

Estimating Probability of Success Rate

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Mountaineer Area Rescue Group

A member of
Appalachian Search and Rescue Conference



Appalachian Search and Rescue
Conference

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Objective

- Provide SAR planners with a tool to help optimize effort allocation based on a number of parameters
 - ⊕ Calculate Probability of Success Rate and Estimated Coverage based on a specified Search Time in a given segment.
- Establish a baseline for Effective Sweep Width for different resource types
 - ⊕ User can easily alter the baseline for their respective area
 - ⊕ User can evaluate different ESW for same resource type
 - ⊕ ***Evaluate slope and land cover to alter the localized effective sweep width within a segment***



Resource Type Baseline Values for ESW

- The basic concept here is to provide some form of a baseline ESW for each individual resource. This baseline value is some hypothetical average value for the entire area and is not necessarily specific to the given search area
- User is provided with default values for ESW
- These values can easily be altered to coincide with locally measurement or estimated ESW
- ESW given per resource (for example Team Size=6, Sweep Width =10m...Search Width = 60 m)

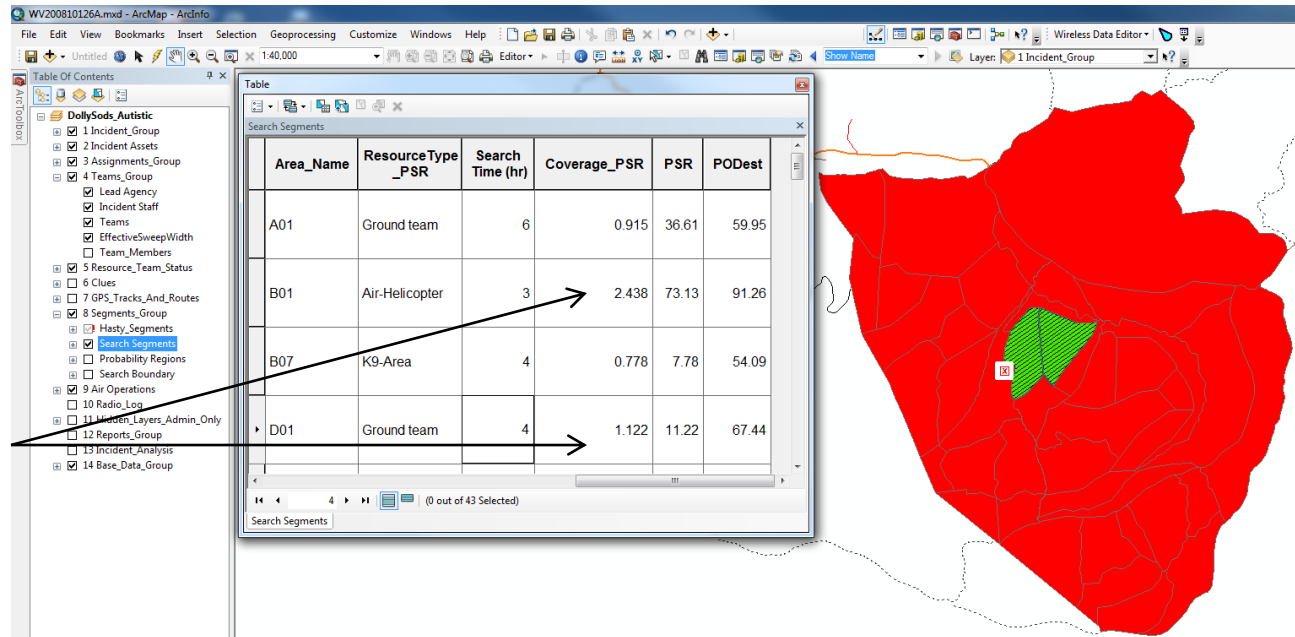
Resource Type	Team Size	Search Speed (mph)	Sweep Width (m)
Ground Team	6	2.0	10
Air-Helicopter	1	25	5
K9-Air Scent	1	2.5	97



Calculate PSR for Each Segment

- Using baseline ESW predict PSR, Coverage and POD for a specified resource type given a prescribed search time.
- Analysis to determine best use of resource with time constraint.

