

FIELD SUMMARY REPORT FOR THE CENTRAL PLATEAU FISCAL YEAR 2017 AERIAL THERMAL SURVEY

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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Plateau Remediation Company
P.O. Box 1600
Richland, Washington 99352

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By Julia Raymer at 3:32 pm, Jan 12, 2021

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Date

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Terms

DEM	digital elevation model
DGPS	differential global positioning system
DN	digital numbers
DOE	U.S. Department of Energy
DSM	digital surface model
FY	fiscal year
GCP	ground control point
GIS	Geographic Information System
GPS	Global Positioning System
HVAC	heating, ventilation, and air conditioning
IMU	inertial measurement unit
ITRES	ITRES Research Limited
LiDAR	light detection and ranging
OU	operable unit
ROI	region of interest
RSL	Remote Sensing Laboratory
SHU	sensor head unit
TABI	Thermal Airborne Broadband Imager
UTM	Universal Transverse Mercator
WGS84	World Geodetic System
WIDS	Waste Information Database System
WRAP	Waste Receiving and Processing

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1 Introduction

This field summary report summarizes field activities, presents field-generated imaging, and provides geospatial analysis for the airborne thermal survey conducted during fiscal year (FY) 2017 over the central portion of the Hanford Site. The U.S. Department of Energy (DOE), Richland Operations Office contracted a team from DOE's Remote Sensing Laboratory (RSL) to conduct the FY 2017 thermal imaging survey. The RSL team holds expertise in remote sensing with a wide array of technology, including thermal infrared imaging. Historic aerial radiological surveys have been conducted by RSL at the Hanford Site periodically since the 1960s.

The mission of the RSL team was based on the need to characterize possible near-surface buried materials and aboveground anomalous features, such as the following:

- Possible buried structures such as pipeline, utility lines, and other industrial nuclear operation structures
- Degraded structures that may be draining, leaking, or indicating a possible cave-in
- Solid and liquid waste that has been buried
- Evidence of historical site activity

1.1 Purpose

The purpose of this report is to provide known hotspot discussions and to analyze the geospatial relationship of FY 2017 thermal imaging results to 200 Area waste sites and structures in support of future operable unit (OU) project evaluations. To meet that objective, this report will do the following:

1. Present the FY 2017 thermal imaging results
2. Expand on the initial analysis performed by RSL, as follows:
 - a. Compare FY 2017 thermal imaging features to the FY 2015 aerial survey (SGW-60352, *Field Summary Report for the 200-SW-2 Operable Unit and Central Plateau 2015 Aerial Survey*).
 - b. Investigate and identify features of interest and anomalous imaging features using Hanford Site data from the Geographic Information System (GIS) and Waste Information Database System (WIDS), aerial ortho-imagery, and site knowledge. All features of interest (anomalies) identified during this project are presented in Appendix A.

1.2 Scope

This report describes the field activities, field quality control, results, and the conclusions from the FY 2017 thermal imaging mission. Imaging equipment, data collection methods, calibration, and data processing are components of this report, which are summarized based on Attachment 1 of RSL's post-survey report, RSL, 2017, *Airborne Thermal Image Mapping of the Hanford Nuclear Reservation, WA*. Chapter 5 of this report is a summary of the geospatial analysis of the FY 2017 thermal imaging results of the Hanford Site surface and near subsurface conditions. Details of the analysis are provided in Appendix B. The following three objectives were identified and systematically carried out as part of the analysis:

1. Compare FY 2017 thermal imaging results to previous radiological surveys.
2. Examine features of interest identified by RSL and during follow-on geospatial analysis.

3. Review thermal imaging for qualitative review of potential subsurface voids and/or anomalies associated with facilities, structures, equipment, waste site, etc., located at the Hanford Site.

The FY 2017 thermal imaging survey covered the 200 East and 200 West Areas, also known as the Inner Area, of the Central Plateau of the Hanford Site, a portion of the Outer Area, and the area around the 618-10 Burial Ground near the 400 Area. Figure 1 depicts the orientation of the Inner and Outer Areas of the Hanford Site.

2 Field Activities

This chapter summarizes the activities conducted during the FY 2017 thermal imaging survey period, including the imaging system, the data requirements, collection method, and completeness.

2.1 Field Activities Scope

The FY 2017 thermal imaging survey of the Hanford Site included two nighttime flights over the Central Plateau and 618-10 waste site with an ITRES Research Limited (ITRES)[©] detector system using a Thermal Airborne Broadband Imager (TABI) system, TABI-1800¹, to collect ground scene radiant temperatures. The TABI-1800 provides a spectral range of approximately 3700 to 4800 nm, which results in imagery that is 1800 spatial pixels by 1 spectral pixel with a spectral bandwidth of 110 nm. The frame time for the thermal mapping with the TABI-1800 is 16 ms.

Using the TABI-1800 for thermal imaging, anything with a temperature above absolute zero will radiate photons in the thermal infrared region of the electromagnetic spectrum. The imaging conducted during the FY 2017 thermal imaging survey recorded the radiation of photons from surface-based objects. This method of remote sensing is not to be confused with the detection of ionizing radiation, which is the emission of gamma rays from an object that occurs at wavelengths 6 orders of magnitude less than those measured during the FY 2017 thermal imaging survey.

Radiant temperatures were collected in the midwave infrared region of 3700 to 4800 nm at night in order to minimize the effects of thermal loading during the daytime and to maximize thermal differences between surfaces resulting in a detection capability of changes as low as 0.05°C (32°F). Flight lines were oriented east to west with data acquisition resulting in image mosaics with a 0.25 m (0.8 ft) pixel resolution.

The aerial survey components included ground-based radiation surveys using detection systems in a mobile mode mounted on a road vehicle and static measurements taken for extended count times at various points on the Central Plateau. The location of the Central Plateau aerial and ground surveys are shown in Figure 2. The 618-10 waste site also included in the FY 2017 thermal imaging survey is shown in Figure 3. These figures present the thermal data from the FY 2017 survey. The continuous strings or lines of data points are made up of thermal detection results attached to horizontal coordinates, and these make up the flight lines that complete the aerial portion of the survey. Flight line locations and orientation relative to each data acquisition flight for this survey are shown in Figure 4 and further discussed in Section 2.3.

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¹ ITRES Research Limited produces TABI-1800, an airborne thermal imager that provides high-resolution thermal imagery.

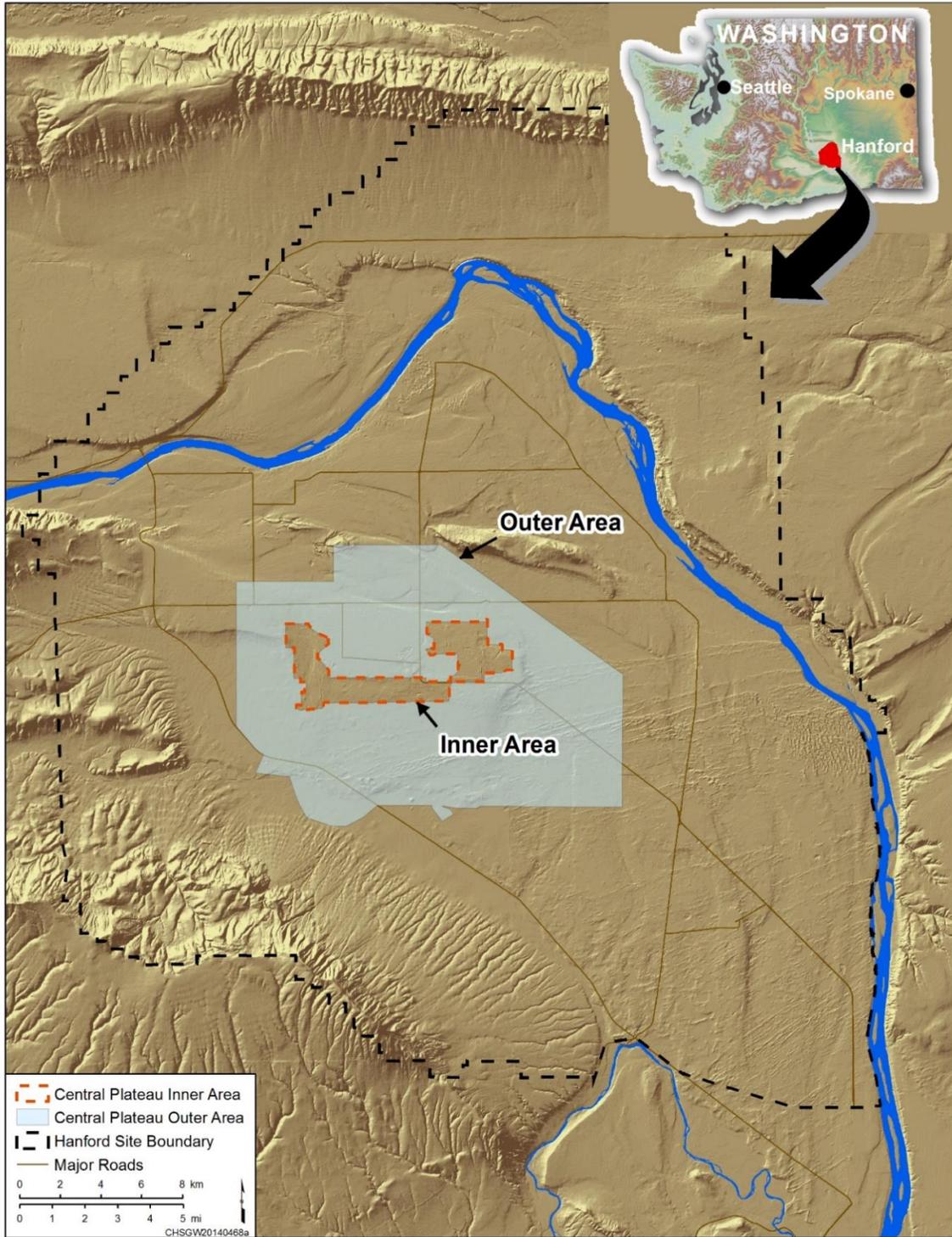


Figure 1. Inner and Outer Areas of the Hanford Site Central Plateau

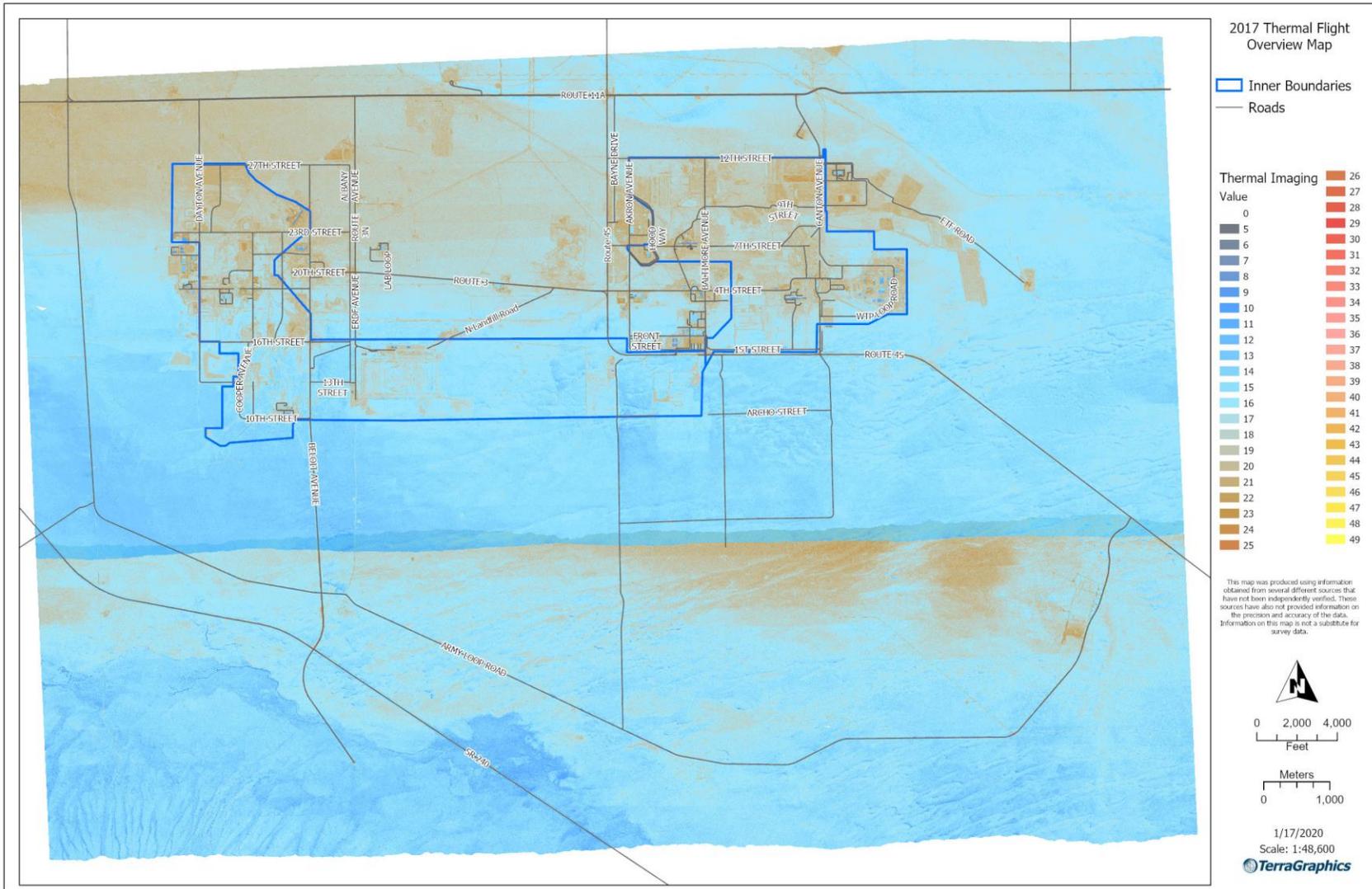


Figure 2. FY 2017 Thermal Imaging Overview – Central Plateau

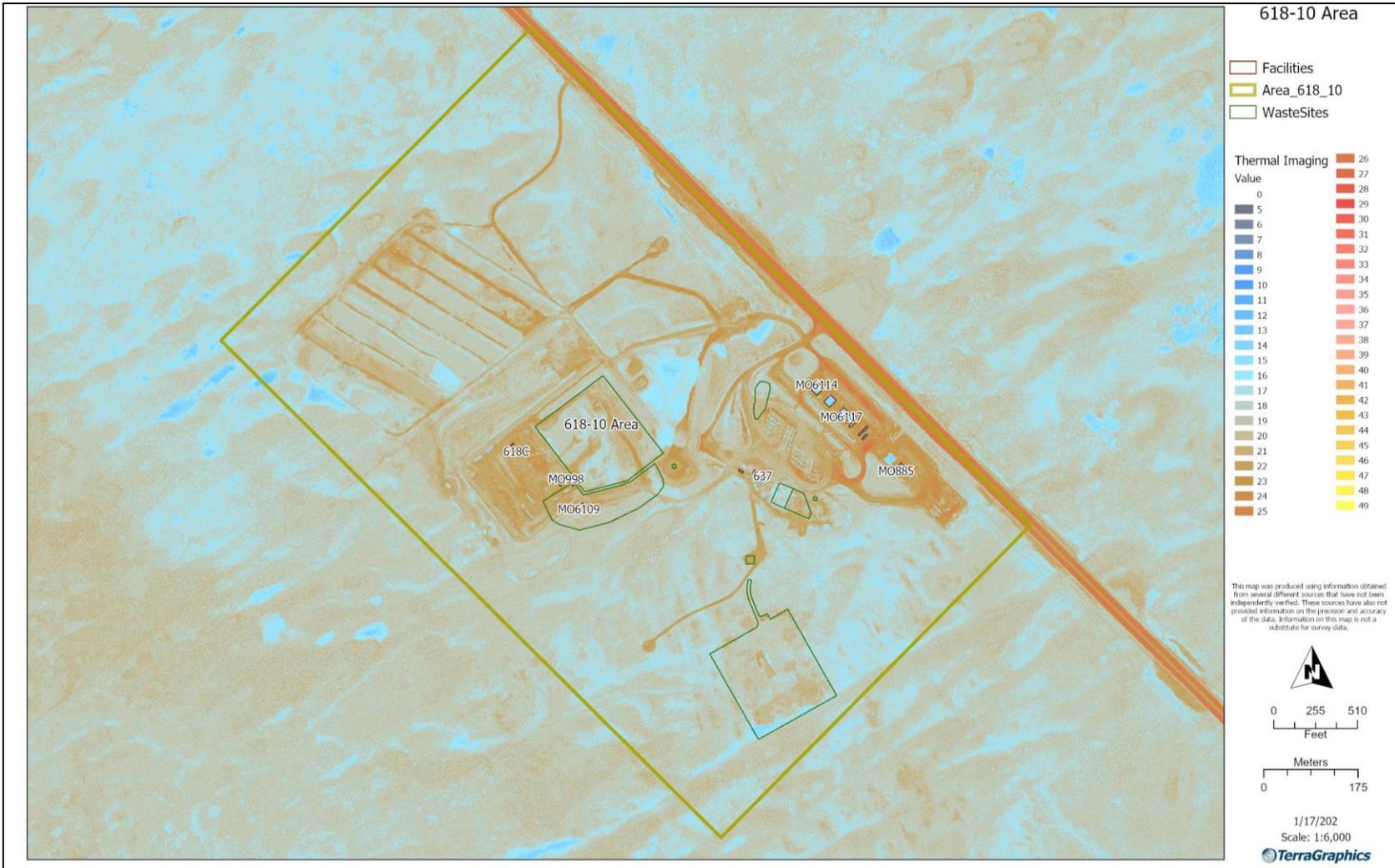
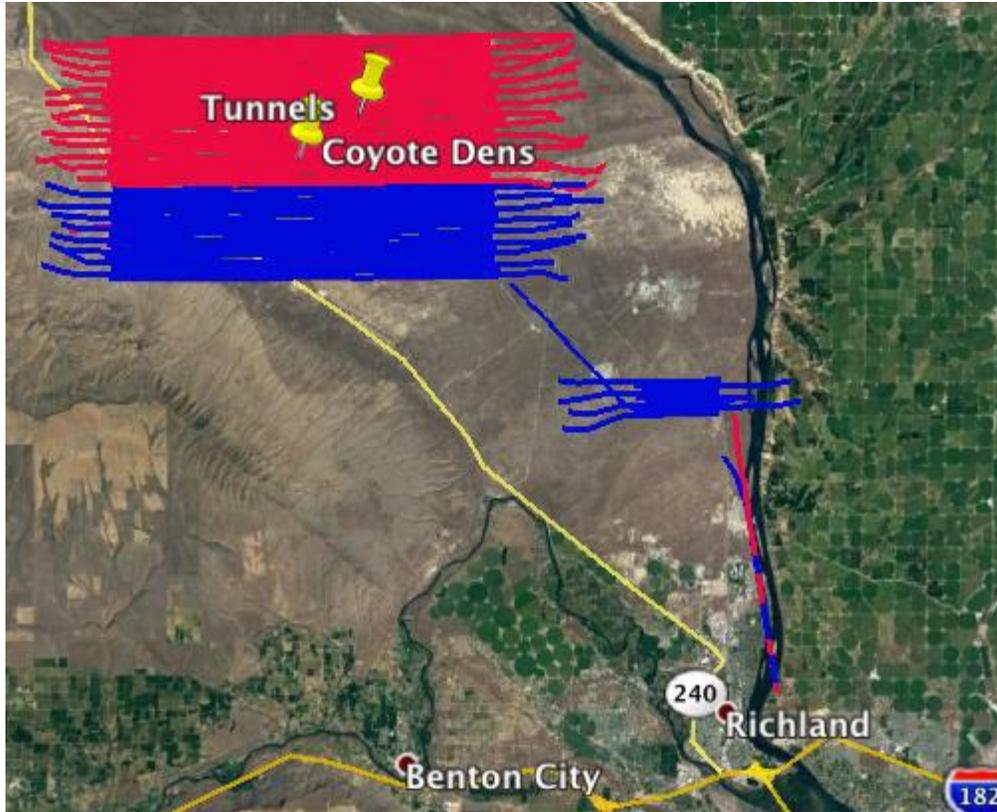


Figure 3. FY 2017 Thermal Imaging Overview – 618-10 Waste Site Area



Reference: RSL, 2017, *Airborne Thermal Image Mapping of the Hanford Nuclear Reservation, WA*.

Figure 4. FY 2017 Thermal Imaging Survey Flight Lines

2.2 Imaging Systems

The TABI-1800 thermal imager was mounted on a fixed-wing Piper PA-31-310 Navajo aircraft, measuring in the midwave infrared range of 3700 to 4800 nm with a 40-degree field of view. The imaging concept used was a pushframe, which allows high spatial resolution at high aircraft speeds. Additional processing included a sensor head unit (SHU) in the TABI-1800 that enabled integrated electronics, controls, data recording, and aircraft inertial measurement unit (IMU) combined with Global Positioning System (GPS) to calculate absolute position.

The TABI-1800 and SHU were mounted within the Navajo aircraft in a vibration-isolated plate fixed over a 19 in. survey port. The IMU and GPS antennae were attached to the sensor unit and the roof of the aircraft, respectively. Figure 5 is a photograph of the Navajo aircraft.



Reference: RSL, 2017, *Airborne Thermal Image Mapping of the Hanford Nuclear Reservation, WA*.

Figure 5. Remote Sensing Laboratory's PA-31-310 Navajo Aircraft

2.3 Data Requirements

This section describes the methods used by the RSL technical team to acquire thermal measurements with the Navajo aircraft-mounted aerial system.

Third-party flight planning software was used to deal with terrain height considerations. The following three project blocks were developed to cover the desired geography of the Hanford Site Central Plateau and the area around the 618-10 waste site to the south:

1. Central Plateau Inner Area - 200 East and 200 West Areas
2. Central Plateau southern region - lands south of the 200 East and 200 West Areas
3. 618-10 waste site

Two nighttime data acquisitions on July 12 and 13, 2017, were performed over a 3-day deployment window at the Hanford Site. Figure 4 shows the flight lines of the three project blocks; the red lines were flown on July 12, 2017, and the two groups of blue lines were flown on July 13, 2017. The flight lines were designed to follow the long axis of each project block, resulting in a 90/270-degree orientation.

Data acquisition was constrained to an average of 4 hours onsite in an effort to obtain stable ground thermal states. Thermal states, which impact air and ground temperatures, are likely to change with the variability of solar fluxes and other environmental conditions. The acquisition windows for data collection were from 1 to 4 a.m. for night acquisitions. The constraints for atmospheric conditions were no cloud effects, ground winds less than 11 kn, and no precipitation within 24 hours. Flight lines were designed to meet a requirement of 0.25 m (0.8 ft) ground sample distance between pixel centers.

2.4 Completeness

The objective of this section is to evaluate whether the data collected were suitable for spatial analysis tasks and discuss the resolution of any issues or problems encountered. Completion of the FY 2017 thermal imaging survey was not directly linked to *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* OU characterization or work plan efforts.

The data collected through the FY 2017 thermal imaging survey intends to aide in the identification of potential anomalous surface and near subsurface features. It is important to note that the data collected using thermal imaging technology is a tool to be used in conjunction with other characterization and analysis efforts using spatial analysis techniques and other existing historical data resources to identify potential surface and subsurface anomalies that may be informative of future characterization or work plan efforts. The thermal data alone may not accurately capture radiological anomalies, artifacts identified as part of the thermal survey are influenced by surface structures and materials.

Thermal infrared data measured represent the thermal emission of scene materials integrated over the wavelength range of the detector and must be interpreted against the contributions of both the target temperature and target emissivity to the apparent signal received. Without prior knowledge of material emissivity of all materials in a thermal image scene, absolute temperature cannot be determined. Thus, interpretation of industrial scenes, such as the Hanford Site, with a range of emissivity values of materials can be large and deviate significantly from assumed unit emissivity in radiometric processing. It is important to consider this in analysis in determining the credibility of thermal artifacts. Thus, the analysis performed as part of the FY 2017 thermal imaging survey to identify credible anomalies relied on the use of multiple data sources and historical knowledge to determine the credibility and validity of thermal anomalies identified as part of the project efforts. Additionally, environmental factors impacting atmospheric conditions (e.g., the amount of moisture in the air, temperature, and flight altitude) that are variable over the course of the data acquisition may impact the interpretation of flight line overlap areas or the interpretation of anomalies that span multiple flight lines. Therefore, such factors that influenced anomaly identification and interpretation of thermal data must be considered as part of data validation and quality assurance.

2.5 Survey Locations

Review of the FY 2017 thermal imaging survey using ArcGIS® mapping and spatial analysis software allowed the thermal data to be overlain on various GIS layers to include satellite imagery, waste sites, facilities, roads, and other supporting infrastructure feature classes located at the Hanford Site.

The thermal imagery files provided by RSL for the spatial analysis under this effort were raster files made up of pixels that showed contiguous coverage over the project blocks, with a verified pixel area of 0.25 m² (2.7 ft²). The data produced during the FY 2017 thermal imaging survey was sufficient in resolution and lateral coverage to permit a high-level analysis of the surfaces of all waste sites, facilities, roads, and nonoperational areas of the Hanford Site Inner Area and southern outer areas, as well as the 618-10 waste site. An exhibit of the Central Plateau survey is shown in Figure 2. The 618-10 waste site included in the FY 2017 thermal imaging survey is shown in Figure 3.

® ArcGIS is a registered trademark of Environmental Systems Research Institute, Inc., Redlands, California.

