

# *UAVs for analyzing legacy issues and development opportunities on former mine lands*

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Architecture, School of Design, Davis College of  
Agriculture, Natural Resources and Design, West Virginia  
University

# Overview

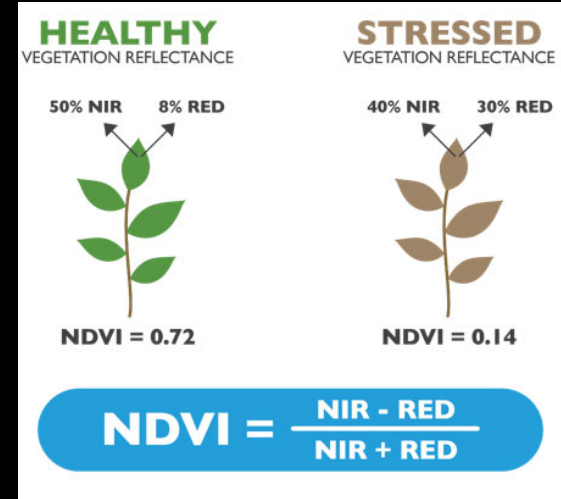
- Background on drone use for landscape analysis
- Former mine lands as development opportunities
- Our approach
- Design plans



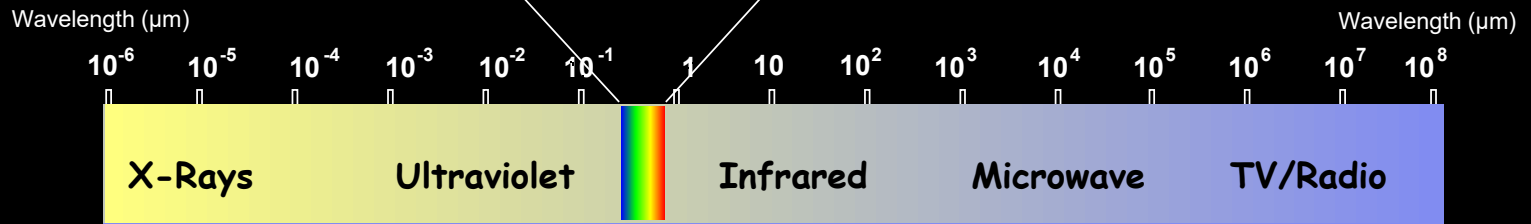








0.4 0.5 0.6 0.7  $\mu\text{m}$





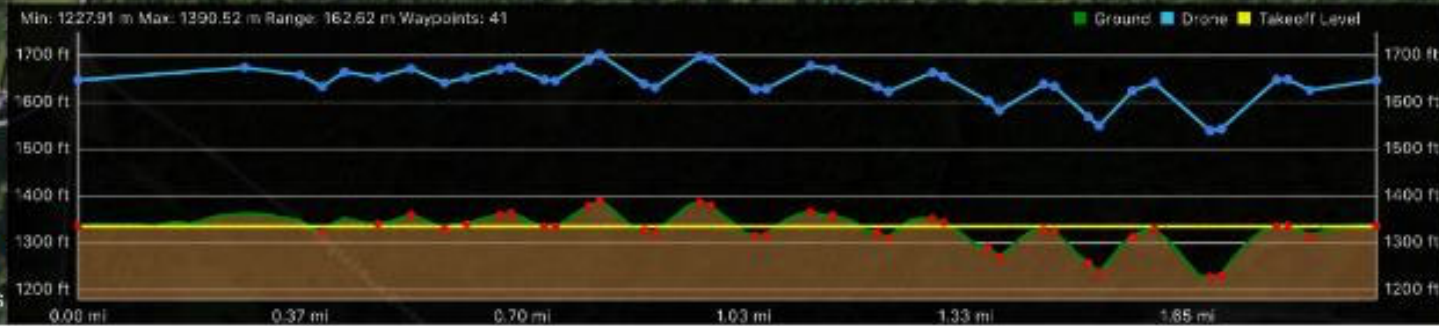
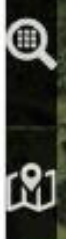
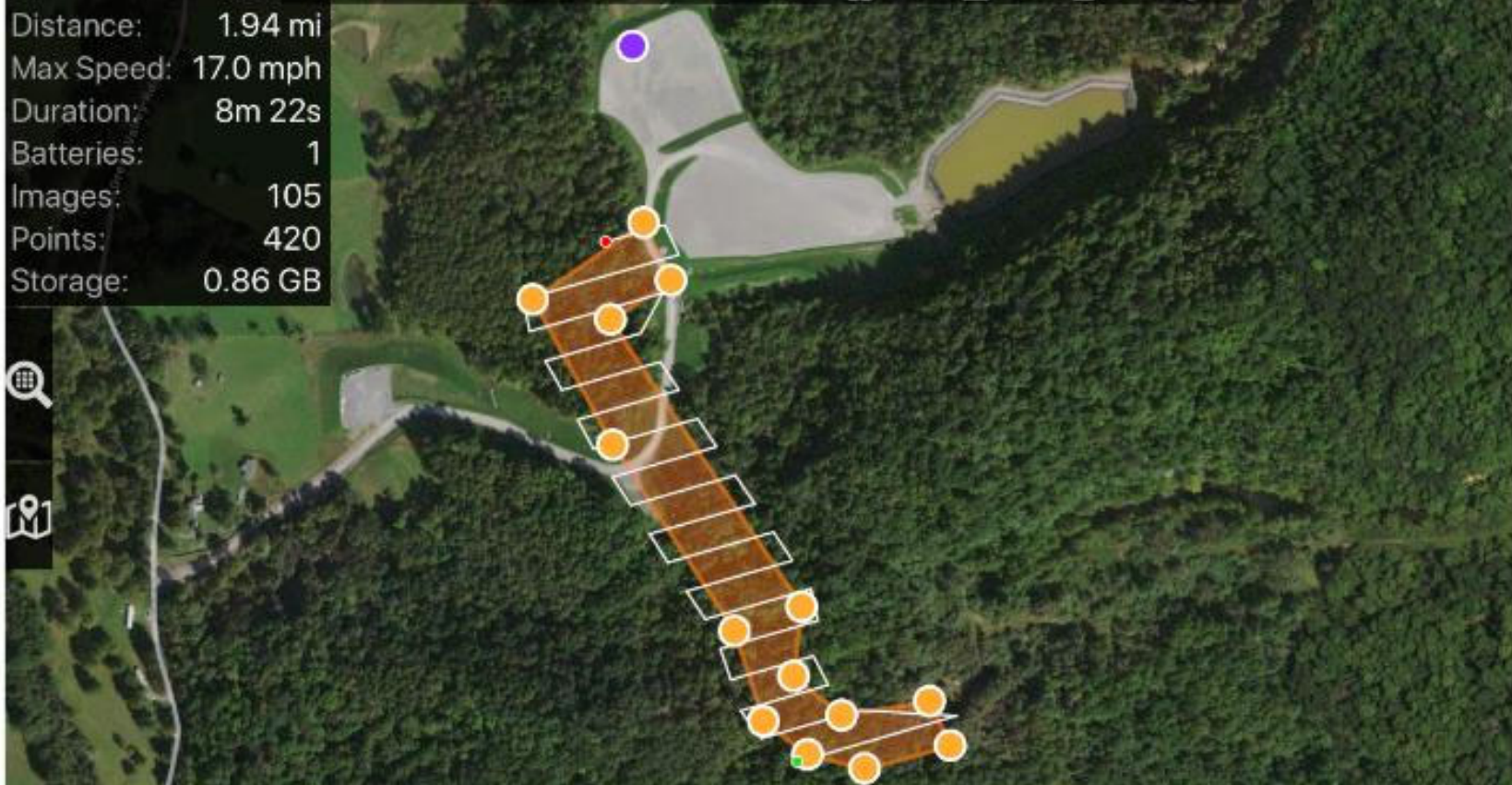






Area: 8.32 acres  
Distance: 1.94 mi  
Max Speed: 17.0 mph  
Duration: 8m 22s  
Batteries: 1  
Images: 105  
Points: 420  
Storage: 0.86 GB

Working for Drone Range: 8% 8% --% --% 0



Legal



Area: 10.24 acres  
Distance: 1.59 mi  
Max Speed: 17.0 mph  
Duration: 7m 9s  
Batteries: 1  
Images: 100  
Points: 400  
Storage: 0.82 GB

Waiting for Drone

Range:

8%



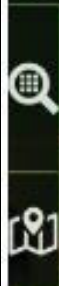
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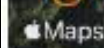
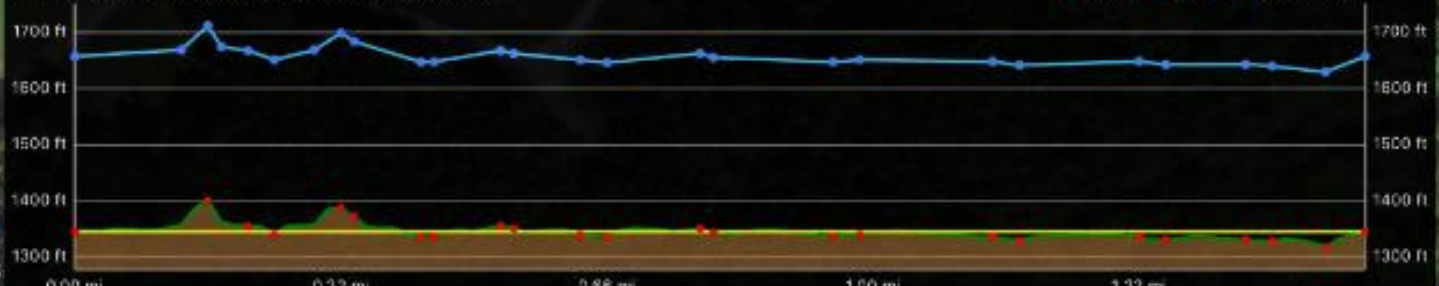
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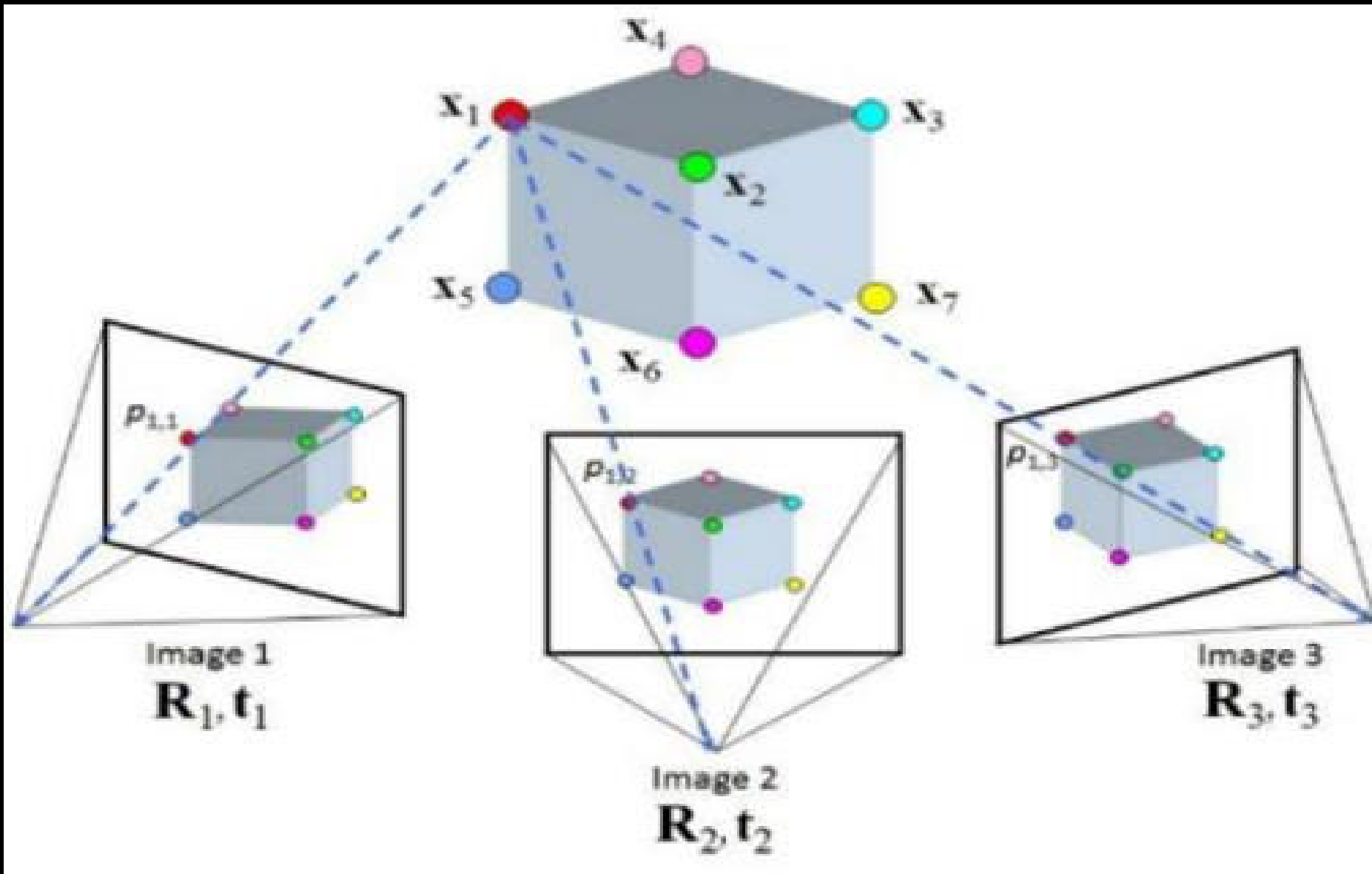
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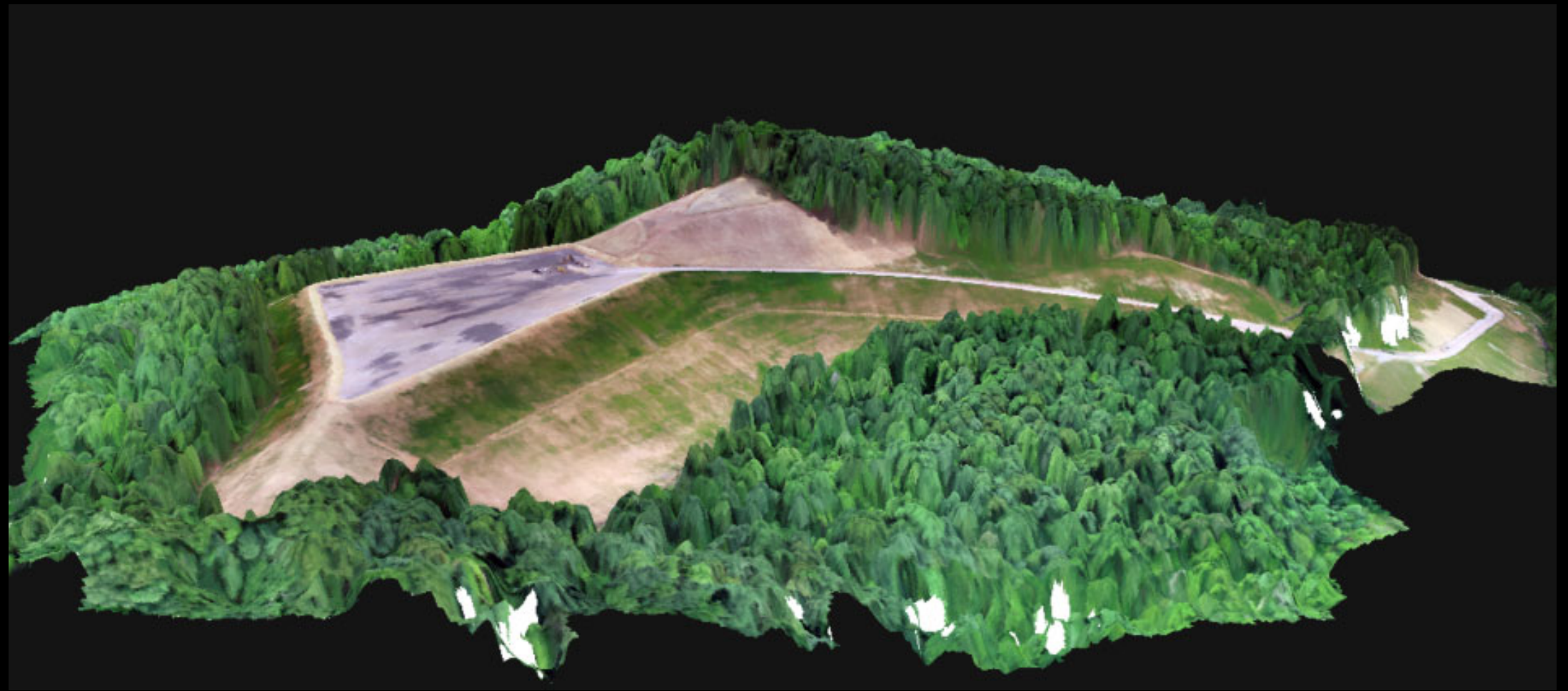


