

SITE EVALUATION REPORT



SITE DESCRIPTION

CLIENT - CIVITAS Resources

SOIL SAGE

DATE: 31 Jul 2022

Operator/#	BONANZA CREEK ENERGY OPERATING COMPANY LLC 8960	County / State	Weld, CO
Location ID / Name	420769 - Antelope / 23-19 Pad	Field ID	Wattenberg - #90750
Facility Status	TA	Status Date	1/15/2019
Disturbance Extent	.37	Pad Extent / Acres	.37
Reclaimed Extent / Acres	.18	Reference Extent/ Acres	.28
Reclaim Weed Percent	1	Reference Weed Percent	7

Reference Descriptions

Coordinates

40.383030

Lat/Long

-104.367910

Imagery

Chronological

2017 – NAIP Imagery from Weld County, Colorado

2019 – NAIP Imagery from Weld County, Colorado

2022 – Remotely Sensed Imagery Ortho, DSM, NDVI and NDRE

Map List

NAIP 2017

NAIP 2019

NAIP 2010 - 2019 NDVI Composite

2022 RS Overview

2022 RS Elevation Contour

2022 RS Slope

2022 RS Hydrology

2022 RS NDVI

2022 RS NDRE

Landscape Summary

2017 – NAIP Imagery

- Landuse mixed use, infrastructure from previous land use activity, well location present

2019 – NAIP Imagery

- Landuse mixed use, infrastructure from previous land use activity, well location present

2022 – Drone imagery from 9 Jun 2022 – orthomosaic and DSM

- Landuse mixed use, non-agricultural – full pad extent detectable with reclamation area present
- Slope - majority of the extent is within the original 0-6% slope range – slopes greater than 10% are present East of the reclaim site
- Contouring lines 1m
- Elevation gradients 1339 - 1397 meter (4393 - 4583 feet)

2022 – Drone imagery from 9 Jun 2022 – NDVI and NDRE (vegetation analysis)

Soil Properties

USDA Soil Description

Reference Soil Information

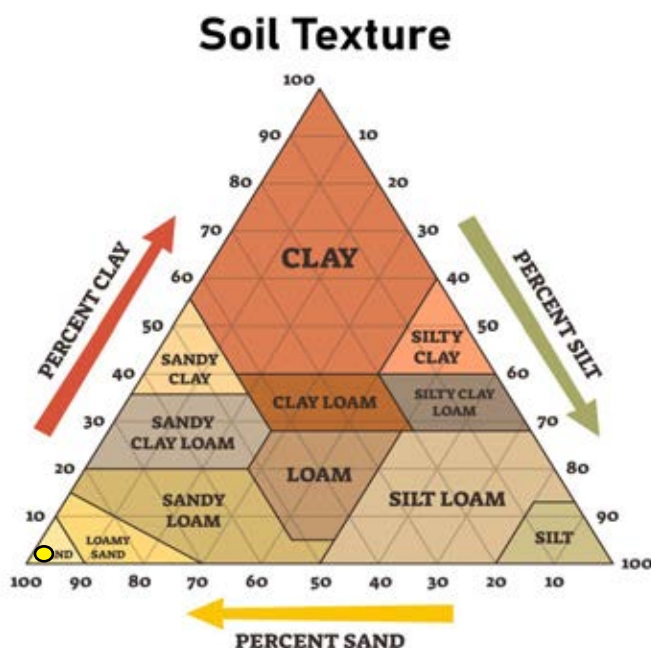
The location of the site is contained within one soil type, Valent sand at two different slopes.

Map Unit 69 Reference Soil information - Valent sand

This soil is formed from noncalcareous eolian sands. Landform is interdunes, with the Deep Sand 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	1.63	96-1-3	6.8	0.1	0.0	0.71
10-20	Sand	1.62	97-1-2	7.0	0.1	0.0	0.26
20-30	Sand	1.62	97-1-2	7.0	0.1	0.0	0.20
30-40	Sand	1.64	97-1-2	7.2	0.1	0.0	0.10
40-50	Sand	1.64	97-1-2	7.2	0.1	0.0	0.10
50 +	Sand	1.64	97-1-2	7.2	0.1	0.0	0.10

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 Properties

USDA Soil Description

Reference Soil Information

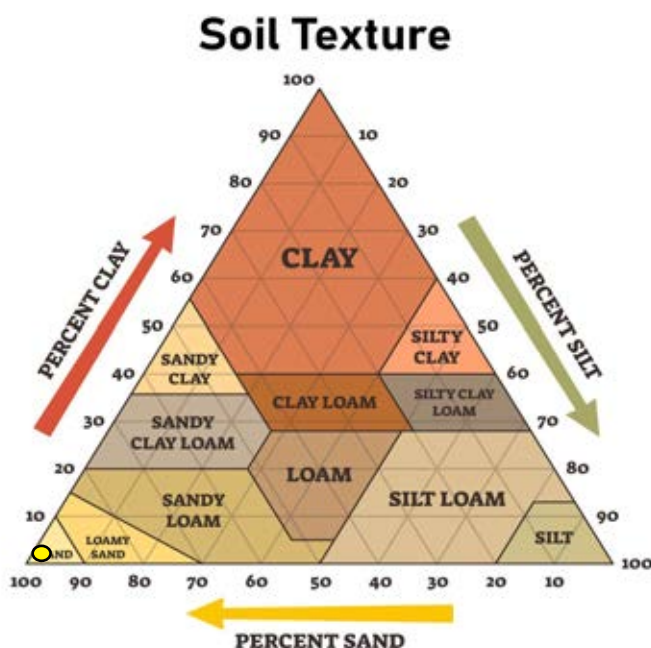
The location of the site is contained within one soil type, Valent sand at two different slopes.

Map Unit 70 Reference Soil information - Valent sand

This soil is formed from noncalcareous eolian sands. Landform is dunes, hills, with the Deep Sand Ecological Site. Soils are excessively drained with a very low water holding capacity, and slope 3-9 percent.

