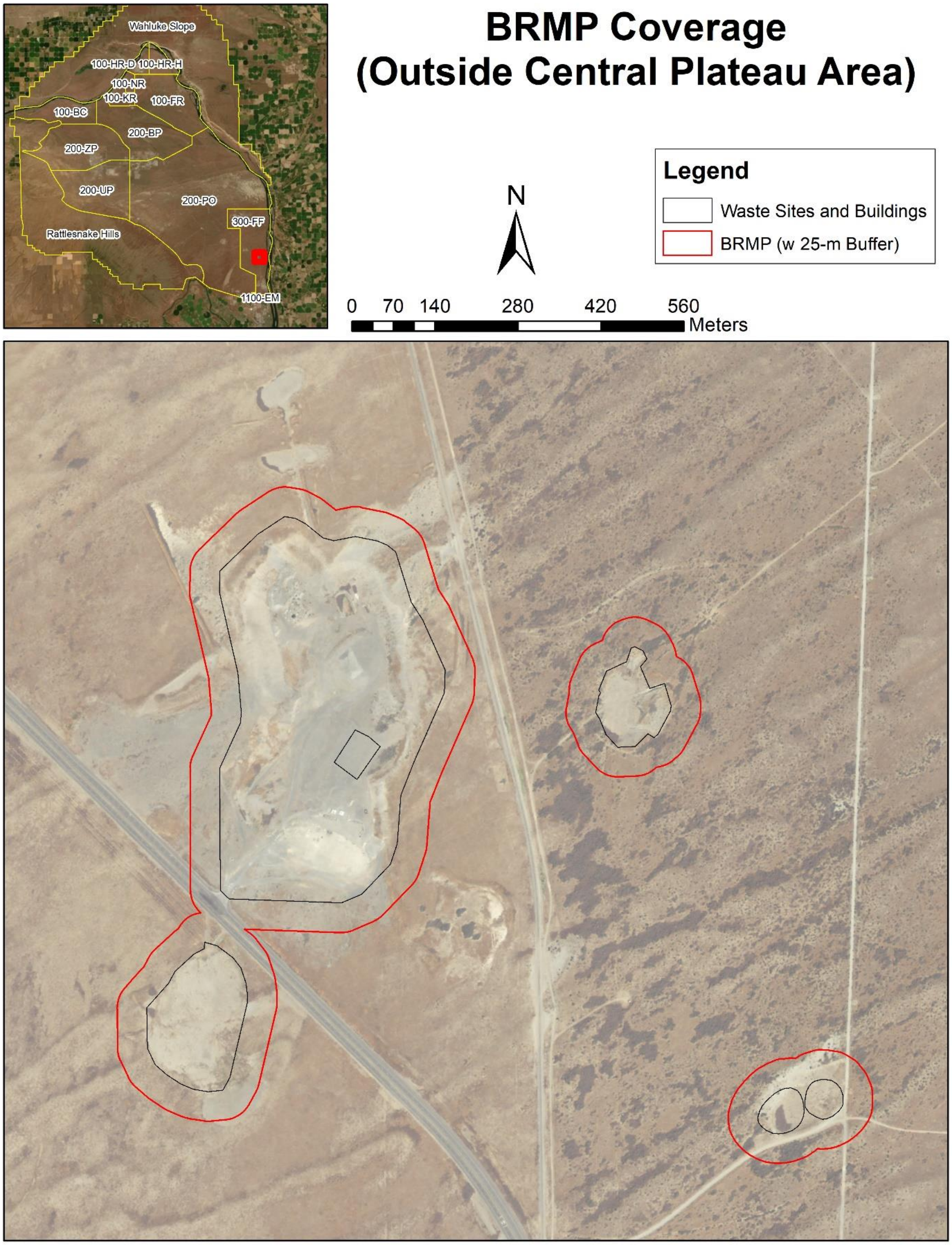


Figure 5. Example of 25 m Buffer Applied as BRMP Layer Outside of the Central Plateau Region

4.1.6.2 Waste Sites (ehsit)

Waste site geospatial information used in this application of the RET is documented in EMDT-GR-0035, “Waste Site and Structure Footprint Shapefiles for Inclusion in Updated Composite Analysis,”[1] which is provided in Appendix B of this ECF). The original waste sites shapefile contained information that detracted from the purposes of the RET. For example, pipelines, and electrical conduit do not significantly affect recharge on anything but a fine, local scale. Including thin, linear features in the RET would suggest greater confidence in its ability to assign recharge than should be implied. Additionally, tanks like those in the B Farms area are subsurface entities and discretizing by tanks inside of the disturbed excavation pit was deemed to be both redundant and unnecessary. For the purposes of the RET, the waste sites shapefile was queried to remove unnecessary features using the following criteria (see effects of the filtering in Figure 6):

- Dividing the shape’s perimeter by the shape’s total area provided a metric for evaluating the linearity of a given shape. Those features whose ratio was 0.9 m^{-1} or greater were removed from the dataset.
- Sites matching the pattern ‘%River Line%’ in the “Site_Name” attribute were removed.
  - The percent sign character (%) is a wildcard in ArcMap representing any valid character combination of any length.
- Other sites removed included those matching the pattern ‘%Shell Tank’ in the “ERS_TYPE_D” attribute field.

With the removal of the tank footprints from the waste sites shapefile, to represent tank farms the excavation boundaries were kept in the shapefile. In the case of the tank farm near PUREX and Waste Management Area (WMA) A/AX, the excavation footprints were not listed in the ehsit shapefile. To make certain that these areas were treated correctly (as waste sites) the building footprints were taken from the bggenexs feature class (discussed in a following subsection). The “SITE_NUM” attribute values of the copied footprints were 241AN and 241AP.

Overlaps in the waste sites shapefile also presented a problem and required modification. Although the RET can handle overlapping features, recharge estimations should be uniquely defined for each location at a given time. Where overlaps exist within a given dataset, the RET algorithm will generate as many recharge estimates as there are overlaps for the same location. Thus, the overlaps were removed by creating multiple features within the dataset. Where there were overlaps, the larger waste site was cut such that the smaller feature would exactly fit inside of the newly cut hole (Figure 7). Exactly coincident features were identified in this process and the extra features were deleted from the shapefile while copying their unique data into the retained feature (Table 3).

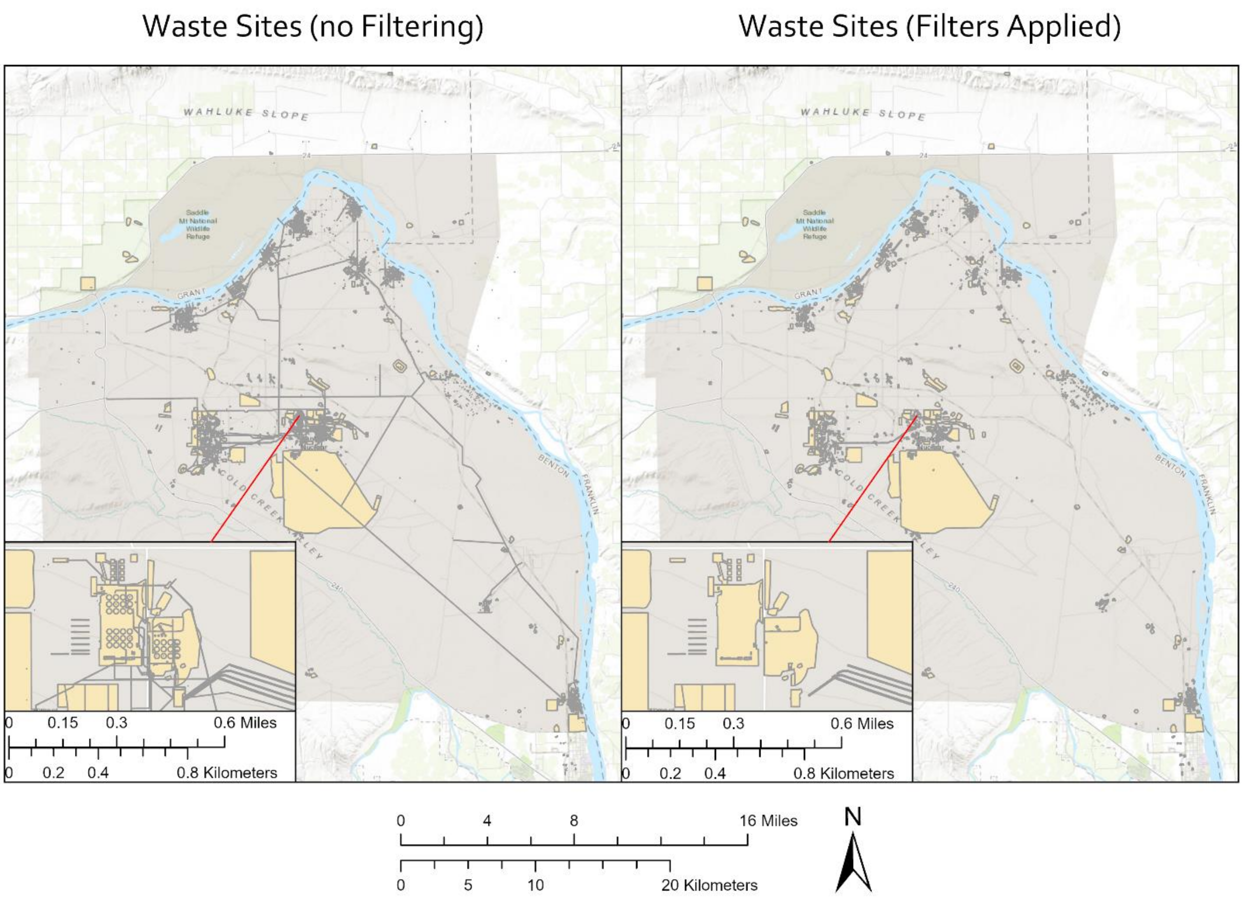


Figure 6. Waste Site Layer Before and After Filters are Applied

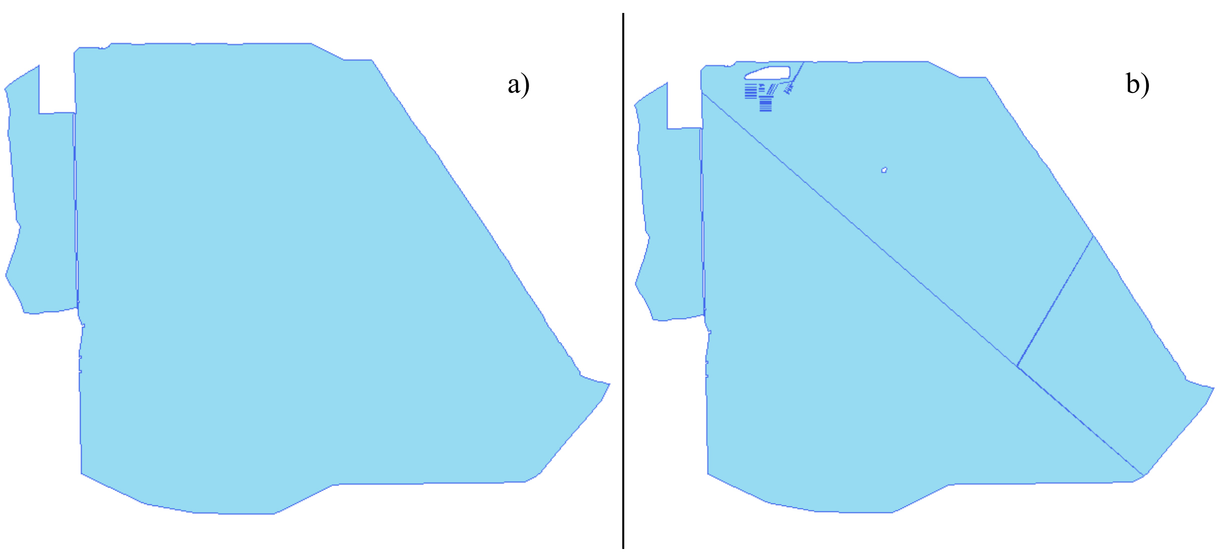


Figure 7. Original Feature (a) and After Removing Overlaps (b)

Table 3. Exactly Coincident Waste Sites Summary

Waste Site Retained	Waste Site(s) Removed
116-H-6	100-H-33
300-249	304 CF
200-W-46	200-W-144
UPR-300-37	UPR-300-32, UPR-300-33, UPR-300-34, UPR-300-35, UPR-300-36
300-36	300-122
UPR-100-N-10	UPR-100-N-3, UPR-100-N-12
200-E-317	217-B NU

4.1.6.3 Facility Footprints (bggenexs and bggensit)

Modifications made to the shapefiles representing structures on the Hanford Site were primarily to remove overlapping features. The same process described in Section 4.1.6.2 for removing overlaps was applied. In the case of the bggenexs shapefile no exactly coincident features were identified. For the bggensit shapefile a summary of the exactly coincident features removed is found in Table 4.

Table 4. Coincident Facilities Summary

Facility Name	Object ID Preserved	Object ID Removed	Notes
101	1	2	Partial duplicate of the original feature
101	1	3	Partial duplicate of the original feature
145	375	374	Partial duplicate of the original feature
145	375	376	Partial duplicate of the original feature
145	375	377	Partial duplicate of the original feature
145	375	378	Partial duplicate of the original feature
145	375	379	Partial duplicate of the original feature
145	375	380	Partial duplicate of the original feature
183B	763	427	Exact duplicate of the original feature
153F2	457	445	Exact duplicate of the original feature
153F4	459	447	Exact duplicate of the original feature
183B	774	450	Exact duplicate of the original feature
183B	771	756	Exact duplicate of the original feature
183B	768	757	Exact duplicate of the original feature
183B	766	758	Exact duplicate of the original feature
183B	767	759	Exact duplicate of the original feature
183B	775	773	Exact duplicate of original feature, different MAP_ID value (inconsequential to RET)
183B	762	776	Exact duplicate of the original feature
183B	761	777	Exact duplicate of the original feature

Table 4. Coincident Facilities Summary

Facility Name	Object ID Preserved	Object ID Removed	Notes
183B	760	778	Exact duplicate of the original feature
183B	772	779	Exact duplicate of the original feature
183B	764	780	Exact duplicate of the original feature
183B	765	781	Exact duplicate of the original feature
MO859	2642	875	Exact duplicate of the original feature, different metadata provided (inconsequential to RET)
1904F	1209	1208	Partial duplicate of the original feature
CC0594	1987	1335	Exact duplicate of the original feature, different metadata provided (inconsequential to RET)
CC1047	1990	1501	Exact duplicate of the original feature
CC1046	1988	1502	Exact duplicate of the original feature
MO684	2516	2490	Exact duplicate of the original feature, different metadata provided (inconsequential to RET)

RET = Recharge Evolution Tool

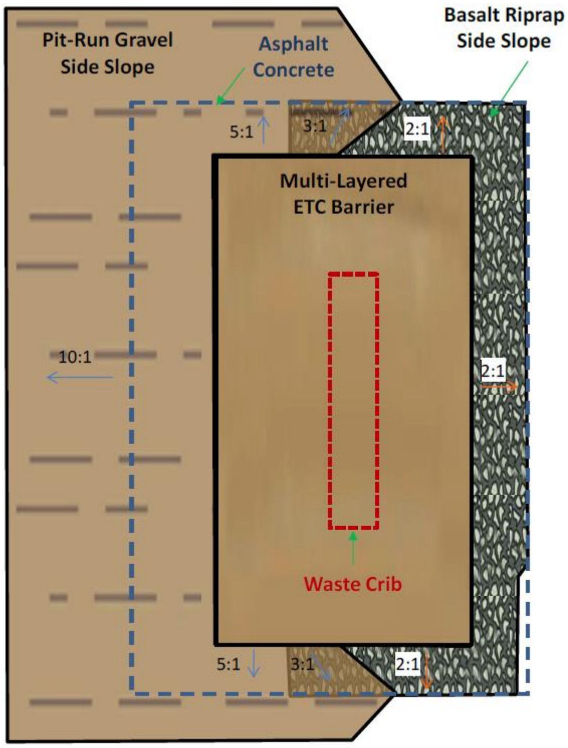
4.1.7 Barrier Footprints

There were two sources included for primary consideration in determining how to represent barrier footprints to be used for the RET: DOE/RL-2016-37, *Prototype Hanford Barrier 1994 to 2016*, and EMDT-RE-0019 for the Prototype Hanford Barrier and IDF studies, respectively. Each source contains information relevant to the size and structure of the barriers implemented/to be implemented over their respective areas and will contribute to the decisions described in this report. The following sections present a summary of the research, reasoning, and methodology behind the barrier footprints incorporated in the RET.

Prior to investigating appropriate assumptions for the shape and size of a given barrier over a known waste site footprint, the barrier footprints originally implemented in DOE/EIS-0391, *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site (TC & WM EIS)* were considered. However, after evaluating the waste site footprints with known radionuclide inventory and proposed remedies (focusing on surface barriers) it was seen that the barriers used in the Environmental Impact Statement (EIS) models were not all inclusive of the areas known to require a barrier based on the most current waste inventory knowledge and proposed remedies. As such, the barriers were deemed inadequate for the purposes of the RET and were discarded.

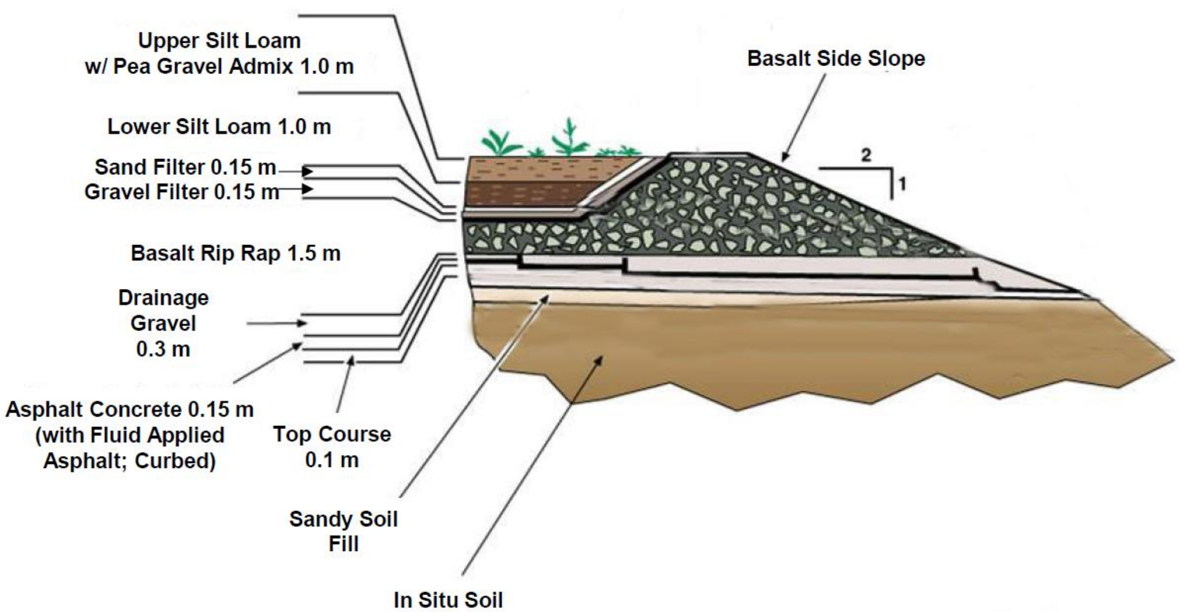
4.1.7.1 Prototype Hanford Barrier

The design of the Prototype Hanford Barrier (PHB) is represented in Figure 8 and Figure 9as plan and profile views, respectively. The nominal height of the PHB using the callouts shown in Figure 9 comes to 4.35 m (14.27 ft). Side slopes vary surrounding the barrier, the steepest slope at 2:1 and the most gradual a 10:1 slope. The label in Figure 8 mentioning the "ETC Barrier" (i.e., evapotranspiration capillary barrier) is the barrier portion designed to inhibit the progress of water to subgrade soil layers. Side slopes are installed to protect the ETC Barrier from damage due to erosion or intrusion. Reading in the "General Notes" section of the Civil Drawings provided in DOE/RL-94-76, *Constructability Report for the 200-BP-1 Prototype Surface Barrier*, the PHB (called "Prototype Surface Barrier" in the plan sheets) was built "to cover the infiltrative surface of the crib plus the near surface plume extension at the south end of the crib." This is contrary to the description provided in DOE/RL-2016-37, which states that the barrier is centered over the crib.



Source: DOE/RL-2016-37, *Prototype Hanford Barrier 1994 to 2016*.

Figure 8. Plan View of PHB

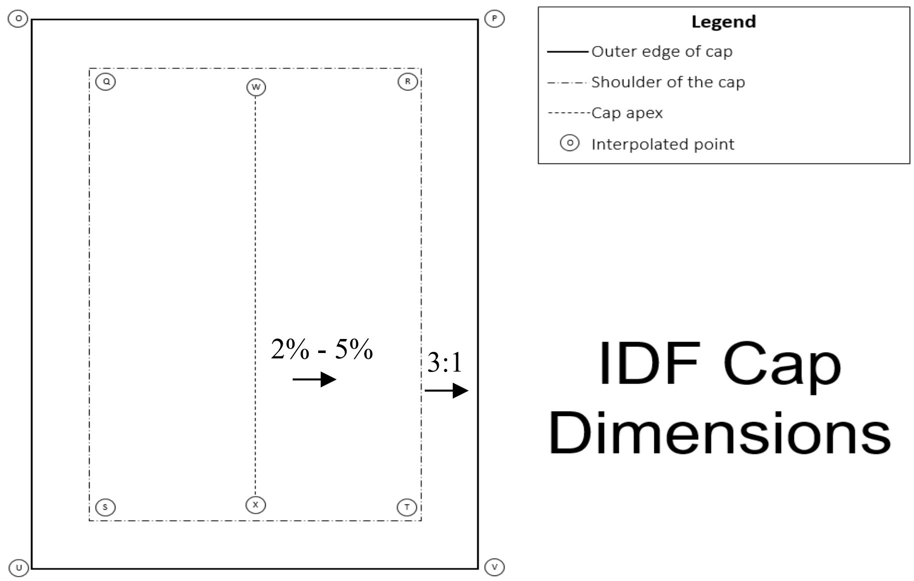


Source: DOE/RL-2016-37, *Prototype Hanford Barrier 1994 to 2016*.

Figure 9. Profile of PHB

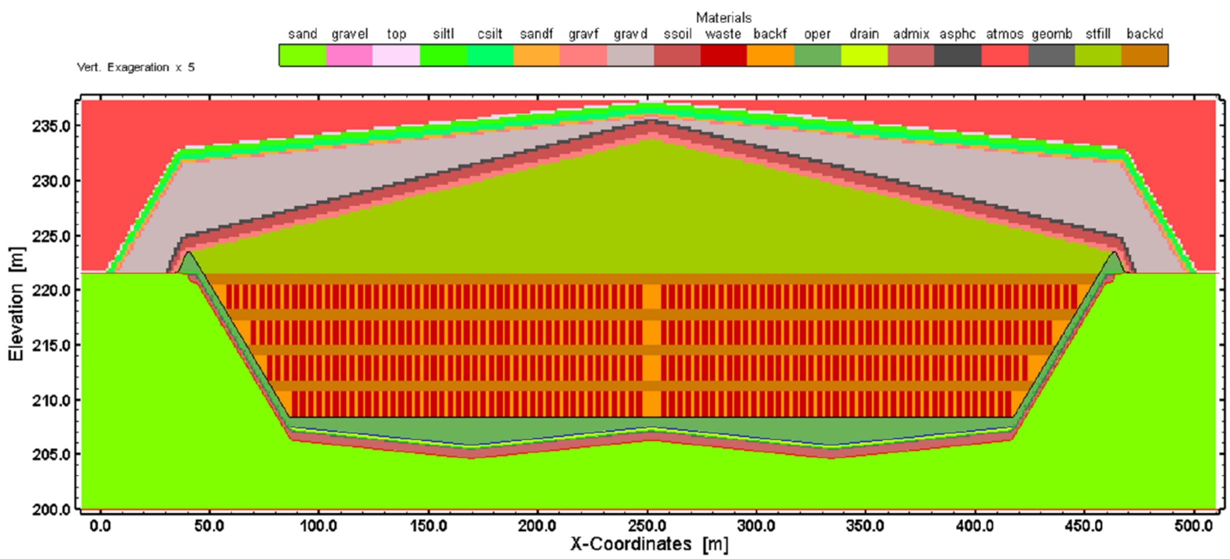
4.1.7.2 Integrated Disposal Facility

No aspect of the cap has been finalized in either construction or design. The initial conceptual design for the cap intended to cover the IDF is represented in Figure 10 and Figure 11 for plan and profile views, respectively. The slopes shown in Figure 10 are taken from RPP-RPT-59958, *Performance Assessment for the Integrated Disposal Facility, Hanford Site, Washington*. The barrier overhang is specified in RPP-RPT-59958 as "the projection of the functional barrier surface beyond the perimeter of the waste zone." This overhang extends six meters past the edge of the IDF trench as defined by the "edge of liner section on plan." Additional conceptual design details of the cap are illustrated in Figure 12.



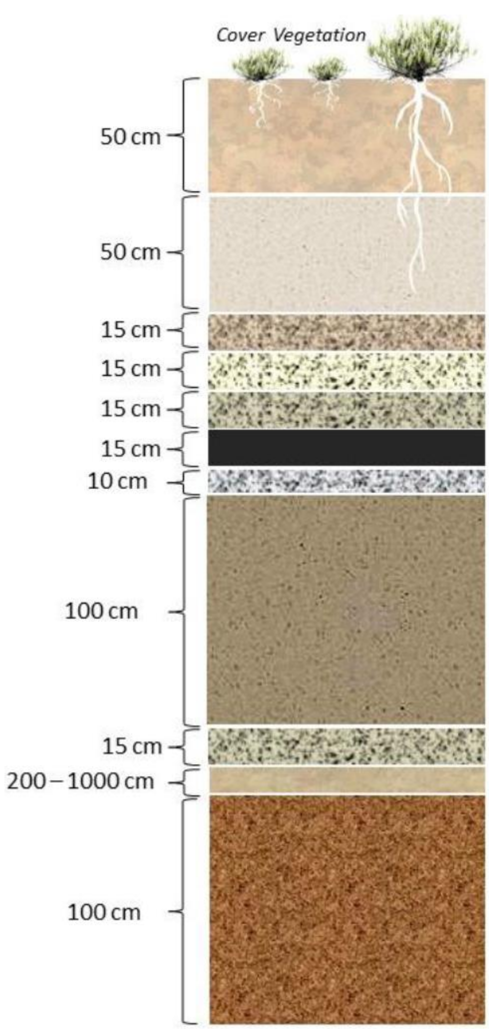
Source: EMDT-RE-0019, "Performance Assessment Results for Inclusion in Composite Analysis: Integrated Disposal Facility" (provided in Appendix A of this ECF).

Figure 10. Plan View of Conceptual Design for IDF Cap



Source: EMDT-RE-0019, "Performance Assessment Results for Inclusion in Composite Analysis: Integrated Disposal Facility" (provided in Appendix A of this ECF).

Figure 11. Profile View of Conceptual Design for IDF Cap



Layer Number	Thickness In inch	Layer Description
1	20″	Silt/loam w/pea Gravel admix
2	20″	Compacted topsoil
3	6″	Sand filter
4	6″	Gravel filter
5	6″	Aggregate
6	6″	Asphaltic concrete
7	4″	Asphalt
8	40″	Sandy soil
9	6″	Gravel filter
10	80″ - 400″	Structural Fill
11	40″	Backfill operations layer - 1 meter above top of canisters

Source: EMDT-RE-0019, “Performance Assessment Results for Inclusion in Composite Analysis: Integrated Disposal Facility” (provided in Appendix A of this ECF).

Figure 12. Cap Profile Detail for IDF Cap Conceptual Design

4.1.7.3 Barrier Footprint Considerations

The considerations for infiltration barriers in the RET include the expected rate of recharge and the appropriate area to assign with the barrier recharge rate. From guidance provided in DOE/RL-2011-50, *Regulatory Basis and Implementation of a Graded Approach to Evaluation of Groundwater Protection* the guidance for infiltration or capillary barriers is to have a fixed average rate of recharge not to exceed 0.5 mm/yr. Barrier recharge rates for the RET will adopt the guidance given by DOE/RL-2011-50 by assuming the highest limit for barrier recharge to be 0.5 mm/yr and the remaining variable is the number and extent of barrier footprints to be applied.

Sites with waste inventory (anticipated or historical) are shown in Figure 13 and Figure 14. Of the sites with known or future inventory many are identified as having a recharge barrier put in place over the waste site, shown in Figure 15 and Figure 16. The following sections propose methods for placing barriers over these sites.

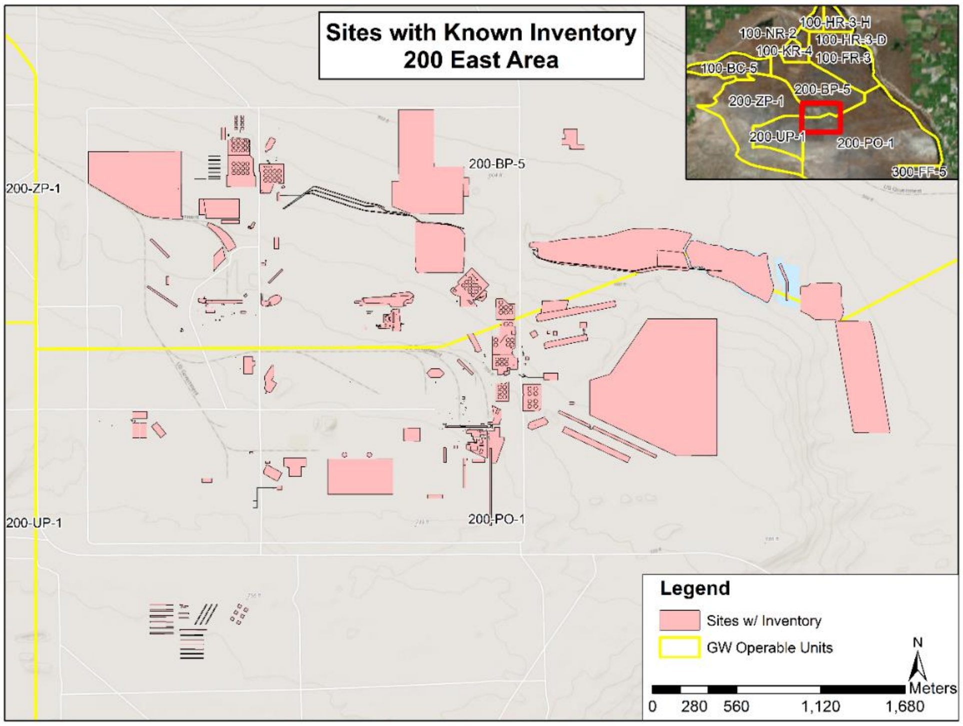


Figure 13. Inventory Sites in the 200 East Area

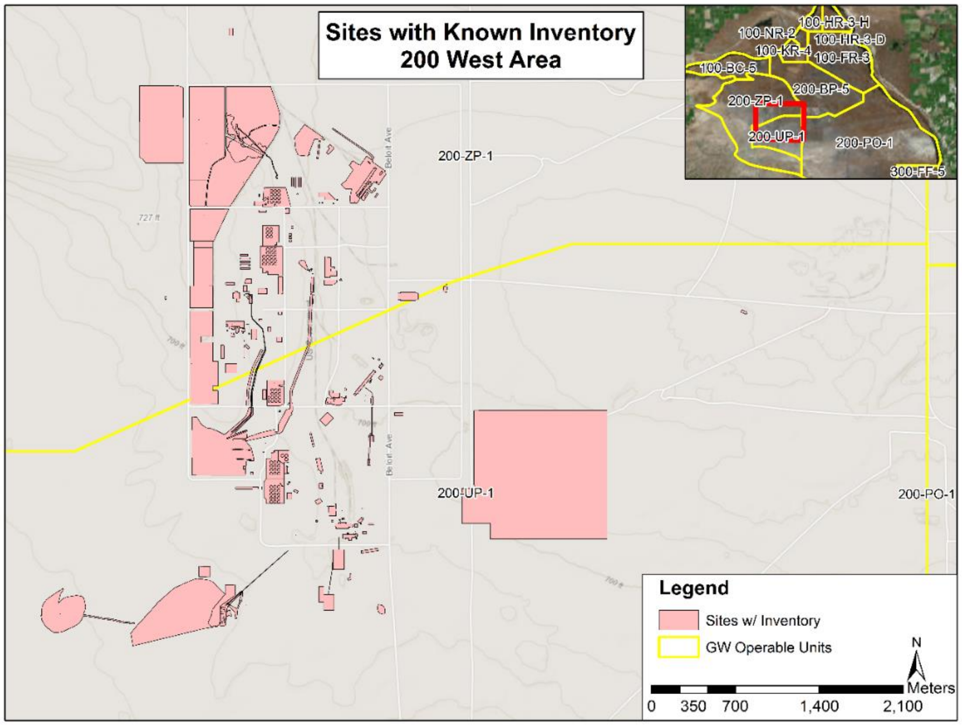


Figure 14. Inventory Sites in the 200 West Area

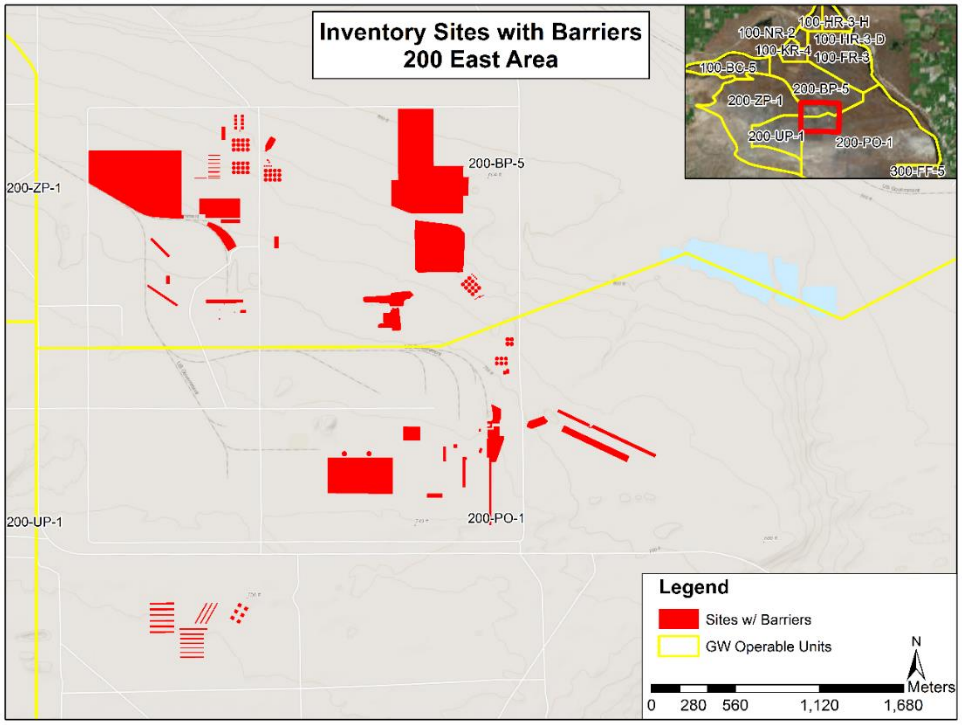


Figure 15. Inventory Sites with "Barrier" as Final Disposition (200 East Area)

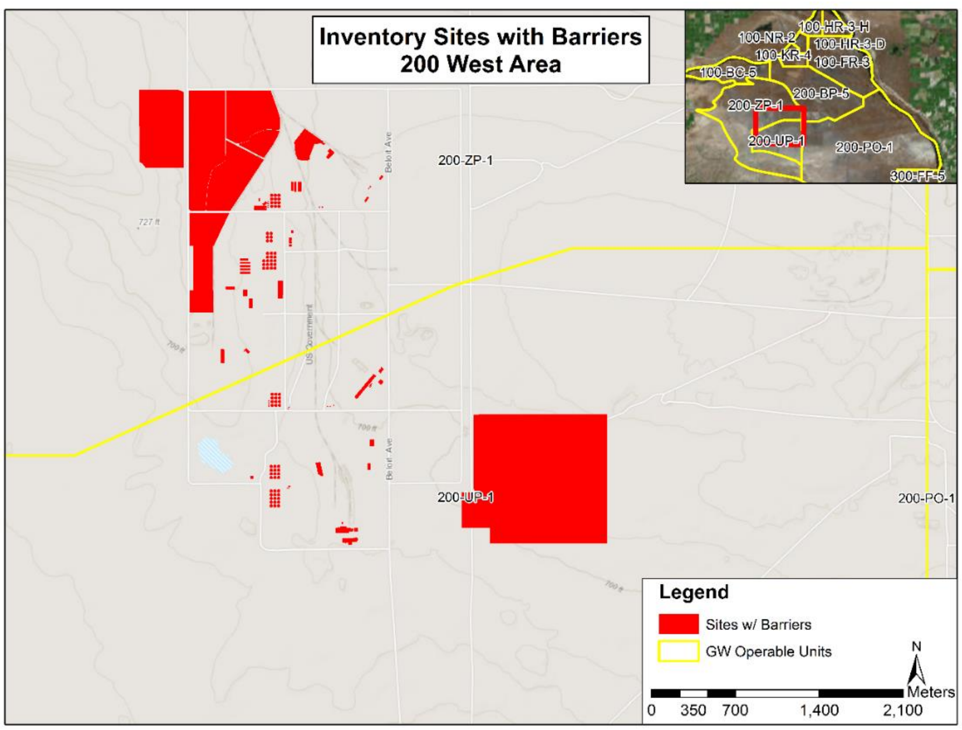


Figure 16. Inventory Sites with "Barrier" as Final Disposition (200 West Area)

4.1.7.4 Barrier Footprint Geometry

The areal extent of barriers not yet finalized or designed will be generated based on the design used for the PHB over 216-B-57, the only existing surface barrier in operation. Some points of consideration for determining the buffer length and geometry are presented herein. The first item to discuss is the extent of coverage for which the barrier is anticipated to stop recharge. The ETC Barrier is designed to intercept water and divert it back to the atmosphere. The side slopes have a limited capacity for holding water before draining off the barrier site. For the intents and purposes of the RET, water-shedding covers are considered to not reduce net recharge and are effectively ignored. DOE/RL-2016-37 Sections 3.1 and 3.2) shows that the drainage through the side slopes was observed to only occur when precipitation exceeded 140 mm/yr. The same section of the report suggests an average year of precipitation to be 172 mm/yr, which results in an estimated recharge of 14.7 mm/yr through the side slopes (over the total area). To be conservative, side slopes are considered to operate as water-shedding surface barriers with no reduction to net recharge. Conservative in this case is to reduce the size of the barrier, increasing the amount of effective recharge to groundwater.

Excluding the areal extents of the side slopes, the remaining portion of the PHB overlaying 216-B-57 is the ETC Barrier. The PHB was designed to prevent moisture infiltration through the crib footprint and the characterized vadose zone plume to the south of the crib. Because future plume footprints are not possible to characterize, barrier placement for the RET will only consider footprints of the waste sites in question. The ETC Barrier portion of the PHB will be analyzed strictly in the context of the waste site footprint for 216-B-57.

The crib and ETC Barrier were divided into quadrants, the common origin being the centroid of the crib footprint. The northeastern quadrant was taken for consideration in the buffer lengths applied to the crib. From the origin, the crib extends 2.5 m to the east and 30.48 m to the north while the ETC Barrier extends 20 m to the east and 32 m to the north. Comparing these lengths by ratio shows an anisotropic relationship in the areal extent of the ETC Barrier and the waste site footprint. The east-west barrier length has a ratio of 1:8 (crib:barrier) and the north-south barrier length is a ratio of 1:1.05.

The anisotropic buffer lengths are not explained in the documents mentioned. Considering that this surface barrier was designed to cover the vadose zone plume characterized near the time of construction in 1994, it is expected that the barrier width was increased to accommodate the theorized plume extent and projected northward. Additionally, site factors such as elevation, equipment placement, anticipated testing plans, etc., may have been additional factors in the geometry of the barrier. In light of these additional considerations taken into account for the PHB, it is assumed that the minimum extent should be at least 2 m from the waste site edge of the surveyed footprint.

For the purposes of RET, the final buffer length based on analysis of the PHB is to use the arithmetic mean of the buffer lengths in the north-south and east-west directions. This results in a uniform buffer length of 9.75 m (Equation 1), which will be rounded up to 10 m. To create a barrier with this 10 m offset, a spherical buffer from the outer rim of the waste site polygons will be generated using a radius of 10 m. The geometry of the buffer will be coerced into a minimum bounding rectangle which entirely encapsulates this buffer outline, an example case is shown in Figure 17. Where applicable, the minimum bounding rectangle will be rotated to fit the buffer.

$$\frac{(ETC_{north} - Crib_{north}) + (ETC_{East} - Crib_{East})}{2} = \frac{\Delta_{north} + \Delta_{East}}{2} = \frac{2m + 17.5m}{2} = 9.75m \approx 10m \qquad \textbf{(Eq. 1)}$$

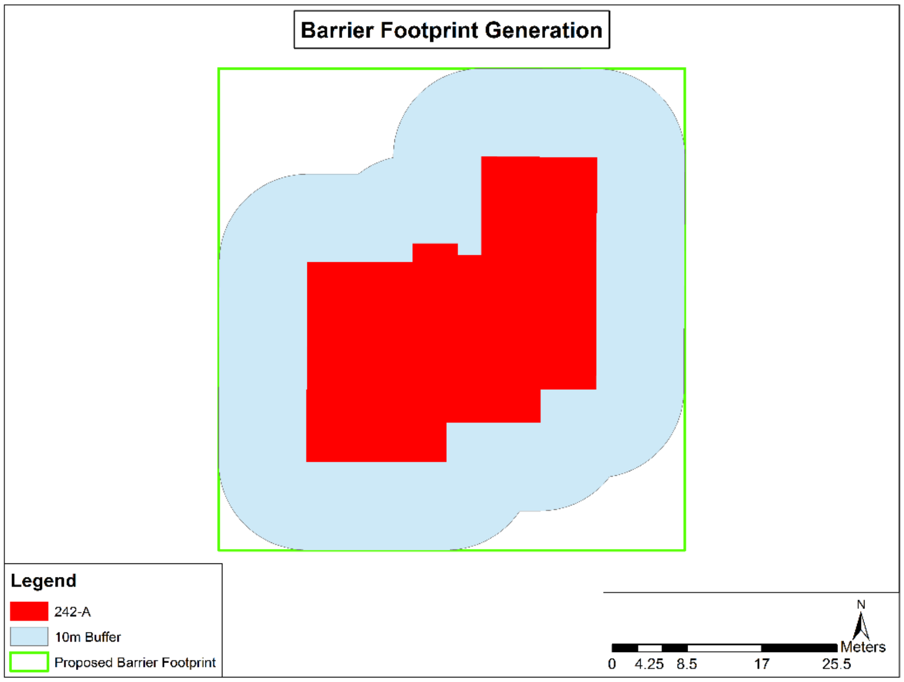


Figure 17. Example Barrier Footprint

4.1.8 Interim Barrier Footprints

Several surface barriers to infiltration have been installed at tank farm facilities at the Hanford Site. Ecology et al., 1989, *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) milestones include plans to install additional interim barriers until all tank farms have an interim barrier. Locations of these barriers are shown in Figure 18 (200 West) and Figure 19 (200 East). It is assumed that these liners are entirely impermeable given the regular maintenance of these liners to ensure that all breaches are sealed against leaks. The locations of these barriers are used in the RET calculation to override to the original output from unvegetated and disturbed to no infiltration over the footprint of the barrier. Where barriers exist, the footprint was determined from the latest satellite imagery. In locations where barriers have not been installed, the footprint was assumed to coincide with the footprint of the tanks within the given tank farm. It is anticipated that the interim barriers will be superseded in all cases by a permanent surface barrier as described in the previous section.