Min: 1317.74 m Max: 1400.09 m Range: 82.35 m Waypoints: 27

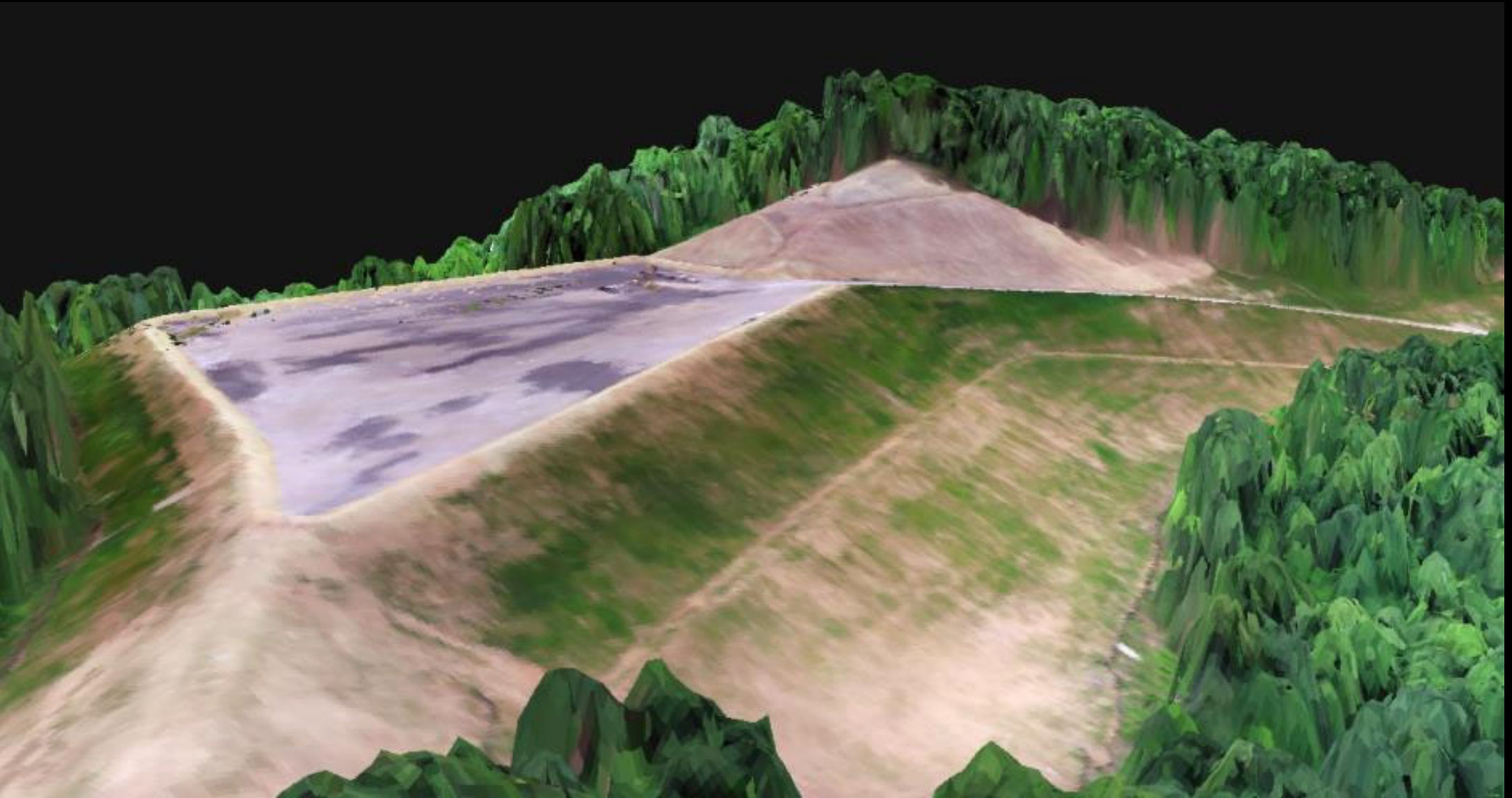


Local

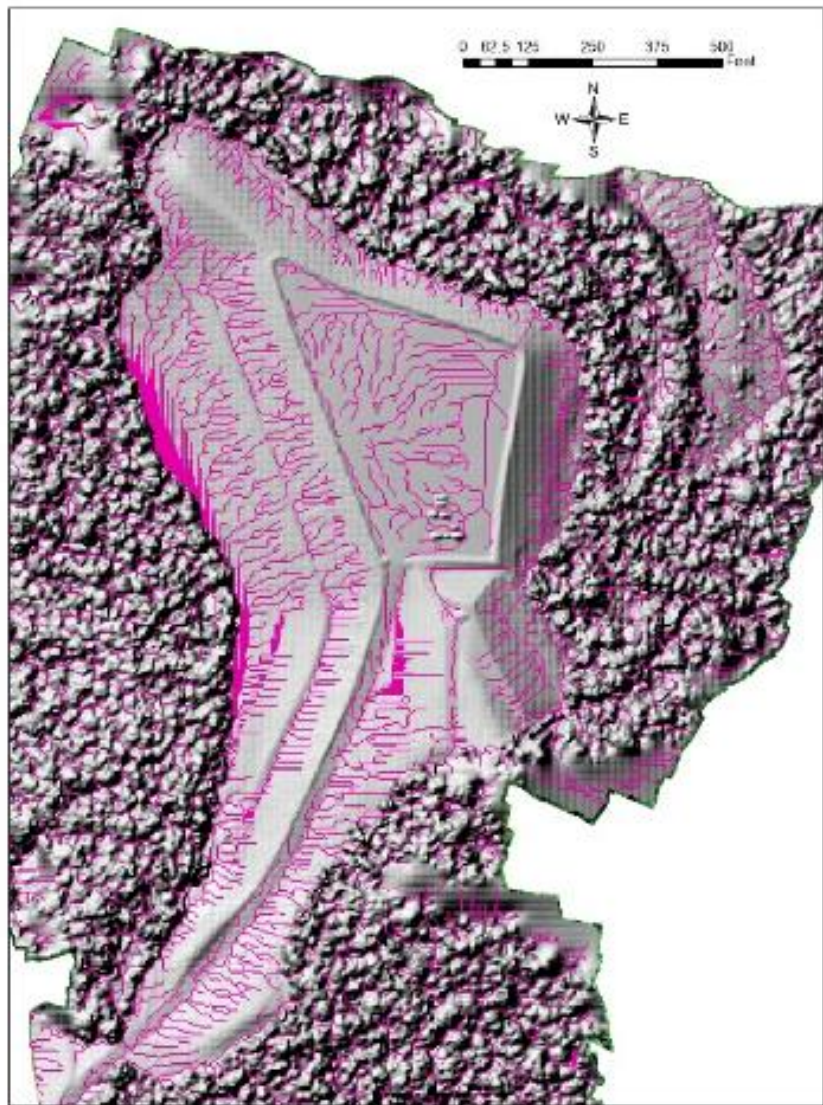




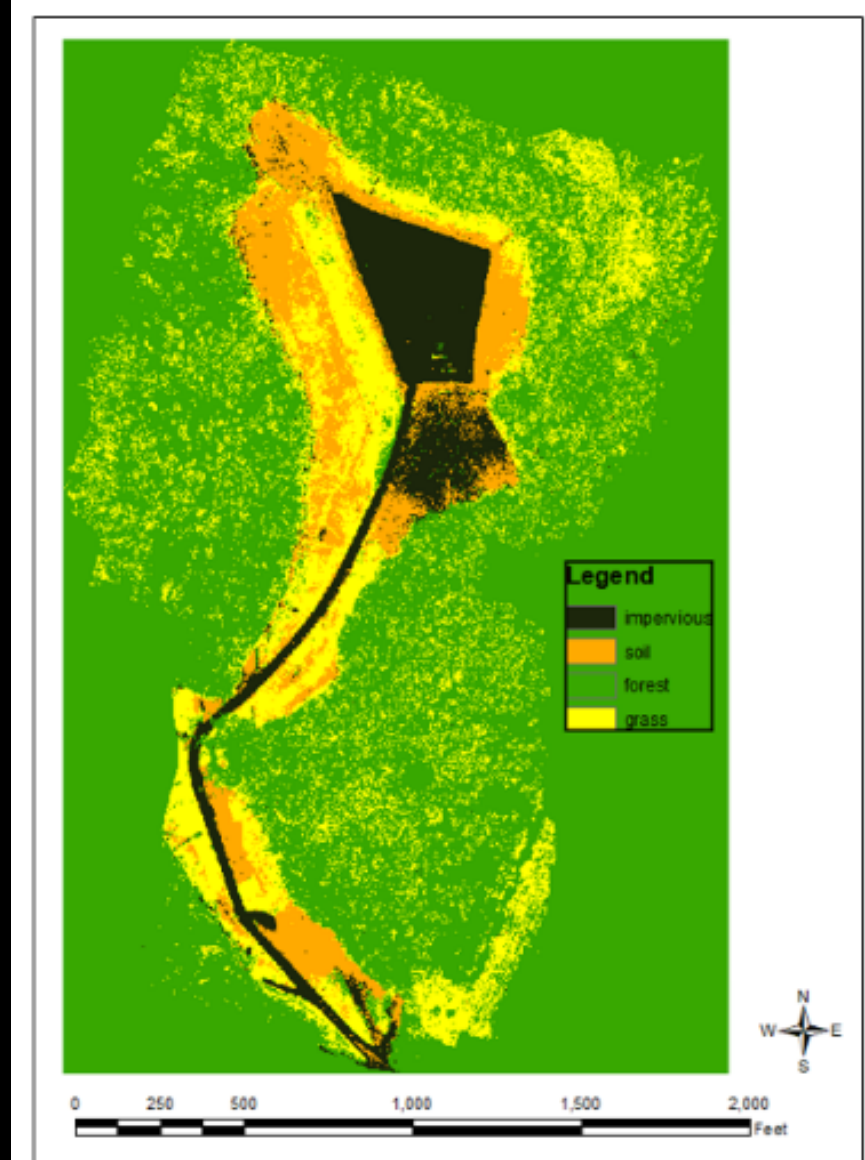


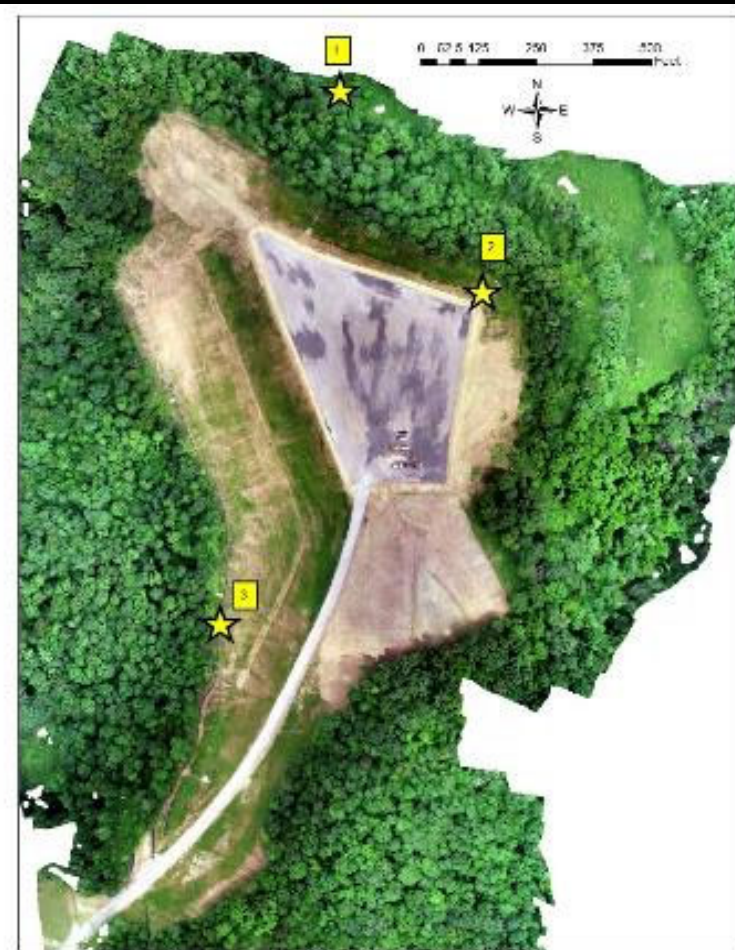
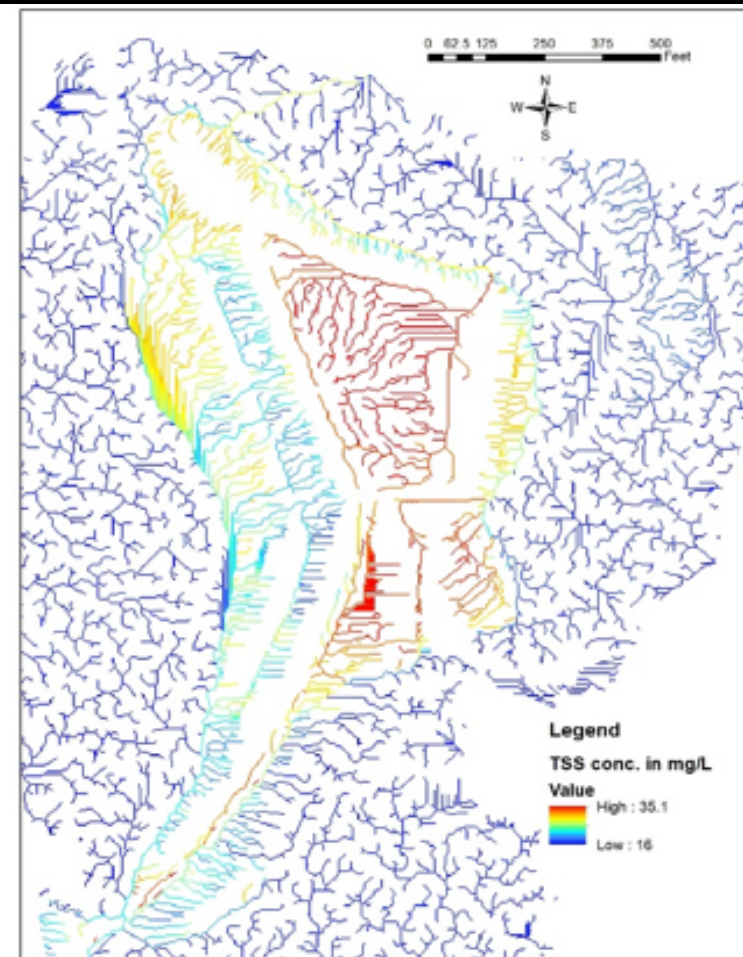












Strager, M. P., A. M. Klein Hentz, P. Kinder, S. Grushecky. 2020. Using unmanned aerial vehicles to model surface runoff during well pad development. *Journal of the American Society of Mining and Reclamation*. ISSN Number 2328-8744. Vol 9, No. 1.pp. 51-69..







E·D·A

U.S. ECONOMIC DEVELOPMENT  
ADMINISTRATION

**INVESTING**  
*in* **AMERICA'S**  
**COMMUNITIES**





# COALFIELD DEVELOPMENT

REBUILDING THE APPALACHIAN ECONOMY FROM THE GROUND UP.



## SYNOPSIS OF THE CLUSTER

Community-based, equity-focused Coalfield Development is leading the Appalachian Climate Technologies Coalition (ACT Now), transforming 21 southern West Virginia (WV) counties into the global hub of climate resilience, green innovation, and environmental clean-tech jobs. President Biden's [Interagency Working Group on Coal Communities](#) recognizes the [ACT Now region](#) as the [most coal-impacted in America](#), suffering severe poverty because of extraction and disinvestment.

WV is poised to emerge as a global energy leader again through economic diversification in renewable climate technologies. Initial signs of this new cluster have been emerging for years, but now a critical mass is gaining momentum. Smart investment, new technology, innovative networks, and a well-trained workforce are needed to realize the full potential of this initial momentum.



## Patriot Gardens Apple Orchard, Muddlety, Nicholas County, West Virginia.

**Post-Mining Land Use:** Agriculture (Apple Orchard).  
**Location:** Muddlety, Nicholas County, WV.

"The first established orchard was an experimental site designed to carry out research on the performance of apples and other fruit trees on the mine soils. This work continues to be conducted in cooperation with researchers at WVU and the USDA Agricultural Research Service. A little over 3,000 apple trees were planted in May 2016". Travis, S. (2016). These 3,000 trees are expected to live about 30 years. They aren't producing many apples yet, they're only two years old. They're also tiny, a type of dwarf apple tree that will need to be trellised.

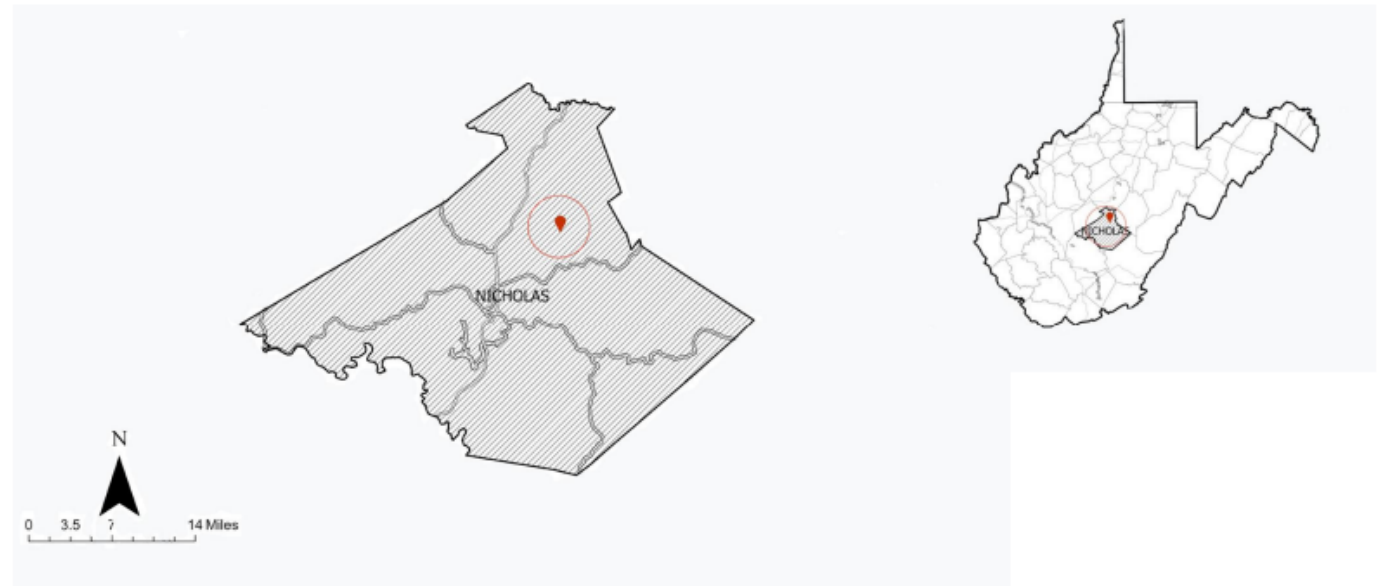


Fig.12. Map showing Nicholas County and West Virginia.





## Lavender Farm Ashford Boone County, West Virginia.

**Post-Mining Land Use:** Agriculture (Lavender Farm).  
**Location:** Ashford Boone, County, WV.

Ashford is an area of reclaimed mining land in the unincorporated town located in Boone County, which is now the site of a 35-acre farm producing lavender for the multi-billion-dollar essential oils industry. "Our goal is to farm 120 acres by 2021," said Appalachian Botanicals Founder and President Jocelyn Sheppard. Active since 2018, the initial planting began in May of that year with an expected harvest of June 2020. Once the lavender leaves the farm, it will be transported in a dried or frozen state to Mystic Formulations, a processing laboratory in Charleston, where the oil is extracted through a steam distillation process. About 35 workers were on site in 2019, a number that will grow to close to 100 in February as February, March, June, July and August are peak months for full-time seasonal workers. About 10 full-time employees are retained during off-peak months". (Phil, P. 2019).