Depth (in)	Physical			Chemical			
	Texture	Bulk Density	Partical Size Percent sand, silt, clay	pH	EC	SAR	OM%
0-10	Sand	1.63	96-1-3	6.8	0.1	0.0	0.71
10-20	Sand	1.63	97-1-2	7.0	0.1	0.0	0.26
20-30	Sand	1.63	97-1-2	7.0	0.1	0.0	0.20
30-40	Sand	1.63	97-1-2	7.2	0.1	0.0	0.10
40-50	Sand	1.63	97-1-2	7.2	0.1	0.0	0.10
50 +	Sand	1.63	97-1-2	7.2	0.1	0.0	0.10

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 – Deep Sand 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 tall grasses (sand bluestem, prairie sandreed, switchgrass, and Indiangrass). The Shrub State is dominated by sand sagebrush and a minor component of under story species. The Eroded State is characterized by annual forbs and grasses (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.

Dominants are sand bluestem, prairie sandreed, switchgrass and Indiangrass. Sub-dominant grasses include needle and thread, blue grama and little bluestem. Significant forbs and shrubs are pacific peavine, prairie clovers, dotted blazing star (aka dotted gayfeather), leadplant, western sandcherry, and sand sagebrush. The potential vegetation is about 70-85% grasses and grass-like plants, 8-15% forbs and 7-15% woody plants.

Not well suited for carbon sequestration.

Reference Vegetation – Deep Sand Ecology

At Risk Plant Community

Key species from the Reference Plant Community, sand bluestem, prairie sandreed, yellow Indiangrass, switchgrass, western sandcherry and leadplant have decreased in frequency and production. Blue grama and sand sagebrush are the dominant species. Sand dropseed, red threeawn, slimflower scurfpea, hairy goldenaster, croton, western ragweed, stickleaf, lupine, loco, and milkvetch have also increased.

The risk of losing some of the tall grass species, palatable forbs and shrubs. The reduction of tall grass 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 may be impaired. It will require considerable time and expense to return this community once it crosses a threshold to the shrub state.

Vegetation

Deep Sand Ecosystem Vegetative Community Composition

Common Name	Scientific Name
Prairie Sandreed	<i>Calamovilfa longifolia</i>
Sand Bluestem	<i>Andropogon hallii</i>
Switchgrass	<i>Panicum virgatum</i>
Indiangrass	<i>Sorghastrum nutans</i>
Blowout grass	<i>Redfeldia flexuosa</i>
Little Bluestem	<i>Schizachyrium scoparium</i>
Sideoats Grama	<i>Bouteloua curtipendula</i>
Sand Dropseed	<i>Sporobuolus cryptandrus</i>
Blue grama	<i>Bouteloua gracilis</i>
Western Wheatgrass	<i>Elymus lanceolatus</i> ssp. <i>lanceolatus</i>
Needle and Thread	<i>Hesperostipa comata</i> ssp. <i>comata</i>
Indian ricegrass	<i>Achnatherum hymenoides</i>
Suirrealtail	<i>Elymus elymoides</i> ssp. <i>elymoides</i>
Purple Prairie Clover	<i>Dalea purpurea</i> var. <i>purpurea</i>
Painted Milkvetch	<i>Astragalus ceramicus</i> var. <i>filifolius</i>
White Prairie Clover	<i>Dalea candida</i>
Dotted Blazing Star	<i>Liatris punctata</i>
Whitest Evening Primrose	<i>Oenothera albicaulis</i>
Upright Prairie Coneflower	<i>Ratibida coumnera</i>
Broadbeard beardtongue	<i>Penstemon angustifolius</i>
Scarlet Globemallow	<i>Sphaeralcea coccinea</i>
Annual Buckwheat	<i>Eriogonum annuum</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 2010-2019, 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 9 Jun 2022, which reflects the current vegetative cover statistics.

NDVI calculations used the Near Infrared and Red bands and the NDRE used the RedEdge band and the Near Infrared from the multispectral sensors. The NDVI reflects the measurements from plants topmost layer of leaves, typically used during spring emergence into mid-season growth. The NDRE reflects the measurements from permanent or later stage growth due to it's ability to measure further down into the canopy. Both analytics were calculated to establish the baseline.

The percent cover calculations reflect the vegetation from the reference area and the reclaimed area. The data reflects 5 bands of reflectance. Classes reflect vegetative and non-vegetative areas. The recovery matrix, which is 80% of the reference vegetation were calculated. The recovery calculation indicate the current rate of recovery at the time of sampling.

All measurements are based on the reclaimed area, the reference area extent and the weed inventory at the time of analysis.

NDVI - NDRE Stats Antelope 23-19
Jun-22

Type	NDVI Class	Reference Percent Cover	Class Sum	Target Recovery 80%	Target - Weeds 7%	Reclaimed Percent Cover	Class Sum	Deficit/Surplus
Veg	1	0.23				0.12		
Veg	2	1.04	1.27	1.02	0.94	0.52	0.65	-0.30
Non-Veg	3	3.45				2.29		
Non-Veg	4	24.32				17.35		
Non-Veg	5	71.53	95.85			80.05	99.69	

NDVI Red Edge
Jun-22

Type	NDRE Class	Reference Percent Cover	Class Sum	Target Recovery 80%	Target - Weeds 7%	Reclaimed Percent Cover	Class Sum	Deficit/Surplus
Veg	1	0.04				0.04		
Veg	2	0.59	0.63	0.50	0.47	0.32	0.36	-0.11
Non-Veg	3	3.43				2.00		
Non-Veg	4	26.41				18.06		
Non-Veg	5	70.11	99.95			79.92	99.98	

Weed Inventory	Class	Reclaimed Percent Cover	Class Sum	Weed Cover 1%	Reclaimed Class Sum	NDVI Actual	Actual - Target %
Veg	1	0.12					
Veg	2	0.52	0.65	0.01	0.65	0.64	-0.30
Non-Veg	3	2.29					
Non-Veg	4	17.35					
Non-Veg	5	80.05	99.69				

Recommendations

Monitoring Change Over Time

Data of Sampling – 9 Jun 2022

Vegetation

The site evaluation results indicate the reference vegetative recovery target for NDVI reflected 0.94% and the reference vegetation recovery target for NDRE reflected 0.47%. The recovery status for the reclaim extent was at a .30% deficit for NDVI and 0.11% deficit for NDRE. These data are based on spring emergence values and not permanent/late season plant growth.

