

SITE-SPECIFIC QUALITY ASSURANCE & QUALITY CONTROL AUDIT

Permit Closure Type – Final



PERMIT CLOSURE REPORT – RANGELAND

Location ID 305223

Location Name DOW LAURA-65N63W/28NESE

Report Date

31 May 2023

Soil Sage has conducted a thorough data audit as part of our Quality Assurance and Quality Control (QA/QC) protocols. The audit revealed this site has gone through a land use change.

Initial Job Assignment

Client	CIVITAS Resources
Work Assignment	CPW Centennial Valley State Wildlife Area Reclamation Report
Date	April 26, 2023

Quality Assurance & Quality Control Audit

Auditor	Soil Sage
Audit Date	05/05/2023

Audit Methodology

The following source materials were consulted during the QA and QC audit process:

- ✓ Site Permit Closures provided by CIVITAS Resources
- ✓ Colorado Oil & Gas Information System – COGIS Database
- ✓ On-site Evaluation and Proprietary Soil Sage Drone Imagery data collection
- ✓ Review of legacy imagery for site location and facility parameters

All pertinent data, imagery, and materials are included at the end of this report.

Site Description

Name	DOW LAURA-65N63W/28NESE		
Location ID	305223		
Operator / #	HIGHPOINT OPERATING CORPORATION / 10071		
Field	WATTENBERG 90750		
County, State	WELD		
Lat/Long	40.367970 / -104.433210		
	Planned Location	X	As Drilled
Facility Status	CL	Location	NESE 28 5N63W
Facility Status Date	02/09/2014	Access Road	Oil & Gas Access
Facility Entities	X	Tank Battery	Pits
	X	Wells	X Off-Location Flowlines (Form 44)
		Domestic Taps	X On-Location Flowlines (Form 42)
Equipment Remaining on Site	X	None	Debris or Non-Oil & Gas
	List of Equipment:		
Environment Incidents & Remediation	X	None	Spill or Release (Form 19)
	Remediation (Form 27/27A)		
Inspection Corrective Actions (CA)s	<p>Corrective Actions (CA)s were detected during the QA & QC Audit.</p> <p>CA Overall Status: 1 of 1 CAs have not been completed</p> <p>Originating Field Inspection Doc # & Date: 697504619 & 04/28/2023</p> <ul style="list-style-type: none"> See "Field Inspection Form" section of this report below for details. <p>Complete COGCC Inspection Search Results: Link</p>		
Sundry Notice (Form 4)	No Form 4s were detected during the QA & QC Audit.		
On Location Flowlines (Form 42)	Form 42s exist for Related Facilities – See individual scout card data for report details.		
Off-Location Flowlines (Form 44)	No Form 44s were detected during the QA & QC Audit.		
Field Inspection Form (Form INSP)	<p>Form INSP Doc # & Date: 697504619 & 04/28/2023</p> <ul style="list-style-type: none"> Status Summary: Follow Up Inspection Required, Corrective Action Response Requested Inspected Facilities: Well DOW LAURA #14-27, access road, and Off-Site Tank Battery (assigned COGCC Location ID 435364) Inspection Status: RI – Reclamation Inspection (Final) Inspection Date & Inspector: 04/20/2023 by Chris Binschus 		

	<ul style="list-style-type: none"> ○ Complaint #: 403379491 ○ Nature of Complaint: CPW (landowner) had concerns about failed reclamation that was previously performed by BONANZA CREEK approximately three years ago. ○ Comments: Note-this is a shared location with Location ID 331381. The well/tank battery location and access road consisted mostly of weeds with little perennial vegetation that is not reflective of reference areas. Refer to the attached photos. Due to the lack of desirable vegetation establishment, COGCC is requiring soil sampling. Operator shall take samples along portions of the failed reclamation and background reference samples for comparison. Operator shall take discrete samples at six (6) inches intervals to a minimum depth of two (2) feet. See COGCC Comments Section for details on analytics. Note- Operator may need to install temporary fencing to facilitate on-going grazing operations. ○ Corrective Action: Comply with Rule 1004 to conduct additional reclamation. For soil samples, submit results via Form 4 Sundry Notice to the attention of Chris Binschus no later than two weeks after receiving results. Soil samples shall be overlaid on an aerial map depicting where soil sample locations and reference samples were taken. ○ CA Dates: 04/20/2023 ○ Overall Final Reclamation: Fail <p>Attachments: Inspection Photos Doc # 697504620</p>
COGIS Tank Facilities Information (Scout Card)	<p>Tank Battery Name: DOW LAURA 14-27 TANK BATTERY/435364 FACILITY ID: 435364</p> <ul style="list-style-type: none"> ○ Status & Date: AC & 12/09/2013 ○ Lat/Long: 40.368656 / -104.433099 ○ COGCC documents: No documents were detected during the QA & QC Audit, however, this off-site Tank Battery for Well DOW LAURA #14-27 <p>Note: This is the primary Tank Battery listing for this Location 305223. The QA & QC Audit detected a second COGCC Location ID for tank battery: FACILITY ID: 450357, Name: DOW LAURA 14-27 TANK BATTERY, Status & Date: 07/26/2017, and same Lat/Long: 40.368656 / -104.433099.</p> <p>Note: This off-site Tank Battery is also the site of a release (SPILL/RELEASE 450598) and associated Remediation Workplan (Remediation Project #</p>

[10781](#)). Details follow:

Site Investigation and Remediation Workplan

Remediation Project #: [10781](#)

Form 27A Supplemental Doc & Date: [401659032](#) & 07/04/2018

- **Purpose:** Closure of Remediation Project, Spill/Release Remediation, Remediation of impacted ground water

- **Final Resolution:** Case Resolved

Form 27 Initial Doc # & Date: [401309678](#) & 12/12/2017

- **Purpose:** Spill/Release Remediation, Remediation of impacted ground water
- **Operator Comments:** Over an extended period of time, oil slowly leaked out of a pin hole in the bottom of a production tank. Upon discovery, the facility was decommissioned and removed. A trackhoe was used to delineate the extent of the release and remove all of the impacted soil. All of the impacted soil was removed via trackhoe and confirmed by laboratory analysis. Five groundwater monitoring wells have been installed and will be sampled on a quarterly basis and analyzed for TPH and BTEX.
- **Remediation Summary:** The excavation was backfilled to a depth of 2' bgs with fill material and then filled to surface grade with topsoil. Following plugging and abandonment of the well, the remaining road base will be stripped and the soil will be cross ripped to a depth of 18" to alleviate compaction. The location will be crimped with straw and seeded with a CPW approved seed mix.
- **Type of Waste Requiring Remediation:** E&P Waste, Oil
- **Impacted Media:** Soil
- **Impacted Type:** Undetermined
- **Site Investigation Plan Start Date:** 05/13/2017

Spill or Release

FACILITY ID: 450598

- **Status & Date:** 07/26/2017
- **Lat/Long:** 40.368608 / -104.433400

Form 19 Resolving Doc # & Date: [401354763](#) & 12/12/2017

- **Date Closed:** 07/26/2017
- **Request for Closure:** Work is proceeding under an approved Form 27 Remediation Workplan

	<ul style="list-style-type: none"> ○ Remediation Project #: 10781 ○ Operator Comments: All soil samples came back compliant with the COGCC Table 910-1 soil standards. Five groundwater monitoring wells were installed to determine if the groundwater was impacted. The monitoring well locations and results have been submitted in a separate Form 27. <p>Form 19 Initial Doc # & Date: 401281883 & 05/15/2017</p> <ul style="list-style-type: none"> ○ Date of Discovery: 05/11/2017 ○ Spill Type: Recent Spill ○ Reference Location Facility ID & Type: Tank Battery 435361 ○ Operator: BONANZA CREEK ENERGY OPERATING COMPANY LLC ○ Operator Comments: A hole on the bottom edge of a production tank released approximately 10 bbls of oil, inside an earthen containment berm. Upon discovery a vac truck was called out to bottom out the tank to prevent further impact. During spill delineation, groundwater was encountered at approximately 3' bgs. A 3" pump and 500 bbl frac tank have been set on location to help control groundwater intrusion during remedial efforts. Once all of the impacted soil has been removed, confirmation soil samples will be collected and submitted for laboratory analysis. ○ Note: Additional spill and release details were provided within the 10 day Condition of Approval (COA) in a subsequent Form 19 Doc # 401287664. Site Map Doc # 401287744.
COGIS Well Information (Scout Card)	<p>Well Name: DOW LAURA #14-27</p> <p>API#: 05-123-22672</p> <p>FACILITY ID: 275791</p> <ul style="list-style-type: none"> ○ Status & Date: PA & 02/09/2014 ○ Lat/Long As Drilled: 40.367970 / -104.433210 ○ Form 6 Subsequent Doc # & Date: 400566631 & 05/19/2014 ○ Form 42 Doc # & Date: 400638461 & 07/02/2014 <p>Purpose: Flowlines Abandoned on 02/21/2014</p>

COGCC Abbreviations: [Location & Facility Status Codes](#), [Inspection Types & Statuses](#) and [COGCC Help](#).

Audit Key Findings – Designation Land Use Observations

PREVIOUS LAND USE	CURRENT LAND USE
Reference Imagery for Infrastructure: Landsat/Copernicus 2016	Remotely Sensed Imagery: 05/02/2023
Designation: Oil and Gas Facility	Designation: Rangeland

The following imagery sources were reviewed during this audit:

EarthExplorer, DRCOG 2002 - 2014, NAIP Imagery 2011, 2013, 2015, 2017, 2019, 2021, ESRI Maxar and Remotely Sensed Imagery Sep 2022

Closure Information

Landowner Colorado Parks and Wildlife (CPW) filed a complaint on 04/20/2023 stating concerns about failed reclamation activities at the Centennial Valley State Wildlife Area performed by operator BONANZA CREEK ENERGY OPERATING COMPANY LLC approximately three years ago. In response, COGCC Reclamation Specialist Chris Binschus performed a Reclamation Inspection of the area that failed and identified a Corrective Action (CA) requiring the operator to perform soil sampling.