3 Field Quality Control

The thermal imaging survey system requires calibration and instrument performance checks to ensure accuracy and precision in data collection and subsequent interpretation. The TABI-1800 system deployed during the FY 2017 effort produced quantitative relative surface temperature data that were used in qualitative analysis relative to known or unknown surface artifacts. The following sections describe the calibration of the thermal imaging system and the performance checks completed during the FY 2017 thermal imaging survey.

3.1 Quality Parameters

As part of the calibration and performance checks of the thermal imaging system, quality parameters were used to evaluate and ensure the precision and accuracy of the surface temperature measurements. The two quality parameters applied during the FY 2017 thermal imaging survey were geometric calibration and ground truth measurements. Geometric calibration is used to precisely determine the location of pointing vectors and imager system positions relative to surface temperature measurement. This is an infrequent task performed after system installation. Ground truth measurements are conducted concurrently with project data acquisition. Ground truth measurements compensate for atmospheric artifacts potentially impacting material emissivity to ensure the radiometric accuracy of apparent temperature measurements. Sections 3.1.1 and 3.1.2 provide further detail on the application and use of geometric calibration and ground truthing.

3.1.1 Geometric Calibrations

Geometric calibration is the measure of relative positioning and pointing of imaging system components to correct for distortions arising from aircraft motion and to generate georeferenced image mosaics of multiple flight lines. Calibrations are made through a series of group adjustments called a bundle adjustment process.

The bundle adjustment process involves flight imagery of a well-established test site and ground control point (GCP) coordinates, corresponding navigation data, image pixel coordinates for the GCPs and tie points, and ground elevation information such as from a digital elevation model (DEM). For this project, a test site established by ITRES at the town of Okotoks, Alberta, was used. A number of surveyed GCPs were selected in the approximately 1 by 1 km (0.6 by 0.6 mi) area at the intersection of the north-south and east-west flight lines, which were all situated in highly visible locations from airborne imagery and have sharp material and temperature contrasts necessary for the TABI-1800 sensor (e.g., sharp intersections between grass and asphalt). Each point was referenced to the Universal Transverse Mercator (UTM) reference system (Zone 11, World Geodetic System [WGS84]) and height values were referenced to the ellipsoid. The GCPs in this area are tied to transportation infrastructure and private walkways, which results in the GCPs being made visible to airborne imaging equipment year-round.

The geometric calibration flight plan for the Hanford Site consisted of five flight lines oriented north-south and three flight lines oriented east-west. Each flight line is 7 km (4.35 mi) long with 60% overlap between adjacent lines and covers a combination of urban and rural areas. The spatial resolution of the calibration flight TABI-1800 imagery was 0.5 m (1.6 ft). The TABI-1800 imagery of the calibration site was processed using ITRES software, and the necessary bundle adjustment parameters were computed, with results within acceptable ITRES specifications.

3.1.2 Ground Truthing

To assess the extent of the radiometric artifacts that may occur in the FY 2017 thermal imaging survey, two ground truth sites were selected in the Tri-Cities area. Apparent temperatures of the ground truth sites were measured using Mount Everest starting radiometers, which were calibrated with certified blackbody cavities prior to deployment, allowing for the direct conversion of measured signal to apparent temperature (assuming the target emissivity is 1). The accuracy of the radiometers determined in the laboratory was $\pm 0.5^{\circ}\text{C}$ (32°F).

The FY 2017 thermal imaging survey included three ground truth flight lines flown over the 2 days of data acquisition. At one ground truth site, the temperature of water was measured from a dock on the Columbia River (Figure 6). The second ground truth site used was a large concrete pad shown in Figure 7. These targets were selected for ground truth because they were large and uniform with relatively well known emissivity values near 1.



Figure 6. Columbia River Ground Truth Site



Figure 7. Concrete Pad Ground Truth Site

The comparison with ground truth showed very good agreement and confirmed that the TABI thermal product fully satisfied the radiometric standards for this project. Further detail for radiometric standards and processing used in this project are documented in RSL, 2017.

3.2 Data Processing

TABI-1800 data processing typically produces georeferenced, apparent radiant temperature imagery. The processing includes steps such as applying radiometric calibration coefficients to convert raw digital numbers into apparent radiant temperature values in degrees Celsius. Measurements from the airborne inertial system and GPS, along with the bundle adjustment parameters, are then used to georeference each image strip. A georeferenced mosaic is developed of the study area in user-specified projection and datum. The data used in this project were processed using the steps outlined above and the procedures detailed in the subsequent sections.

3.2.1 Radiometric Processing

Data files from the TABI-1800 are digitized at 14-bit resolution and recorded as digital numbers (DN). These DN are converted into apparent radiant temperature in degrees Celsius using ITRES laboratory-generated calibration coefficient files, based off the calibration of the TABI sensor.

The following parameters are used in radiometric processing:

- Dark data system offset
- Electronic offset
- Thermal drift
- Radiometric (temperature) calibration coefficients from laboratory calibration

The ITRES proprietary radiometric correction software converts each of the flight images from DN to apparent radiant temperature (degrees Celsius) using the following:

1. Remove the detector additive components (including the dark data offset and the electronic offset) and correct for thermal drift.
2. Apply radiometric calibration coefficients to convert the corrected signal into apparent radiant temperature in degrees Celsius.

3.2.2 Georeferencing and Image Mosaics

In order to create georeferenced imagery, the following data inputs are required:

- Radiometrically corrected image data (i.e., processed into apparent radiant temperature)
- Coincident airborne GPS data from the integrated GPS receiver
- Coincident attitude data from the integrated IMU onboard the aircraft
- Coincident ground-based GPS data from externally operated base stations
- Terrain height from a DEM

These data streams are blended to generate geometrically corrected images using the following five steps:

1. Airborne GPS data are differentially corrected using the GPS base-station data.
2. Blended solutions of Differential Global Positioning System (DGPS) positions with aircraft attitude data from the IMU are generated.
3. Navigation solution is optimized using positional and angular offsets determined in the bundle adjustment process and is applied to the image data.
4. The DEM is used by the geometric correction process to remove topographic effects and to facilitate the final ortho-rectification of the imagery.
5. Georeferenced imagery with square pixels is generated and populated using a nearest neighbor algorithm.

The ITRES DEM was generated by the light detection and ranging (LiDAR) data taken over the Hanford Site, provided by National Security Technologies, LLC. The height values in the DEMs were converted from orthometric height to ellipsoidal height by adding an average geoid undulation over the area². The sensor height and the terrain heights in the DEMs would be referenced with respect to the same height datum.

The ITRES proprietary geometric correction software used the post-processed DGPS navigation solution, the synchronization timing information, the bundle adjustment offset parameters, and the DEM/digital surface model (DSM) to produce georeferenced images of this project area.

The TABI-1800 data over the Hanford Site thermal survey area were processed into thermal image mosaics based on the date of acquisition and/or block boundaries. The mosaic is in UTM Zone 11N projection and referenced to the WGS84 datum, with a square pixel resolution of 0.25 m (0.8 ft). Areas without any image data (e.g., mosaic edges) have temperature values of zero.

The TABI-1800 imagery meets ITRES quality assessment standards in terms of image quality and geometric accuracy. The different temperatures of the scene buildings and other features are evident.

² The geoid undulation is negative over this area.

When looking at the overlapping regions of adjacent images, some small temperature differences are observed, but the difference is typically less than a few tenths of a degree. Some of the temperature variation observed between adjacent images is expected because the environment temperature will vary over the course of an image acquisition.

Some misalignment between adjacent flight lines is attributed to changes in the surface profile since the 2008 date of the LiDAR DSM used in orthorectification. That is almost a decade for changes in the landscape to occur, which could be significant given the active nature of the site management.

4 Thermal Spatial Analysis

This chapter discusses the geospatial analysis of thermal data collected during the FY 2017 thermal imaging survey. The analysis required use of RSL; generated GIS data files containing numerous attributes pertinent to the collection of radiological data; and Hanford Site base map layers for roads, waste sites, aerial imagery, and the waste site information from WIDS. Analysis of the FY 2017 thermal imaging survey relies heavily on the approach for large-scale analysis of aerial data established in this report, as well as the findings and tabulated data reported therein.

4.1 Background

An extensive spatial analysis was conducted to create a systematic approach to identify anomalies as part of the FY 2017 thermal imaging survey and a comparison to previous aerial data including the FY 2015 aerial survey. Part of that discussion also included a focused analysis of RSL radiological regions of interest (ROIs) (from the FY 2015 aerial survey) to identify surface features (e.g., waste sites, facilities) that could contribute to elevated radiological detections. Waste sites in the proximity of ROIs were tabulated, and an evaluation and comparison to the features and elevated radiological data identified during the FY 2015 aerial survey was conducted. As presented in Chapter 5, a list of credible anomalies is identified with an associated waste site or responsible owner. Credible anomalies that are present within previously identified ROIs are also discussed in Chapter 5.

4.2 Approach

The spatial analysis performed involved overlaying the Hanford Site GIS layers for waste sites, pipelines, and facilities on the FY 2017 thermal imaging raster layers and reviewing thermal attributes for acute contrast (focused radiant temperature deltas of greater than 5°C [32°F] occurring over a small area) and broad contrast (low magnitude temperature deltas spread over a larger area).

The spatial analysis of thermal imaging features identified during the FY 2017 thermal imaging survey consisted of the following steps:

1. Overlay RSL thermal survey data and ROIs onto the Hanford Site base map layers (see Appendix B).
2. Compile a list of waste sites, facilities, structures, and other areas of lands (i.e., areas not associated with existing waste sites) and FY 2015 aerial survey (SGW-60352) ROIs and associated radiation conditions at each waste site.
3. Analyze radiological ROI and thermal imagery relationships relative to identified thermal features and artifacts.
4. Identify deltas between known waste sites and radiological ROI conditions and carry forward overlapping and credible anomalies as features of interest.
5. Review imagery (thermal and ortho) for other thermal anomaly analysis.

6. Discuss and evaluate surface or near subsurface features contributing to the feature(s) of interest.
7. Based on evidence gathered in Step 1 through Step 6, determine the credibility and provide justification of features of interest identified.

All features of interest (anomalies) identified during this project are presented in Appendix A. Credible anomalies are discussed in Chapter 5.

When acute or broad thermal contrasts were identified, satellite imagery and/or site resources were used to determine whether the observed temperature changes could be attributed to known surface features that made logical sense. If the contrast could not be explained in this way, then it was retained as a credible anomaly. An example of thermal contrast that can be explained are roof-mounted heating, ventilation, and air conditioning (HVAC) units, which during the summer months, do not cool down as much as the surrounding roof. Thermal imaging of this condition shows clear contrast on roofs with operating HVAC units, and review of satellite imagery confirms the location of these units. This condition is shown in Figure 8.

Figure 8 also shows the thermal imagery of the roof of the Waste Receiving and Packaging (WRAP) facility obtained during field activities performed as part of this project. The location of HVAC units associated with the roof of the WRAP facility correspond to elevated thermal signatures when compared to the rest of the facility, and thus, easily identifiable, and the temperature contrast observed is thus explainable.

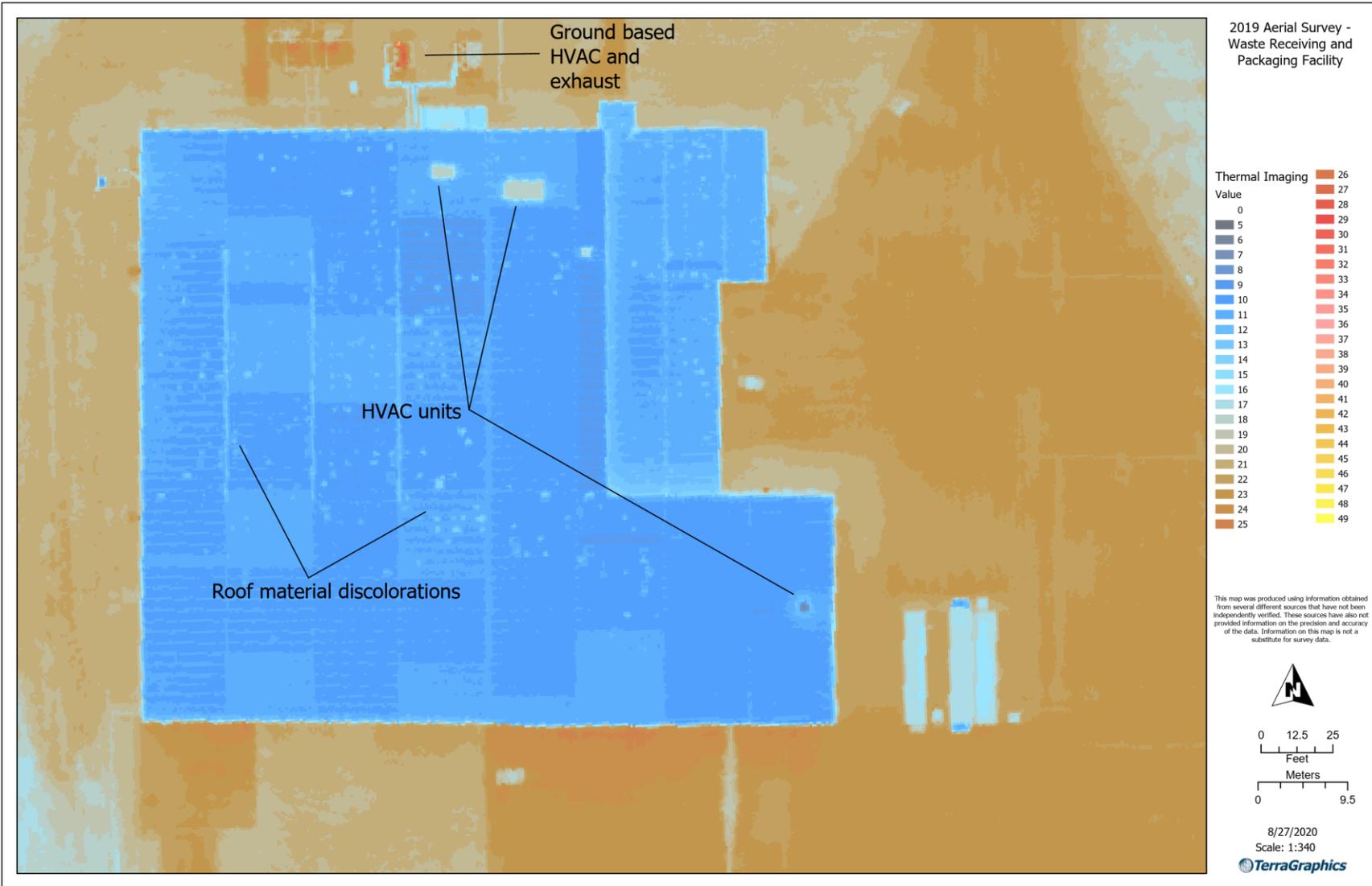


Figure 8. Thermal Imagery of the WRAP Facility

5 Results

This chapter summarizes the results of the spatial analysis performed on the thermal imaging data collected during the FY 2017 thermal imaging survey. Similar to the FY 2015 aerial survey (SGW-60352) that was conducted to identify radiological hotspots on the Central Plateau, the analysis performed on the thermal imaging data was to identify anomalies within waste sites, pipelines, and facilities, and compare those credible anomalies to previous radiological surveys, specifically radiological ROIs identified in the FY 2015 aerial survey. The following sections present a summary of the analysis conducted.

5.1 Anomalies Analysis

This section provides a summary of the thermal anomalies observed during spatial analysis of the FY 2017 thermal imaging survey. The focus for anomaly identification was to look for temperature deltas within waste sites, pipelines, and facilities that could not be explained through review of orthogonal (satellite) images, site operations at the time of the FY 2017 thermal imaging survey, or site knowledge.

Figure 9 shows the locations of the credible anomalies identified in Tables 1 and 2. Additional location and spatial information regarding the credible anomalies identified can be found in Appendix B.

Through evaluation of all areas imaged during the FY 2017 thermal imaging survey, 187 anomalies were initially identified. Anomalies were then assigned to a waste site if the location fell within a waste site boundary. All other anomalies were assigned to a responsible contractor (as identified in Hanford Site Geographic Information System layers) based on the proximity to facilities, structures, or ground location. A full listing of anomalies identified by RSL is provided in Appendix A.

Following spatial analysis, 74 anomalies were determined to be credible. Table 1 provides a list and brief description of credible anomalies associated with waste sites and cataloged by OU. Thirty credible anomalies were found to be associated with waste sites managed as part of existing OUs. Table 2 lists credible anomalies associated with facilities, structures, or areas of land and the responsible prime contractor. Forty-four credible anomalies were identified to be associated with facility, structures, or areas of land not part of an existing OU. The Feature Type/ID column in the tables is an alphanumeric identification system developed by the RSL team to categorize the anomalies. The identifiers correspond to the following definitions:

- MISC – miscellaneous thermal feature
- PA – probable anomaly
- ROOF – roof anomaly
- SEEP – surface water, runoff, seeps, and drainage
- SS – surface staining, spills, and scrapes
- USS – under surface structure

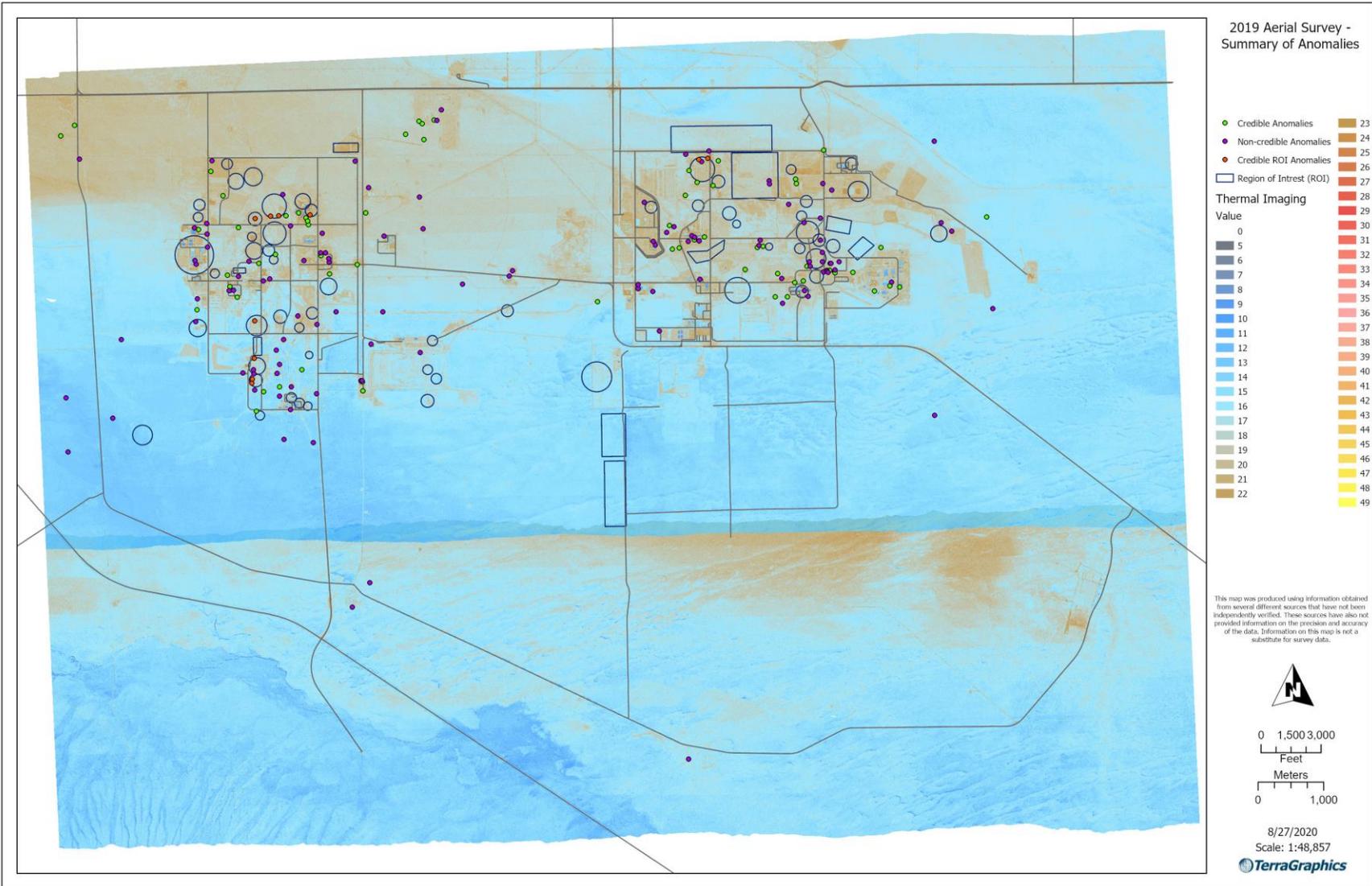


Figure 9. Credible Anomalies Identified During the FY 2017 Aerial Imaging Survey

Table 1. Summary of Credible Thermal Anomalies Associated with Waste Sites by Operable Unit

OU/Feature Owner	Feature Type/ID*	Anomaly Description	Justification
200-DV-1	USS35	Rectangular thermal feature indicating an underground structure in this inactive crib.	The anomaly is located at the head end of the 216-T-19 Crib and tile field in the location of the crib structure. No visible surface discoloration at this location.
200-EA-1	MISC03	Thermal anomaly in an area of known surface contamination.	The anomaly is located at the 216-C-7 Crib. Past photographs show the crib surface cover to be small sands and gravels with surrounding surface materials made up of gravels and small cobbles, which could account for the thermal anomaly.
200-EA-1	MISC13	Thermal features not evident in visible imagery.	The anomaly is located at the 216-B-12 Crib. Surface cover includes sands and gravels with large patches of wheatgrass. Warmer features correspond to areas with decreased vegetation.
200-EA-1	PA04	Cooler features that delineate geometric structure.	Heterogeneous gravel area between the 216-B-47 Crib and contamination migration UPR-200-E-89 waste site.
200-IS-1	USS04	Linear thermal feature crossing road. May be associated with a network of pipelines.	The anomaly is in the location of a dense network of active and inactive pipelines east of the AP Tank Farm. Pipelines include 200-E-127-PL, 200-E-187-PL, and 200-E-289-PL. Mapped features do not directly mirror thermal images.
200-IS-1	USS05	Thermal feature in the road. May be associated with a network of pipelines crossing at this juncture.	The anomaly is in the location of a dense network of active and inactive pipelines east of the AP Tank Farm. Pipelines include 200-E-127-PL, 200-E-187-PL, and 200-E-289-PL. Mapped features do not directly mirror thermal images.
200-IS-1	USS09	Linear thermal feature that does not correspond with utility vectors.	The anomaly is located near T Plant, just east of 210W. The area is an asphalt parking lot where HGIS shows no mapped pipelines or underground utilities. The 200-W-163-PL pipeline is mapped approximately 40 m east of this location.
200-IS-1	USS18	Double linear thermal anomaly not seen in visible imagery.	The anomaly is located near the southeast corner of B Plant, proximal to the 200-E-226-PL-A pipeline. There are no mapped features in HGIS, nor does aerial imagery show any indication of corresponding surface features.
200-IS-1	USS22	Linear feature leading to an effluent pond south of T Plant.	The anomaly is located beneath 23 rd Street, north of the 200-W-237 waste site. The waste site is an open and inactive effluent pond that has an unmapped inlet pipe entering from a location and orientation consistent with this anomaly.

Table 1. Summary of Credible Thermal Anomalies Associated with Waste Sites by Operable Unit

OU/Feature Owner	Feature Type/ID*	Anomaly Description	Justification
200-IS-1	USS36	Evidence of a subsurface structure with a warm anomaly at the south end that is not seen on visible imagery.	The anomaly is located north of the 241-TX-155 diversion box. Aerial imagery shows surface scaring consistent with linear thermal features, as well as a warm feature consistent with the location of 200-W-143-PL.
200-IS-1	USS60	Linear thermal features that may correspond with buried pipes/drains.	The anomaly corresponds to the location and orientation of 200-E-221-PL near the 216-B-51 Crib. The pipeline consists of two 1 in carbon steel lines.
200-IS-1	USS61	Thermal features associated with waste streams.	The anomalies are at the locations of the 216-C-3 and 216-C-5 Cribs. The cribs are buried perforated pipes that have been blanked. The 200-E-169-PL and 200-E-173-PL pipelines also end at the location of this anomaly.
200-IS-1	USS72	Linear thermal feature near a junction in an inactive radioactive process sewer. Possible connection with 2607-W3.	The anomaly is located on the 200-E-163-PL pipeline south of the 219W soil and groundwater drilling laydown yard. The point is located at a visible surface access point to the pipeline.
200-IS-1	USS73	Linear thermal feature near a junction in an inactive radioactive process sewer. Possible connection with 2607-W3.	The anomaly is located on the 200-E-163-PL pipeline south of the 219W soil and groundwater drilling laydown yard. The point is located at a visible surface access point to the pipeline.
200-OA-1	SS02	Sharply defined thermal feature that is less defined in visible imagery.	Ground disturbance in the southwest corner of OCSA, along with ground undulations and inconsistent vegetation.
200-OA-1	SS03	Sharply defined thermal feature that is less defined in visible imagery.	Ground disturbance outside of the southwest corner of OCSA; potential for inclusion in that waste site.
200-OA-1	MISC17	Randomly distributed unidentified objects.	The anomaly is located in the vegetation south of the 600-284-PL-B pipeline, southwest of the intersection of 4 th Street and Route 4. The objects identified in the thermal survey are visible in aerial imagery.
200-OA-1	USS10	Rectangular thermal anomalies with no corresponding visible signature.	Located in the central portion of the OCSA waste site, thermal imagery reveals the outline of an old structure not currently visible in aerial imagery.
200-OA-1	USS25	Sharply defined thermal features defining edges of buried structure.	The anomaly is in the location of the 600-218 anti-aircraft artillery dumping site. Aerial imagery does not show corresponding surface features at this location, which indicates subsurface features.