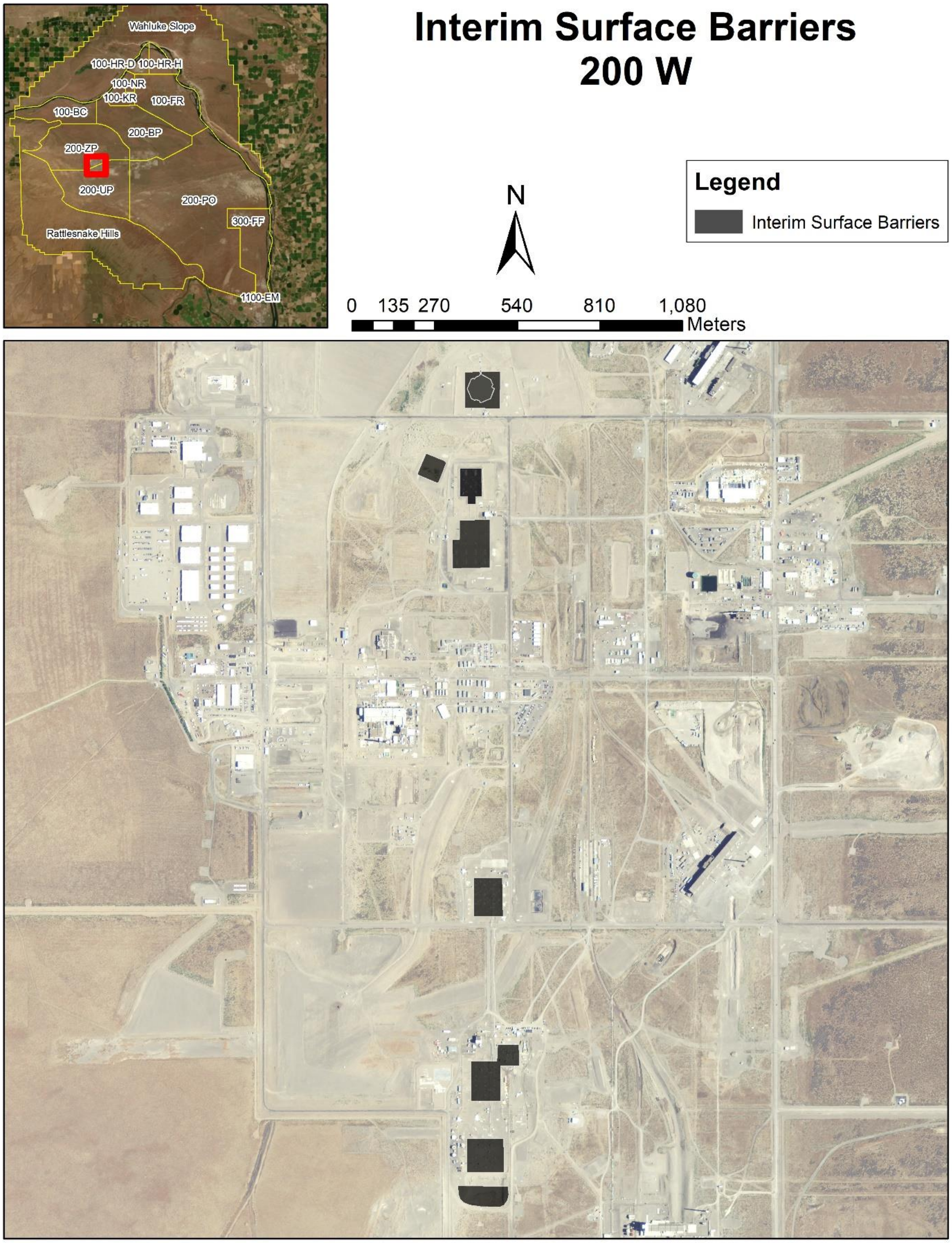


Figure 18. Interim Surface Barriers (200 West)

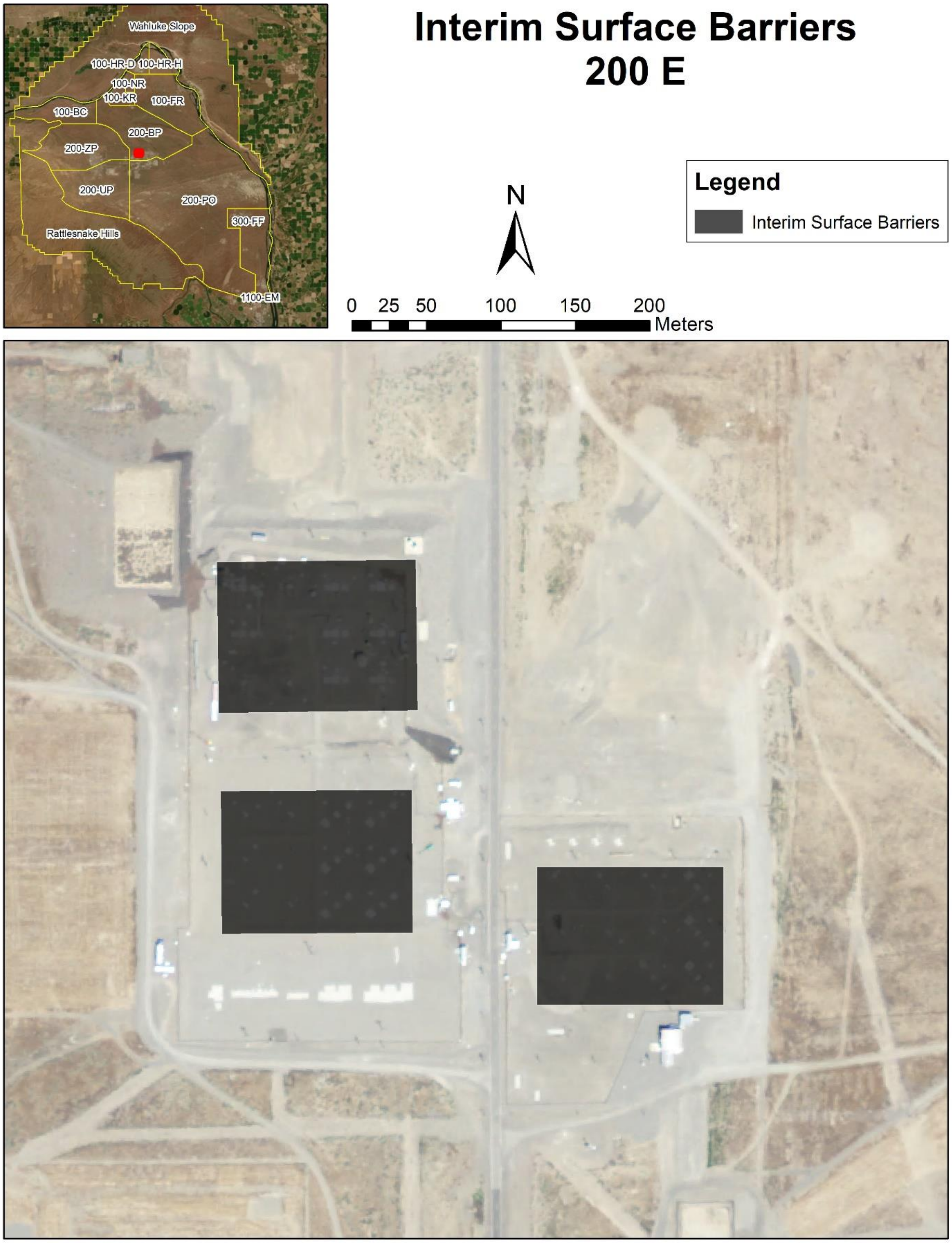


Figure 19. Interim Surface Barriers (200 East)

4.1.9 Central Plateau Focus Area

As mentioned in the introduction, data input preparation for the RET focused on the modeling area pertinent to the vadose zone facet of the Composite Analysis (CA). The focus area for data input preparation is shown Figure 20. The areas within the area extents designate the area of increased scrutiny for the RET modeling effort because the small scale effect of input datasets, including detailed input from the Waste Information Data System (WIDS), must be captured at the refined scale used for vadose zone models. Outside of the focus area the analysis datasets are less refined because the Hanford Site operational activities were less densely spaced laterally.

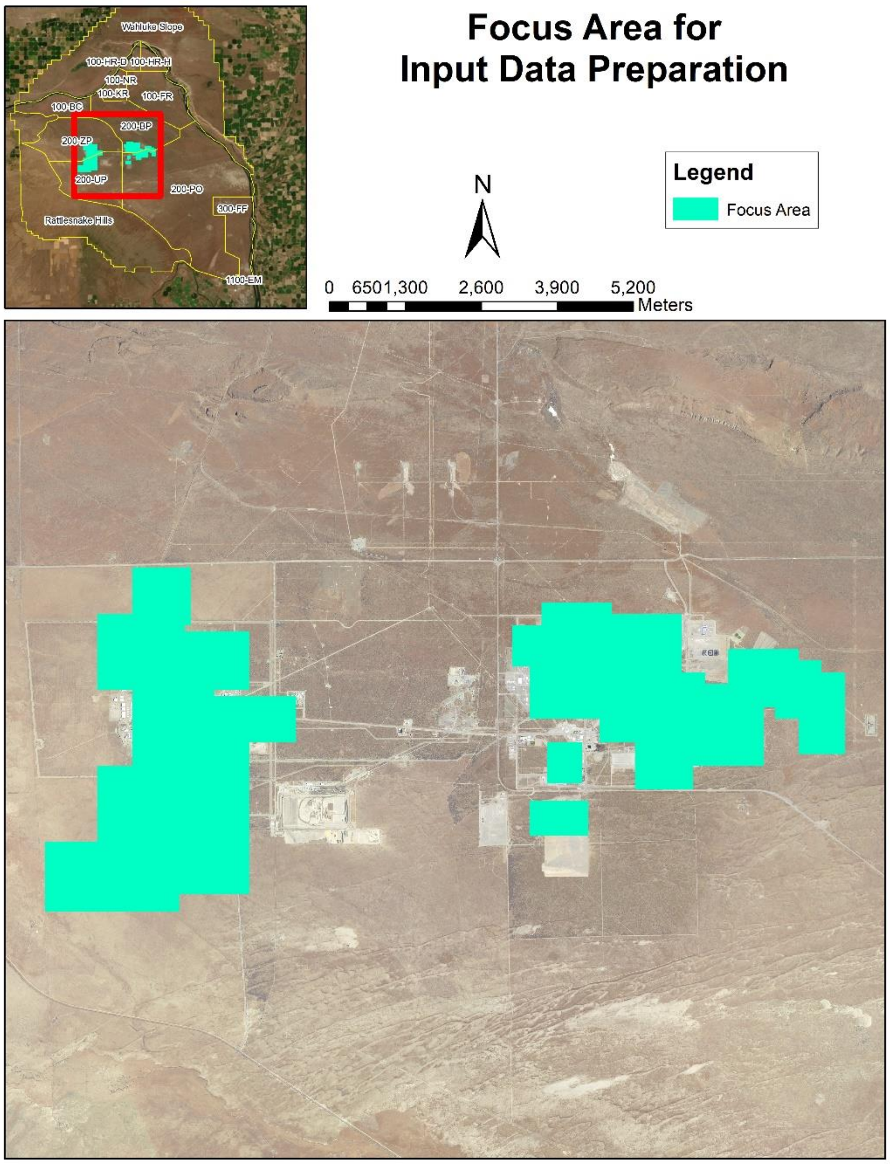


Figure 20. Focus Area for Data Input Preparation

4.1.10 Site-Specific Models

The RET calculation is intended to be a sitewide scale analysis. Site-specific models are expected to provide analyses that will evaluate infiltration at a more refined scale than the RET. Several performance assessment (PA) models were available that were incorporated into the RET. These include the following:

- The Environmental Restoration Disposal Facility (ERDF), documented in WCH-520, *Performance Assessment for the Environmental Restoration Disposal Facility, Hanford Site, Washington*
- WMA C, documented in RPP-ENV-58782, *Performance Assessment of Waste Management Area C, Hanford Site, Washington*
- The IDF documented in RPP-CALC-61032, *Vadose Zone and Saturated Zone Flow and Transport Calculations for the Integrated Disposal Facility Performance Assessment*

The recharge rates of these PA models are adopted as presented in the cited reports and overwrite those determined through the normal RET process. All PA model information used in this application of the RET are described in EMDT-BC-0033, "Data Sources for Accounting for Recharge Spatial and Temporal Variability at the Hanford Site (Inputs to the Recharge Evolution Tool,"[1] which is provided in Appendix C of this ECF).

Exceptions to adopting site-specific model recharge rates and geometry occurs where a more recent decision has been made regarding recharge rates that was not available during the creation of the PA model. One exception that has been applied for this revision of the RET is a recent agreement made by the Interagency Management Integration Team (IAMIT) regarding the recharge rate after revegetation of waste sites. In AR-02612, *Determination: Tri-Party Program Managers agree to maintain the 4.0 mm/year long-term recharge rate for the 200-EA-1 Operable Unit (OU) RFI/RI groundwater protection evaluations, and to perform a sensitivity analysis during the 200-EA-1 OU CMS/FS remedial alternatives evaluations*, as described in this determination, revegetated waste sites were determined to have a recharge rate of 4 mm/yr. The PA models in question predate this decision, necessitating an update to the recharge fields prior to their incorporation into the RET recharge maps. Side-by-side comparisons are shown in Figure 21 through Figure 23.

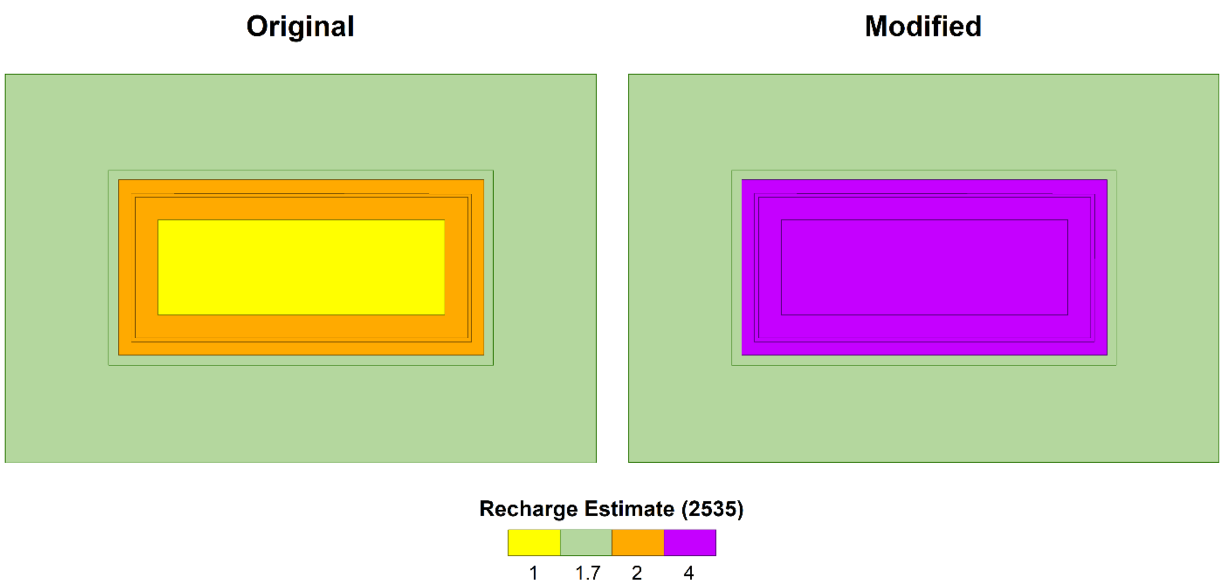


Figure 21. Changes to ERDF PA Recharge Rates per IAMIT Decision

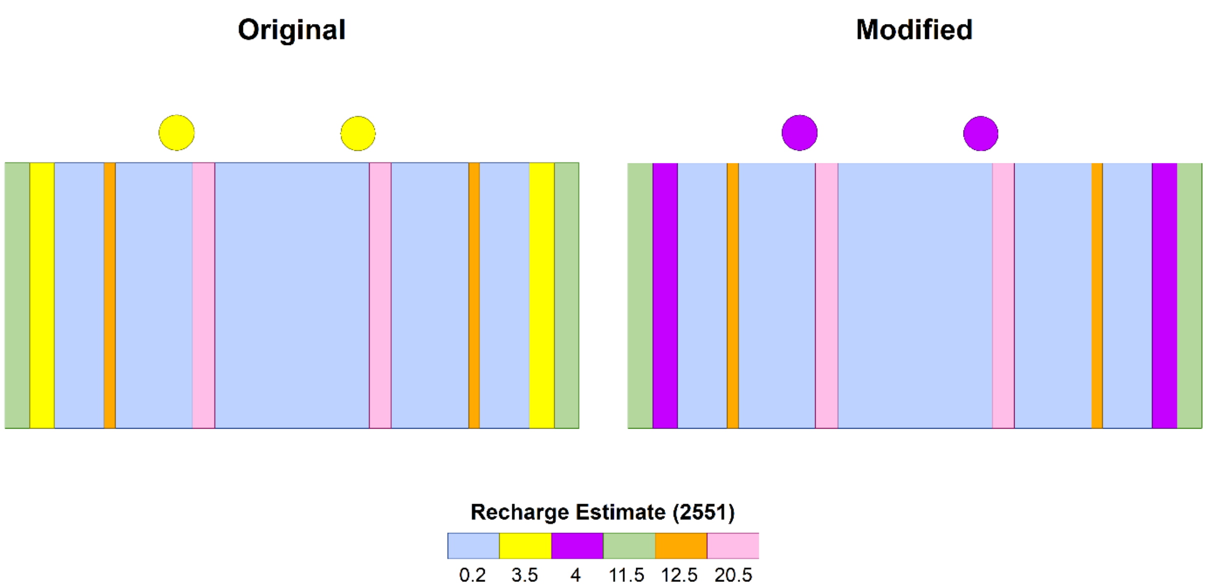


Figure 22. Changes to IDF PA Recharge Rates per IAMIT Decision

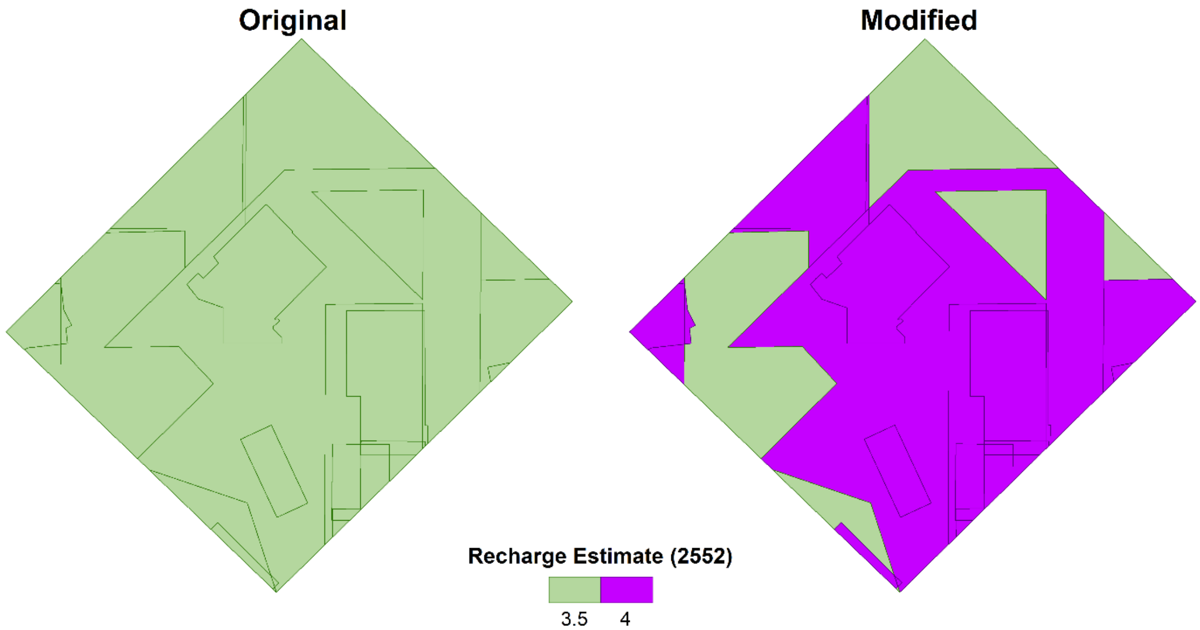


Figure 23. Changes to WMA C PA Recharge Rates per IAMIT Decision

Additionally, recharge-affecting decisions/anticipated actions from the Tri-Party Agreement were updated in the recharge maps for WMA C. The decisions/anticipated actions impacting recharge included the addition of surface barriers intersecting with/contained in the WMA C PA model. Example side-by-side comparisons illustrating the Tri-Party Agreement decisions within the boundaries of the WMA C PA are shown in Figure 24.

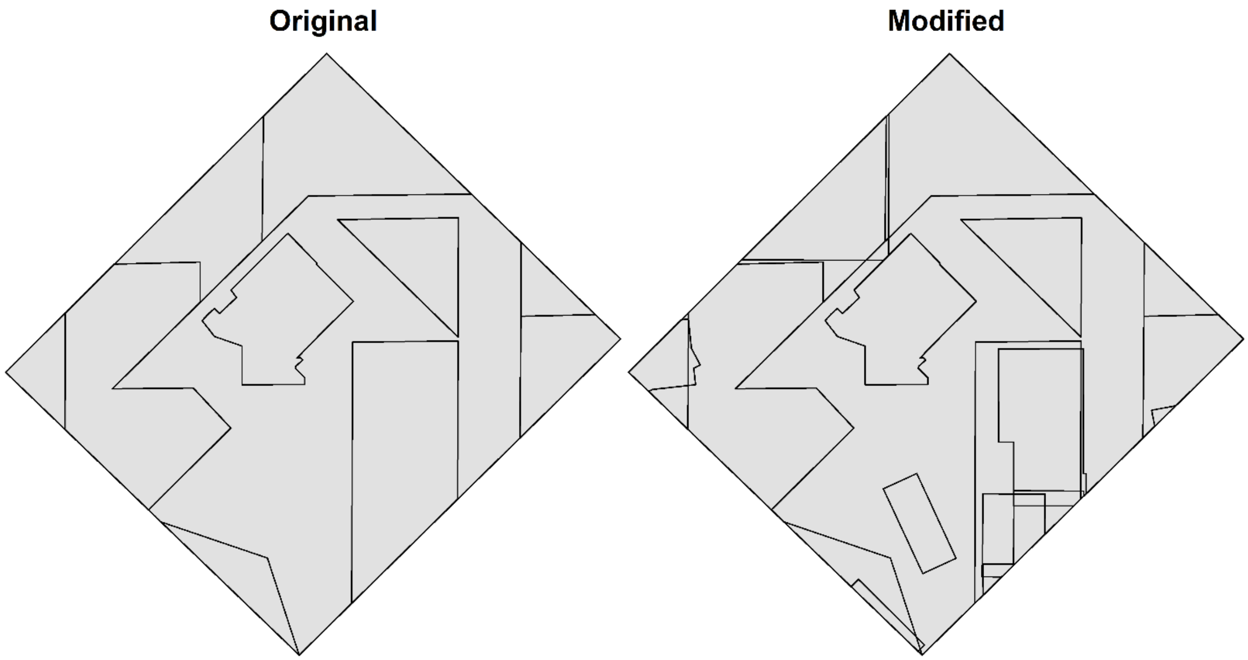


Figure 24. Modifications to WMA C Recharge Map

4.2 Nonspatial Data Sources

Nonspatial data sources include the temporal and recharge datasets. The Hanford Site Disposition Baseline (HSDB) provides the timeline for changes in the vegetative cover and condition of the soil based on known Hanford Site-related activities. Recharge rates were compiled into one table from Hanford Site-specific lysimeter studies, observations, and regulatory guidance.

4.2.1 Hanford Site Disposition Baseline

The HSDB, documented in CP-60254, *Hanford Site Composite Analysis Technical Approach Description: Hanford Site Disposition Baseline* and CP-63386, *Hanford Site Disposition Baseline for Composite Analysis*), is the primary source regarding changes through time in the surface condition for waste sites and facilities within the Hanford Site boundaries from the date of initial disturbance to the expected final condition, or "disposition" of the site. The details regarding how the information was compiled into a single table (including modifications and corrections) for the RET to use can be found in Appendix D of this ECF. Dispositions focus on surface conditions of the sites resulting from changes in operations; specifically, the years in which a site began accepting waste(s), no longer accepted waste(s), was remediated/plans for remediation, and the type of remediation. This disposition does not include changes in the surface conditions of roads, gravel pits, and other types of infrastructure that are not listed in WIDS, the Mission Support Alliance Structures List, or the DOE Dashboards.

Sites in the HSDB have dispositions and related disposition dates, upon which recharge assignments are based. For example, a site that was capped in 2005 will generate a different recharge than one that continues to be active or that has a cap put in place at a later time. Unless dictated otherwise by the HSDB, the surface condition will maintain pre-Hanford Site conditions until the vegetative cover survey values are applied in 2011.

The current calculation is designed to incorporate new information from the HSDB as it becomes available by re-running the script using the updated HSDB. This modularity allows the user to provide new sources/rationale to enhance/update the HSDB (or other sources) and subsequently update the associated recharge rates.

4.2.2 Recharge Rates

There are four primary references used to establish the recharge rate for the unique combinations of surface condition and soil type typical for the Hanford Site. The primary source for the majority of the Hanford Site will be defined using the values in Table 4.1 of PNL-10285 (UC-2010) (Figure 25). Operational areas, containing the majority of human disturbance, are defined using the values in Table 4.15 of PNNL-14072 (Figure 26); and these values supplant any that were previously defined. Guidance for barrier implementation and revegetation cycles are taken from DOE/RL-2011-50. Finally, the recharge rate selected for revegetated waste sites (4.0 mm/yr) is taken from AR-02612.

Table 5 indicates for each soil type which reference is considered the most recent, primary source for defining the recharge rate for the Hanford Site. The "Reference Source" listed here will be the source used in the RET if different rates are defined in more than one report.

Table 5. Reference Data Sources Considered Most Current for Groundwater Recharge by Soil Type

GRID_CODE	TEXT_SYM	SOIL_NAME	Reference Source
8	Eb	Ephrata Stoney Loam	PNNL-14072
5	Ba	Burbank Loamy Sand	
6	El	Ephrata Sandy Loam	
14	Rv	Riverwash	PNL-10285 (UC-2010)
2	Qy	Quincy Sand (was Rupert Sand, Rp)	
12	P	Pasco Silt Loam	
9	Ki	Kiona Silt Loam	
10	Wa	Warden Silt Loam	
1	Ri	Ritzville Silt Loam	
13	Qu	Esquatzel Silt Loam	
3	He	Hezel Sand	
15	D	Dunesand	
4	Kf	Koehler Sand	
11	Sc	Scooteney Stoney Silt Loam	
7	Ls	Lickskillet Silt Loam	
0	XX	Not Coded	--

References: PNL-10285 (UC-2010), *Estimated Recharge Rates at the Hanford Site, Pacific Northwest National Laboratory*.
PNNL-14702, *Vadose Zone Hydrology Data Package for Hanford Assessments*.

Table 4.1. Estimated Recharge Rates at the Hanford Site for Each Combination of Soil Type and Vegetation/Land Use. The recharge estimate for each combination is based on either measurements, modeling, or inferences from other combinations, as explained in Section 3.0.

Vegetation/Land Use		Recharge Rates (mm/yr)							
		Soil Types							
Index	Description	Ri	Rp	He	Kf	Ba	El	Ls	Eb
1	Shrub-steppe on slopes	3.4	8.6	2.6	2.6	2.6	2.6	3.4	2.6
2	Shrub-steppe on plain/uplands	3.4	8.6	2.6	2.6	2.6	2.6	3.4	2.6
3	Recovering shrub-steppe on plain/uplands	3.4	11.3	2.6	2.6	2.6	2.6	3.4	2.6
4	Bunchgrass on slopes	3.4	11.3	2.6	2.6	2.6	2.6	3.4	2.6
5	Hopsage/greasewood	3.4	8.6	2.6	2.6	2.6	2.6	3.4	2.6
6	Cheatgrass	4.8	25.4	3.4	3.4	2.6	4.9	4.8	4.9
7	Abandoned fields	4.8	25.4	3.4	3.4	2.6	4.9	4.8	4.9
8	Riparian	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	Agricultural areas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Sand dunes	55.4	55.4	55.4	55.4	55.4	55.4	55.4	55.4
11	Disturbed/Facilities	6.8	55.4	6.4	6.4	4.4	17.3	6.8	17.3
12	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	Basalt outcrops	86.7	86.7	86.7	86.7	86.7	86.7	127.1	86.7

Vegetation/Land Use		Recharge Rates (mm/yr)						
		Soil Types						
Index	Description	Ki	Wa	Sc	P	Qu	Rv	D
1	Shrub-steppe on slopes	3.4	3.4	3.4	3.4	3.4	8.6	8.6
2	Shrub-steppe on plain/uplands	3.4	3.4	3.4	3.4	3.4	8.6	8.6
3	Recovering shrub-steppe on plain/uplands	3.4	3.4	3.4	3.4	3.4	11.3	11.3
4	Bunchgrass on slopes	3.4	3.4	3.4	3.4	3.4	11.3	11.3
5	Hopsage/greasewood	3.4	3.4	3.4	3.4	3.4	8.6	8.6
6	Cheatgrass	4.8	4.8	4.8	4.8	4.8	25.4	25.4
7	Abandoned fields	4.8	4.8	4.8	4.8	4.8	25.4	25.4
8	Riparian	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	Agricultural areas	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	Sand dunes	55.4	55.4	55.4	55.4	55.4	55.4	55.4
11	Disturbed/Facilities	6.8	6.8	6.8	6.8	6.8	55.4	55.4
12	Water	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	Basalt outcrops	86.7	86.7	86.7	86.7	86.7	86.7	86.7

Source: Table 4.1 in PNL-10285 (UC-2010), *Estimated Recharge Rates at the Hanford Site, Pacific Northwest National Laboratory*.

Figure 25. Estimated Recharge Rates

Area Label	Brief Description	Major (Secondary)[a] Soil Type(s) and Sediments	Estimated Recharge Rate (mm/yr)[b] No Vegetation	Cheatgrass	Young Shrub-Steppe	Shrub-Steppe
C	Reactor along river	E_b (B_a)	17 (52)	8.5 (26.5)	3.0 (6.0)	1.5 (3.0)
K	Reactor along river	E_b (E_l)	17 (17)	8.5 (8.5)	3.0 (3.0)	1.5 (1.5)
N	Reactor along river	E_b	17	8.5	3.0	1.5
D	Reactor along river	E_l	17	8.5	3.0	1.5
H	Reactor along river	B_a	52	26	6.0	3.0
F	Reactor along river	R_p (E_l)	44 (17)	22 (8.5)	8.0 (3.0)	4.0 (1.5)
R	300 Area	R_p (E_l)	44 (17)	22 (8.5)	8.0 (3.0)	4.0 (1.5)
Q	400 Area	R_p (B_a)	44 (52)	22 (26)	8.0 (3.0)	4.0 (3.0)
P	618-10 Area	R_p (B_a)	44 (52)	22 (26)	8.0 (3.0)	4.0 (3.0)
M	618-11 Area	R_p (B_a)	44 (52)	22 (26)	8.0 (3.0)	4.0 (3.0)
G	Gable Mtn. Pond Area	E_l (B_a)	17 (52)	8.5 (26)	3.0 (6.0)	1.5 (3.0)
I	200N Area	E_l (B_a)	17 (52)	8.5 (26)	3.0 (6.0)	1.5 (3.0)
T	Northern 200W Area	R_p (B_a)	44 (52)	22 (26)	8.0 (3.0)	4.0 (3.0)
S	Southern 200W Area and ERDF	R_p	44	22	8.0	4.0
A	Southern 200E Area	R_p (B_a, R_{pi}, R_{pu})	44 (52, 44, 30)	22 (26, 22, na)	8.0 (6.0, 1.8, na)	4.0 (3.0, 0.9, na)
B	Northwestern 200E Area	E_l	17	8.5	3.0	1.5
E	Eastern 200E Area	B_a (R_p)	52 (44)	26 (22)	6.0 (1.8)	3.0 (0.9)
--	All Areas with soils disturbed by excavations	Hanford sand	63	31.5	8.0	4.0
--	All Areas with an Evapotranspiration (ET) surface barrier after design life	Warden silt loam (Wa)	na	na	0.08	0.04
--	All Areas with gravel surface and no plants	gravel	92	46	na	na

B_a = Burbank loamy sand
E_b = Ephrata stony loam
E_l = Ephrata sandy loam
R_p = Rupert sand
R_{pi} = Rupert sand in the IDF in the 200 East Area.
R_{pu} = Rupert sand at the US Ecology Site, southwest of the 200 East Area.
na = not applicable
(a) Only the major soil types were used to represent each aggregate area.
(b) Alternate/reference case values shown in Table 4.14 are not provided here.
(c) Value to be used in reference case analyses (DOE. October 21, 2005. *Technical Guidance Document for Composite Analysis of Low-Level Waste Disposal at the Hanford Site.* DOE/RL-2005-66, U.S. Department of Energy, Richland, Washington [unsigned]).

Source: PNNL-14702, *Vadose Zone Hydrology Data Package for Hanford Assessments*.

Figure 26. Estimated Recharge Rates

4.2.3 Vegetation Changes Due to Revegetation

To account for recharge rate changes due to revegetation the following approach will be applied to each location that undergoes revegetation. Per DOE/RL-2011-50, revegetation efforts will result in a mature cover after 30 years. It is assumed that the revegetation process will continue undisturbed over the 30-year timeframe. For all waste sites, revegetation begins at the time cleanup action dates are specified. According to AR-02612, the recharge rates reduce in stepwise fashion from a disturbed value to 8 mm/yr for 30 years and are assigned 4 mm/yr at the end of the revegetation cycle. For all other locations revegetation is simulated using recharge rates that reduce linearly from the what is assigned at the start of revegetation until reaching the pre-Hanford Site recharge rate over a 30-year period.

4.2.4 Infiltration Rate of Barriers

The PHB has a different recharge rate from simple grout barriers or caps. Surface barriers without a capillary barrier or ponding mechanism are assumed to still allow meteoric recharge to take place in the absence of storm drainage or other collection mechanisms shifts the location of infiltration. However, for all waste sites declared with an infiltration barrier (a barrier capturing and preventing water from infiltrating into the soil), DOE/RL-2011-50 provides a design life of 500 years for such barriers at a recharge rate of 0.5 mm/yr. These barriers are assigned a rate of 4.0 mm/yr (AR-02612) at the end of their design life. Grout covers, concrete structures, and other similar caps are not considered to reduce net recharge to the soil and are assigned bare and disturbed vegetative and soil conditions, respectively. The exceptions to this assumption are the interim barriers given their increased maintenance and storm drainage management. Interim barriers at tank farms are actively monitored and maintained to prevent water infiltration within its footprint.

4.3 Data Interpretation: Surface Condition to Disposition

The HSDB provides a single definition of the current or planned disposition for the waste sites and facilities that contain some element of contamination. In support of the recharge calculations, a cover type and surface condition were defined for each disposition type that is currently in the HSDB. The covers and surface conditions used in the RET calculation are included in Table 6.

Table 6. Dispositions from the Hanford Disposition Baseline with the Corresponding Cover and Surface Conditions for Calculations of Recharge

Disposition[a]	Cover_Type	SurfCond
<Blanks>	Gravel/industrial/nonvegetated/weeds	Cheatgrass
ABAR	Barrier	Barrier/MinRchrg
ABAR, mod RCRA C low permeability	Barrier	Barrier/MinRchrg
Addressed by remedy from adjacent site	Gravel/industrial/nonvegetated/weeds	Cheatgrass
Administratively closed out	Gravel/industrial/nonvegetated/weeds	Cheatgrass
Barrier	Barrier	Barrier/MinRchrg
Barrier plus RTD	Barrier	Barrier/MinRchrg
Cobble, not vegetated	Gravel/industrial/nonvegetated/weeds	Cheatgrass
Cocoon	Disturbed sand	Bare
CS/MESC/MNA/IC	Gravel/industrial/nonvegetated/weeds	Cheatgrass

Table 6. Dispositions from the Hanford Disposition Baseline with the Corresponding Cover and Surface Conditions for Calculations of Recharge

Disposition[a]	Cover_Type	SurfCond
CSNA	Gravel/industrial/nonvegetated/weeds	Cheatgrass
csna	Gravel/industrial/nonvegetated/weeds	Cheatgrass
D&D	Disturbed sand	Bare
D4	Disturbed sand	Bare
D4 (demolish in place, backfill)	Disturbed sand	Bare
D4 (removed aboveground tanks)	Disturbed sand	Bare
D4 + burial in place	Disturbed sand	Bare
D4 abovegrade structure	Disturbed sand	Bare
D4 to 3 ft bgs	Disturbed sand	Bare
D4 to grade	Disturbed sand	Bare
D4 to slab-on-grade	Disturbed sand	Bare
D4, grout, barrier	Barrier	Barrier/MinRchrg
D4, ISS	Disturbed sand	Bare
D4S	Disturbed sand	Bare
Deactivation	Bldg	Barrier/MinRchrg
Decommission (septic tank left in place)	Bldg	Barrier/MinRchrg
Decontamination	Bldg	Barrier/MinRchrg
Decontamination, CSNA	Bldg	Barrier/MinRchrg
Demolish	Disturbed sand	Bare
Demolish plus barrier	Barrier	Barrier/MinRchrg
Demolish plus void fill	Disturbed sand	Bare
Demolished	Disturbed sand	Bare
Demolition to slab-on-grade	Disturbed sand	Bare
Engineered surface barrier	Barrier	Barrier/MinRchrg
Enhanced attenuation	Gravel/industrial/nonvegetated/weeds	Cheatgrass
Ex situ bioremediation	Disturbed sand	Bare
Excavation (gravel)	Disturbed gravel	Bare
Excavation (sand)	Disturbed sand	Bare
Fines with gravel, not vegetated	Gravel/industrial/nonvegetated/weeds	Cheatgrass
Fines with gravel, yes	Gravel/industrial/nonvegetated/weeds	Cheatgrass
Fines, not vegetated	Gravel/industrial/nonvegetated/weeds	Cheatgrass
Fines, yes	Gravel/industrial/nonvegetated/weeds	Cheatgrass
Gravel and concrete pad, not vegetated	Gravel/industrial/nonvegetated/weeds	Cheatgrass

Table 6. Dispositions from the Hanford Disposition Baseline with the Corresponding Cover and Surface Conditions for Calculations of Recharge

Disposition[a]	Cover_Type	SurfCond
Gravel with fines, not vegetated	Gravel/industrial/nonvegetated/weeds	Cheatgrass
Gravel with fines, yes	Gravel/industrial/nonvegetated/weeds	Cheatgrass
Gravel, not vegetated	Gravel/industrial/nonvegetated/weeds	Cheatgrass
Gravel, yes	Gravel/industrial/nonvegetated/weeds	Cheatgrass
Grout	Disturbed sand	Bare
Grout fill; install surface barrier; revegetate	Barrier	Barrier/MinRchrg
Grout fill; revegetate	Gravel/industrial/nonvegetated/weeds	Cheatgrass
Grout, barrier	ET Barrier	Barrier/MinRchrg
Hazard mitigation for public access	Gravel/industrial/nonvegetated/weeds	Cheatgrass
IC	Artificial regeneration	Developing
IC: Prohibit application of irrigation water except to establish vegetation	Artificial regeneration	Developing
ISS	Bldg	Barrier/MinRchrg
ISS, possibly display a portion	Bldg	Barrier/MinRchrg
Lined landfill	Lined landfill	Barrier/MinRchrg
Maintain/enhance soil cover. Maintain a 15 ft thickness of soil cover over these waste sites (ET Barrier).	Barrier	Barrier/MinRchrg
MESC	Gravel/industrial/nonvegetated/weeds	Cheatgrass
MESC/MEESC/MNA	Gravel/industrial/nonvegetated/weeds	Cheatgrass
No action	Gravel/industrial/nonvegetated/weeds	Cheatgrass
No action	Gravel/industrial/nonvegetated/weeds	Cheatgrass
No action since these waste sites do not pose a risk to human health and the environment	Gravel/industrial/nonvegetated/weeds	Cheatgrass
No further action	Gravel/industrial/nonvegetated/weeds	Cheatgrass
No RL-40 action	Gravel/industrial/nonvegetated/weeds	Cheatgrass
No RL-40 action	Gravel/industrial/nonvegetated/weeds	Cheatgrass
Operating	Bldg	Barrier/MinRchrg
Pipeline capping	Disturbed sand	Bare
Remove	Disturbed sand	Bare
RTD	Disturbed sand	Bare

Table 6. Dispositions from the Hanford Disposition Baseline with the Corresponding Cover and Surface Conditions for Calculations of Recharge

Disposition[a]	Cover_Type	SurfCond
RTD - Option A: Remove soil to 0.6 m (2 ft) below the bottom of the disposal structure to 6 m to 7 m (20 ft - 23 ft) bgs. Plutonium waste will be disposed of at WIPP or ERDF, as appropriate. SVE to treat VOCs. Use of ET Barriers.	Barrier	Barrier/MinRchrg
RTD - Option C: Remove soil up to a depth of 6.7 m to 10 m (22 ft - 33 ft) at each waste site. Plutonium waste will be disposed of at WIPP or ERDF, as appropriate. Use of ET Barriers.	Barrier	Barrier/MinRchrg
RTD or void fill	Disturbed sand	Bare
RTD plus void fill	Disturbed sand	Bare
RTD to 3 ft bgs	Disturbed sand	Bare
RTD to 3 ft bgs, partial barrier	Barrier	Barrier/MinRchrg
RTD to 4.6 m. IC: Prohibit application of irrigation water except to establish vegetation	Artificial regeneration	Developing
RTD to bottom of structure & engineered surface barrier	Barrier	Barrier/MinRchrg
RTD top 15 ft; clean backfill; revegetate	Gravel/industrial/nonvegetated/weeds	Cheatgrass
RTD with disposal at ERDF or WIPP, as appropriate	Disturbed sand	Bare
RTD, barrier	Barrier	Barrier/MinRchrg
RTD, ET Barrier, IC	Barrier	Barrier/MinRchrg
RTD, grout	Bldg	Barrier/MinRchrg
RTD, grout	Bldg	Barrier/MinRchrg
RTD, mod RCRA C LP	Barrier	Barrier/MinRchrg
RTD, on-site ex-situ bioremediation	Disturbed sand	Bare
RTD, or void fill plus barrier	Barrier	Barrier/MinRchrg
RTD, vapor barrier	Barrier	Barrier/MinRchrg
Shallow soil removal	Gravel/industrial/nonvegetated/weeds	Cheatgrass
Shutdown pending	Bldg	Barrier/MinRchrg
Shutdown pending D&D	Bldg	Barrier/MinRchrg
Shutdown pending disposal	Bldg	Barrier/MinRchrg
Sludge removal and tank stabilization	Disturbed sand	Bare
Soil cap, MNA, IC	Gravel/industrial/nonvegetated/weeds	Cheatgrass
Soil cover	Gravel/industrial/nonvegetated/weeds	Cheatgrass

Table 6. Dispositions from the Hanford Disposition Baseline with the Corresponding Cover and Surface Conditions for Calculations of Recharge

Disposition[a]	Cover_Type	SurfCond
TBD in 200-IS-1 process	Gravel/industrial/nonvegetated/weeds	Cheatgrass
Void fill	Disturbed sand	Bare
Void fill	Disturbed sand	Bare
Void fill	Disturbed sand	Bare
Void fill or RTD	Disturbed sand	Bare
Void fill plus barrier	Barrier	Barrier/MinRchrg

Sources: CP-60254, *Hanford Site Composite Analysis Technical Approach Description: Hanford Site Disposition Baseline*.

CP-63386, *Hanford Site Disposition Baseline for Composite Analysis*.

ABAR = aggregated barrier
bgs = below ground surface
CS = confirmatory sampling
CSNA = confirmatory sampling, no action
D&D = decontamination and decommissioning
D4 = decontamination, deactivation, decommissioning, and demolition
ERDF = Environmental Restoration Disposal Facility
ET = evapotranspiration
IC = institutional control
ISS = interim safe storage
LP = low permeability
MESC = maintain existing soil cover
MNA = monitored natural attenuation
RCRA = *Resource Conservation and Recovery Act of 1976*
RTD = remove, treat, dispose
SVE = soil vapor extraction
TBD = to be determined
VOC = volatile organic compound
WIPP = Waste Isolation Pilot Plant

4.4 Recharge Lookup Table

Based on the available data on recharge, defined in Section 4.2.2 above, all vegetative cover types and disposition values were assigned for every combination of cover type, surface condition, and soil type. Table 7 represents the values used in the current calculation for each combination of cover type, surface condition, and soil type considered in this model.

For locations where a soil type remains undefined ('XX') in the GIS data source, the values for Rupert Sand are applied. Rupert Sand was selected to replace undefined soil code features as a conservative choice, assigning higher recharge rates than another soil type, and for the fact that the majority of the Central Plateau is a Rupert Sand soil type. Where possible, references are listed for the combinations of surface condition and cover types according to their corresponding soil types where references differentiate recharge rates by soil type.