The inspection for this Location (305223) includes plugged and abandoned Well DOW LAURA #14-27, access road, and off-site Tank Battery (435364). The inspection noted these areas consisted mostly of weeds with little perennial vegetation that is not reflective of reference areas. It also noted this is a shared location with 331381.

Our post-inspection audit revealed an oil release at the tank battery Location 435364 on 05/11/2017. The release is reported under Spill or Release ID 450598 (case closed on 07/26/2017) and remediated under a Remediation Workplan RPN# 10781 (case resolved on 07/04/2018).

This is a shared location with Location [331381](#).

Site Photos

Site Investigation and Photos Date

05/02/2023

Cardinal directional photos of the site



North



East



South



West

ATTACHMENTS

Maps and Figures

Location Maps

CPW Overview Soil and Vegetation Locations
CPW Overview Observation Locations
CPW Overview Roads and Reclamation Extents
CPW Overview Reference Extents

Area Maps

Previous Infrastructure Overview
Current Site Overview
Elevation & Contours
Slope
Hydrology
NDVI Composite
NDVI

Reports

Reclamation Report
Soil Analytics
Reference Soil and Vegetation
Observations

Background Information

Natural Resources Conservation Service (NRCS) Map Unit Description

Reference Soil and Ecological Description

SITE-SPECIFIC RECLAMATION PLAN



Permit Closure Type – Final

Failed Reclamation Inspection

Site Description

Name	DOW LAURA-65N63W/28NESE
Location ID	305223
Operator / #	BONANZA CREEK ENERGY OPERATING COMPANY LLC / 8960
Field	WATTENBERG / 90750
County, State	WELD, CO

Report Date

31 May 2023

Site Evaluation

Investigator: Soil Sage

Investigation Date: 2-4 May 2023

Reference Soil Information: This site is comprised within one soil type, Map Unit 10 - Ellicott-Ellicott sandy-skeletal complex, 0 to 3 percent slopes, sandy texture surface and at depth. These soils are formed from noncalcareous, stratified sandy alluvium. Landform is drainageways, flood plains on intermittent streams. Excessively drained with a very low available water holding capacity. Depth ranges from 0 – 10 inches, the pH is 6.5 and the organic matter is 0.35%.

Soil chemical properties within the rooting zone to 50 inches is described in the Soil Properties – USDA Soil Properties section of this report.

Current Land Use in Reference Area: Range land

Observations

The Northern section is intermixed leased grazing land and “native” ecosystem along the South Platte River. The reclaimed areas have residual gravel and excessive applications of manure which have impacted the recovery of the sites.

Weed pressure has occurred along the roads and patchy areas at each site.

Debris remains along the roads and sites in the form of silt fencing, waddles and oil and gas operational equipment. Reference the observation document for specifics.

Site Soils

During the field investigation, Soil Sage collected soil samples every six inches from 0 – 24 inches within the site and reference locations within the map unit. These soils were analyzed to establish current soil physicochemical properties for reclamation planning. See spreadsheet attachment Table 1 for site

specific soil characterizations and associated reference soils. Reference USDA Soils and Ecological Site Description for historical properties.

Recommendations

Data of Sampling – 2-4 May 2023

Vegetation

Spring vegetation characteristics were present, newly emerging grasses and weeds are the primary vegetation during the site visit.

Ecological Site observations serve as the baseline vegetation cover.

Table represents the present cover observations.

Sample Number	Bare Ground	Grass	Forbs	Shrubs	Litter	Weeds	Field Notes
12	5	5	0	0	85	5	Veg similar, spray for weeds

Weeds

Weed Summary Reference

Common Name	Weed List Type	Percent Cover (%)
Field Bindweed	List C	5

Weed Inventory Criteria

- Each site is accessed for noxious weeds and common weeds
- Data are aggregated using point locations coupled with percent cover assessments and area measurements as needed
- Governance - Colorado Department of Agriculture - Colorado Noxious Weeds List, effective October 2020
- List A - Designated for eradication, List B - Designated to stop the continued spread, List C - Facilitate more integrated effective weed management, Watch List - Determined to pose a potential threat to ag and natural productivity.
- Common - designates weeds that do not fall within the Colorado Department of Agriculture lists
- Other - designates other identified weeds at the site

Site Characteristics

Hydrology

Hydrology – Stream Orders 1 – 6 are present - dominant streams are orders are 1, 2 and 3. Order 3 are present in locations that have the potential for soil erosion represented by gullying and riling that follow the elevation gradient from high to low within the current reclaim extent. These could be major runoff areas for gullying and soil erosion with heavy precipitation events.

Ponding - potential ponding can occur where water follows the elevation gradients in low lying area.

Reference Hydrology and Elevation and Contour Maps

Soil/Erosion

Exposed soils have low susceptibility to water erosion and are in the high susceptible group for wind erosion due to ecosystem dynamics and vegetative cover.

Summary Acreage Table

Description	Acres
Total Disturbance Extent	1.88
○ Reclaim Extent	0.55
○ Road	N/A
○ Reference Extent	0.71

Total Disturbance Extent is for four Locations: 305223, 331381, 435361, and 435364.

Road is accounted for in the Location 331381 Report.

Reference Extent is the same Reference Extent as Locations 331381, 453361, and 435364 - North Reference Document and Site Overview Reference Map.

Site Recommendation and Re-Evaluation

North Side

Road: 12 inches remove and replace

Pad: 6 inches remove and replace

Replacement Soil

Texture: Sandy Loam

Organic Matter: 1%

pH: 7.0 - 8.3

Nitrate N: less than 50 ppm

Sodium: less than 150 ppm

Chloride Cl: less than 100 ppm

Sulfate S: less than 100 ppm

Soil tests must be submitted to Luke Kelly (lkelly@civiresources.com) AND Sam Streeter (sam@soilsage.com) for approval prior to use on the project. Certified Weed Free Straw must be used, and evidence must be supplied to Luke Kelly and Sam Streeter. Soil Sage will be performing inspections during reclamation activities and after work is complete to ensure success. On-site access must be coordinated with Colorado Parks and Wildlife (CPW) before work commences. Schedule of reclamation activities (approximate) must be submitted before reclamation starts and any changes to the schedule must be communicated via email to Luke Kelly and Sam Streeter.

Seed Mix

Vegetation Seed Mix

Additional reclamation procedures are recommended at this time.

Sandy Bottomland - Salt Meadow Ecosystems CPW Mix

Common Name	Scientific Name	#PLS/Acre	% of Mix
Alkali Sacaton	<i>Puccinellia distans</i>	4	26.7
Western Wheatgrass	<i>Pascopyrum smithii</i>	4	26.7
Switchgrass	<i>Spartina pectinata</i>	3	20.0
Prairie Cordgrass	<i>Spartina pectinata</i>	2	13.3
Needle and Thread	<i>Hesperostipa comata ssp. comata</i>	2	13.3
Total Mix		15	100.0

NOTE: The seed mix is based on the soil type and landscape position. The surrounding area has similar soil properties, and this seed mix is subject to change based on land use type.

Soil Amendments

New soil specifications are outlined above with NPK and OM recommendations.

Pre-Reclamation Activities and Notes:

- There are active and abandoned midstream assets in both the northern and southern parts of the reclamation area.
- Remove silt fencing, waddles and remaining oil and gas operational equipment.

Reclaim Area Protocol

Time Frame	Activity	Specifications	Site Totals
Prior to Reclamation Activities	Pre-Reclamation	Remove trash, silt fencing, waddles, and oil and gas operational equipment	Refer to the observation document for the area
Spring 2023	Remove and Replace Soil	Texture: Sandy Loam Organic Matter: 1% pH: 7.0 - 8.3 Nitrate N: less than 50 ppm Sodium: less than 150 ppm Chloride Cl: less than 100 ppm Sulfate S: less than 100 ppm	0.55 Acres
	Rip	Deep rip to 18 inches, do not rip below 18 inches. Evidence of seasonably high-water table found as shallow as 18 inches. Do not interact with this layer	
	Disc	Disc the site to a depth of 6.0-inches using a disk and harrow, field cultivator, vibrashank, or another alternative suitable to site conditions	
	Seed	CPW Mix	15 LBS/acre
	Straw	Spread certified weed free straw	2 Tons/acre
	Crimp	Crimp Straw	
Monitoring	Continuous	Site should be monitored post reclamation to ensure success	
Weed Management		Due to the seed bank of cheatgrass, thistle and kochia monthly monitoring is recommended with appropriate herbicide control	

Site Photos – Soil 11

Lat/Long: 40.367965 / -104.433192

Nearest Facility #: 305223

Date Range: 2-4 May 2023

Photo locations correspond with the overview map and vegetation table.