The site evaluation indicates the presents of weeds within the reclaim extent that have a percent cover of 7%, reflecting an actual .30% deficit in the recovery rate for NDVI in the spring observation (June).

The target recovery was based on one reference extents that fall within the same soil types. Typical land use was observed in this area similar vegetation properties.

Recommendation

Due to the very low vegetation in the surrounding area and there are no noxious weeds present.

Reference Extent Vegetation Observations

Native or Endemic in the surrounding area

Percent cover is determined using random sampling methods within the vegetation extent and using a sampling hoop of 0.5 sq meters in size.

Bractless Blazingstar - *Mentzelia nuda* - 5%

Invasive

Russian Thistle – *Salsola tragus* L. – 1%

Sunflower - *Helianthus annuus* - 5%

Western Ragweed - *Ambrosia psilostachya* - 1%

Recovery Extent Vegetation Observations

Native or Endemic

Bractless Blazingstar - *Mentzelia nuda* - 2%

Unidentifiable Native Grass - 2%

Invasive

Sunflower - *Helianthus annuus* - 1%

Weed Summary Reference

Common Name	Weed List Type	Percent Cover (%)
Russian Thistle	Common	1
Sunflowers	Common	5
Western Ragweed	Common	1

Weed Summary Recovery

Common Name	Weed List Type	Percent Cover (%)
Sunflowers	Common	1

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 - Designed 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

Weed Pressure

Current weed pressure is dominated by common Sunflowers. The total calculated percent of weed coverage is ~1%. This occurs primarily within the main reclaim extent and is 6% lower than the reference area weed pressure.

Weeds in the reference extent are Russian Thistle, sunflowers and Western Ragweed. Weed pressure in the reference extent is ~7%.

Weed percentages have been accounted for in the Vegetation Section above.

Hydrology

Hydrology – Stream Orders 1 – 5 are present - dominant streams are orders are 1, 2 and 3. Order 3-5 are present in locations that have the potential for soil erosion represented by gully and rilling that follow the relic land use activities. These could be major runoff areas for gully and soil erosion with heavy precipitation events. Soil texture in the area is primarily sanding.

Ponding - potential ponding can occurring were water follows the elevation gradients in low lying areas from previous land use activities. The flow directions is primarily from East to West.

Soil/Erosion

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

Site Recommendation & Re-Evaluation

The site vegetation recovery rate is statically equivalent to the reference extent due to lack of vegetation and relic land use. The weed pressure within the reclaim extent is primarily from Sunflowers, which are common weed. The present of Russian Thistle, Sunflowers and Western Ragweed in the reference extent is higher than the reclaim extent. Bare ground is also equivalent to the reference extent.

Recommend this site for permit closure.

Seed Mix

Vegetation Seed Mix

No additional reclamation procedures are recommended at this time.

Deep Sand Ecosystem

	Common Name	Scientific Name	#PLS/Acre	% of Mix
Grasses	Needle and Thread	<i>Hesperostipa comata</i>	2	8
	Sand Bluestem	<i>Andropogon hallii</i>	3	13
	Prairie Sandreed	<i>Calamovilfa longifolia</i>	4	17
	Blue Grama	<i>Bouteloua gracilis</i>	2	8
	Western Wheatgrass	<i>Pascopyrum smithii</i>	0.2	1
	Switchgrass	<i>Panicum virgatum L.</i>	5	21
	Sideoats Grama	<i>Bouteloua curtipendula</i>	2	8
	Purple Prairie Clover	<i>Dalea purpurea</i>	0.2	1
Forbs/Legumes	Scarlet Globemallow	<i>Sphaeralcea coccinea</i>	0.1	0
	Buckwheat	<i>Eriogonum spp.</i>	5	21
	Fourwing Saltbrush	<i>Atriplex canescens</i>	0.5	2
Total	Total		24	100

NOTE: The above 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.

Reclaim Area Protocol

Time Frame	Activity	Specifications	Site Totals
Jun 2022	Monitoring	Common weeds Present	6 Jun 2022 – Submitted Weed Control Recommendations
Aug 2022	Permit Closure		.28 acres

Site Photos

Reference

40.383057, -104.368142



North



East

Soil Sage



South



West

Soil Sage



Vegetation

Soil Sage

Native or Endemic



Bractless Blazingstar - *Mentzelia nuda*

Soil Sage

Invasive



Russian Thistle - *Salsola tragus* L.

Sunflower - *Helianthus annuus*



Western Ragweed - *Ambrosia psilostachya*

Recovery

40.383239, -104.367943



North



East



South



West

Soil Sage



Vegetation

Soil Sage

Native or Endemic



Bractless Blazingstar - *Mentzelia nuda*



Unidentifiable Native Grass

Invasive



Sunflower - *Helianthus annuus*

Weeds



Russian Thistle - *Salsola tragus* L.