Table 7. Recharge Rates

Descriptive Name	Cover_Type	SurfCond	Reference_Source	Qy	Ri	Rp	He	Kf	Ba	El	Ls	Eb	Ki	Wa	Sc	P	Qu	Rv	D	XX
Actively Irrigated	Agricultural/ Orchard	Irrigated	DOE/RL-96-17 ECF-HANFORD-11-0063 WDOH/320-015	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72	72
Bare - Basalt	Basalt	Bare	PNL-10285 (UC-2010)	86.7	86.7	86.7	86.7	86.7	86.7	86.7	127.1	86.7	86.7	86.7	86.7	86.7	86.7	86.7	86.7	86.7
Bare - Riparian	Riparian/ Wetlands/Aquatic Habitats	Mature	PNNL-14702 PNL-10285 (UC-2010) (based off of vegetation type present, used "Mature-Vegetated")	4	3.4	4	2.6	2.6	3	1.5	3.4	1.5	3.4	3.4	3.4	3.4	3.4	8.6	8.6	4
Bare - Sand	Non-Vegetated Sand - Bluffs - Talus	Bare	PNL-10285 (UC-2010)	55.4	55.4	55.4	55.4	55.4	55.4	55.4	55.4	55.4	55.4	55.4	55.4	55.4	55.4	55.4	55.4	55.4
Barrier - Post Design Life	ET Barrier - Post Design Life	Mature	AR-02612	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Barrier - Successi on Developing	ET Barrier	Developing	DOE/RL-2011-50	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Barrier - Successi on Mature	ET Barrier	Mature		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Barrier[a]	ET Barrier	Barrier/ MinRchrg		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Barrier[b]	Barrier	Barrier/ MinRchrg		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Building	Bldg	Barrier/ MinRchrg	Applied "Disturbed Sand & Bare" Rates	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63
Cheatgrass - Gravel	Gravel/Industrial/ Nonvegetated/ Exotic Weed	Cheatgrass	PNNL-14702	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46
Cheatgrass - Gravel	Gravel/industrial/ non-vegetated/ weeds	Cheatgrass		46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46

Table 7. Recharge Rates

Descriptive Name	Cover_Type	SurfCond	Reference_Source	Qy	Ri	Rp	He	Kf	Ba	El	Ls	Eb	Ki	Wa	Sc	P	Qu	Rv	D	XX
Cheatgrass - Vegetated	Bluebunch Wheatgrass - Sandberg's Bluegrass	Cheatgrass	PNNL-14702 PNL-10285 (UC-2010)	22	4.8	22	3.4	3.4	26	8.5	4.8	8.5	4.8	4.8	4.8	4.8	4.8	25.4	25.4	22
Cheatgrass - Vegetated	Bunchgrass Mosaic	Cheatgrass		22	4.8	22	3.4	3.4	26	8.5	4.8	8.5	4.8	4.8	4.8	4.8	4.8	25.4	25.4	22
Cheatgrass - Vegetated	Crested Wheatgrass - Bluegrass - Cheatgrass	Cheatgrass		22	4.8	22	3.4	3.4	26	8.5	4.8	8.5	4.8	4.8	4.8	4.8	4.8	25.4	25.4	22
Cheatgrass - Vegetated	Sand Dropseed - Sandberg's Bluegrass - Cheatgrass	Cheatgrass		22	4.8	22	3.4	3.4	26	8.5	4.8	8.5	4.8	4.8	4.8	4.8	4.8	25.4	25.4	22
Cheatgrass - Vegetated	Sandberg's Bluegrass	Cheatgrass		22	4.8	22	3.4	3.4	26	8.5	4.8	8.5	4.8	4.8	4.8	4.8	4.8	25.4	25.4	22
Cheatgrass - Vegetated	Sandberg's Bluegrass - Cheatgrass	Cheatgrass		22	4.8	22	3.4	3.4	26	8.5	4.8	8.5	4.8	4.8	4.8	4.8	4.8	25.4	25.4	22
Developing - Gravel	Gravel/Industrial/ Nonvegetated/ Exotic Weed	Developing	PNNL-14702	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46
Developing - Gravel	Gravel/Industrial/ Nonvegetated/ Weeds	Developing		46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46
Developing - Vegetated	Rabbitbrush/ Bunchgrass Mosaic	Developing	PNNL-14702 PNL-10285 (UC-2010)	8	3.4	8	2.6	2.6	6	3	3.4	3	3.4	3.4	3.4	3.4	3.4	11.3	11.3	8
Developing - Vegetated	Rabbitbrush/ Sandberg's Bluegrass - Cheatgrass	Developing		8	3.4	8	2.6	2.6	6	3	3.4	3	3.4	3.4	3.4	3.4	3.4	11.3	11.3	8

Table 7. Recharge Rates

Descriptive Name	Cover_Type	SurfCond	Reference_Source	Qy	Ri	Rp	He	Kf	Ba	El	Ls	Eb	Ki	Wa	Sc	P	Qu	Rv	D	XX
Developing - Vegetated	Snow Buckwheat/ Bunchgrass Mosaic	Developing	PNNL-14702 PNL-10285 (UC-2010)	8	3.4	8	2.6	2.6	6	3	3.4	3	3.4	3.4	3.4	3.4	3.4	11.3	11.3	8
Developing - Vegetated	Snow Buckwheat/ Sandberg's Bluegrass - Cheatgrass	Developing		8	3.4	8	2.6	2.6	6	3	3.4	3	3.4	3.4	3.4	3.4	3.4	11.3	11.3	8
Developing - Vegetated	Spiny Hopsage/ Sandberg's Bluegrass - Cheatgrass	Developing		8	3.4	8	2.6	2.6	6	3	3.4	3	3.4	3.4	3.4	3.4	3.4	11.3	11.3	8
Developing - Vegetated	Thymeleaf Buckwheat/ Sandberg's Bluegrass	Developing		8	3.4	8	2.6	2.6	6	3	3.4	3	3.4	3.4	3.4	3.4	3.4	11.3	11.3	8
Developing - Vegetated	Winterfat/ Bunchgrass Mosaic	Developing		8	3.4	8	2.6	2.6	6	3	3.4	3	3.4	3.4	3.4	3.4	3.4	11.3	11.3	8
Developing - Vegetated	Artificial Regeneration	Developing	2x the rates used for "Mature - Vegetated" cover with "Mature" surface condition	8	3.4	8	2.6	2.6	6	3	3.4	3	3.4	3.4	3.4	3.4	3.4	11.3	11.3	8
Developing - Vegetated	Artificial Regeneration	Developing		8	3.4	8	2.6	2.6	6	3	3.4	3	3.4	0.08	3.4	3.4	3.4	11.3	11.3	8
Disturbed - Bare	Disturbed Gravel	Bare	PNNL-14702	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Disturbed - Succession Cheatgrass	Disturbed	Cheatgrass	PNNL-14702 PNL-10285 (UC-2010)	22	4.8	22	3.4	3.4	26	8.5	4.8	8.5	4.8	4.8	4.8	4.8	4.8	25.4	25.4	22
Disturbed - Succession Developing	Disturbed	Developing		8	3.4	8	2.6	2.6	6	3	3.4	3	3.4	3.4	3.4	3.4	3.4	11.3	11.3	8
Excavation (Sand)	Disturbed Sand	Bare	PNNL-14702	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63

Table 7. Recharge Rates

Descriptive Name	Cover_Type	SurfCond	Reference_Source	Qy	Ri	Rp	He	Kf	Ba	El	Ls	Eb	Ki	Wa	Sc	P	Qu	Rv	D	XX
Hanford Average	Average	Mature	AR-02612	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Landfill (Lined)	Lined Landfill	Barrier/ MinRchrg	(Rate assumed zero during lifetime of leachate collection system for a lined landfill)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mature - Gravel	Gravel/Industrial/ Nonvegetated/ Exotic Weed	Mature	PNNL-14702	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46
Mature - Gravel	Gravel/Industrial/ Nonvegetated/ Weeds	Mature		46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46	46
Mature - Vegetated	Big Sagebrush - Bitterbrush/ Bunchgrass Mosaic	Mature	PNNL-14702 PNL-10285 (UC-2010)	4	3.4	4	2.6	2.6	3	1.5	3.4	1.5	3.4	3.4	3.4	3.4	3.4	8.6	8.6	4
Mature - Vegetated	Big Sagebrush - Bitterbrush/ Sandberg's Bluegrass	Mature		4	3.4	4	2.6	2.6	3	1.5	3.4	1.5	3.4	3.4	3.4	3.4	3.4	8.6	8.6	4
Mature - Vegetated	Big Sagebrush - Rigid Sagebrush/ Bunchgrass Mosaic	Mature		4	3.4	4	2.6	2.6	3	1.5	3.4	1.5	3.4	3.4	3.4	3.4	3.4	8.6	8.6	4
Mature - Vegetated	Big Sagebrush - Spiny Hopsage/ Bunchgrass Mosaic	Mature		4	3.4	4	2.6	2.6	3	1.5	3.4	1.5	3.4	3.4	3.4	3.4	3.4	8.6	8.6	4
Mature - Vegetated	Big Sagebrush - Spiny Hopsage/ Sandberg's Bluegrass - Cheatgrass	Mature		4	3.4	4	2.6	2.6	3	1.5	3.4	1.5	3.4	3.4	3.4	3.4	3.4	8.6	8.6	4

Table 7. Recharge Rates

Descriptive Name	Cover_Type	SurfCond	Reference_Source	Qy	Ri	Rp	He	Kf	Ba	El	Ls	Eb	Ki	Wa	Sc	P	Qu	Rv	D	XX
Mature - Vegetated	Big Sagebrush/ Bluebunch Wheatgrass - Sandberg's Bluegrass	Mature	PNNL-14702 PNL-10285 (UC-2010)	4	3.4	4	2.6	2.6	3	1.5	3.4	1.5	3.4	3.4	3.4	3.4	3.4	8.6	8.6	4
Mature - Vegetated	Big Sagebrush/ Bunchgrass Mosaic	Mature		4	3.4	4	2.6	2.6	3	1.5	3.4	1.5	3.4	3.4	3.4	3.4	3.4	8.6	8.6	4
Mature - Vegetated	Big Sagebrush/ Sandberg's Bluegrass - Cheatgrass	Mature		4	3.4	4	2.6	2.6	3	1.5	3.4	1.5	3.4	3.4	3.4	3.4	3.4	8.6	8.6	4
Mature - Vegetated	Bitterbrush/ Bunchgrass Mosaic	Mature		4	3.4	4	2.6	2.6	3	1.5	3.4	1.5	3.4	3.4	3.4	3.4	3.4	8.6	8.6	4
Mature - Vegetated	Bitterbrush/ Sandberg's Bluegrass - Cheatg rass	Mature		4	3.4	4	2.6	2.6	3	1.5	3.4	1.5	3.4	3.4	3.4	3.4	3.4	8.6	8.6	4
Mature - Vegetated	Black Greasewood/ Alkali Saltgrass	Mature		4	3.4	4	2.6	2.6	3	1.5	3.4	1.5	3.4	3.4	3.4	3.4	3.4	8.6	8.6	4
Mature - Vegetated	Purple Sage/ Sandberg's Bluegrass - Cheatgrass	Mature		4	3.4	4	2.6	2.6	3	1.5	3.4	1.5	3.4	3.4	3.4	3.4	3.4	8.6	8.6	4
Mature - Vegetated	Rigid Sagebrush/ Sandberg's Bluegrass	Mature		4	3.4	4	2.6	2.6	3	1.5	3.4	1.5	3.4	3.4	3.4	3.4	3.4	8.6	8.6	4
Mature - Vegetated	Threetip Sagebrush/ Bunchgrass Mosaic	Mature		4	3.4	4	2.6	2.6	3	1.5	3.4	1.5	3.4	3.4	3.4	3.4	3.4	8.6	8.6	4

Table 7. Recharge Rates

Descriptive Name	Cover_Type	SurfCond	Reference_Source	Qy	Ri	Rp	He	Kf	Ba	El	Ls	Eb	Ki	Wa	Sc	P	Qu	Rv	D	XX
Mature - Vegetated	Mature - Vegetated	Mature	PNNL-14702 PNL-10285 (UC-2010)	4	3.4	4	2.6	2.6	3	1.5	3.4	1.5	3.4	3.4	3.4	3.4	3.4	8.6	8.6	4
Previously Irrigated	Abandoned Fields	Cheatgrass		22	4.8	22	3.4	3.4	26	8.5	4.8	8.5	4.8	4.8	4.8	4.8	4.8	25.4	25.4	22
Water[b]	Open Reservoir	Barrier/ MinRchrg		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5

Notes: All values reported in mm/yr.

Complete reference citations are provided in Chapter 8.

All recharge rates are subject to change with new information as it becomes available. Any application of these recharge rates should be evaluated on a case-by-case (or model-by-model) basis before direct application.

a. PNNL-14702, Table 4.16 provides recharge rates for 5 types of barriers, 4 of which are assigned the same recharge rate (the exception is the geosynthetic cap at US Ecology). It is assumed the various types of barriers listed in this table all would be assigned the same recharge rates over time -- intact barrier, transitioning to post-design life young shrub-steppe and shrub-steppe.

b. Denotes dispositions that were added to accommodate specific, unanticipated disposition combinations. The recharge values associated with these dispositions should not be taken at face value and merit additional scrutiny before being applied in any calculation.

ET = evapotranspiration

5 Software Applications

ArcGIS™ Version 10.3.1 (both ArcGIS for Desktop Basic and ArcGIS for Desktop Advanced; including ArcMap, ArcCatalog™, ArcToolbox™, and ArcPy) was the primary software used for this calculation and data were ingested as shapefiles and output to feature classes within geodatabases. Digitization of new features from aerial imagery was done within the desktop application directly, while the automation of the data ranking and calculation of recharge output features was done with Python script.

Edits and supporting work in producing the RET calculation was performed using a commercial software license that is maintained by INTERA Inc., a preselected subcontractor to CH2M HILL Plateau Remediation Company (CHPRC). The data preparation, editing, and final product preparation were performed on a computer with ID INTERA-00909. The hardware is a ThinkPad® P50 Signature Edition with a 2.80-GHz Intel® Xeon® processor and 16.0 GB of RAM loaded with the Windows® 10 Professional 64-bit operating system.

5.1 Exempt Software

Microsoft® Excel® spreadsheets were used for data storage, of both waste site attributes and of calculation parameters such as valid values lists and were queried from within ArcGIS for attributes being joined to spatial features and for processing parameters within the geoprocessing tool.

5.2 Approved Software

The RET software is approved calculation software, whose use by CHPRC is managed under CHPRC-04002, *Recharge Evolution Tool (RET)*; registered in the Hanford Information System Inventory (HISI) under identification number 4493.

5.2.1 Description

The following required information for the RET software package build used for this calculation is provided here:

- Software Title: RET
- Software Version: CHPRC Build 2
- HISI Identification Number: 4493
- Workstation type and property number (from which the software is run): This software was run on a desktop using a commercial software license that is maintained by INTERA Inc., a preselected subcontractor to CHPRC. The computer in question has the ID INTERA-00771. The hardware specifications are: manufactured by Dell® with a 3.50-GHz Intel Xeon processor and 40.0 GB of RAM loaded with the Windows 10 Professional 64-bit operating system.

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5.2.2 Software Installation and Checkout

A copy of the Software Installation and Checkout Form (Site Form A-6005-149) for the RET installation used for this calculation is provided in Appendix E to this ECF.

6 Calculation

All the reference source data to be used in the calculations were loaded as shapefiles into a single geodatabase used as the source for all subsequent calculations. A default map document (MXD) was created containing the data sources and organized into logical groups based on their relevance to the calculations. This MXD served as the starting point for new map documents developed for interim processing steps.

Specific ArcGIS commands are referenced in the ECF text in a bold font with all capital letters (e.g., **CLIP**), while parameters specified within a command are indicated in bold font with initial capitals only (e.g., **Clip_Features**). Attribute field names within a feature class are enclosed in double quotes (e.g., "Cover_Type"), attribute values in single quotes ('Developing'), and variables are indicated with less than and greater than brackets (e.g., <YYYY>).

6.1 Extend the 'Sitewide' Datasets for Soils and Vegetation

Gaps in the soils and vegetation data within the model area domain were identified in the far northwest and southernmost extents of the model domain, as highlighted in Figure 27.

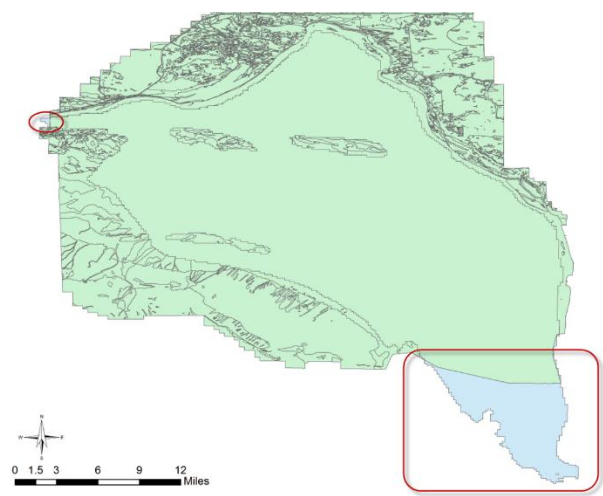

Figure 27. Gaps in the Vegetation and Soils Data

1. The most current SSURGO dataset for Benton County was downloaded from the NRCS Web Soil Survey site.
2. The soil descriptions contained in a related Access® database were joined to the geographic features following instructions provided on the Web Soil Survey.
3. The resulting geographic shapefile (*SSURGO_soil_a_wa605.shp*) was projected to match the current calculation requirements, and then clipped by the model domain boundary and the existing Hanford Site soils data extent.

The clipped shapefile was modified to add a new attribute for "TEXT_SYM" and then updated according to the corresponding Hanford Site soil type specified in Table 2.

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4. The existing feature class, *SOILSP,* from HGIS was renamed to Soils and a new attribute "HAN_SYM" was added and values from "TEXT_SYM" were copied into "HAN_SYM."
5. The modified SSURGO shapefile was then loaded into the geodatabase as a temporary feature class, and then loaded into *NRBC_Soils*, assigning "MUSY" to "HAN_SYM" and "MUName" to "Comments".
6. Basic metadata for the new feature class was created.

There are small, sliver-type areas along the model domain boundary that are missing a soil type (Figure 28). These should be resolved in a future calculation.

Figure 28. Missing Soil Type (in Red)

The default vegetative cover for pre-Hanford Site conditions was extended to cover the additional portion of the modeling domain as shown in Figure 29.

While creating the default vegetative, pre-Hanford Site cover, the extents of the shapefile were extended to cover the southern portion of the extended soils domain previously discussed (Figure 29). Extensions were focused on covering the extended soil coverage over the modeling domain. The red slivers shown in Figure 29 represent areas where the modeling domain is not covered. The purple coverage showing underneath the green is the extended soil cover. Attribute fields called "SurfCon" and "Cover" were added and filled with the default values of "Mature" and "Mature – Vegetated," respectively.

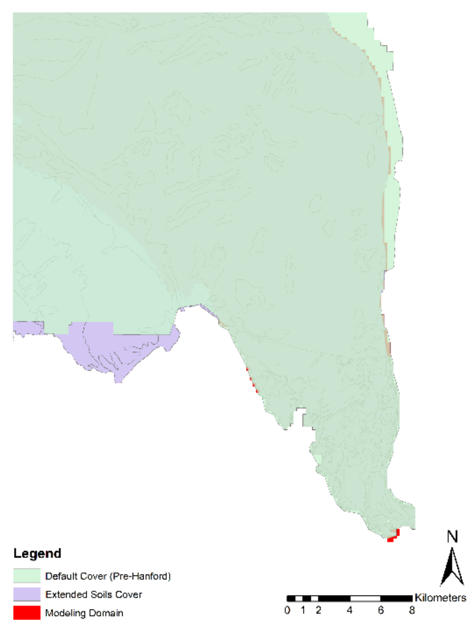

Figure 29. Extensions to Default Vegetative Cover

6.2 Rank Data Sources

The preliminary step in ranking the data sources pertains to selecting features to include in the RET based on the scale, accuracy, and relative coverage of the Hanford Site. The ideal dataset has a highly refined level of detail, accurate representations of surface cover/condition for a given time and covers as large a portion of the Hanford Site as possible. Data layers selected for inclusion in the RET are identified in Table 1.

The importance of establishing a ranking or priority list of the features used in the RET pertains to overlaps. Inevitably, the selected data sources will overlap in space and time and a value must be chosen for supplying a recharge estimate. The desired ranking system will emphasize data with the greatest level of detail and accuracy in space and time. Using these criteria, each data source included in the RET were ranked such that the source with the lowest number would supersede those with higher numbers (Table 8).

Table 8. Spatial Data Prioritization

Input	Valid Time Zone	Priority[a]	Description
Site-Specific	Indefinite – Indefinite	0	Selected site-specific models (like performance assessment models) will supersede the RET calculation entirely where present
Barriers	1994[b] – 2570[c]	1	Compilation of known (e.g. Hanford Prototype Barrier) and anticipated barrier footprints
ehsit	1850[d] – 2100[e]	2	Hazardous waste site footprints
bggensit	1850[d] – 2100[e]	3	Historical building footprints
bggenexs	1850[d] – 2100[e]	4	Existing building footprints
AAC_1943	1880 – Indefinite	5	Cover type digitized from 1943 Affected Area Coverage (AAC) aerial raster data
BRMP	1850[d] – 2100[d]	6	Natural vegetative cover (cover type) as described by the Biological Resources Management Plan (BRMP)
Default Cover	Indefinite – Indefinite	7	Represents a land use with no disturbance and with a “Mature Vegetated” cover

a. “Priority” in this context means that features whose number is closer to zero will supersede features whose priority number is greater when applicable in the timeline (e.g., ehsit will always supersede BRMP if/when both are present).

b. Start dates for barrier construction based on Hanford Site Disposition Baseline and projected barrier construction.

c. Following guidance given in DOE/RL-2011-50, *Regulatory Basis and Implementation of a Graded Approach to Evaluation of Groundwater Protection*, for barrier dissolution, barriers are assumed to fail at the end of a 500-year span after barrier installation. The date is dependent on the initial construction of the barrier, with the latest year for installation being 2070.

d. Start dates are dependent on the Hanford Site Disposition Baseline (CP-60254, *Hanford Site Composite Analysis Technical Approach Description: Hanford Site Disposition Baseline*) when waste site areas become active/disturbed.

e. The end of the revegetation cycle back to mature shrub steppe.

6.3 Automate the Calculation of Recharge Sitewide

The recharge estimates produced by the script are not performing any hydrologic calculations. The script uses the sources provided to compile the most reasonable recharge rates for a specified time period over the domain previously described. The basis for the recharge rates produced are solely based on the guidance sourced in this document, using only Hanford Site-specific research and regulatory guidance.

The overall process for generating spatiotemporal recharge is described herein as follows (also illustrated in Figure 30):

1. Create a database to contain the interim data products and organize the contents for the **UPDATE** procedure to be applied. Name the geodatabase by the year being calculated.
2. Determine which layers are valid for the year being calculated.

   The script verifies that the datasets used in the calculation are valid for the year being calculated. Years for which a dataset is valid are listed in Table 8.

   a. A critical exception to this rule is the BRMP layer. Because the BRMP layer is phased in as intersecting waste sites become active, BRMP is always calculated, but will assume the condition and cover type of the default cover until at least one its features become "active." For years including and after 2011 all BRMP features are considered valid where they are available.
3. Assign the appropriate surface condition and cover type for each feature.
4. Apply approved rates based on each feature's combination of soil type, cover type, and surface condition.
5. Merge the features from each valid input layer such that any valid features are retained in lieu of other, lower ranked features, until all valid features are merged together as a composite mosaic.
6. Update the output surface condition feature class with the soils feature class, preserving features by priority (Figure 30).
7. Remove unwanted interim data products and attributes from the output feature classes.
8. Update the metadata for each feature class with standard language that reflects the date therein.
9. Using site-specific models, incorporate recharge rates as polygonal features to replace/supersede the RET calculation with site specific data.

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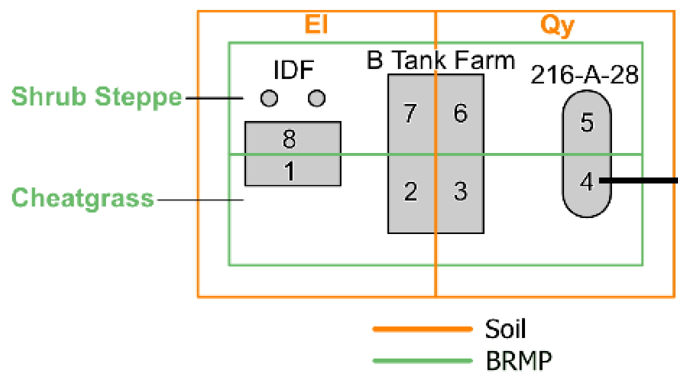
Example



Disposition

Site	Start of Operation	Final Action	Final Action Year
B Tank Farm	1948	ET Cap	2043
216-A-28	1958	RTD(15')	2030
IDF	2006	ET Cap	2050

Shapefiles

Soil
Barriers
ehsit
bggenexs
bggensit
AAC 1943
BRMP
Default

Recharge Lookup (mm/yr)

Cover	Surface	Qy	El
Mature-Vegetated	Mature	4.0	1.5
Disturbed Sand	Bare	63.0	63.0
Disturbed Gravel	Bare	100.0	100.0
Shrub Steppe	Mature	4.0	1.5
Cheatgrass	Developing	8.0	3.0
Lined Landfill	Barrier	0.0	0.0
Barrier	Barrier	0.5	0.5

FID	Source	Cover	Surface	Soil	Recharge Rate
1	BRMP	Cheatgrass	Developing	El	3.0
2	ehsit	Disturbed Gravel	Bare	El	100.0
3	ehsit	Disturbed Gravel	Bare	Qy	100.0
4	BRMP	Cheatgrass	Developing	Qy	8.0
5	BRMP	Shrub Steppe	Mature	Qy	4.0
6	ehsit	Disturbed Gravel	Bare	Qy	100.0
7	ehsit	Disturbed Gravel	Bare	El	100.0
8	BRMP	Shrub Steppe	Mature	El	1.5
	1948				

Rules & Assumptions [Cover, Surface]

-All anthropogenic sites while active = [Disturbed Sand, Bare]
-Tank farms while active = [Disturbed Gravel, Bare]
-Lined Landfills = [Lined Landfill, Barrier]
-Barrier/ET Cap = [Barrier, Barrier]
Barrier recharge rate = 0.5 mm/yr
Duration of barriers = 500 years

FID	Source	Cover	Surface	Soil	Recharge Rate
1	Default	Mature-Vegetated	Mature	El	1.5
2	Default	Mature-Vegetated	Mature	El	1.5
3	Default	Mature-Vegetated	Mature	Qy	4.0
4	Default	Mature-Vegetated	Mature	Qy	4.0
5	Default	Mature-Vegetated	Mature	Qy	4.0
6	Default	Mature-Vegetated	Mature	Qy	4.0
7	Default	Mature-Vegetated	Mature	El	1.5
8	Default	Mature-Vegetated	Mature	El	1.5
	1943				

FID	Source	Cover	Surface	Soil	Recharge Rate
1	BRMP	Cheatgrass	Developing	El	3.0
2	ehsit	Disturbed Gravel	Bare	El	100.0
3	ehsit	Disturbed Gravel	Bare	Qy	100.0
4	BRMP	Cheatgrass	Developing	Qy	8.0
5	BRMP	Shrub Steppe	Mature	Qy	4.0
6	ehsit	Disturbed Gravel	Bare	Qy	100.0
7	ehsit	Disturbed Gravel	Bare	El	100.0
8	BRMP	Shrub Steppe	Mature	El	1.5
	1948				

FID	Source	Cover	Surface	Soil	Recharge Rate
1	BRMP	Cheatgrass	Developing	El	3.0
2	ehsit	Disturbed Gravel	Bare	El	100.0
3	ehsit	Disturbed Gravel	Bare	Qy	100.0
4	ehsit	Disturbed Sand	Bare	Qy	63.0
5	ehsit	Disturbed Sand	Bare	Qy	63.0
6	ehsit	Disturbed Gravel	Bare	Qy	100.0
7	ehsit	Disturbed Gravel	Bare	El	100.0
8	BRMP	Shrub Steppe	Mature	El	1.5
	1958				

FID	Source	Cover	Surface	Soil	Recharge Rate
1	ehsit	Lined Landfill	Barrier	El	0.0
2	ehsit	Disturbed Gravel	Bare	El	100.0
3	ehsit	Disturbed Gravel	Bare	Qy	100.0
4	ehsit	Disturbed Sand	Bare	Qy	63.0
5	ehsit	Disturbed Sand	Bare	Qy	63.0
6	ehsit	Disturbed Gravel	Bare	Qy	100.0
7	ehsit	Disturbed Gravel	Bare	El	100.0
8	ehsit	Linded Landfill	Barrier	El	0.0
	2006				

Figure 30. RET Workflow Summary

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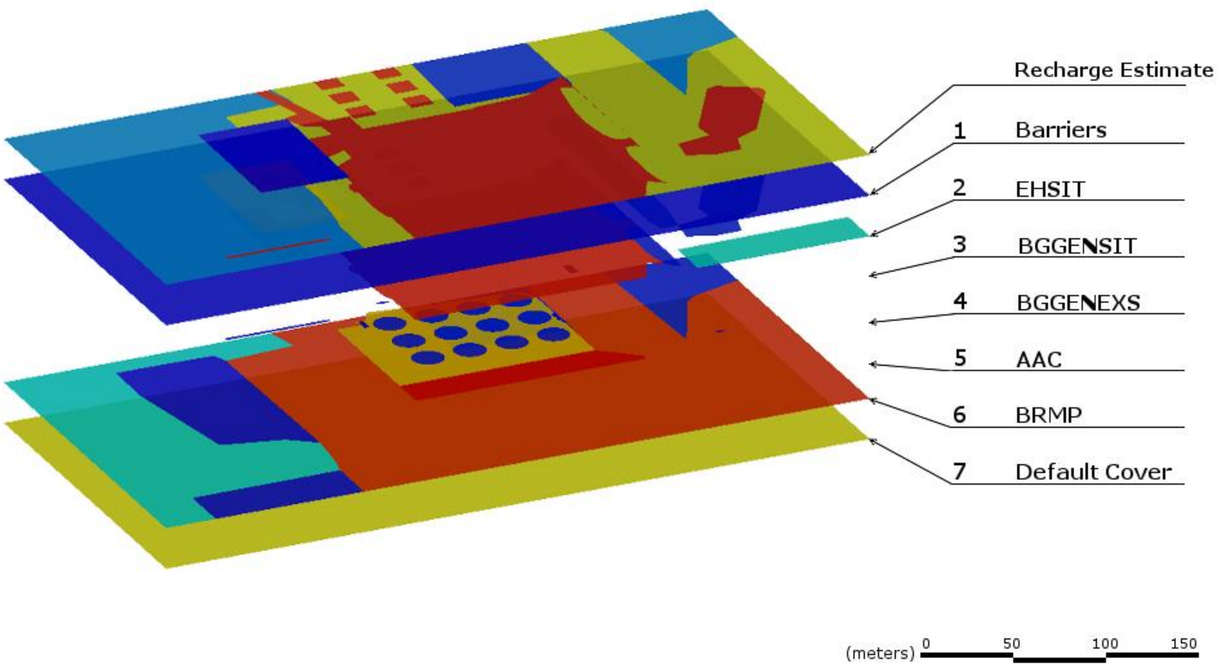

Figure 31. Prioritization Example

7 Results/Conclusions

The resulting spatiotemporal recharge produced by the automation script is captured by a series of shapefiles, each individual shapefile comprised of polygons representing the sitewide recharge estimate for a given year.

7.1 Results

Visually observing the spatiotemporal recharge estimate is accomplished by showing two-dimensional estimates of recharge changing with time. For the purposes of those reading this report, several example images in series have been provided to illustrate the effect of the recharge estimates generated through time. For Figure 32 through Figure 38 a close-up on the B Farms area was chosen to illustrate the level of detail captured in the RET within the area of focused study.

Figure 32. B Complex 1943

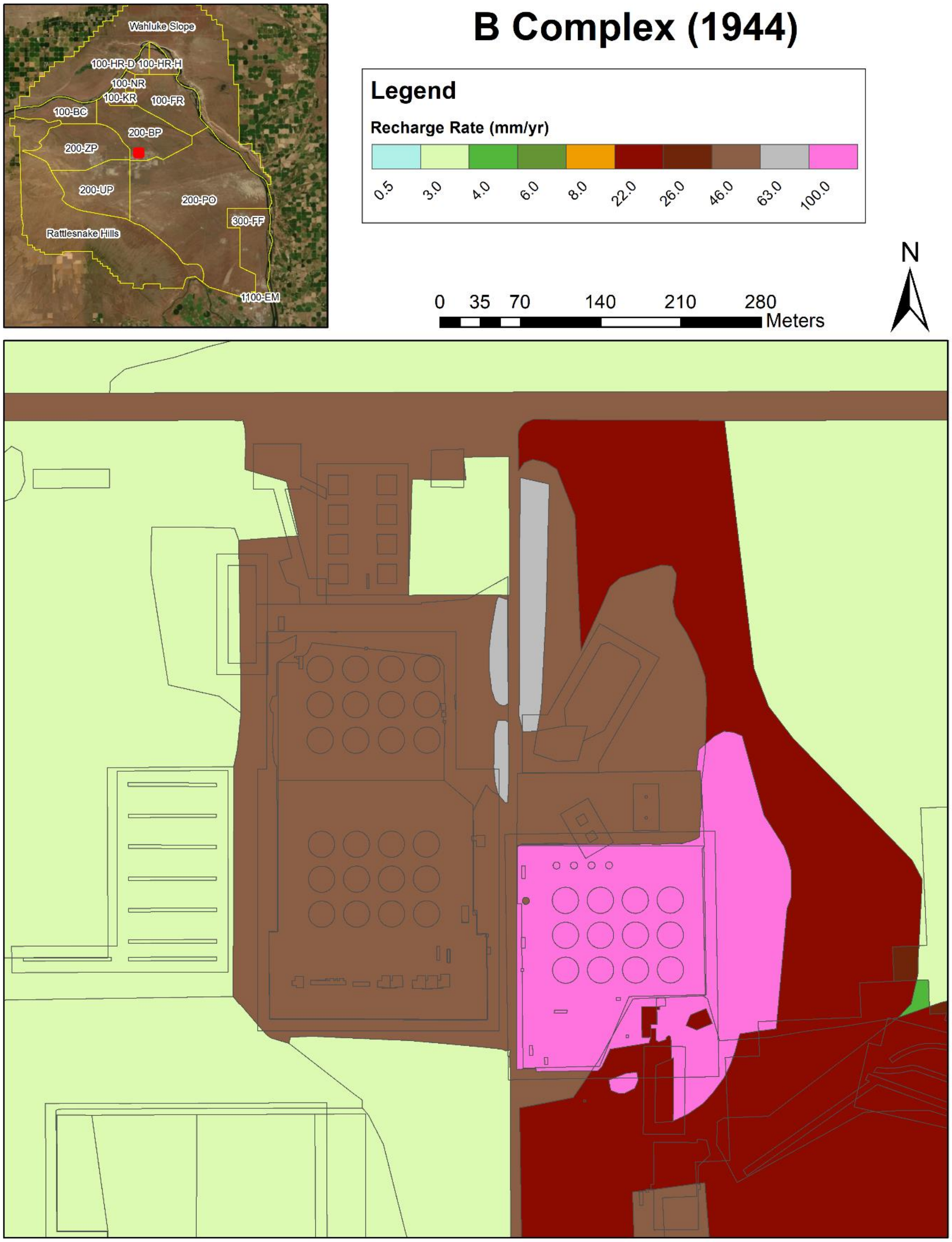

Figure 33. B Complex 1944

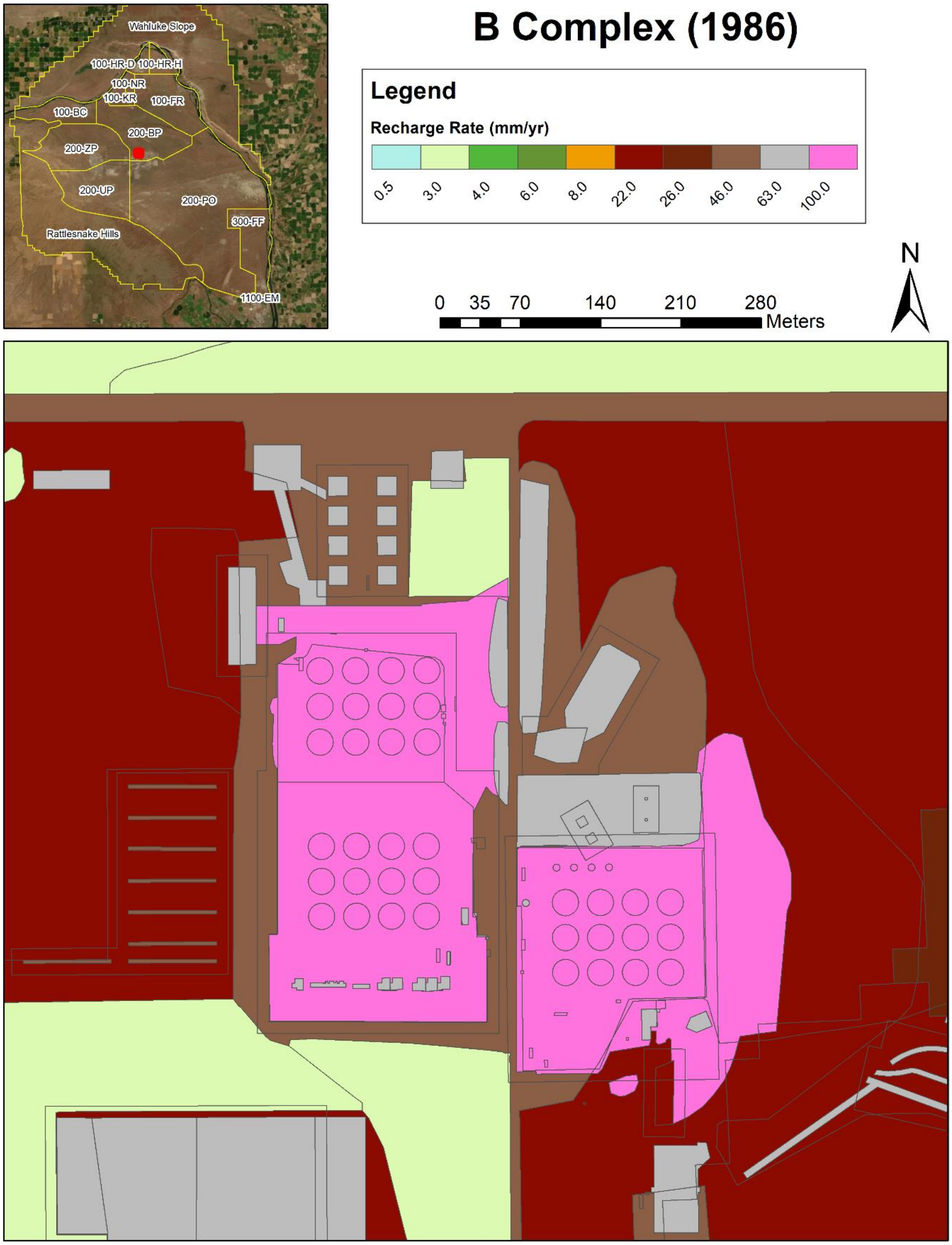

Figure 34. B Complex 1986

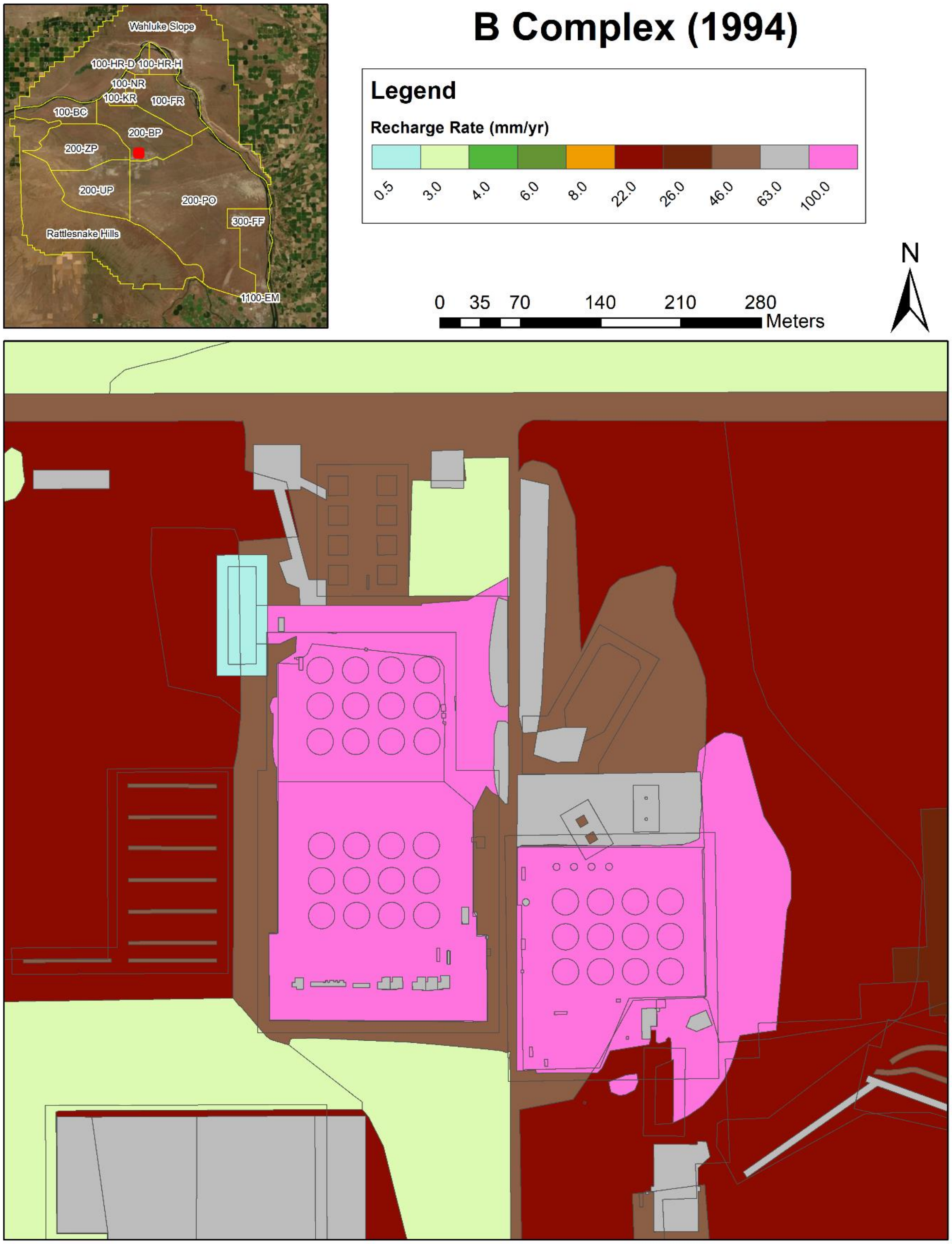

Figure 35. B Complex 1994 (PHB Completion)

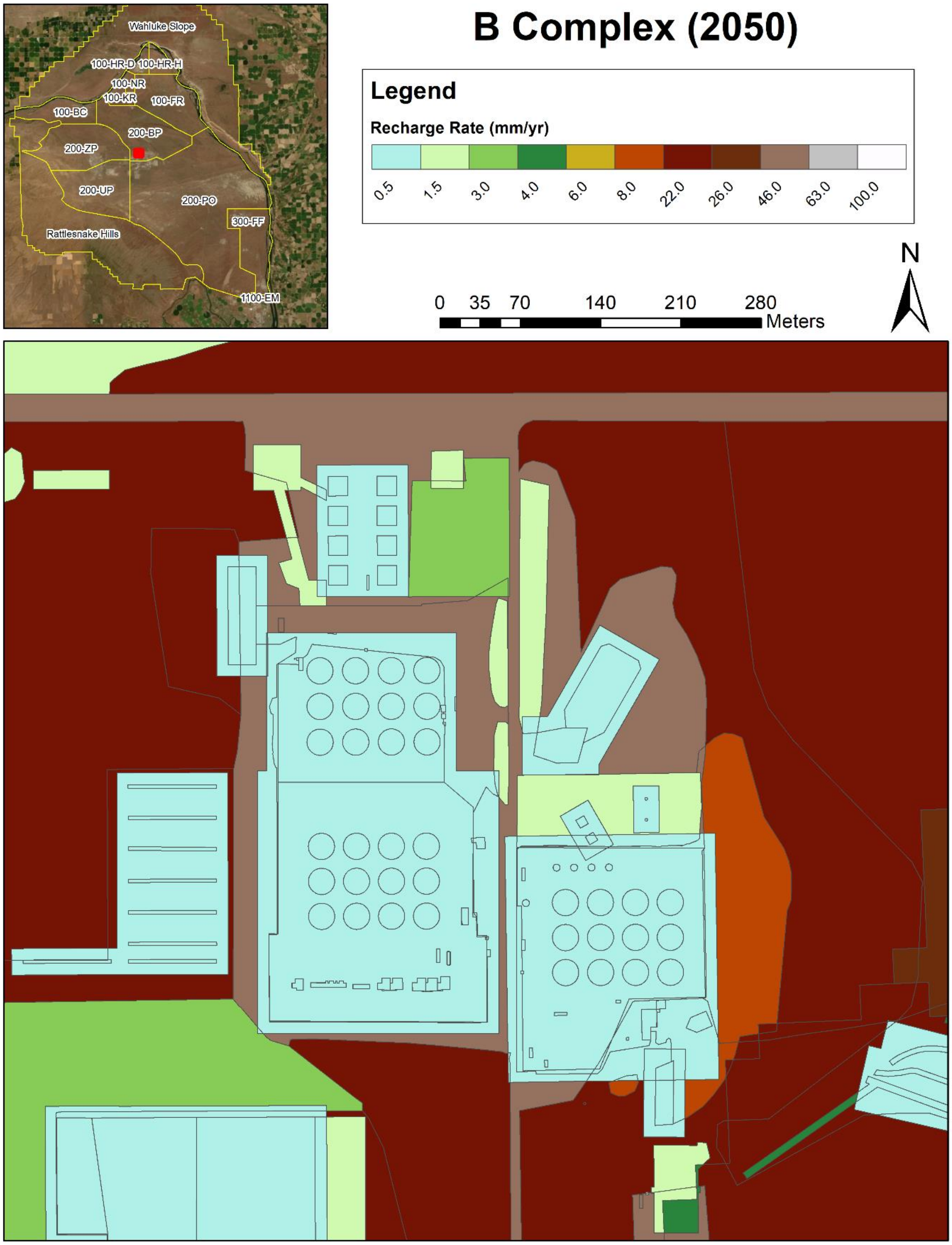

Figure 36. B Complex 2050

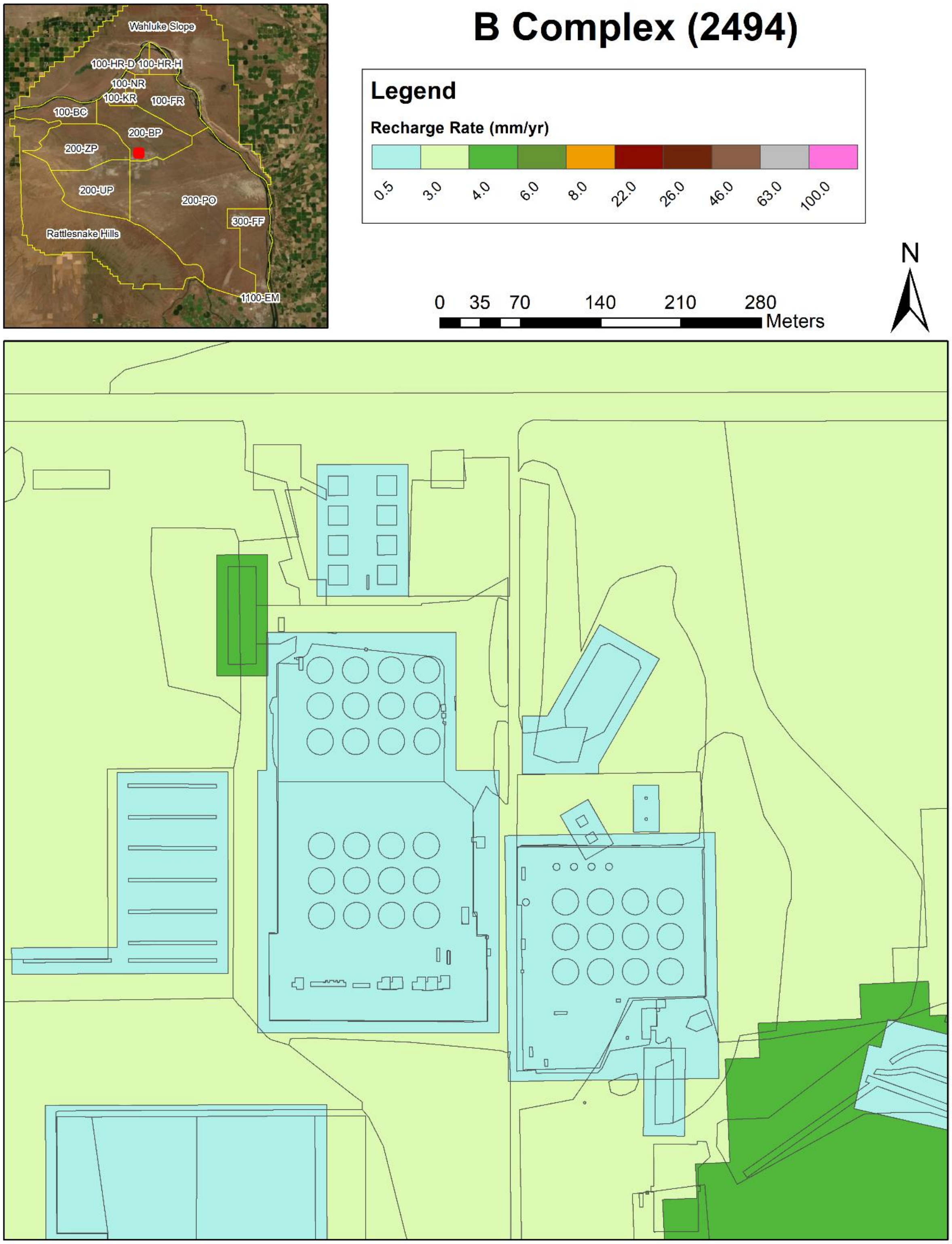

Figure 37. B Complex (PHB Breakdown in 2494)

Figure 38. B Complex 2570

The detail captured in the preceding figures of the B Farms area extends over the majority of the Hanford Site. Example figures depicting the comprehensive reach of the RET are shown in Figure 39 through Figure 44.