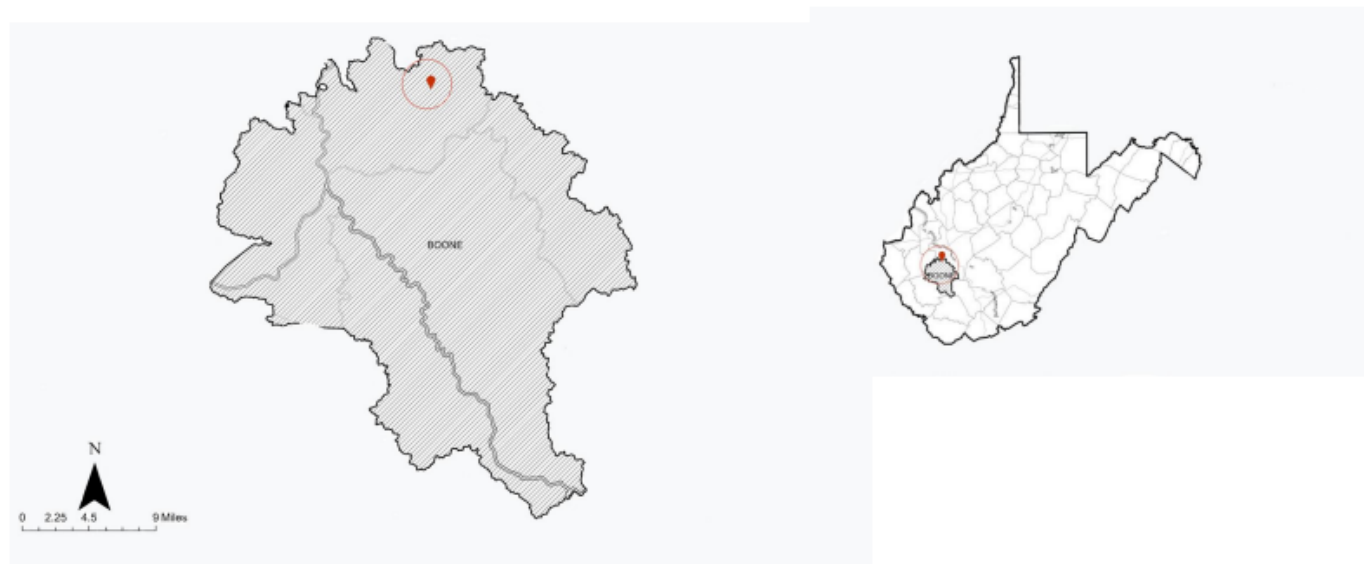


Fig.14. Map showing Boone County and West Virginia.





# Appalachian Salmon West Beckley, Raleigh County, West Virginia.

**Post-Mining Land Use:** Aquaculture (Appalachian Salmon).

**Location:** West Beckley Raleigh County, WV.

Austin Caperton, aims to produce the salmon in a re-circulation aquaculture system (RAS) on a 20-acre site in west Beckley Raleigh County, which will use water stored in the abandoned Maple Meadow Mine, which is the first Appalachian Salmon farm. The business received a \$5 million Abandoned Mine Lands (AML) grant, while 19 investors are funding the new enterprise. "The process is completely enclosed, environmentally friendly, sustainable, and targets an area that has lost thousands of jobs due to the decline of the coal industry. The process is circular, in that water is continuously circulated in the facility, treated, and also circulated through the mine void with very little effluent". (Austin, C. 2022).



Fig.15.Map showing Raleigh County and West Virginia.



## Twisted Gun Golf course Wharncliffe, Mingo County, West Virginia.

**Post-Mining Land Use:** Recreation (Twisted Gun Golf).

**Location:** Wharncliffe, Mingo County, WV.

Twisted Gun Golf club is located 8 miles from the town of Gilbert WV which is on Route 52. The Club opened in the fall of 2002 with rave reviews but was recognized and ranked 17th out of 50 in the year 2007. "Twisted Gun is located on a former coal mining site and the site is indeed an interesting one because the course is isolated and free of any invasive clutter, also, it is the only 18-hole golf course in the surrounding tri-county area, due to the region's extreme terrain" (James, W. 2020). Twisted Gun became possible because it was built on a former strip-mining site, one of only two such mountain-top sites in the United States.

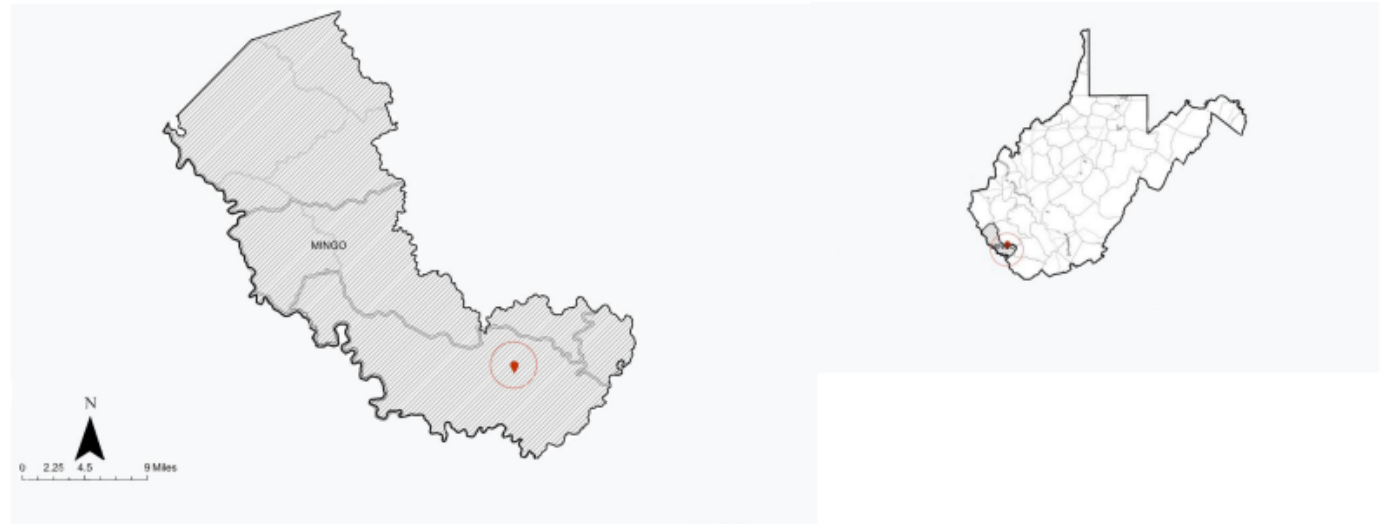


Fig.17.Map showing Mingo County and West Virginia.

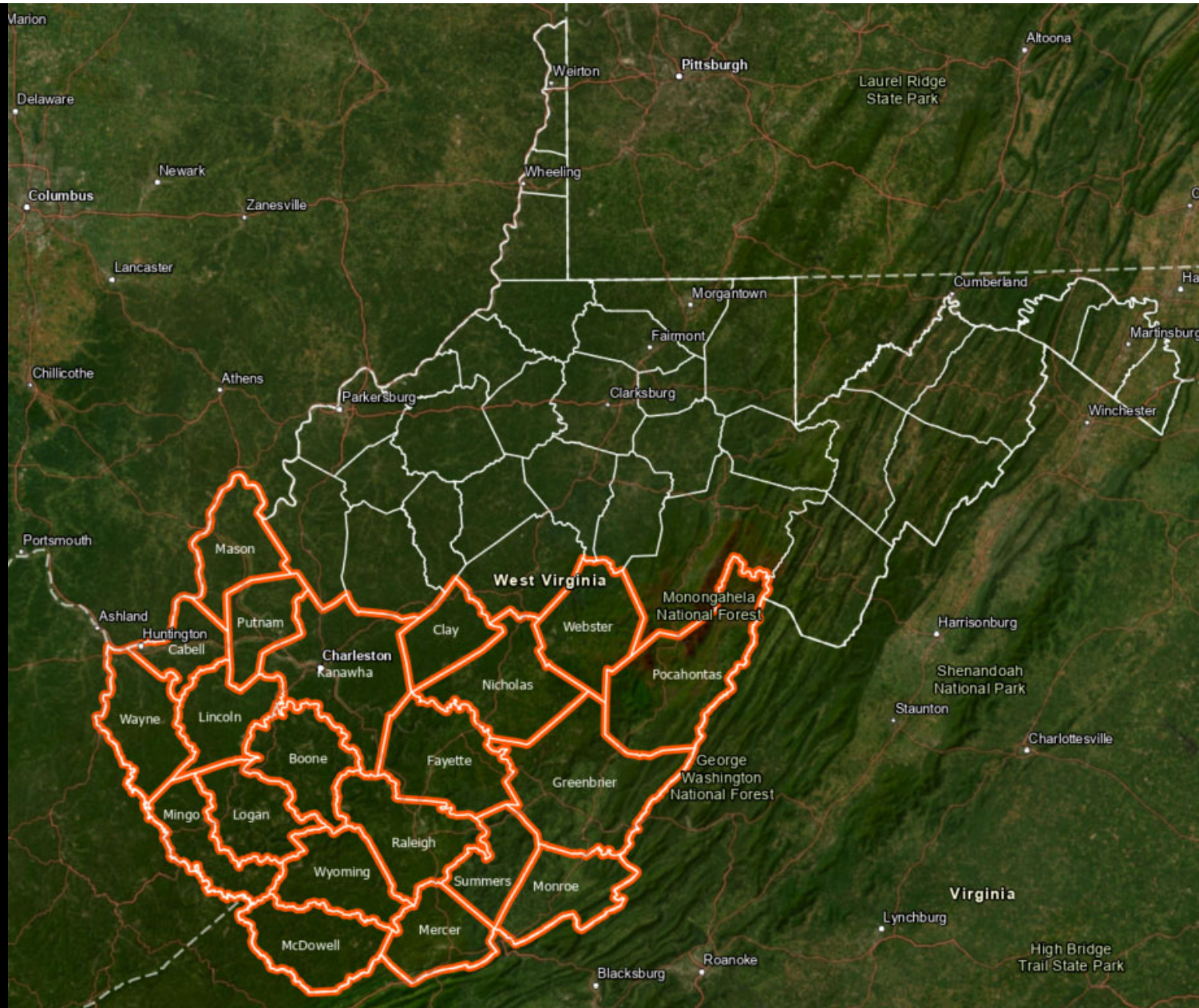


Fig. 17.1. Mingo County, WV. Photo by [unreadable]