Sunflower - *Helianthus annuus*



Western Ragweed - *Ambrosia psilostachya*

Site Overview Photo's

Date – 9 Jun 2022

Cardinal Direction – in order from NESW



North



East



South



West



CIV - 420769 - Antelope 23-19
Map Extent - USDA NAIP 2017

Imagery: USDA NAIP
Imagery Date: 2017
Map Date: 02 Aug 2022
Datum: NAD_1983_UTM_Zone_13N
POC: Soil Sage

Legend

☆	Wells	 	Road & Pad Extent
	Reclaim Point	 	Reclaim Extent
	Reference Point	 	Reference Extent

000.010.02 Miles

Scale: 1:463

Pad Location:
40.383030
-104.367910





CIV - 420769 - Antelope 23-19
Map Extent - USDA NAIP 2019

Imagery: USDA NAIP
Imagery Date: 2019
Map Date: 02 Aug 2022
Datum: NAD_1983_UTM_Zone_13N
POC: Soil Sage

Legend

☆	Wells		Road & Pad Extent
	Reclaim Point		Reclaim Extent
	Reference Point		Reference Extent

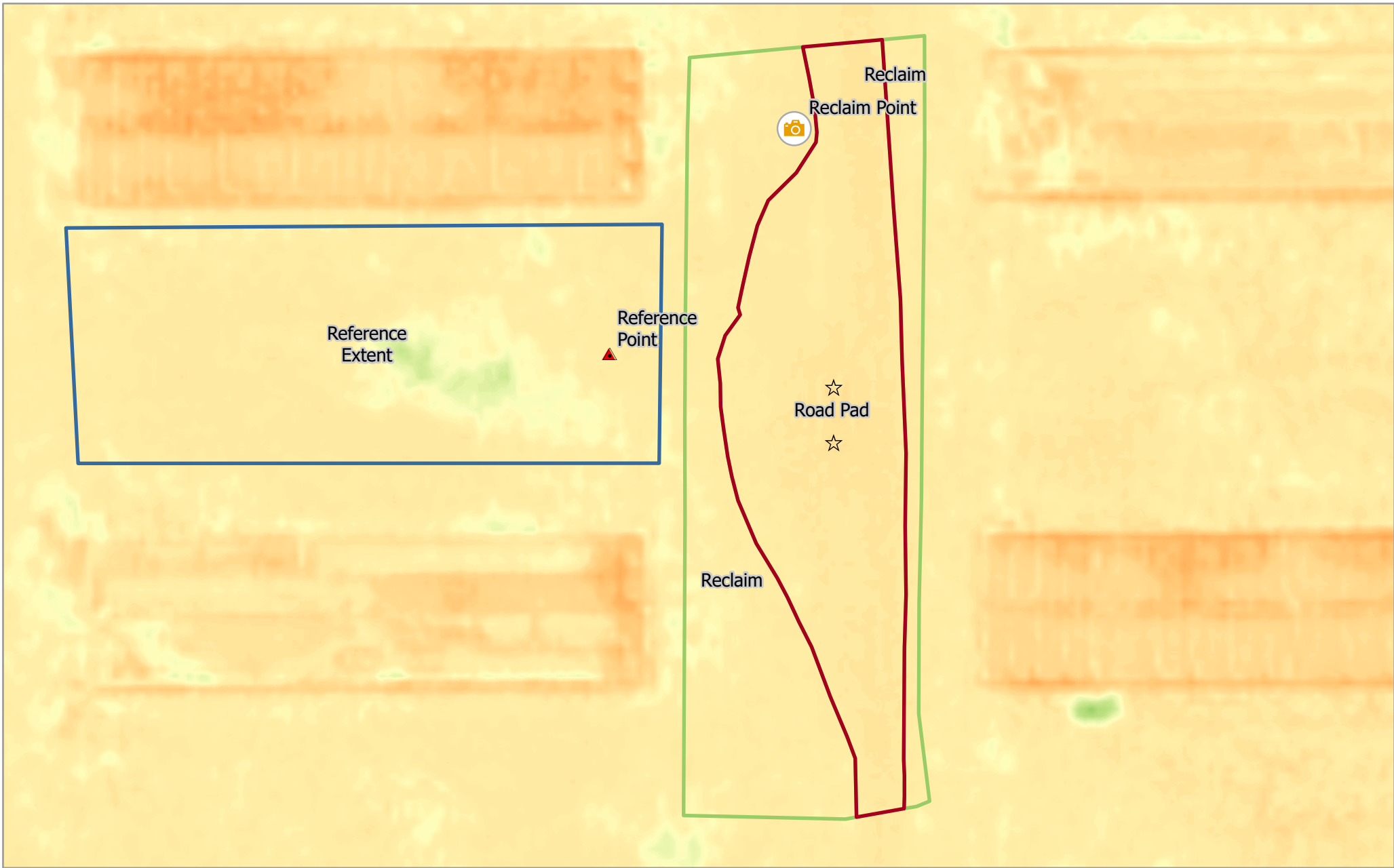
00.010.02 Miles

Scale: 1:463

Pad Location:
40.383030
-104.367910

Service Credits -





CIV - 420769 - Antelope 23-19
Map Extent - USDA NAIP Composite

Imagery: USDA NAIP
 Imagery Date: 2010 - 2019
 Map Date: 02 Aug 2022
 Datum: NAD_1983_UTM_Zone_13N
 POC: Soil Sage

Legend

- ☆ Wells
- 📷 Reclaim Point
- ▲ Reference Point
- 📏 Road & Pad Extent
- 📏 Reclaim Extent
- 📏 Reference Extent

0 0 0.01 0.02 Miles

Scale: 1:463

Pad Location:
 40.383030
 -104.367910

N



CIV - 420769 - Antelope 23-19
Map Extent - Overview

Imagery: RS Orthomosaic & DSM
 Imagery Date: 9 Jun 2022
 Map Date: 02 Aug 2022
 Datum: NAD_1983_UTM_Zone_13N
 POC: Soil Sage