For case with
Coverage > 1,
alter time to
reduce
Coverage or use
additional time
to increase POD



Further Refinement based on Terrain and Environmental Data

- Using terrain and environmental data to alter the Sweep Width (proportional to the baseline)
 - Develop a Proportionality Factor to alter the baseline ESW. Ideally utilize a multiple linear regression model
 - $ESW = \text{Baseline} + B_1 * \text{Slope} + B_2 * \text{LandCover} + \dots$
 - The current approach is to apply a “best guess” for B1 and B2
 - This assumes the Slope has an impact on ESW. Was this considered in previous studies? If so do you have a correlation factor?
 - How well was vegetation characterized in previous studies? One thought is to go back through the study areas and attempt to determine B1 and B2 from previous data. This won't be had as the data is readily available but would take a little bit of time.
- Data layers
 - Digital Elevation Model (DEM) for slope and National Land Cover Database for Land Cover (www.mrlc.gov)



Reclassify Data Layers - Slope

- In this first approximation, the slope and NLCD need to be reclassified for the appropriate impact on Sweep Width.
 - ⊕ For example: A slope of 0° - 6° may have no impact on sweep width so it would receive a $ESW_{factor} = 1.0$
 - ⊕ A slope of 45° is more challenging to search, takes more time and the searcher has to focus some attention on not falling off the hill. This would have a $ESW_{factor} = 0.75$.
 - ⊕ A slope of 90° would require vertical gear. While it may be easy to see clues or the like on this slope it would take a very long time to search methodically. So it may have an $ESW_{factor} = 0.3$
 - ⊕ See Slope Map below for legend



Reclassify Data Layers - NLCD

- National Land Cover Database is a 16-class land cover classification scheme that has been applied consistently across the conterminous US at a spatial resolution of 30 meters.
- Places like the National Park have more detailed land cover data but the NLCD is more universal.
- Need to reclassify the values for impact on the ESW.
 - ⊕ More challenging as the ESW is typically based on local environment.
 - ⊕ However, what if we make an approximate baseline based on a single classification, such as "Mixed Forest"

NLCD Land Cover Classification Legend	
	11 Open Water
	12 Perennial Ice/ Snow
	21 Developed, Open Space
	22 Developed, Low Intensity
	23 Developed, Medium Intensity
	24 Developed, High Intensity
	31 Barren Land (Rock/Sand/Clay)
	41 Deciduous Forest
	42 Evergreen Forest
	43 Mixed Forest
	51 Dwarf Scrub*
	52 Shrub/Scrub
	71 Grassland/Herbaceous
	72 Sedge/Herbaceous*
	73 Lichens*
	74 Moss*
	81 Pasture/Hay
	82 Cultivated Crops
	90 Woody Wetlands
	95 Emergent Herbaceous Wetlands
* Alaska only	



Reclassify Data Layers - NLCD

- Using the ESW approximated for “Mixed Forest” environment, how would the other classifications impact ESW.

- ⊕ For example: for “Mixed Forest” the $ESW_{\text{factor}} = 1.0$
- ⊕ For “Grassland/Herbaceous” the $ESW_{\text{factor}} = 1.5$
- ⊕ For “Open Water” the $ESW_{\text{factor}} = 2.0$ (looking for a floater).
- ⊕ For “Deciduous Forest” the $ESW_{\text{factor}} = 0.5$

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General Thoughts

- Is this a perfect process?
 - ⊕ No...but it is better than what we have now. Currently we have ESW results from only a few locations across the country.
 - ⊕ How could we leverage the limited ESW data we have to provide an approximation for local impact on ESW for any search area?
 - ⊕ This is just a first attempt and can be refined as we obtain a better understanding.



What are your thoughts? - Slope

Slope (Degrees)	ESW_Factor
0 – 10	1.0
11 – 30	
31 – 45	
45 – 60	
61 – 90	



What are your thoughts? - NLCD

Classification	ESW_Factor
Open Water	
Perennial Ice/Snow	
Developed, Open Space	
Developed, Low Intensity	
Developed, Medium Intensity	
Developed, High Intensity	
Barren Land (Rock, Clay, Sand)	
Deciduous Forest	
Evergreen Forest	

Classification	ESW_Factor
Mixed Forest	1.0
Dwarf Scrub	
Shrub/Scrub	
Grassland/Herbaceous	
Sedge/Herbaceous	
Lichens	
Moss	
Pasture/Hay	
Cultivated Crops	
Woody Wetlands	
Emergent Herbaceous Wetlands	