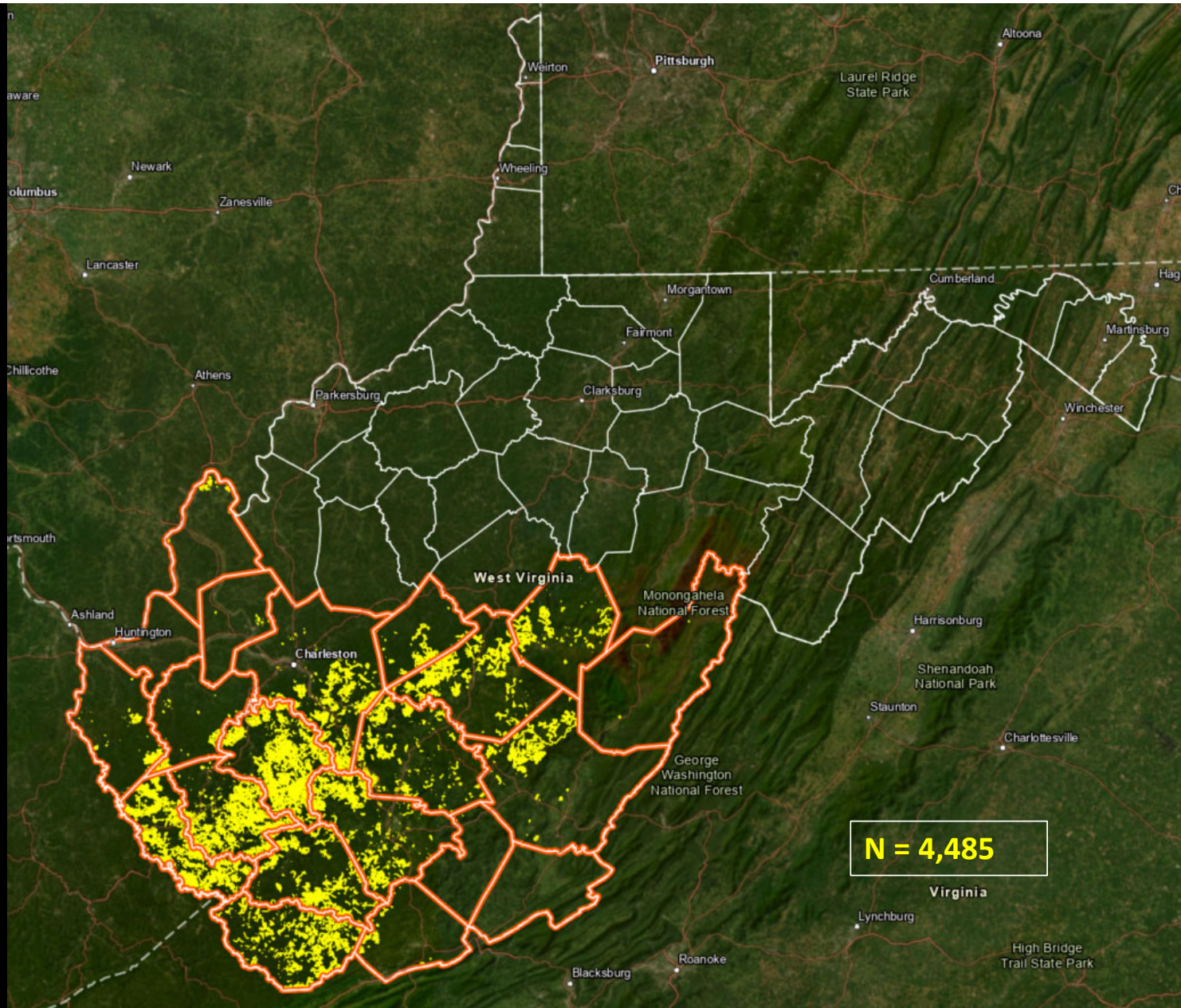
Fig. 17.2. Mingo County, WV. Photo by [unreadable]

Fig. 17.3. Mingo County, WV. Photo by [unreadable]









## GENERAL Dashboard

This table provides an explanation of current dashboard criteria, including data source, relevant processing steps, units, and attribute field name. Attribute field names are visible in the map feature popups. Popups appear when you click on an individual feature on the web map.

Additional criteria may be added in future iterations of the dashboard.

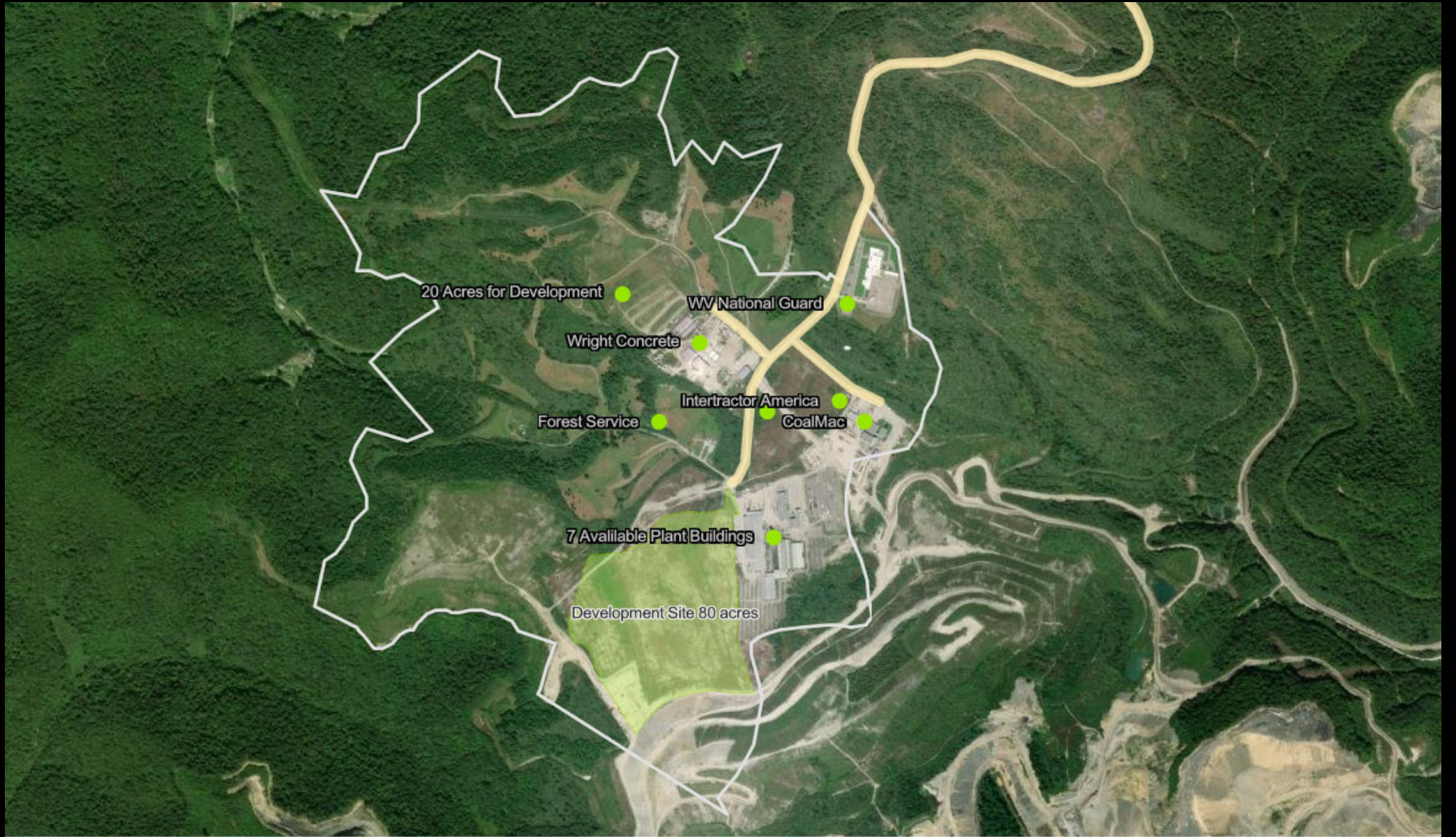
Last update: November 13, 2023

Criteria	Description	Attribute Field Name
Site category	Original type of site. Choices include: <ul style="list-style-type: none"> <li>Abandoned mine land</li> <li>DMR site – Surface (prefix S on mine permit)</li> <li>DMR site – Underground (prefix U)</li> <li>DMR site – Other (prefix E, H, T, O etc)</li> <li>Special reclamation</li> </ul>	CATEGORY
County/Counties	The primary county for each site was added to the attributes for each site. Primary county refers to the county with the highest total acreage within a single site. Many sites intersect more than one county.	
Site size	Calculated acreage of former mine land site, from GIS	Acre
Site shape	Is the mine land site (in general) a narrow shape less than 100m wide at its widest point? Values of 0 indicate no, value of 1 indicates yes. Note that if any part of the mine land site is wider than 100m, this will be a value of 0.	NARROWPOLY
Parcels intersecting site	Number of different surface parcels intersecting the former mine land site. Surface parcels data source is 2023 WV Parcels dataset available from the WVGIS Technical Center. <a href="https://wvgis.wvu.edu/data/dataset.php?ID=371">https://wvgis.wvu.edu/data/dataset.php?ID=371</a>	NUMPARCELS
Different parcel owners	Number of unique parcel owners for parcels intersecting the former mine land site. Surface parcels data source is 2023 WV Parcels dataset available from the WVGIS Technical Center. <a href="https://wvgis.wvu.edu/data/dataset.php?ID=371">https://wvgis.wvu.edu/data/dataset.php?ID=371</a>	NUMOWNERS
Private landowners	Are the majority of the parcel land owners private entities? Yes or No. (Public entities include the federal government, state of WV, and local government units).	OWNMAJPVT
Intersects floodplain	Does the site intersect a mapped FEMA floodplain? Yes or No. Floodplain data source is FEMA flood hazard areas as mapped in the current WV statewide floodplain polygons map available from the WVGIS Technical Center.	INT_FLOOD

	<a href="https://wvgis.wvu.edu/data/dataset.php?ID=373">https://wvgis.wvu.edu/data/dataset.php?ID=373</a>	
Intersects active railroad	Does the mine land site intersect an active railroad? Values of 0 indicate no, values of 1 indicate yes. Active railroads mapped using US Bureau of Transportation Statistics North American Rail Network Lines dataset, last updated July 2023.	INT_RAIL
Distance to nearest substation	Minimum distance from site to nearest mapped electrical substation, in meters. Substation data source: HIFLD energy infrastructure datasets (last update 2019).	DIST2SUB
Distance to nearest paved road	Minimum distance from site to nearest paved road, in meters. Paved road data source: WVDOT lane information layer (includes road surface type), USFS roads	DIST2ROADS
Distance to nearest transmission line	Minimum distance from site to nearest mapped electrical transmission line, in meters. Transmission line data source: HIFLD energy infrastructure datasets (last update 2019).	DIST2TRANS
Area between 10-20% slope, acres	Total acres within site with slope between 10-10% Elevation data source: WV 3m DEM	AC_20PCT
Area over 20% slope, acres	Total acres within site with slope greater than 20%. Elevation data source: WV 3m DEM	AC_OVER20P
Area forested (acres)	Total area on site in forested land cover (acres) Land cover data source: 2016 classified NAIP Imagery	AC_FOR
Area low vegetation (acres)	Total area on site in low vegetation land cover (acres) Land cover data source: 2016 classified NAIP Imagery	AC_LOWVEG
Area mixed development (acres)	Total area on site in mixed development land cover (acres) Land cover data source: 2016 classified NAIP Imagery	AC_MIXDEV
Minimum elevation (m)	Minimum elevation value occurring on site, meters Elevation data source: WV 3m DEM	ELEV_MIN
Maximum elevation (m)	Maximum elevation value occurring on site, meters Elevation data source: WV 3m DEM	ELEV_MAX
Elevation change (m)	Elevation change (range between minimum-maximum elevation) on site, meters Elevation data source: WV 3m DEM	ELEV_RANGE
Cleared flat land (acres)	Total acres on site with slope <5% and non-forested land cover Source for slope: 3m DEM Source for land cover: 2016 NAIP classified land cover. Cleared land includes areas that are not forested, water, or mixed development	CLEARD_AT5
Cleared land (acres)	Total acres on site with non-forested land cover Source for land cover: 2016 NAIP classified land cover. Cleared land includes areas that are not forested, water, or mixed development	CLEARD_AC
Population within 5 miles, estimate	Estimated population within 5 miles of former mine land, based on apportioned 2020 Census block population data (assumes population is evenly distributed)	POP20_5MI

Population within 10 miles, estimate	Estimated population within 10 miles of former mine land, based on apportioned 2020 Census block population data (assumes population is evenly distributed)	POP20_10MI
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20 Acres for Development

WV National Guard

Wright Concrete

Intertractor America

Forest Service

CoalMac

7 Available Plant Buildings

Development Site 80 acres



## THE JAMES H. HARLESS INDUSTRIAL PARK

Winner of the EPA's prestigious Brownfields Award in 2004, the James H. ("Buck") Harless Industrial Park is now home to a number of successful businesses, with capital investments exceeding \$50 million.