Legend

☆ Wells

Reclaim Point

Reference Point

Road & Pad Extent

Reclaim Extent

Reference Extent

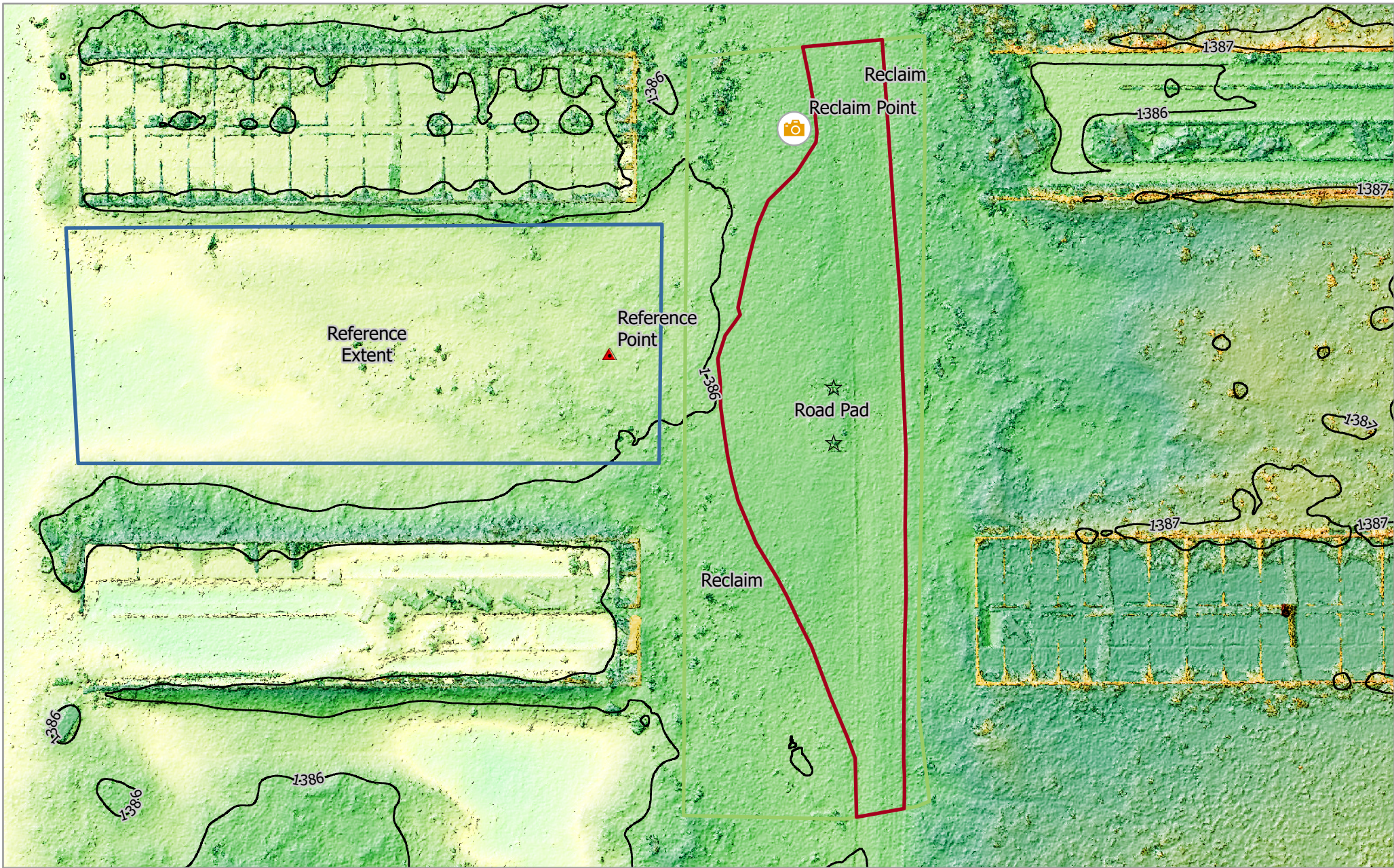
Soil Survey

0 0 0.01 0.02 Miles

Scale: 1:463

Pad Location:
40.383030
-104.367910



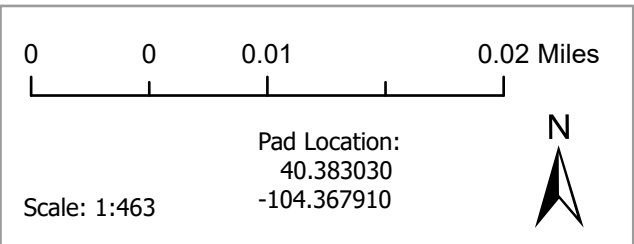


CIV - 420769 - Antelope 23-19
Map Extent - Elevation & Contours

Imagery: RS Orthomosaic & DSM
 Imagery Date: 9 Jun 2022
 Map Date: 02 Aug 2022
 Datum: NAD_1983_UTM_Zone_13N
 POC: Soil Sage