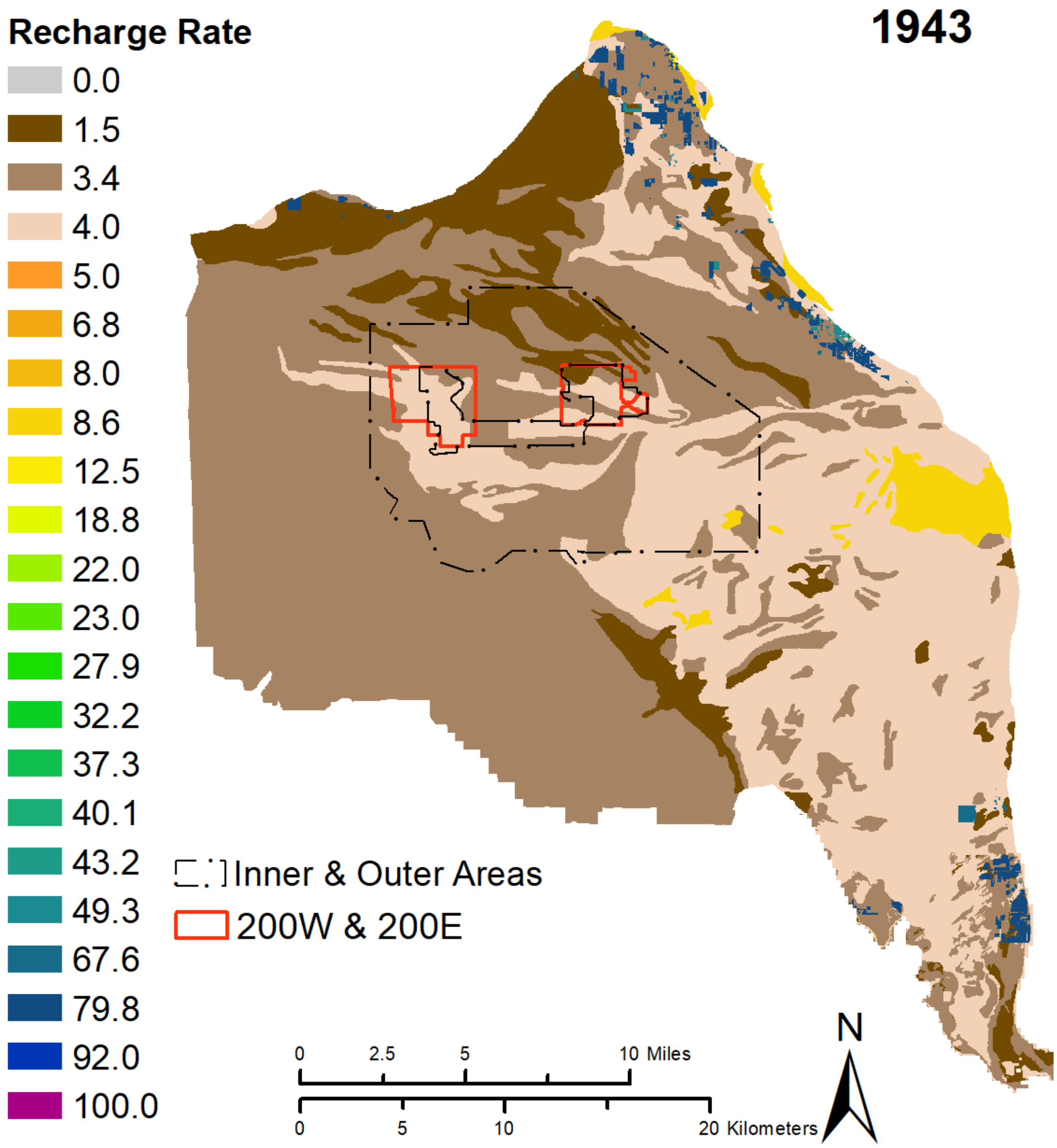

Figure 39. Hanford RET 1943

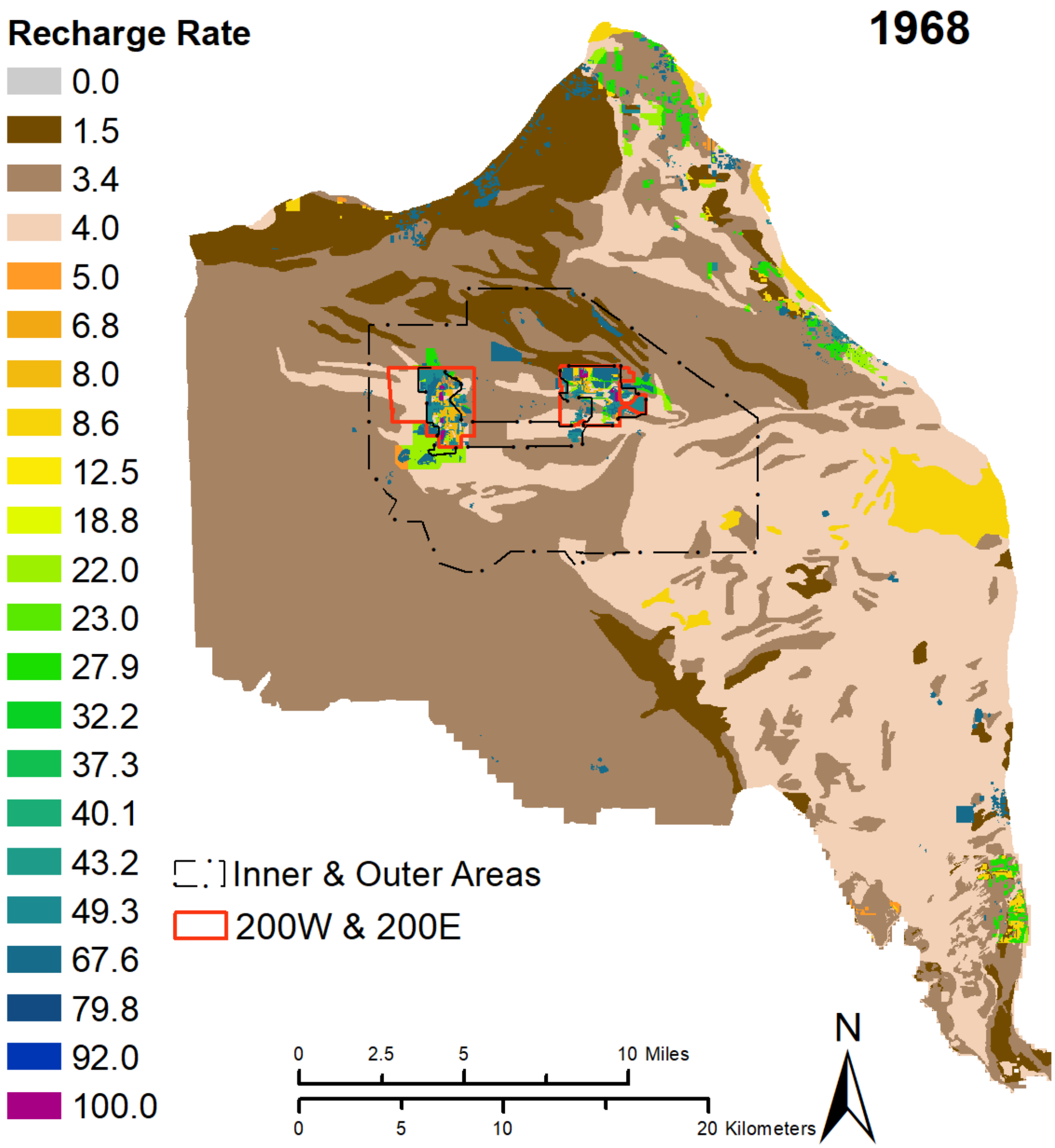

Figure 40. Hanford RET 1968

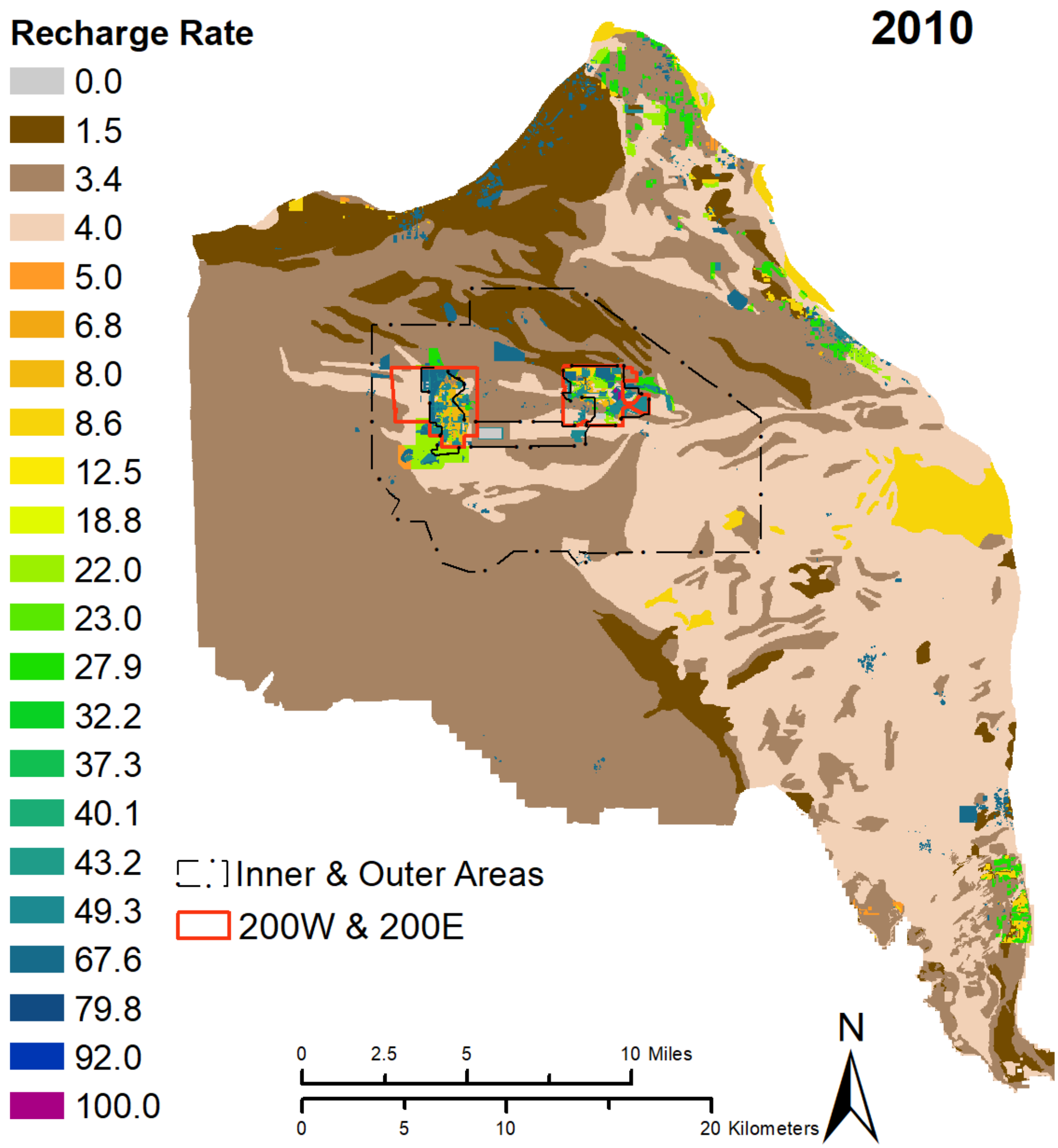

Figure 41. Hanford RET 2010

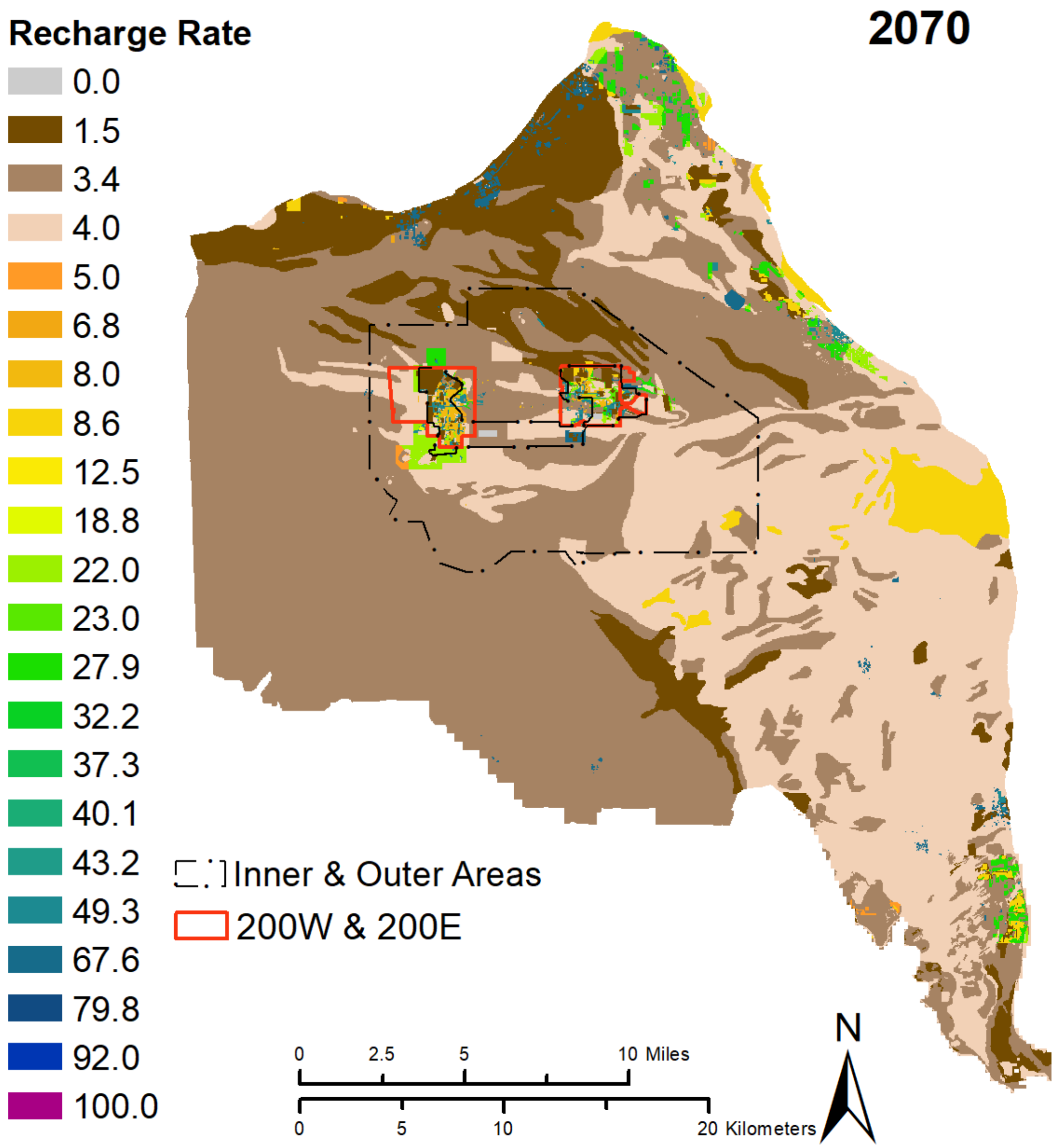

Figure 42. Hanford RET 2070

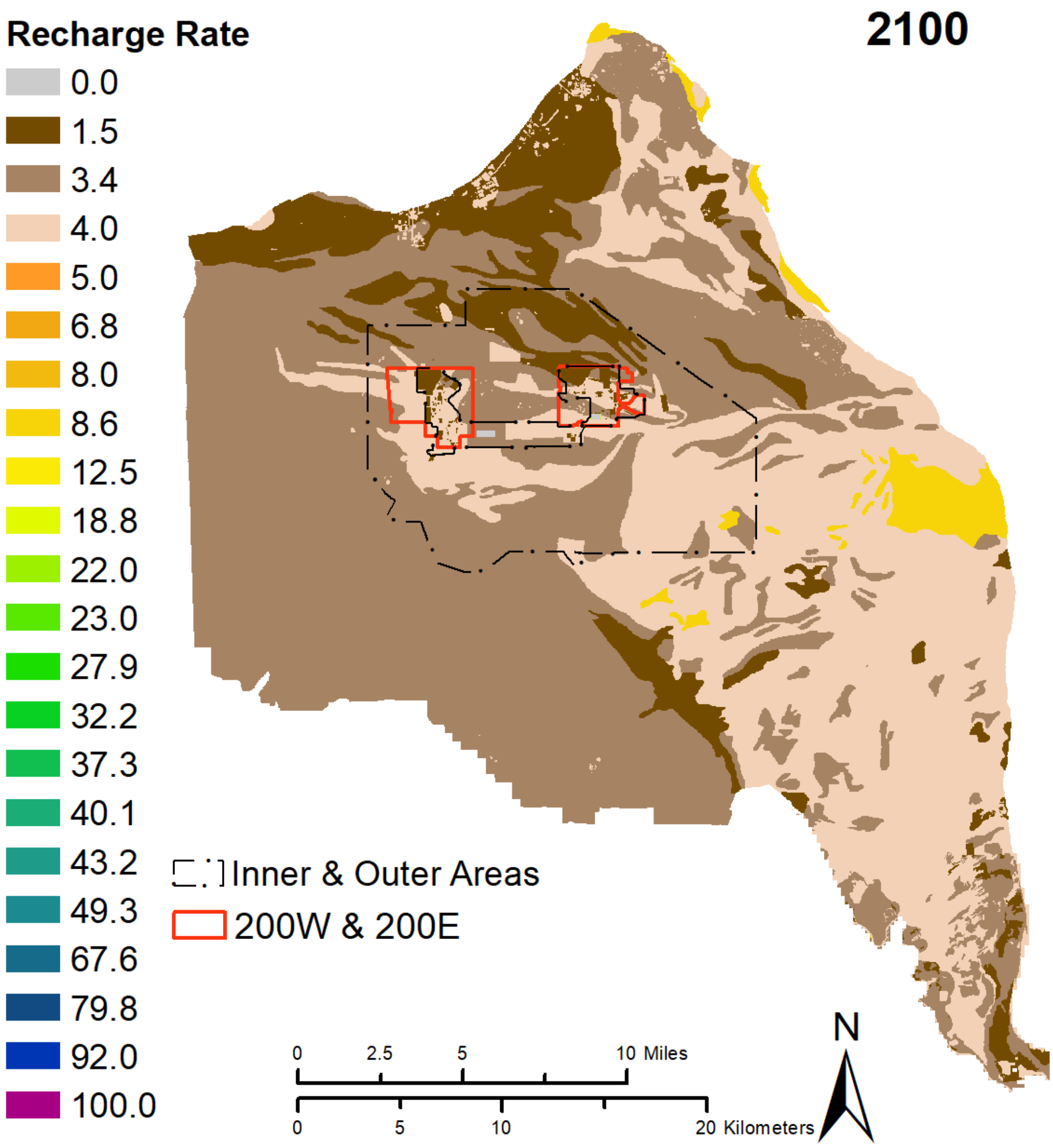

Figure 43. Hanford RET 2100

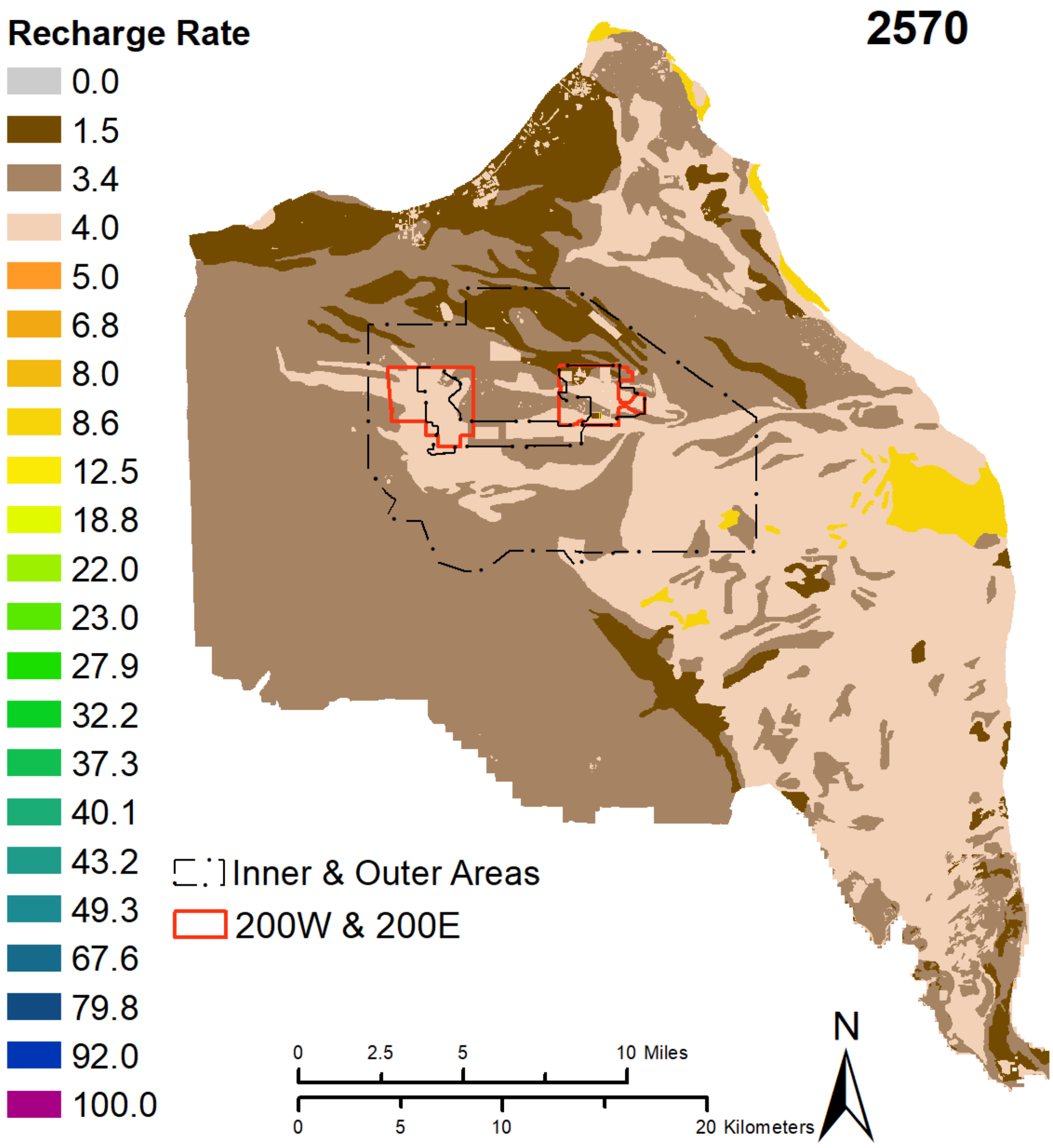

Figure 44. Hanford RET 2570

7.2 Notable Areas of the RET Calculation

After performing the RET calculation and prior to its final release, the output recharge rates were altered in several instances to provide additional detail to several locations within the analysis focus area for the Central Plateau. These edits will be discussed in the following sections.

7.2.1 BRMP Layer (Near T Plant)

To the southeast of T Plant there was found a section of the Central Plateau focus area for vadose models where a discontinuity existed. The discontinuity was based on the initial boundary of the vadose zone model calculations for the CA produced at the start of RET dataset development. These boundaries were slightly changed as work on vadose zone modeling progressed. Figure 45 shows the location where the discontinuity exists. To mitigate the effects of this discontinuity, a section of the recharge rates directly to the north was extended down into the discontinuous zone and produced recharge rates that removed the discontinuity (Figure 46). This process was repeated on a year-by-year basis for all years produced in this calculation.

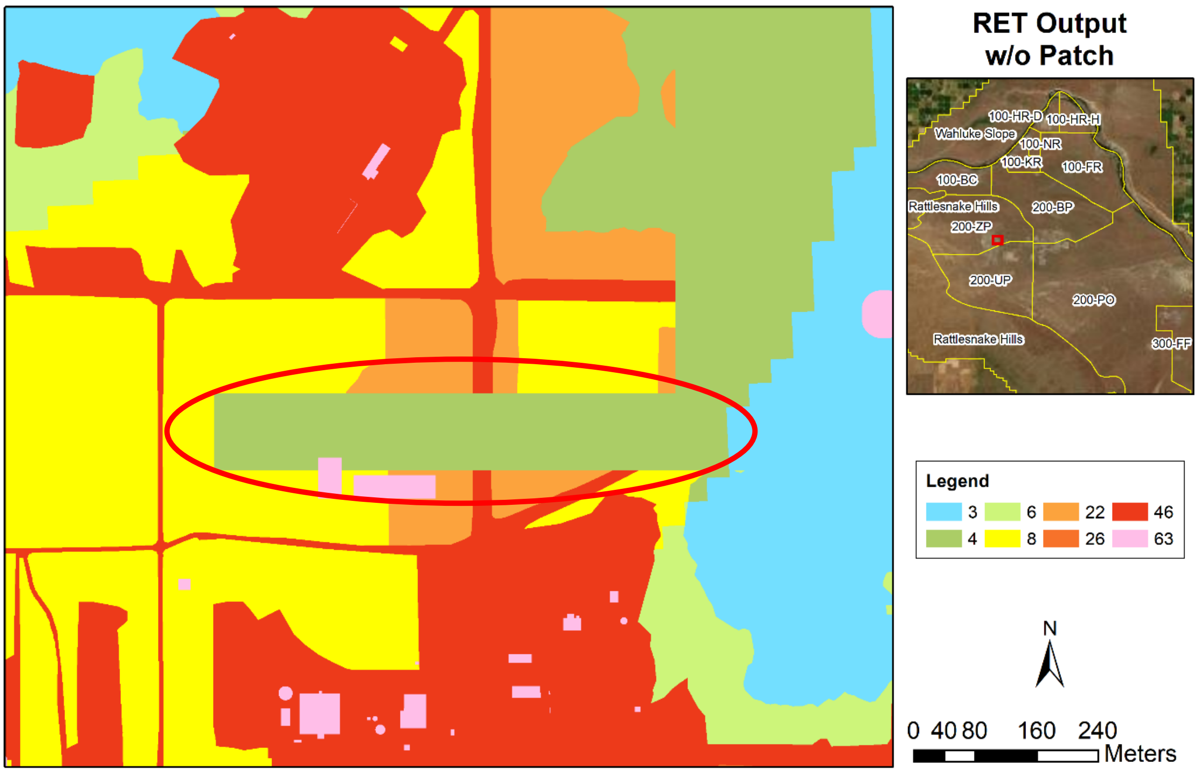

Figure 45. Close-Up of Gap in BRMP Layer (RET Output Year: 2019)

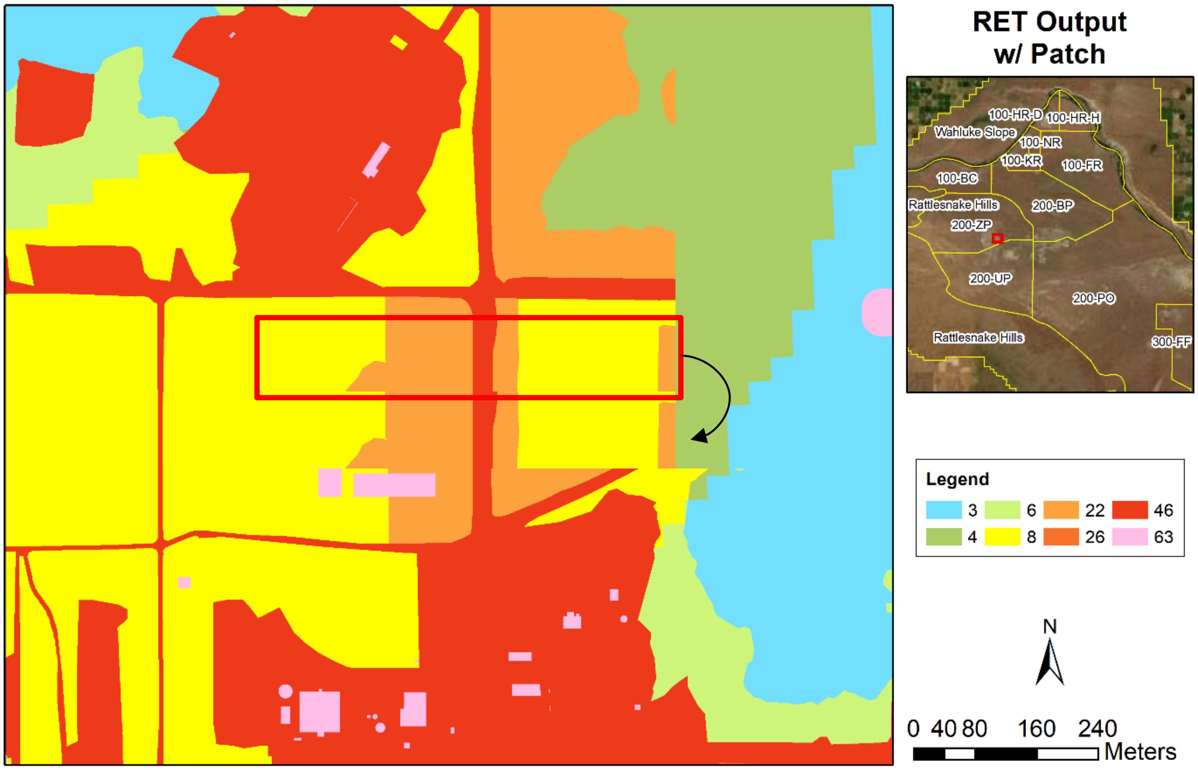

Figure 46. RET Output with Fix Applied (RET Output Year: 2019)

7.2.2 End States and Revegetation Cycles

Some sites were observed to have the wrong end recharge rate or applied an incorrect revegetation pattern due to the disposition timeline assigned in the HSDB. These sites were hand-modified to match the appropriate revegetation pattern (stepwise versus linear) and end state recharge rate (Table 9).

Table 9. Sites Whose End State/Revegetation Cycle(s) Were Revisited

Site ID							
200-E-102	216-B-15	216-B-2-2	216-B-42	216-B-8	216-S-23	216-T-24	216-U-8
200-W-52	216-B-16	216-B-3	216-B-43	216-B-9	216-S-4	216-T-25	216-W-LWC
216-A-1	216-B-17	216-B-3	216-B-44	216-C-10	216-S-5	216-T-26	216-Z-16
216-A-10	216-B-18	216-B-30	216-B-45	216-C-5	216-S-6	216-T-27	216-Z-21
216-A-18	216-B-19	216-B-31	216-B-46	216-C-7	216-S-7	216-T-28	216-Z-4
216-A-19	216-B-20	216-B-32	216-B-47	216-S-10P	216-S-8	216-T-32	216-Z-6
216-A-2	216-B-21	216-B-33	216-B-48	216-S-13	216-S-9	216-T-35	
216-A-20	216-B-22	216-B-34	216-B-49	216-S-14	216-T-14	216-T-4A	
216-A-21	216-B-23	216-B-35	216-B-50	216-S-16P	216-T-15	216-T-4A	
216-A-32	216-B-24	216-B-36	216-B-52	216-S-17	216-T-16	216-T-5	
216-A-39	216-B-25	216-B-37	216-B-53A	216-S-17	216-T-17	216-T-6	
216-A-4	216-B-26	216-B-38	216-B-53B	216-S-17	216-T-18	216-T-7	
216-A-40	216-B-27	216-B-39	216-B-54	216-S-17	216-T-19	216-U-10	
216-A-5	216-B-28	216-B-3B RAD	216-B-55	216-S-17	216-T-20	216-U-12	
216-B-10A	216-B-29	216-B-3C RAD	216-B-58	216-S-1&2	216-T-21	216-U-13	
216-B-10B	216-B-2-1	216-B-40	216-B-59	216-S-21	216-T-22	216-U-15	
216-B-14	216-B-2-1	216-B-41	216-B-7A&B	216-S-22	216-T-23	216-U-1&2	

7.2.3 Start Years

Many sites lacked a start year for an operational/construction period in the HSDB. Additional research was done to ascertain if these sites had new information available to allow for a more appropriate start year or to confirm the 1943 start year. The analysis start year 1943 defines pre-Hanford Site conditions. Thus, a default start date of 1944 was assigned in cases where no additional information was available. The list of sites affected and their modified start years with associated assumption/reference is shown in Table 10. The RET output was modified to match the new start years listed.

Table 10. Sites Whose Start Years Were Modified

Waste Site ID	New Start Year	Reference/Logic
600-124	1944	Assume 1944 start year
600-125	1944	Assume 1944 start year
600-127	1944	Assume 1944 start year
600-129	1944	Assume 1944 start year
600-146	1944	Assume 1944 start year
600-220	1958	Recent WIDS information suggests that this area was active during the year listed
600-222	1944	Assume 1944 start year
600-223	1958	Recent WIDS information suggests that this area was active during the year listed

Table 10. Sites Whose Start Years Were Modified

Waste Site ID	New Start Year	Reference/Logic
600-224	1958	Recent WIDS information suggests that this area was active during the year listed
600-227	1944	Assume 1944 start year
600-228	1944	Assume 1944 start year
600-232	1944	Assume 1944 start year
600-236	1944	Assume 1944 start year
600-237	1984	Recent WIDS information suggests that this area was active during the year listed
600-239	1944	Assume 1944 start year
600-240	1944	Assume 1944 start year
600-245	1944	Assume 1944 start year
600-246	1944	Assume 1944 start year
600-247	1944	Assume 1944 start year
600-248	1944	Assume 1944 start year
600-39	1958	Recent WIDS information suggests that this area was active during the year listed
600-53	1958	Recent WIDS information suggests that this area was active during the year listed
6607-3	1945	Recent WIDS information suggests that this area was active during the year listed
600-23	1944	Assume 1944 start year

WIDS = Waste Information Data System.

7.3 Future Considerations

The RET is designed so as more data and detailed analysis are conducted, the implementation of these data into the spatiotemporal recharge estimate can be improved in subsequent revisions. The focus of this revision was within the Central Plateau of the Hanford Site. Enhancements to the data and algorithms applied in this version are described in the following sections. These include increased utilization of aerial imagery, further refinement of the HSDB, surface condition estimates expansion, and alteration to the automation scripts used in the RET. The merit of any of these activities should be weighed against the likelihood of recharge influencing future impacts to groundwater from the influence of recharge.

7.3.1 Aerial Imagery

Digitized aerial photography through time can be used to more precisely determine the location of anthropogenic activities at the Hanford Site. Aerial photography has the benefit of definitively showing areas of disturbance. The data can be used to further refine the evolution of disturbances through time using multiple aerial imagery datasets. Time should be devoted to evaluating methods to automate the process of aerial imagery analysis using software designed for this purpose to increase the efficiency of the process.

7.3.2 HSDB

The HSDB provides both a history and anticipated projection of surface conditions for waste sites described in the dataset. An important characteristic of the HSDB is that it provides pertinent timeline information for as much of the Hanford Site as possible. A recommendation for improving the HSDB dataset is to ensure that the database encapsulates as much as possible of the Hanford Site in its history and anticipated actions.

After review of this calculation, sites recommended for additional research and verification are included in Appendix F of this ECF. The recommendation for these sites is to ascertain proper dates and references for actions and active operation years. The current algorithm of the RET lends itself to conservatively higher recharge rates by assigning start dates based on nearby locations. Otherwise, the site with no information could remain at pre-Hanford Site conditions longer than occurred. Future revisions of the HSDB should include further detail to the timeline for these sites where referenced information can be identified.

7.3.3 Surface Condition

As new information on surface condition in different time periods become available, refine the ranking of data sources and update the process automation to incorporate the new sources. For example, there is multispectral aerial imagery available for 1976, which could provide representation of actual operations relative to the current assumptions. Another source of variable surface condition are road features. The current transportation feature classes provide accurate information on the location of features, and at least some information about the condition (trails and two-track roads that have grown-over will differ from regularly maintained gravel or paved roadways). Further, if the collective influence of roadways on local recharge is deemed valuable, then a pre-operations road layer could be developed, by first evaluating which of the existing roads were already active in 1943, and then adding any additional ones that were present in 1943 but not part of the current transportation feature sets.

Basalt subcrops and outcrops within the Hanford Site were not considered as part of the current calculation because these locations are currently outside the groundwater model domain. However, because the recharge rates [PNL-10285 (UC2010)] for this substrate are relatively high (86.7 mm/yr) to all other soil types considered, future sitewide recharge calculations may want to account for these areas.

7.3.4 Refine the Current Automation Process

The geoprocessing scripts for the spatiotemporal recharge estimates have improvements that could be made. The improvements target the performance of the script, which currently takes approximately 6 days to complete a full RET simulation. Aspects of the tool architecture could be modified to improve the efficiency of the tool. The following are recommended improvements:

- The current script contains redundancies in its production of metadata. Adjusting the algorithm to use a single geodatabase containing multiple feature classes whose attributes span the differences in years would reduce this load.
- The metadata should be populated by the script. This includes the time of file creation, the date and version of the input used, and the version of the RET script used to produce the outputs. Additional metadata should also be considered for transparency in showing what inputs contribute to the resulting recharge rate (on a polygon-by-polygon basis).
- Increasing the user options for customizing RET output could also provide efficiencies. Example options include limited spatial and temporal extent, customizable disposition information, and/or recharge values.

- Add logic to the script to handle duplicate IDs in the HSDB. The current implementation depends on the user interaction to verify the input HSDB table.
- Simplify the geoprocessing steps. It is not necessary that shapefiles be merged repeatedly as does the current RET calculation. Instead, an initial mosaic of polygons can be produced and held in memory, then assigned the appropriate recharge rates and metadata. This would significantly decrease the computation time.

8 References

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Appendix A

Cover Page for EMDT-RE-0019

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76b

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Environmental Modeling Data Transmittal Cover Page

No.: EMDT-RD-0019 **Revision No.:** 0

[Request EMDT number from Modeling Team Leader]

Title: Performance Assessment Results for Inclusion in Composite Analysis: Integrated Disposal Facility **Date:** 9/18/2017

1. Data Description

Provide the description of data set or data type.