	
Soil Picture 1	Soil Picture 2 Vegetation at Soil Location





Site Photos – Vegetation 12

Lat/Long: 40.367968 / -104.43312

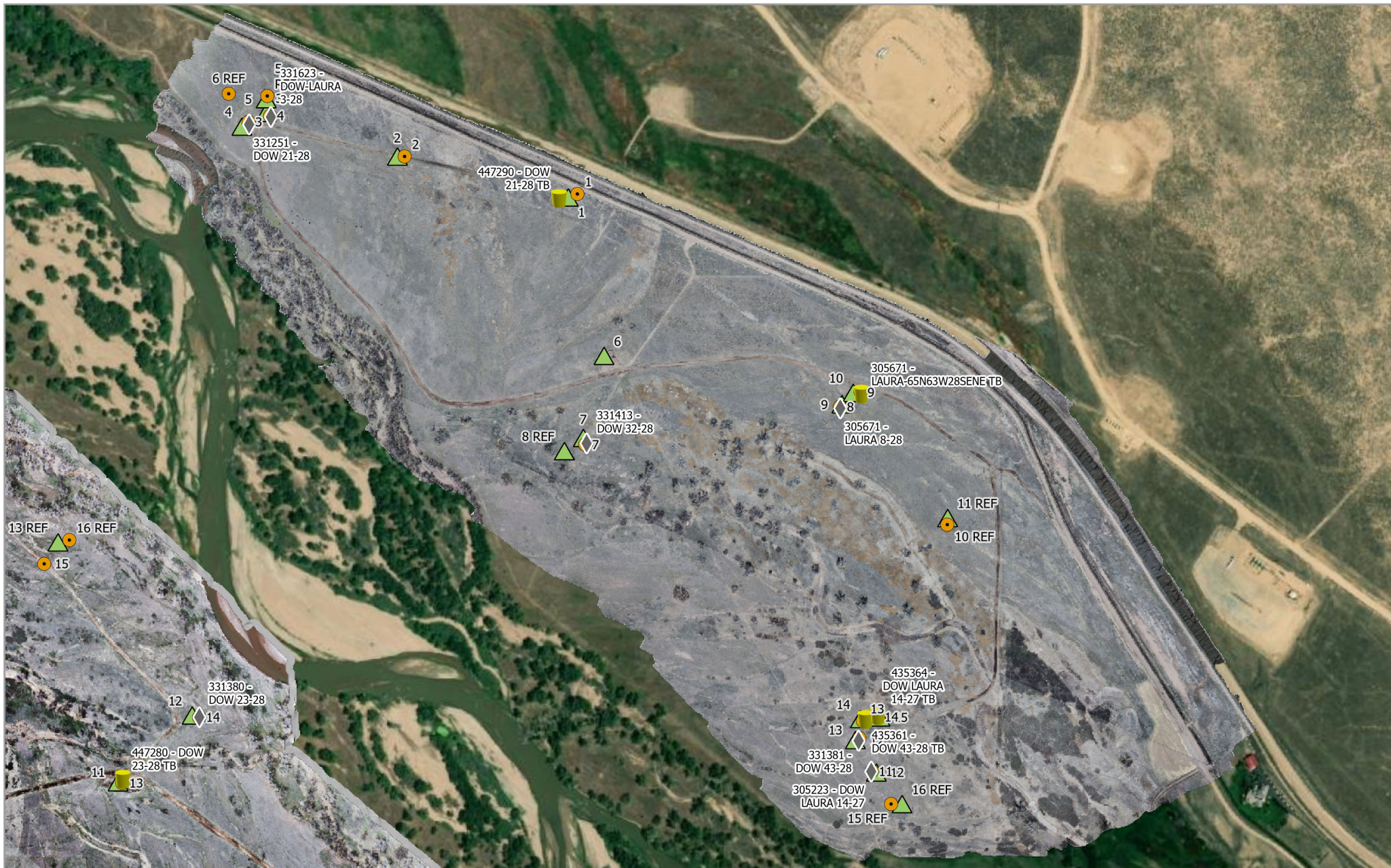
Nearest Facility #: 305223

Date Range: 2-4 May 2023

Photo locations correspond with the overview map and vegetation table.

	
Veg	Veg - North
	
Veg - East	Veg - South

	
Veg – West	Field Bindweed – <i>Convolvulus arvensis</i> – Colorado List C Noxious Weed



CIV - CPW North Side **Map Extent - Overview Soil & Veg Points**

Imagery: RS Orthomosaic & DSM
 Imagery Date: 2 May 2023
 Map Date: 29 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage

Legend

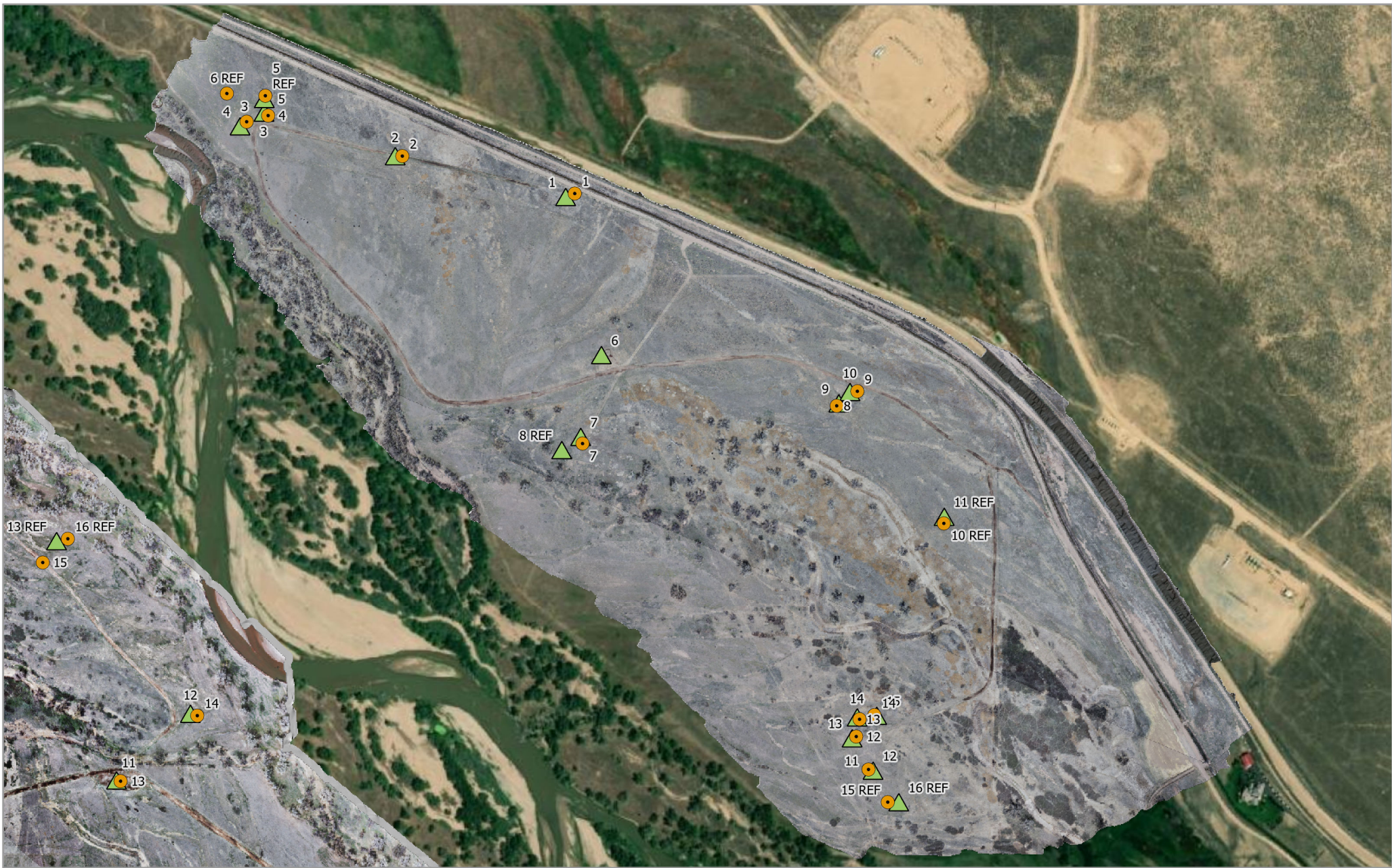
- ◆ Well
- Tank Battery
- Soils
- ▲ Veg

0 210 420 Meters

Scale: 1:7,000



Service Credits - Maxar

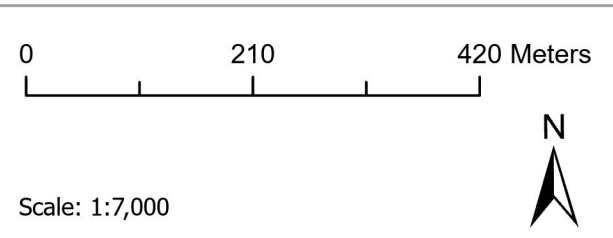


CIV - CPW North Side
Map Extent - Overview Soil & Veg Points

Imagery: RS Orthomosaic & DSM
 Imagery Date: 2 May 2023
 Map Date: 29 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage

Legend

- Soils
- ▲ Veg





CIV - CPW North Side **Map Extent - Overview Observation** **Points**

Imagery: RS Orthomosaic & DSM
 Imagery Date: 2 May 2023
 Map Date: 29 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage

Legend

- ◆ Well
- Tank Battery
- 📷 Observations

0 210 420 Meters

Scale: 1:7,000



Service Credits - Maxar



CIV - CPW North Side
Map Extent - Overview Observation
Points

Imagery: RS Orthomosaic & DSM
Imagery Date: 2 May 2023
Map Date: 29 May 2023
Datum: WGS 1984 UTM Zone 13N
POC: Soil Sage

Legend

 Observations

0 210 420 Meters

Scale: 1:7,000



Service Credits - Maxar



CIV - CPW North Side **Map Extent - Overview Reclaim & Road** **Reclaim Extent**

Imagery: RS Orthomosaic & DSM
 Imagery Date: 2 May 2023
 Map Date: 31 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage

Well

Tank Battery

Reclaim Extent

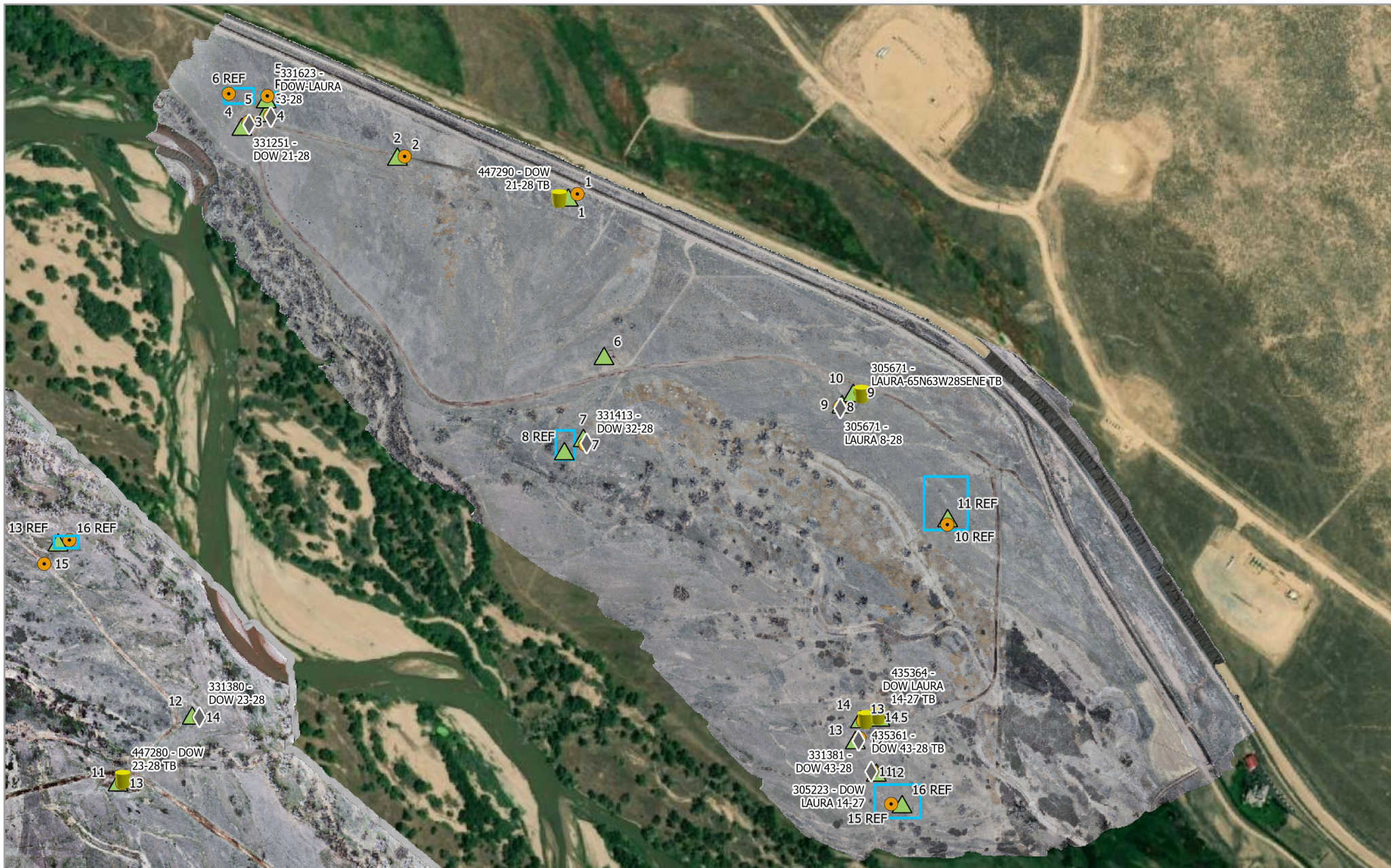
Road Reclaim

0
 210
 420 Meters

Reclaim Extent: 3.1 surface Acres
 Road: 7 surface Acres including buffer

Scale: 1:7,000





CIV - CPW North Side **Map Extent - Overview Reference Extent**

Imagery: RS Orthomosaic & DSM
 Imagery Date: 2 May 2023
 Map Date: 29 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage

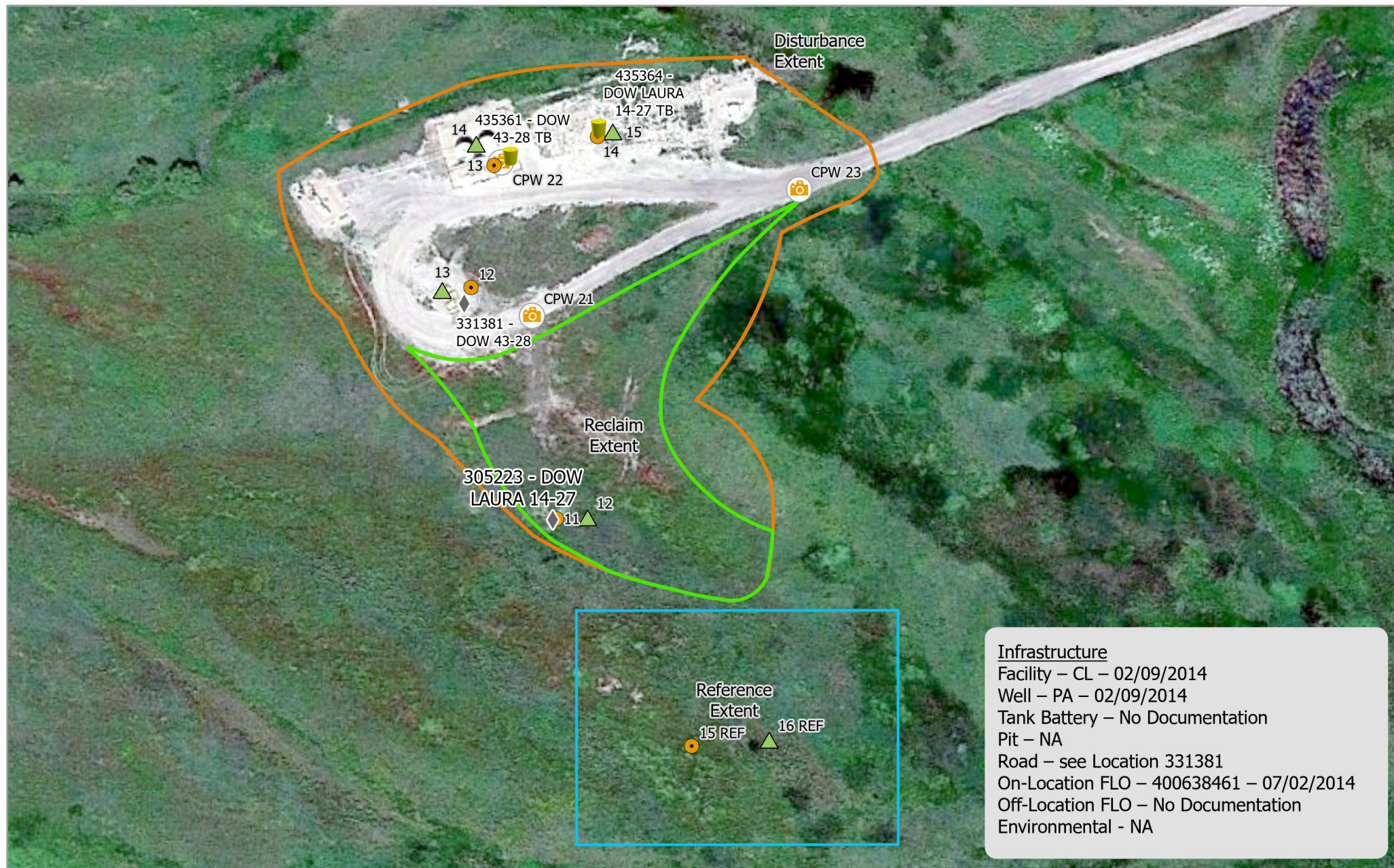
Legend

- ◆ Well
- Tank Battery
- Soils
- ▲ Veg
- Reference Extent

0 210 420 Meters

Scale: 1:7,000

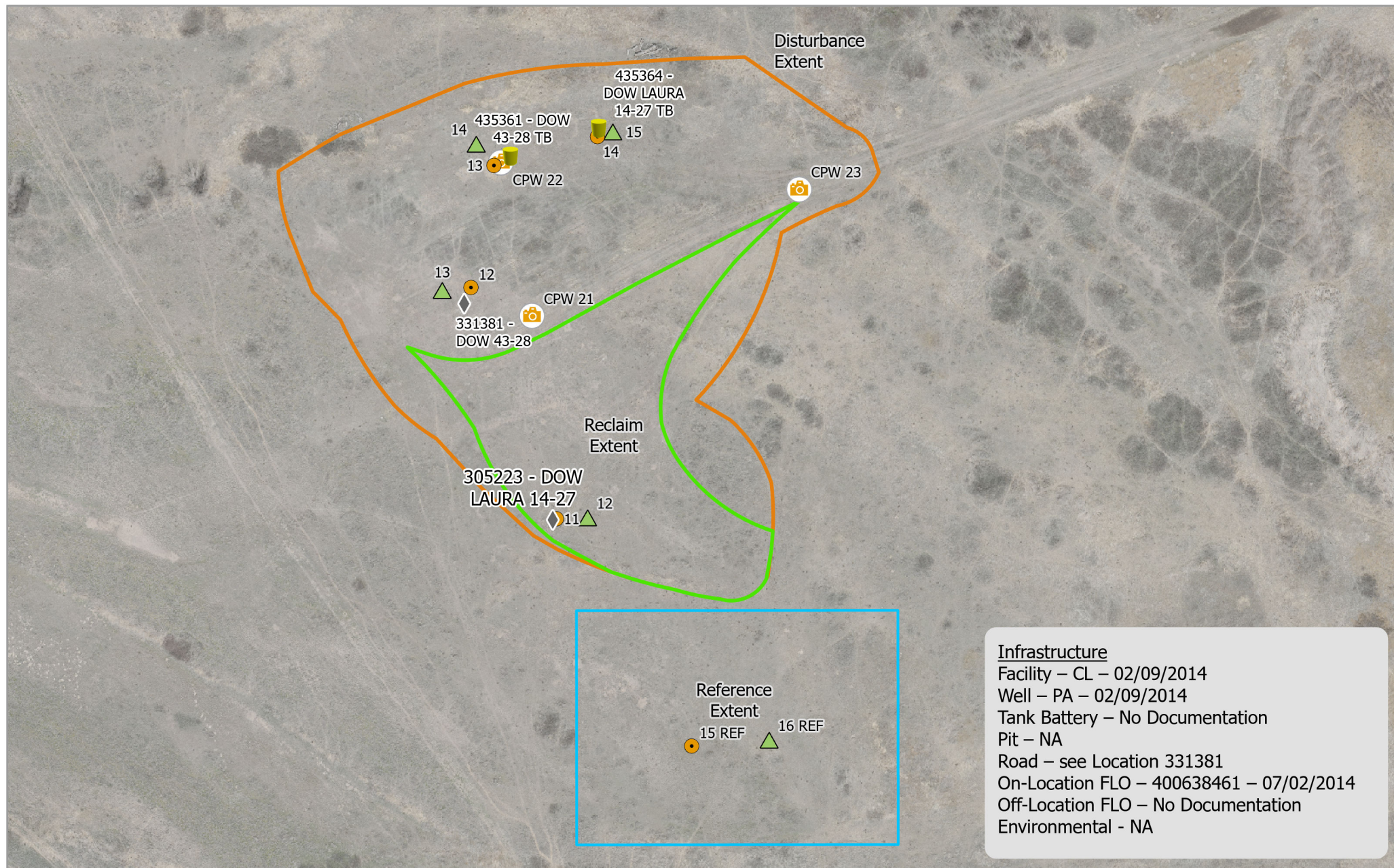




Imagery: Landsat/Copernicus
 Imagery Date: 14 Jun 2016
 Map Date: 25 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage

Service Credits -



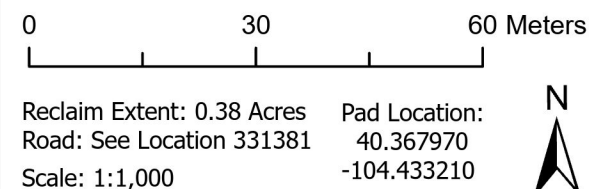


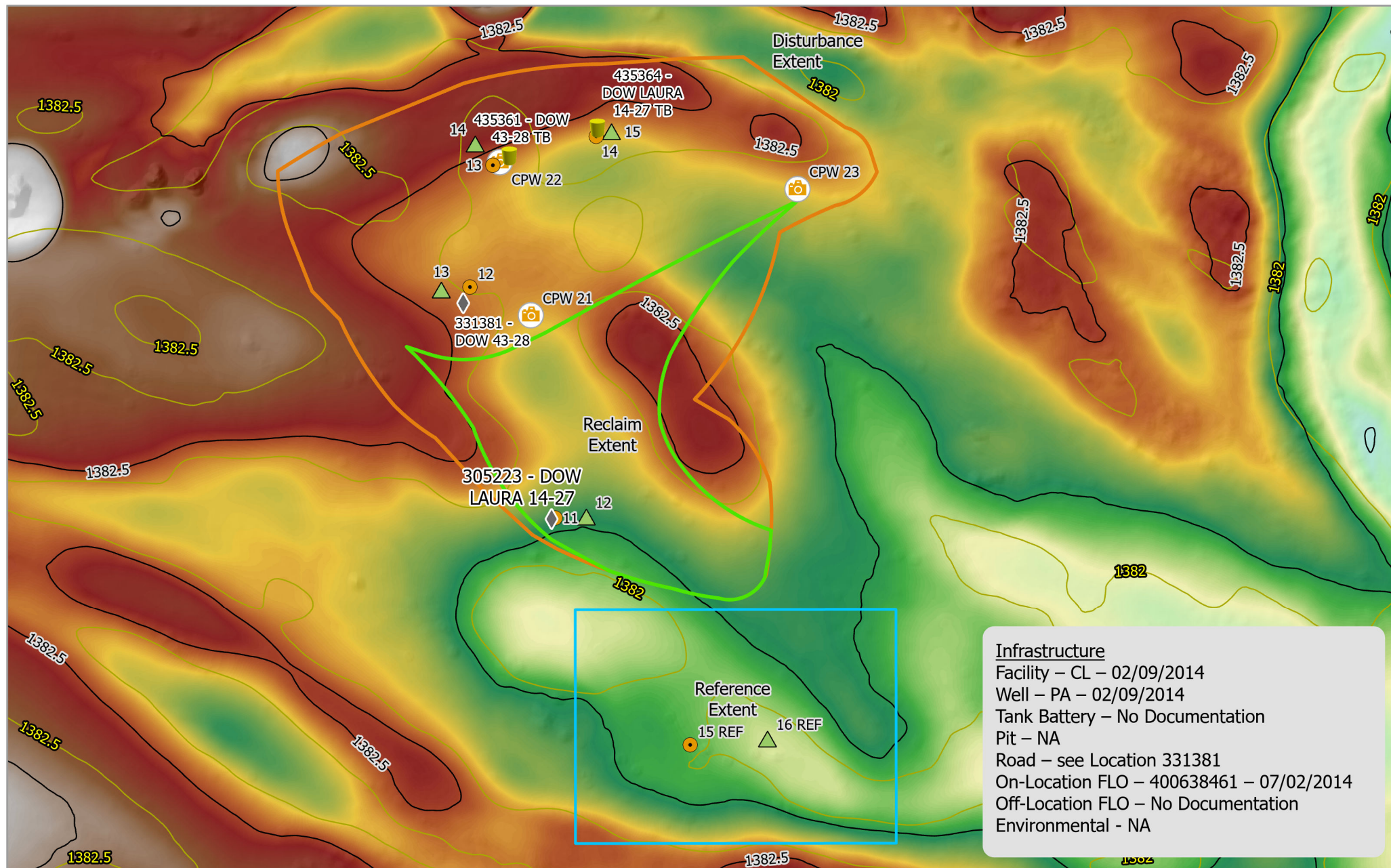
Service Credits -

CIV - 305223 - DOW LAURA 14-27 Map Extent - Overview

Imagery: RS Orthomosaic & DSM
 Imagery Date: 2 May 2023
 Map Date: 25 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage

- | | |
|----------------|----------------------|
| ◆ Well | 📷 Observation Points |
| 🛢 Tank Battery | 🔲 Disturbance Extent |
| ● Soils | 🟩 Reclaim Extent |
| ▲ Veg | 🔵 Reference Extent |





Infrastructure
 Facility – CL – 02/09/2014
 Well – PA – 02/09/2014
 Tank Battery – No Documentation
 Pit – NA
 Road – see Location 331381
 On-Location FLO – 400638461 – 07/02/2014
 Off-Location FLO – No Documentation
 Environmental - NA

CIV - 305223 - DOW LAURA 14-27 Map Extent - Elevation and Contours

Imagery: RS DSM, USGS
 Imagery Date: 2 May 2023, 2013
 Map Date: 25 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage



0.25 m Contours (2013)
 0.25 m Contours (2023)
 Disturbance Extent
 Reclaim Extent
 Reference Extent