Table 1. Summary of Credible Thermal Anomalies Associated with Waste Sites by Operable Unit

OU/Feature Owner	Feature Type/ID*	Anomaly Description	Justification
200-OA-1	USS26	Circular thermal feature with slight visible signature in vegetation.	The anomaly is at the end of a sidewalk among the 600-216 anti-aircraft site slabs. No mapped features are present in HGIS.
200-OA-1	SS25	Sharply defined thermal feature that is less defined in visible imagery.	Located in the southwestern corner of the OCSA waste site, HGIS layers and aerial imagery show no indication of surface disturbance at this location.
200-OA-1	SS26	Thermal feature that does not appear in visible imagery.	The anomaly extends westward out of a historic vehicle turnaround area off of one of the abandoned roads leading south out of the OCSA waste site. Visible surface features are not consistent with thermal imagery.
200-SW-2	USS16	Rectangular thermal feature extending from a landfill.	Located at the south end of the 218-E-1 Burial Ground, thermal variations are not consistent with mapped HGIS layers or aerial imagery.
200-SW-2	SS09	Sharply defined thermal feature that is less defined in visible imagery.	An area of poor vegetation growth compared to surrounding portions of the 218-E-12B waste site. The anomaly is in the area of the northern ends of Trenches 8, 9, and 10.
200-SW-2	USS29	Rectangular thermal anomaly that has visibly uniform ground cover.	Radiant temperatures in the central portion of the 218-W-3A Burial Ground are unexpected. This anomaly is in the vicinity of Trenches 23 through 28.
200-SW-2	USS30	Distinct thermal features in a visibly uniform area.	The anomaly is in the 218-W-3A Burial Ground at Trench T08. The western portion of the anomaly is an area of TRU waste that has been excavated, and the eastern portion contains TRU waste and has a uniform surface sands and gravels.
200-SW-2	USS59	Buried structure is clearly defined in the thermal imagery.	The anomaly is located in the 218-E-5A Burial Ground at the location of Trench T01. The anomaly may be indicating the location of the four large foam-covered wooden boxes documented in the trench.
200-SW-2	SS24	Sharply defined thermal feature in a visibly uniform area.	An area of poor vegetation growth compared to the surrounding portions of the 218-E-12B waste site. The anomaly is in the area of the center portion of Trenches 8 and 9.
200-WA-1	USS11	Cool geometric features indicate an underground structure of this inactive crib.	The 216-S-7 Crib shows visible variations in surface gravels consistent with the thermal imagery. The cooler thermal zone is consistent with the center of the crib structure, indicative of subgrade void space.

Table 1. Summary of Credible Thermal Anomalies Associated with Waste Sites by Operable Unit

OU/Feature Owner	Feature Type/ID*	Anomaly Description	Justification
200-WA-1	MISC31	Uniquely shaped thermal anomaly in generally uniform gravel.	The anomaly is located along the north edge of the 200-W-53 waste site. Small variations in surface sands and gravels correspond partially to this anomaly. There are no HGIS features at this location.

*The Feature Type/ID column in this table is an alphanumeric identification system developed by the RSL team to categorize the anomalies. The identifiers correspond to the following definitions:

- MISC = miscellaneous thermal feature
- PA = probable anomaly
- SS = surface staining, spills, and scrapes
- USS = under surface structure

- HGIS = Hanford Site Geographic Information System
- ID = identifier
- OCSA = Old Central Shop Area
- OU = operable unit
- RSL = Remote Sensing Laboratory
- TRU = transuranic

Table 2. Summary of Credible Thermal Anomalies Associated with Facilities, Structures, and Areas of Land and the Responsible Owner

OU/Feature Owner	Feature Type/ID*	Anomaly Description	Justification
BNI	SEEP04	Surface runoff into holding pond.	The holding ponds are located in the GTFL waste site, currently a RCRA TSD site.
BNI	MISC14	Long, linear cooling scar possibly related to construction.	The anomaly is located along the southeast corner of the 2320WTP building. Aerial imagery from the time of the survey does not show any corresponding surface features.
BNI	ROOF12	Rectangular thermal anomaly in southwest corner of building roof that is not seen in visible imagery.	Slightly warmer zone at the southwest corner of 2256WTP is not consistent with visible exterior materials.
BNI	USS68	Several thermal features that do not correspond with visible data.	The anomaly is located east of 2884AWTP01 fire water tanks. HGIS and aerial imagery show no corresponding features at this location. This appears to be a highly travelled portion of the WTP laydown area.
CHPRC	SS01	Surface staining from spill.	The anomaly is located at the northern corner of the GTF waste site in a gravel area. At the time of the survey, there was clear surface staining at this location. Currently, the staining is gone, and new gravel has taken its place.
CHPRC	PA01	Possible holding area that drains along the east edge.	Vegetated area north of the BX-BY Tank Farm and south of a contamination migration area; UPR-200-E-89 waste site. No underground features visible in HGIS.
CHPRC	MISC21	Grid with thermal background related to surface elevation. Possible site study.	This anomaly is located southwest of 216-U-12. The gridded features are not mapped in HGIS and the area is clearly visible from aerial imagery.
CHPRC	PA05	East-west scar along the road and warm anomaly that shows watered vegetation.	A number of groundwater extraction lines traverse the highly disturbed area of surface sands. The green vegetation at the south of the scar is abnormal.
CHPRC	ROOF04	Thermal anomaly on the roof of an inactive process unit/plant.	Uniform surface materials on the roof of 224T with thermal features near the eastern edge roof openings (steel plate, sealed one square foot); potential presence of pooling.

Table 2. Summary of Credible Thermal Anomalies Associated with Facilities, Structures, and Areas of Land and the Responsible Owner

OU/Feature Owner	Feature Type/ID*	Anomaly Description	Justification
CHPRC	USS19	Thermal geometries not seen in visible imagery. Area is uniform cover.	This anomaly is located west of 241-ER-151, inside the jersey barriers to the east of the CSB. HGIS and aerial imagery show no mapped features that correspond to the linear thermal features.
CHPRC	USS23	Three linear features extending from a building in the T Plant Complex to an inactive burial vault.	Located between 222T and 218-W-8, the southernmost feature corresponds to a water utilities distribution line, and the other two thermal features correspond to slight surface discolorations visible in aerial imagery but not mapped in HGIS.
CHPRC	USS37	Multiple linear thermal features in an area with visibly uniform surface cover indicating subsurface infrastructure.	This anomaly is at the geophysical logging source material location on the east side of Route 3. HGIS shows no mapped features at this location, and aerial imagery does not show any surface features that would explain the thermal variation.
CHPRC	ROOF06	Thermal anomaly on roof that is not seen in visible imagery.	Some thermal variations on the roof of 275W are explained by small exhaust ports. Cool anomalies on the southern edge are potential pooling locations.
CHPRC	USS42	Linear thermal feature extending from equipment in the center of a gravel pad.	Located at groundwater well 299-W18-37, this anomaly shows a linear feature not present in HGIS layers or aerial imagery extending north from the well.
CHPRC	SS16	Linear thermal anomaly connected to a thermal feature near an unplanned release. Area has uniform cover in visible imagery.	Proximal to UPR-200-W-91 at the northwest corner of PFP, the cool thermal presence is not consistent with surface features at the time of the survey.
CHPRC	USS44	Thermal evidence of buried foundation from an old building.	Located on the south side of the demolished 241Z Facility, the anomaly is not visible in aerial photos taken at the time of the survey. HGIS layers show no structure here.
CHPRC	PA09	Sharply defined thermal features in visibly uniform surface cover.	Historic aerial images indicate the likelihood of sparse grasses in this portion of 216-W-LWC. Growth and/or herbicide application could explain this anomaly.

Table 2. Summary of Credible Thermal Anomalies Associated with Facilities, Structures, and Areas of Land and the Responsible Owner

OU/Feature Owner	Feature Type/ID*	Anomaly Description	Justification
CHPRC	USS51	Square thermal feature that extends beyond the visible site.	The anomaly is located at the northeast corner of well pad 299-W22-47 in an area of vegetation that is not consistent with surrounding vegetation, indicating surface disturbance at the time of drilling. No HGIS mapped features.
CHPRC	USS54	Linear thermal feature that may be an underground power line not included in vector database.	This anomaly is located on the east side of the 6618D Building at ERDF. There are no corresponding features in HGIS or aerial imagery.
CHPRC	USS55	Linear thermal features that do not correspond to visible data.	The linear thermal anomaly is located at the southwest corner of ERDF, south of 6681D. Aerial photos taken in June 2017 show this as an area of wetted sand with dry, linear features corresponding to this anomaly. No mapped features in HGIS.
CHPRC	PA12	Multiple thermal features that do not coincide with visible surface materials.	The large anomaly at this location is the 241-B-153 diversion box. The anomaly directly south of the diversion box cannot be attributed to a known feature.
CHPRC	USS62	Linear thermal feature extending from building.	The anomaly is located south of the dry material facility truck loadout building. HGIS layers and aerial imagery do not show features that correspond to this anomaly.
CHPRC	USS64	Grid of thermal anomalies not seen in visible data.	The anomaly is located north of the 218A Facility and west of the 2607-E6 drain field in a vegetated area that appears undisturbed. There are no HGIS layers that correspond to this unique anomaly.
CHPRC	ROOF11	Thermal anomalies on roof that are not seen in visible imagery.	Thermal anomalies on the northwest portion of the 2701AB Building roof correspond to slight discoloration of roof materials in an aerial imagery. Possible location of pooling.
CHPRC	USS67	Multiple linear features extending between an inner and outer fenced area.	The anomaly is located southwest of PUREX, between the inner and outer facility fences. The linear anomalies connect four electric utility poles and/or light poles. HGIS layers show no corresponding features.

Table 2. Summary of Credible Thermal Anomalies Associated with Facilities, Structures, and Areas of Land and the Responsible Owner

OU/Feature Owner	Feature Type/ID*	Anomaly Description	Justification
CHPRC	PA14	Thermal feature that does not coincide with visible surface materials.	Warm feature in a visibly uniform area of vegetation at the northern corner of well pad 699-44-39B. The well was visited for well maintenance 2 weeks before the survey.
CHPRC	USS69	Linear thermal feature extending from a facility that may correspond to a pipeline connecting the 224-T building to the effluent pond to the south (200-W-237).	The linear anomaly is located southeast of 224T and extends toward 23 rd Street. HGIS and aerial imagery show no corresponding features.
CHPRC	USS70	Thermal feature that does not correspond to a visible signature.	The anomaly is located east of the northeast corner of WRAP. No mapped features in HGIS or aerial imagery correspond with the anomaly. Thermal and aerial imagery show evidence of water runoff from the asphalt adjacent to the anomaly; possible pooling.
CHPRC	USS71	Thermally cool drainage patterns that don't correspond to anything visible.	The anomaly is located east of the 289TE transfer building in a gravel area made up of a web of primitive gravel roads. The cooler features correspond to untraversed areas of land. No corresponding HGIS or aerial imagery features at his location.
MSA	USS02	Possible thermal evidence of prior roadwork/repair. Could be associated with pipelines.	The anomaly is located on 4 th Street north of 241AP271. HGIS shows no mapped utilities at this location, and aerial imagery shows no visible surface feature.
MSA	USS43	Possible thermal signature of underground power lines.	West of 234-5Z-BA boiler annex building. There are a number of mapped electrical utilities in this area but match the orientation of the linear thermal feature.
MSA	USS45	Linear thermal feature under the road.	Located at the intersection of 20 th Street and Albany Avenue, there are multiple electrical utilities mapped in HGIS at this location, but none with the exact orientation of the anomaly.
MSA	SS23	Linear thermal feature extending across the road and beyond.	The location of this feature is at the intersection of Canton and 12 th Street. HGIS layers, aerial imagery, and aerial photos show no indication of surface or subsurface features at this location.

Table 2. Summary of Credible Thermal Anomalies Associated with Facilities, Structures, and Areas of Land and the Responsible Owner

OU/Feature Owner	Feature Type/ID*	Anomaly Description	Justification
MSA	USS66	Thermal features in a visibly uniformly covered area.	The anomaly is located east of 210A. The orientation and location correspond to one abandoned water utility line and an active service water line. Other portions of the lines are not evident in thermal imagery.
MSA	USS77	Curved feature that partially corresponds with different vegetation but extends into an unvegetated area and may end in a channel.	The anomaly is located south of 10 th Street near the corner of 10 th Street and Cooper Avenue. The anomaly is an extension of a large linear feature of dark vegetation on the north side of 10 th Street. No HGIS features are present at this location.
WRPS	ROOF03	Pooling surface water on the roof. May indicate current or future location of leaks.	Thermal indication of potential pooling water on the roof of 222B, as surface materials appear uniform.
WRPS	USS12	Possible underground utility lines.	The anomaly extends south from the 2712B electrical/instrumentation building, east of 241-ER-151. HGIS shows no mapped underground features in this area. Aerial imagery shows faint surface discoloration at this location.
WRPS	USS24	Can thermally see structure beneath the surface that is not seen in visible imagery.	This anomaly identifies features beneath the surface of the barrier at the T Tank Farm, which are not visible in aerial imagery.
WRPS	ROOF07	Thermal anomaly on the roof that is not seen in visible imagery.	The north/south cooler feature in the center of the roof is not consistent with the roof surface and may be a function of interior features or a possible pooling area.
WRPS	USS50	Many subsurface linear features that can't be seen in the visible imagery.	The anomaly is located in the SX Tank Farm and identifies many linear features that are not mapped in HGIS and not visible in aerial imagery.
WRPS	USS58	Rectangular thermal feature is probably a buried foundation. Also, a circular thermal feature that is a mound.	The location is in the BX Tank Farm north of the 241-BYR-154 diversion box. HGIS layers and aerial imagery show no corresponding features at this location.
WRPS	ROOF10	Thermal anomaly on the roof that is not seen in visible imagery. Two circular thermal anomalies on the ground east of the building also not in visible data.	Southwestern edge of the 204AR roof shows cool thermal area and aerial imagery shows slight discoloration of roof materials in this area. These factors indicate potential pooling.

Table 2. Summary of Credible Thermal Anomalies Associated with Facilities, Structures, and Areas of Land and the Responsible Owner

OU/Feature Owner	Feature Type/ID*	Anomaly Description	Justification
WRPS	USS75	Several thermal features that do not correspond to visible surface features. May be different cover material used to bury contaminated soil.	Located at the west end of the 244UR Vault, this anomaly shows subsurface features that are not mapped in HGIS or visible in aerial imagery.
WRPS	USS76	Many thermal features that may indicate covered infrastructure.	The anomaly is located in SX Tank Farm and identifies many linear features that are not mapped in HGIS and are not visible in aerial imagery.

Reference: *Resource Conservation and Recovery Act of 1976.*

*The Feature Type/ID column in this table is alphanumeric identification system developed by the RSL team to categorize the anomalies. The identifiers correspond to the following definitions:

- MISC = miscellaneous thermal feature
- PA = probable anomaly
- ROOF = roof anomaly
- SEEP = surface water, runoff, seeps, and drainage
- SS = surface staining, spills, and scrapes
- USS = under surface structure

- BNI = Bechtel National, Inc.
- CHPRC = CH2M HILL Plateau Remediation Company
- CSB = Canister Storage Building
- ERDF = Environmental Restoration Disposal Facility
- GTF = Grout Treatment Facility
- GTFL = Grout Treatment Facility Landfill
- HGIS = Hanford Site Geographic Information System
- ID = identifier
- MSA = Mission Support Alliance

- OU = operable unit
- PFP = Plutonium Finishing Plant
- PUREX = Plutonium Uranium Extraction Plant
- RCRA = *Resource Conservation and Recovery Act of 1976*
- RSL = Remote Sensing Laboratory
- TSD = temporary, storage, and disposal
- WRAP = Waste Receiving and Processing
- WRPS = Washington River Protection Solutions
- WTP = Waste Treatment Plant

5.1.1 618-10 Waste Site

The area of the 618-10 waste site was specifically evaluated for anomalies and features because waste site remediation and construction activities were concluding in this area at the time of the thermal survey. Various raster image contrasting techniques were used in the review of the thermal imagery collected over the 618-10 waste site. The area surveyed is bisected by Route 4 South, a highly traveled four-lane highway. The waste site is west of the highway, and undisturbed shrub and grass vegetation is found east of the highway. All surveyed areas were evaluated thoroughly for anomalies and features that may have originated within the remediation area but migrated out of the construction zone. East of the highway, all thermal variations were attributed to the broad range of transmissivity resulting from surface grasses, sands, shrubs, and ground slopes. Proximal to the construction zone on the west side of the highway, no anomalies were identified, as all suspected thermal variations were attributed to vehicle travel, service water usage, building structures, laydown areas, and general construction activities happening at the time of the survey.

5.2 Comparison to Previous Radiological Surveys (Region of Interest Analysis)

As recommended by RSL (RSL, 2017) this section provides a comparison of the thermal imaging data to the most recent aerial radiological survey conducted on the Central Plateau of the Hanford Site. Although the presence of a credible anomaly does not in itself indicate elevated radiological conditions, identification of thermal anomalies in areas containing high sources of radiation provides baseline for investigatory decision making in places with an elevated consequence from an upset condition.

The spatial analysis performed involved overlaying the ROIs described in this report on the FY 2017 thermal imaging raster layers and reviewing thermal attributes for acute contrast (focused on radiant temperature deltas of greater than 5°C [32°F] occurring over a small area) and broad contrast (low-magnitude temperature deltas spread over a larger area). All 67 ROIs identified in the FY 2015 aerial survey (SGW-60352) were analyzed for thermal anomalies. Of the 74 credible anomalies listed in Tables 1 and 2 of this report, 9 anomalies were found to be collocated in the boundaries of the ROIs. These anomalies and the associated ROIs are listed in Table 3.

Table 3. Summary of Credible Thermal Anomalies Associated with Regions of Interest Identified as Part of the FY 2015 Aerial Survey

ROI	Feature Type/ID*	Anomaly Description	OU/Facility Owner
ROI 5	USS24	This anomaly identifies features beneath the surface of the barrier at the T Tank Farm, which are not visible in aerial imagery.	WRPS
ROI 11	USS75	Located at the west end of the 244UR Vault, this anomaly shows subsurface features that are not mapped in HGIS or visible in aerial imagery.	WRPS
ROI 15	ROOF07	The north/south cooler feature in the center of the roof is not consistent with the roof surface and may be a function of interior features or a possible pooling area.	WRPS
ROI 16	USS50	The anomaly is located in the SX Tank Farm and identifies many linear features that are not mapped in HGIS and not visible in aerial imagery.	WRPS
ROI 16	USS76	The anomaly is located in the SX Tank Farm and identifies many linear features that are not mapped in HGIS and not visible in aerial imagery.	WRPS

Table 3. Summary of Credible Thermal Anomalies Associated with Regions of Interest Identified as Part of the FY 2015 Aerial Survey

ROI	Feature Type/ID*	Anomaly Description	OU/Facility Owner
ROI 25	PA04	Heterogeneous gravel area between the 216-B-47 Crib and contamination migration UPR-200-E-89 waste site.	200-EA-1
ROI 44	MISC31	The anomaly is located along the north edge of the 200-W-53 waste site. Small variations in surface sands and gravels correspond partially to this anomaly. There are no HGIS features at this location.	200-WA-1
ROI 44	USS72	The anomaly is located on the 200-E-163-PL pipeline south of the 219W soil and groundwater drilling laydown yard. The point is located at a visible surface access point to the pipeline.	200-IS-1
ROI 47	USS23	Located between 222T and 218-W-8, the southernmost feature corresponds to a water utilities distribution line and the other two thermal features correspond to slight surface discolorations visible in aerial imagery, but not mapped in HGIS.	CHPRC

Reference: SGW-60352, *Field Summary Report for the 200-SW-2 Operable Unit and Central Plateau 2015 Aerial Survey*, Appendix A.

Note: ROIs for which no credible findings were found to be located were not included in this table.

*The Feature Type/ID column in this table is alphanumeric identification system developed by the RSL team to categorize the anomalies. The identifiers correspond to the following definitions:

MISC = miscellaneous thermal feature
 PA = probable anomaly
 ROOF = roof anomaly
 SEEP = surface water, runoff, seeps, and drainage
 SS = surface staining, spills, and scrapes
 USS = under surface structure

CHPRC = CH2M HILL Plateau Remediation Company ROI = region of interest
 HGIS = Hanford Site Geographic Information System RSL = Remote Sensing Laboratory
 ID = identifier WRPS = Washington River Protection Solutions
 OU = operable unit

Additional location and spatial information regarding the anomalies observed in radiological ROIs can be found in Appendix B.

6 Conclusions

During July 2017, a thermal imaging survey using TABI-1800 was performed over the Hanford Site. The purpose of the FY 2017 thermal imaging survey was to identify any thermally evident environmental characteristics and anomalies that could be used in further Hanford Site remedial evaluations.

Based on the results of the FY 2017 thermal imaging survey, a total of 187 anomalies were identified by RSL and were further analyzed for credibility based on the conditions described in Chapters 2 through 5. Of the total number of anomalies identified, 74 were found to be credible. Table 4 provides a summary of the number of credible findings with respect to each associated OU or the responsible owner based in its location. The locations of credible anomalies could be used further by associated OU or the responsible owner managers to inform remedial evaluations.

Table 4. FY 2017 Thermal Imaging Survey Summary of Credible Thermal Anomalies Identified by Operable Unit or Responsible Owner

Operable Unit/Responsible Owner	Credible Findings
200-DV-1	1
200-EA-1	3
200-IS-1	10
200-WA-1	2
200-SW-2	6
200-OA-1	8
Bechtel National, Inc.	4
CH2M HILL Plateau Remediation Company	25
Mission Support Alliance	6
Washington River Protection Solutions	9
Total	74

The FY 2017 thermal imaging survey was performed to build upon the FY 2015 aerial survey (SGW-60352). The FY 2015 aerial survey (SGW-60352) was an update to a 2009 survey, which itself was an update to a 1996 survey. The ability to see the change in survey results over time is valuable with respect to assessing the time-related effects of contaminant releases, mitigation, containment, and decay. Periodic updates are recommended to view survey result changes over time and further inform the credibility of anomalies identified.

6.1 Data Usability

The survey was conducted in accordance with acceptable industry standards and analogous to the FY 2015 aerial survey (SGW-60352). Field control and data processing parameters such as geometric calibrations, ground truthing, radiometric processing, and georeferencing and image mosaics in conjunction with spatial analysis techniques were used in this project to provide quality control and quality assurance. These techniques are documented in the previous chapters and further detailed in Attachments 1 and 2 of RSL, 2017.

7 References

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 USC 9601, et seq., Pub. L. 107-377, December 31, 2002. Available at:

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RSL, 2017, *Airborne Thermal Image Mapping of the Hanford Nuclear Reservation, WA*, National Security Technologies, LLC Remote Sensing Laboratory, Las Vegas, Nevada.