Data packaged in this transmittal page contains selected Excel spreadsheets, documents, and STOMP model outputs that were developed to complete the 2017 performance assessment (PA) of the Hanford Integrated Disposal Facility (IDF) reported in RPP-RPT-59958 Revision B. The selected model outputs are fluxes of technetium-99 (Tc-99) and iodine-129 (I-129) to the water table from simulated contaminant releases from IDF in the PA model base case for a 10,000-year period following the assumed facility closure in calendar year 2051, and these outputs are extracted from a larger set of model output files archived with RPP-CALC-61032 Revision 0 in the Environmental Model Management Archive (EMMA). As of September 2017, these outputs provide the best information currently available on long-term groundwater impacts from future disposal of solid waste at IDF, given the objectives of the Hanford Site Composite Analysis.

In Fiscal Year 2017, the Department of Energy Office of River Protection and its subcontractors completed development of a PA for the near-surface disposal of low-level and mixed low-level waste at IDF. IDF is a double-lined landfill expected to be the disposal facility for the vitrified low-activity waste that will be produced at the Hanford Waste Treatment and Immobilization Plant (WTP). The IDF is also expected to receive secondary solid waste (SSW) generated by the WTP, SSW generated by the Effluent Treatment Facility (ETF), and other solid wastes from Hanford site remediation efforts. Phase 1 construction of IDF was completed between 2004 and 2006. The 2017 IDF PA uses computer models to assess the potential impacts of disposed waste to human health and the environment after facility closure for multiple exposure pathways, including a groundwater pathway. Contaminant fate and transport for the groundwater pathway is simulated in a three-dimensional finite difference model of the vadose zone and saturated zone at IDF and the surrounding area using the Subsurface Transport Over Multiple Phases (STOMP) simulator described in PNNL-15782. Although the 2017 IDF PA has not completed all of its regulatory reviews and is not yet publicly available, it is appropriate to include its outputs in the Hanford Site Composite Analysis, because a 2013 Record of Decision ("Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington: Record of Decision", 78 FR 75913) designated IDF as the permanent disposal destination for significant inventories of contaminants, and because the 2017 IDF PA incorporates changes in assumptions developed at or since that time which supersede past PA analyses of WTP wastes or of preconstruction concepts of the IDF.

76b
CH2MHILL

Environmental Modeling Data Transmittal Cover Page

No.: EMDT-RD-0019 **Revision No.:** 0

[Request EMDT number from Modeling Team Leader]

Title: Performance Assessment Results for Inclusion in Composite Analysis: Integrated Disposal Facility **Date:** 9/18/2017

2. Data Intended Use

Identify the data's intended use. Describe the rationale for its selection and how the data will be incorporated into a model, report, or database. Include discussion of the extent to which the data demonstrate the properties of interest.

The intended use of the data is to provide contaminant mass flux from IDF to the Hanford Composite Analysis (CA) groundwater model.

The 2013 Record of Decision ("Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington: Record of Decision", 78 FR 75913) designates IDF as the permanent disposal destination for low activity waste generated by the WTP (among other wastes). Consistent with numerous other Hanford Site PAs and modeling analyses, the 2017 IDF PA (RPP-RPT-59958 Revision B) determined that Tc-99 and I-129 are by far the dominant IDF waste contaminants contributing to radiological risk for the groundwater pathway. Simulation results indicating Tc-99 does not arrive at the water table during the compliance timeframe of 1,000 years following facility closure while assuming Tc-99 is a non-sorbing solute support a conclusion that no other contaminants would arrive at the water table within the compliance timeframe. The 2017 IDF PA base case simulated I-129 with a Kd of 0.1 mL/g. The PA also reported uncertainty and sensitivity analyses with a small range of I-129 soil Kd values based on PNNL – 13037 Rev. 2. The STOMP simulation results for flux of Tc-99 and I-129 released by IDF to the water table are the most directly useful form of IDF-related input for the CA groundwater model.

76b

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Environmental Modeling Data Transmittal Cover Page

No.: EMDT-RD-0019 **Revision No.:** 0

[Request EMDT number from Modeling Team Leader]

Title: Performance Assessment Results for Inclusion in Composite Analysis: Integrated Disposal Facility **Date:** 9/18/2017

3. Data Sources

List databases, documents, etc. – provide sufficient detail to enable data to be located by independent reviewer

The base case inventory was adopted from Inventory Case 7 in RPP- ENV- 58562 Rev.3

The 2017 IDF PA model base case outputs are extracted from output files archived with RPP-CALC-61032 Revision 0 and transmitted as follows.

Data Folder: IDF Base case input and raw output "surface" files selected for transmittal were placed in a .zip file

- Input and output files were provided by IDF PA team in file "IDF_PA_basecase.zip"
- This .zip file contains base case runs that simulate mass flux of combined waste forms from IDF to the groundwater table. Individual subfolders for radionuclides I-129 and Tc-99 contain files needed to execute simulations. The subfolder names match the base case simulation IDs used for the PA files in RPP-CALC-61032:
    - Vzp00_Infd06_gwp15_all_I-129_Ph1-2_kd1
    - Vzp00_Infd06_gwp15_all_Tc-99_Ph1-2

Data Folder: Post-processed STOMP results

- Post-processed STOMP results provided in a project directory, " STOMP Model Results".
- This folder contains .dat files that were converted from raw surface files in order to view base case results in a user-friendly format. Initial conversion was done with the Perl script surfaceTo.pl distributed with STOMP. The .dat files were then converted to 2 Excel (.xlsx) files for Tc-99 and I-129 results. Within each spreadsheet, highlighted columns A and F represent calendar year (assuming facility closure in 2051) and solute flux to the water table, respectively.

4. Impact of Use or Nonuse of Data

Describe the importance of the data to the model, report, and/or conclusions which they support. Identify the value added and discuss the impacts of not using the data.

Base case results for groundwater pathway were calculated using the 3-D STOMP model of the vadose zone and saturated zone at IDF.

Performance assessment results can be used to support decisions regarding best management practices (ALARA) and cost-benefit analysis during future operation on the IDF. Because the IDF is currently in pre-operational stages, PA conclusions could also influence final design features of the facility.

The 2013 Record of Decision ("Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington: Record of Decision", 78 FR 75913) designated IDF as the permanent disposal destination for significant inventories of Hanford Site contaminants, therefore nonuse of the data from the 2017 IDF PA from the Composite Analysis would constitute an unacceptable omission from the site-wide contaminant mass inventory.

76b

Environmental Modeling Data Transmittal Cover Page

No.: EMDT-RD-0019 **Revision No.:** 0

[Request EMDT number from Modeling Team Leader]

Title: Performance Assessment Results for Inclusion in Composite Analysis: Integrated Disposal Facility **Date:** 9/18/2017

5. Prior Uses

Identify the data's prior uses. Describe whether the data have been used in similar applications by the scientific or regulatory community. Include the associated verification processes and prior reviews and review results.

The data were used in the 2017 performance assessment (PA) of the Hanford Integrated Disposal Facility (IDF) reported in RPP-RPT-59958 Revision B. The data are from model outputs documented in RPP-CALC-61032 Revision 0.

As documented in RPP-CALC-61032, the simulations were performed, checked, and internally reviewed in accordance with 10 CFR 830, "Nuclear Safety Management," and Subpart A, "Quality Assurance"; DOE O 414.1D, "Quality Assurance"; ASME-NQA-1-2008 with 2009 addenda; other State and Federal environmental regulations; and associated quality assurance procedures by Washington River Protection Solutions, LLC (WRPS) for preparation and issuance of Environmental Model Calculation Files, which are equivalent to the procedures used by CH2M Hill Plateau Remediation Company. Among other measures, implementation of these procedures included verification of inputs, rerunning base case simulations, and verification of post-processing by an independent checker not involved in preparation of the model files and use of an internal senior reviewer. RPP-CALC-61032 and RPP-RPT-59958 were also externally reviewed by subject matter experts at Pacific Northwest National Laboratory, Savannah River National Laboratory, and Savannah River Site. An LFRG review is currently scheduled to be initiated in October 2017.

Note that as of September 2017, the 2017 IDF PA has not completed all of its regulatory reviews including the DOE-mandated review by an LFRG committee. Therefore, the documentation is not publicly available and base case assumptions and results are subject to change. The LFRG Review is scheduled to be initiated in October 2017.

6. Data Acquisition Method(s)

Describe the data acquisition method and associated QA/QC, considering the following:

- *a. Qualifications of personnel or organizations generating the data;*
- *b. Technical adequacy of equipment and procedures used;*
- *c. Environmental and programmatic conditions if germane to the data quality;*
- *d. The extent to which acquisition processes reflect modeling requirements;*
- *e. The quality and reliability of the measurement control program;*
- *f. The degree to which independent audits of the process were conducted;*
- *g. Extent and reliability of the associated documentation.*

The data development and management used for the IDF PA adheres to EPA and DOE guidance and requirements provided in Section 10 of the IDF PA.

a. Modeling staff are required to participate in training to ensure QA/QC processes and requirements for model development are communicated and followed. Selection of PA modelers, authors, checkers, and reviewers is based on qualification by education and professional experience as documented in attachments to RPP-RPT-59958 and RPP-CALC-61032.

b. STOMP software used to calculate vadose fate and transport meets safety and software requirements of ASME-NQA-1-2008 with 2009 addenda and DOE O 414.1D. Technical assumptions and inputs were reviewed by an internal senior reviewer and external peer reviewers.

c. RPP-RPT-59958 describes environmental conditions and uncertainties associated with the numerous inputs to the 2017 IDF PA models and the assumptions adopted in the base case simulations. In 2013, 78 FR 75913 designated IDF as the permanent disposal destination for low activity waste from WTP and other secondary waste. Phase 1 construction of IDF was completed in 2006, but construction of further phases assumed in the PA is dependent on actual waste generated by WTP, which is not yet operational in 2017. Disposal of waste in IDF requires authorization via updates to the existing RCRA permit and DOE Disposal Authorization Statement issued prior to the 2013 Record of Decision. As of September 2017, the 2017 IDF PA has not completed all regulatory reviews required to approve the PA or obtain such authorizations. Future programmatic conditions may differ from those assumed in the 2017 IDF PA in ways that could affect the nature, quantity, or spatial arrangement of wastes in IDF and thus affect the simulated contaminant releases and impacts to groundwater.

d. DOE/RL-2011-50 documents the capability of the STOMP code to meet identified attributes and criteria. Technical assumptions and inputs were reviewed by an internal senior reviewer and external peer reviewers.

e. Quality of underlying data used in model input is addressed in multiple data packages cited in RPP-RPT-59958. STOMP software is registered in the Hanford Information Systems Inventory, under controlled management by CHPRC. PA modeling attributes are compliance with the following Quality Assurance documents:
   - i. EPA *Guidance for Quality Assurance Project Plans for Modeling* (EPA/240/R-02/007)
   - ii. CHPRC *Procedure for Controlled Software Management* (PRC-PRO-IRM-309)
   - iii. DOE management expectations for compliance in *EM Quality Assurance Program* (EM-QA-001)

f. Simulation inputs and outputs were checked by an independent checker who did not participate in preparing the model input files. Simulation inputs and results were reviewed by an internal senior reviewer and external peer reviewers. In accordance with TFC-PLN-155, WRPS quality assurance personnel provided oversight including two independent surveillances and multiple work site assessments.

g. The 2017 IDF PA results are documented in RPP-RPT-59958 Revision A, RPP-CALC-61032 Rev. 0, and associated model package reports, environmental model calculation files, data packages, environmental modeling data transmittals, and other documents cited therein. The documentation is verified by independent checkers and reviewed by internal senior reviewers and external peer reviewers. As of September 2017, the 2017 IDF PA has not completed all regulatory reviews including review by an LFRG committee.

For databases, identify query language used to obtain data from database (SQL, etc.), briefly describe the query description and attach copy

Not applicable.

76b

Environmental Modeling Data Transmittal Cover Page

No.: EMDT-RD-0019 **Revision No.:** 0

[Request EMDT number from Modeling Team Leader]

Title: Performance Assessment Results for Inclusion in Composite Analysis: Integrated Disposal Facility **Date:** 9/18/2017

7. Corroborating Data

Identify and discuss any corroborating datasets. Provide any documentation that confirms the corroborating data substantiate existing parameter values, distributions, or data quality

Data Packages, reports, and literature with corroborating data referenced in the vadose zone and saturated zone fate and transport modeling included:

PNNL – 13037 Rev.2, PNNL 14744, PNNL-14960, PNNL – 15237, PNNL- 23711, RPP- 20691 Rev.1 and RPP-58562 Rev.3.

Fayer, M.J. and G.W. Gee, 2006, "Multiple-Year Water Balance of Soil Covers in a Semiarid Setting." *Journal of Environmental Quality*, Vol. 35, No. 2, pp.366-377.

Zhang, Z.F. and R. Khaleel, 2010, "Simulating field-scale moisture flow using a combined power-averaging and tensional connectivity-tortuosity approach," *Water Resources Research*, Vol.46, W09505, pp. 1-14

xc8. Data Quality Considerations

Discuss data quality considerations not identified in other sections. Include discussion of data quality indicators (i.e., accuracy, precision, representativeness, completeness, and comparability).

RPP-RPT-59958 reports sensitivity and uncertainty analyses of the inputs and assumptions of the 2017 IDF PA model base case and includes discussion of accuracy, representativeness, etc. of the simulation results. Fluxes to the water table are calculated with high precision but are accurate to only 2 or 3 significant digits at the most and subject to conceptual uncertainties affecting the first digit, typical of other PA simulation results. Simulation times are specified exactly, however the cumulative uncertainties in the contaminant transport calculations imply timing of results over the 1,000-year timeframe is likely uncertain to the nearest decade or more. Assumptions adopted for the base case parameterization ranged from representative to reasonable conservative. The base case does not represent a central tendency or most likely case, although as shown in the probabilistic uncertainty analyses the base case results are similar to the mean of the probabilistic results. It is the responsibility of the data user to determine whether those assumptions are reasonably consistent with those of other inputs for the Composite Analysis.

76b

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Environmental Modeling Data Transmittal Cover Page

No.: EMDT-RD-0019 **Revision No.:** 0

[Request EMDT number from Modeling Team Leader]

Title: Performance Assessment Results for Inclusion in Composite Analysis: Integrated Disposal Facility **Date:** 9/18/2017

9. Assumptions and Limitations on Data Use

Document known uncertainties, assumptions, constraints or limits on data.

Summaries of key uncertainties and key assumptions can be found in Sections 1.9 and 2.8 of the IDF PA, respectively. Base case assumptions are detailed in Section 5.2.1 of the PA. Significance of key assumptions is discussed in Section 8.4. As of September 2017, the 2017 IDF PA has not completed all regulatory reviews including review by an LFRG committee. Therefore, the documentation is not publicly available, and base case assumptions and results are subject to change.

Data Configuration Item Submittal:

Data Provider Submittal Avril Carter / Data Provider
NAME/POSITION

[signature]
SIGNATURE

10-11-17
DATE

Data Configuration Item Review and Verification:

10. Verification Process

Describe steps taken to verify that these data are appropriate for intended use, noting any limitations

Reviewed all citations and section numbers provided, requested additional detail be provided in some areas.

76b

CH2MHILL

Environmental Modeling Data Transmittal Cover Page

No.: EMDT-RD-0019 **Revision No.:** 0

[Request EMDT number from Modeling Team Leader]

Title: Performance Assessment Results for Inclusion in Composite Analysis: Integrated Disposal Facility **Date:** 9/18/2017

11. Summary of Data Review

The review shall ensure that the report meets the listed criteria. Consideration includes ensuring that the data collection method employed was appropriate for the type of data being considered and confidence in the data acquisition and subsequent processing methodology is warranted.

Is documentation technically adequate, complete, and correct?	[x] Yes	[ ] No
Are uncertainties and limitations on appropriate use of data discussed?	[x] Yes	[ ] No
Are the assumptions, constraints, bounds, or limits on the data identified?	[x] Yes	[ ] No

Data Reviewer Approval

Approval of Data Configuration Item

LINDA LEHMAN, SCIENTIST

NAME/POSITION

L. Lehman

SIGNATURE

10/11/17

DATE

EMDT accepted for Composite Analysis input in Data Readiness Review on 11/20/2017.

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Environmental Modeling Data Transmittal Cover Page

No.: EMDT-GR-0035 **Revision No.:** 0

[Request EMDT number from Modeling Team Leader]

Title: Waste Site and Structure Footprint Shapefiles for Inclusion in Updated Composite Analysis **Date:** 06/24/2019

Data Configuration Item Submittal:

Data Provider Submittal	Jose Lopez/GIS Analyst NAME/POSITION	
	[signature] SIGNATURE	6-24-19 DATE

Data Configuration Item Review and Verification:

10. Verification Process

Describe steps taken to verify that these data are appropriate for intended use, noting any limitations

I reviewed this document and the data provided by Margo Aye on July 26, 2018. The information stated herein is accurate.

11. Summary of Data Review

The review shall ensure that the report meets the listed criteria. Consideration includes ensuring that the data collection method employed was appropriate for the type of data being considered and confidence in the data acquisition and subsequent processing methodology is warranted.

Is documentation technically adequate, complete, and correct?	[X] Yes	[ ] No
Are uncertainties and limitations on appropriate use of data discussed?	[X] Yes	[ ] No
Are the assumptions, constraints, bounds, or limits on the data identified?	[X] Yes	[ ] No

Data Reviewer Approval	*Approval of Data Configuration Item*	
	Leonard Habel, P.E. Engineer NAME/POSITION	
	[signature] SIGNATURE	6/24/2019 DATE

Electronic Modeling Data Transmittal Form Rev. 2 Cover Page 3 of 3

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Appendix B

Cover Page for EMDT-GR-0035

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Environmental Modeling Data Transmittal Cover Page

No.: EMDT-GR-0035 **Revision No.:** 0

[Request EMDT number from Modeling Team Leader]

Title: Waste Site and Structure Footprint Shapefiles for Inclusion in Updated Composite Analysis **Date:** 06/24/2019

1. Data Description

Provide the description of data set or data type.

Ehsit is a shapefile of known or suspected waste sites across the Hanford site (3,390 features in this version). Bggenexs is a shapefile of existing buildings/structures across the Hanford site (2,443 features in this version).

2. Data Intended Use

Identify the data's intended use. Describe the rationale for its selection and how the data will be incorporated into a model, report, or database. Include discussion of the extent to which the data demonstrate the properties of interest.

These shapefiles provide the footprints to identify features commonly modeled/reported. They identify the location of where these features are on the Hanford site and the extent of their domains.

3. Data Sources

List databases, documents, etc. – provide sufficient detail to enable data to be located by independent reviewer

These were obtained as part of the data transfer to create the 2017 HIGRV. These files were originally sent as a feature dataset within an ArcGIS geodatabase by Margo Aye at Jacobs, to Jose Lopez at INTERA via email on 7/26/2018.

The original geodatabase and shapefiles can be found at:

S:\PSC\CHPRC.C003.HANOFF\Rel.044\HIGRV2017\Data\MargoAye@Jacobs

4. Impact of Use or Nonuse of Data

Describe the importance of the data to the model, report, and/or conclusions which they support. Identify the value added and discuss the impacts of not using the data.

This dataset has supported, and still supports, a variety of Hanford projects. These can be used as visual aids by generating figures for reports, presentations, or for discussions. Attributes, such as inventory, are also mapped to these features to evaluate their impact. Excluding this dataset would impact a project's ability to identify a site spatially with a reliable source.

5. Prior Uses

Identify the data's prior uses. Describe whether the data have been used in similar applications by the scientific or regulatory community. Include the associated verification processes and prior reviews and review results.

Ehsit and bggenexs have been used to support the Hanford Groundwater Annual Reports. Figures in the report incorporate these datasets. The Hanford Interactive Groundwater Viewer (HIGRV) of the annual report also use these datasets.

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Environmental Modeling Data Transmittal Cover Page

No.: EMDT-GR-0035 **Revision No.:** 0

[Request EMDT number from Modeling Team Leader]

Title: Waste Site and Structure Footprint Shapefiles for Inclusion in Updated Composite Analysis **Date:** 06/24/2019

6. Data Acquisition Method(s)

Describe the data acquisition method and associated QA/QC, considering the following:

a. Qualifications of personnel or organizations generating the data;
b. Technical adequacy of equipment and procedures used;
c. Environmental and programmatic conditions if germane to the data quality;
d. The extent to which acquisition processes reflect modeling requirements;
e. The quality and reliability of the measurement control program;
f. The degree to which independent audits of the process were conducted;
g. Extent and reliability of the associated documentation.

For databases, identify query language used to obtain data from database (SQL, etc.), briefly describe the query description and attach copy

As mentioned in section 3, these files were given to INTERA by Margo Aye. Margo Aye is the GISP Lead Soil and Ground Water at Jacobs. Margo retrieved this data from the Mission Support Alliance (MSA) Central Mapping Services server. Ehsit was retrieved on 12/14/2017 and bggenexs on 12/17/2017.

7. Corroborating Data

Identify and discuss any corroborating datasets. Provide any documentation that confirms the corroborating data substantiate existing parameter values, distributions, or data quality.

Not applicable.

8. Data Quality Considerations

Discuss data quality considerations not identified in other sections. Include discussion of data quality indicators (i.e., accuracy, precision, representativeness, completeness, and comparability).

Waste site (and structure) data are compiled using a variety of methods including translations from annotated field maps, estimates based on published reports, and digitizing from aerial photography/scanned drawings/global positioning surveys. Mapped location is based on the best available information at the time. As new data becomes available, mapped location is modified to account for newly identified information.

9. Assumptions and Limitations on Data Use

Document known uncertainties, assumptions, constraints or limits on data.

Due to the explanation in section 8, there may be a level of uncertainty behind this dataset. None of the mapped locations are absolute. Features may have changed/removed/added throughout different iterations of this dataset.

Appendix C

Cover Page for EMDT-BC-0033

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Environmental Modeling Data Transmittal Cover Page

No.: EMDT-BC-0033	**Revision No.: 0**
Title: Data Sources for Accounting for Recharge Spatial and Temporal Variability at the Hanford Site (Inputs to the Recharge Evolution Tool)	**Date: 12/16/2019**

1. Data Description

Provide the description of data set or data type.

The inputs included in this Environmental Modeling Data Transmittal (EMDT) include 2 groups of data:

1. The Performance Assessment (PA) Recharge zones
2. The Interim Surface Barriers

The PA recharge zones are defined as shapefiles with attribute fields represent key years in the PA models where recharge rates change (e.g. 1943, 2020, 2050, etc.). Values of the attribute fields correspond with the recharge rates that should be applied with their corresponding polygon feature at the time indicated by the name of the attribute column (e.g. attribute name of 2050 with a value of 0.5 represents a polygon in the shapefile whose entire area should be a recharge rate of 0.5 mm/yr in the year 2050). The PA's included in this shapefile are the Environmental Restoration Disposal Facility (ERDF), Waste Management Area C (WMA C), and Integrated Disposal Facility (IDF).

The interim surface barriers are also represented as a shapefile dataset. Attribute fields include a name field (associated with the associated Hanford facility to be covered), the construction year ("CONSTR_YEA"), and the type of cover.

2. Data Intended Use

Identify the data's intended use. Describe the rationale for its selection and how the data will be incorporated into a model, report, or database. Include discussion of the extent to which the data demonstrate the properties of interest.

The intended use of the PA and interim surface barrier shapefile datasets is to provide spatiotemporal information relevant to recharge estimation within the extents of these datasets.

Environmental Modeling Data Transmittal Cover Page

No.: EMDT-BC-0033 **Revision No.: 0**

Title: Data Sources for Accounting for Recharge Spatial and Temporal Variability at the Hanford Site (Inputs to the Recharge Evolution Tool) **Date: 12/16/2019**

3. Data Sources

List databases, documents, etc. – provide sufficient detail to enable data to be located by independent reviewer

Information for the PA recharge zones is described in the following documents:

- ERDF: *Performance Assessment for the Environmental Restoration Disposal Facility, Hanford Site*, Washington (WCH-520)
- WMA C: *Performance Assessment of Waste Management Area C, Hanford Site, Washington* (RPP-ENV-58782)
- IDF: *Vadose zone and saturated zone flow and transport calculations for the Integrated Disposal Facility Performance Assessment* (RPP-CALC-61032)

Supporting information for the interim surface barriers comes from satellite imagery, viewable on www.google.com/maps as of December 16, 2019 (only for existing barriers). Barriers with an expected installation date have approximate spatial covers corresponding with the extent of tanks within tank farms that are planned to be covered. Temporal information such as the start or end year corresponding with surface barrier construction comes from the Tri-Party Agreement (TPA) milestones (M-045-93) and the *Hanford Site Disposition Baseline for Composite Analysis*; CP-60254 (draft in progress).

4. Impact of Use or Nonuse of Data

Describe the importance of the data to the model, report, and/or conclusions which they support. Identify the value added and discuss the impacts of not using the data.

The importance of the data described in this EMDT is its ease of application. In contrast to the reports mentioned as sources for the shapefiles described in this EMDT, data in shapefiles are more readily extracted than the same information in text format. The nonuse of this data would mean that the intended user must translate the report information into a format for use in any modeling or geospatial application.

5. Prior Uses

Identify the data's prior uses. Describe whether the data have been used in similar applications by the scientific or regulatory community. Include the associated verification processes and prior reviews and review results.

This data's first use-case was to support the recharge information product documented in ECF-HANFORD-0019 Rev. 1. No other use cases have been documented for this data.

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Environmental Modeling Data Transmittal Cover Page

No.: EMDT-BC-0033 **Revision No.: 0**

Title: Data Sources for Accounting for Recharge Spatial and Temporal Variability at the Hanford Site (Inputs to the Recharge Evolution Tool) **Date: 12/16/2019**

6. Data Acquisition Method(s)

Describe the data acquisition method and associated QA/QC, considering the following:

- *a. Qualifications of personnel or organizations generating the data;*
- *b. Technical adequacy of equipment and procedures used;*
- *c. Environmental and programmatic conditions if germane to the data quality;*
- *d. The extent to which acquisition processes reflect modeling requirements;*
- *e. The quality and reliability of the measurement control program;*
- *f. The degree to which independent audits of the process were conducted;*
- *g. Extent and reliability of the associated documentation.*

Coordinate information and satellite imagery were used to digitize the spatial coverage. Information from the reports were indexed manually into the corresponding attribute fields for each location

For databases, identify query language used to obtain data from database (SQL, etc.), briefly describe the query description and attach copy

Not Applicable

7. Corroborating Data

Identify and discuss any corroborating datasets. Provide any documentation that confirms the corroborating data substantiate existing parameter values, distributions, or data quality.

Not Applicable

8. Data Quality Considerations

Discuss data quality considerations not identified in other sections. Include discussion of data quality indicators (i.e., accuracy, precision, representativeness, completeness, and comparability).

Not applicable

9. Assumptions and Limitations on Data Use

Document known uncertainties, assumptions, constraints or limits on data.

This data is limited to the spatial and temporal extents recorded in the shapefiles. The scope of these shapefiles is limited to the inner area of the Central Plateau of the Hanford Site.

Data Configuration Item Submittal:

Data Provider Submittal	TJ Budge/Hydrogeologist NAME/POSITION	
	[signature] SIGNATURE	12-18-19 DATE

Electronic Modeling Data Transmittal Form Rev. 2

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Environmental Modeling Data Transmittal Cover Page

No.: EMDT-BC-0033		**Revision No.:**	**0**
Title: **Data Sources for Accounting for Recharge Spatial and Temporal Variability at the Hanford Site (Inputs to the Recharge Evolution Tool)**		**Date:**	**12/16/2019**

Data Configuration Item Review and Verification:

10. Verification Process

Describe steps taken to verify that these data are appropriate for intended use, noting any limitations

This information was brought into a software application to view the data records captured in the shapefiles. All information captured herein is as described/stated.

11. Summary of Data Review

The review shall ensure that the report meets the listed criteria. Consideration includes ensuring that the data collection method employed was appropriate for the type of data being considered and confidence in the data acquisition and subsequent processing methodology is warranted.

Is documentation technically adequate, complete, and correct?	[✓] Yes	[ ] No
Are uncertainties and limitations on appropriate use of data discussed?	[✓] Yes	[ ] No
Are the assumptions, constraints, bounds, or limits on the data identified?	[✓] Yes	[ ] No

Data Reviewer Approval

Approval of Data Configuration Item

JB Fullerton/Hydrogeologist
NAME/POSITION

Jacob Fullerton (signature)
SIGNATURE

12/18/19
DATE

Appendix D

Summary of HSDB Changes for Application in the RET

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Appendix D

Summary of HSDB Changes for Application in the RET

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D1 Preface

This Appendix summarizes the changes made to the HSDB for application in the RET. Initial changes described in Sections 2-16 may have been overwritten by changes documented in CP-63386. The changes described in Document CP-63386 and documented in the spreadsheets "CA_CIE_Disposition_04.24.2019.xlsx" and "Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx" should be considered final.

D2 Tank Farm Barriers

Issue

While evaluating the list of solid waste release models for recharge rates to be applied through time, it was discovered that tank farms with RODs were assigned barrier dispositions too early [explained in the OneNote page entitled "RODs (final and interim)"], while some tanks were misrepresented with "no action" remedies as their future/final state.

Change

- Assign each tank farm as having a surface barrier to match the footprint of the WMA
- Where information is not available, follow current closure plans and apply barriers in 2050

This change was applied in the RET version of the HSDB on 1/22/2019

D3 Start/End Dates from SIMV2

Issue

Based on the information given by the SIMV2 data package, waste sites were found to have dates inconsistent with those reported in the HSDB (usually differing by a couple years at most).

Change

The start dates have been modified to match the SIMV2 inventory for consistency. The changes made are shown in the table below

WSTR's, sub model of the HDW (Hanford Defined Waste), mainly records from SIMV1. See LA-UR-96-3860 for the years listed for the transactions.

<<StartEnd Dates from SIMV2 - Spreadsheet.xlsx>>

SITE_NUM	Date Begin	Date End	Final Action	Final Disposition	Notes/Changes
116-B-1	1948				Modified start year to match SIM-V2 model inventory.
116-H-1	1950				Modified start year to match SIM-V2 model inventory.
200-W PP	1984	1995	2070	RTD	Added because of known inventory in SIM-V2 model. Final disposition data taken from 216-U-14 based on the comment provided in WIDS about the two waste sites being combined.
216-A-7	1955				Modified start year to match SIM-V2 model inventory.
216-B-32	1956				Modified start year to match SIM-V2 model inventory.
216-B-33	1956				Modified start year to match SIM-V2 model inventory.
216-B-34	1956				Modified start year to match SIM-V2 model inventory.
216-B-3B RAD	1983				Modified start year to match SIM-V2 model inventory.
216-B-3C RAD	1983				Modified start year to match SIM-V2 model inventory.
216-B-42	1954				Modified start year to match SIM-V2 model inventory.
216-C-1	1952				Modified start year to match SIM-V2 model inventory.
216-S-10P	1951				Modified start year to match SIM-V2 model inventory.
216-S-13	1951				Modified start year to match SIM-V2 model inventory.
216-T-7	1947				Modified start year to match SIM-V2 model inventory.
2607-Z	1948				Modified start year to match SIM-V2 model inventory.
6607-5	1985				Modified start year to match SIM-V2 model inventory.
UPR-200-E-82	1968	1968			Added because of known inventory in SIM-V2 model
UPR-200-W-163	1952	1988			Added because of known inventory in SIM-V2 model.

D4 Disposition Corrections

Issue

Some waste sites do not have the proper dispositions identified by the cited documents. The Prototype Hanford Barrier is an example of this change.

The WIDS report for 216-B-57 does not include the any action in the summary report regarding the barrier construction in 1994, however the barrier has proven to be effective at keeping recharge to groundwater less than 0.5 mm/yr since it's construction.

IDF (200-E-106) is another example of a disposition in the RET that needs modification. This relates more to the RET and how to fit in the appropriate dispositions for the respective time periods. The HSDB does not include a disposition for the construction of waste sites, so the assumption used by the RET is that all waste sites (excluding contaminant migration and unplanned releases) signal a removal of vegetation and disturbance to the soil (representing excavation activities). In the case of IDF, the waste site is a lined landfill designed to prevent water from penetrating the footprint of the waste site.

Change

Summarized below are the changes made to these two waste sites, others will be added as deemed necessary.

Disposition Corrections - Spreadsheet.xlsx

SITE_NUM	Date_ Begin	Begin_ Disposition	Date_ End	End_ Disposition	1st_ Action	Actual_ Disposition	Final_ Action	Final_ Disposition	Notes/Changes
200-E-106	2005		Null		2005				The start year was updated to match the WIDS report for IDF. Also changed 1st Action to match the start year and removed end year (makes IDF act as barrier from onset, expected behavior). This was done given that IDF is a lined landfill and will have a barrier disposition, bypassing the typical waste site ("typical" meaning sites which are created by disturbing the natural vegetation and increasing net recharge to groundwater).
216-B-57	1968	Bare, Disturbed	1973	Bare_ Disturbed	1994	Hanford Barrier	2070	Hanford Barrier	Added the 1st Action of remediation as Hanford Barrier. Changed Final_Disposition to Hanford Barrier. The source documentation is DOE-RL-2016-37

D5 Adjacent Remedies

Issue

Waste sites were often labeled with a disposition of "Addressed by adjacent remedy" which is not effective for assigning a disposition as the RET cannot distinguish what the adjacent site(s) should be, relative to each other.

Corrections were made based on the contextual information provided and the "Addressed by adjacent…" was replaced with the actual/anticipated disposition. The list of those changes is provided in the following table.

Changes

<<Adjacent Remedies - Spreadsheet.xlsx>>

SITE_NUM	Notes/Changes
200-E-102	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Demolish plus Barrier" to match the comment in Column J and the remedy selected for 202-A (PUREX Canyon)
200-E-136	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Demolish plus Barrier" to match the comment in Column J and the remedy selected for 202-A (PUREX Canyon)
200-E-28	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier, ET Cap" to match the comment in Column J and the remedy selected for 221-B (B Plant Canyon)
200-E-56	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" to match site 200-E-41
200-E-57	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" to match site 200-E-41
200-W-126	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Hanford or ET barrier"
200-W-128	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier plus treatment" to match 218-W-4A
200-W-136	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Hanford or ET barrier" based on comments
200-W-144	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Demolish plus Barrier" based on comments
200-W-76	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Demolish plus Barrier" based on comments
200-W-81	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier plus GW monitoring" based on comments
201-C	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" based on comments
207-A-SOUTH	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Remove" based on comments
216-A-2	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Demolish plus Barrier" based on comments

SITE_NUM	Notes/Changes
216-A-39	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Hanford Barrier", waste site lies between 241-A Tank Farm Complex tanks. The tanks will be capped with a surface barrier to the north and south of 216-A-39, making it a logical decision to include 216-A-39 as a barrier as well as the tanks.
216-A-4	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Demolish plus Barrier" based on comments
216-C-1	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" based on comments
216-C-10	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" based on comments
216-C-3	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" based on comments
216-C-5	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" based on comments
216-S-15	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" based on comments
216-S-3	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier", waste site intersects with 216-S-15 which will be covered by the S Tank Farm barrier.
216-S-4	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "RTD", waste site falls within boundary for U-10 whose final disposition is RTD.
216-T-4A	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier plus GW monitoring" based on comments
216-T-4B	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier plus GW monitoring" based on comments
221-B-WS-2	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Demolish plus Barrier" based on comments
241CXV	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" based on comments
244-A LS	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Demolish plus void fill" based on comments
244AR40	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "RTD" based on comments
244-S DCRT	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier", waste site in close proximity to 216-S-3, based on available information and context this area will also be covered with a barrier.
271BA	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "RTD" based on comments
276B	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" based on comments
291AK	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" based on comments
291-C	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" based on comments
291-C-1	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" based on comments
TRUSAF	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Demolish plus Barrier" based on comments

SITE_NUM	Notes/Changes
UPR-200-E-1	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Demolish plus Barrier" based on comments
UPR-200-E-144	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Hanford or ET barrier" based on comments
UPR-200-E-21	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier plus RTD" based on comments
UPR-200-E-37	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" based on comments
UPR-200-E-79	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "RTD" based on comments
UPR-200-E-95	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" based on comments
UPR-200-W-102	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" based on comments
UPR-200-W-162	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" based on comments
UPR-200-W-2	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" based on comments
UPR-200-W-20	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" based on comments
UPR-200-W-38	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" based on comments
UPR-200-W-97	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "RTD" based on comments
WESF	Changed Column H of '!CP_Optimization_Study' from "Addressed by remedy from adjacent site" to "Barrier" based on comments

D6 Added Sites

Issue

Based on modeling needs and additional information, additional entries were added to the HSDB. Some examples for adding these sites include known waste inventory being dumped in areas/sites not previously denoted by the HSDB and adding in the tank waste management areas to specify closure dates more explicitly for barrier placement.

The sites added and the associated reasons are included in the table below. Some sites overlap with other corrections mentioned in this notebook.

Changes

<<Added Sites - Spreadsheet.xlsx>>

SITE_NUM	Date_ Begin	Date_ End	Final_ Action	Final_ Disposition	Notes/Changes
200-W PP	1984	1995	2070	RTD	Added because of known inventory in SIM-V2 model. Final disposition data taken from 216-U-14 based on the comment provided in WIDS about the two waste sites being combined.
241SX			2050	Void Fill Plus Barrier	WMA SX to have a barrier, added this designation using the bggenexs shapefile (from HGIS_Prod on HLAN)
241 SY			2050	Void Fill Plus Barrier	WMA SY to have a barrier, added this designation using the bggenexs shapefile (from HGIS_Prod on HLAN)
241A			2050	Void Fill Plus Barrier	WMA A to have a barrier, added this designation using the bggenexs shapefile (from HGIS_Prod on HLAN)
241AN			2050	Void Fill Plus Barrier	WMA AN to have a barrier, added this designation using the bggenexs shapefile (from HGIS_Prod on HLAN)
241AW			2050	Void Fill Plus Barrier	WMA AW to have a barrier, added this designation using the bggenexs shapefile (from HGIS_Prod on HLAN)
241AX			2050	Void Fill Plus Barrier	WMA AX to have a barrier, added this designation using the bggenexs shapefile (from HGIS_Prod on HLAN)
241AY			2050	Void Fill Plus Barrier	WMA AY to have a barrier, added this designation using the bggenexs shapefile (from HGIS_Prod on HLAN)
241AZ			2050	Void Fill Plus Barrier	WMA AZ to have a barrier, added this designation using the bggenexs shapefile (from HGIS_Prod on HLAN)
241B			2050	Void Fill Plus Barrier	WMA B to have a barrier, added this designation using the bggenexs shapefile (from HGIS_Prod on HLAN)
241BX			2050	Void Fill Plus Barrier	WMA BX to have a barrier, added this designation using the bggenexs shapefile (from HGIS_Prod on HLAN)
241BY			2050	Void Fill Plus Barrier	WMA BY to have a barrier, added this designation using the bggenexs shapefile (from HGIS_Prod on HLAN)
241S			2050	Void Fill Plus Barrier	WMA S to have a barrier, added this designation using the bggenexs shapefile (from HGIS_Prod on HLAN)
241T			2050	Void Fill Plus Barrier	WMA T to have a barrier, added this designation using the bggenexs shapefile (from HGIS_Prod on HLAN)
241TX			2050	Void Fill Plus Barrier	WMA TX to have a barrier, added this designation using the bggenexs shapefile (from HGIS_Prod on HLAN)

SITE_NUM	Date_ Begin	Date_ End	Final_ Action	Final_ Disposition	Notes/Changes
241TY			2050	Void Fill Plus Barrier	WMA TY to have a barrier, added this designation using the bggenexs shapefile (from HGIS_Prod on HLAN)
UPR-200-E-82	1968	1968			Added because of known inventory in SIM-V2 model
UPR-200-W-163	1952	1988			Added because of known inventory in SIM-V2 model.

D7 Solid Waste Release Model (Barrier Locations)

Issue

From: Jacob Fullerton
Sent: Tuesday, January 29, 2019 10:24 AM
To: Nichols, William E <william_e_nichols@rl.gov>; Mark Williams <MWilliams@intera.com>
Cc: Mart Oostrom <MOostrom@intera.com>; Ryan Nell <RNell@intera.com>; Christelle Courbet <CCourbet@intera.com>; Dennis G. Fryar <DFryar@intera.com>; Greg Ruskauff <GRuskauff@intera.com>
Subject: Solid Waste Release Final Dispositions

All:

I have updated the new barriers shapefile, checking those with Dennis Fryar soon. After creating the new barriers shapefile I was able to assign barrier recharge rates to several more areas. However, the question remains now for the list of waste sites that I am providing in this email as a table. Please let me know if it is acceptable for these waste sites to have non-barrier recharge rates. I especially need to know which (if any) of these waste sites should be barriers.

Waste Site	Build Year	1st Action Year	1st Remedial Action	Final Action Year	Final Remedial Action	Source
212B (212-B)	1969			2050	D4 to slab-on-grade	Action Memo
234-5Z	1949			2050	RTD	CP Optimization Study
236-Z	1964	NULL	D4	2050	RTD	CP Optimization Study
241-T-361	1944	NULL	CSNA	2050	MESC/MNA/IC	Proposed Plans
242Z	1964			2050	RTD	CP Optimization Study
2736-Z	1971	2012	D4	2050	No Action	CP Optimization Study
291-Z	1949	NULL	D4	2050	Void Fill	CP Optimization Study

2

Jacob Fullerton | E.I.T.

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From: Jacob Fullerton <JFullerton@intera.com>
Sent: Thursday, January 31, 2019 1:14 PM
To: Nichols, William E <william_e_nichols@rl.gov>; Mark Williams <MWilliams@intera.com>
Cc: Mart Oostrom <MOostrom@intera.com>; Ryan Nell <RNell@intera.com>; Christelle Courbet <CCourbet@intera.com>; Dennis G. Fryar <dfryar@intera.com>; Greg Ruskauff <gruskauff@intera.com>
Subject: RE: Solid Waste Release Final Dispositions

All:

I haven't heard back on this issue and I just wanted to refresh this question/email thread for Christelle's sake as she is waiting on me for her MPR writeup. I need to know if it is ok if we do not have barriers over all of the solid waste release modeling sites. Those sites which I have questions about are listed in the message from earlier this week.

Jacob Fullerton | E.I.T.

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Jacob Fullerton

From: Nichols, William E <william_e_nichols@rl.gov>
Sent: Thursday, January 31, 2019 3:11 PM
To: Jacob Fullerton; Mark Williams
Cc: Mart Oostrom; Ryan Nell; Christelle Courbet; Dennis G. Fryar; Greg Ruskauff; Lehman, Linda L; Mehta, Sunil

Subject: RE: Solid Waste Release Final Dispositions

The LLBG Closure Plan (DOE/RL-2000-70, Rev. 0) calls for different covers depending on whether the facility is Category 1 or Category 3:

- Category 1 LLW facility: The Category 1 facility would be covered by a minimum thickness about 3 m (10 ft) of sand-gravel cover with no vegetation or sparse shallow-rooted vegetation such as cheatgrass, permitting a maximum amount of moisture infiltration (assumed to be 5 cm/yr, 2 in/yr) into the buried waste layer. The thickness of cover material would not be sufficient to prevent an inadvertent intruder who digs a basement or drills a well from coming into direct contact with buried waste. Stabilization of buried waste to support a final cover was not assumed. Immobilization of radionuclides in waste disposed in a Category 1 facility is not required.
- Category 3 LLW facility: The Category 3 facility would be covered with suitable soil to support natural vegetation, including a mix of shallow- and deep-rooted plant species. The cover treatment would limit infiltration into the waste layer to 0.5 cm/yr (0.2 in/yr). A minimum of 5 m (16.1 ft) of cover materials would be placed over a Category 3 facility, so that the inadvertent intruder would not expose buried waste in a typical basement excavation, but would penetrate the waste layer in the process of drilling a well. The assumption was made that buried waste in a Category 3 facility would have to be stabilized to achieve acceptable cover performance. Immobilization of radionuclides may be required for some wastes disposed in a Category 3 facility, depending on the concentrations of long-lived radionuclides that are mobile in the soil column.

The CP goes on to note, however, that the Category 1 and 3 wastes have not been segregated, so in fact the cover requirements for Category 3 would be applied to all LLBGs. Hence, the CP calls for a Modified RCRA Subtitle C Barrier for final closure of the active LLBGs. For the inactive LLBGs, final remediation will follow the CERCLA process, but the CP proposes transitioning active LLBGs to the ER Program after conclusion of operations so these can be closed in an integrated manner.

Taken together, I read all this to mean we should assume a barrier will go over all the LLBGs. (That will be a LOT of barrier.) I also note the EIS only put a barrier over Trenches 31 and 34, and left the rest outside their barrier extents. However, the EIS treated all LLBGs outside of Tr31/34 under cumulative impacts with no further actions.