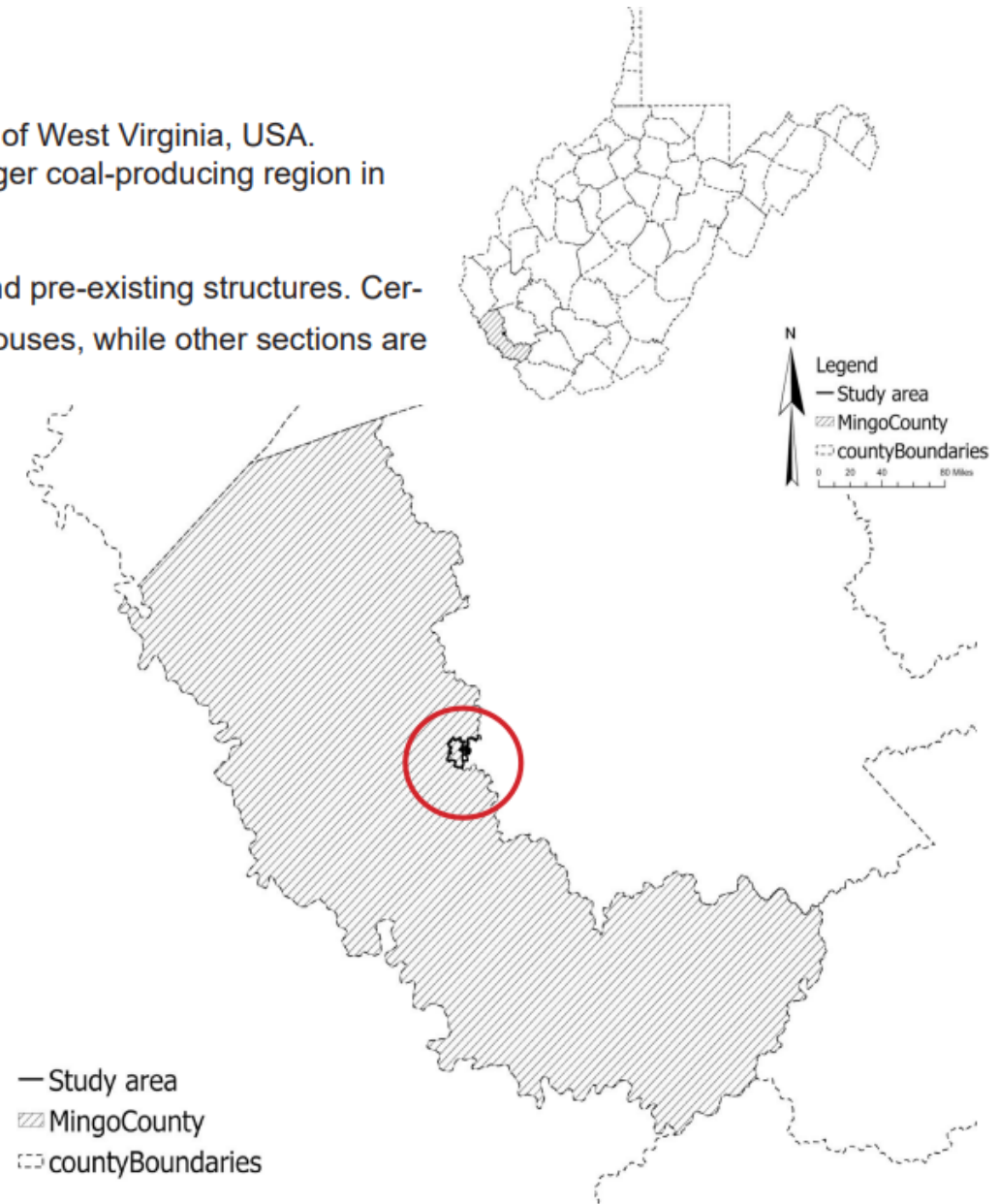
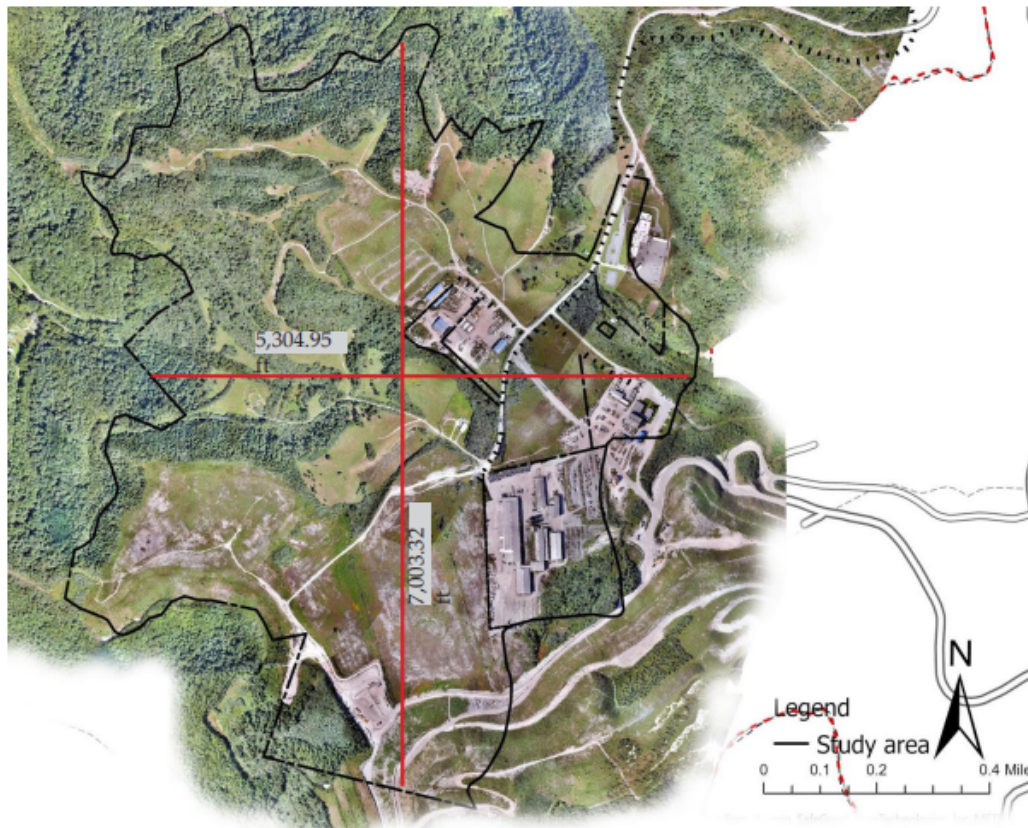


## Introduce the specific Project Location

Harless Industrial Park is in Mingo County in the southern part of the state of West Virginia, USA. The site is rugged terrain, with hills, valleys, and forests. It is part of the larger coal-producing region in West Virginia.

The Area of the Site: 577,486.759 Acre (233.7 Hectare).

The site encompasses various components, including connection roads and pre-existing structures. Certain flat areas lend themselves to use as sites for solar panels and greenhouses, while other sections are covered by forests.



eBee X Series

# eBee X

Lightweight mapping drone for large coverage and sharp data

eBee X offers 90-minute flights, RTK, PPK, online training, eMotion flight planning software, and more.

Perform professional mapping operations, including flying safely over people and BVLOS, with the NDAA-compliant eBee X drone.









0 0.5 1 2 Kilometers



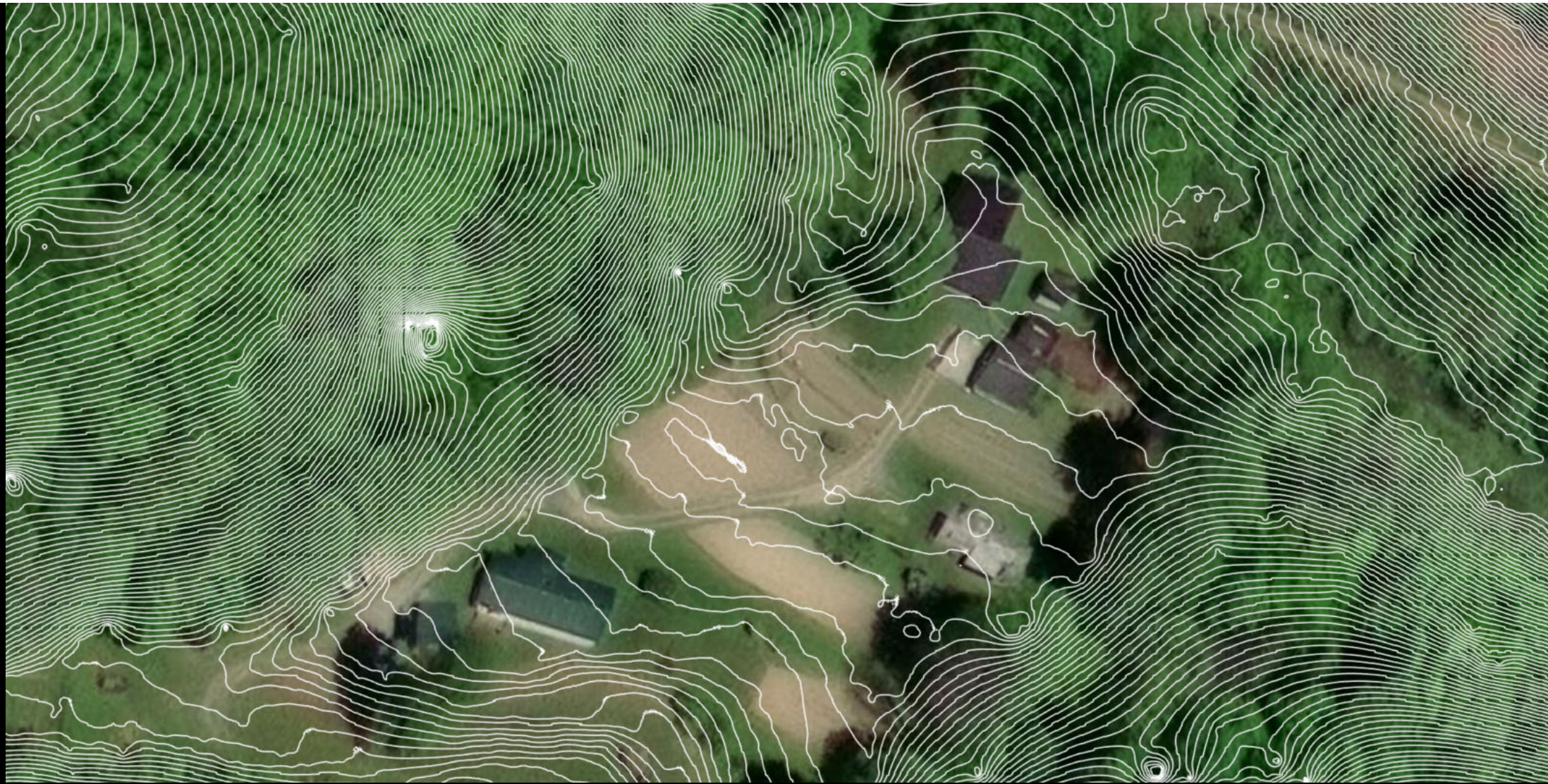














# Topography Maps

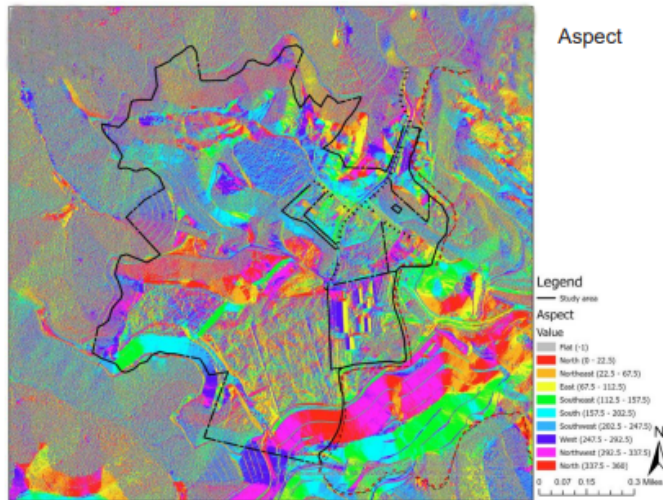


Fig.22.Aspect Map(WVU NRAC Drone Image,2023)

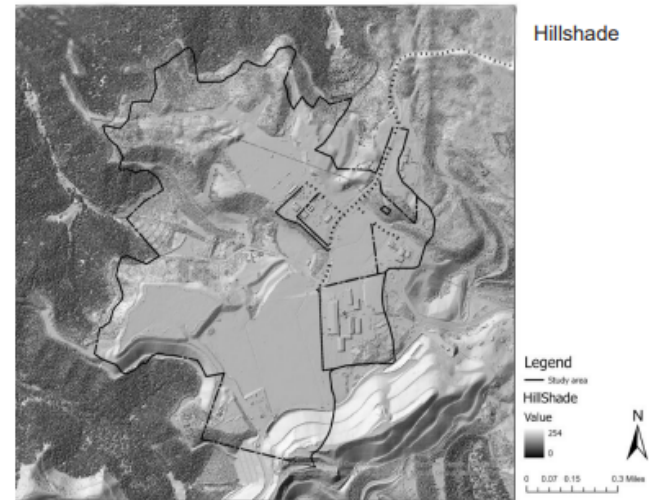


Fig.23.Hillshade Map(WVU NRAC Drone Image,2023)