SGW-60352, 2017, *Field Summary Report for the 200-SW-2 Operable Unit and Central Plateau 2015 Aerial Survey*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.
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Appendix A

Index of Identified Thermal Anomalies

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Table A-1. Summary of Thermal Anomalies Identified by Operable Unit or Feature Owner

Operable Unit/Feature Owner	Feature Type/ID	Description	Justification	Credible (Yes/No)
200-EA-1	SEEP01	Thermal anomalies at the edge of ponds.	Anomalies at the northern edge of the 207A retention basins correspond to vegetation and small debris piles.	No
200-EA-1	SEEP02	Thermal anomalies at the edge of ponds.	Anomalies at the northern edge of the 207A retention basins correspond to vegetation and small debris piles.	No
200-EA-1	SEEP03	Thermal anomalies at the edge of ponds.	Anomalies at the northern edge of the 207A retention basins correspond to vegetation and small debris piles.	No
MSA	USS01	Possible thermal evidence of prior roadwork/repair. Could be associated with pipelines.	The anomaly is located in front of MO2259 beneath 4 th Street. The thermal feature corresponds to a belowgrade service water line at this location.	No
MSA	USS02	Possible thermal evidence of prior roadwork/repair. Could be associated with pipelines.	The anomaly is located on 4 th Street north of 241AP271. HGIS shows no mapped utilities at this location, and aerial imagery shows no visible surface feature.	Yes
MSA	USS03	Linear thermal anomaly that corresponds to repaired asphalt in visible imagery.	This feature corresponds to variation in asphalt materials. HGIS shows no mapped features at this location.	No
200-IS-1	USS04	Linear thermal feature crossing road. May be associated with network of pipelines.	The anomaly is located in a dense network of active and inactive pipelines east of the AP Tank Farm. Pipelines include 200-E-127-PL, 200-E-187-PL, and 200-E-289-PL. Mapped features do not directly mirror thermal images.	Yes
200-IS-1	USS05	Thermal feature in road. May be associated with network of pipelines crossing at this juncture.	The anomaly is located in a dense network of active and inactive pipelines east of the AP Tank Farm. Pipelines include 200-E-127-PL, 200-E-187-PL, and 200-E-289-PL. Mapped features do not directly mirror thermal images.	Yes
BNI	SEEP04	Surface runoff into a holding pond.	The holding ponds are located in the GTFL waste site, currently a RCRA TSD.	Yes
CHPRC	SS01	Surface staining from spill.	The anomaly is located at the northern corner of the GTF waste site in a gravel area. There was clear surface staining at the time of the survey. Currently, the staining is gone, and new gravel has taken its place.	Yes
200-OA-1	SS02	Sharply defined thermal feature that is less defined in visible imagery.	Ground disturbance in the southwest corner of OCSA, along with ground undulations and inconsistent vegetation.	Yes
200-OA-1	SS03	Sharply defined thermal feature that is less defined in visible imagery.	Ground disturbance outside the southwest corner of OCSA; potential for inclusion in that waste site.	Yes
CHPRC	MISC01	Evidence of a third tank that is no longer present.	This anomaly is located at ERDF, north of the 6618C pump house. The anomaly shows the location of a demolished leachate tank.	No

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Table A-1. Summary of Thermal Anomalies Identified by Operable Unit or Feature Owner

Operable Unit/Feature Owner	Feature Type/ID	Description	Justification	Credible (Yes/No)
200-EA-1	MISC02	Example of surface soil temperature differences.	Located at the 216-B-55 Crib, this anomaly is a result of changes in surface materials which are visible in aerial imagery (contrasting light and dark gravels).	No
MSA	USS06	Possible conduit from holding area to the north.	The feature is representative of a roadway culvert at the intersection of 12 th Street and Baltimore Avenue.	No
CHPRC	PA01	Possible holding area that drains along the east edge.	Vegetated area north of the BX-BY Tank Farm and south of a contamination migration area; UPR-200-E-89 waste site. No underground features visible in HGIS.	Yes
200-EA-1	MISC03	Thermal anomaly in an area of known surface contamination.	The anomaly is located at the 216-C-7 Crib. Past photographs show the crib surface cover to be small sands and gravels with surrounding surface materials made up of gravels and small cobbles. This could account for the thermal anomaly.	Yes
CHPRC	MISC04	Cooling scars caused by old foundations.	The anomaly is located northeast of the 216-C-7 Crib. HGIS facilities layer shows a demolished building identified as "ice house" at this location.	No
MSA	MISC05	Surface irrigation pattern.	This anomaly is located in the grass lawn south of the 2721EA fire systems maintenance shop. It shows an irrigated circle of lawn.	No
MSA	MISC06	Irrigation runoff.	The anomaly shows confirmed irrigation runoff into the south parking lot at the 2721E Building.	No
MSA	MISC07	Irrigation runoff.	The anomaly is located at the gravel entrance to the parking lot north of the 2721E Building. An adjacent grass lawn suggests this is an area of irrigation runoff.	No
BNI	MISC08	Industrial stains that are not evident in current visible imagery.	The anomaly is located east of 2320WTP in a highly traversed area of vehicle and equipment traffic. Slight variations in surface gravel colors visible in aerial imagery from the time of the survey correspond to thermal variations.	No
CHPRC	ROOF01	Thermal variability in roof.	The PUREX roof featured in this anomaly was replaced prior to the survey. The thermal variations are due to mild color striations in roofing material, which is visible from aerial imagery.	No
CHPRC	ROOF02	Thermal variability in roof.	The B Plant roof featured in this anomaly was replaced prior to the survey. The thermal variations are due to mild color striations in roofing material, which is visible from aerial imagery.	No

Table A-1. Summary of Thermal Anomalies Identified by Operable Unit or Feature Owner

Operable Unit/Feature Owner	Feature Type/ID	Description	Justification	Credible (Yes/No)
CHPRC	USS07	Several thermal features that are more clearly defined than in the visible.	The anomaly is located south of the 241-BX-154 diversion box. Thermal variations are consistent with visible changes in surface gravels of traveled and untraveled areas.	No
CHPRC	MISC10	Aperture of active stack.	The anomaly represented the 219-B-001 stack.	No
WRPS	ROOF03	Pooling surface water on the roof. May indicate current or future location of leaks.	Thermal indication of potential pooling water on the roof of 222B, as surface materials appear uniform.	Yes
MSA	MISC12	Thermal pattern indicates excess watering.	The anomaly represents a green lawn on the north side of MO256.	No
200-EA-1	SEEP05	Runoff into the basin.	The runoff patterns present in thermal imagery are at the southwestern corner of the 2607-E12 septic system. Stations could also be a function of foot traffic during vapor investigations at the septic system.	No
200-EA-1	MISC13	Thermal features not evident in visible imagery.	The anomaly is located at the 216-B-12 Crib. Surface cover includes sands and gravels with large patches of wheatgrass. Warmer features correspond to areas with decreased vegetation.	Yes
CHPRC	SS04	Sharply defined thermal feature that does not correspond to visible imagery.	The 2017 aerial imagery shows an accumulation of tumbleweeds at this location along with scraped ground, which accounts for the thermal anomaly east of 216-B-12.	No
BNI	MISC14	Long, linear cooling scar possibly related to construction.	The anomaly is located along the southeast corner of the 2320WTP Building. Aerial imagery from the time of the survey does not show any corresponding surface features.	Yes
CHPRC	MISC15	Thermal evidence of subsurface feature.	This anomaly is in the location of a shallow road crossing for P&T water transfer lines.	No
CHPRC	MISC16	Thermal evidence of subsurface feature.	This anomaly is in the location of a shallow road crossing for P&T water transfer lines.	No
200-SW-2	PA02	Cool area indicating prior vegetative cover.	Northwest corner of the 218-W-3A Burial Ground. Thermal variations are consistent with changes in surface cover materials and sparse vegetation.	No
200-OA-1	MISC17	Randomly distributed unidentified objects.	The anomaly is located in the vegetation south of the 600-284-PL-B pipeline, southwest of the intersection of 4 th Street and Route 4. The objects identified in the thermal survey are visible in aerial imagery.	Yes
200-WA-1	PA03	Cool anomaly within a surface contamination area that could indicate retention of water by subsurface feature.	The observed anomaly is the 216-U-16 Crib. Thermal variations are consistent with slight variations in color and characteristics of cover sands and gravel at this location.	No

Table A-1. Summary of Thermal Anomalies Identified by Operable Unit or Feature Owner

Operable Unit/Feature Owner	Feature Type/ID	Description	Justification	Credible (Yes/No)
200-WA-1	MISC18	Possible revegetation over an inactive crib.	The anomaly is consistent with visible cover in aerial imagery.	No
200-WA-1	MISC19	Nonvegetated cover over an inactive crib. Some structure delineated.	The anomaly is consistent with visible cover in aerial imagery.	No
CHPRC	MISC20	Thermal evidence of subsurface feature.	This anomaly is in the location of a shallow road crossing for P&T water transfer lines.	No
CHPRC	MISC21	Grid with thermal background related to surface elevation. Possible site study.	This anomaly is located southwest of 216-U-12. The gridded features are not mapped in HGIS, and the area is clearly visible from aerial imagery.	Yes
CHPRC	USS08	Can thermally see internal structure of septic tank farm.	The thermal anomaly indicated the structure of the 2607-W6 septic system, south of REDOX.	No
CHPRC	MISC22	Inactive pond with evidence of historical activity. Thermal pattern does not follow visible surface conditions.	The anomaly is located at the remediated 216-S-19 Pond, and thermal striations correspond to visible surface features.	No
200-EA-1	PA04	Cooler features that delineate geometric structure.	Heterogeneous gravel area between the 216-B-47 Crib and contamination migration; UPR-200-E-89 waste site.	Yes
CHPRC	PA05	East-west scar along the road and warm anomaly that shows watered vegetation.	A number of groundwater extraction lines traverse the highly disturbed area of surface sands. The green vegetation at the south of the scar is abnormal.	Yes
200-EA-1	PA06	Warm rectangular area coincides with a surface contamination area/inactive crib.	Located at the 216-B-61 Crib, this anomaly is explained by a change in vegetation cover, compared to vegetation patterns surrounding the waste site.	No
MSA	PA07	Elliptical thermal feature of a contamination migration area.	Located at one of the 200-E-109 tumbleweed accumulation sites, north of 200-E-BP, the feature shape corresponds to foot and vehicle disturbance at the site boundary.	No
CHPRC	PA08	Sharply defined thermal features in visibly uniform surface cover.	The anomaly is characterized by surface disturbance of injection well pad for 299-W18-39.	No
CHPRC	MISC24	Possible evidence of road resurfacing.	The anomaly identifies an old well access road that had been improved prior to the time of the survey for access to new well locations.	No
CHPRC	MISC25	Evidence of inactive foundations, pits, and septic tanks.	The anomaly identifies the location of the 600-224 sun site septic tank.	No
CHPRC	MISC26	Evidence of change to soil cover.	The anomaly identifies the well pad for 699-25-70.	No
CHPRC	MISC27	Sharply demarcated linear thermal features leading to inactive dumping areas.	The anomaly identifies a primitive access road used in 2011 to excavate the 600-281 waste site.	No

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Table A-1. Summary of Thermal Anomalies Identified by Operable Unit or Feature Owner

Operable Unit/Feature Owner	Feature Type/ID	Description	Justification	Credible (Yes/No)
CHPRC	ROOF04	Thermal anomaly on a roof of an inactive process unit/plant.	Uniform surface materials on the roof of 224T with thermal features near eastern edge roof openings (steel plate, sealed 1 ft ²); potential presence of pooling.	Yes
200-IS-1	USS09	Linear thermal feature that does not correspond with utility vectors.	The anomaly is located near T Plant, just east of 210W. The area is an asphalt parking lot where HGIS shows no mapped pipelines or underground utilities. The 200-W-163-PL pipeline is mapped approximately 40 m east of this location.	Yes
200-EA-1	MISC28	Point thermal anomaly of unknown source.	The anomaly identifies the location of an access riser in the 216-A-38-1 Crib.	No
WRPS	SEEP06	Embankment with finger-shaped thermal features. Could be seepage from subsurface water or surface runoff.	Finger shapes along the embankment east of the AX Tank Farm are a function of foot traffic from personnel parking below the bank and traversing the hill.	No
200-OA-1	MISC29	Variable thermal signatures not seen in visible data. Possibly shallow buried cable or pipe.	Located in the central portion of the OCSA waste site, the anomaly depicts a linear feature faintly visible in aerial imagery, which appears to be a historic path, trail, or road.	No
200-OA-1	USS10	Rectangular thermal anomalies with no corresponding visible signature.	Located in the central portion of the OCSA waste site, thermal imagery reveals the outline of an old structure not currently visible in aerial imagery.	Yes
WRPS	MISC30	Thermal demarcation at gate entry.	This anomaly locates the north entrance to the AP Tank Farm.	No
WRPS	SS05	Cooling scar on concrete pad, covered road, and several surface stains.	Equipment and waste staging area east of 204AR. Changing configuration and feature movement in this area. Anomalies attributed to frequent and unknown equipment coming and going.	No
200-WA-1	USS11	Cool geometric features indicate underground structure of this inactive crib.	The 216-S-7 Crib shows visible variations in surface gravels consistent with the thermal imagery. The cooler thermal zone is consistent with the center of the crib structure, indicative of subgrade void space.	Yes
WRPS	SS06	Thermal feature that does not appear in visible imagery.	The anomaly is west of the 200-E-17 LERF basins. An area of sparse large vegetation contrasting with flat gravel and sand surfaces, where warm and cool zones correspond to surface materials.	No
WRPS	USS12	Possible underground utility lines.	The anomaly extends south from the 2712B electrical/instrumentation building, east of 241-ER-151. HGIS shows no mapped underground features in this area. Aerial imagery shows faint surface discoloration at this location.	Yes

Table A-1. Summary of Thermal Anomalies Identified by Operable Unit or Feature Owner

Operable Unit/Feature Owner	Feature Type/ID	Description	Justification	Credible (Yes/No)
CHPRC	USS13	Site of demolished infrastructure. Thermal anomalies may be remnants of foundations.	The anomaly is located in the 200-W-246 waste site, at the location of the demolished 2707W change house. The anomaly is consistent with the former building footprint.	No
MSA	USS14	Clearly defined rectangular thermal feature that does not correspond with visible imagery.	The anomaly is consistent with the former location of MO955. The mobile trailer had been removed prior to the thermal survey.	No
CHPRC	USS15	Two circular thermal features in a visibly uniform surface cover.	The anomaly is in the location of a gravel pad for well 299-W22-114, which was visited and sampled a number of times within weeks preceding the thermal survey.	No
200-SW-2	USS16	Rectangular thermal feature extending from a landfill.	Located at the south end of the 218-E-1 Burial Ground, thermal variations are not consistent with mapped HGIS layers nor aerial imagery.	Yes
CHPRC	USS17	Subsurface thermal anomaly that could be a remnant of an old road or walkway.	The thermal feature, extending south from the 224B Building, is consistent with dark surface materials present in aerial imagery.	No
200-IS-1	USS18	Double linear thermal anomaly not seen in visible imagery.	The anomaly is located near the southeast corner of B Plant, proximal to the 200-E-226-PL-A pipeline. There are no mapped features in HGIS, nor does aerial imagery show any indication of corresponding surface features.	Yes
CHPRC	USS19	Thermal geometries not seen in visible imagery. Area is uniform cover.	This anomaly is located west of 241-ER-151, inside the jersey barriers to the east of the CSB. HGIS and aerial imagery show no mapped features that correspond to the linear thermal features.	Yes
200-SW-2	SS07	Sharply defined thermal feature that is less defined in visible imagery.	The anomaly lies in the eastern corner of the 218-E-12B Annex, at the location of decommissioned well 299-E34-13. The feature corresponds to the retired well pad.	No
200-SW-2	SS08	Sharply defined thermal feature that is less defined in visible imagery.	The anomaly lies in the eastern corner of the 218-E-12B Annex, at the location of decommissioned well 299-E34-13. The feature corresponds to the retired well pad.	No
200-SW-2	SS09	Sharply defined thermal feature that is less defined in visible imagery.	An area of poor vegetation growth compared to surrounding portions of the 218-E-12B waste site. The anomaly is in the area of the northern ends of Trenches 8, 9, and 10.	Yes
200-SW-2	SS10	Sharply defined thermally cool area in a visibly uniform area.	The long rectangular anomaly corresponds to a change in vegetation cover in the 218-E-12A Burial Ground. Small, cool circular zones correspond to stabilization of surface contamination areas with sand and gravel.	No
CHPRC	USS20	Thermal expression of culverts.	The anomaly is in the location of culverts beneath the gravel road in front of the 216-ZP-1A transfer building.	No

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Table A-1. Summary of Thermal Anomalies Identified by Operable Unit or Feature Owner

Operable Unit/Feature Owner	Feature Type/ID	Description	Justification	Credible (Yes/No)
WRPS	SS11	Sharply defined thermally cool area in a visibly uniform area.	The anomaly is located between the 241-A-152 diversion box and the eastern boundary of A Farm. The 2017 aerial imagery shows a surface feature of lighter color than surrounding gravels, which corresponds to the location and shape of this anomaly.	No
WRPS	USS21	Linear features indicating buried structure not existing in the vector dataset.	Located in the AP Tank Farm just north of 241-AP-101, HGIS does not provide any mapped underground features at the location of this anomaly. Aerial imagery shows lighter surface gravels and vehicle travel patterns at this location.	No
200-IS-1	USS22	Linear feature leading to an effluent pond south of T Plant.	The anomaly is located beneath 23 rd Street, north of the 200-W-237 waste site. The waste site is an open inactive effluent pond, which has an unmapped inlet pipe entering from a location and orientation consistent with this anomaly.	Yes
CHPRC	USS23	Three linear features extending from a building in the T Plant Complex to an inactive burial vault.	Located between 222T and 218-W-8, the southernmost feature corresponds to a water utilities distribution line, and the other two thermal features correspond to slight surface discolorations visible in aerial imagery, but not mapped in HGIS.	Yes
200-WA-1	MISC31	Uniquely shaped thermal anomaly in generally uniform gravel.	The anomaly is located along the north edge of the 200-W-53 waste site. Small variations in surface sands and gravels correspond partially to this anomaly. There are no HGIS features at this location.	Yes
WRPS	USS24	Can thermally see structure beneath the surface that is not seen in visible imagery.	This anomaly identifies features beneath the surface of the barrier at the T Tank Farm that are not visible in aerial imagery.	Yes
200-OA-1	USS25	Sharply defined thermal features defining edges of buried structure.	The anomaly is in the location of the 600-218 anti-aircraft artillery dumping site. Aerial imagery does not show corresponding surface features at this location, which indicates subsurface features.	Yes
200-OA-1	USS26	Circular thermal feature with slight visible signature in vegetation.	The anomaly is at the end of a sidewalk among the 600-216 anti-aircraft site slabs. No mapped features are present in HGIS.	Yes
CHPRC	USS27	Square thermal feature with slight visible signature in vegetation.	The anomaly identifies the abandoned well pad for 699-46-85A, which has been decommissioned.	No
200-OA-1	USS28	Thermal data show the footprint and internal structure of an old facility.	Located in the central portion of the OCSA waste site, thermal imagery shows structure foundations and roadways, faintly visible in aerial imagery.	No
CHPRC	MISC32	Three aligned culverts.	This anomaly corresponds to visible pump and treat groundwater transfer lines.	No

Table A-1. Summary of Thermal Anomalies Identified by Operable Unit or Feature Owner

Operable Unit/Feature Owner	Feature Type/ID	Description	Justification	Credible (Yes/No)
200-SW-2	USS29	Rectangular thermal anomaly that has visibly uniform ground cover.	Radiant temperatures in the central portion of 218-W-3A Burial Ground are unexpected. This anomaly is in the vicinity of Trenches T-23 through T-28.	Yes
200-SW-2	USS30	Distinct thermal features in a visibly uniform area.	The anomaly is in the 218-W-3A Burial Ground at Trench T08. The western portion of the anomaly is an area of TRU waste, which has been excavated, and the eastern portion contains TRU waste and has a uniform surface of sands and gravels.	Yes
MSA	USS31	Thermal evidence of historical infrastructure.	The anomaly is located between the 216-T-34 and 216-T-35 Cribs in an area of visible surface disturbance and poor vegetation recovery. No mapped features are present in HGIS.	No
MSA	USS32	Rectangular thermal feature that does not have a visible signature at the surface.	The anomaly is located at the corner of 27 th Street and Albany Avenue in the 200 West Area. The large rectangular thermal feature contains vegetation consistent with surrounding grounds, with slightly visible evidence of disturbance in aerial imagery.	No
MSA	USS33	Thermal signature of covered concrete entrance pads from a conex last seen in May 2015.	The anomaly identifies the entrance area to demolished mobile office MO315, located north of 622-RST.	No
CHPRC	MISC33	Conduit under the road.	This anomaly represents a shallow road crossing for P&T groundwater transfer lines.	No
CHPRC	SS12	Runoff or surface stain where nothing is seen in visible imagery.	The 2017 aerial imagery shows some sort of material on the asphalt surface of the parking lot north of WRAP, which corresponds to the shape and location of this anomaly.	No
CHPRC	USS34	Linear thermal feature crossing the road ending with a plumelike feature.	Aerial photos show this anomaly in an area of discolored asphalt southeast of 2403WD, with a runoff area on the west side of the asphalt road.	No
CHPRC	SS13	Appears like drainage from a building.	Located directly east of the entrance to 2403WD in the Central Waste Complex, the thermal contrast present in this anomaly does not correspond to contrast between brown and gray patches of sand at this location.	No
CHPRC	MISC34	Conduit under the road.	This anomaly represents a shallow road crossing for P&T groundwater transfer lines.	No
200-DV-1	USS35	Rectangular thermal feature indicating underground structure in this inactive crib.	The anomaly is located at the head end of the 216-T-19 Crib and tile field in the location of the crib structure. No visible surface discoloration at this location.	Yes
CHPRC	MISC35	Conduit under the road.	This anomaly represents a shallow road crossing for P&T groundwater transfer lines.	No

Table A-1. Summary of Thermal Anomalies Identified by Operable Unit or Feature Owner

Operable Unit/Feature Owner	Feature Type/ID	Description	Justification	Credible (Yes/No)
200-IS-1	USS36	Evidence of subsurface structure with a warm anomaly at the south end that is not seen on visible imagery.	The anomaly is located north of the 241-TX-155 diversion box. Aerial imagery shows surface scaring consistent with linear thermal features, as well as a warm feature consistent with the location of 200-W-143-PL.	Yes
MSA	MISC36	Thermal plumes.	This anomaly identifies the 282W water basin.	No
CHPRC	USS37	Multiple linear thermal features in area with visibly uniform surface cover indicating subsurface infrastructure.	This anomaly is at the geophysical logging source material location on the east side of Route 3. HGIS shows no mapped features at this location, and aerial imagery does not show any surface features that would explain the thermal variation.	Yes
CHPRC	USS38	Multiple thermal features in an area with visibly uniform surface cover indicating subsurface infrastructure.	The anomaly identifies 211W PFP lag storage yard on the east side of Beloit Avenue. The yard was in constant flux during the time of the thermal survey. No underground structures are mapped here.	No
CHPRC	ROOF05	Thermal anomaly on a roof that is not seen in visible imagery.	Warm northern portion of 2713W due to the HVAC system and roof-mounted ventilation stack located in the center of the northern roof.	No
CHPRC	ROOF06	Thermal anomaly on a roof that is not seen in visible imagery.	Some thermal variations on the roof of 275W are explained by small exhaust ports. Cool anomalies on the southern edge are potential pooling locations.	Yes
CHPRC	USS39	Thermal evidence of prior infrastructure.	This anomaly identifies the former 2722W welding lab building foundation. A portion of the area is posted as 200-W-251 waste site asbestos in the soil area.	No
CHPRC	USS40	Striations in thermal signature as well as showing a buried structure in a visibly uniform area.	The anomaly is located in the 200-W-246 waste site, at the location of the demolished 272W machine shop. The subsurface features identified by this anomaly are consistent with the former building footprint.	No
CHPRC	SS14	Possible cable runs and leakage from a building.	This anomaly lies in the gravel pad at the 289TD injection transfer building. The thermal features are consistent with surface materials, injection lines, and frequent well maintenance at 699-43-67.	No
CHPRC	USS41	Two rectangular thermal anomalies in a visibly uniform area, indicating subsurface infrastructure.	Northwest of the 6265 Building, this anomaly is consistent with variations in surface materials visible in aerial imagery. Light-colored sand patches match the thermal anomaly in an area of darker gravels.	No
CHPRC	USS42	Linear thermal feature extending from equipment in the center of a gravel pad.	Located at groundwater well 299-W18-37, this anomaly shows a linear feature not present in HGIS layers or aerial imagery extending north from the well.	Yes

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Table A-1. Summary of Thermal Anomalies Identified by Operable Unit or Feature Owner

Operable Unit/Feature Owner	Feature Type/ID	Description	Justification	Credible (Yes/No)
CHPRC	SS15	Uniquely shaped thermal feature that is not clearly defined in visible imagery.	Located in the asphalt to the east of south end of 231Z, this anomaly appears to be a function of dirt or sand that had accumulated in this area at the time of the thermal survey.	No
CHPRC	SS16	Linear thermal anomaly connected to a thermal feature near an unplanned release. Area has uniform cover in visible imagery.	Proximal to UPR-200-W-91 at the northwest corner of PFP, the cool thermal presence is not consistent with surface features at the time of the survey.	Yes
MSA	USS43	Possible thermal signature of underground power lines.	West of the 234-5Z-BA boiler annex building. There are a number of mapped electrical utilities in this area but match the orientation of the linear thermal feature.	Yes
CHPRC	SS17	Thermal feature extending from a facility. The area has undergone a lot of demolition since available visible imagery.	The anomaly was a covered, open-sided storage area on the south side of PFP, which has since been demolished. Cooler thermal observations at this location are consistent with surface materials.	No
CHPRC	USS44	Thermal evidence of a buried foundation from an old building.	Located on the south side of the demolished 241Z facility, the anomaly is not visible in aerial photos taken at the time of the survey. HGIS layers show no structure here.	Yes
CHPRC	MISC37	Conduit under the road.	This anomaly represents a shallow road crossing for P&T groundwater transfer lines.	No
MSA	MISC38	Conduit under the road.	Aerial imagery shows a discolored portion of the roadway in the location of this anomaly. No HGIS layers illustrate features at this location.	No
MSA	USS45	Linear thermal feature under road.	Located at the intersection of 20 th Street and Albany Avenue, there are multiple electrical utilities mapped in HGIS at this location, but none with the exact orientation of the anomaly.	Yes
CHPRC	PA09	Sharply defined thermal features in visibly uniform surface cover.	Historic aerial images indicate the likelihood of sparse grasses in this portion of 216-W-LWC. Growth and/or herbicide application could explain this anomaly.	Yes
WRPS	ROOF07	Thermal anomaly on roof that is not seen in visible imagery.	The north/south cooler feature in the center of the roof is not consistent with the roof surface and may be a function of interior features or a possible pooling area.	Yes
CHPRC	USS46	Line of thermal anomalies in a visibly uniform concrete slab.	The thermal anomaly is consistent with boundary stations shown in aerial imagery.	No

Table A-1. Summary of Thermal Anomalies Identified by Operable Unit or Feature Owner