Will Nichols
Modeling Team Leader
D 1 509 376 4553
M 1 505 551 4394

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Changes

After receiving guidance from Will, I will modify the HSDB to mark the waste sites listed in the table with barriers. A summary of the changes is included below:

Waste Site	Build Year	1st Action Year	1st Remedial Action	Final Action Year	Final Remedial Action	Source
212B (212-B)	1969			2050	Barrier	DOE/RL-2000-70, Rev. 0
234-5Z	1949			2050	Barrier	DOE/RL-2000-70, Rev. 0
236-Z	1964	NULL	D4	2050	Barrier	DOE/RL-2000-70, Rev. 0
241-T-361	1944	NULL	CSNA	2050	Barrier	DOE/RL-2000-70, Rev. 0
242Z	1964			2050	Barrier	DOE/RL-2000-70, Rev. 0
2736-Z	1971	2012	D4	2050	Barrier	DOE/RL-2000-70, Rev. 0
291-Z	1949	NULL	D4	2050	Barrier	DOE/RL-2000-70, Rev. 0

D8 RODS (final and interim)

Issue

The problem is two-fold:

1. The HSDB records the dates of the ROD signatures and applies this date as the year for the disposition. ROD signature dates should have no bearing on the disposition unless the ROD was immediately implemented
2. RODs by nature are final actions. The current HSDB structure treats final RODs as "actual" dispositions and interim RODs as "future" dispositions.

An illustration of these problems is given in the table below:

Example: 241-T-106, (a Single-Shell Tank)

Action/State	Year	Source for Year	Disposition	Source for Disposition
Construction	1947	WIDS	Bare, Disturbed	RET (Assumption)
Cease Operations	1973	WIDS	Bare, Disturbed	RET (Assumption)
1st Remedial Action	2013	ROD Signature	Grout, barrier	ROD
Final Remedial Action	2043	DOE/RL-2015-10, M-045-00 (TPA)	No RL-40 action	CP Optimization Study

Outlook Email
Date: Tue 1/22/2019 5:08 PM
From: Jacob Fullerton JFullerton@intera.com
Re: HSDB ROD Dispositions and Dates
To: Nichols, William E william_e_nichols@rl.gov, Mark Williams MWilliams@intera.com, Greg Ruskauff GRuskauff@intera.com, Mart Oostrom MOostrom@intera.com
CC: Batal, Wafa H (Wafa_H_Batal@rl.gov), Randy Dockter <RDockter@intera.com>

All:

While evaluating the dispositions and dates assigned to waste sites listed with RODs (interim and final), I came across some inconsistencies. The dates used in the HSDB for final ROD resolutions are the years that the documents were signed. Interim RODs were also included in the spreadsheet column as the future (and final) disposition for corresponding waste sites. This is inconsistent with the document and the macro created for the HSDB, and I would maintain the spreadsheet's interpretation of Interim RODs as an appropriate "future or final" disposition where no better data are available (which would mean changing the document and macro to match the spreadsheet in its next revision).

As an example of the problem this creates, the tank farm in WMA T area has a bad selection of dispositions/remedies. Taking 241-T-106 for this example (a Single-Shell Tank):

Action/State	Year	Source for Year	Disposition	Source for Disposition
Construction	1947	WIDS	Bare, Disturbed	RET (Assumption)
Cease Operations	1973	WIDS	Bare, Disturbed	RET (Assumption)
1st Remedial Action	2013	ROD Signature	Grout, barrier	ROD
Final Remedial Action	2043	DOE/RL-2015-10, M-045-00 (TPA)	No RL-40 action	CP Optimization Study

I'll identify the problems first before suggesting a way forward. The problem here is two-fold: 1) The ROD signature has no bearing on the actual disposition and should not be considered for the year assignment for any disposition, 2) RODs by nature are final actions and should not be included in 1st Remedial Actions and should be considered future/final dispositions. In the document describing the HSDB both interim and final RODs were considered "Actual/Existing" remedies, but in the case of final RODs the action should not be superseded by any future action, and interim RODs should only be used when there is no final ROD.

The solution I propose for your consideration is to treat interim and final ROD dispositions as "future" dispositions. The dates for these dispositions should be the TPA date as denoted in DOE/RL-2015-10. Interim RODs will still be considered in the same way as before, superseded only by dispositions from final RODs. The resultant change will resemble something like the following (using 241-T-106 as an example again):

Action/State	Year	Source for Year	Disposition	Source for Disposition
Construction	1947	WIDS	Bare, Disturbed	RET (Assumption)
Cease Operations	1973	WIDS	Bare, Disturbed	RET (Assumption)
1st Remedial Action	NULL	NULL	NULL	NULL
Final Remedial Action	2043	DOE/RL-2015-10, M-045-00 (TPA)	Grout, barrier	ROD

Let me know your feedback concerning this proposed modification to the HSDB (for the RET).

Jacob Fullerton | E.I.T.

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Changes

1. Dates for RODs (interim and final) should be those dates used by the TPA in DOE/RL-2015-10
2. Final and interim RODs should be considered as "future" remedies

Applying these changes would result in the following for 241-T-106:

Action/State	Year	Source for Year	Disposition	Source for Disposition
Construction	1947	WIDS	Bare, Disturbed	RET (Assumption)
Cease Operations	1973	WIDS	Bare, Disturbed	RET (Assumption)
1st Remedial Action	NULL	NULL	NULL	NULL
Final Remedial Action	2043	DOE/RL-2015-10, M-045-00 (TPA)	Grout, barrier	ROD

Discussion:
1/23/2019

- The suggestions are appropriate given the available data. The better alternative would be to collect ROD completion years from the RODs where available (to be extracted/discussed further).
- Approved for application by Will Nichols and Greg Ruskauff January 29, 2019. Use TPA dates where no better data is provided by the RODs, apply RODs as final/future dispositions in HSDB.

D9 Added Fields

Issues

Given that the current array of information has not satisfactorily answered all of the waste sites, additional fields were added to the spreadsheet to provide additional data where needed. The columns added are:

- Intermediate Dispositions
  - The latest known disposition or interim remedy of a site
- Citation (Intermediate)
  - The citation/reference/explanation for the intermediate disposition
- Year (Intermediate)
  - The year which the intermediate disposition is to be applied
- Final Dispositions
  - The final disposition
- Citation (Final)
  - The citation/reference/explanation for the final disposition
- Year (Final)
  - The year in which the final disposition is to be applied

The particular sites for which these fields have been used for are shown in the table copied below.

Changes

ID	Intermediate Dispositions	Citation (Intermediate)	Year (Intermediate)	Final Dispositions	Citation (Final)	Year (Final)
200-E-106	Barrier		2005			
200-W-20				Void Fill Plus Barrier	DOE/RL-2000-70, Rev. 0	
216-B-57				Hanford Barrier	DOE-RL-2016-37	1994
241-AN-101				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AN-102				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	

ID	Intermediate Dispositions	Citation (Intermediate)	Year (Intermediate)	Final Dispositions	Citation (Final)	Year (Final)
241-AN-103				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AN-104				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AN-105				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AN-106				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AN-107				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AP-101				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AP-102				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AP-103				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AP-104				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AP-105				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AP-106				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AP-107				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	

ID	Intermediate Dispositions	Citation (Intermediate)	Year (Intermediate)	Final Dispositions	Citation (Final)	Year (Final)
241-AP-108				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AW-101				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AW-102				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AW-103				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AW-104				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AW-105				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AW-106				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AY-101				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AY-102				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AZ-101				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-AZ-102				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-SY-101				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	

ID	Intermediate Dispositions	Citation (Intermediate)	Year (Intermediate)	Final Dispositions	Citation (Final)	Year (Final)
241-SY-102				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-SY-103				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241-T-361				Void Fill Plus Barrier	DOE/RL-2000-70	
212B				Void Fill Plus Barrier	DOE/RL-2000-70, Rev. 0	
234-5Z				Void Fill Plus Barrier	DOE/RL-2000-70	
236Z				Void Fill Plus Barrier	DOE/RL-2000-70, Rev. 0	
241A				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241AN				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241AP				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241AW				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241AX				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241AY				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	

ID	Intermediate Dispositions	Citation (Intermediate)	Year (Intermediate)	Final Dispositions	Citation (Final)	Year (Final)
241AZ				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241B				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241BX				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241BY				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241S				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241SX				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241SY				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241T				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241TX				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241TY				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
241U				Void Fill Plus Barrier	Final ROD (TC&WM EIS)	
242Z				Void Fill Plus Barrier	DOE/RL-2000-70, Rev. 0	

ID	Intermediate Dispositions	Citation (Intermediate)	Year (Intermediate)	Final Dispositions	Citation (Final)	Year (Final)
2736Z				Void Fill Plus Barrier	DOE/RL-2000-70, Rev. 0	
291Z				Void Fill Plus Barrier	DOE/RL-2000-70, Rev. 0	

D10 Order of Priority (Future Disposition)

Issues

Jacob Fullerton

From: Greg Ruskauff
Sent: Wednesday, February 13, 2019 2:06 PM
To: Jacob Fullerton; Nichols, William E; Mark Williams; Mart Oostrom
Cc: Randy Dockter; Batal, Wafa H (Wafa_H_Batal@rl.gov); Wafa Batal
Subject: RE: HSDB

The action memo should come first. At the B Complex an action memo was written prior to the removal action work plan.

From: Jacob Fullerton
Sent: Wednesday, February 13, 2019 1:29 PM
To: Nichols, William E <William_E_Nichols@rl.gov>; Mark Williams <MWilliams@intera.com>; Mart Oostrom <MOostrom@intera.com>; Greg Ruskauff <gruskauff@intera.com>
Cc: Randy Dockter <rdockter@intera.com>; Batal, Wafa H (Wafa_H_Batal@rl.gov) <Wafa_H_Batal@rl.gov>; Wafa Batal <WBatal@intera.com>
Subject: HSDB

All:

I want to know which should come first in this pair: "Proposed Plans" or "Action Memos". The current implementation of the HSDB uses Proposed Plans first where available, then Action Memos. These sources are difficult in that specific dates for either source are not provided in an easily accessible column of data.

I'm having second guesses about this ordering and am currently inclined to put Action Memos before Proposed Plans. I look forward to your input on this matter.

Jacob Fullerton | E.I.T.

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Changes

Per the email discussion attached above, the order of the HSDB master list columns were changed accordingly.

D11 Surplus Reactor Disposal Site

Issue

Jacob Fullerton

From: Nichols, William E <william_e_nichols@rl.gov>
Sent: Wednesday, February 20, 2019 6:57 AM
To: Mart Oostrom; Jacob Fullerton; Mark Williams; Dennis G. Fryar
Cc: Lehman, Linda L
Subject: RE: Reactor Core Question

We will assume it will be capped, just as we are assuming for all LLBGs.

Linda, please kindly ensure the issue already entered for the surplus reactor disposal includes this assumption.

Will Nichols
Modeling Team Leader
D 1 509 376 4553
M 1 509 551 4394

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From: Mart Oostrom <MOostrom@intera.com>
Sent: Tuesday, February 19, 2019 3:55 PM
To: Jacob Fullerton <JFullerton@intera.com>; Nichols, William E <william_e_nichols@rl.gov>; Mark Williams <MWilliams@intera.com>
Cc: Dennis G. Fryar <dfryar@intera.com>
Subject: Re: Reactor Core Question

It's hard to see how this site, of all places, would not be capped. But I'm deferring to Will for the final answer.

Mart

From: Jacob Fullerton
Sent: Tuesday, February 19, 2019 2:42:06 PM
To: Nichols, William E; Mark Williams
Cc: Mart Oostrom; Dennis G. Fryar
Subject: Reactor Core Question

All:

The reactor core site (the site where the river corridor site reactors will be moved single-piece for final disposal) is not part of the HSDB (not surprising as it doesn't have an official destination yet). How do we want to treat this site with regard to recharge? The buildings housing the reactor cores will be cocooned in a concrete shell of some sort according to their RODs, but once they've been relocated to the Central Plateau is there a plan to build a surface barrier to prevent recharge from reaching the cores/concrete shells?

1

Do we place a barrier over the top of the reactor core site?

Jacob Fullerton | E.I.T.

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Linked in

From: Nichols, William E <william_e_nichols@rl.gov>
Sent: Tuesday, February 19, 2019 10:47 AM
To: Mark Williams <MWilliams@intera.com>; Jacob Fullerton <JFullerton@intera.com>
Cc: Mart Oostrom <MOostrom@intera.com>; Dennis G. Fryar <dfryar@intera.com>
Subject: RE: RET status please

Yes; recall the attached email of Jan. 31 on this subject.

Will Nichols
Modeling Team Leader
D 1 509 376 4553
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a Jacobs company

From: Mark Williams <MWilliams@intera.com>
Sent: Tuesday, February 19, 2019 10:30 AM
To: Jacob Fullerton <JFullerton@intera.com>; Nichols, William E <william_e_nichols@rl.gov>
Cc: Mart Oostrom <MOostrom@intera.com>; Dennis G. Fryar <dfryar@intera.com>
Subject: Re: RET status please

Will ... Is there a plan to put covers on all these? We discussed the one trench yesterday?

Mark

On Feb 19, 2019, at 10:20 AM, Jacob Fullerton <JFullerton@intera.com> wrote:

> So I wasn't aware until I was discussing with Ryan that LLBG's were officially being added in as solid waste release models. I need to know the full list of the solid waste release models so that I can place barriers over the tops of each location in our STOMP models. When will this list be locked down?

2

Jacob Fullerton | E.I.T.

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LinkedIn

From: Mark Williams <MWilliams@intera.com>
Sent: Monday, February 18, 2019 8:52 PM
To: Jacob Fullerton <JFullerton@intera.com>
Cc: Mart Oostrom <MOostrom@intera.com>
Subject: RET status please

Changes

CA_Reactor_Core_Model.zip

The new site footprint is also included now as part of the barrier shapefile

D12 T Plant Canyon Barrier

Issues

Two sites that were questionable as to whether they should have a barrier in place were: 200-W-20 and 2706T. 2706T is being included as a solid waste release location and 200-W-20 does not have any known inventory associated with the waste site (in specific, sites within the domain do have known inventory).

Email Conversation:

From: Mark Williams<MWilliams@intera.com>
RE: Barrier Questions
Sent: Tuesday, February 26, 2019 3:45 PM
To: Jacob Fullerton, Ryan Nell <RNell@intera.com>
Cc: Nichols, William E <william_e_nichols@rl.gov>; Mart Oostrom <MOostrom@intera.com>; Greg Ruskauff <gruskauff@intera.com>; Dennis G. Fryar <dfryar@intera.com>; Christelle Courbet <CCourbet@intera.com>; Batal, Wafa H (Wafa_H_Batal@rl.gov) <Wafa_H_Batal@rl.gov>

Jacob, I'm good with this (note to others that we have been discussing this on the side, I'm sure you are grateful). The figures were really helpful (thanks).

Just to be clear, U and T Canyon Complexes have the overarching complex footprint used for barriers (200-W-16 and 200-W-20). S and B Canyon Complexes do not. There is no inventory associated with the large areas of 200-W-16 and 200-W-20 (rubble from demolition of the canyons goes into canyon building footprints, e.g. 221-U and 221-T).

Mark

From: Jacob Fullerton
Sent: Tuesday, February 26, 2019 12:29 PM
To: Ryan Nell <RNell@intera.com>; Mark Williams <MWilliams@intera.com>
Cc: Nichols, William E <william_e_nichols@rl.gov>; Mart Oostrom <MOostrom@intera.com>; Greg Ruskauff <gruskauff@intera.com>; Dennis G. Fryar <dfryar@intera.com>; Christelle Courbet <CCourbet@intera.com>; Batal, Wafa H (Wafa_H_Batal@rl.gov) <Wafa_H_Batal@rl.gov>
Subject: RE: Barrier Questions

I've made a map of the T Canyon for more context of what I'm trying to resolve. I've highlighted and made callouts for the two barriers that are up for debate in this thread.

Jacob Fullerton | E.I.T.

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From: Ryan Nell <RNell@intera.com>
Sent: Tuesday, February 26, 2019 9:12 AM
To: Mark Williams <MWilliams@intera.com>; Jacob Fullerton <JFullerton@intera.com>
Cc: Nichols, William E <william_e_nichols@rl.gov>; Mart Oostrom <MOostrom@intera.com>; Greg Ruskauff <gruskauff@intera.com>; Dennis G. Fryar <dfryar@intera.com>; Christelle Courbet <CCourbet@intera.com>; Batal, Wafa H (Wafa_H_Batal@rl.gov) <Wafa_H_Batal@rl.gov>
Subject: RE: Barrier Questions

Mark,

I agree with what Jacob outlined below. There are also a few liquid discharge waste sites near the T Plant that fall under 200-WA-1 which may/may not require extending the barrier. Being conservative on the barrier extent seems appropriate considering the ROD and WP language. This can also be a point of updating during RET maintenance if progress is made for these sites in the future.

For the purposes of inventory, we will assign the 200-W-20 inventory to the T Plant itself.

From: Mark Williams
Sent: Tuesday, February 26, 2019 8:59 AM
To: Jacob Fullerton <JFullerton@intera.com>
Cc: Nichols, William E <william_e_nichols@rl.gov>; Mart Oostrom <MOostrom@intera.com>; Greg Ruskauff <gruskauff@intera.com>; Dennis G. Fryar <dfryar@intera.com>; Christelle Courbet <CCourbet@intera.com>; Ryan Nell <RNell@intera.com>; Batal, Wafa H (Wafa_H_Batal@rl.gov) <Wafa_H_Batal@rl.gov>
Subject: Re: Barrier Questions

200-W-20 is an enormous footprint. It's that entire complex including many buildings, parking lots, and waste sites (which may need covers).

For T-plant to be treated like the other canyons, we need to assign it to 221-T.

This is what we are doing for the inventory in the CA (Ryan, Mart, and I looked at this for a while before). The barriers should follow that to be consistent.

Mark

On Feb 26, 2019, at 8:46 AM, Jacob Fullerton <JFullerton@intera.com> wrote:

I did more homework on this, hopefully this will help for making a decision.

I read in the work plan under the Canyons section (DOE/RL-2010-49). The text states the following:

"**T Plant:** The T Plant (221T Facility) is currently operational and has not yet been assigned to an OU. The final remedy is also expected to be similar to the remedy selected for the U Plant, except that waste sites in the vicinity of T Plant will be assigned to the same OU as the T Plant Facility. The anticipated remedy will be considered when identifying data needs and potential remedies for adjacent 200-WA-1 OU waste sites."

"**U Plant (200-CU-1):** The 221U Facility ROD (EPA et al., 2005, *Record of Decision 221-U Facility (Canyon Disposition Initiative) Hanford Site, Washington*) selected partial demolition of the canyon, void filling to stabilize contamination and mitigate subsidence potential, and placement of a surface barrier as a final remedy. Waste sites adjacent to the U Plant are likely to be covered by the barrier footprint; however, these waste sites are not addressed in the 221U Facility ROD. The barrier will be considered when identifying data needs and potential remedies for adjacent 200-WA-1 OU waste sites. The barrier footprint may be evaluated during remedial design to consider consolidation with adjacent 200-WA-1 OU waste site remedial action."

Based on this, I still come to having a barrier over 200-W-20 and 2706T until we have more information. However, I don't anticipate that in reality these locations will have barriers once the RI/FS is done for this area (unless contamination exists under the building footprint). Anyway, I present this information to you all, hopefully we can come to a consensus on what we need to do for this region.

This is important to the RET as I can't finalize a barriers coverage until we decide on these stragglers.

Jacob Fullerton | E.I.T.

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<image002.png>

From: Mark Williams <MWilliams@intera.com>
Sent: Monday, February 25, 2019 4:18 PM
To: Jacob Fullerton <JFullerton@intera.com>

Cc: Nichols, William E <william_e_nichols@rl.gov>; Mart Oostrom <MOostrom@intera.com>; Greg Ruskauff <gruskauff@intera.com>; Dennis G. Fryar <dfryar@intera.com>; Christelle Courbet <CCourbet@intera.com>; Ryan Nell <RNell@intera.com>; Batal, Wafa H (Wafa_H_Batal@rl.gov) <Wafa_H_Batal@rl.gov>
Subject: Re: Barrier Questions

As usual, I could be completely wrong. I hope others chime in to correct me.

On Feb 25, 2019, at 4:11 PM, Mark Williams <MWilliams@intera.com> wrote:

For T plant, the highly contaminated canyon building will broken up and buried in place. Definitely with a barrier. Note that we are using 221-T for the disposal waste site not 200-w-20. We attempted in get this corrected in Appendix F, but failed.

I don't think the assumption that all demolished buildings get covers is appropriate unless specific info states it will (such as the canyon building). The rubble from a lot of decommissioned buildings has gone to ERDF in the past.

Sometimes they have found contamination beneath the building after demolition. Then they've gotta do something. But they don't plan on that as far as I know.

Mark

On Feb 25, 2019, at 3:59 PM, Jacob Fullerton <JFullerton@intera.com> wrote:

Will,

I dug through the WIDS document for 200-W-20 which contains details about 2706T in addition to several other sites. It describes 2706T as a decontamination facility whose wastewater was piped over to the 211-T collection sump and thence to the 211-T collection tank system. Not having better information, 200-W-20 is currently being treated as a low-level burial ground. The optimization study states that 200-W-20 will be treated the same as T Plant, which is somewhat ambiguous as various treatments are used over T Plant area. Barriers are used in several locations within the area discussed, but it is unclear whether a barrier should be placed over the entire location.

The 2706T building and 200-W-20 are similar in their ambiguity, partially due to their coincident location, but also for the available disposition information (very little specific information). I don't have a lot more than that at the moment. If I were to continue with what I have, I would suggest that barriers be placed over the area for both the waste site and the building. This would be consistent with the EIS future end state and the PNNL Remedy references.

Jacob Fullerton | E.I.T.

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From: Nichols, William E <william_e_nichols@rl.gov>
Sent: Monday, February 25, 2019 2:00 PM
To: Jacob Fullerton <JFullerton@intera.com>; Mark Williams <MWilliams@intera.com>; Mart Oostrom <MOostrom@intera.com>
Cc: Greg Ruskauff <gruskauff@intera.com>; Dennis G. Fryar <dfryar@intera.com>; Christelle Courbet <CCourbet@intera.com>; Ryan Nell <RNell@intera.com>
Subject: RE: Barrier Questions

As a building, presumably, D&D'd down to slab on grade, I cannot imagine the need for a barrier.

Unless there is substantial subsurface contamination – do we know if this is the case?

Will Nichols

Modeling Team Leader

D 1 509 376 4553

M 1 509 551 4394

<image004.png>

<image005.gif>

<image006.png>

From: Jacob Fullerton <JFullerton@intera.com>
Sent: Friday, February 22, 2019 10:09 AM
To: Nichols, William E <william_e_nichols@rl.gov>; Mark Williams <MWilliams@intera.com>; Mart Oostrom <MOostrom@intera.com>
Cc: Greg Ruskauff <gruskauff@intera.com>; Dennis G. Fryar <dfryar@intera.com>; Christelle Courbet <CCourbet@intera.com>; Ryan Nell <RNell@intera.com>
Subject: Barrier Questions

All:

After looking through the solid waste release models again I have a question about 2706T.

The Hanford Disposition Baseline currently lists 2706T as being demolished by 2050. Do we want to treat this "Grouted Residual Waste" site as having a surface barrier over top even though it isn't officially anything other than a building?

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Changes

It has been decided after some lengthy discussion that we should have this site capped, consistent with the decisions made for the U Plant Canyon. Analogous to the 200-W-20 is the 200-W-136 of the U Plant Canyon. However, neither the B Plant nor the S Plant Canyons have large sites equivalent to 200-W-20 or 200-W-136.

D13 Site Naming Convention (MasterList Sheet)

Issues

The current site naming convention is subject to change in accordance with the unified convention currently in development for the CA/CIE projects. The changes made up to this point are included in this page (see spreadsheet below).

When this finalized list comes out, the names will need to be updated to match the unified convention. It will be crucial that the naming convention is carried forward throughout the entire workbook of the HSDB as the linked references depend on

Changes

<<Site Naming Convention - Spreadsheet.xlsx>>

SITE_NUM	Notes/Changes
116-DR-1&2	Changed "SITE_NUM" field to replace '%' with '&' to match ehsit designation
216-B-7A&B	Changed "SITE_NUM" field to replace '%' with '&' to match ehsit designation (throughout entire workbook)
216-S-1&2	Changed "SITE_NUM" field to replace '%' with '&' to match ehsit designation
216-U-1&2	Changed "SITE_NUM" field to replace '%' with '&' to match ehsit designation

Discussion:

1/23/2019

- Need to make all names compatible with Access Database format (Randy to check translation)

D14 Excel "RODs" Sheet Changes

Issues

Changes

Sites (original)	Sites (modified)	Reason
600-104	600-104_superseded	Ecology and DOE, 1997, "Action Memorandum, USDOE Hanford 100 Area NPL, 100-IU-3 Operable Unit (Wahluke Slope), Hanford Site, Adams, Grant, and Franklin Counties, WA"
216-Z-19 Ditch	216-Z-19	
216-Z-1D Ditch	216-Z-1D	
216-Z-20 Tile Field	216-Z-20	
216-Z-8 French drain	216-Z-8	
241-Z-8 settling tank	241-Z-8	
628-4 (Landfill 1d)	628-4	
JA Jones #1	JA JONES 1	

D15 Excel "Action Memos" Sheet Changes

Issues

Changes

Sites ID (original)	Sites ID (modified)
600 OCL	600 OCL

D16 218-W-4C

Issues

There is a conflict between DOE guidance in DOE/RL-2000-70 Rev. 0 and a later action memo (DOE, EPA, and Ecology, 2004, "Action Memorandum: U.S. Department of Energy, 200 Area, Burial Ground 218-W-4C Waste Retrieval, Hanford Site, Benton County, Washington," U.S. Department of Energy, Richland Operations Office; U.S. Environmental Protection Agency; and Washington State Department of Ecology, Richland, Washington, April 19.)

Because the Action Memo is ambiguous about a definitive action to take place (can be indefinitely postponed) the decision is to assume an ET Cap/Barrier over the waste site area until the action memo is carried out or superseded by a later regulatory decision.

Changes

Jacob Fullerton

From: Nichols, William E <william_e_nichols@rl.gov>
Sent: Thursday, March 14, 2019 3:51 PM
To: Jacob Fullerton; Mark Williams; Mart Oostrom; Greg Ruskauff; Ryan Nell
Cc: Batal, Wafa H; Wafa Batal
Subject: RE: 218-W-4C

Judgment call, and I suppose I get to be the judge.

My coin flip is to assume indefinite delay and no RTD. This is an assumption – and of course needs to be documented.

Will Nichols
Modeling Team Leader
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From: Jacob Fullerton <JFullerton@intera.com>
Sent: Thursday, March 14, 2019 3:48 PM
To: Mark Williams <MWilliams@intera.com>; Mart Oostrom <MOostrom@intera.com>; Greg Ruskauff <gruskauff@intera.com>; Nichols, William E <william_e_nichols@rl.gov>; Ryan Nell <RNell@intera.com>
Cc: Batal, Wafa H <wafa_h_batal@rl.gov>; Wafa Batal <WBatal@intera.com>
Subject: RE: 218-W-4C

Just want to revive this question because I haven't had an answer on this.

Jacob Fullerton | E.I.T.

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From: Jacob Fullerton
Sent: Monday, March 11, 2019 1:52 PM
To: Mark Williams <MWilliams@intera.com>; Mart Oostrom <MOostrom@intera.com>; Greg Ruskauff

<GRuskauff@intera.com>; Nichols, William E <william_e_nichols@rl.gov>; Ryan Nell <RNell@intera.com>
Subject: 218-W-4C

All:

While preparing a site list for a presentation on the sites currently known to have a ROD or Action Memo I came across a case that needs clarification. 218-W-4C has a signed Action Memo from 2009 (DOE/RL-2009-86 Rev.0) to "RTD" the site. However, following guidance from DOE/RL-2000-70 we would put a barrier over the top, but of course the Action Memo would take precedence in this case as it has a later date.

The question I have relevant to the RET and HSDB is whether we would do a source removal plan for this site given that the Action Memo doesn't actually have a time for completion and could possibly be delayed indefinitely (stated in the Action Memo). The current designation is that this LLBG is active without immediate plans to carry out this Action Memo based on what I can see in the HSDB.

I'll keep my eyes open to other such cases.

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D17 CP-63386 Documentation

Additional changes made to the HSDB are described in Document CP-63386 and documented in the following spreadsheets:

- CA_CIE_Disposition_04.24.2019.xlsx
- Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx

It is possible that the changes described in Section 2 – 16 were overwritten by changes made in the CP-63386 document. The changes made in the CP-63386 document are the final and accepted alterations to the HSDB for incorporation into the RET.

Changes were made to the following site numbers.

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
UPR-200-E-83
OCSA
CWC
GTFL
600-38
600-354
600 CL
216-B-3-1
200-E-304
UPR-600-20
218-W-6
600-355
600-60
200 CP
200-E-109
200-W BP
UPR-200-E-37
600-364
600-70
GTF
200-W-33
600 NRDWL
200-E-17
200-A TEDF

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
200-E-100
200-E-102
200-E-103
200-E-107
200-E-136
200-E-25
200-E-28
200-E-30
200-E-4
200-E-41
200-E-54
200-E-55
200-E-56
200-E-57
200-E-60
200-E-61
200-E-62
200-E-63
200-E-64
200-E-65
200-E-67
200-E-68
200-E-69
200-E-70

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
200-E BP
271-U
216-A-29
291-U
291-U-1
216-B-3A
200-W ADB
600-388
WRAP
200-W-136
292-U
216-N-8
200-W-54
300-10
600-214
300-109
300-18
300-224
300-258
300-259
UPR-200-W-41
200-W-53
600-220
UPR-300-FF-1
300-270
300-274
600-361
200-E-296
600-36
300-275
200-W-236
200-E-44
300-276
200-W-245
300-277
200-W-246
UPR-200-W-117
300-52

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
200-E-71
200-E-72
200-E-73
200-E-74
200-E-75
200-E-76
200-E-77
200-E-78
200-E-79
200-E-80
200-E-81
200-E-82
200-E-84
200-E-88
200-E-89
200-E-90
200-E-91
200-E-92
200-E-93
200-E-94
200-E-95
200-E-97
200-E-98
200-E-99
200-W PP
200-W-20
200-W-22
200-W-42
200-W-44
200-W-45
200-W-52
200-W-72
200-W-9
201-C
202-S
2101-M POND
212-B
216-A-1

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
200-E-13
400-40
200 ETF
UPR-200-W-161
216-B-59B
300-279
300-286
300-289
UPR-200-W-65
200-W-11
202-A
UPR-200-W-76
UPR-200-E-69
UPR-200-E-144
UPR-200-E-64
216-S-16D
UPR-200-W-99
216-T-4-1D
600-362
200-E PD
300-32
300-4
200-W-247
218-W-11
UPR-200-W-167
618-2
200-E-295
600-360
600-391
216-B-2-3
200-W-71
300-45
200-E-139
216-A-42
200-E-121
207-S
2607-W16
600-398

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
216-A-10
216-A-11
216-A-12
216-A-13
216-A-14
216-A-15
216-A-16
216-A-17
216-A-18
216-A-19
216-A-2
216-A-20
216-A-21
216-A-22
216-A-23A
216-A-23B
216-A-24
216-A-25
216-A-26
216-A-26A
216-A-27
216-A-28
216-A-3
216-A-30
216-A-31
216-A-32
216-A-35
216-A-36A
216-A-36B
216-A-37-1
216-A-37-2
216-A-39
216-A-4
216-A-40
216-A-41
216-A-45
216-A-5
216-A-6

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
300-7
207-U
300-8
200-E-46
216-B-3-2
200-E-294
600-62
218-E-9
216-S-18
300-9
303-M SA
303-M UOF
618-3
221-B-WS-2
200-E-24
200-E-29
216-S-11
JA JONES 1
CTFN 2703-E
600-49
316-1
200-E-5
316-2
UPR-200-E-89
216-B-64
200-W-240
200-W-13
316-4
UPR-200-W-115
400-42
316-5
200-E-43
200-W-239
618-1
333 ESHWSA
333 WSTF
6607-16
600-278

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
216-A-7
216-A-8
216-A-9
216-B-10A
216-B-10B
216-B-11A&B
216-B-12
216-B-13
216-B-14
216-B-15
216-B-16
216-B-17
216-B-18
216-B-19
216-B-20
216-B-21
216-B-2-1
216-B-22
216-B-2-2
216-B-23
216-B-24
216-B-25
216-B-26
216-B-27
216-B-28
216-B-29
216-B-3
216-B-30
216-B-31
216-B-32
216-B-33
216-B-34
216-B-35
216-B-36
216-B-37
216-B-38
216-B-39
216-B-3A RAD

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
200-W-87
207-A-NORTH
207-A-SOUTH
207-B
216-A-38-1
216-T-4-2
300-50
400 PPSS
218-E-2A
207-T
200-W-55
216-B-3-3
600-281
UPR-200-W-71
200-E-135
200-E-287
300-49
400-37
200-E-297
UPR-200-W-116
6241-V
6241-A
200-W-243
200-W-127
UPR-200-E-95
400-38
200-E-7
216-T-4B
600-109
600-334
200-E-53
600-110
200-N-3
600-387
600 OCL
200-W-64
244-A LS
200-E-2

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
216-B-3B RAD
216-B-3C RAD
216-B-4
216-B-40
216-B-41
216-B-42
216-B-43
216-B-44
216-B-45
216-B-46
216-B-47
216-B-48
216-B-49
216-B-5
216-B-50
216-B-51
216-B-52
216-B-53A
216-B-53B
216-B-54
216-B-55
216-B-57
216-B-58
216-B-59
216-B-6
216-B-60
216-B-62
216-B-63
216-B-7A&B
216-B-8
216-B-9
216-BY-201
216-C-1
216-C-10
216-C-2
216-C-3
216-C-4
216-C-5

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
200-W-249
216-A-34
200-W-67
216-S-10D
218-W-9
600-359
600-186
200-E-45
600-227
600-202
600-282
600-288
200-W-81
600-389
241-EW-151
UPR-200-N-1
200-W-172
400-31
UPR-600-12
242-A
616
300-51
200-W-241
622-R ST
200-W-89
600-205
200-W-43
600-228
600-208
2727-S
UPR-200-E-100
242-S
200-E-300
600-40
200-W-63
200-W-1
244-AR VAULT
600-337

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
216-C-6
216-C-7
216-C-8
216-C-9
216-N-1
216-N-2
216-N-3
216-N-4
216-N-5
216-N-6
216-N-7
216-S-1&2
216-S-10P
216-S-12
216-S-13
216-S-14
216-S-15
216-S-16P
216-S-17
216-S-19
216-S-20
216-S-21
216-S-22
216-S-23
216-S-25
216-S-26
216-S-3
216-S-4
216-S-5
216-S-6
216-S-7
216-S-8
216-S-9
216-SX-2
216-T-1
216-T-12
216-T-14
216-T-15

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
200-E-110
600-23
600-320
200-W-253
200-W-104
200-W-92
200-W-106
200-E-292
242-T
600-239
200-W-14
UPR-200-W-164
600-71
300-44
244-CR VAULT
218-W-8
2607-EE
600-390
600-316
600-259
200-E-124
291-C
2607-WT
204-AR
200-W-6
221-T CSTF
600-325
207-SL
600-272
6607-5
600-322
UPR-200-W-14
600-321
200-W-21
600-365
600-323
2727-WA
2607-EJ

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
216-T-16
216-T-17
216-T-18
216-T-19
216-T-2
216-T-20
216-T-21
216-T-22
216-T-23
216-T-24
216-T-25
216-T-26
216-T-27
216-T-28
216-T-29
216-T-3
216-T-32
216-T-33
216-T-34
216-T-35
216-T-36
216-T-4A
216-T-5
216-T-6
216-T-7
216-T-8
216-TY-201
216-U-1&2
216-U-10
216-U-12
216-U-13
216-U-14
216-U-15
216-U-16
216-U-17
216-U-3
216-U-4
216-U-4A

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
207-Z
600-336
6607-4
200-E-26
200-E-16
200-E-293
600-324
UPR-200-W-48
600-327
241-A-151
241-TX-153
200-W-251
200-W-237
200-W-80
241-TXR-151
4843
200-W-83
244-BXR VAULT
200-E-6
600-328
240-S-151
200-E-115
241-TX-155
241-C-801
216-T-13
200-W-231
6607-2
241-TXR-152
244-UR VAULT
600-318
241-BXR-152
600-329
244-TXR VAULT
241-BYR-152
241-BR-152
241-TXR-153
241-BXR-153
241-AP VP

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
216-U-4B
216-U-5
216-U-6
216-U-7
216-U-8
216-W-LWC
216-Z-1&2
216-Z-10
216-Z-11
216-Z-12
216-Z-13
216-Z-14
216-Z-15
216-Z-16
216-Z-17
216-Z-18
216-Z-19
216-Z-1A
216-Z-1D
216-Z-20
216-Z-21
216-Z-3
216-Z-4
216-Z-5
216-Z-6
216-Z-7
216-Z-8
216-Z-9
218-C-9
218-E-1
218-E-10
218-E-12A
218-E-12B
218-E-14
218-E-15
218-E-2
218-E-4
218-E-5

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
600-59
222-SD
241-BYR-153
241-TY-153
216-T-11
241-UR-153
241-CR-151
241-UR-152
600-342
216-T-9
241-SX-402
216-T-10
600-353
241-SX-401
241-CR-153
241-UX-302A
241-UR-154
241-TR-152
244-BX DCRT
600-187
241-CR-152
2607-WUT
200-W-101
241-SX-151
241-BYR-154
241-UX-154
UPR-200-W-60
241-A-152
600-400
241-SX-302
2607-WTX
244-TX DCRT
241-ER-151
241-UR-151
244-S DCRT
241-A-417
200-W-76
244-U DCRT

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
218-E-5A
218-E-8
218-W-1
218-W-1A
218-W-2
218-W-2A
218-W-3
218-W-3A
218-W-3AE
218-W-4A
218-W-4B
218-W-4C
218-W-5
218-W-REACTOR
221-B
221T
221-U
222-S
224-B
224-T
231Z
232-Z
233-S
234-5Z
236Z
241-A-ANC
241-A-101
241-A-102
241-A-103
241-A-104
241-A-105
241-A-106
241-AN-ANC
241-AN-101
241-AN-102
241-AN-103
241-AN-104
241-AN-105

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
200-E-130
600-343
200-W-58
600-262
600-224
200-E-27
200-W-73
241-TX-154
UPR-200-W-112
241-BXR-151
600-319
600-350
241-S-151
200-W-82
600-356
200-W-90
600-367
200-W-144
600-378
600-386
200-E-9
200-E-299
200-W-85
241-BX-302C
200-E-123
200-W-59
600-46
218-W-7
332 SF
241-AX-151
200-E-301
UPR-600-15
600-326
200-W-12
200-W-15
241-CX-70
241-ER-311
241-ER-311A

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
241-AN-106
241-AN-107
241-AP-ANC
241-AP-101
241-AP-102
241-AP-103
241-AP-104
241-AP-105
241-AP-106
241-AP-107
241-AP-108
241-AW-ANC
241-AW-101
241-AW-102
241-AW-103
241-AW-104
241-AW-105
241-AW-106
241-AX-ANC
241-AX-101
241-AX-102
241-AX-103
241-AX-104
241-AY-ANC
241-AY-101
241-AY-102
241-AZ-ANC
241-AZ-101
241-AZ-102
241-B-ANC
241-B-101
241-B-102
241-B-103
241-B-104
241-B-105
241-B-106
241-B-107
241-B-108

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
600-47
241-A-431
241-TR-153
241-B-154
200-E-298
241-S-302A
241-BX-302A
240-S-302
200-E-118
241-TX-302C
UPR-200-E-67
241-B-302B
241-TY-302A
241-TX-302A
200-E-14
241-C-252
241-BX-153
241-AZ-152
UPR-200-W-108
241-TX-302B
2607-W14
241-B-252
200-W-128
241-T-252
241-B-301
UPR-200-W-109
241-C-301
600-63
241-T-301B
200-E-285
241-C-153
200-E-117
241-U-252
200-E-129
241-S-302B
241-U-152
UPR-200-W-114
241-U-153

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
241-B-109
241-B-110
241-B-111
241-B-112
241-B-153
241-B-201
241-B-202
241-B-203
241-B-204
241-B-361
241-BX-ANC
241-BX-101
241-BX-102
241-BX-103
241-BX-104
241-BX-105
241-BX-106
241-BX-107
241-BX-108
241-BX-109
241-BX-110
241-BX-111
241-BX-112
241-BY-ANC
241-BY-101
241-BY-102
241-BY-103
241-BY-104
241-BY-105
241-BY-106
241-BY-107
241-BY-108
241-BY-109
241-BY-110
241-BY-111
241-BY-112
241C
241-C-101

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
618-10
276-S-142
241-TY-302B
200-W-36
618-11
200-E-125
241-SX-152
241-AY-152
231-W-151
276-S-141
241-C-152
241-B-152
241-A-302B
218-E-7
241-TX-302XB
618-12
241-ER-153
241-TX-302BR
241-T-152
241-AX-152DS
2607-W10
UPR-200-N-2
292-S
6607-18
618-4
241-BX-302B
200-W-252
618-5
242-TA-R1
241-U-151
241-T-151
241-T-153
241-AN-B
618-7
2607-W12
2607-W11
2607-W15
240-S-152

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
241-C-102
241-C-103
241-C-104
241-C-105
241-C-106
241-C-107
241-C-108
241-C-109
241-C-110
241-C-111
241-C-112
241-C-201
241-C-202
241-C-203
241-C-204
241-CX-72
241-S-ANC
241-S-101
241-S-102
241-S-103
241-S-104
241-S-105
241-S-106
241-S-107
241-S-108
241-S-109
241-S-110
241-S-111
241-S-112
241-SX-ANC
241-SX-101
241-SX-102
241-SX-103
241-SX-104
241-SX-105
241-SX-106
241-SX-107
241-SX-108

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
241-AN-A
241-BX-155
241-S-A
241-C-151
600-314
241-B-151
241-S-D
241-SX-A
241-S-B
241-U-B
200-W-242
241-AW-A
241-AX-B
6607-13
241-SX-B
241-AX-A
241-SY-A
241-S-C
241-AW-B
241-A-153
241-U-D
241-U-A
2607-E13
241-U-C
241-ER-152
200-E-137
241-A-B
241-A-A
241-A-302A
241-SY-B
600-212
241-BX-154
241-AX-155
296-A-13
216-A-508
216-A-524
200-W-77
270-W

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
241-SX-109
241-SX-110
241-SX-111
241-SX-112
241-SX-113
241-SX-114
241-SX-115
241-SY-ANC
241-SY-101
241-SY-102
241-SY-103
241-T-ANC
241-T-101
241-T-102
241-T-103
241-T-104
241-T-105
241-T-106
241-T-107
241-T-108
241-T-109
241-T-110
241-T-111
241-T-112
241-T-201
241-T-202
241-T-203
241-T-204
241-T-361
241-TX-ANC
241-TX-101
241-TX-102
241-TX-103
241-TX-104
241-TX-105
241-TX-106
241-TX-107
241-TX-108

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
270-E-1
200-E-284
200-E-58
241-AR-151
2904-S-171
242-T-151
300 SE
6607-8
242-B-151
216-S-172
UPR-200-W-3
600-65
6607-17
334 TFWAST
241-TX-152
6607-6
2607-EF
241-AZ-151DS
200-E-223
2607-ES
200-W-232
2904-S-160
241-S-152
241-AY-151
241-S-304
219-S-101
219-S-102
241-C-154
200-W-7
334-A-TK-B
334-A-TK-C
200-W-86
241-AX-501
618-8
241-AX-IX
200-E-179
628-4
600-37

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
241-TX-109
241-TX-110
241-TX-111
241-TX-112
241-TX-113
241-TX-114
241-TX-115
241-TX-116
241-TX-117
241-TX-118
241-TY-ANC
241-TY-101
241-TY-102
241-TY-103
241-TY-104
241-TY-105
241-TY-106
241-U-ANC
241-U-101
241-U-102
241-U-103
241-U-104
241-U-105
241-U-106
241-U-107
241-U-108
241-U-109
241-U-110
241-U-111
241-U-112
241-U-201
241-U-202
241-U-203
241-U-204
241-U-361
241-WR VAULT
241-Z
241-Z-361