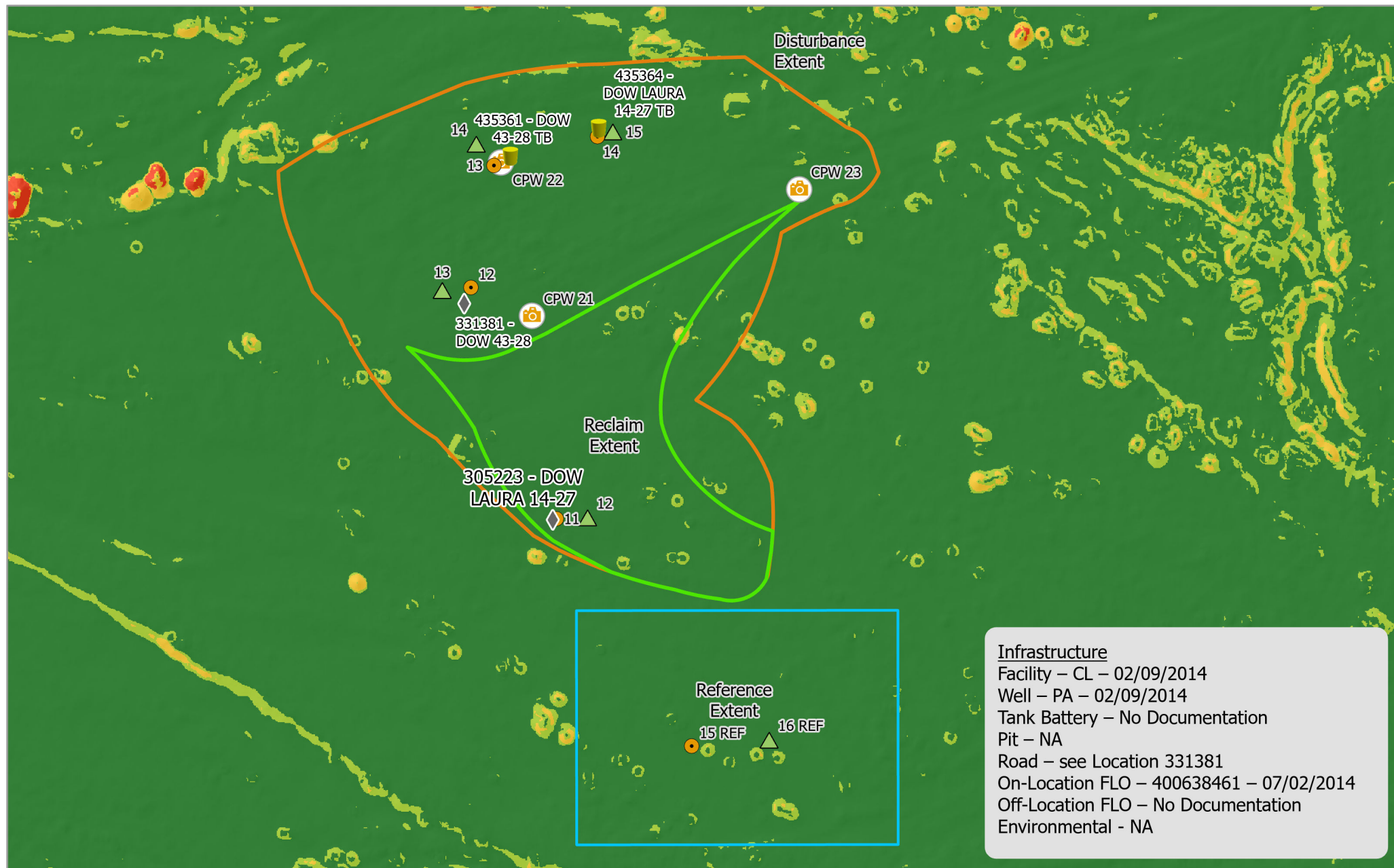
Elevation
 Meters
 1404
 1369

0 30 60 Meters

Scale: 1:1,000

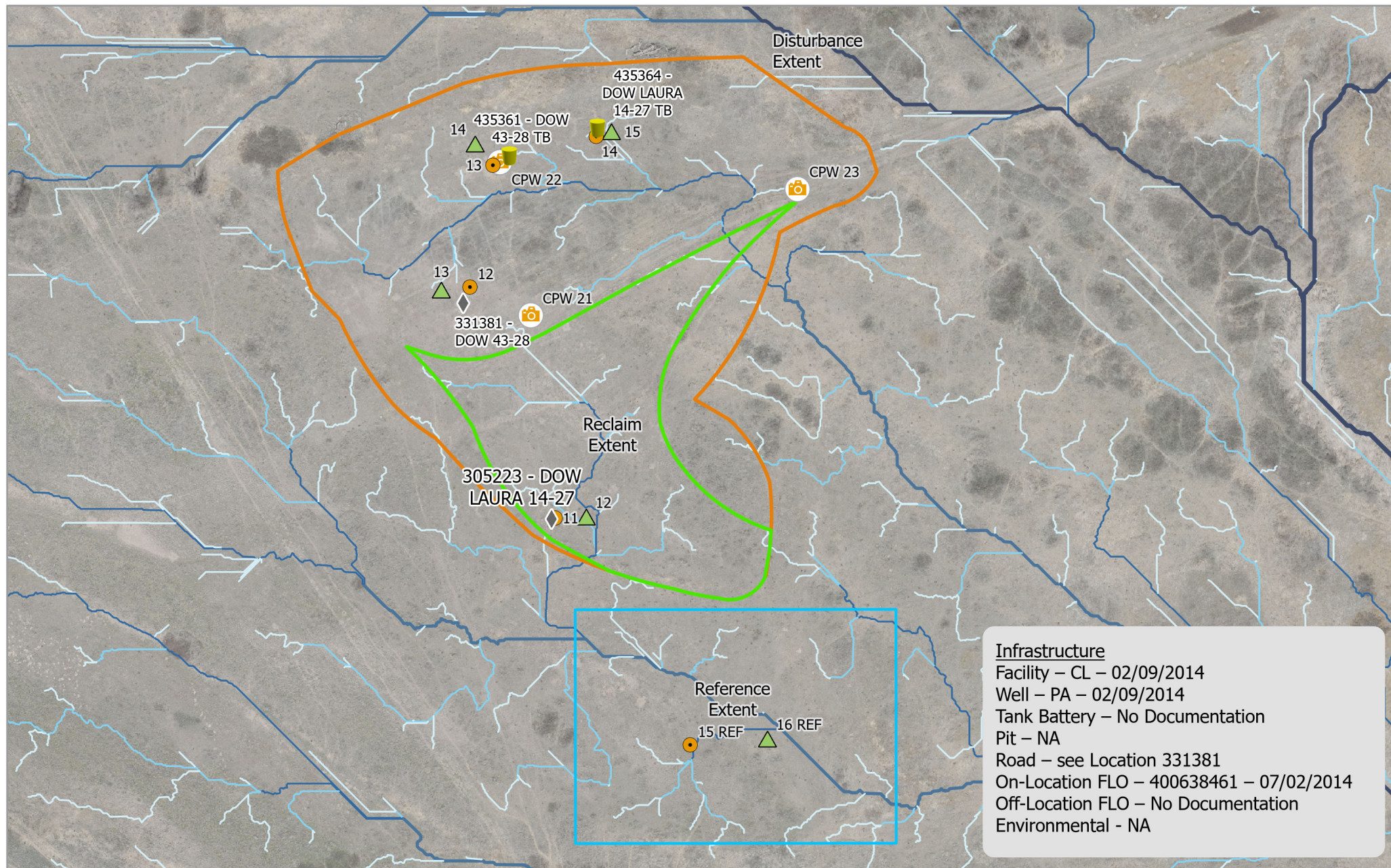
Pad Location:
 40.367970
 -104.433210





Service Credits -

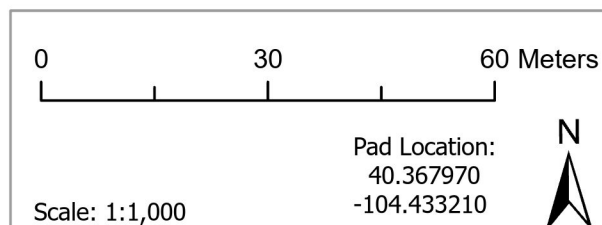
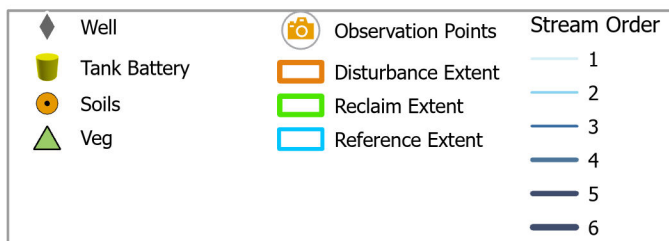


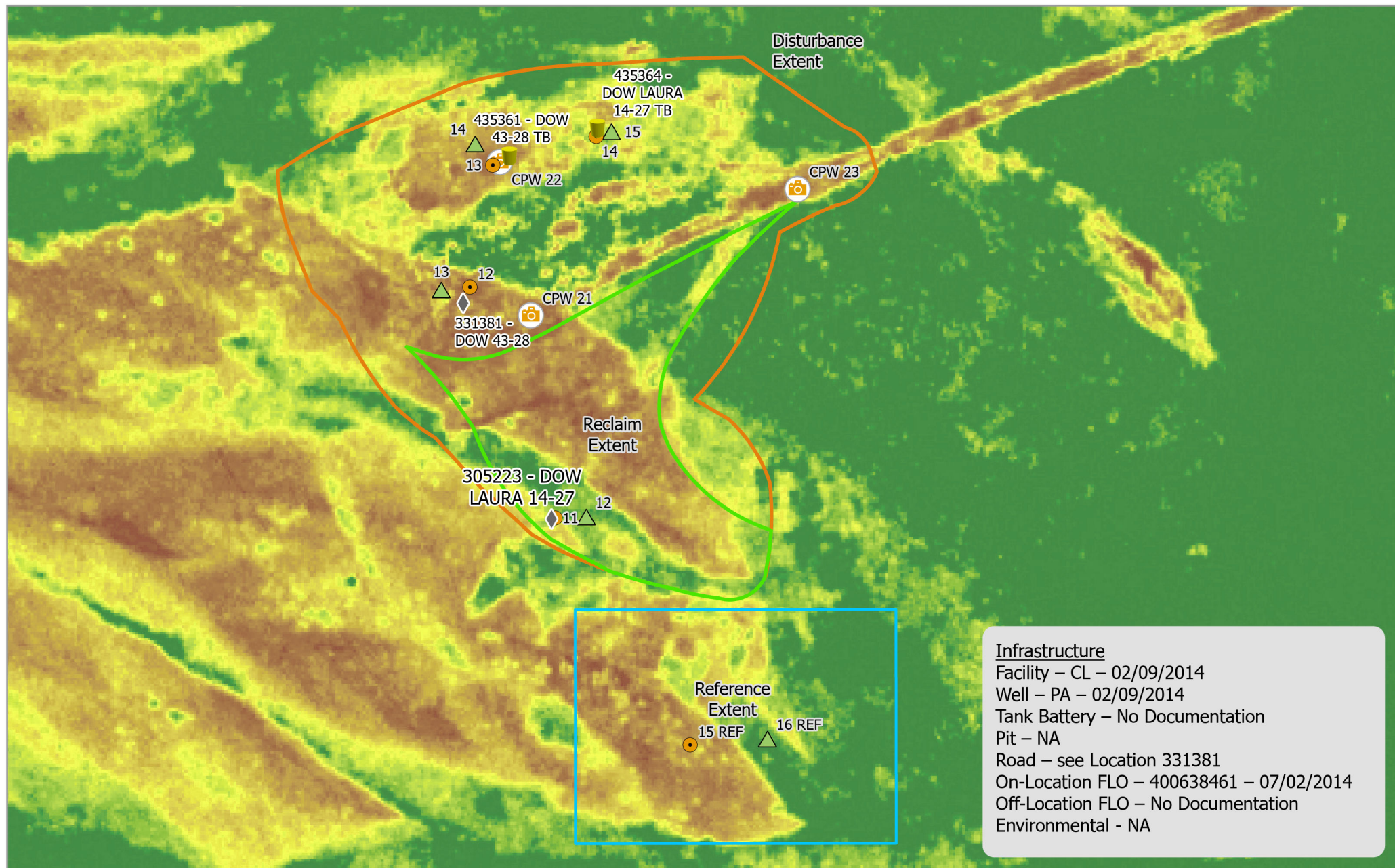


Service Credits -

CIV - 305223 - DOW LAURA 14-27 Map Extent - Hydrology

Imagery: RS Orthomosaic & DSM
 Imagery Date: 2 May 2023
 Map Date: 25 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage





Infrastructure
 Facility – CL – 02/09/2014
 Well – PA – 02/09/2014
 Tank Battery – No Documentation
 Pit – NA
 Road – see Location 331381
 On-Location FLO – 400638461 – 07/02/2014
 Off-Location FLO – No Documentation
 Environmental - NA

Service Credits - Esri, USDA Farm Service Agency



CIV - 305223 - DOW LAURA 14-27 Map Extent - NAIP NDVI Composite

Imagery: USDA NAIP
 Imagery Date: 2011-2021
 Map Date: 25 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage