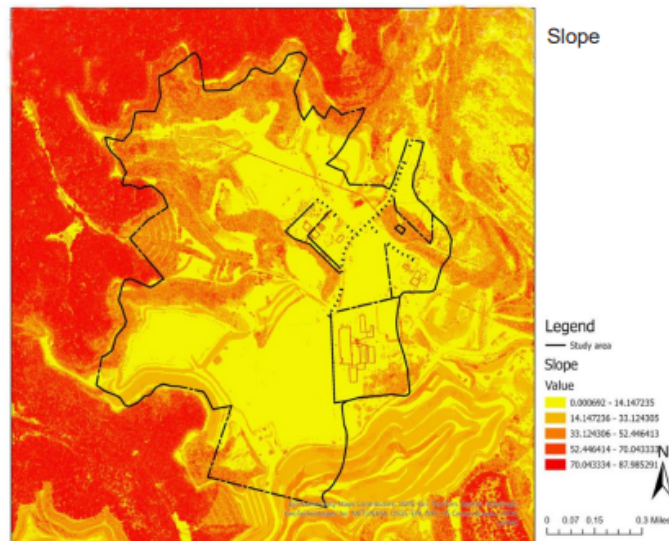


Fig.24.Slope Map(WVU NRAC Drone Image,2023)

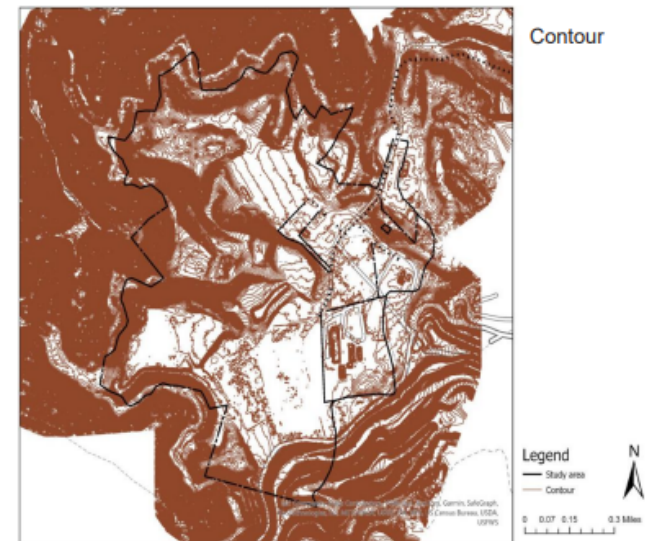
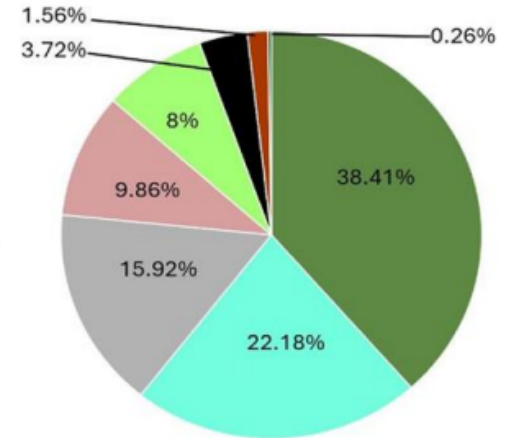
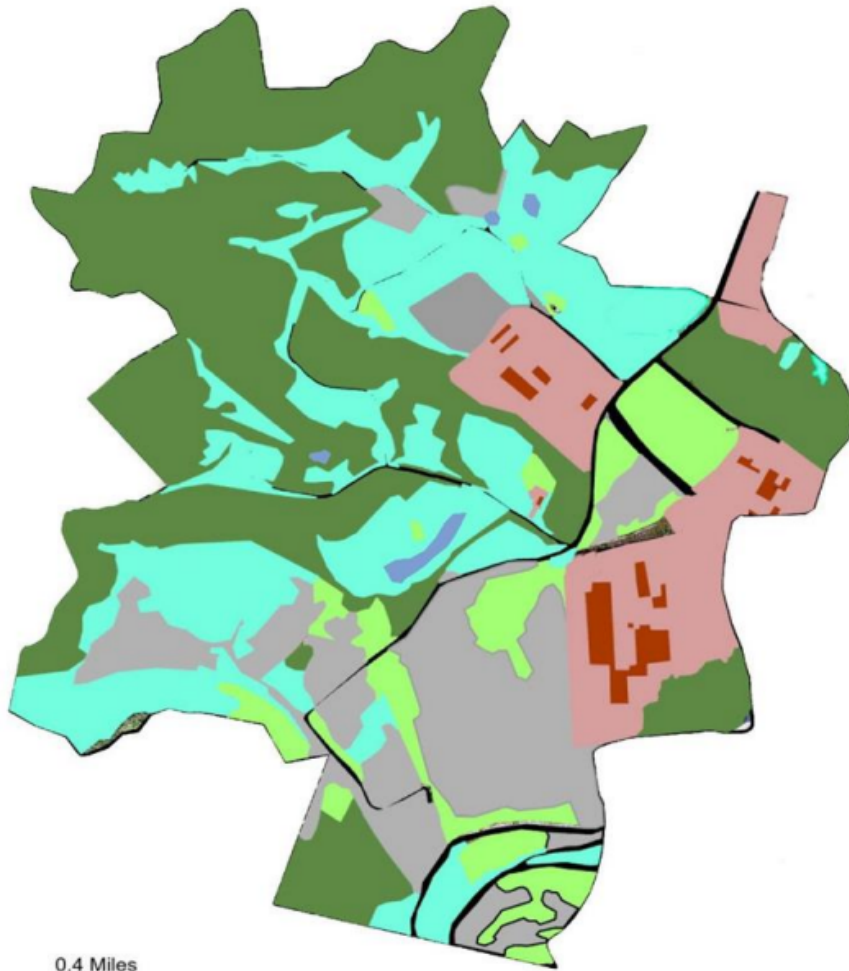


Fig.25.Contour Map(WVU NRAC Drone Image,2023)



# Existing Land Cover Map

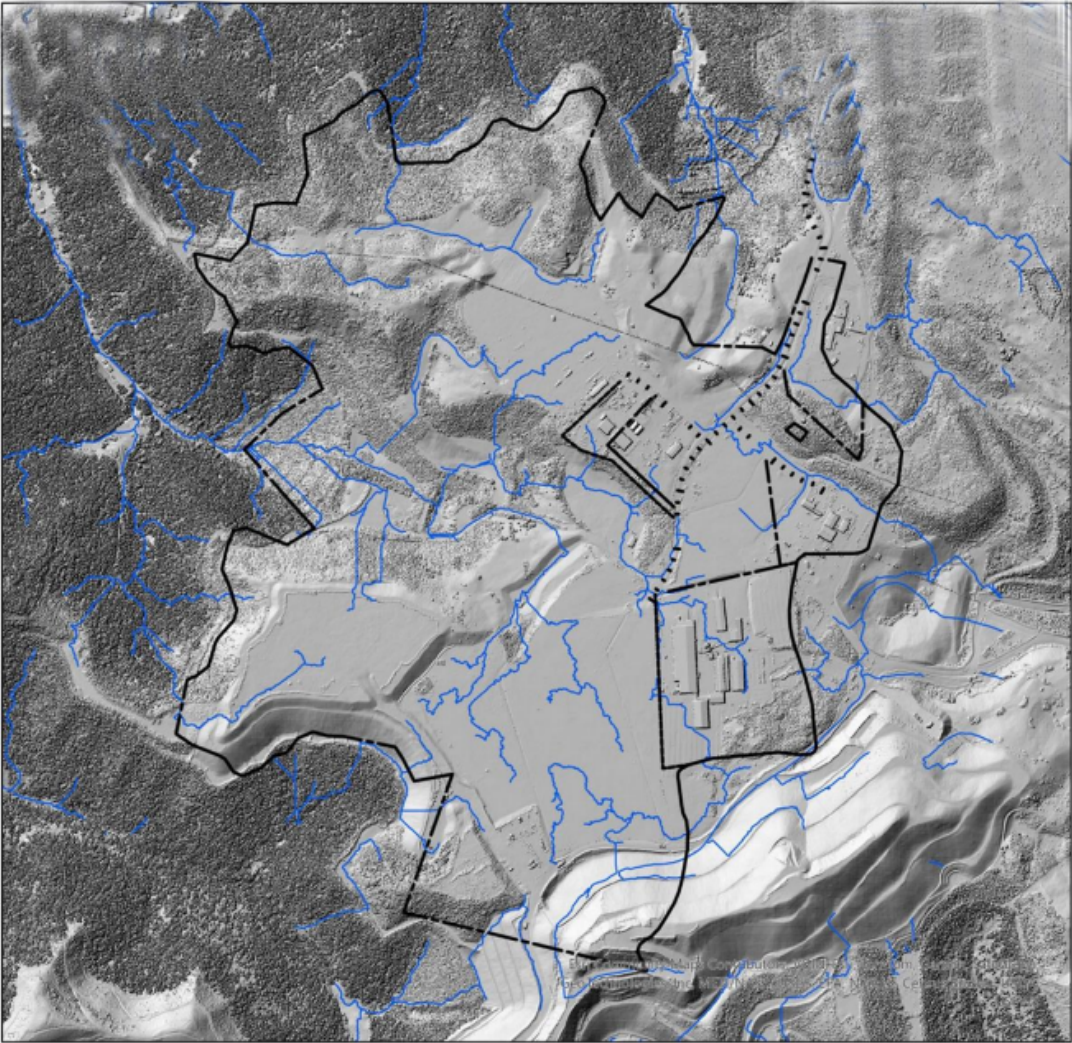


Total site area = 577.49 acres

## Legend

- Water Impoundment
- Forest
- New forest/Low vegetation
- Barren Land/Extremely stony soil
- Parking lot/Storage area
- Grass
- Buildings
- Existing Roads

# Hydrology Map



**Legend**

- Study area
- HillShade
- Value
- 254
- 0
- Water Channel

0 0.07 0.15 0.3 Miles




Fig.27.Hydrology Map(WVU NRAC Drone Image,2023)



# Solar Radiation

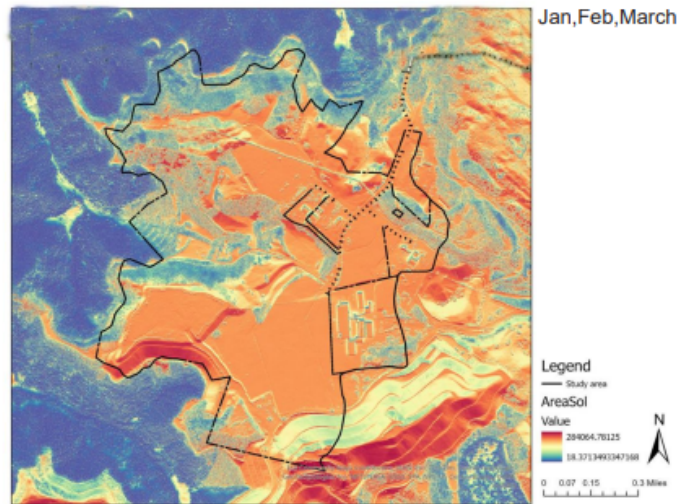


Fig.29.Solar Radiation Map(WVU NRAC Drone Image,2023)

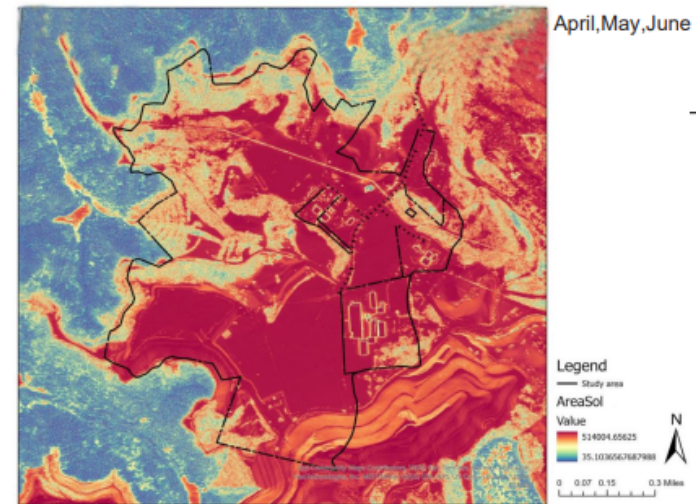


Fig.29-1.Solar Radiation Map(WVU NRAC Drone Image,2023)