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
200-W-75
200-E-190
200-E-189
219-S-104
219-S-103
HSVP
200-W-126
216-A-33
600-58
200-E-138
UPR-300-7
200-W-238
200-E-141
241-CX-71
241-A-702-WS-1
209-E-WS-2
UPR-200-E-56
616-WS-1
200-W-16
UPR-200-W-64
UPR-200-E-54
200-E-128
221-T-6-1
UPR-200-W-67
UPR-200-W-110
600-66
200-E-303
UPR-200-E-33
UPR-200-E-101
UPR-200-E-66
221-B-27-4
200-W-119
UPR-200-E-43
UPR-200-E-35
UPR-200-W-43
UPR-200-E-50
UPR-200-E-10
296-S-21

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
241-Z-8
242-Z
2607-E1
2607-E10
2607-E11
2607-E12
2607-E1A
2607-E3
2607-E4
2607-E5
2607-E6
2607-E7A
2607-E8
2607-E8A
2607-E9
2607-EA
2607-EB
2607-EC
2607-ED
2607-EG
2607-EK
2607-EL
2607-EM
2607-EP
2607-EQ
2607-ER
2607-FSN
2607-W1
2607-W2
2607-W3
2607-W4
2607-W5
2607-W6
2607-W7
2607-W8
2607-W9
2607-WA
2607-WB

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
UPR-200-W-36
UPR-200-E-19
UPR-300-30
221-B-WS-1
UPR-300-38
UPR-300-22
UPR-300-28
UPR-200-E-2
200-W-116
UPR-200-E-99
UPR-200-E-45
UPR-200-W-55
202-A-G7
221-B SDT
221-B-29-4
221-B-28-3
241-AZ-154
UPR-200-W-56
200-W-115
221-T-5-6
244-A CT
UPR-200-W-35
UPR-200-W-57
202-A-WS-1
241-A-350
UPR-200-E-52
2704-C-WS-1
400-5
UPR-300-25
UPR-300-47
UPR-200-W-78
221-B-28-4
UPR-200-W-165
202-A-F16
UPR-300-20
UPR-200-W-51
202-A-F15
299-E24-111

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
2607-WC
2607-WL
2607-Z
2607-Z1
2706T
2736Z
291-C-1
291-S
291Z
600-211
6607-9
T31
T34
TRUSAF
UPR-200-E-1
UPR-200-E-105
UPR-200-E-107
UPR-200-E-108
UPR-200-E-109
UPR-200-E-110
UPR-200-E-117
UPR-200-E-119
UPR-200-E-141
UPR-200-E-145
UPR-200-E-16
UPR-200-E-17
UPR-200-E-29
UPR-200-E-3
UPR-200-E-38
UPR-200-E-39
UPR-200-E-40
UPR-200-E-7
UPR-200-E-73
UPR-200-E-74
UPR-200-E-75
UPR-200-E-77
UPR-200-E-78
UPR-200-E-79

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
221-B NANU
UPR-300-8
221-T-5-9
221-B-27-3
209-E-WS-3
202-A-E-F11
200-W-121
200-W-117
UPR-200-E-103
200-W-113
UPR-200-E-21
UPR-200-E-18
200-E-59
2607-E7B
UPR-200-E-55
UPR-600-21
UPR-200-W-6
221-T-15-1
UPR-300-46
UPR-200-E-72
200-W-51
UPR-200-W-111
2607-WZ
UPR-200-E-42
300-3
202-A-E5
200-W-3
221-T-11-R
UPR-200-E-62
UPR-200-E-20
UPR-200-W-166
UPR-300-15
HWVP
UPR-300-23
UPR-200-W-4
202-A-U4
UPR-200-W-124
UPR-200-E-12

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
UPR-200-E-80
UPR-200-E-81
UPR-200-E-82
UPR-200-E-84
UPR-200-E-85
UPR-200-E-86
UPR-200-E-87
UPR-200-E-9
UPR-200-W-100
UPR-200-W-102
UPR-200-W-103
UPR-200-W-113
UPR-200-W-12
UPR-200-W-127
UPR-200-W-130
UPR-200-W-131
UPR-200-W-132
UPR-200-W-135
UPR-200-W-138
UPR-200-W-162
UPR-200-W-163
UPR-200-W-19
UPR-200-W-2
UPR-200-W-20
UPR-200-W-21
UPR-200-W-24
UPR-200-W-28
UPR-200-W-29
UPR-200-W-32
UPR-200-W-33
UPR-200-W-38
UPR-200-W-39
UPR-200-W-61
UPR-200-W-74
UPR-200-W-8
UPR-200-W-82
UPR-200-W-87
UPR-200-W-95

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
200-W-250
600-226
200-W-2
200-E8 BPDS
UPR-200-E-96
UPR-300-27
202-A-U3
200-W ADS
UPR-200-W-118
296-S-16
600-394
UPR-300-29
242-T-135
UPR-300-19
UPR-200-E-98
216-B-3C
UPR-300-9
221-B SHNU
200-W-171
UPR-300-21
2904-S-170
221-B-30-3
216-B-3B
202-A-F18
UPR-200-W-5
200-W-122
UPR-200-W-70

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
UPR-200-W-96
UPR-200-W-97
UPR-200-W-98
WESF

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx	CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
221-T-5-7	
200-E-142	
UPR-200-E-91	
UPR-200-E-143	
UPR-300-26	
200-W-120	
213-W-1	
200-E-1	
437 MASF	
200-W-114	
UPR-200-E-44	
241-U-301	
200-W-112	
UPR-200-W-46	
UPR-300-24	
UPR-600-11	
296-S-13	
200-W-118	
221-B-26-1	
UPR-200-W-23	
UPR-200-E-28	
333-TK-7	
333-TK-11	
UPR-600-22	
200-E-302	

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx	CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
216-T-31	
200-W-234	
244-CR-WS-1	
600-237	
218-E-12B ANNEX	
600-246	
200-W-25	
200-E-21	
216-E-28	
200-E-20	
600-240	
200-E-19	
200-W-26	
200-E-49	
200-W-29	
600-248	
200-E-140	
200-W CSLA	
200-E-286	
200-W-28	
218-W-4C ANNEX	
200-W-24	
600-97	
200-E PAP	
200-E-280	

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
600-206
200-W-123
600-276
600-247
600-50
200-E-52
600-245
400-17
600-96
200-W PAP
600-207
200-W-27
400-6
200-E-42
200-W-62
300-220
200-E-314
600-118
400-18
400-1
400-8
600-250
600-26
622-1
400-2

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx	CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
400-4	
200-E-23	
600-117	
200-E-101	
600-1	
400-35	
600-406	
200-E-122	
400-13	
600-27	
200-W-70	
600-236	
600-169	
203-S & 205-S	
UPR-200-E-93	
600-39	
600-357	
600-283	
400-3	
200-E-12	
600-153	
UPR-200-W-104	
216-B-61	
UPR-200-W-105	
600-20	

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
600-216
400-39
UPR-200-W-106
UPR-200-E-92
600-266
600-210
400-11
600 BPHWSA
212-R
212-P
200-E-35
218-E-3
200-E-315
200-W-74
600-53
600-268
400 RSP
200-E-51
216-B-56
400-19
200-W-57
276-U
242-B
400-16
200-W-35

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
200-W-61
276-S
400-14
600-185
200-E-318
UPR-200-W-49
200-E-306
600-69
226-B HWSA
200-E-313
600-223
215-C
4831 LHWSA
200-E-312
600-192
200-E-307
6607-3
200-W-40
213-W
400-7
600-215
293-S
291-S-1
400 SBT
200-W-46

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
200-W-56
200-E-8
200-E-317
217-B NU
200-E-50
427 HWSA
200-W-60
600-260
6607-1
600-219
233-SA
200-E-319
600-156
4713-B HWSA
200-W-10
200-E-316
2718-S
2711-S
600-217
333 LHWSA
200-W-145
200-W-49
200-W-66
600-333
UPR-300-13

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx	CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
2718-E-WS-1	
2904-SA	
200-W-103	
600-330	
600-335	
200-E-105	
UPR-200-W-44	
400 RST	
UPR-200-E-34	
296-S-12	
296-S-7	
200-W-41	
200-W-68	
UPR-200-W-160	
2607-R	
400-22	
211-A NU	
200-W-37	
400 FD5	
UPR-200-W-45	
UPR-200-E-15	
UPR-200-E-22	
400 FD10A	
UPR-200-W-89	
241-AX-152CT	

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
UPR-200-E-53
2607-GF
UPR-200-W-77
UPR-200-W-126
UPR-200-W-134
UPR-200-E-97
UPR-200-E-133
UPR-200-W-143
400 FD1A
300-79
UPR-200-W-140
218-E-6
200-W-108
UPR-200-W-86
400-20
UPR-600-9
UPR-200-W-156
UPR-200-W-159
200-E-3
UPR-200-E-142
TFS OF 218-E-4
241-T-302
UPR-200-E-137
UPR-200-E-36
UPR-200-E-125

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx	CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
UPR-200-E-127	
UPR-200-E-129	
UPR-200-E-132	
UPR-200-E-106	
600-155	
2703-E HWSA	
400 FD2	
UPR-200-W-148	
UPR-200-W-83	
200-W-109	
296-S-1	
400-21	
UPR-200-W-17	
400-25	
UPR-600-10	
600-265	
UPR-200-W-157	
UPR-200-W-13	
200-W-18	
UPR-200-E-4	
UPR-200-E-114	
UPR-200-W-144	
UPR-200-W-154	
400-23	
UPR-200-W-79	

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx	CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
UPR-200-E-126	
600-256	
UPR-200-E-49	
UPR-200-E-140	
200-E-47	
UPR-200-W-129	
UPR-600-5	
UPR-200-W-150	
234-5Z HWSA	
224-U CNT	
UPR-200-W-90	
UPR-200-W-91	
UPR-200-E-138	
UPR-200-W-80	
UPR-200-W-141	
400-26	
4721 FD	
296-S-4	
200-W-17	
2704-E HWSA	
UPR-200-W-81	
UPR-200-W-145	
UPR-200-W-72	
UPR-200-E-61	
400 STF	

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx	CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
UPR-600-4	
200-W-4	
2607-WWA	
UPR-200-W-137	
UPR-200-W-88	
UPR-200-W-26	
UPR-200-W-34	
UPR-200-E-118	
UPR-200-E-128	
400 FD10	
UPR-200-E-134	
200-E-11	
UPR-200-W-68	
UPR-200-W-7	
UPR-200-E-65	
UPR-200-W-153	
400 RFD	
UPR-600-1	
UPR-200-E-59	
400-9	
400-10	
400 SS	
300-21	
UPR-200-W-59	
UPR-200-W-42	

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx	CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
200-W-111	
UPR-200-E-63	
UPR-200-W-75	
UPR-200-E-58	
400 FD9	
UPR-200-E-136	
296-S-2	
UPR-200-E-26	
UPR-200-W-37	
224-U HWSA	
UPR-200-E-94	
UPR-200-W-152	
UPR-200-E-27	
200-W-65	
4722-C FD	
2607-EH	
400 FD4	
UPR-200-E-30	
UPR-300-14	
UPR-400-1	
UPR-200-E-32	
UPR-200-E-70	
400 FD7	
200-E-119	
4713-B FD	

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx	CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx
UPR-200-W-149	
UPR-200-E-23	
UPR-600-7	
400-12	
400 FD3	
UPR-200-W-84	
403 FD	
UPR-200-W-69	
UPR-200-W-128	
200-W-32	
UPR-200-W-16	
UPR-200-E-25	
UPR-200-W-52	
UPR-200-E-116	
UPR-200-E-76	
UPR-200-E-68	
205-A	
UPR-200-E-135	
UPR-200-W-147	
UPR-200-E-51	
UPR-200-W-85	
UPR-200-E-115	
200-W-110	
UPR-200-W-40	
UPR-600-6	

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
200-W-47
UPR-200-E-24
200-W-107
UPR-200-W-107
UPR-200-W-142
4713-B LDFD
UPR-200-E-31
400 FD1B
4722 PSHWSA
4722-B FD
UPR-200-W-47
202-A NU
UPR-200-E-60
2607-Z8
296-U-10
UPR-200-W-146
UPR-200-E-131
UPR-200-W-53
UPR-200-W-50
2715-EA HWSA
400-15
241-AZ-151CT
UPR-200-E-90
UPR-200-E-130
UPR-200-E-14

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx	**CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx**
296-S-6	
400 FD6	
UPR-200-W-151	
200-W-31	
UPR-600-3	
UPR-200-W-15	
600-251	
200-E-48	
UPR-600-2	
400-36	
400 FD8	
UPR-200-E-5	
UPR-200-W-123	
UPR-200-W-10	
200-W-19	
202-A HWSA	
200-W-48	
200-W-124	
UPR-200-E-48	
400-24	
UPR-200-E-47	
UPR-200-W-155	
UPR-600-8	
200-W-30	
600-404	

SITE_NUM From Non_CA_CIE_Waste_Sites_Updated_4.25.19.xlsx
2607-P
209-E-WS-1

CA_CIE_Site From CA_CIE_Disposition_04.24.2019.xlsx

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Appendix E

RET Software Installation and Checkout Form

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CHPRC SOFTWARE INSTALLATION AND CHECKOUT FORM

Software Owner Instructions:
Complete Fields 1-13, then run test cases in Field 14. Compare test case results listed in Field 15 to corresponding Test Report outputs. If results are the same, sign and date Field 19. If not, resolve differences and repeat above steps.

Software Subject Matter Expert Instructions:
Assign test personnel. Approve the installation of the code by signing and dating Field 21, then maintain form as part of the software support documentation.

GENERAL INFORMATION:

1. Software Name: Recharge Evolution Tool (RET) Software Version No.: Bld 2

EXECUTABLE INFORMATION:

2. Executable Name (include path):
\RET\Build 002\CA RET v3.3.1.py"
3. Executable Size (bytes): 132,000

COMPILATION INFORMATION:

4. Hardware System (i.e., property number or ID):
Not Applicable
5. Operating System (include version number):
Not Applicable

INSTALLATION AND CHECKOUT INFORMATION:

6. Hardware System (i.e., property number or ID):
INTERA-00771
7. Operating System (include version number):
Windows 10 Professional 64-bit, version: 1903
8. Open Problem Report? ◉ No ○ Yes PR/CR No.

TEST CASE INFORMATION:

9. Directory/Path:
\RET\Build 002"
10. Procedure(s):
CHPRC-04002 Rev. 1
11. Libraries:
Not Applicable
12. Input Files:
\RET\Build 002\RET STP Data 1-3.gdb"
13. Output Files:
\RET\Build 002"
14. Test Cases:
\RET\Build 002"
15. Test Case Results:
\RET\Build 002"
16. Test Performed By: Jacob Fullerton
17. Test Results: ◉ Satisfactory, Accepted for Use ○ Unsatisfactory
18. Disposition (include HISI update):
Accepted; installation added to HISI Entry -WEN

CHPRC SOFTWARE INSTALLATION AND CHECKOUT FORM (continued)

1. Software Name: Recharge Evolution Tool (RET) Software Version No.: Bld 2

Prepared By:

19. WILLIAM NICHOLS (Affiliate) Digitally signed by WILLIAM NICHOLS (Affiliate) Date: 2019.12.18 15:32:00 -08'00' | William Nichols |

Software Owner (Signature) | Print | Date

20. Test Personnel:

[signature] | Jacob Fullerton | 12/18/19

Sign | Print | Date

Sign | Print | Date

Sign | Print | Date

Approved By:

21. | Not required per SMP |

Software SME (Signature) | Print | Date

A-6005-149 (REV 0)

Appendix F

Sites Recommended for Further Evaluation

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Table F-1. Sites Recommended for Additional Research

Site_ID						
100-B (A) Riverlines	100-C-6:1	100-D-31:3	100-D-67	100-D-98	100-F-38	100-H-14
100-B (B) Riverlines	100-C-6:2	100-D-31:4	100-D-68	100-D-98:1	100-F-39	100-H-17
100-B-1	100-C-6:3	100-D-31:5	100-D-69	100-D-98:2	100-F-4	100-H-2
100-B-10	100-C-6:4	100-D-31:6	100-D-7	100-D-98:3	100-F-42	100-H-21
100-B-12	100-C-7	100-D-31:7	100-D-70	100-D-99	100-F-43	100-H-22
100-B-14:1	100-C-7:1	100-D-31:8	100-D-72	100-DR Riverlines	100-F-44	100-H-24
100-B-14:2	100-C-9:1	100-D-31:9	100-D-73	100-F (A) Riverlines	100-F-44:1	100-H-28
100-B-14:3	100-C-9:2	100-D-32	100-D-74	100-F (B) Riverlines	100-F-44:2	100-H-28:1
100-B-14:4	100-C-9:3	100-D-4	100-D-75	100-F-10	100-F-44:4	100-H-28:2
100-B-14:5	100-C-9:4	100-D-42	100-D-75:1	100-F-11	100-F-44:5	100-H-28:3
100-B-14:6	100-D (A) Riverlines	100-D-43	100-D-75:2	100-F-12	100-F-44:8	100-H-28:4
100-B-14:7	100-D (B) Riverlines	100-D-45	100-D-75:3	100-F-14	100-F-44:9	100-H-28:5
100-B-15	100-D-1	100-D-46	100-D-77	100-F-15	100-F-45	100-H-28:6
100-B-16	100-D-100	100-D-47	100-D-78	100-F-16	100-F-46	100-H-28:8
100-B-18	100-D-101	100-D-48:1	100-D-80	100-F-18	100-F-48	100-H-30
100-B-19	100-D-102	100-D-48:2	100-D-80:1	100-F-19:1	100-F-49	100-H-31
100-B-2	100-D-103	100-D-48:3	100-D-80:2	100-F-19:2	100-F-50	100-H-34
100-B-20	100-D-104	100-D-48:4	100-D-81	100-F-19:3	100-F-51	100-H-35
100-B-21	100-D-105	100-D-49:1	100-D-82	100-F-2	100-F-52	100-H-36
100-B-21:1	100-D-106	100-D-49:2	100-D-83	100-F-20	100-F-53	100-H-37
100-B-21:2	100-D-107	100-D-49:3	100-D-83:1	100-F-23	100-F-54	100-H-38
100-B-21:3	100-D-108	100-D-49:4	100-D-83:2	100-F-24	100-F-55	100-H-4
100-B-21:4	100-D-109	100-D-50	100-D-83:3	100-F-25	100-F-56	100-H-40
100-B-22	100-D-12	100-D-50:1	100-D-83:4	100-F-26:1	100-F-56:1	100-H-41
100-B-22:1	100-D-14	100-D-50:10	100-D-83:5	100-F-26:10	100-F-56:2	100-H-42
100-B-22:2	100-D-15	100-D-50:2	100-D-84	100-F-26:11	100-F-57:1	100-H-43
100-B-23	100-D-18	100-D-50:5	100-D-84:1	100-F-26:12	100-F-57:2	100-H-44
100-B-24	100-D-2	100-D-50:6	100-D-84:2	100-F-26:13	100-F-58	100-H-45
100-B-25	100-D-20	100-D-50:7	100-D-85	100-F-26:14	100-F-59	100-H-46
100-B-26	100-D-21	100-D-50:8	100-D-85:1	100-F-26:15	100-F-60	100-H-48
100-B-27	100-D-23	100-D-50:9	100-D-85:2	100-F-26:16	100-F-61	100-H-49
100-B-28	100-D-24	100-D-52	100-D-86	100-F-26:2	100-F-62	100-H-49:1
100-B-31	100-D-25	100-D-54	100-D-86:1	100-F-26:3	100-F-63	100-H-49:2
100-B-32	100-D-27	100-D-56	100-D-86:2	100-F-26:4	100-F-64	100-H-5
100-B-33	100-D-28	100-D-56:1	100-D-86:3	100-F-26:5	100-F-65	100-H-50
100-B-34	100-D-28:1	100-D-56:2	100-D-87	100-F-26:6	100-F-7	100-H-51
100-B-35	100-D-29	100-D-58	100-D-88	100-F-26:7	100-F-9	100-H-51:1
100-B-35:1	100-D-3	100-D-60	100-D-9	100-F-26:8	100-H (A) Riverlines	100-H-51:2
100-B-35:2	100-D-30	100-D-61	100-D-90	100-F-26:9	100-H (B) Riverlines	100-H-51:3
100-B-8:1	100-D-31:1	100-D-62	100-D-94	100-F-31	100-H-1	100-H-51:4
100-B-8:2	100-D-31:10	100-D-63	100-D-96	100-F-33	100-H-10	100-H-51:5
100-C (A) Riverlines	100-D-31:11	100-D-64	100-D-96:1	100-F-34	100-H-11	100-H-51:6
100-C (B) Riverlines	100-D-31:12	100-D-65	100-D-96:2	100-F-35	100-H-12	100-H-53
100-C-3	100-D-31:2	100-D-66	100-D-97	100-F-37	100-H-13	100-H-54

Table F-1. Sites Recommended for Additional Research

Site_ID						
100-H-56	100-K-131	100-K-74	100-N-13	100-N-68	105D Water tunnels	111KE
100-H-57	100-K-132	100-K-75	100-N-14	100-N-77	105DR	1120N
100-H-58	100-K-14	100-K-77	100-N-16	100-N-78	105DR Water tunnels	112B
100-H-59	100-K-18	100-K-78	100-N-17	100-N-79	105F	1134NA
100-H-59:1	100-K-19	100-K-79	100-N-18	100-N-80	105H	1143N
100-H-59:2	100-K-25	100-K-79:1	100-N-22	100-N-81	105KE	114D
100-H-60	100-K-27	100-K-79:2	100-N-23	100-N-82	105KE Basin	115KE
100-H-7	100-K-29	100-K-79:3	100-N-24	100-N-83	105KE Water Tunnels	115KW
100-H-8	100-K-30	100-K-79:4	100-N-25	100-N-84	105KW	116-B-10
100-H-9	100-K-31	100-K-79:5	100-N-26	100-N-84:1	105KW Basin	116-B-12
100-K (A) Riverlines	100-K-32	100-K-79:6	100-N-28	100-N-84:2	105KW Water tunnels	116-B-16
100-K (B) Riverlines	100-K-33	100-K-79:7	100-N-29	100-N-84:3	105N	116-B-2
100-K-1	100-K-34	100-K-79:8	100-N-3	100-N-84:4	105NA	116-B-5
100-K-100	100-K-35	100-K-80	100-N-30	100-N-84:5	105NB	116-B-6A
100-K-101	100-K-36	100-K-81	100-N-31	100-N-84:6	105NC	116-B-6B
100-K-102	100-K-38	100-K-82	100-N-32	100-N-84:7	105ND	116-B-7
100-K-103	100-K-42	100-K-83	100-N-33	100-N-84:8	105NE	116-B-9
100-K-104	100-K-43	100-K-84	100-N-34	100-N-84:9	107K	116-C-1
100-K-105	100-K-46	100-K-85	100-N-36	100-N-85	107N	116-C-2A
100-K-106	100-K-47	100-K-86	100-N-37	100-N-86	108F	116-C-2B
100-K-107	100-K-48	100-K-87	100-N-38	100-N-88	108N	116-C-2C
100-K-108	100-K-49	100-K-88	100-N-4	100-N-89	109N	116-C-3
100-K-109	100-K-5	100-K-89	100-N-46	100-N-90	109NA	116-C-6
100-K-110	100-K-50	100-K-90	100-N-5	100-N-91	1100 BSUHR	116-D-7
100-K-111	100-K-54	100-K-91	100-N-51	100-N-92	1100 HPADS	116-DR-6
100-K-113	100-K-55:1	100-K-92	100-N-51B	100-N-93	1100 HWSA	116-F-1
100-K-114	100-K-55:2	100-K-94	100-N-52	100-N-94	1100 UOT4	116-F-10
100-K-115	100-K-56:1	100-K-95	100-N-53	100-N-95	1100 UOT5	116-F-11
100-K-116	100-K-56:2	100-K-96	100-N-55	100-N-96	1100 UOT6	116-F-12
100-K-117	100-K-56:3	100-K-97	100-N-58	100-N-97	1100 USPT2	116-F-14
100-K-118	100-K-57	100-K-98	100-N-59	100-N-98	1100 USPT3	116-F-15
100-K-119	100-K-6	100-K-99	100-N-6	100-N-99	1100-1	116-F-16
100-K-120	100-K-60	100-N Riverlines	100-N-60	100EMS	1100-11	116-F-2
100-K-121	100-K-61	100-N-100	100-N-61:1	103B	1100-19	116-F-3
100-K-122	100-K-63	100-N-101	100-N-61:2	103D	1100-2	116-F-4
100-K-123	100-K-64	100-N-102	100-N-61:3	104B1	1100-3	116-F-6
100-K-124	100-K-66	100-N-102:1	100-N-61:4	104B2	1100-4	116-F-7:1
100-K-125	100-K-67	100-N-102:2	100-N-63:1	104N	1100-8	116-F-7:2
100-K-126	100-K-68	100-N-103	100-N-63:2	105B	110KE	116-F-9
100-K-127	100-K-69	100-N-103:1	100-N-64:1	105C	110KW	116-H-1
100-K-128	100-K-70	100-N-104	100-N-64:2	105C Fan room	1112N	116-H-2
100-K-129	100-K-71	100-N-106	100-N-64:3	105C High tanks	1112NA	116-H-3
100-K-13	100-K-72	100-N-107	100-N-65	105C Water tunnels	1112NB	116-H-4
100-K-130	100-K-73	100-N-108	100-N-67	105D	111B	116-H-7

Table F-1. Sites Recommended for Additional Research

Site_ID						
116-K-1	117NVH	118C4	126-H-2	1322N	1605KE	1608B
116-K-2	118-B-10	118D	126-KE-2	1322NA	1605KW	1608D
116-K-3	118-B-2	118H	128-B-2	1322NB	1605NE	1608DR
116-KE-2	118-B-3	118KE	128-B-3	1322NC	1606D	1608F
116-KE-4	118-B-4	118KW	128-C-1	1323N	1606K	1608H
116-KE-6B	118-B-5	119B	128-D-2	1324N	1606KA	1608K
116-KE-6C	118-B-8	119DR	128-F-2	1324NA	1607-B1	1614D3
116-KE-6D	118-B-8:1	119KE	128-F-3	1325N	1607-B10	1614K3
116-KW-2	118-B-8:2	119KW	128-H-2	1327N	1607-B11	1614N
116-KW-3	118-B-8:3	119N	128-H-3	1330N	1607-B2	163N
116-N-1	118-C-1	119NA	128-K-2	1331N	1607-B2:1	165KE
116-N-3	118-C-2	11N	128-N-1	1332N	1607-B2:2	165KW
116-N-4	118-C-3:1	120-B-1	130-K-2	13N	1607-B3	166AKE
1161	118-C-3:2	120-D-2	130-KE-2	141-C	1607-B4	166KE
1162	118-C-3:3	120-F-1	130-KW-1	142K	1607-B5	166KW
1163	118-C-4	120-KE-1	130-KW-2	142KA	1607-B6	166N
1164	118-D-2:1	120-KE-2	130-N-1	147D	1607-B8	167K
1167	118-D-2:2	120-KE-3	130-N-1:1	1506K1	1607-B9	1701BA
1167A	118-D-3:1	120-KE-4	130-N-1:2	1506K2	1607-D2:2	1701NA
1168	118-D-3:2	120-KE-5	1300N	150KE	1607-D2:3	1702C
1169	118-D-6:1	120-KE-6	1301N	150KW	1607-D2:4	1702DR
116B	118-D-6:2	120-KE-8	1303N	151-B SwitchYard	1607-D2:5	1702N
116C	118-D-6:3	120-KE-9	1304N	151-D SwitchYard	1607-D3	1703N
116D	118-D-6:4	120-KW-3	1310N	1512N	1607-F1	1705KE
116DR	118-DR-2:1	120-KW-4	1312N	1515N	1607-F2	1705N
116KE	118-DR-2:2	120-KW-6	1313N	1516N	1607-F3	1705NA
116KW	118-F-1	120-KW-7	1314N	1517N	1607-F4	1706KE
116N	118-F-2	120-N-7	1315N	1518N	1607-F5	1706KEL
1170	118-F-3	120DR	1315NA	1519N	1607-F6	1706KER
1171	118-F-8:1	122-DR-1:1	1316N	151B	1607-F7	1706N
1171A	118-F-8:2	122-DR-1:2	1316NA	151D	1607-H1	1706NA
1171B	118-F-8:3	122-DR-1:3	1316NB	151K	1607-H2	1707N
1171C	118-F-8:4	122-DR-1:4	1316NC	151KE	1607-H4	1712N
1172A	118-H-1:1	122-DR-1:5	132-B-2	151KW	1607-K1	1713H
1173	118-H-1:2	122-DR-1:6	132-B-6	151N	1607-K2	1713KE
1174	118-H-6:1	122-DR-1:7	132-C-2	1524N	1607-K4	1713KER
1175	118-H-6:2	1220	132-D-2	1525N	1607-K5	1713KW
1176	118-H-6:3	124-N-1	132-F-1	152K	1607-K6	1714C
1177	118-H-6:4	124-N-10	132-F-4:1	153N	1607K	1714KE
1179	118-H-6:5	124-N-3	132-F-4:2	155N	1607KA	1714KW
117DR	118-H-6:6	124-N-9	132-H-1	1601D	1607N1	1714N
117KE	118-KE-1	126-B-2	132-H-2	1601H	1607N2	1714NA
117KW	118-KW-1	126-DR-1	132-H-3	1602H	1607N3	1714NB
117N	118-N-1	126-F-2	132-KW-1	1604K	1607N9	1715N

Table F-1. Sites Recommended for Additional Research

			Site_ID			
1715NA	183.1KW	1901H17	2.51E+07	200-E-125	200-E-160-PL	200-E-193-PL
1716N	183.2KE	1901U	2.61E+09	200-E-126-PL-A	200-E-161-PL	200-E-194-PL
1716NE	183.2KW	1901Y	2.61E+18	200-E-126-PL-B	200-E-162-PL	200-E-195-PL
1717AKE	183.3KE	1901Z	2.71E+69	200-E-127-PL-A	200-E-162-PL:1	200-E-195-PL:1
1717K	183.3KW	1902D	2.96E+03	200-E-127-PL-B	200-E-162-PL:2	200-E-195-PL:2
1720HA	183.4KE	1902N	200 CP	200-E-128	200-E-164-PL	200-E-196-PL
1720K	183.4KW	1902N81	200 ETF	200-E-129	200-E-165-PL	200-E-197-PL
1722N	183.5KE	1903N	200-A TEDF	200-E-13	200-E-165-PL:1	200-E-198-PL
1723N	183.5KW	1904B1	200-E BP	200-E-130	200-E-165-PL:2	200-E-199-PL
1723NX	183.6KE	1904B2	200-E PAP	200-E-131	200-E-166-PL	200-E-2
1724K	183.6KW	1904D	200-E PD	200-E-132	200-E-167-PL	200-E-20
1724KA	183.7KE	1904K	200-E-1	200-E-133	200-E-168-PL	200-E-200-PL
1724KB	183.7KW	1904N	200-E-100	200-E-134	200-E-169-PL	200-E-201-PL
1724N	183B	1904NA	200-E-101	200-E-135	200-E-17	200-E-202-PL
1734N	183C	1904NB	200-E-102	200-E-136	200-E-170-PL	200-E-203-PL
175KE	183D	1904NC	200-E-103	200-E-137	200-E-171-PL	200-E-204-PL
1802N	183F	1908-N	200-E-105	200-E-138	200-E-172-PL	200-E-204-PL:1
1802NE	183F (old)	1908K	200-E-106	200-E-139	200-E-173-PL	200-E-204-PL:2
1803K	183H	1908KE	200-E-107	200-E-14	200-E-174-PL	200-E-205-PL
1804D	183H TSD	1908N	200-E-109	200-E-140	200-E-174-PL:1	200-E-205-PL:1
1805D	183KE	1908NE	200-E-11	200-E-141	200-E-174-PL:2	200-E-205-PL:2
1806D	183KW	1909F	200-E-110	200-E-142	200-E-174-PL:3	200-E-206-PL
180B	183N	1909KE	200-E-111-PL	200-E-143-PL	200-E-174-PL:4	200-E-207-PL
180D	183NA	1909KW	200-E-112-PL	200-E-144-PL	200-E-175-PL	200-E-208-PL
181B	183NB	1909N	200-E-112-PL:1	200-E-145-PL	200-E-176-PL-A	200-E-209-PL
181B101	183NC	190C	200-E-112-PL:2	200-E-147-PL	200-E-176-PL-B	200-E-21
181B102	184D	190D	200-E-112-PL:3	200-E-148-PL	200-E-177-PL	200-E-210-PL
181B66	184N	190DA	200-E-112-PL:4	200-E-149-PL	200-E-178-PL	200-E-211-PL
181D	184NA	190DR	200-E-113-PL	200-E-150-PL	200-E-179	200-E-212-PL
181D101	184NB	190KE	200-E-114-PL	200-E-151-PL	200-E-180-PL	200-E-213-PL
181D102	184NC	190KW	200-E-114-PL:1	200-E-152-PL	200-E-182-PL	200-E-214-PL
181KE	184ND	1914N	200-E-114-PL:2	200-E-153-PL	200-E-183-PL	200-E-215-PL
181KW	184NE	1926N	200-E-114-PL:3	200-E-154-PL	200-E-184-PL	200-E-216-PL
181N	184NF	195D	200-E-115	200-E-155-PL	200-E-185-PL	200-E-216-PL:1
181NA	185D	2.16E+45	200-E-116-PL	200-E-156-PL	200-E-186-PL	200-E-216-PL:2
181NB	185K	2.18E+09	200-E-117	200-E-157-PL	200-E-187-PL	200-E-216-PL:3
181NC	185N	2.18E+16	200-E-118	200-E-157-PL:1	200-E-188-PL	200-E-217-PL
181NE	186B	2.18E+17	200-E-119	200-E-157-PL:2	200-E-189	200-E-217-PL:1
182-F	186D	2.18E+18	200-E-12	200-E-158-PL	200-E-19	200-E-217-PL:2
182B	186N	2.19E+03	200-E-120	200-E-159-PL	200-E-190	200-E-218-PL
182D	188D	2.19E+203	200-E-121	200-E-159-PL:1	200-E-191-PL	200-E-219-PL
182K	189D	2.51E+04	200-E-122	200-E-159-PL:2	200-E-192-PL	200-E-219-PL:1
182N	189K	2.51E+05	200-E-123	200-E-159-PL:3	200-E-192-PL:1	200-E-219-PL:2
183.1KE	1900N	2.51E+06	200-E-124	200-E-16	200-E-192-PL:2	200-E-220-PL

Table F-1. Sites Recommended for Additional Research

			Site_ID			
200-E-220-PL:1	200-E-247-PL:2	200-E-277-PL:2	200-E-319	200-E-8	200-W-115	200-W-150-PL:1
200-E-220-PL:2	200-E-248-PL	200-E-277-PL:3	200-E-35	200-E-80	200-W-116	200-W-150-PL:2
200-E-221-PL	200-E-248-PL:1	200-E-277-PL:4	200-E-4	200-E-81	200-W-117	200-W-150-PL:3
200-E-222-PL	200-E-248-PL:2	200-E-278-PL	200-E-41	200-E-82	200-W-118	200-W-150-PL:4
200-E-222-PL:1	200-E-249-PL	200-E-279-PL	200-E-42	200-E-84	200-W-119	200-W-151-PL
200-E-222-PL:2	200-E-249-PL:1	200-E-28	200-E-43	200-E-85	200-W-12	200-W-152-PL
200-E-223	200-E-249-PL:2	200-E-280	200-E-44	200-E-88	200-W-120	200-W-153-PL
200-E-224-PL	200-E-25	200-E-281-PL	200-E-45	200-E-89	200-W-121	200-W-153-PL:1
200-E-225-PL	200-E-250-PL	200-E-282-PL	200-E-46	200-E-9	200-W-122	200-W-153-PL:2
200-E-226-PL	200-E-251-PL	200-E-283-PL	200-E-47	200-E-90	200-W-123	200-W-154-PL
200-E-227-PL	200-E-252-PL	200-E-284	200-E-48	200-E-91	200-W-124	200-W-155-PL-A
200-E-228-PL	200-E-253-PL	200-E-285	200-E-49	200-E-92	200-W-125-PL	200-W-155-PL-B
200-E-228-PL:1	200-E-254-PL	200-E-286	200-E-5	200-E-93	200-W-125-PL:1	200-W-156-PL
200-E-228-PL:2	200-E-255-PL	200-E-287	200-E-50	200-E-94	200-W-125-PL:2	200-W-157-PL
200-E-228-PL:3	200-E-256-PL	200-E-288-PL	200-E-51	200-E-95	200-W-126	200-W-157-PL:1
200-E-229-PL	200-E-257-PL	200-E-289-PL	200-E-52	200-E-97	200-W-127	200-W-157-PL:2
200-E-23	200-E-258-PL	200-E-29	200-E-53	200-E-98	200-W-128	200-W-158-PL
200-E-230-PL	200-E-259-PL	200-E-290-PL	200-E-54	200-E-99	200-W-129-PL	200-W-159-PL
200-E-231-PL	200-E-26	200-E-291-PL	200-E-55	200-E8 BPDS	200-W-13	200-W-16
200-E-232-PL	200-E-260-PL	200-E-292	200-E-56	200-N-3	200-W-130-PL	200-W-160-PL
200-E-232-PL:1	200-E-261-PL	200-E-293	200-E-57	200-W ADB	200-W-131-PL	200-W-161-PL
200-E-232-PL:2	200-E-262-PL	200-E-294	200-E-58	200-W ADS	200-W-132-PL	200-W-162-PL
200-E-233-PL	200-E-263-PL	200-E-295	200-E-59	200-W BP	200-W-136	200-W-163-PL
200-E-234-PL	200-E-264-PL	200-E-296	200-E-6	200-W CSLA	200-W-137-PL	200-W-163-PL:1
200-E-234-PL:1	200-E-265-PL	200-E-297	200-E-60	200-W PAP	200-W-138-PL	200-W-163-PL:2
200-E-234-PL:2	200-E-265-PL:1	200-E-298	200-E-61	200-W PP	200-W-139-PL	200-W-163-PL:3
200-E-237-PL	200-E-265-PL:2	200-E-299	200-E-62	200-W-1	200-W-14	200-W-164-PL
200-E-237-PL:1	200-E-265-PL:3	200-E-3	200-E-63	200-W-10	200-W-140-PL	200-W-165-PL
200-E-237-PL:2	200-E-266-PL	200-E-30	200-E-64	200-W-100-PL	200-W-141-PL	200-W-166-PL
200-E-238-PL	200-E-267-PL	200-E-300	200-E-65	200-W-101	200-W-142-PL	200-W-167-PL
200-E-239-PL	200-E-268-PL	200-E-301	200-E-67	200-W-102-PL	200-W-143-PL	200-W-168-PL
200-E-24	200-E-269-PL	200-E-302	200-E-68	200-W-103	200-W-144	200-W-168-PL:1
200-E-240-PL	200-E-27	200-E-303	200-E-69	200-W-104	200-W-145	200-W-168-PL:2
200-E-241-PL	200-E-270-PL	200-E-304	200-E-7	200-W-105-PL	200-W-146-PL	200-W-169-PL
200-E-241-PL:1	200-E-271-PL	200-E-305-PL	200-E-70	200-W-106	200-W-147-PL-A	200-W-17
200-E-241-PL:2	200-E-272-PL	200-E-306	200-E-71	200-W-107	200-W-147-PL-A:1	200-W-170-PL
200-E-241-PL:3	200-E-273-PL	200-E-307	200-E-72	200-W-108	200-W-147-PL-A:2	200-W-171
200-E-242-PL	200-E-273-PL:1	200-E-312	200-E-73	200-W-109	200-W-147-PL-B	200-W-172
200-E-243-PL	200-E-273-PL:2	200-E-313	200-E-74	200-W-11	200-W-149-PL	200-W-173-PL
200-E-244-PL	200-E-274-PL	200-E-314	200-E-75	200-W-110	200-W-149-PL:1	200-W-174-PL
200-E-245-PL	200-E-275-PL	200-E-315	200-E-76	200-W-111	200-W-149-PL:2	200-W-174-PL:1
200-E-246-PL	200-E-276-PL	200-E-316	200-E-77	200-W-112	200-W-149-PL:3	200-W-174-PL:2
200-E-247-PL	200-E-277-PL	200-E-317	200-E-78	200-W-113	200-W-15	200-W-175-PL
200-E-247-PL:1	200-E-277-PL:1	200-E-318	200-E-79	200-W-114	200-W-150-PL	200-W-176-PL

Table F-1. Sites Recommended for Additional Research

			Site_ID			
200-W-177-PL	200-W-205-PL:2	200-W-229-PL	200-W-4	200-W-82	202-S	2102E
200-W-178-PL	200-W-206-PL	200-W-230-PL	200-W-40	200-W-83	202-S:1	2102F
200-W-179-PL	200-W-207-PL-A	200-W-230-PL:1	200-W-41	200-W-84-PL	2025E	2102HV
200-W-18	200-W-207-PL-B	200-W-230-PL:2	200-W-42	200-W-84-PL:1	2025EA	2102M
200-W-180-PL	200-W-208-PL	200-W-230-PL:3	200-W-43	200-W-84-PL:2	2025EC71	2102N
200-W-180-PL:1	200-W-208-PL:1	200-W-231	200-W-44	200-W-84-PL:3	2025ED	2103HV
200-W-180-PL:2	200-W-208-PL:2	200-W-232	200-W-45	200-W-85	202A	2104M
200-W-181-PL	200-W-208-PL:3	200-W-233	200-W-46	200-W-86	202A417	2104N
200-W-182-PL	200-W-209-PL	200-W-234	200-W-47	200-W-87	202S	2105HV
200-W-183-PL	200-W-209-PL:1	200-W-235-PL	200-W-48	200-W-88-PL	203-S & 205-S	2106HV
200-W-184-PL	200-W-209-PL:2	200-W-236	200-W-49	200-W-88-PL:1	203A	2107
200-W-185-PL	200-W-209-PL:3	200-W-237	200-W-51	200-W-88-PL:2	203U	2109E
200-W-186-PL	200-W-21	200-W-238	200-W-52	200-W-88-PL:3	203UX	210A
200-W-187-PL	200-W-210-PL	200-W-239	200-W-53	200-W-88-PL:4	203UXA	210E
200-W-188-PL	200-W-210-PL:1	200-W-24	200-W-54	200-W-88-PL:5	204-AR	210M
200-W-188-PL:1	200-W-210-PL:2	200-W-240	200-W-55	200-W-88-PL:6	204A	210T
200-W-188-PL:2	200-W-210-PL:3	200-W-241	200-W-56	200-W-89	204AR	210W
200-W-189-PL	200-W-211-PL	200-W-242	200-W-57	200-W-9	205-A	211-A NU
200-W-19	200-W-211-PL:1	200-W-243	200-W-58	200-W-90	205A	211A
200-W-190-PL	200-W-211-PL:2	200-W-244-PL	200-W-59	200-W-92	206A	211B
200-W-191-PL	200-W-211-PL:3	200-W-245	200-W-6	200-W-93	207-A-NORTH	211BA
200-W-192-PL	200-W-211-PL:4	200-W-246	200-W-60	200-W-94	207-A-SOUTH	211BA151
200-W-192-PL:1	200-W-212-PL	200-W-247	200-W-61	200-W-95	207-B	211BB
200-W-192-PL:2	200-W-213-PL	200-W-248-PL	200-W-62	200-W-96	207-S	211E
200-W-192-PL:3	200-W-213-PL:1	200-W-249	200-W-63	200-W-97-PL	207-SL	211ED
200-W-192-PL:4	200-W-213-PL:2	200-W-25	200-W-64	200-W-98-PL	207-T	211H
200-W-193-PL	200-W-214-PL	200-W-250	200-W-65	200-W-99-PL	207-U	211S
200-W-194-PL	200-W-215-PL	200-W-251	200-W-66	200CC-BA	207-Z	211T
200-W-195-PL	200-W-216-PL	200-W-252	200-W-67	201-C	207A	211T52
200-W-196-PL	200-W-217-PL	200-W-253	200-W-68	201C	207B	211U
200-W-197-PL	200-W-218-PL	200-W-254	200-W-69	201R	207BA	211UA
200-W-198-PL	200-W-219-PL	200-W-255	200-W-7	201W	207S	212-B
200-W-199-PL	200-W-22	200-W-26	200-W-70	202-A	207SL	212-P
200-W-2	200-W-220-PL	200-W-27	200-W-71	202-A HWSA	207T	212-R
200-W-20	200-W-221-PL	200-W-28	200-W-72	202-A NU	207U	2120WA
200-W-200-PL	200-W-222-PL	200-W-29	200-W-73	202-A-E-F11	209-E-WS-1	2120WB
200-W-201-PL	200-W-223-PL	200-W-3	200-W-74	202-A-E5	209-E-WS-2	2125E
200-W-202-PL	200-W-224-PL	200-W-30	200-W-75	202-A-F15	209-E-WS-3	2125E (old)
200-W-202-PL:1	200-W-224-PL:1	200-W-31	200-W-76	202-A-F16	209-E-WS-3:1	212A
200-W-202-PL:2	200-W-224-PL:2	200-W-32	200-W-77	202-A-F18	209E	212C
200-W-203-PL	200-W-225-PL	200-W-33	200-W-78-PL	202-A-G7	209EA	212E
200-W-204-PL	200-W-226-PL	200-W-35	200-W-79-PL	202-A-U3	2101-M POND	212ED
200-W-205-PL	200-W-227-PL	200-W-36	200-W-80	202-A-U4	2101HV	212H
200-W-205-PL:1	200-W-228-PL	200-W-37	200-W-81	202-A-WS-1	2101M	212N