Operable Unit/Feature Owner	Feature Type/ID	Description	Justification	Credible (Yes/No)
CHPRC	SS18	Elliptical thermal feature in an area of visibly uniform ground cover.	The cool anomaly is along the eastern edge of the well pad for 299-W19-125, southeast of U Plant. Aerial imagery from 2017 shows light-colored sands consistent with the location and shape of the anomaly.	No
CHPRC	USS47	Zigzag thermal features that run along a dirt road.	Zigzag striations shown in this anomaly are consistent with the surface material variations at the 600-284-PL, cause by vehicle travel during surveys and herbicide application. The location of this anomaly is north of ERDF.	No
CHPRC	SS19	Thermal feature that looks like drainage or a leak.	The anomaly is in the location of a water fill stand (J-stand) at ERDF. Truck overflow and water runoff is common at this location and consistent with thermal imagery.	No
MSA	SS20	Thermal anomaly in an area of visibly uniform ground cover in an inactive crib.	The anomaly is south of the 216-S-21 Crib, near 13 th Street. At the time of the thermal survey, 2017 aerial imagery shows vegetation growth or a collection of tumbleweeds consistent in size, shape, and location with this anomaly.	No
WRPS	USS48	Thermal evidence of historical pavement/road that is not seen in visible imagery.	The anomaly identifies the abandoned roadway that used to separate S and SX Tank Farms.	No
WRPS	USS49	Many subsurface linear features in a tank farm.	The anomaly is located in the S Tank Farm and is consistent with many features visible in aerial imagery and historic aerial photos.	No
WRPS	USS50	Many subsurface linear features that can't be seen in the visible imagery.	The anomaly is located in the SX Tank Farm and identifies many linear features that are not mapped in HGIS and not visible in aerial imagery.	Yes
CHPRC	USS51	Square thermal feature that extends beyond the visible site.	The anomaly is located at the northeast corner of well pad 299-W22-47 in an area of vegetation that is not consistent with surrounding vegetation, indicating surface disturbance at the time of drilling. No HGIS-mapped features.	Yes
CHPRC	PA10	Sharply defined thermal features in visibly uniform surface cover.	Groundwater well 299-W23-236 at his location had been visited four times in the month prior to the thermal survey. Vehicle traffic that causes disturbance of surface sands explains this thermal anomaly.	No
CHPRC	USS52	Thermal features that do not correspond to visible data, indicating subsurface infrastructure.	This anomaly is located north of well 299-W22-96 in a gravel area with vehicle travel patterns surrounding it. There are no mapped features in HGIS at this location. Changes in traffic patterns could influence the presence of this anomaly.	No

Table A-1. Summary of Thermal Anomalies Identified by Operable Unit or Feature Owner

Operable Unit/Feature Owner	Feature Type/ID	Description	Justification	Credible (Yes/No)
CHPRC	MISC39	Thermal data defines shape of the old pad not seen in visible imagery.	This anomaly represents groundwater operation vehicles at well 299-W22-92, near the 216-S-13 Crib, which were present during the time of the thermal survey.	No
WRPS	MISC40	Many cooling scars from cars in a parking lot.	These anomalies represent parking locations south of 222S Laboratory facilities.	No
CHPRC	SS21	Thermal feature in an area of visibly uniform ground cover.	The anomaly is north of the 6618D shop at ERDF. At the time of the thermal survey, aerial imagery shows heavy patches of wetted ground consistent with the anomaly.	No
CHPRC	USS53	Linear thermal feature that may be underground power lines as indicated in a vector database.	This linear thermal anomaly corresponds to a mapped electrical utility north of the 6618D shop at ERDF. The line is visible from an aerial photo taken in June 2016.	No
CHPRC	USS54	Linear thermal feature that may be an underground power line not included in vector database.	This anomaly is located on the east side of the 6618D Building at ERDF. There are no corresponding features in HGIS or aerial imagery.	Yes
CHPRC	USS55	Linear thermal features that do not correspond to visible data.	The linear thermal anomaly is located at the southwest corner of ERDF, south of 6618D. Aerial photos taken in June 2017 show this as an area of wetted sand with dry linear features corresponding to this anomaly. No mapped features in HGIS.	Yes
MSA	SS22	Sharply defined thermal feature in a visibly uniform area.	The anomaly is adjacent to an abandoned section of arc loop road, south of Route 3, west of the fire station. Aerial imagery shows an area of dense tumbleweed growth, indicative of previous scraping.	No
WRPS	ROOF08	Plume-shaped thermal anomaly on a roof that is not seen in visible imagery.	Thermal plume shape on the roof of 616 corresponds to the location of a small roof-mounted ventilation/exhaust port.	No
MSA	MISC41	Runoff from watering.	This anomaly is confirmed to be an area of lawn irrigation water runoff, located in front of the 609A Fire Station.	No
WRPS	USS56	Linear features crossing this site, indicating buried infrastructure.	The anomaly is at the 213B laydown yard north of 2704HV. The thermal features are representative of discolored surface sands and gravels from vehicle traffic patterns in the yard. No HGIS-mapped features in this location.	No
CHPRC	PA11	Sharply defined thermal features in a visibly uniform surface cover and linear feature (possible subsurface channel).	This anomaly corresponds to variations in surface materials visible in 2017 aerial imagery, south of 272HV.	No

Table A-1. Summary of Thermal Anomalies Identified by Operable Unit or Feature Owner

Operable Unit/Feature Owner	Feature Type/ID	Description	Justification	Credible (Yes/No)
CHPRC	ROOF09	Possible interior roof infrastructure detected in thermal data.	North/south-oriented parallel thermal features cross over the control room area of the 212H (CSB) support building. Features have no plume shape and the roof is metal, indicating an effect of interior structure.	No
200-IS-1	USS57	Significant thermal variability, only some of which corresponds to different surface materials.	Thermal variability at this location corresponds to an area of light-colored surface gravel. The 216-BY-201 flush tank and 200-E-220-PL settling tank are beneath this anomaly and contribute to surface cooling.	No
CHPRC	PA12	Multiple thermal features that do not coincide with visible surface materials.	The large anomaly at this location is the 241-B-153 diversion box. The anomaly directly south of the diversion box cannot be attributed to a known feature.	Yes
WRPS	USS58	Rectangular thermal feature is probably buried foundation. Also a circular thermal feature that is a mound.	The location is in the BX Tank Farm north of the 241-BYR-154 diversion box. HGIS layers and aerial imagery show no corresponding features at this location.	Yes
200-SW-2	USS59	Buried structure is clearly defined in the thermal imagery.	The anomaly is located in the 218-E-5A Burial Ground at the location of trench T01. The anomaly may be indicating the location of the four large foam-covered wooden boxes documented in the trench.	Yes
200-IS-1	USS60	Linear thermal features that may correspond with buried pipes/drains.	The anomaly corresponds to the location and orientation of 200-E-221-PL near the 216-B-51 Crib. The pipeline consists of two 1-in. carbon steel lines.	Yes
CHPRC	PA13	Cool circular feature within holding septic systems.	The cool feature exists upstream of the abandoned 2607-E5 septic system at the location of a manhole.	No
200-IS-1	USS61	Thermal features associated with waste streams.	The anomalies are at the locations of the 216-C-3 and 216-C-5 Cribs. The cribs are buried perforated pipes that have been blanked. 200-E-169-PL and 200-E-173-PL pipelines also end at the location of this anomaly.	Yes
CHPRC	USS62	Linear thermal feature extending from a building.	The anomaly is located south of the dry material facility truck loadout building. HGIS layers and aerial imagery do not show features that correspond to this anomaly.	Yes
MSA	SS23	Linear thermal feature extending across a road and beyond.	This feature is located at the intersection of Canton and 12 th Street. HGIS layers, aerial imagery, and aerial photos show no indication of surface or subsurface features at this location.	Yes
200-SW-2	SS24	Sharply defined thermal feature in a visibly uniform area.	An area of poor vegetation growth compared to surrounding portions of the 218-E-12B waste site. The anomaly is in the area of the center portion of Trenches 8 and 9.	Yes

Table A-1. Summary of Thermal Anomalies Identified by Operable Unit or Feature Owner

Operable Unit/Feature Owner	Feature Type/ID	Description	Justification	Credible (Yes/No)
WRPS	USS63	Three isolated thermal features and a linear feature across the road with no corresponding visible signature.	Located on 8 th Street northeast of C farm, no HGIS layers or aerial imagery correspond to the anomaly. The anomaly appears to be vehicles. During the summer of 2017 C Farm was very busy.	No
WRPS	SEEP07	Runoff.	Located at the northern corner of C Farm, the thermal anomaly is a function of surface material disturbance due to high foot traffic.	No
WRPS	MISC42	Section adjacent to tank hotter than the rest of the line.	The anomaly represents transfer line shielding at the AP tank farm.	No
WRPS	SEEP08	Possible leakage from tanks below grade.	The anomaly south of the 244AR Building is due to surface gravel and cobble located in a depression area with sloped sides.	No
WRPS	ROOF10	Thermal anomaly on a roof that is not seen in visible imagery. Two circular thermal anomalies on the ground east of a building also not in visible data.	Southwestern edge of the 204AR roof shows cool thermal area and aerial imagery shows slight discoloration of roof materials in this area. These factors indicate potential pooling.	Yes
CHPRC	USS64	Grid of thermal anomalies not seen in visible data.	The anomaly is located north of the 218A facility and west of the 2607-E6 drain field in vegetated area that appears undisturbed. No HGIS layers correspond to this unique anomaly.	Yes
CHPRC	USS65	Two parallel features crossing into a fenced area.	Located in the gravel area north of the 218A facility, the anomaly is consistent with historic traffic patterns and vehicle tracks at this location prior to installation of a fence. No HGIS features are in this area.	No
CHPRC	ROOF11	Thermal anomalies on a roof that are not seen in visible imagery.	Thermal anomalies on the northwest portion of the 2701AB Building roof correspond to slight discoloration of roof materials in aerial imagery. Possible location of pooling.	Yes

Table A-1. Summary of Thermal Anomalies Identified by Operable Unit or Feature Owner

Operable Unit/Feature Owner	Feature Type/ID	Description	Justification	Credible (Yes/No)
MSA	USS66	Thermal features in a visibly uniformly covered area.	The anomaly is located east of 210A. The orientation and location corresponds to one abandoned water utility line and an active service water line. Other portions of the lines are not evident in thermal imagery.	Yes
CHPRC	USS67	Multiple linear features extending between an inner and outer fenced area.	The anomaly is located southwest of PUREX, between the inner and outer facility fences. The linear anomalies connect four electric utility poles and/or light poles. HGIS layers show no corresponding features.	Yes
CHPRC	MISC43	Linear feature not seen in visible imagery	The anomaly represents a faintly visible surface feature extending from the 217A Building southeast toward the 218-E-14 tunnel.	No
CHPRC	MISC44	Unidentified structures with a regular thermal pattern.	This anomaly represents small mounds of soil piled to the northeast of 207A. There are no HGIS-mapped features that correspond to this anomaly.	No
CHPRC	MISC45	Thermal signature of a possible previous pad footprint.	This anomaly represents the well pad at 699-47-42.	No
200-EA-1	MISC46	Thermal features that do not match visible expression.	This anomaly represents surface vegetation variations in the 216-B-3A Pond.	No
BNI	ROOF12	Rectangular thermal anomaly in the southwest corner of a building roof that is not seen in visible imagery.	Slightly warmer zone at the southwest corner of 2256WTP is not consistent with visible exterior materials.	Yes
BNI	USS68	Several thermal features that do not correspond with visible data.	The anomaly is located east of the 2884AWTP01 fire water tanks. HGIS and aerial imagery show no corresponding features at this location. This appears to be a highly traveled portion of the WTP laydown area.	Yes
CHPRC	PA14	Thermal feature that does not coincide with visible surface materials.	Warm feature in a visibly uniform area of vegetation at the northern corner of well pad 699-44-39B. The well was visited for well maintenance 2 weeks before the survey.	Yes
200-OA-1	PA15	Sharply defined thermal feature that does not coincide with visible surface materials.	The defined feature is an access ramp to the 216-B-3B-RAD Pond floor, with unique surface gravel, vegetation, and elevation gradients.	No
CHPRC	MISC47	Thermal heating around electrical power poles.	This anomaly represents the well pad at 699-39-39.	No
MSA	MISC48	Sharply demarcated thermal anomalies not seen in visible imagery. Possible firefighting activity.	This anomaly is located north of 600-53. The linear thermal features correspond to surface features visible in aerial imagery as historic roadways.	No
200-OA-1	SS25	Sharply defined thermal feature that is less defined in visible imagery.	Located in the southwestern corner of the OCSA waste site, HGIS layers and aerial imagery show no indication of surface disturbance at this location.	Yes

Table A-1. Summary of Thermal Anomalies Identified by Operable Unit or Feature Owner

Operable Unit/Feature Owner	Feature Type/ID	Description	Justification	Credible (Yes/No)
200-OA-1	SS26	Thermal feature that does not appear in visible imagery.	The anomaly extends westward out of a historic vehicle turnaround area off of one of the abandoned roads leading south out of the OCSA waste site. Visible surface features are not consistent with thermal imagery.	Yes
CHPRC	USS69	Linear thermal feature extending from a facility that may correspond to a pipeline connecting the 224-T Building to the effluent pond to the south (200-W-237).	The linear anomaly is located southeast of 224T and extends toward 23 rd Street. HGIS and aerial imagery show no corresponding features.	Yes
CHPRC	USS70	Thermal feature that does not correspond to a visible signature.	The anomaly is located east of the northeast corner of WRAP. No mapped features in HGIS or aerial imagery correspond with the anomaly. Thermal and aerial imagery show evidence of water runoff from the asphalt adjacent to the anomaly, possible pooling.	Yes
CHPRC	USS71	Thermally cool drainage patterns that do not correspond to anything visible.	The anomaly is located east of the 289TE transfer building in a gravel area made up of a web of primitive gravel roads. The cooler features correspond to untraversed areas of land. No corresponding HGIS or aerial imagery features at this location.	Yes
200-IS-1	USS72	Linear thermal feature near a junction in an inactive radioactive process sewer. Possible connection with 2607-W3.	The anomaly is located on the 200-E-163-PL pipeline south of the 219W soil and groundwater drilling laydown yard. The point is located at a visible surface access point to the pipeline.	Yes
200-IS-1	USS73	Linear thermal feature near a junction in an inactive radioactive process sewer. Possible connection with 2607-W3.	The anomaly is located on the 200-E-163-PL pipeline south of the 219W soil and groundwater drilling laydown yard. The point is located at a visible surface access point to the pipeline.	Yes
CHPRC	SS27	Thermal feature that does not correspond in shape to visible imagery.	The anomaly was at a gravel pad near the southwest corner of PFP in an area of high activity during the thermal survey.	No
MSA	MISC49	Sharply demarcated thermal anomalies not seen in visible imagery. Possible firefighting activity.	This anomaly represents a change in vegetation along a recent wildland fire.	No
MSA	MISC50	Sharply demarcated thermal anomalies not seen in visible imagery. Possible firefighting activity.	This anomaly represents a change in vegetation along a recent wildland fire.	No
MSA	MISC51	Tracks and thermal scar not seen in visible imagery.	This anomaly represents a change in vegetation along a recent wildland fire.	No
200-OA-1	USS74	Thermal features that do not correspond with anything visible on the surface.	The anomaly is located along the 600-284-PL-B cross-site transfer pipeline, south of 200-W-BP. Surface materials are sands and gravel, and the anomaly corresponds to a dark patch of surface material.	No

Table A-1. Summary of Thermal Anomalies Identified by Operable Unit or Feature Owner

Operable Unit/Feature Owner	Feature Type/ID	Description	Justification	Credible (Yes/No)
WRPS	USS75	Several thermal features that do not correspond to visible surface features. May be different cover material used to bury contaminated soil.	Located at the west end of the 244UR Vault, this anomaly shows subsurface features that are not mapped in HGIS or visible in aerial imagery.	Yes
WRPS	USS76	Many thermal features that may indicate covered infrastructure.	The anomaly is located in the SX Tank Farm and identifies many linear features that are not mapped in HGIS and not visible in aerial imagery.	Yes
MSA	USS77	Curved feature that partially corresponds with different vegetation but extends into unvegetated area and may end in a channel.	The anomaly is located south of 10 th Street near the corner of 10 th Street and Cooper Avenue. The anomaly is an extension of a large linear feature of dark vegetation on the north side of 10 th Street. No HGIS features are present at this location.	Yes

*The Feature Type/ID column in the table is alphanumeric identification system developed by the RSL team to categorize the anomalies. The identifiers correspond to the following definitions:

- MISC = miscellaneous thermal feature
- PA = probable anomaly
- ROOF = roof anomaly
- SEEP = surface water, runoff, seeps, and drainage
- SS = surface staining, spills, and scrapes
- USS = under surface structure

- BNI = Bechtel National, Inc.
- CHPRC = CH2M HILL Plateau Remediation Company
- CSB = Canister Storage Building
- ERDF = Environmental Restoration Disposal Facility
- GTF = Grout Treatment Facility
- GTFL = Grout Treatment Facility Landfill
- HGIS = Hanford Site Geographic Information System
- HVAC = heating, ventilation, and air conditioning
- ID = identifier
- LERF = Liquid Effluent Retention Facility
- MSA = Mission Support Alliance
- OCSA = Old Central Shop Area

- OU = operable unit
- P&T = pump and treat
- PFP = Plutonium Finishing Plant
- PUREX = Plutonium Uranium Extraction Plant
- RCRA = *Resource Conservation and Recovery Act of 1976*
- REDOX = Reduction and Oxidation facility
- RSL = Remote Sensing Laboratory
- TSD = temporary storage and disposal site
- TRU = transuranic
- WRAP = Waste Receiving and Processing Facility
- WRPS = Washington River Protection Solutions
- WTP = Waste Treatment Plant

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Appendix B
Thermal Survey Imagery

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B1 Introduction

This appendix provides a visual exhibit of the geospatial analysis of thermal data collected during the fiscal year (FY) 2017 thermal imaging survey (RSL, 2017, *Airborne Thermal Image Mapping of the Hanford Nuclear Reservation, WA*). This appendix also presents the survey results for the Hanford Site Central Plateau using aerial radiation survey data and thermal anomaly analysis to identify potential subsurface anomalies.

As described in Chapters 4 and 5 of the main text of this report, an extensive Geographic Information System effort was conducted to create a systematic approach for the spatial analysis of previous aerial data. For the purposes of mapping this data, the surveyed area was divided into Central Plateau survey units. Maps are presented for each *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) operable unit (OU) and responsible contractor (owner) and the 618-10 waste site area, which exhibits the FY 2017 thermal imagery, waste sites, regions of interest surveyed within the topic area, and all identified credible findings listed in Appendix A. Maps in this appendix present credible anomalies by CERCLA OU and then by responsible contractor. All credible features of interest (anomalies) identified during this project are presented in Appendix A.

B1.1 Credible Anomalies by Operable Unit

Table B-1 lists the OUs and corresponding figures. Figures B-1 through B-6 illustrate the location of anomalies identified in the FY 2017 thermal survey (RSL, 2017) along with proximal features and a brief description of the credibility evaluation. The figures are presented by CERCLA OU and include 200-DV-1, 200-EA-1, 200-IS-1, 200-OA-1, 200-SW-2, and 200-WA-1. The figures provide a spatial representation of all credible anomalies associated with CERCLA OUs at the Hanford Site.

Table B-1. Summary of Anomaly Figures by Operable Unit

Operable Unit	Justification
200-DV-1	Figure B-1
200-EA-1	Figure B-2
200-IS-1	Figure B-3
200-OA-1	Figure B-4
200-SW-2	Figure B-5
200-WA-1	Figure B-6



Figure B-1. Credible Anomalies in the 200-DV-1 OU



Figure B-2. Credible Anomalies in the 200-EA-1 OU (1 of 3)

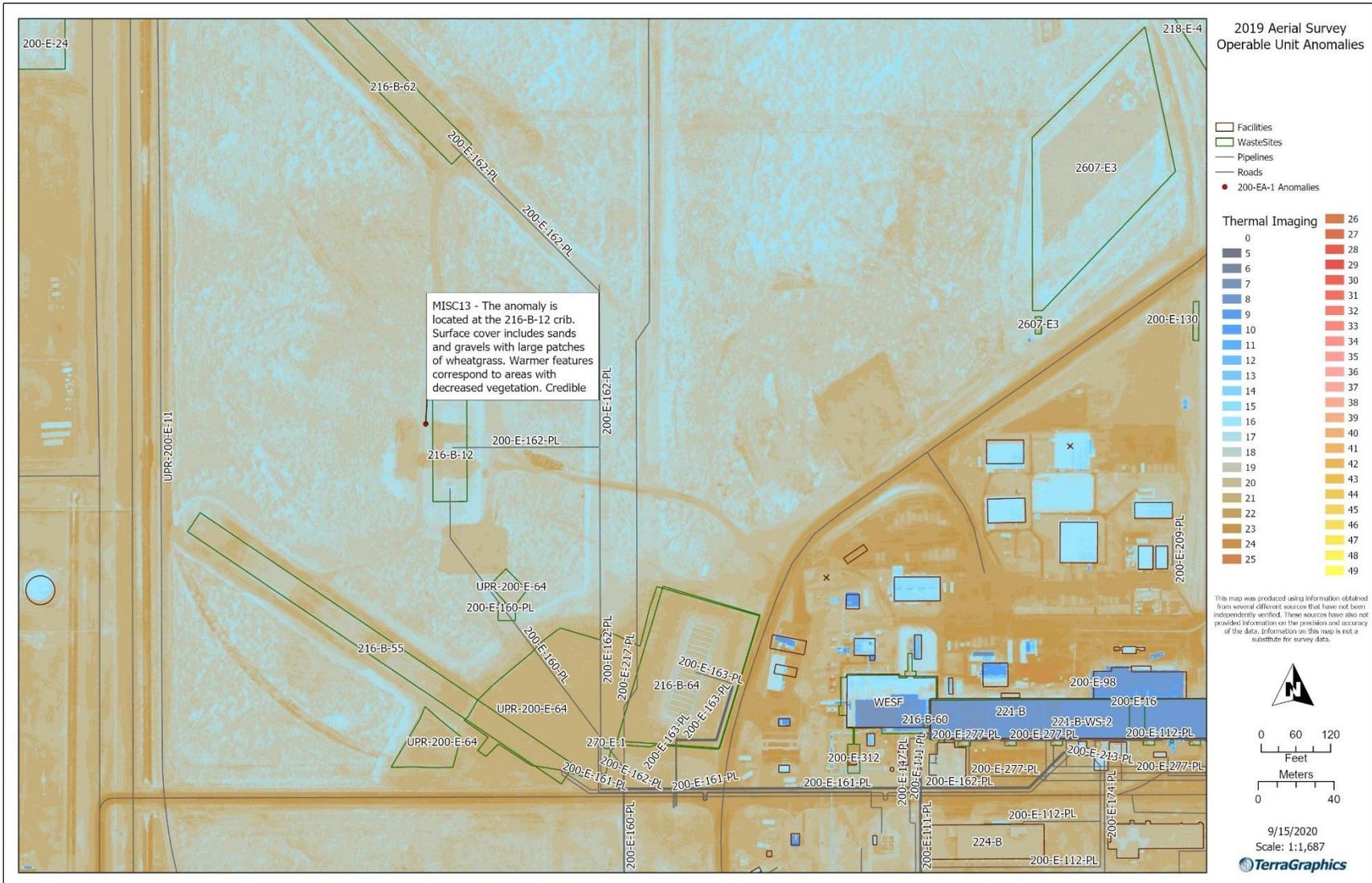


Figure B-2. Credible Anomalies in the 200-EA-1 OU (2 of 3)

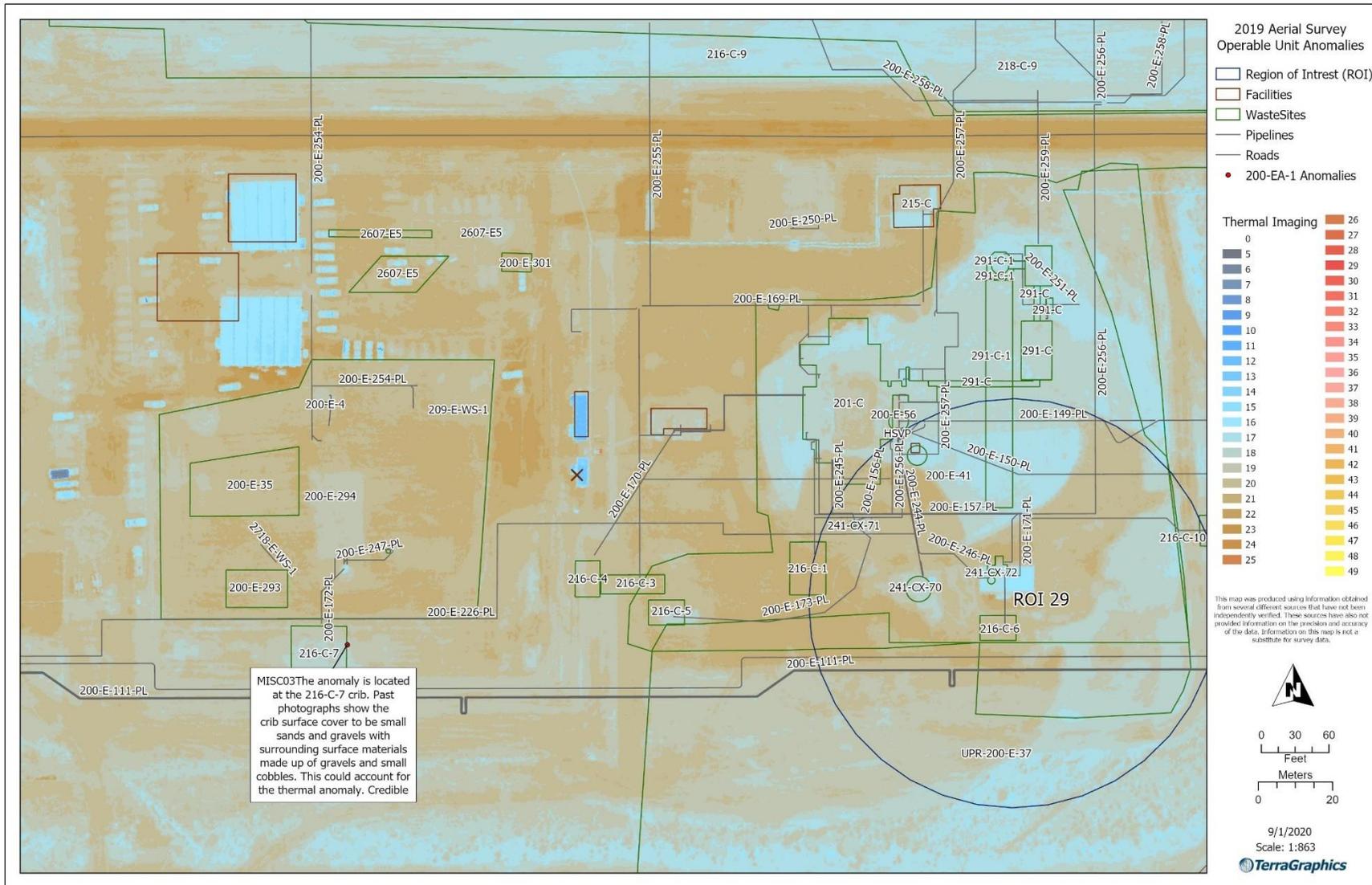


Figure B-2. Credible Anomalies in the 200-EA-1 OU (3 of 3)