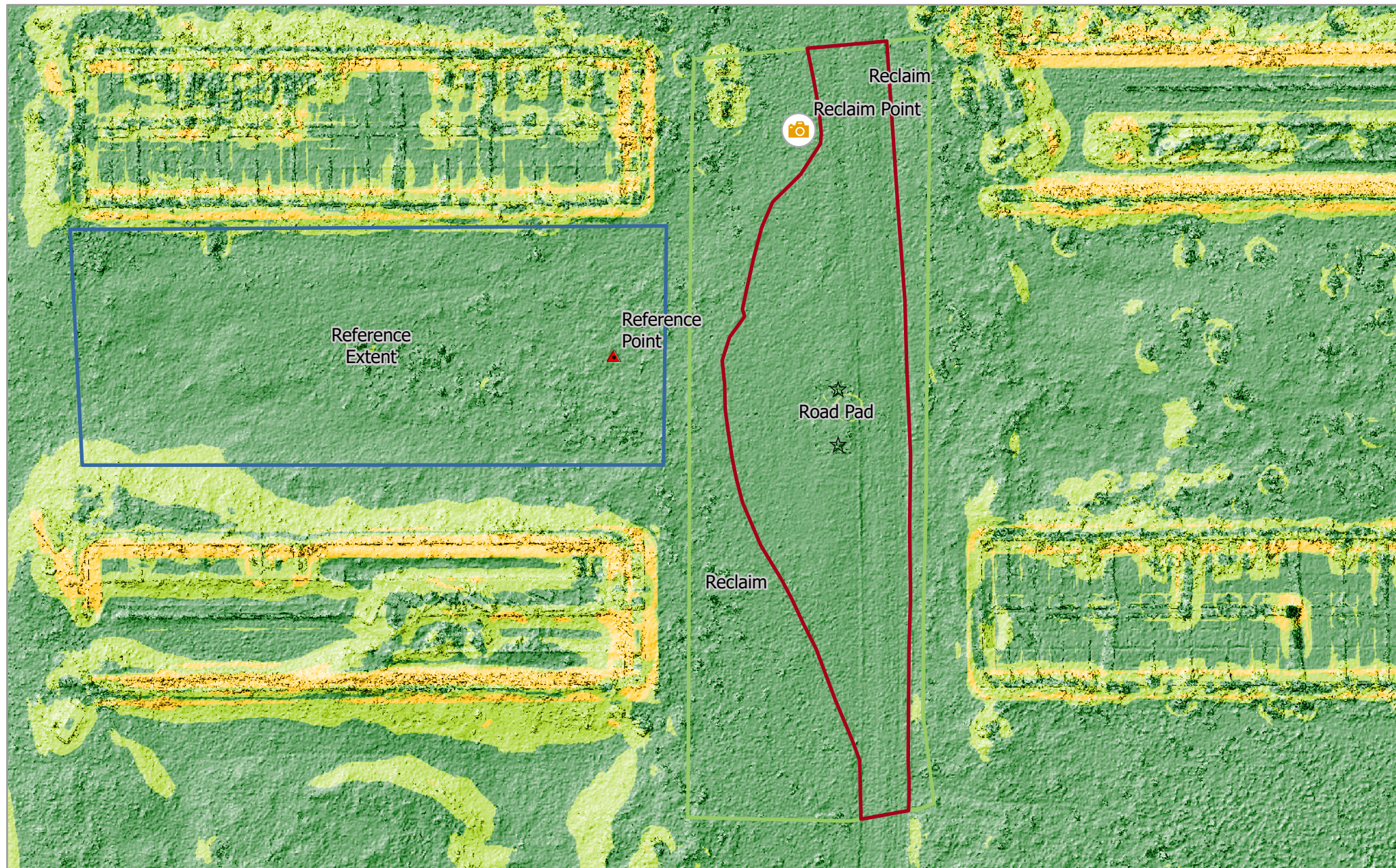
Legend

- ☆ Wells
- 📷 Reclaim Point
- ▲ Reference Point
- 📏 Road & Pad Extent
- 📏 Reclaim Extent
- 📏 Reference Extent
- 📏 Contour 1m
- Elevation Meters
- 1397
- 1339



Pad Location:
 40.383030
 -104.367910

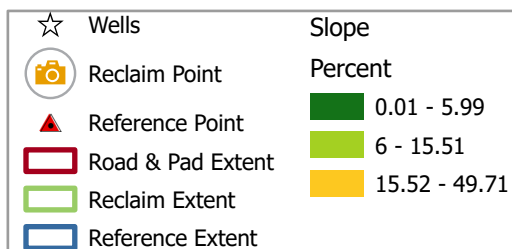




Service Credits -

CIV - 420769 - Antelope 23-19 Map Extent - Slope

Imagery: RS Orthomosaic & DSM
Imagery Date: 9 Jun 2022
Map Date: 02 Aug 2022
Datum: NAD_1983_UTM_Zone_13N
POC: Soil Sage