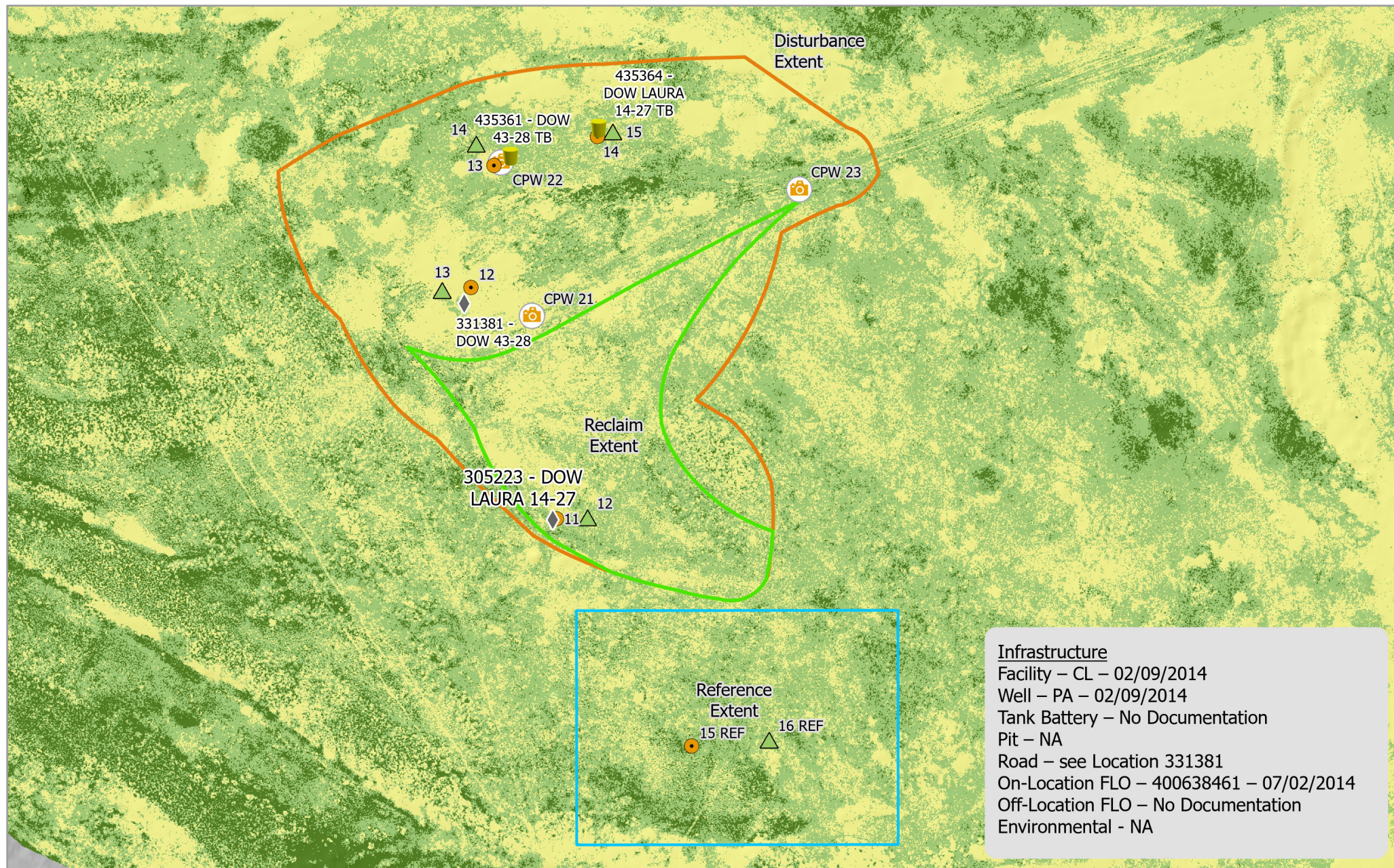
- | | |
|----------------|----------------------|
| ◆ Well | 📷 Observation Points |
| 🛢 Tank Battery | 🔲 Disturbance Extent |
| ● Soils | 🟩 Reclaim Extent |
| ▲ Veg | 🔵 Reference Extent |

0 30 60 Meters

Scale: 1:1,000

Pad Location:
 40.367970
 -104.433210





CIV - 305223 - DOW LAURA 14-27 Map Extent - NDVI

Imagery: RS Multispectral
 Imagery Date: 2 May 2023
 Map Date: 25 May 2023
 Datum: WGS 1984 UTM Zone 13N
 POC: Soil Sage

Service Credits -



CPW Soil and Vegetation

North Side Reference



Site Soils

These soils were analyzed to establish current soil physicochemical properties.

Soil Analytical Spreadsheet

Map Unit(s) – 10

The CPW_North_SoilData_17MAY2023 - contains 4 soil references.

Overview of the 0-12 inches

- Soil texture is a Sandy Loam/Loamy Sand with intermixed Sandy Clay Loam
- pH 7.5
- ECe 1.1
- Organic Matter % - 1.5
- SAR 1.4
- N-P-K – 6-38-199
- Nitrate-N Lbs/A = 11
- Sodium – 105 ppm
- Chloride – 18 ppm
- Sulfate – 64 ppm

NOTE: The native soils have elevated sodium levels in 2 of the 4 samples in the top 12 inches which has a direct correlation to the higher ECe and SAR values.

Vegetation Analysis

Ecological Site observations serve as the baseline vegetation cover.

Table represents the present cover observations.

During the time of sampling the site contained bare ground no vegetation analysis performed.

Sample Number	Bare Ground	Grass	Forbs	Shrubs	Litter	Weeds	Field Notes
8	5	20	0	0	65	10	
11	20	15	5	0	50	10	
16	10	20	0	0	60	10	

Site Average for Vegetative Cover and Total Percent Cover based on field sampling.

Grasses	Forbs	Total Percent Cover	Site Target Recovery (80%)
18	5	23	18

Weeds

Weed Summary Reference based on 2-4 May 2023 Monitoring

Common Name	Weed List Type	Percent Cover (%)
Field Bindweed	List C Noxious	10
Tansy Mustard	Common Weed	10



Site Photos – Soil 5

Lat/Long: 40.376311 / -104.442836

Nearest Facility #: 331623 and 331251

Date Range: 2-4 May 2023

Photo locations correspond with the overview map and vegetation table.

			
Soil Picture 1			Soil Picture 2 Vegetation at Soil Location




Site Photos – Soil 6

Lat/Long: 40.376343 / -104.443456

Nearest Facility #: 331623 and 331251

Date Range: 2-4 May 2023

Photo locations correspond with the overview map and vegetation table.

	
Soil Picture 1	Soil Picture 2 Vegetation at Soil Location
	

Site Photos – Soil 10

Lat/Long: 40.370999 / -104.431953

Nearest Facility #: 305671, 331381 and 305223

Date Range: 2-4 May 2023

Photo locations correspond with the overview map and vegetation table.

	
Soil Picture 1	Soil Picture 2 Vegetation at Soil Location

Site Photos – Soil 15

Lat/Long: 40.367564 / -104.432884

Nearest Facility #: 305223

Date Range: 2-4 May 2023

Photo locations correspond with the overview map and vegetation table.

	
Soil Picture 1	Soil Picture 2 Vegetation at Soil Location





Site Photos – Vegetation 8

Lat/Long: 40.371947 / -104.438097

Nearest Facility #: 331413

Date Range: 2-4 May 2023

Photo locations correspond with the overview map and vegetation table.

	
Veg	Veg - North
	
Veg - East	Veg - South

	
<p>Veg – West</p>	<p>Grass ssp.</p>
	
<p>Field Bindweed – <i>Convolvulus arvensis</i> – Colorado List C Noxious Weed</p>	

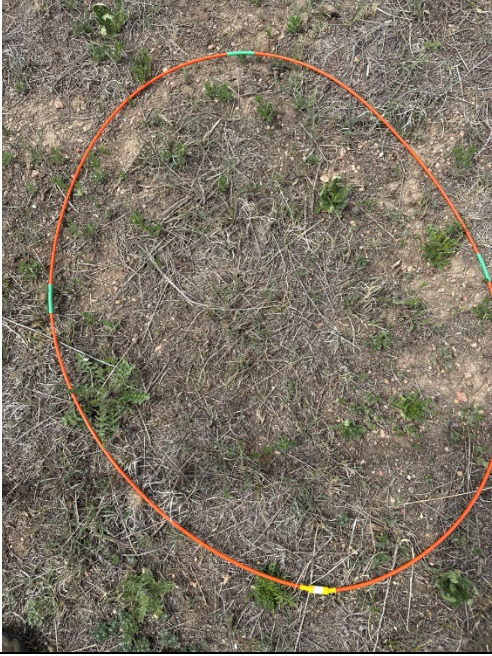



Site Photos – Vegetation 11





Lat/Long: 40.371095 / -104.431946

Nearest Facility #:

Date Range: 2-4 May 2023

Photo locations correspond with the overview map and vegetation table.

	
Veg	Veg - North
	
Veg - East	Veg - South

	
<p>Veg – West</p>	<p>Tansy Mustard – <i>Descurainia pinata</i> – Common Weed</p>
	
<p>Grass ssp.</p>	<p>Tansy Mustard – <i>Descurainia pinata</i> – Common Weed</p>





Site Photos – Vegetation 16

Lat/Long: 40.367575 / -104.432707

Nearest Facility #: 305223

Date Range: 2-4 May 2023

Photo locations correspond with the overview map and vegetation table.