Figure B-3. Credible Anomalies in the 200-IS-1 OU (1 of 7)

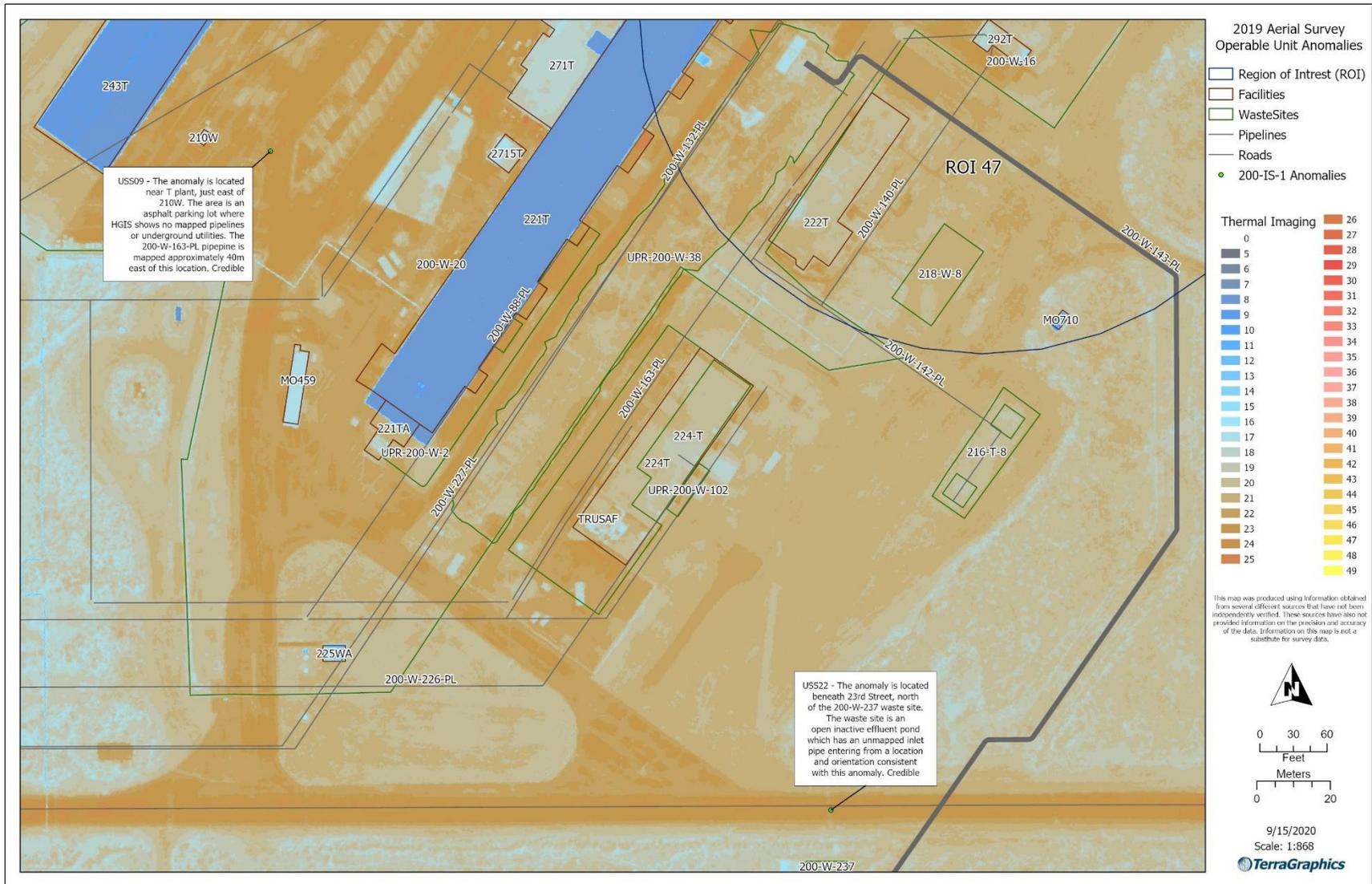


Figure B-3. Credible Anomalies in the 200-IS-1 OU (2 of 7)

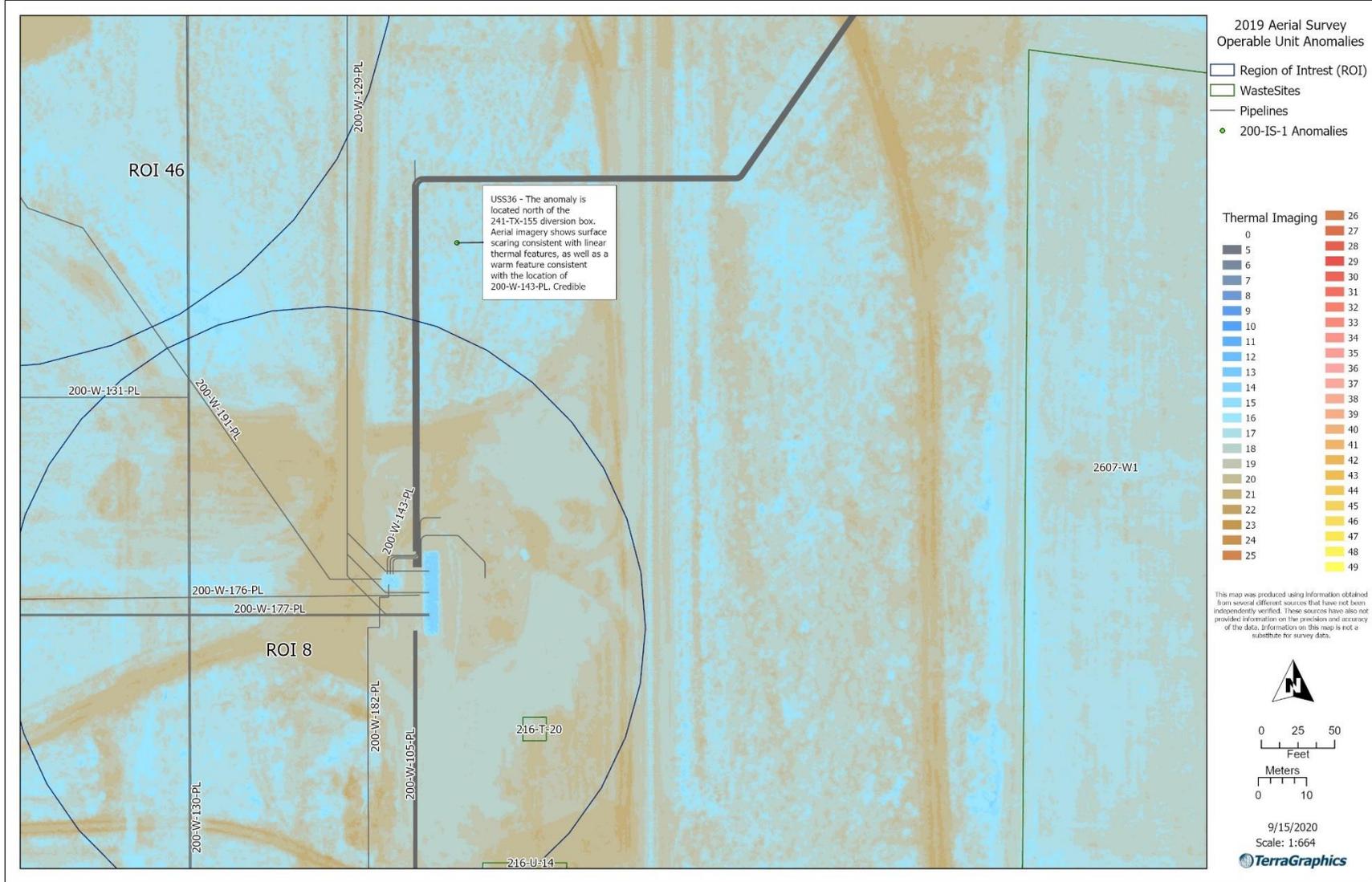


Figure B-3. Credible Anomalies in the 200-IS-1 OU (3 of 7)

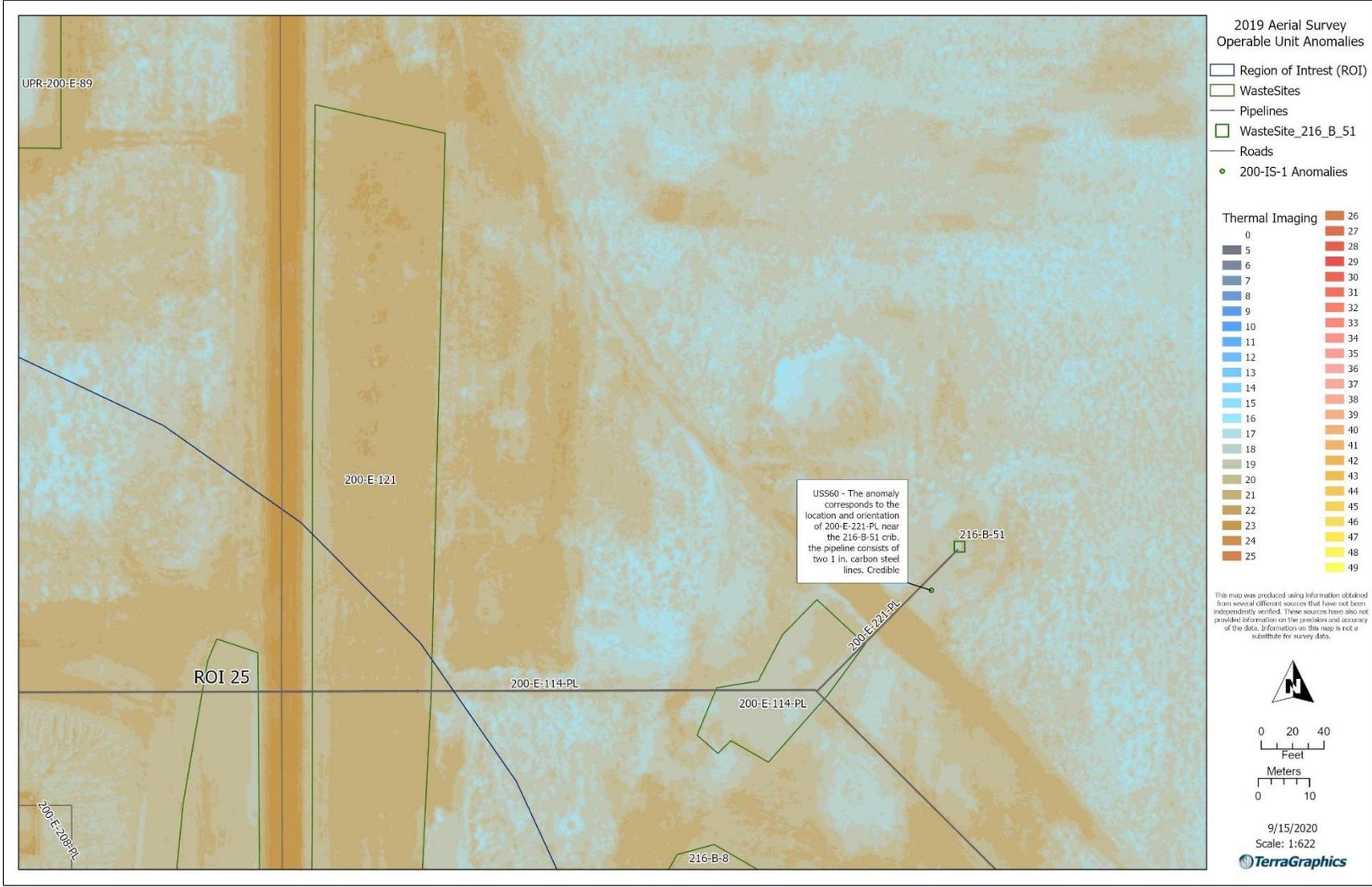


Figure B-3. Credible Anomalies in the 200-IS-1 OU (4 of 7)

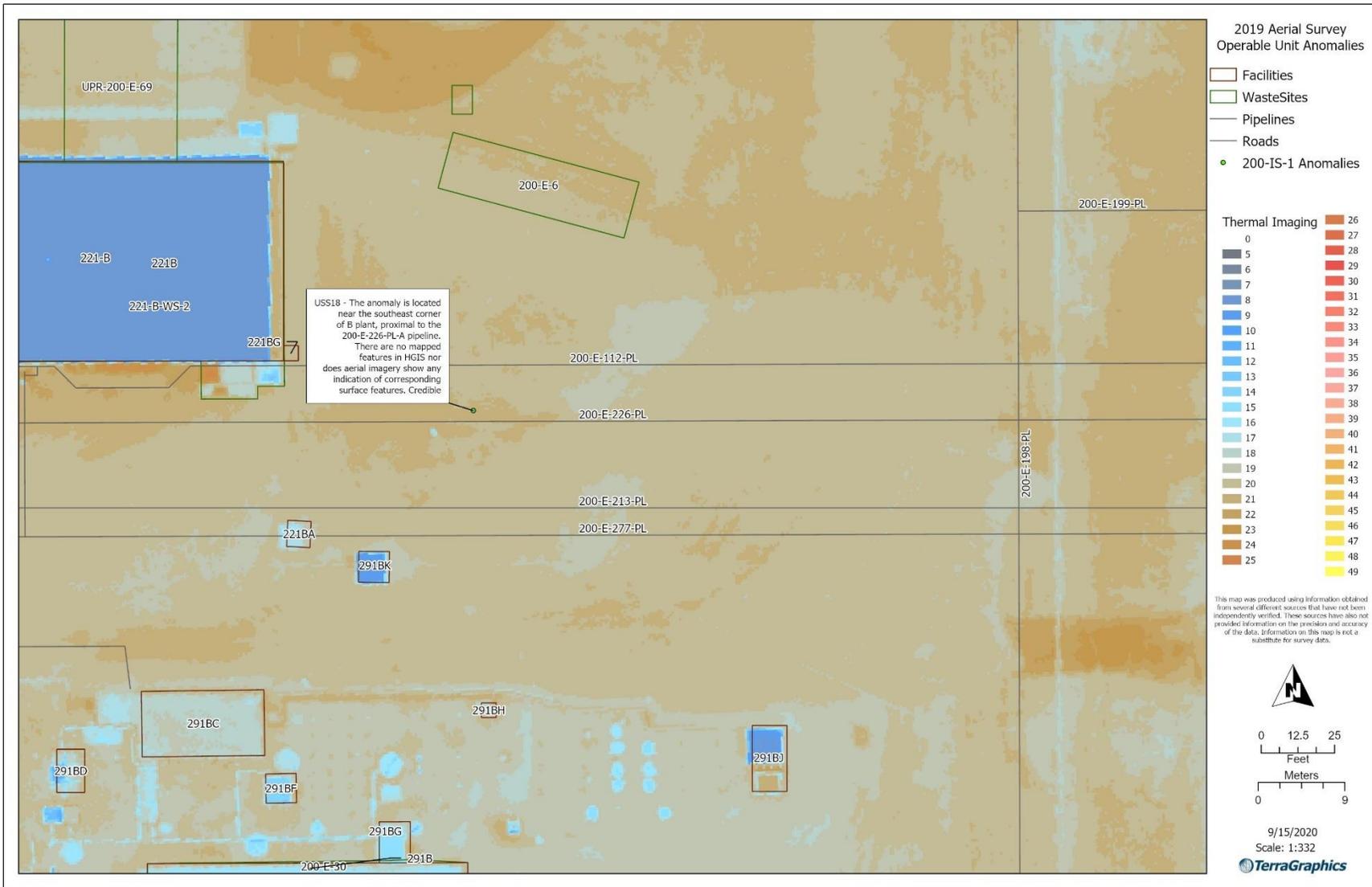


Figure B-3. Credible Anomalies in the 200-IS-1 OU (5 of 7)

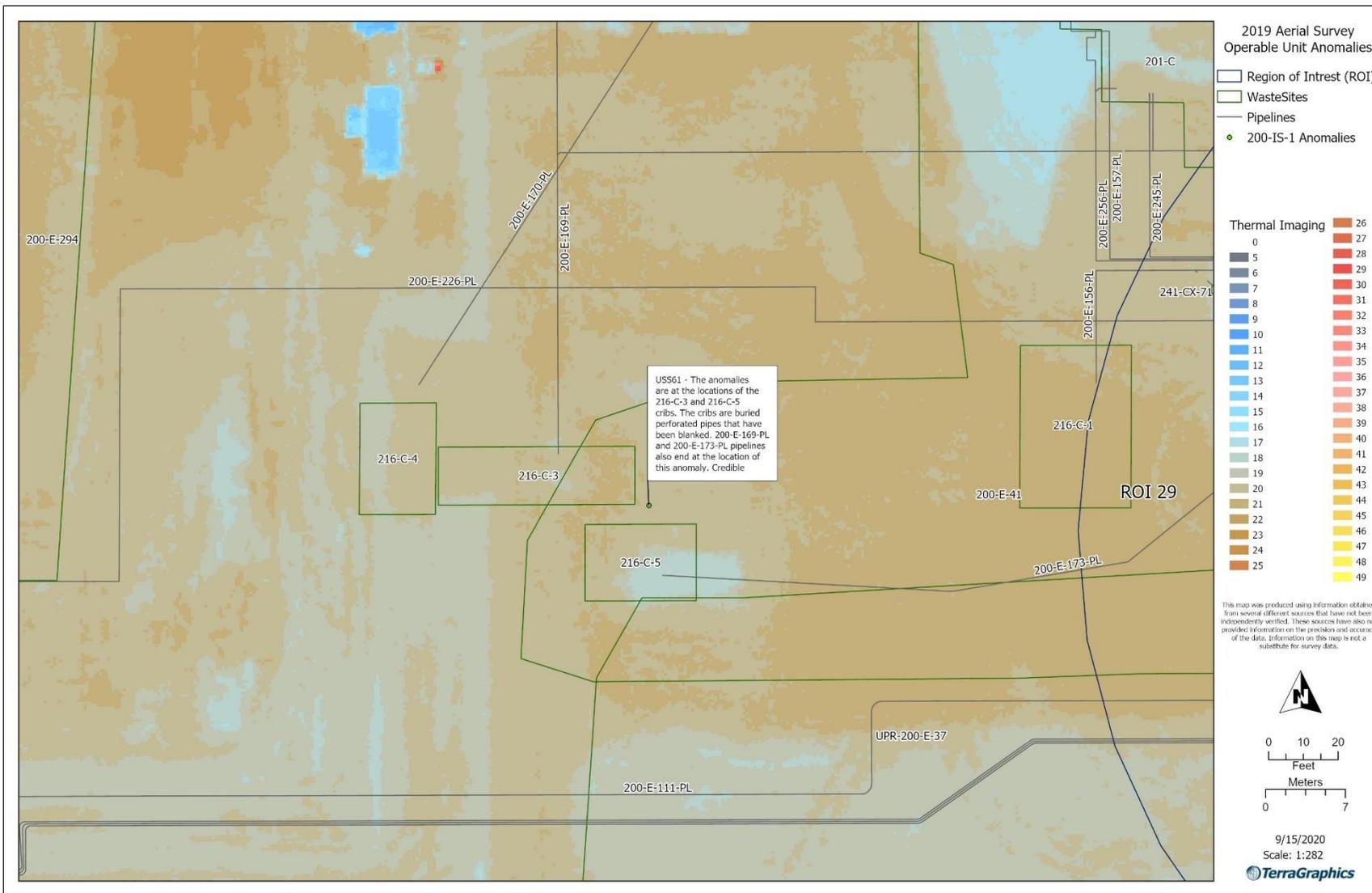


Figure B-3. Credible Anomalies in the 200-IS-1 OU (6 of 7)

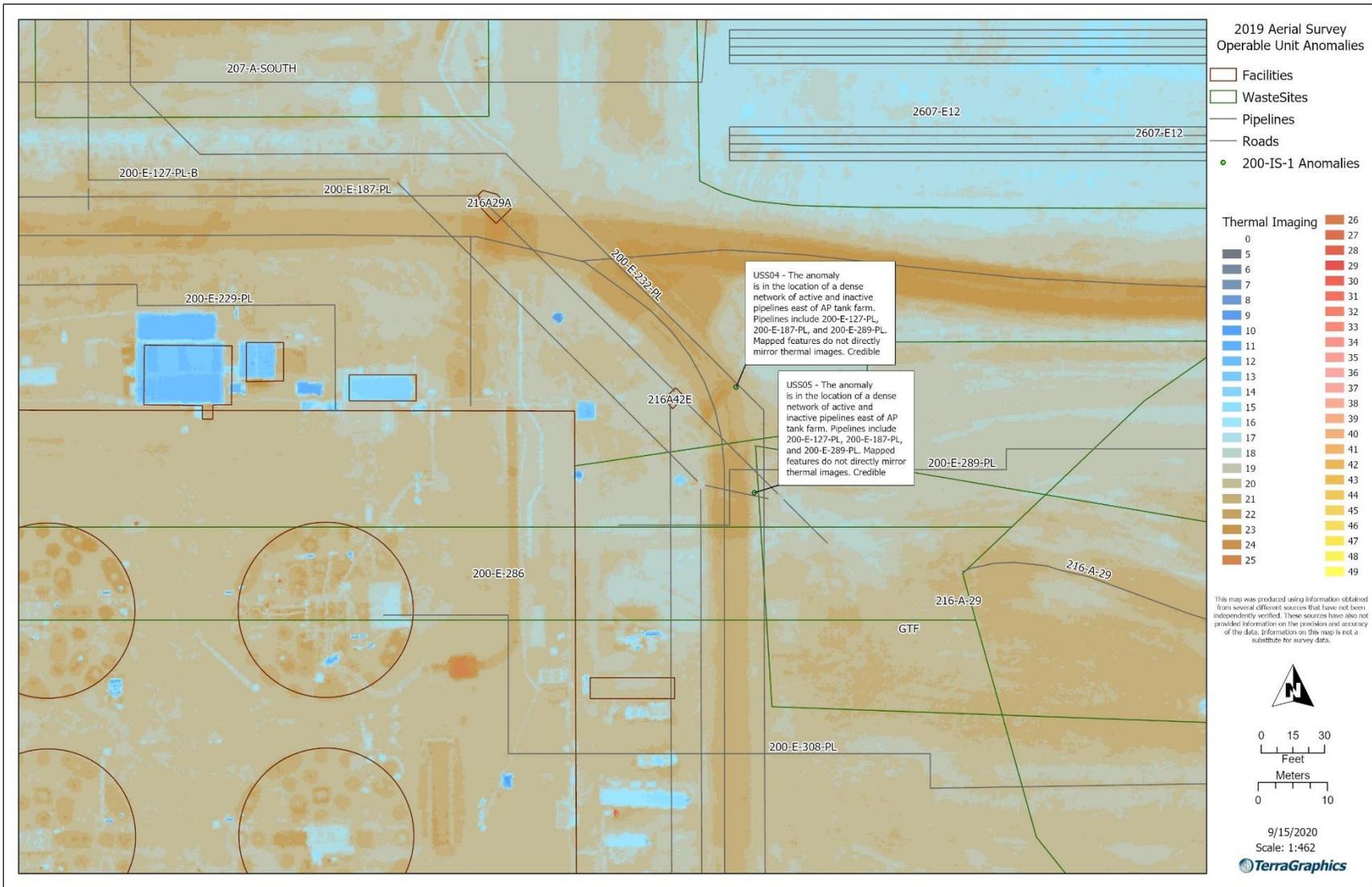


Figure B-3. Credible Anomalies in the 200-IS-1 OU (7 of 7)