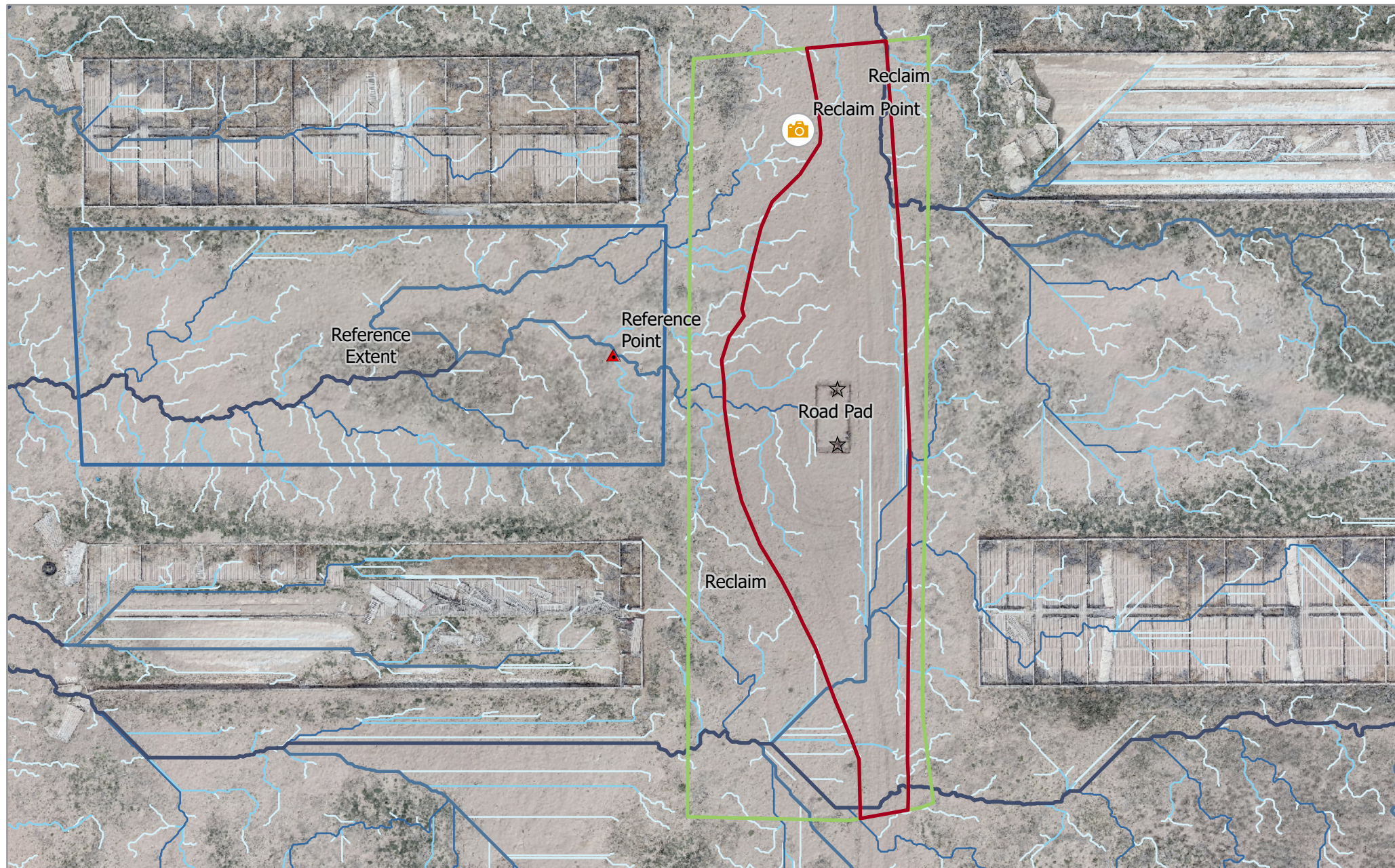


0 0 0.01 0.02 Miles

Scale: 1:463

Pad Location:
40.383030
-104.367910





Service Credits -

CIV - 420769 - Antelope 23-19 Map Extent - Hydrology

Imagery: RS Orthomosaic & DSM
Imagery Date: 9 Jun 2022
Map Date: 02 Aug 2022
Datum: NAD_1983_UTM_Zone_13N
POC: Soil Sage

Legend

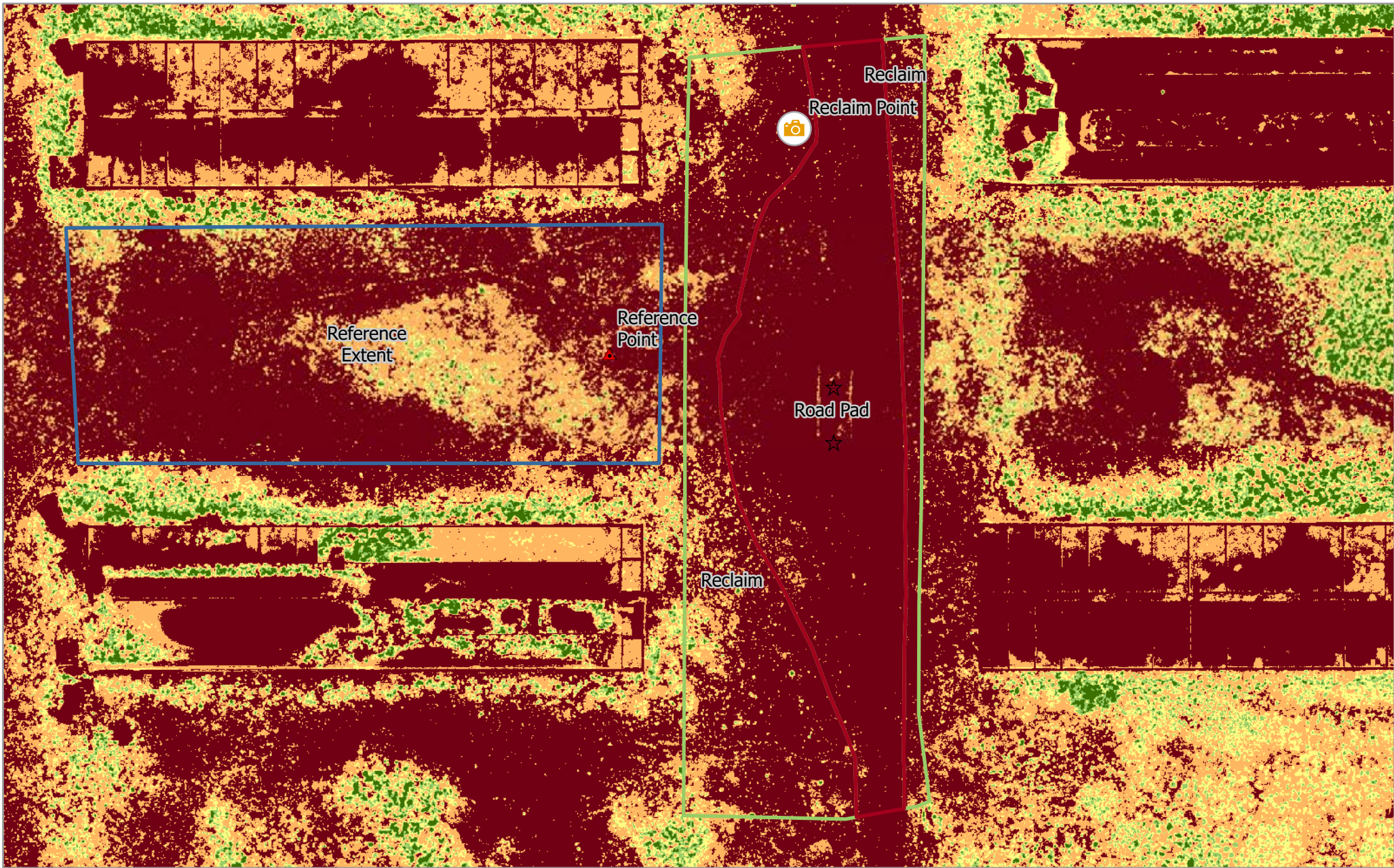
- | | | |
|---------------------|------------------|---|
| ☆ Wells | Reclaim Extent | 3 |
| 📷 Reclaim Point | Reference Extent | 4 |
| ▲ Reference Point | Stream Order | 5 |
| ▭ Road & Pad Extent | 1 | |
| | 2 | |