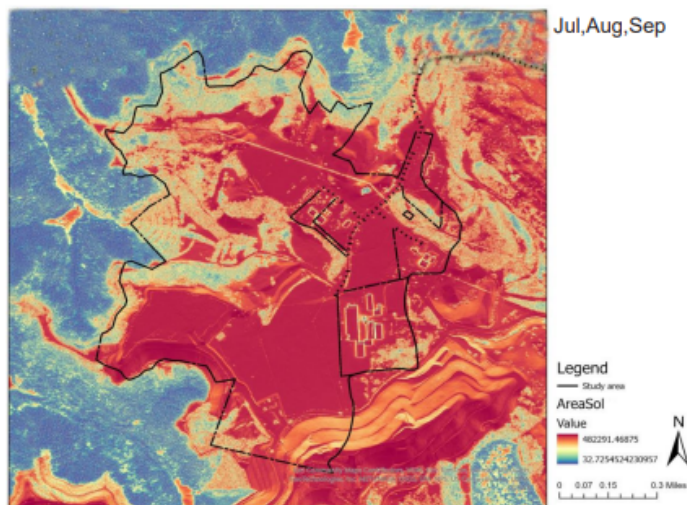


Fig.29-2.Solar Radiation Map(WVU NRAC Drone Image,2023)

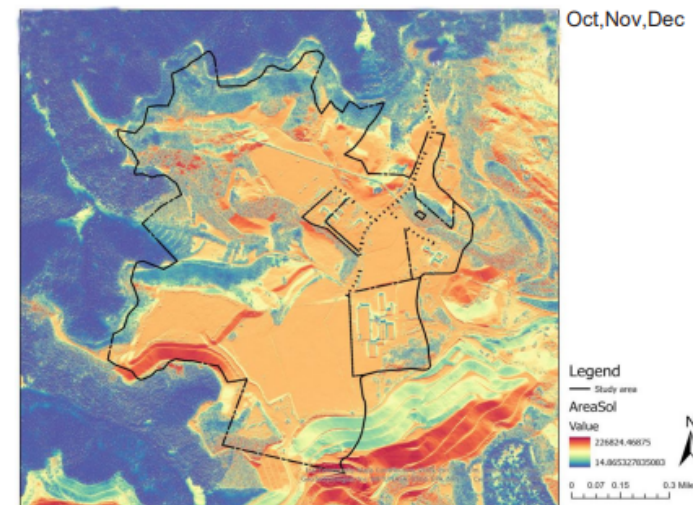
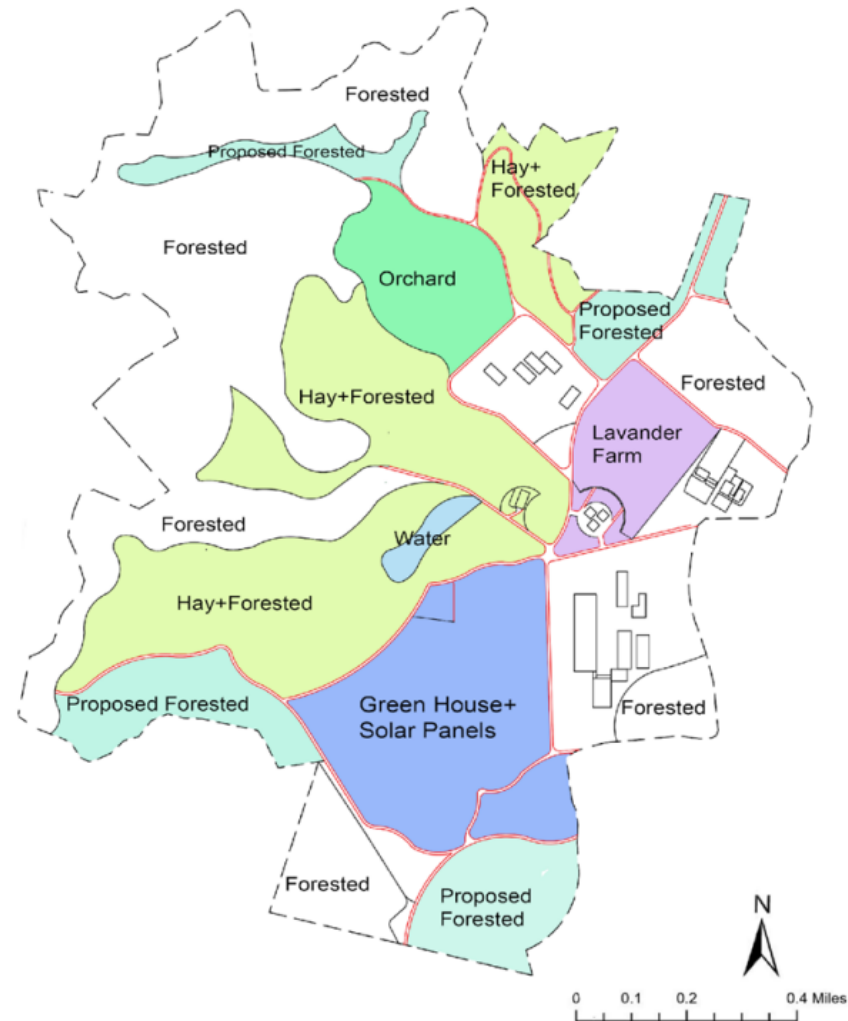
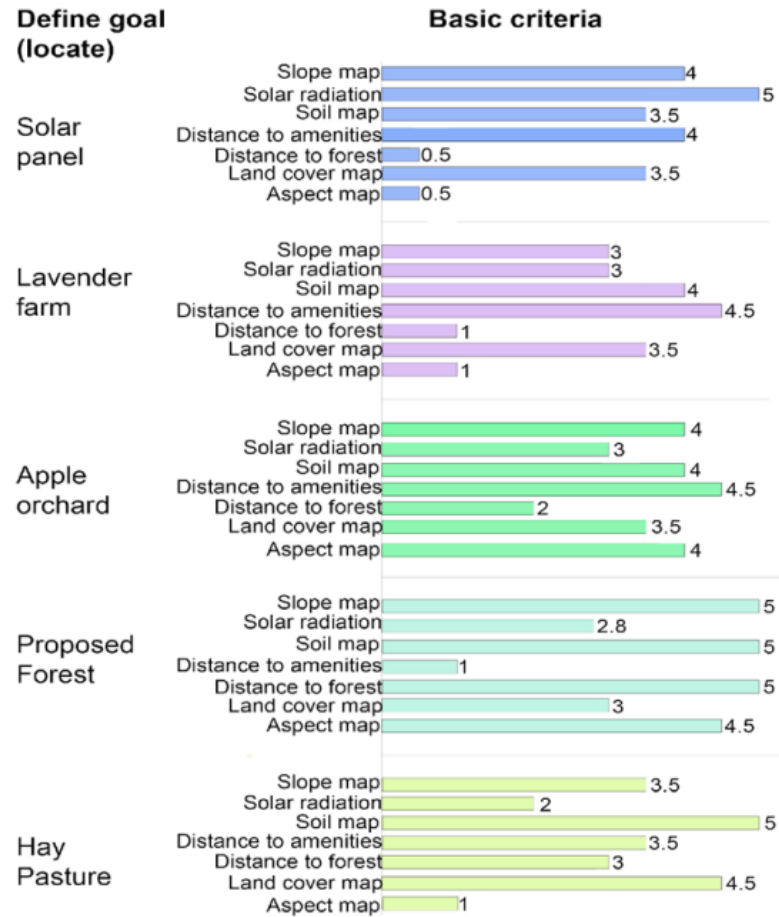


Fig.29-4.Solar Radiation Map(WVU NRAC Drone Image,2023)



# Suitability Map for Post-mine Land Uses



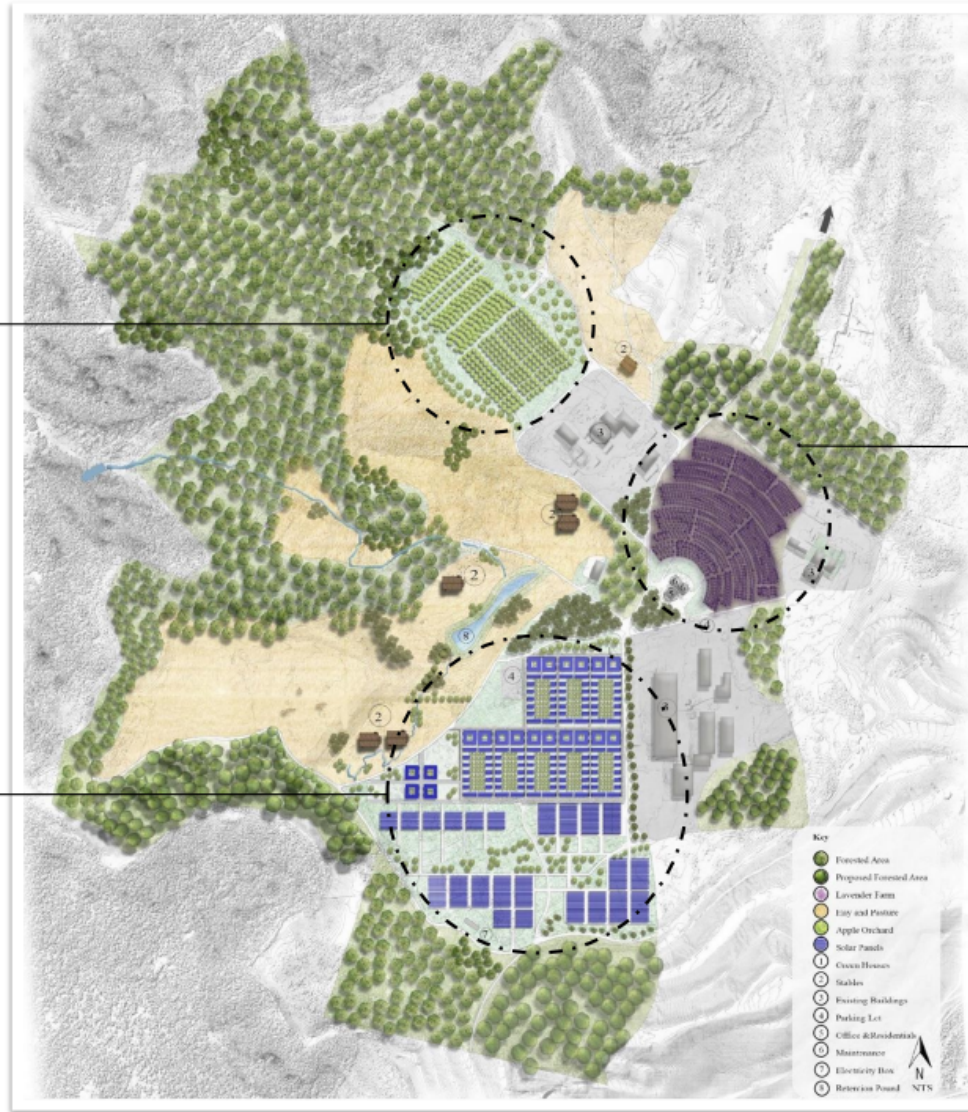
# Master Plan



Apple Orchard



Solar Panel and Greenhouse

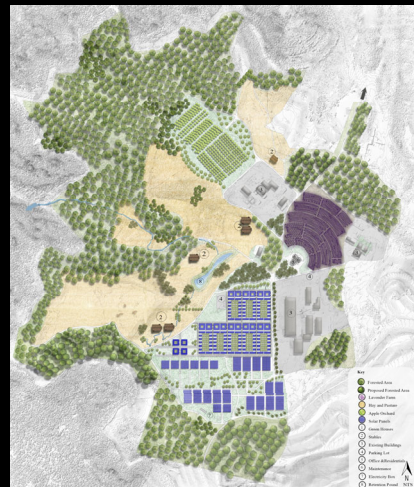


Lavender Farm



# Concluding notes

- Fixed wing UAV
- Data processing
- High resolution temporal and spatial data
  - High resolution topography
  - Imagery
- Planning products



eBee X Series

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