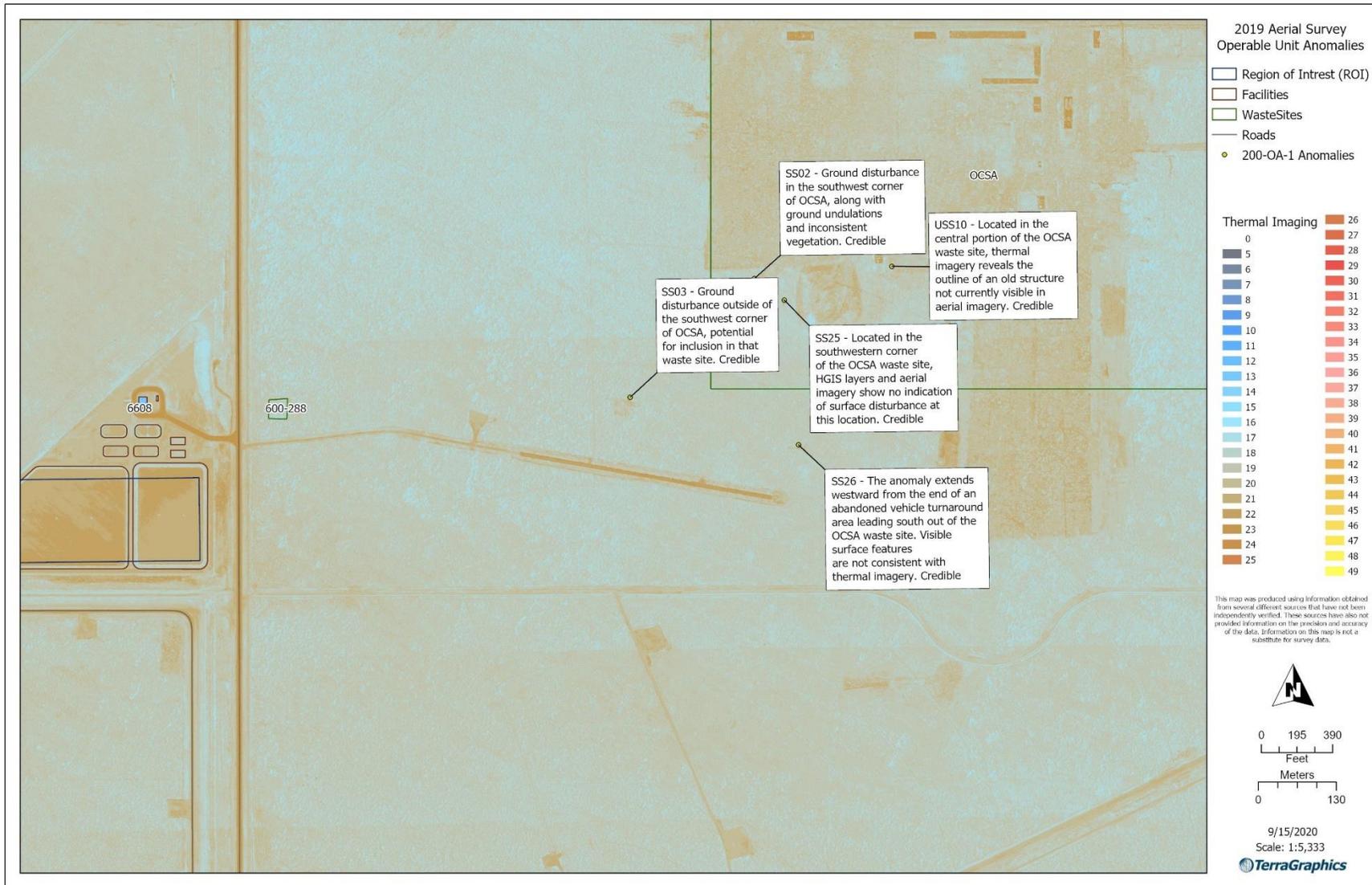


Figure B-4. Credible Anomalies in the 200-OA-1 OU (1 of 3)

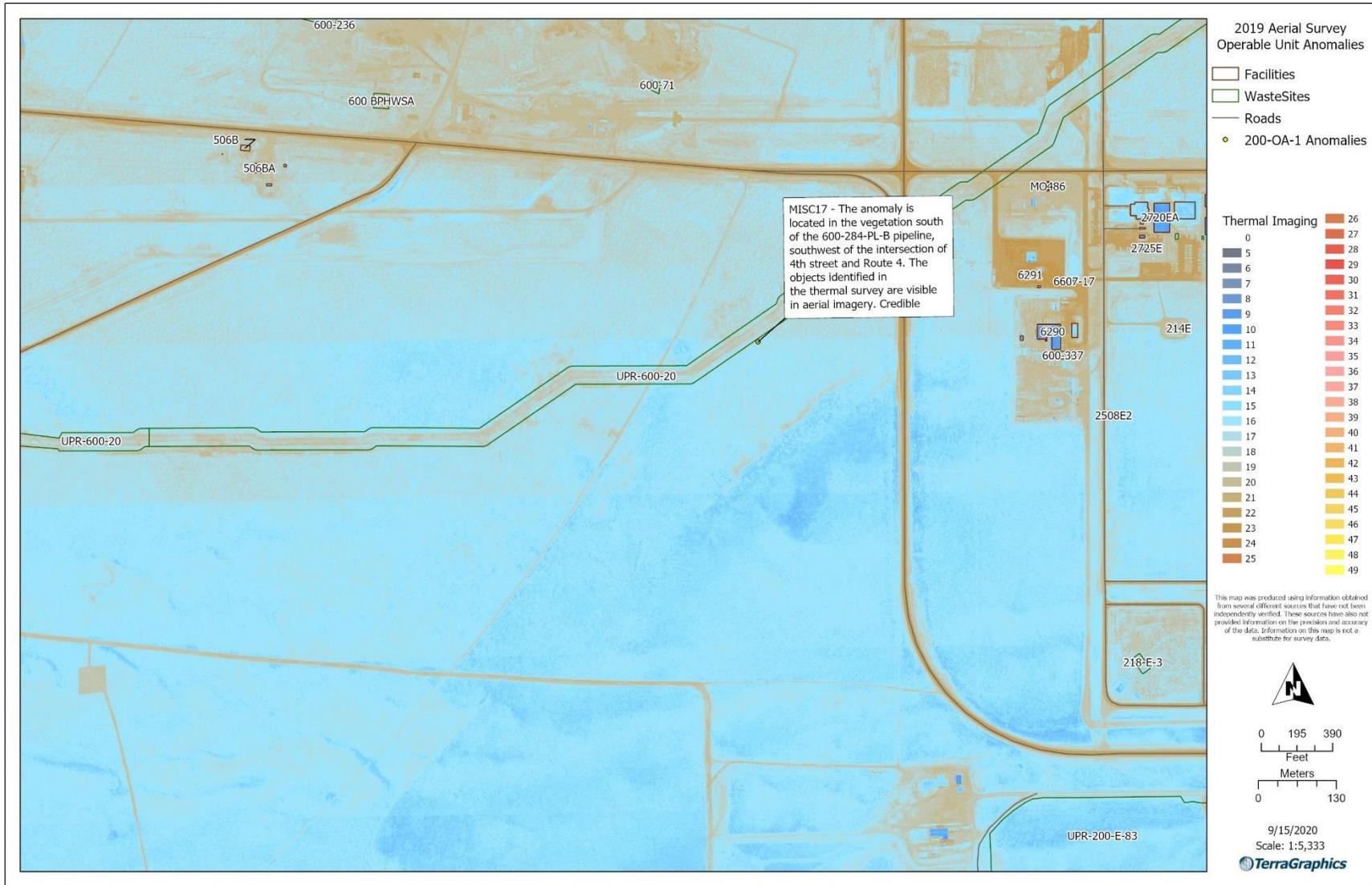


Figure B-4. Credible Anomalies in the 200-OA-1 OU (2 of 3)



Figure B-4. Credible Anomalies in the 200-OA-1 OU (3 of 3)

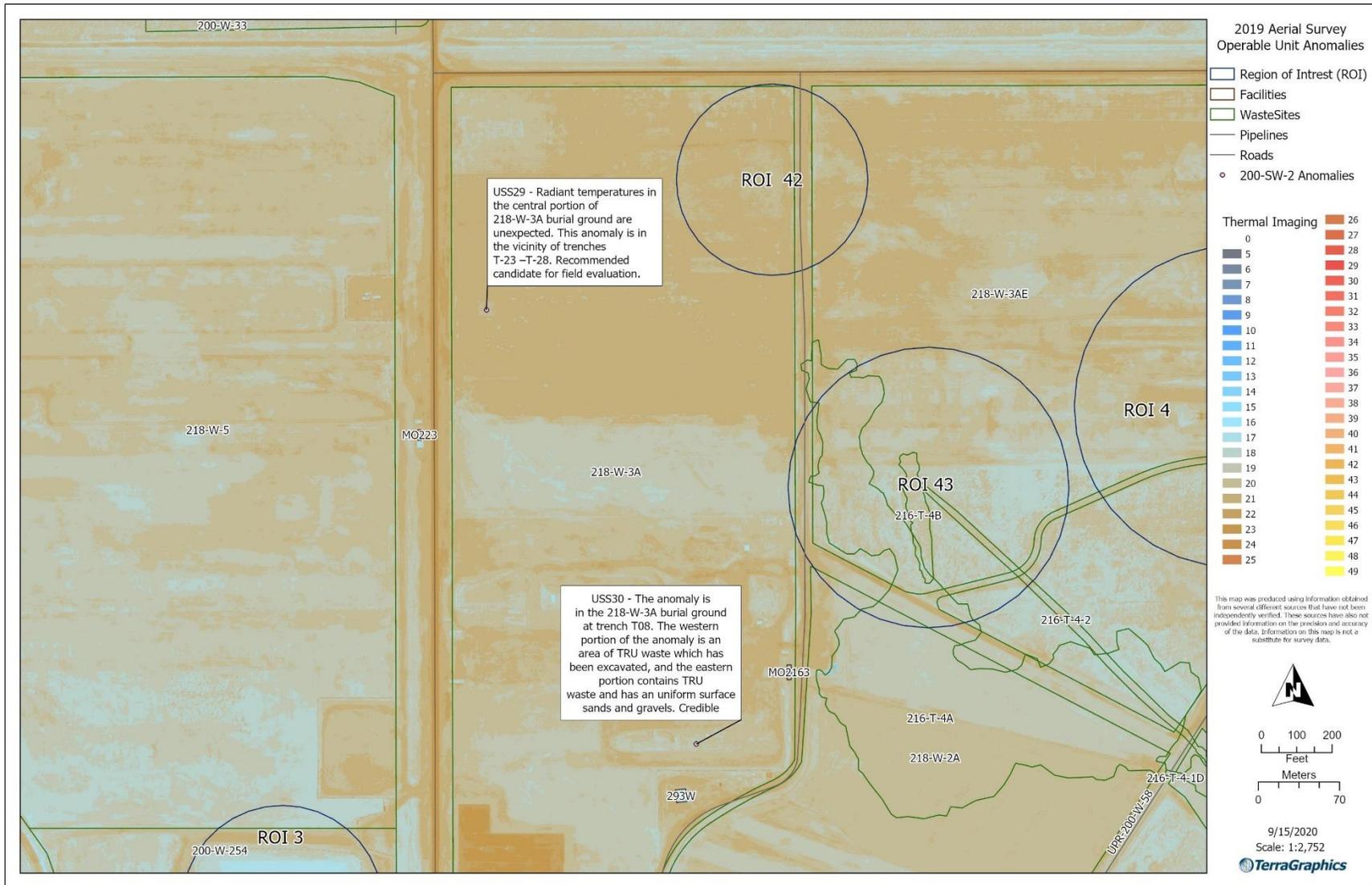


Figure B-5. Credible Anomalies in the 200-SW-2 OU (1 of 4)



Figure B-5. Credible Anomalies in the 200-SW-2 OU (2 of 4)

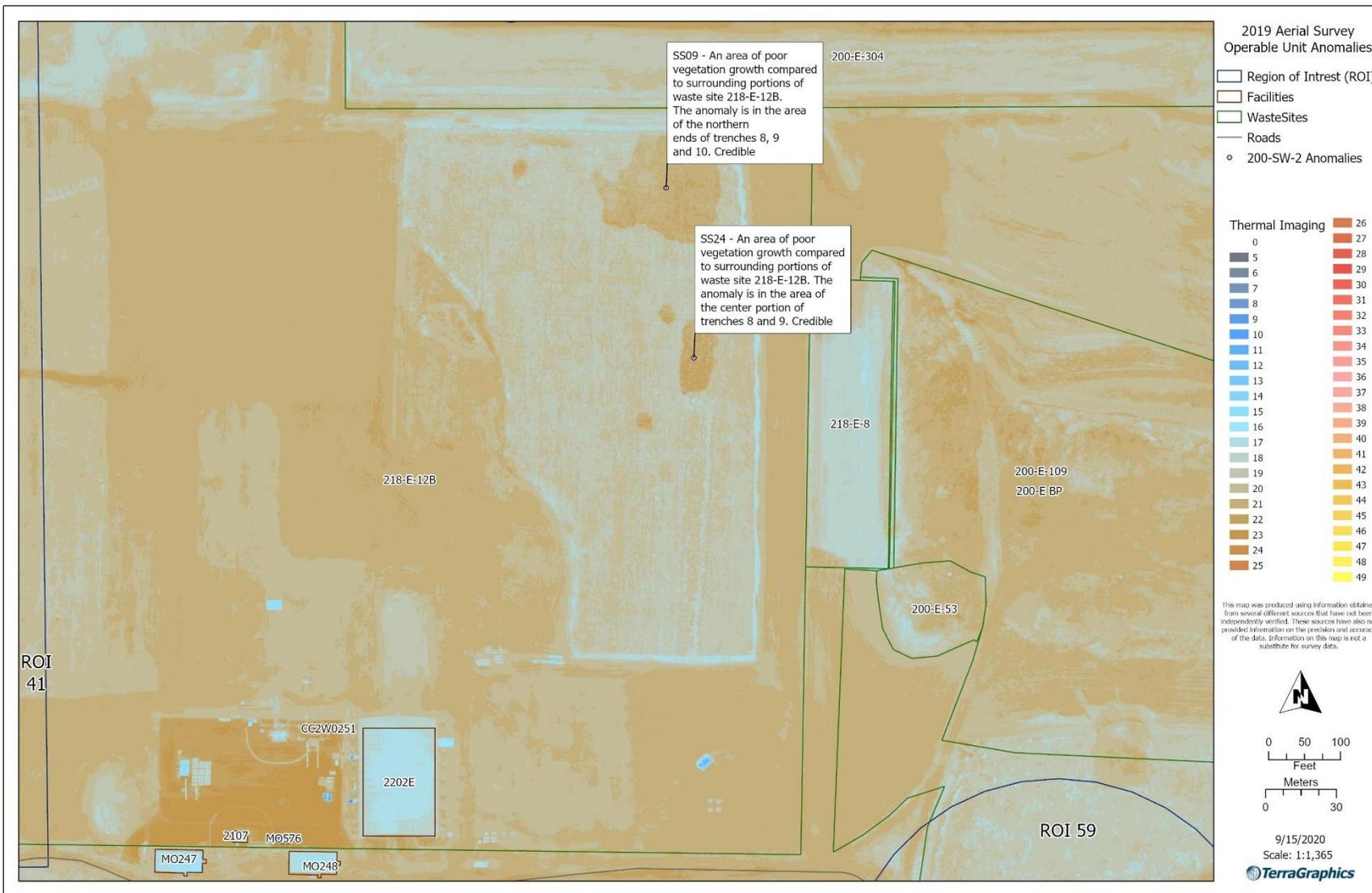


Figure B-5. Credible Anomalies in the 200-SW-2 OU (3 of 4)



Figure B-5. Credible Anomalies in the 200-SW-2 OU (4 of 4)

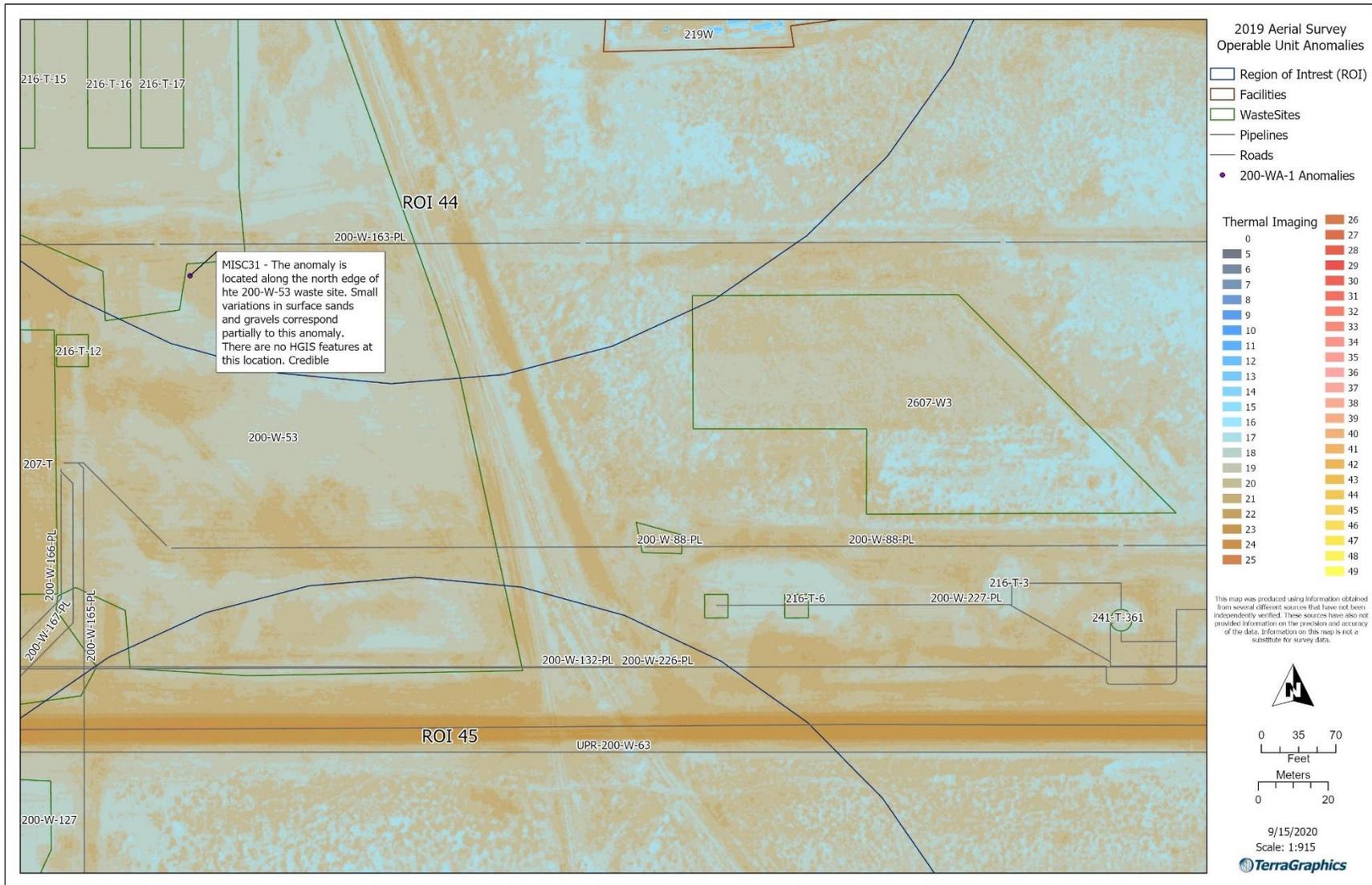


Figure B-6. Credible Anomalies in the 200-WA-1 OU (1 of 2)

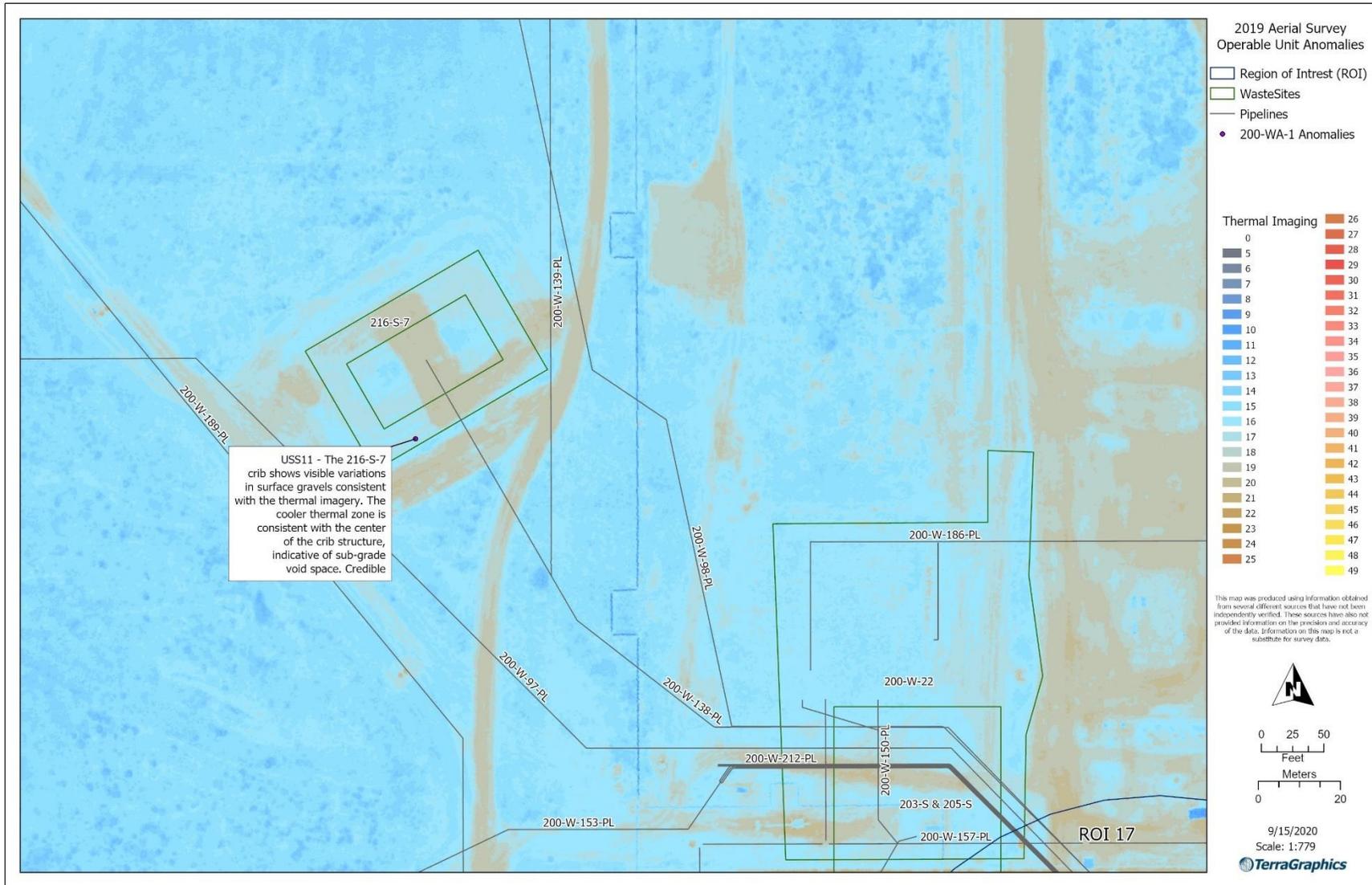


Figure B-6. Credible Anomalies in the 200-WA-1 OU (2 of 2)

B1.2 Credible Anomalies by Responsible Contractor

Table B-2 lists the responsible contractor and corresponding figures. Figures B-7 through B-11 illustrate the location of anomalies identified in the FY 2017 thermal survey (RSL, 2017) along with proximal features and a brief description of the credibility evaluation. The figures are presented by responsible contractor and include Bechtel National, Inc., CH2M HILL Plateau Remediation Company, Mission Support Alliance, and Washington River Protection Services. The figures provide a spatial representation of all credible anomalies associated with structures, facilities, and areas of land (not associated with a CERCLA OU) and the responsible contractor (owner).

B1.3 618-10 Waste Site

Figure B-11 illustrates that no credible anomalies were identified in the FY 2017 thermal imaging survey (RSL, 2017) at the 618-10 waste site.

Table B-2. Summary of Anomaly Figures by Responsible Contractor

Responsible Contractor	Justification
Bechtel National, Inc.	Figure B-7
CH2M HILL Plateau Remediation Company	Figure B-8
Mission Support Alliance	Figure B-9
Washington River Protection Services	Figure B-10



Figure B-7. Credible Anomalies in Locations Managed by the Waste Treatment Plant Contractor (Bechtel National, Inc.)