0 0 0.01 0.02 Miles

Scale: 1:463

Pad Location:
40.383030
-104.367910





CIV - 420769 - Antelope 23-19
Map Extent - Jun NDVI

Imagery: RS Multispectral
Imagery Date: 9 Jun 2022
Map Date: 02 Aug 2022
Datum: NAD_1983_UTM_Zone_13N
POC: Soil Sage

Legend

☆ Wells

📷 Reclaim Point

▲ Reference Point

📏 Road & Pad Extent

Reclaim Extent

Reference Extent

NDVI

Classes

1-Veg

2-Veg

3-Non Veg

4-Non Veg

5-Non Veg

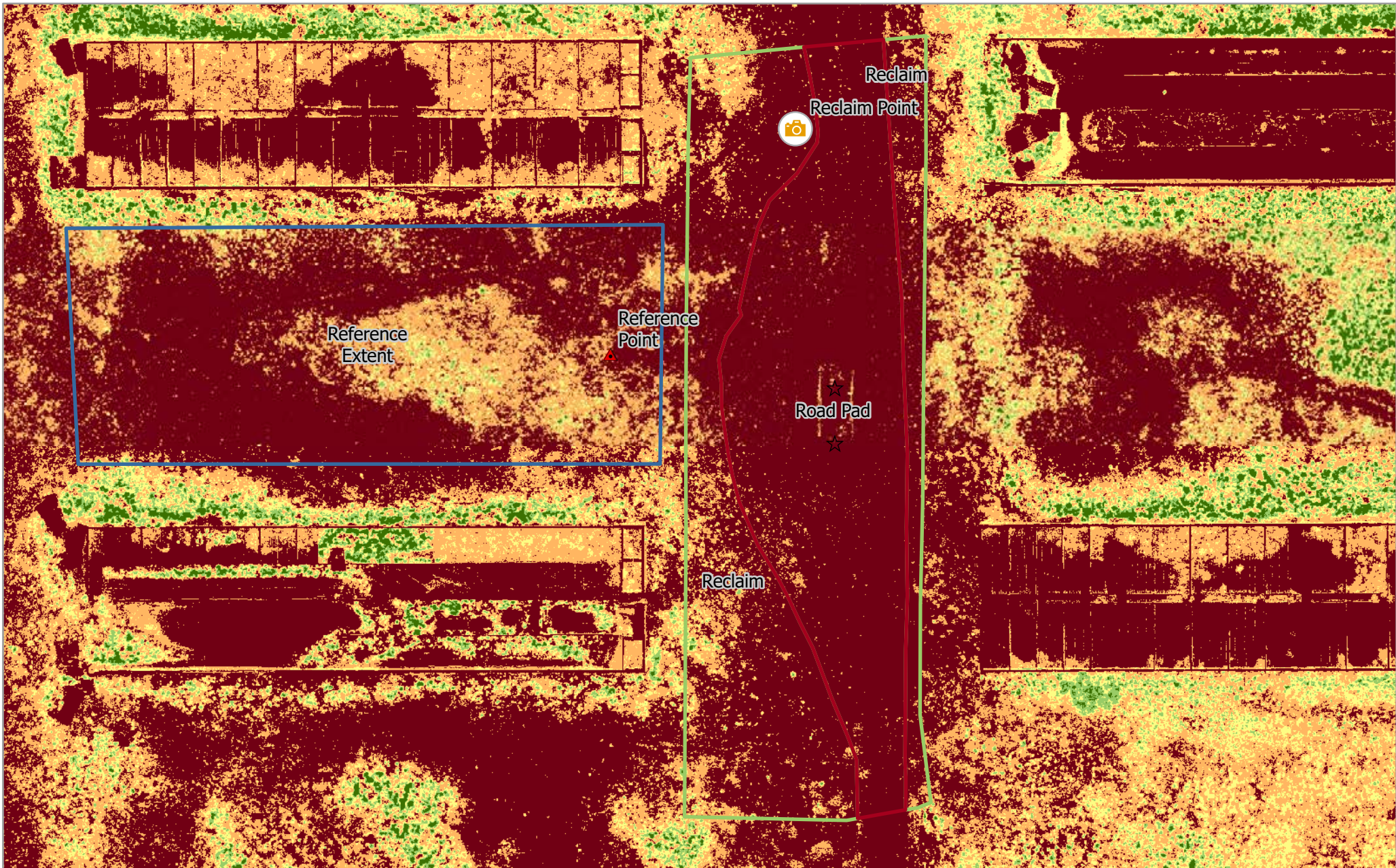
0 0 0.01 0.02 Miles

Scale: 1:463

Pad Location:
40.383030
-104.367910

N





CIV - 420769 - Antelope 23-19
Map Extent - Jun NDRE

Imagery: RS Multispectral
 Imagery Date: 9 Jun 2022
 Map Date: 02 Aug 2022
 Datum: NAD_1983_UTM_Zone_13N
 POC: Soil Sage

Legend

- | | | |
|---|---|---|
| ☆ Wells | Reclaim Extent | 2-Veg |
| Reclaim Point | Reference Extent | 3-Non Veg |
| Reference Point | Int_NDRE | 4-Non Veg |
| Road & Pad Extent | Classes | 5-Non Veg |
| | 1-Veg | |

0 0 0.01 0.02 Miles

Scale: 1:463

Pad Location:
 40.383030
 -104.367910



Service Credits -