					
Veg				Veg - North	
					
Veg - East				Veg - South	

	
<p>Veg – West</p>	<p>Grass ssp. and Field Bindweed – <i>Convolvulus arvensis</i> – Colorado List C Noxious Weed</p>
	
<p>Grass ssp. and Field Bindweed – <i>Convolvulus arvensis</i> – Colorado List C Noxious Weed</p>	<p>Grass ssp. and Field Bindweed – <i>Convolvulus arvensis</i> – Colorado List C Noxious Weed</p>

CPW Site Observations



North

Reference the Observation overview map

Observation 12 – ROAD - North

40.375215 / -104.43867

 A photograph showing a dirt road in a field. The road is dark brown and appears to have been recently tilled or compacted. There are patches of green vegetation and dry grass along the edges of the road. The background shows a flat landscape under a cloudy sky.	 A photograph showing a dirt road in a field, similar to the one in the left image. In the distance, a small vehicle is visible on the road. The road is dark brown and appears to have been recently tilled or compacted. There are patches of green vegetation and dry grass along the edges of the road. The background shows a flat landscape under a cloudy sky.
<p>Distinctive start of the manure application, 4-6 inches manure and compaction.</p>	



Observation 13 - ROAD- North

40.375561 / -104.440652



Manure in the top 4 inches then compaction

Observation 14 - ROAD- North

40.374259 / -104.44192



Sand and manure with compaction

Observation 15 – ROAD - North

40.372523 / -104.439919



Top 6 inches is manure, sand with compaction

Observation 16 – ROAD, CORRAL, VEHICLE TRAFFIC - North

North of the 331413

40.372919 / -104.437395



Cheatgrass and gravel



Road



OK Corral on the footprint of the disturbance



Gravel and weds

Observation 17 - ROAD - North

40.39306 / -104.43523

	
6 inches of Sandy manure with compaction	
	
Unincorporated manure	

Observation 18 - DEBRIS - North

40.372523 / -104.433646



Trash – buried cable



Trash – buried cable

Observation 19 - ROAD - North

40.371765 / -104.431303



4inches of manure with compactions



Unincorporated manure

Observation 20 – ROAD and WADDLES- North

40.369642 / -104.431193



Manure, sand, and compaction



Unincorporated manure



Waddles



Waddles



Waddles

Observation 21 – ROAD- North

40.368321 / -104.433245



Gravel on access road



Gravel on access road

Observation 22 – TANK BATTERY - North

40.36859 / -104.433314

	
Cow feeding station	Hay
	
Hay on the tank battery location	

Observation 23 - ROAD - North

40.36854 / -104.43263



Weeds and 6 inches of gravel and rock and compaction on the access road

Weeds



Gravel and rocks

Observation 26 – ROAD - North

40.3717320 / -104.4313185



Trash – Straw Waddle



Trash – Straw Waddle

Soil Properties

USDA Soil Description

Reference Soil Information

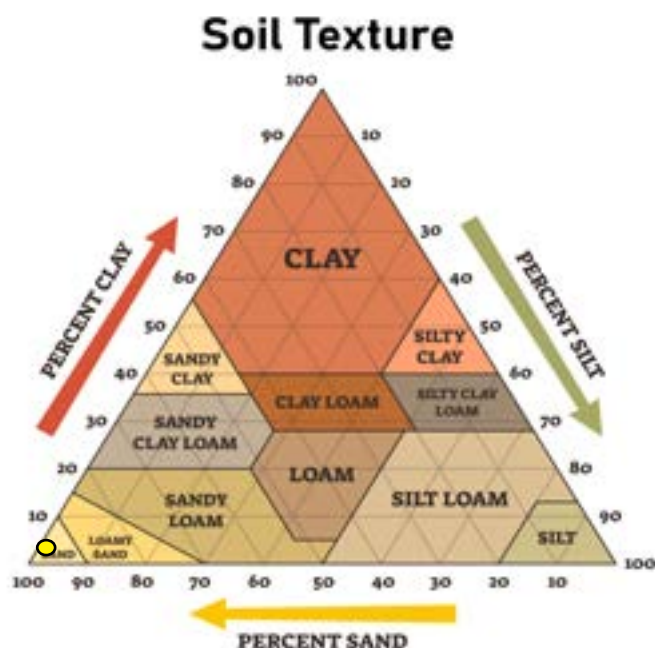
The location of the site is contained within one soil type, Ellicott-Ellicott sandy-skeletal complex.

Map Unit 10 Reference Soil information - Ellicott-Ellicott sandy-skeletal complex

This soil is formed from noncalcareous, stratified sandy alluvium. Landform is drainageways, flood plains on intermittent streams, with the Sandy Bottomland Ecological Site. Soils are excessively drained with a very low water holding capacity, and slope 0-3 percent.

Depth (in)	Physical			Chemical			
	Texture	Bulk Density	Partical Size Percent sand, silt, clay	pH	EC	SAR	OM%
0-10	Sand	1.65	95-3-2	6.5	0.1	0.0	0.35
10-20	Sand	1.64	95-4-1	7.0	0.1	0.0	0.25
20-30	Sand	1.63	95-4-1	7.2	0.1	0.0	0.25
30-40	Sand	1.63	95-4-1	7.6	0.1	0.0	0.25
40-50	Coarse Sand	1.66	95-4-1	7.6	0.1	0.0	0.25
50 +	Coard Sand	1.68	95-4-2	7.6	0.1	0.0	0.25

Soil Texture Triangle reflect the 0-10 in depth



Erosion Potential (10 inches)

- K Factor, Whole soil - .02. Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.
- Wind Erodibility Group – 1. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible.

Soil Reference Information

There is a general relationship of soil bulk density to root growth based on soil texture. Bulk densities ideal for root growth are less than 1.60 g/cc for sandy textures, less than 1.40 g/cc for loamy textures, and less than 1.10 g/cc for clayey textures. Bulk densities that restrict root growth are greater than 1.80 g/cc for sandy textures, 1.65 g/cc for loamy textures, and 1.47 g/cc for clayey textures.

Vegetation

Reference vegetation – Sandy Bottomland Ecology

Climate

Average Annual Precipitation 14 to 17 inches annually - average 15 inches

Average Annual Air Temperature ranges from 48 to 52 degrees F

Drought conditions in effect

Long-term effects of these latest drought events have yet to be determined. Growth of native cool-season plants begin about April 1 and continue to mid-June. Native warm-season plants begin growth about May 1 and continue to about August 15. Regrowth of cool-season plants occur in September in most years, depending on moisture.

Reference dynamics

The Reference State is characterized by a dominance of warm-season tallgrasses (sand bluestem, prairie sandreed, and switchgrass). The Shrub State is dominated by sand sagebrush and a minor component of understory species (sand dropseed, Fendler threeawn). The Eroded State is characterized by annual forbs and grasses (sunflower, kochia, Russian thistle, cheatgrass) and early successional plants (sandhill muhly, sand dropseed, Fendler threeawn, and lemon scurfpea).

Drought has increased mortality of blue grama and other bunchgrasses significantly in some locales.

Principle dominants are sand bluestem, prairie sandreed, and switchgrass. Subdominant grasses include needle and thread, blue grama, little bluestem, and western wheatgrass. Significant forbs and shrubs are pacific peavine, evening primrose, prairie clovers, leadplant and western sandcherry. Cottonwoods may be present. The potential vegetation is about 70-85% grasses or grass-like plants, 8-15% forbs and 7-15% shrubs.

Carbon sequestration is greatly reduced.

Reference Vegetation – Sandy Bottomland Ecology

At Risk Plant Community

Key species from the Reference Plant Community, Sand bluestem, prairie sandreed, switchgrass, western sandcherry and leadplant have decreased in frequency and production. Blue grama and sand sagebrush have increased. Sand dropseed, Fendler threeawn, slimflower scurfpea, and Cuman ragweed (western ragweed) have also increased.

The risk of losing some of the tallgrass species, palatable forbs and shrubs. The reduction of tallgrass species, nitrogen-fixing forbs, key shrub component and increased warm-season shortgrass has altered the biotic integrity of this plant community. Nutrient cycle, water cycle and energy flow are at risk of becoming impaired.

Vegetation

Sandy Bottomland Ecosystem Vegetative Community Composition

Common Name	Scientific Name
Sand Bluestem	<i>Andropogon hallii</i>
Prairie Sandreed	<i>Calamovilfa longifolia</i>
Switchgrass	<i>Panicum virgatum</i>
Indiangrass	<i>Sorghastrum nutans</i>
Needle and Thread	<i>Hesperostipa comata</i> ssp. <i>comata</i>
Blue Grama	<i>Bouteloua gracilis</i>
Western Wheatgrass	<i>Pascopyrum smithii</i>
Little Bluestem	<i>Schizachyrium scoparium</i>
Sideoats Grama	<i>Bouteloua curtipendula</i>
Sand Dropseed	<i>Sporobolus cryptandrus</i>
Indian Ricegrass	<i>Achnatherum hymenoides</i>
Hairy Grama	<i>Bouteloua hirsuta</i>
Prairie Junegrass	<i>Koeleria macrantha</i>
Saltgrass	<i>Distichlis spicata</i>
Sixweeks Fescue	<i>Vulpia octoflora</i>
Sand Bluestem	<i>Andropogon hallii</i>
Switchgrass	<i>Panicum virgatum</i>
Indiangrass	<i>Sorghastrum nutans</i>
Manystem Pea	<i>Lathyrus polymorphus</i>
Dotted Blazing Star	<i>Liatris punctata</i>
Purple Prairie Clover	<i>Dalea purpurea</i> var. <i>purpurea</i>
Broadbeard Beardtongue	<i>Penstemon angustifolius</i>
Upright Prairie Coneflower	<i>Ratibida columnifera</i>
Scarlet Globemallow	<i>Sphaeralcea coccinea</i>
White Heath Aster	<i>Symphyotrichum ericoides</i> var. <i>ericoides</i>
Annual Buckwheat	<i>Eriogonum annuum</i>
White Sagebrush	<i>Artemisia ludoviciana</i>
Painted Milkvetch	<i>Atragalus ceramicus</i> var. <i>filifolius</i>

Change Detection

Normalized Difference Vegetation (NDVI)

Section will primarily focus on the NDVI imagery for vegetation reference and current analytics.

The composite NAIP NDVI imagery from 2010-2020, this data set does not contain the NDVI values to perform statistical analysis. The imagery foot print encompasses the site extent and a vegetation reference extent for vegetative analysis.

Remotely sensed data was gathered on 2 - 4 May 2023, which reflects the current vegetative cover statistics.

NDVI calculations used the Near Infrared from the multispectral sensors. The NDVI reflects the measurements from the plant's topmost layer of leaves, typically used during spring emergence into mid-season growth.