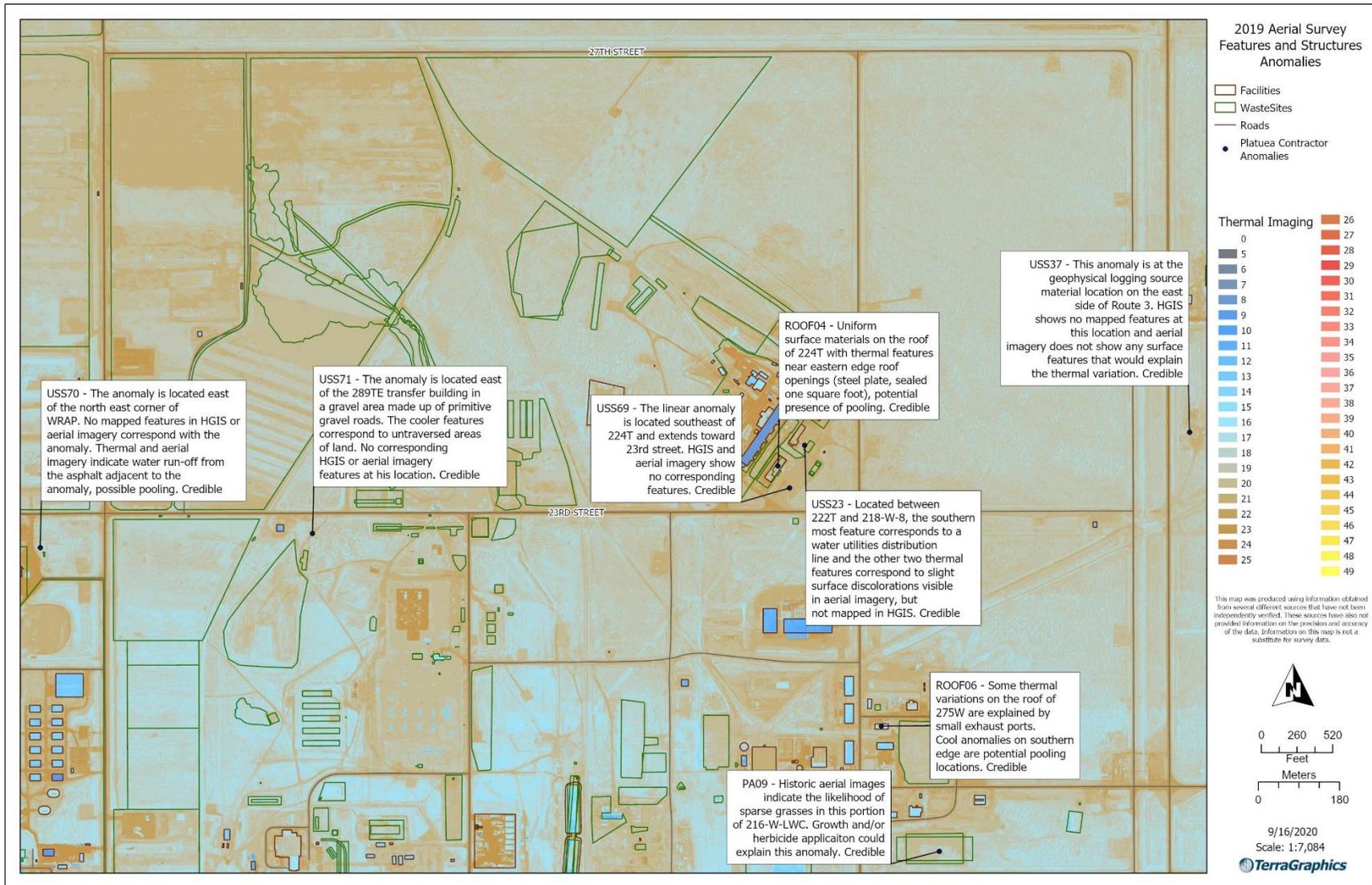


Figure B-8. Credible Anomalies in Locations Managed by the Central Plateau Contractor (CH2M HILL Plateau Remediation Company) (1 of 4)

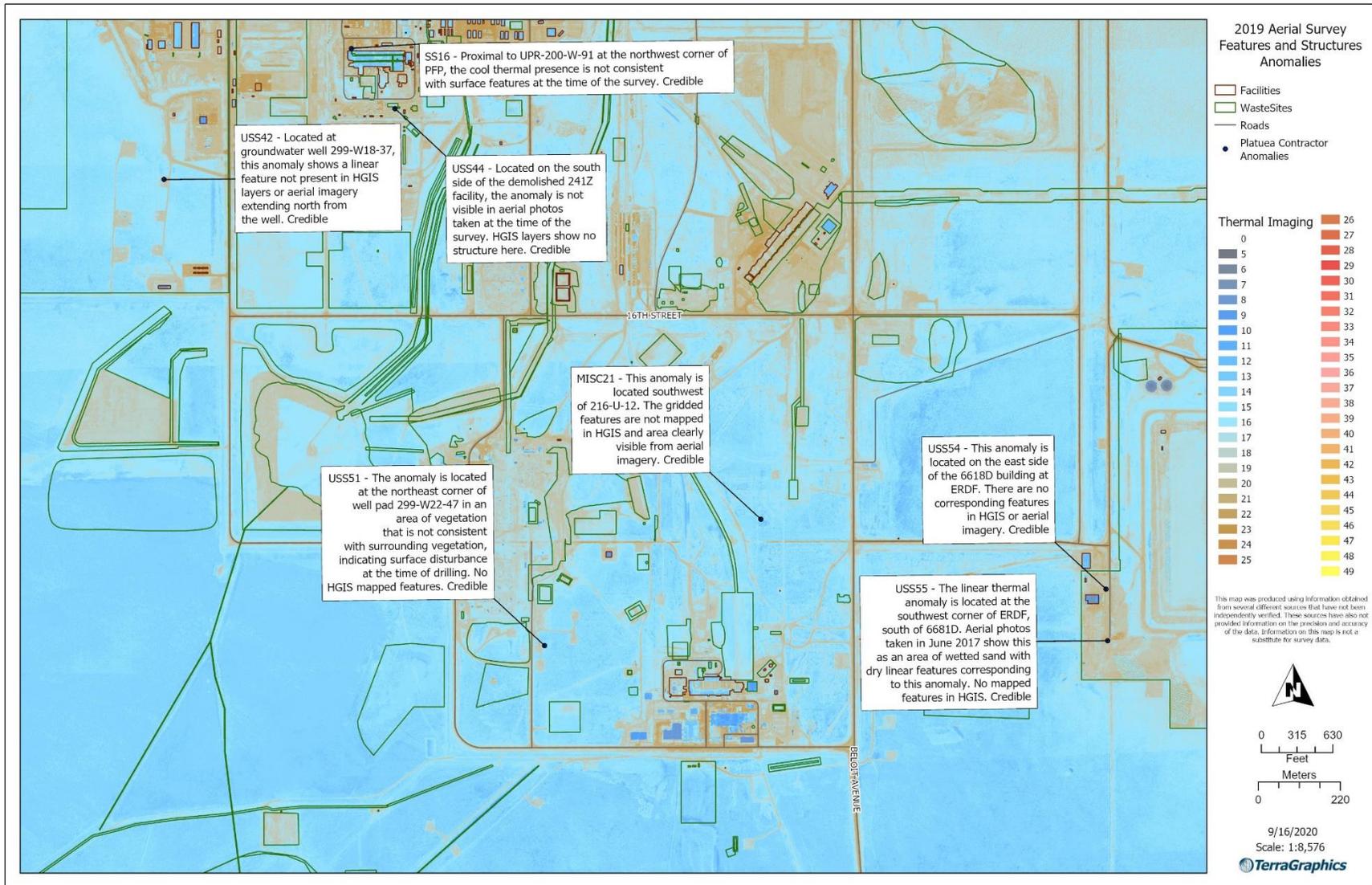


Figure B-8. Credible Anomalies in Locations Managed by the Central Plateau Contractor (CH2M HILL Plateau Remediation Company) (2 of 4)

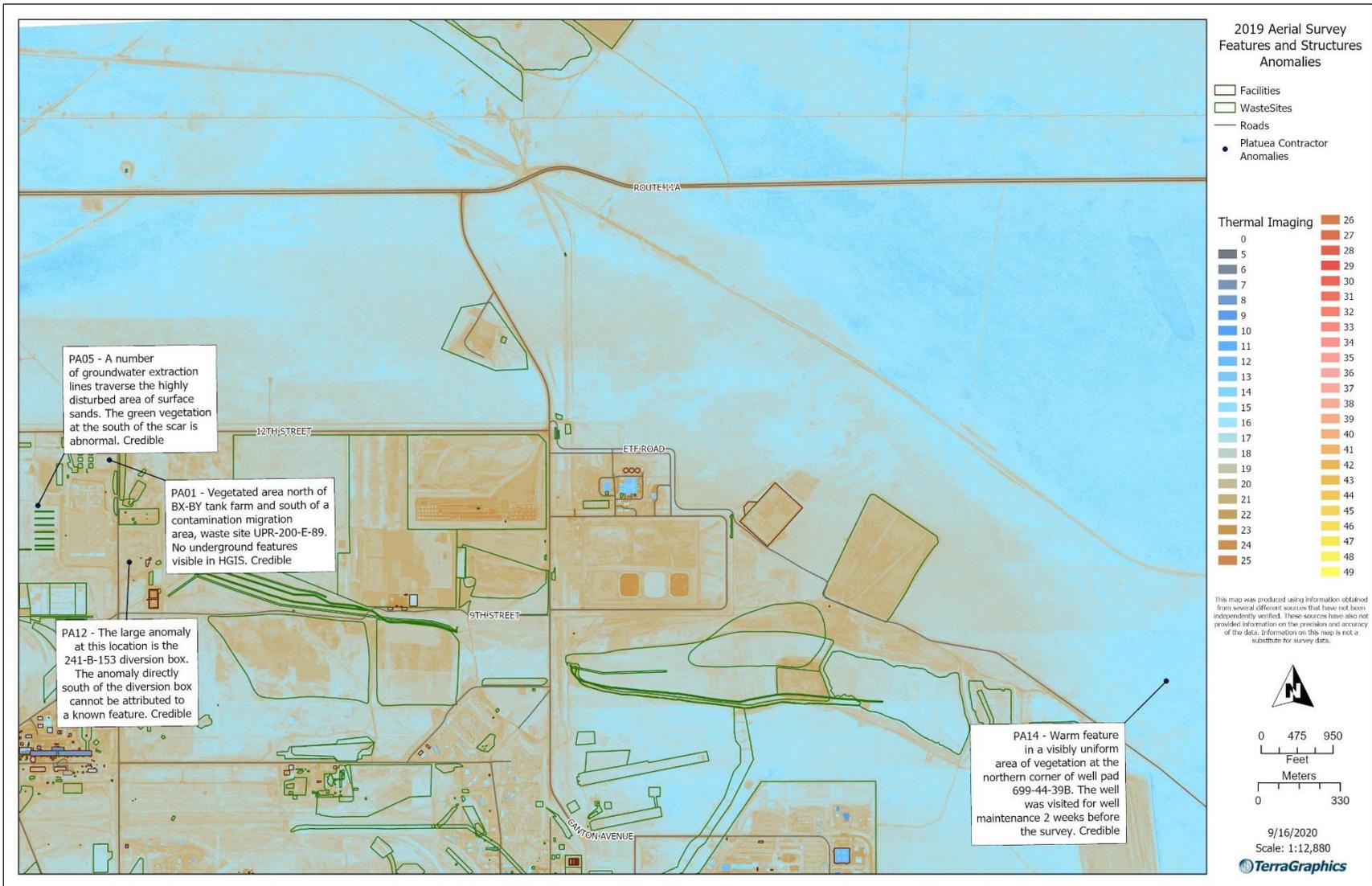


Figure B-8. Credible Anomalies in Locations Managed by the Central Plateau Contractor (CH2M HILL Plateau Remediation Company) (3 of 4)

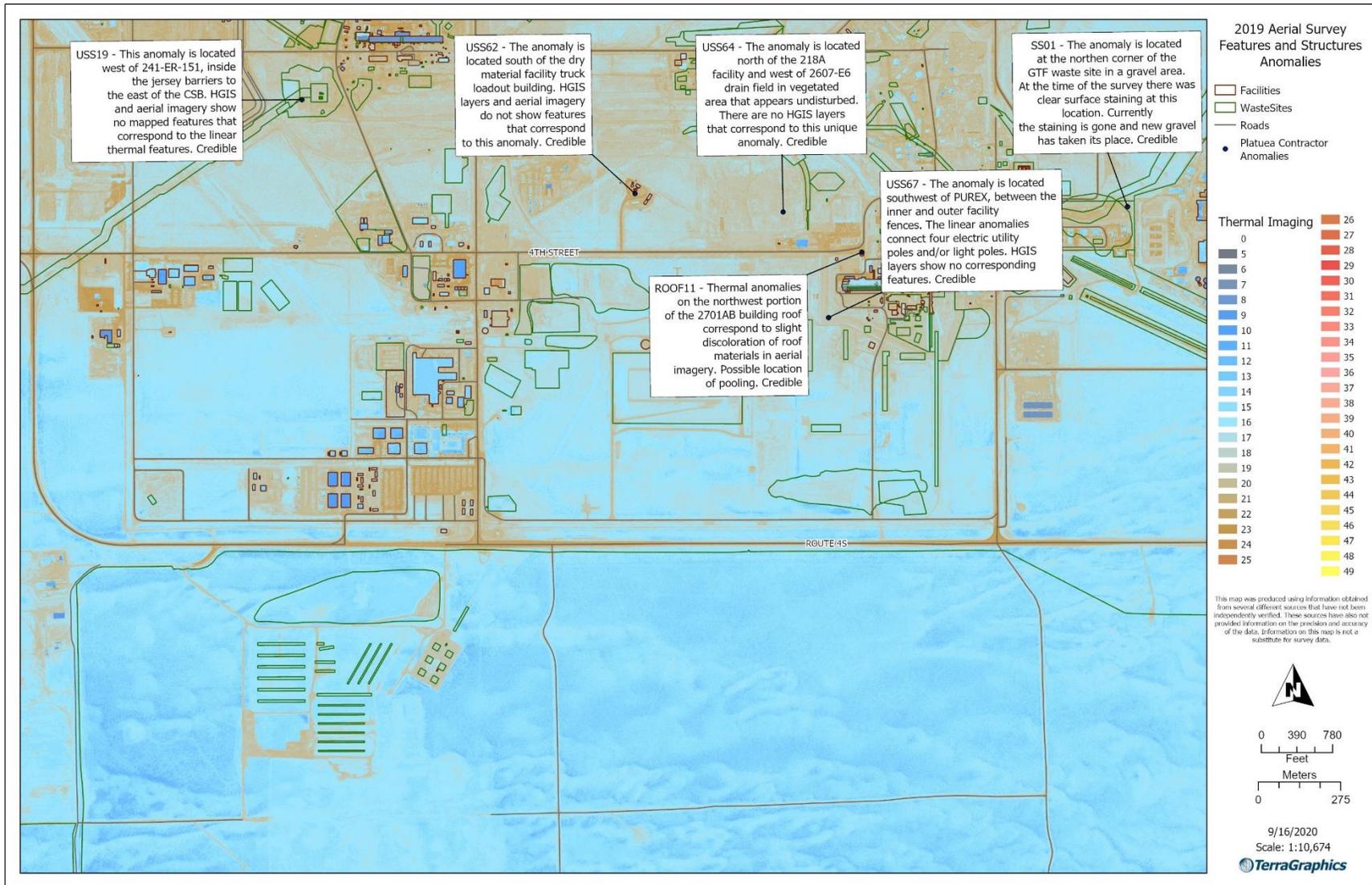


Figure B-8. Credible Anomalies in Locations Managed by the Central Plateau Contractor (CH2M HILL Plateau Remediation Company) (4 of 4)

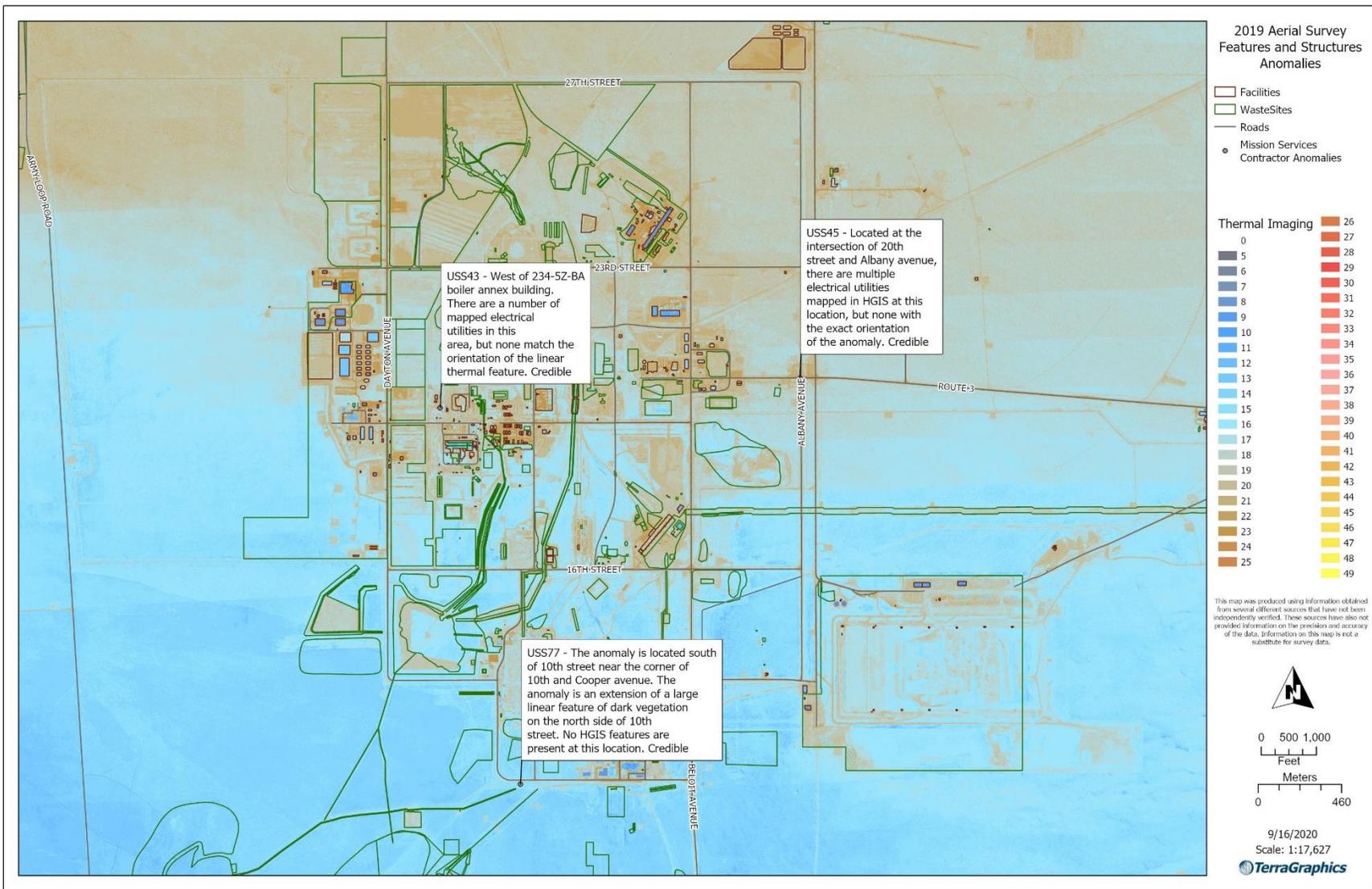


Figure B-9. Credible Anomalies in Locations Managed by the Mission Services Contractor (Mission Support Alliance) (1 of 2)



Figure B-9. Credible Anomalies in Locations Managed by the Mission Services Contractor (Mission Support Alliance) (2 of 2)



Figure B-10. Credible Anomalies in Locations Managed by the Mission Services Contractor (Washington River Protection Solutions) (1 of 2)

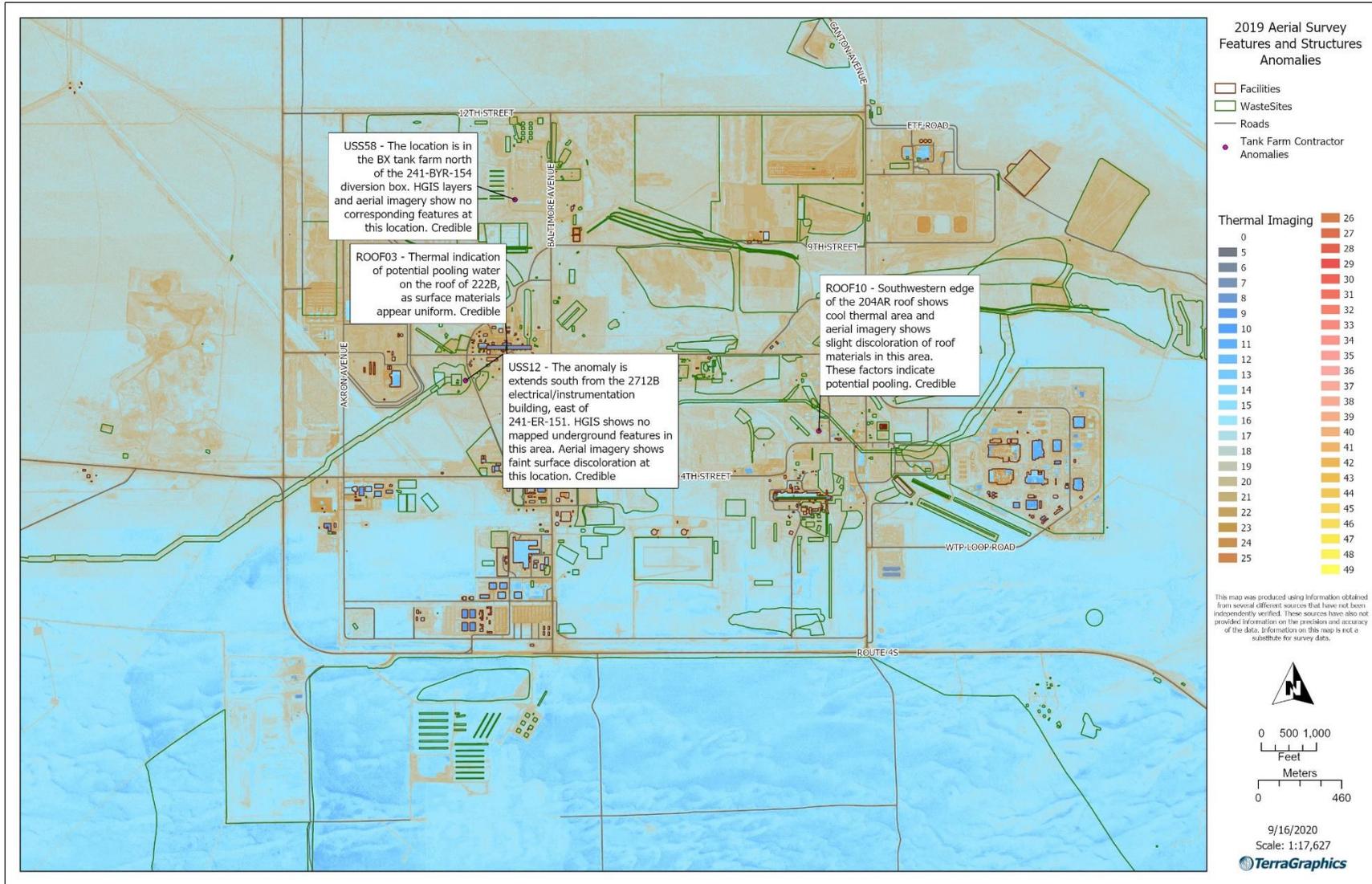


Figure B-10. Credible Anomalies in Locations Managed by the Mission Services Contractor (Washington River Protection Solutions) (2 of 2)

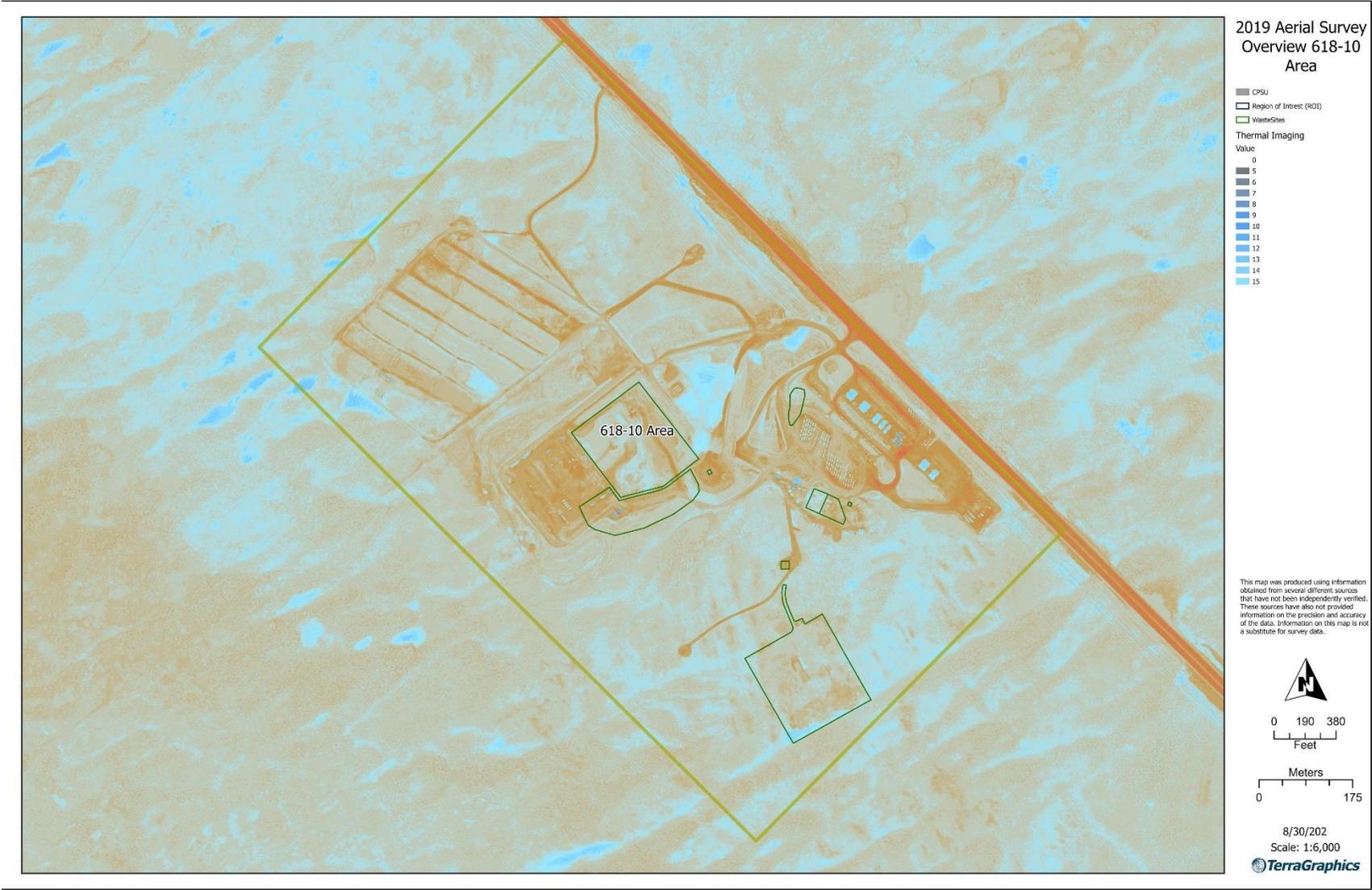


Figure B-11. FY2017 Thermal Imaging Survey Results for the 618-10 Waste Site

B2 Reference

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RSL, 2017, *Airborne Thermal Image Mapping of the Hanford Nuclear Reservation, WA*,
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