Table F-1. Sites Recommended for Additional Research

Site_ID						
212P	216-A-24	216-B-2-2	216-B-50	216-S-18	216-T-36	216-Z-3
212R	216-A-25	216-B-2-3	216-B-51	216-S-20	216-T-4-1D	216-Z-4
212S	216-A-26	216-B-20	216-B-52	216-S-21	216-T-4-2	216-Z-5
212T	216-A-26A	216-B-21	216-B-53A	216-S-22	216-T-4A	216-Z-6
212W	216-A-27	216-B-22	216-B-53B	216-S-23	216-T-4B	216-Z-7
212Z	216-A-28	216-B-23	216-B-54	216-S-25	216-T-5	216-Z-8
213-W	216-A-29	216-B-24	216-B-55	216-S-3	216-T-6	216-Z-9
213-W-1	216-A-3	216-B-25	216-B-56	216-S-4	216-T-7	216A
213A	216-A-30	216-B-26	216-B-57	216-S-5	216-T-8	216A1A
213E	216-A-31	216-B-27	216-B-58	216-S-5:1	216-T-9	216A25
213J	216-A-32	216-B-28	216-B-59	216-S-5:2	216-TY-201	216A271
213K	216-A-33	216-B-29	216-B-59B	216-S-6	216-U-1&2	216A29A
213P	216-A-34	216-B-3	216-B-6	216-S-7	216-U-10	216A37-1
213S	216-A-35	216-B-3-1	216-B-60	216-S-8	216-U-11	216A37-2
213W	216-A-36A	216-B-3-2	216-B-61	216-S-9	216-U-12	216A40A
213WB	216-A-36B	216-B-3-3	216-B-62	216-SX-2	216-U-13	216A42E
213WTK1	216-A-37-1	216-B-30	216-B-63	216-T-1	216-U-14	216A524
214A	216-A-37-2	216-B-31	216-B-7A&B	216-T-10	216-U-15	216A5A
214C	216-A-38-1	216-B-32	216-B-8	216-T-11	216-U-16	216ATK1
214E	216-A-39	216-B-33	216-B-9	216-T-12	216-U-17	216ATK2
214F	216-A-4	216-B-34	216-BY-201	216-T-13	216-U-3	216B351
214G	216-A-40	216-B-35	216-C-1	216-T-14	216-U-4	216B352
214T	216-A-41	216-B-36	216-C-10	216-T-15	216-U-4A	216B353
215-C	216-A-42	216-B-37	216-C-2	216-T-16	216-U-4B	216B354
215A	216-A-45	216-B-38	216-C-3	216-T-17	216-U-5	216B57
215C	216-A-5	216-B-39	216-C-4	216-T-18	216-U-6	216B59
215E	216-A-508	216-B-3A	216-C-5	216-T-19	216-U-7	216B59A
216-A-1	216-A-524	216-B-3A RAD	216-C-6	216-T-2	216-U-8	216B59B
216-A-10	216-A-6	216-B-3B	216-C-7	216-T-20	216-U-9	216E28A
216-A-11	216-A-7	216-B-3B RAD	216-C-8	216-T-21	216-W-LWC	216E28B
216-A-12	216-A-8	216-B-3C	216-C-9	216-T-22	216-Z-1&2	216E28C
216-A-13	216-A-9	216-B-3C RAD	216-E-28	216-T-23	216-Z-10	216E43A
216-A-14	216-B-10A	216-B-4	216-N-8	216-T-24	216-Z-11	216E43B
216-A-15	216-B-10B	216-B-40	216-S-1&2	216-T-25	216-Z-12	216Z9A
216-A-16	216-B-11A&B	216-B-41	216-S-10D	216-T-26	216-Z-13	216Z9B
216-A-17	216-B-12	216-B-42	216-S-10P	216-T-27	216-Z-14	216Z9C
216-A-18	216-B-13	216-B-43	216-S-11	216-T-28	216-Z-15	216ZP1
216-A-19	216-B-14	216-B-44	216-S-12	216-T-29	216-Z-16	216ZP1A
216-A-2	216-B-15	216-B-45	216-S-13	216-T-3	216-Z-17	216ZP1B
216-A-20	216-B-16	216-B-46	216-S-14	216-T-31	216-Z-18	216ZP1C
216-A-21	216-B-17	216-B-47	216-S-15	216-T-32	216-Z-19	217-B NU
216-A-22	216-B-18	216-B-48	216-S-16P	216-T-33	216-Z-1A	217A
216-A-23A	216-B-19	216-B-49	216-S-17	216-T-34	216-Z-1D	217AZ
216-A-23B	216-B-2-1	216-B-5	216-S-172	216-T-35	216-Z-20	217B

Table F-1. Sites Recommended for Additional Research

Site_ID						
217E	218HV	221-T-6-1	223E	2262W	234ZB	241-A-106
217F	218W5-252	221-U	224-B	2263W	234ZC	241-A-151
217G	218W5-252A	221-U:1	224-T	2264W	236Z	241-A-152
217H	218W5T31T1	221-U:2	224-U CNT	2265W	240-S-151	241-A-153
217I	218W5T34T1	221-U:3	224-U HWSA	2266E	240-S-152	241-A-302A
218-C-9	218W7	221A	2240E	2268E	240-S-302	241-A-302B
218-E-1	218W8	221B	2241B	2269E	2400E	241-A-350
218-E-10	219-S-101	221BA	2242B	226B	2401W	241-A-417
218-E-12A	219-S-102	221BB	2244B	226W	2402EA	241-A-431
218-E-12B	219-S-103	221BC	2245B	226Z	2402EB	241-A-501
218-E-12B ANNEX	219-S-104	221BD	2247B	227S	2402EC	241-A-702-WS-1
218-E-14	219A	221BE	2249B	229E	2402ED	241-A-A
218-E-15	219A1	221BF	224B	229W	2402EF	241-A-ANC
218-E-2	219A201	221BG	224T	2300W	2402EG	241-A-B
218-E-2A	219B	221BK	224U	2304W	2402W	241-AN-101
218-E-3	219C	221T	224UA	2305W	2402WB	241-AN-102
218-E-4	219D	221TA	2251E	2306W	2402WC	241-AN-103
218-E-5	219E	221TB	2252E	2307W	2402WD	241-AN-104
218-E-5A	219F	221U	2253E	2308W	2402WE	241-AN-105
218-E-6	219G	222-S	2254E	2309W	2402WF	241-AN-106
218-E-7	219H	222-SD	2255E	231-W-151	2402WG	241-AN-107
218-E-8	219S	2220E	2255EA	231-W-151:1	2402WH	241-AN-A
218-E-9	219T	2220W	2256E	231-W-151:2	2402WI	241-AN-ANC
218-W-1	2200B	222B	2256WTP	2310W	2402WJ	241-AN-B
218-W-11	2201B	222S-BA	2257E	2314W	2402WK	241-AP VP
218-W-1A	2202E	222SA	2258E	2315W	2402WL	241-AP-101
218-W-2	220A	222SB	2259W	2316W	2403E	241-AP-102
218-W-2A	221-B	222SC	225B	2318W	2403EA	241-AP-103
218-W-3	221-B SDT	222SD	225B-BA	231W151	2403WA	241-AP-104
218-W-3A	221-B-26-1	222SE	225BA	231Z	2403WB	241-AP-105
218-W-3AE	221-B-27-2	222SF	225BB	232-Z	2403WC	241-AP-106
218-W-4A	221-B-27-3	222SH	225BC	232-Z:1	2403WD	241-AP-107
218-W-4B	221-B-27-4	222T	225BD	232-Z:2	2404E	241-AP-108
218-W-4C	221-B-28-3	222U	225BE	232-Z:3	2404WA	241-AP-ANC
218-W-4C ANNEX	221-B-28-4	2230E	225BF	232Z	2404WB	241-AR-151
218-W-5	221-B-29-4	2231E	225BG	233-S	2404WC	241-AW-101
218-W-6	221-B-30-3	2232E	225BG-GEN1	233-SA	2405W	241-AW-102
218-W-7	221-B-WS-1	2233E	225E	2336W	2406W	241-AW-103
218-W-8	221-B-WS-2	2234E	225EC	233SA	240W	241-AW-104
218-W-9	221-T-11-R	2235E	225W	234-5Z	241-A-101	241-AW-105
218-W-REACTOR	221-T-15-1	2236E	225WA	234-5Z HWSA	241-A-102	241-AW-106
218A	221-T-5-6	2237E	225WB	234-5Z-BA	241-A-103	241-AW-A
218B	221-T-5-7	2238E	225WC	234-5Z-BE	241-A-104	241-AW-ANC
218E16101	221-T-5-9	2239E	226-B HWSA	234-5ZA	241-A-105	241-AW-B

Table F-1. Sites Recommended for Additional Research

			Site_ID			
241-AX-101	241-B-110	241-BY-106	241-ER-152	241-SX-302	241-TX-107	241-U-110
241-AX-102	241-B-111	241-BY-107	241-ER-153	241-SX-401	241-TX-108	241-U-111
241-AX-103	241-B-112	241-BY-108	241-ER-311	241-SX-402	241-TX-109	241-U-112
241-AX-104	241-B-151	241-BY-109	241-ER-311A	241-SX-A	241-TX-110	241-U-151
241-AX-151	241-B-152	241-BY-110	241-EW-151	241-SX-ANC	241-TX-111	241-U-152
241-AX-151:1	241-B-153	241-BY-111	241-S-101	241-SX-B	241-TX-112	241-U-153
241-AX-151:2	241-B-154	241-BY-112	241-S-102	241-SY-101	241-TX-113	241-U-201
241-AX-151:3	241-B-201	241-BY-ANC	241-S-103	241-SY-102	241-TX-114	241-U-202
241-AX-151:4	241-B-202	241-BY-ITS1	241-S-104	241-SY-103	241-TX-115	241-U-203
241-AX-151:5	241-B-203	241-BYR-09A	241-S-105	241-SY-A	241-TX-116	241-U-204
241-AX-152CT	241-B-204	241-BYR-152	241-S-106	241-SY-ANC	241-TX-117	241-U-252
241-AX-152DS	241-B-252	241-BYR-153	241-S-107	241-SY-B	241-TX-118	241-U-301
241-AX-153	241-B-301	241-BYR-154	241-S-108	241-T-101	241-TX-152	241-U-361
241-AX-155	241-B-302B	241-C-101	241-S-109	241-T-102	241-TX-153	241-U-A
241-AX-501	241-B-361	241-C-102	241-S-110	241-T-103	241-TX-154	241-U-ANC
241-AX-A	241-B-ANC	241-C-103	241-S-111	241-T-104	241-TX-155	241-U-B
241-AX-ANC	241-BR-152	241-C-103 VP	241-S-112	241-T-105	241-TX-302A	241-U-C
241-AX-B	241-BX-101	241-C-104	241-S-151	241-T-106	241-TX-302B	241-U-D
241-AX-IX	241-BX-102	241-C-105	241-S-152	241-T-107	241-TX-302BR	241-UR-151
241-AY-101	241-BX-103	241-C-106	241-S-302A	241-T-108	241-TX-302C	241-UR-152
241-AY-102	241-BX-104	241-C-107	241-S-302B	241-T-109	241-TX-302XB	241-UR-153
241-AY-151	241-BX-105	241-C-108	241-S-304	241-T-110	241-TX-ANC	241-UR-154
241-AY-152	241-BX-106	241-C-109	241-S-A	241-T-111	241-TXR-151	241-UX-154
241-AY-501	241-BX-107	241-C-110	241-S-ANC	241-T-112	241-TXR-152	241-UX-302A
241-AY-ANC	241-BX-108	241-C-111	241-S-B	241-T-151	241-TXR-153	241-WR VAULT
241-AZ VP	241-BX-109	241-C-112	241-S-C	241-T-152	241-TY-101	241-WR VAULT:1
241-AZ-101	241-BX-110	241-C-151	241-S-D	241-T-153	241-TY-102	241-WR VAULT:2
241-AZ-102	241-BX-111	241-C-152	241-SX-101	241-T-201	241-TY-103	241-Z
241-AZ-151CT	241-BX-112	241-C-153	241-SX-102	241-T-202	241-TY-104	241-Z-361
241-AZ-151DS	241-BX-153	241-C-154	241-SX-103	241-T-203	241-TY-105	241-Z-8
241-AZ-152	241-BX-154	241-C-201	241-SX-104	241-T-204	241-TY-106	241A152
241-AZ-154	241-BX-155	241-C-202	241-SX-105	241-T-252	241-TY-153	241A201
241-AZ-155	241-BX-302A	241-C-203	241-SX-106	241-T-301B	241-TY-302A	241A271
241-AZ-301	241-BX-302B	241-C-204	241-SX-107	241-T-302	241-TY-302B	241A401
241-AZ-ANC	241-BX-302C	241-C-252	241-SX-108	241-T-361	241-TY-ANC	241A431
241-B-101	241-BX-ANC	241-C-301	241-SX-109	241-T-ANC	241-U-101	241A701
241-B-102	241-BXR-151	241-C-801	241-SX-110	241-TR-152	241-U-102	241A702
241-B-103	241-BXR-152	241-CR-151	241-SX-111	241-TR-153	241-U-103	241AA
241-B-104	241-BXR-153	241-CR-152	241-SX-112	241-TX-101	241-U-104	241AB
241-B-105	241-BY-101	241-CR-153	241-SX-113	241-TX-102	241-U-105	241AN271
241-B-106	241-BY-102	241-CX-70	241-SX-114	241-TX-103	241-U-106	241AN273
241-B-107	241-BY-103	241-CX-71	241-SX-115	241-TX-104	241-U-107	241AN274
241-B-108	241-BY-104	241-CX-72	241-SX-151	241-TX-105	241-U-108	241AN801
241-B-109	241-BY-105	241-ER-151	241-SX-152	241-TX-106	241-U-109	241ANA

Table F-1. Sites Recommended for Additional Research

Site_ID						
241ANB	241CX72	242AB	244-BXR VAULT:2	251W	2607-ER	2701AB
241AP271	241CXV	242AC	244-BXR VAULT:3	251W66	2607-ES	2701AC
241AP273	241EW151	242AL11	244-BXR VAULT:4	2524WTP	2607-FSM	2701EC
241AP801	241S271A	242AL42	244-CR VAULT	252A	2607-FSN	2701HV
241AW271	241S271B	242AL43	244-CR VAULT:1	252AB	2607-GF	2701M
241AW273	241SX271	242AL44	244-CR VAULT:2	252AC	2607-P	2701Z
241AW801	241SX281	242AL71	244-CR VAULT:3	252BY	2607-R	2701ZA
241AX80	241SX401	242B	244-CR VAULT:4	252E	2607-W1	2701ZB
241AX801A	241SX402	242BL	244-CR-WS-1	252S	2607-W10	2701ZC
241AX801B	241SX701	242S	244-S DCRT	252U	2607-W11	2701ZD
241AX801C	241SY271	242S302C	244-TX DCRT	252W	2607-W12	2701ZE
241AXA	241SY272	242S702	244-TXR VAULT	252Z1	2607-W13	2702Z
241AXB	241SY274	242T	244-TXR VAULT:1	253E	2607-W14	2703-E HWSA
241AY401	241SY275	242T271	244-TXR VAULT:2	254E	2607-W15	2703E
241AY402	241SY276	242T601	244-TXR VAULT:3	2607-E10	2607-W16	2704-C-WS-1
241AY51	241T361	242T701	244-U DCRT	2607-E11	2607-W2	2704-E HWSA
241AY51A	241T701	242TB	244-UR VAULT	2607-E12	2607-W3	2704C
241AY801A	241TX154	242TC	244-UR VAULT:1	2607-E12:1	2607-W4	2704HV
241AZ156	241TX302C	242ZA	244-UR VAULT:2	2607-E12:2	2607-W5	2704S
241AZ271	241TX701	243G1	244-UR VAULT:3	2607-E13	2607-W6	2704W
241AZ301	241U271	243G12	244-UR VAULT:4	2607-E14	2607-W7	2704Z
241AZ301A	241U361	243G1A	244A	2607-E1A	2607-W8	2705S
241AZ401	241U701	243G2	244AR	2607-E3	2607-W9	2705Z
241AZ402	241UX302A	243G3	244AR40	2607-E4	2607-WA	2706S
241AZ701	241WR	243G4	244AR701	2607-E5	2607-WB	2706T
241AZ702	241Z	243G5	244AR702	2607-E6	2607-WC	2706TA
241AZ801A	241ZA	243G6	244AR712	2607-E7A	2607-WL	2706TB
241B361	241ZB	243G8	244AR715	2607-E7B	2607-WT	2707AR
241B701	241ZG	243G81	244AR716	2607-E8	2607-WTX	2707AX
241BX155	241ZRB	243G82	244AR717	2607-E8A	2607-WUT	2707E
241BY254	242-A	243G9	244BX271	2607-E9	2607-WWA	2707SX
241BY301	242-B	243S-TK1	244CR	2607-EA	2607-WZ	2707W
241BY302	242-B-151	243T	244S271	2607-EB	2607-Z	2708AR
241C	242-S	243Z	244S2904	2607-EC	2607-Z1	2708S
241C51	242-T	243ZA	244TX271	2607-ED	2607-Z8	2709A
241C51A	242-T-135	243ZB	244TX2904	2607-EE	2607W1	270A
241C73	242-T-151	244-A CT	244U271	2607-EF	2610E	270E
241C801	242-TA-R1	244-A LS	244U2904	2607-EG	2611E	270W
241C90	242-Z	244-A LS:1	2451E	2607-EH	2620W	270Z
241C91	2420W	244-A LS:2	246S	2607-EK	2652WTP	271-U
241CR271	242A	244-AR VAULT	2503Z	2607-EL	267Z	2710E
241CX40	242A-BA	244-BX DCRT	2506W1	2607-EM	268Z	2710S
241CX70	242A702	244-BXR VAULT	2506W4	2607-EP	270-E-1	2710W
241CX71	242A81	244-BXR VAULT:1	251E	2607-EQ	270-W	2711-B1

Table F-1. Sites Recommended for Additional Research

			Site_ID			
2711-S	2716E	2724W	2736ZA	277E	289TC	291-U
2711A	2716S	2724WB	2736ZB	277T	289TD	291-U-1
2711B	2716T	2725E	2736ZC	277W	289TE	291A
2711E	2716U	2726S	2736ZD	278AW	289TF	291A001
2711E66A	2718-E-WS-1	2726U	2736ZF	278WA	289W	291AA
2711EA	2718-S	2727-WA	2736ZG	279W	2901A	291AB
2711EB	2718E	2727E	2736ZH	281A	2901E	291AC
2711EC	2718S	2727W	2736ZM	281W	2901R	291AD
2711ED	2719E	2727WA	2736ZN	282B	2901S	291AE
2711EF	2719EA	2727Z	2736ZP	282BA	2901SX1	291AF
2711S	2719WB	2728W	2736ZQ	282E	2901SX2	291AG
2712A	271AB	2729Z	2736ZR	282EA	2901T	291AH
2712B	271B	272A	2736ZS	282EB	2901U	291AJ
2712S	271BA	272AW	2736ZU	282EC	2901W	291AK
2712T	271CR	272B	273E	282ED	2901X	291AR
2712U	271E	272BA	273EA	282W	2901Y	291B
2712Z	271T	272BB	273W	282WA	2901Z	291B001
2713E	271U	272BC	2740W	282WB	2902B	291BA
2713S	271UR	272E	274AW	282WC	2902E	291BB
2713W	2720EA	272EA	274E	282WD	2902HV80	291BC
2713WB	2721E	272HV	2750E	283E	2902HV82	291BD
2713WC	2721EA	272S	2751E	283E-BA	2902HV83	291BF
2714A	2721Z	272U	2752E	283EA	2902T	291BG
2714AR	2722E	272W	2753E	283W	2902W	291BH
2714S	2722W	272W-BA	2754W	283W-BA	2902Z	291BJ
2714U	2722Z	272WA	275E	283WA	2904-S-160	291BK
2715-EA HWSA	2723W	2731Z	275E-BA	283WB	2904-S-170	291CR
2715AW	2724A	2731ZA	275EA	283WC	2904-S-171	291S001
2715B	2724AB	2734EA	275UR	283WD	2904-SA	291T
2715E	2724AY	2734S	275W	283WE	2904AR	291T001
2715EA	2724AZ	2734SX	276-S	283WF	2904EA	291U
2715EC	2724B	2734Z	276-S-141	284E	2904S160	291U001
2715ED	2724BX	2734ZA	276-S-142	284E Salt Dissolving Pit	2904S170	291Z
2715EF	2724BY	2734ZB	276-U	284EA	2904S171	291Z001
2715M	2724BYA	2734ZC	2766E	284EB	2904S172	292-S
2715S	2724C	2734ZD	2767E	284W	2904SA	292-U
2715T	2724CA	2734ZF	276A	284W Salt Dissolving Pit	2904ZA	292A
2715U	2724SX	2734ZG	276B	284WB	2904ZB	292AA
2715UA	2724SY	2734ZH	276C	285W	2905P	292AB
2715WA	2724T	2734ZJ	276S	286W	2905R	292AR
2715Z	2724TX	2734ZK	276S141	287W	291-C	292B
2715ZL	2724TXA	2734ZL	276S142	289T	291-C-1	292T
2716A	2724TXB	2735Z	276U	289TA	291-S	292U
2716B	2724U	2736Z	277A	289TB	291-S-1	293-S

Table F-1. Sites Recommended for Additional Research

Site_ID						
293A	296B012	300-15	300-284	303-M UOF	313-TK-2	324B
293AA	296B013	300-15:1	300-286	303A	314	324C
293S	296C005	300-15:2	300-287	303B	314A	324D
293W	296C006	300-15:3	300-288	303C	314B	324S
294A	296C007	300-15:4	300-288:1	303E	315	325
294B	296G001	300-16	300-288:2	303F	315A	325 WTF
295A	296G1	300-16:1	300-289	303G	315B	325-BA
295AA	296H212	300-16:2	300-29	303J	315C	325A
295AB	296K105	300-16:3	300-290	303K	315D	325B
295AC	296K142	300-175	300-291	303M	316-1	325C
295AD	296P017	300-18	300-293	304	316-2	325D
295AE	296P022	300-19	300-293:1	304 CF	316-5	325E
295AZ	296P023	300-21	300-293:2	304 SA	317T	326
296-A-13	296P026	300-214	300-294	304A	318	326-BA
296-S-1	296P028	300-22	300-296	305	318-BA	327
296-S-12	296S012	300-220	300-3	305-B SF	318B	327-BA
296-S-13	296S015	300-223	300-32	305-BA	318C	328
296-S-16	296S016	300-23	300-33	305A	320	328-BA
296-S-2	296S018	300-24	300-34	305AA	320-BA	328A
296-S-21	296S021	300-249	300-35	305B	321	329
296-S-4	296S025	300-25	300-4	306E	3212	331
296-S-6	296S07E	300-251	300-40	306E-BA	3212LS	331 Dog Run
296-S-7	296S07W	300-253	300-41	306W	321B	331 LSLDF
296-U-10	296U006	300-255	300-43	307	321C	331 LSLT1
296A008	296Z003	300-256	300-44	308	321D	331 LSLT2
296A010	296Z006	300-257	300-45	308A	3220	331-BA
296A012	296Z015	300-258	300-46	309	3221	331A
296A013	299-E24-111	300-259	300-48	310	3222	331B
296A018	300 ASH PITS	300-260	300-49	310S	3223	331C
296A019	300 FBP:1	300-262	300-5	310T1	3224	331D
296A020	300 FBP:2	300-263	300-50	310T2	3225	331G
296A021	300 RFBP	300-265	300-51	310T3	3226	331H
296A022	300 RLWS	300-269	300-53	310T7A	3227	331K
296A027	300 RLWS:1	300-270	300-7	310T7B	3228	332
296A028	300 RLWS:2	300-272	300-79	310V	3229	332 SF
296A029	300 RRLWS	300-274	300-8	311	323	333
296A030	300 VTS	300-275	300-80	311-TK-40	323-BA	333 ESHWSA
296A040	300-1	300-277	300-9	311-TK-50	3231	333 LHWSA
296A041	300-10	300-278	3000 JYHWSA	312	3232	333-TK-11
296A044	300-109	300-279	3000 UUOT	3128	3234	333-TK-7
296A045	300-11	300-28	3000/1234	313	3235	334
296A048	300-110	300-280	300LYS	313 CENTRIFUGE	324	334 TFWAST
296A049	300-121	300-281	3020	313 ESSP	324-BA	334-A-TK-B
296B010	300-123	300-283	303-M SA	313 FP	324A	334-A-TK-C

Table F-1. Sites Recommended for Additional Research

Site_ID						
334A	3621D	3718G	3902A	400-24	437 MASF:6	4727
334TF	366	3718M	3902B	400-25	437 MASF:7	4732A
335	366A	3718N	3906	400-26	437 MASF:8	4732B
336	3701C	3718O	3906A	400-3	440	4732C
337	3701D	3718P	3906B	400-31	451A	4734A
337-BA	3701L	3718S	3906C	400-35	451B	4734B
337B	3701U	3719	3906D	400-36	453A	4734C
338	3704	3720	3906E	400-37	453B	4734D
339A	3705	3720-BA	3906F	400-38	453C	4760
340	3705-BA	3721	400 FD10	400-39	4607	4790
340 COMPLEX	3706	3722	400 FD10A	400-4	4607T2	4790A
340A	3706-BA	3723	400 FD1A	400-40	4608B	4791TC
340B	3706A	3726	400 FD1B	400-40:1	4621E	4802
3410	3707D	3727	400 FD2	400-40:2	4621W	480A
342	3707E	3728	400 FD3	400-41	4701A	480B
3420	3707EA	3730	400 FD4	400-42	4701B	480D
3425	3707F	3731	400 FD5	400-5	4701C	481
342A	3707G	3731A	400 FD6	400-6	4702	4814
342B	3707H	3734A	400 FD7	400-7	4703	481A
342C	3708	3745	400 FD8	400-8	4704N	482A
3430	3709	3745A	400 FD9	400-9	4704S	482B
3440	3709A	3745B	400 PPSS	402	4706	482C
350	3709B	3746	400 RFD	403	4707	483
3503A	3710A	3746A	400 RSP	403 FD	4710	4831
3503B	3711	3746D	400 RST	405	4713-B FD	4831 LHWSA
3506A	3712	3760	400 SBT	408A	4713-B HWSA	483A
3506B	3712 USSA	3762	400 SS	408B	4713-B LDFD	483B
3506C	3713	3763	400 STF	408C	4713A	484
3507	3714	3764	400-1	409A	4713B	4842A
350A	3715	3766	400-10	409B	4713C	4842B
350B	3716	3767	400-11	4220	4713D	4852
350C	3717	3768	400-12	4221	4716	4862
350D	3717B	3769	400-13	427	4717	491E
350LS	3717C	377	400-14	427 HWSA	4718	491S
351	3718	3770	400-15	427A	4719	491W
351A	3718-F BS	3790	400-16	432A	4721	506A
351B	3718-F SF	3802A	400-17	436	4721 FD	506B
352E	3718-F TT1	382	400-18	437	4722 PSHWSA	506BA
352F	3718-F TT2	382-BA	400-19	437 MASF	4722-B FD	600 BPHWSA
361	3718A	382B	400-2	437 MASF:1	4722-C FD	600 CL
3614A	3718B	382C	400-20	437 MASF:2	4722B	600 ESST
3614B	3718C	382D	400-21	437 MASF:3	4722C	600 NRDWL
3621-66	3718E	384	400-22	437 MASF:4	4725	600 NSTFST
3621BC	3718F	385	400-23	437 MASF:5	4726	600 NSTFUT

Table F-1. Sites Recommended for Additional Research

Site_ID						
600 OCL	600-20	600-259:2	600-299:2	600-316	600-329	600-369
600-1	600-201	600-26	600-299:3	600-316:1	600-330	600-369:1
600-102	600-202	600-260	600-299:4	600-316:2	600-331	600-369:2
600-105	600-204	600-265	600-299:5	600-316:3	600-332	600-369:3
600-106	600-205	600-266	600-299:6	600-316:4	600-333	600-369:4
600-108	600-206	600-268	600-3	600-316:5	600-334	600-369:5
600-111	600-207	600-269-PL	600-30	600-316:6	600-334:1	600-369:6
600-113	600-208	600-27	600-300	600-317	600-334:2	600-369:7
600-114	600-210	600-270	600-300:1	600-318	600-335	600-369:8
600-115	600-211	600-271	600-300:10	600-318:1	600-336	600-37
600-116	600-212	600-272	600-300:11	600-318:2	600-337	600-370
600-117	600-214	600-274	600-300:12	600-318:3	600-338	600-371
600-118	600-215	600-275	600-300:2	600-318:4	600-339	600-372
600-120	600-216	600-276	600-300:3	600-318:5	600-340	600-372:1
600-124	600-217	600-278	600-300:4	600-319	600-341	600-372:2
600-125	600-218	600-279	600-300:5	600-319:1	600-341:1	600-373
600-127	600-219	600-28	600-300:6	600-319:2	600-341:2	600-374
600-128	600-22	600-280	600-300:7	600-319:3	600-342	600-375
600-129	600-220	600-281	600-300:8	600-320	600-343	600-375:1
600-131	600-222	600-282	600-300:9	600-320:1	600-344	600-375:2
600-132	600-223	600-283	600-301	600-320:2	600-345	600-375:3
600-139	600-224	600-284-PL	600-302	600-320:3	600-346	600-375:4
600-146	600-226	600-288	600-303	600-320:4	600-347	600-375:5
600-148	600-227	600-289	600-305	600-320:5	600-348	600-376
600-149	600-228	600-290:1	600-305:1	600-320:6	600-349	600-376:1
600-149:1	600-23	600-290:2	600-305:2	600-320:7	600-35	600-376:2
600-149:2	600-230	600-291-PL	600-305:3	600-320:8	600-350	600-377
600-151	600-232	600-292-PL	600-305:4	600-320:9	600-351	600-378
600-152	600-233	600-293	600-305:5	600-321	600-353	600-379
600-153	600-235	600-294	600-306	600-321:1	600-354	600-38
600-155	600-236	600-295	600-307	600-321:2	600-355	600-380
600-156	600-237	600-296	600-308	600-321:3	600-356	600-381
600-169	600-239	600-297	600-309	600-321:4	600-357	600-382
600-176	600-240	600-298	600-310	600-322	600-358	600-382:1
600-178	600-243	600-298:1	600-311	600-323	600-359	600-382:2
600-181	600-245	600-298:2	600-312	600-324	600-36	600-382:3
600-182	600-246	600-298:3	600-313	600-325	600-360	600-382:4
600-185	600-247	600-298:4	600-314	600-325:1	600-361	600-382:5
600-186	600-248	600-298:5	600-314:1	600-325:2	600-362	600-383
600-187	600-250	600-298:6	600-314:2	600-326	600-363	600-383:1
600-188	600-251	600-298:7	600-314:3	600-326:1	600-364	600-383:10
600-190	600-256	600-298:8	600-314:4	600-326:2	600-365	600-383:2
600-191	600-257	600-299	600-314:5	600-327	600-367	600-383:3
600-192	600-259:1	600-299:1	600-315	600-328	600-368	600-383:4

Table F-1. Sites Recommended for Additional Research

Site_ID						
600-383:5	600-61	6092V	618-7	6260	6607-4	6643
600-383:6	600-62	6093	618-8	6265	6607-5	6644
600-383:7	600-63	6094	618-9	6265A	6607-6	6652C
600-383:8	600-65	6095	618A	6266	6607-7	6652CSHED
600-383:9	600-66	6096	618B	6266A	6607-8	6652D
600-384	600-69	6097	618C	6266B	6607-9	6652DOME2
600-384:1	600-70	6098	619C	6266L	6608	6652E
600-384:2	600-71	6099	620	6267	6618	6652G
600-384:3	600-8	609A	621A	6268	6618A	6652H
600-384:4	600-96	609B	621B	6269	6618B	6652I
600-384:5	600-97	609C	622	6270	6618C	6652J
600-385	6004KW	609D	622-1	628-1	6618D	6652K
600-386	600LYS	609E	622-R ST	628-2	6618E	6652L
600-387	6010	609G	6221N	628-3	6618F	6652M
600-388	604A	609H	6221NA	628-4	6618G	6652O
600-389	604F	609J	6223	6290	6618H	6652PH
600-39	604G	609K	6223A	6291	6618I	6652R
600-390	604H	609L	6224	6291-66	6618J	6652S
600-391	607	609M	6224A	6291-66A	6618K	6652T
600-392	6088	609N	6225	6291-66B	6618L	6652U
600-393	6089	609P	6226	6292	6618M	6653
600-394	609	610	622A	6293	6618N	6653A
600-395	6091	611	622B	6294	6618T3	6654
600-396	6092	612	622C	630	6618T4	668
600-397	6092A	6120	622D	631	661A	669
600-398	6092B	613	622F	633	662	669A
600-399-PL	6092C	6130	622G	635	6620	6701
600-40	6092D	614	622R	636	6621	6701A
600-400	6092E	6140	622S	637	662A	6701B
600-401-PL	6092F	614A1	623	637-A	663	6701C
600-404	6092G	614B1	6230A	638	6630	6701D
600-406	6092H	614BYRL	6231NA	646	6631	6701E
600-44	6092I	616-WS-1	6233A	650	6632	6701F
600-46	6092J	616A	6234A	652	6633	6701H
600-47	6092K	618-1	623A	6607-1	6634	671
600-49	6092L	618-10	623B	6607-10	6635	672
600-5	6092M	618-11	6241-A	6607-13	6636	674
600-50	6092N	618-12	6241-V	6607-16	6637	676
600-51	6092O	618-1:1	6241A	6607-17	6638	678
600-52	6092P	618-1:2	6241L	6607-18	6639	680
600-53	6092Q	618-2	6241V	6607-19	664	682A
600-58	6092R	618-3	6250	6607-2	6640	682B
600-59	6092S	618-4	6251	6607-2A	6641	682C
600-60	6092U	618-5	626	6607-3	6642	682D

Table F-1. Sites Recommended for Additional Research

Site_ID						
682E	RBWTK2	UPR-100-N-23	UPR-200-E-127	UPR-200-E-38	UPR-200-E-83	UPR-200-W-124
682F	RBWTK3	UPR-100-N-24	UPR-200-E-128	UPR-200-E-39	UPR-200-E-83:1	UPR-200-W-126
683	SHLWSTS	UPR-100-N-25	UPR-200-E-129	UPR-200-E-4	UPR-200-E-83:2	UPR-200-W-127
684	T11WTP	UPR-100-N-26	UPR-200-E-130	UPR-200-E-40	UPR-200-E-84	UPR-200-W-128
685	T1WTP	UPR-100-N-29	UPR-200-E-131	UPR-200-E-42	UPR-200-E-85	UPR-200-W-129
686	T23WTP	UPR-100-N-3	UPR-200-E-132	UPR-200-E-43	UPR-200-E-86	UPR-200-W-13
687	T27WTP	UPR-100-N-30	UPR-200-E-133	UPR-200-E-44	UPR-200-E-87	UPR-200-W-130
688	T28WTP	UPR-100-N-31	UPR-200-E-134	UPR-200-E-45	UPR-200-E-88	UPR-200-W-131
689	T31	UPR-100-N-32	UPR-200-E-135	UPR-200-E-47	UPR-200-E-89	UPR-200-W-132
700 WST	T31WTP	UPR-100-N-36	UPR-200-E-136	UPR-200-E-48	UPR-200-E-9	UPR-200-W-134
703	T33WTP	UPR-100-N-37	UPR-200-E-137	UPR-200-E-49	UPR-200-E-90	UPR-200-W-135
712	T34	UPR-100-N-39	UPR-200-E-138	UPR-200-E-5	UPR-200-E-91	UPR-200-W-137
712B	T40WTP	UPR-100-N-4	UPR-200-E-14	UPR-200-E-50	UPR-200-E-92	UPR-200-W-138
7220	T520-6	UPR-100-N-42	UPR-200-E-140	UPR-200-E-51	UPR-200-E-93	UPR-200-W-14
747	TC1301N	UPR-100-N-43	UPR-200-E-141	UPR-200-E-52	UPR-200-E-94	UPR-200-W-140
747A	TC1301NA	UPR-100-N-5	UPR-200-E-142	UPR-200-E-53	UPR-200-E-95	UPR-200-W-141
747B	TC1301NB	UPR-100-N-6	UPR-200-E-143	UPR-200-E-54	UPR-200-E-96	UPR-200-W-142
748	TC272HV	UPR-100-N-7	UPR-200-E-144	UPR-200-E-55	UPR-200-E-97	UPR-200-W-143
77AA	TEST	UPR-100-N-8	UPR-200-E-145	UPR-200-E-56	UPR-200-E-98	UPR-200-W-144
8726	TFS OF 218-E-4	UPR-100-N-9	UPR-200-E-15	UPR-200-E-58	UPR-200-E-99	UPR-200-W-145
8727	TRUSAF	UPR-1100-5	UPR-200-E-16	UPR-200-E-59	UPR-200-N-1	UPR-200-W-146
B PLANT FILTER	TTTF	UPR-1100-6	UPR-200-E-17	UPR-200-E-60	UPR-200-N-2	UPR-200-W-147
BTTF	UPR-100-D-1	UPR-200-E-1	UPR-200-E-18	UPR-200-E-61	UPR-200-W-10	UPR-200-W-148
C8S49	UPR-100-D-2	UPR-200-E-10	UPR-200-E-19	UPR-200-E-62	UPR-200-W-100	UPR-200-W-149
C8S77	UPR-100-D-3	UPR-200-E-100	UPR-200-E-2	UPR-200-E-63	UPR-200-W-101	UPR-200-W-15
CTFN 2703-E	UPR-100-D-4	UPR-200-E-101	UPR-200-E-20	UPR-200-E-64	UPR-200-W-102	UPR-200-W-150
CWC	UPR-100-D-5	UPR-200-E-103	UPR-200-E-21	UPR-200-E-65	UPR-200-W-103	UPR-200-W-151
EMSL Tr1	UPR-100-F-1	UPR-200-E-105	UPR-200-E-22	UPR-200-E-66	UPR-200-W-104	UPR-200-W-152
GTF	UPR-100-F-2	UPR-200-E-106	UPR-200-E-23	UPR-200-E-67	UPR-200-W-105	UPR-200-W-153
GTFL	UPR-100-F-3	UPR-200-E-107	UPR-200-E-24	UPR-200-E-68	UPR-200-W-106	UPR-200-W-154
HO6405929	UPR-100-K-1	UPR-200-E-108	UPR-200-E-25	UPR-200-E-69	UPR-200-W-107	UPR-200-W-155
HO646382	UPR-100-N-1	UPR-200-E-109	UPR-200-E-26	UPR-200-E-7	UPR-200-W-108	UPR-200-W-156
HO646386	UPR-100-N-10	UPR-200-E-11	UPR-200-E-27	UPR-200-E-70	UPR-200-W-109	UPR-200-W-157
HRD	UPR-100-N-11	UPR-200-E-110	UPR-200-E-28	UPR-200-E-72	UPR-200-W-110	UPR-200-W-159
HS Units at WRAP	UPR-100-N-12	UPR-200-E-112	UPR-200-E-29	UPR-200-E-73	UPR-200-W-111	UPR-200-W-16
HS0007	UPR-100-N-13	UPR-200-E-114	UPR-200-E-3	UPR-200-E-74	UPR-200-W-112	UPR-200-W-160
HS0008	UPR-100-N-14	UPR-200-E-115	UPR-200-E-30	UPR-200-E-75	UPR-200-W-113	UPR-200-W-161
HSVP	UPR-100-N-17	UPR-200-E-116	UPR-200-E-31	UPR-200-E-76	UPR-200-W-114	UPR-200-W-162
HWVP	UPR-100-N-18	UPR-200-E-117	UPR-200-E-32	UPR-200-E-77	UPR-200-W-115	UPR-200-W-163
JA JONES 1	UPR-100-N-19	UPR-200-E-118	UPR-200-E-33	UPR-200-E-78	UPR-200-W-116	UPR-200-W-164
Low-Level Waste Burial Grounds	UPR-100-N-2	UPR-200-E-119	UPR-200-E-34	UPR-200-E-79	UPR-200-W-117	UPR-200-W-165
OCSA	UPR-100-N-20	UPR-200-E-12	UPR-200-E-35	UPR-200-E-80	UPR-200-W-118	UPR-200-W-166
PCTTF	UPR-100-N-21	UPR-200-E-125	UPR-200-E-36	UPR-200-E-81	UPR-200-W-12	UPR-200-W-167
RBWTK1	UPR-100-N-22	UPR-200-E-126	UPR-200-E-37	UPR-200-E-82	UPR-200-W-123	UPR-200-W-17

Table F-1. Sites Recommended for Additional Research

Site_ID			
UPR-200-W-19	UPR-200-W-65	UPR-300-24	UPR-600-7
UPR-200-W-2	UPR-200-W-67	UPR-300-25	UPR-600-8
UPR-200-W-20	UPR-200-W-68	UPR-300-26	UPR-600-9
UPR-200-W-21	UPR-200-W-69	UPR-300-27	WBF1
UPR-200-W-23	UPR-200-W-7	UPR-300-28	WBF2
UPR-200-W-24	UPR-200-W-70	UPR-300-29	WESF
UPR-200-W-26	UPR-200-W-71	UPR-300-30	WESF:1
UPR-200-W-28	UPR-200-W-72	UPR-300-32	WRAP
UPR-200-W-29	UPR-200-W-73	UPR-300-33	X1
UPR-200-W-3	UPR-200-W-74	UPR-300-34	X13
UPR-200-W-32	UPR-200-W-75	UPR-300-35	X4
UPR-200-W-33	UPR-200-W-76	UPR-300-36	X7
UPR-200-W-34	UPR-200-W-77	UPR-300-37	X8
UPR-200-W-35	UPR-200-W-78	UPR-300-38	
UPR-200-W-36	UPR-200-W-79	UPR-300-39	
UPR-200-W-37	UPR-200-W-8	UPR-300-4	
UPR-200-W-38	UPR-200-W-80	UPR-300-40	
UPR-200-W-39	UPR-200-W-81	UPR-300-41	
UPR-200-W-4	UPR-200-W-82	UPR-300-42	
UPR-200-W-40	UPR-200-W-83	UPR-300-45	
UPR-200-W-41	UPR-200-W-84	UPR-300-46	
UPR-200-W-42	UPR-200-W-85	UPR-300-47	
UPR-200-W-43	UPR-200-W-86	UPR-300-48	
UPR-200-W-44	UPR-200-W-87	UPR-300-5	
UPR-200-W-45	UPR-200-W-88	UPR-300-7	
UPR-200-W-46	UPR-200-W-89	UPR-300-8	
UPR-200-W-47	UPR-200-W-90	UPR-300-9	
UPR-200-W-48	UPR-200-W-91	UPR-300-FF-1	
UPR-200-W-49	UPR-200-W-95	UPR-3000-1	
UPR-200-W-5	UPR-200-W-96	UPR-400-1	
UPR-200-W-50	UPR-200-W-97	UPR-600-1	
UPR-200-W-51	UPR-200-W-98	UPR-600-10	
UPR-200-W-52	UPR-200-W-99	UPR-600-11	
UPR-200-W-53	UPR-300-10	UPR-600-12	
UPR-200-W-55	UPR-300-12	UPR-600-15	
UPR-200-W-56	UPR-300-13	UPR-600-16	
UPR-200-W-57	UPR-300-14	UPR-600-2	
UPR-200-W-58	UPR-300-15	UPR-600-20	
UPR-200-W-59	UPR-300-17	UPR-600-21	
UPR-200-W-6	UPR-300-19	UPR-600-22	
UPR-200-W-60	UPR-300-20	UPR-600-3	
UPR-200-W-61	UPR-300-21	UPR-600-4	
UPR-200-W-63	UPR-300-22	UPR-600-5	
UPR-200-W-64	UPR-300-23	UPR-600-6	

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