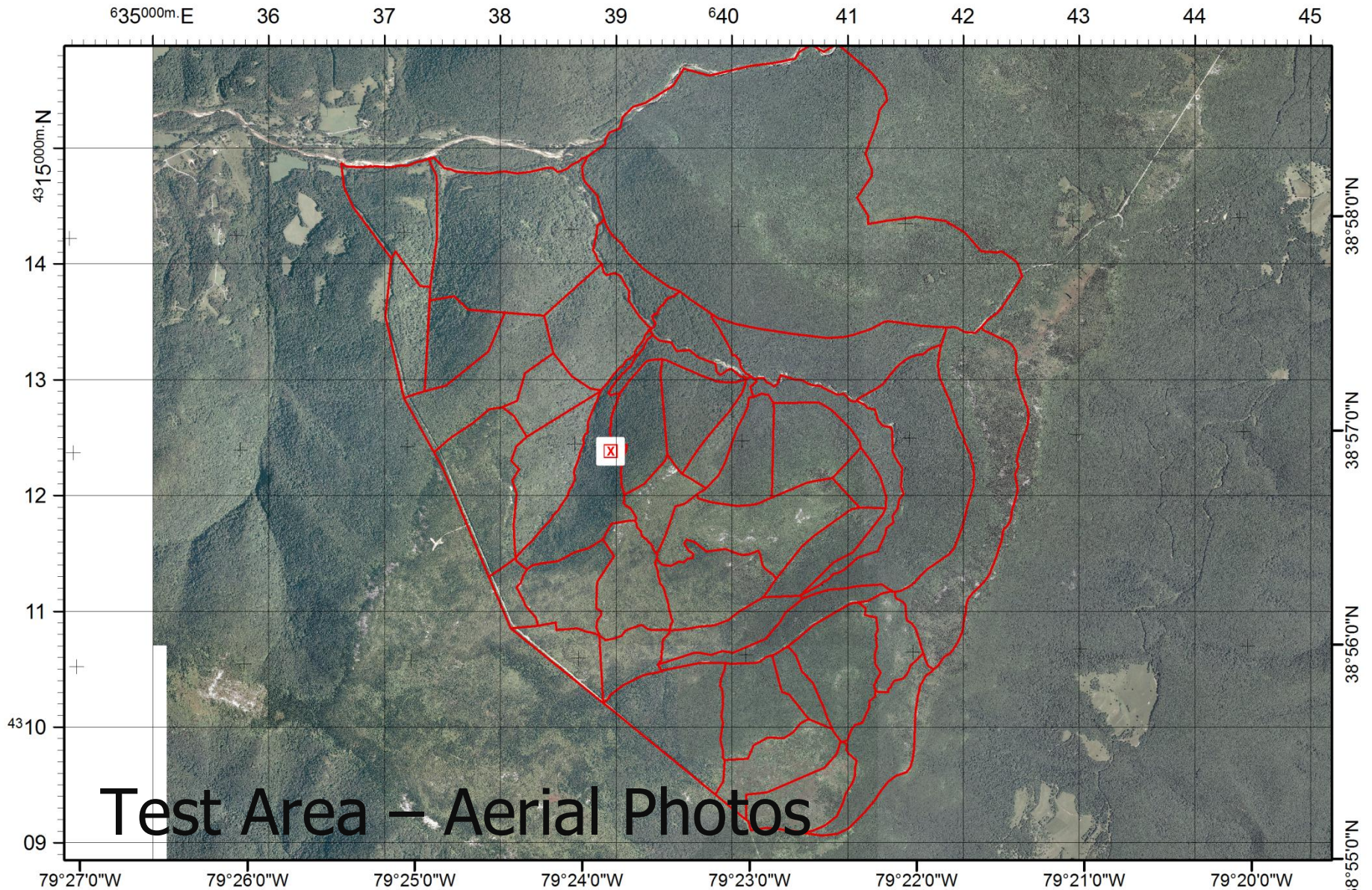


Map Name:

Mission Name: DollySods_Autistic
Mission Number: WV200810126A

Planning #:
Task #:

Date: 1/10/2012



ArcGIS provided by



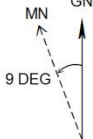
1:43,000
0 900 1,800 Meters
CONTOUR INTERVAL 20 FEET

GRID EXAMPLE
READ RIGHT THEN UP
UTM: 17N 060245 438963
USNG: 17S PD 0245 8963

US National Grid	Map Datum: WGS 1984
100,000-m Square ID	Grid Zone Designation
PD	17 S

TO CONVERT FROM MAP
TO COMPASS BEARING
ADD MN ANGLE.

TO CONVERT A COMPASS
BEARING TO A MAP
SUBTRACT MN ANGLE.

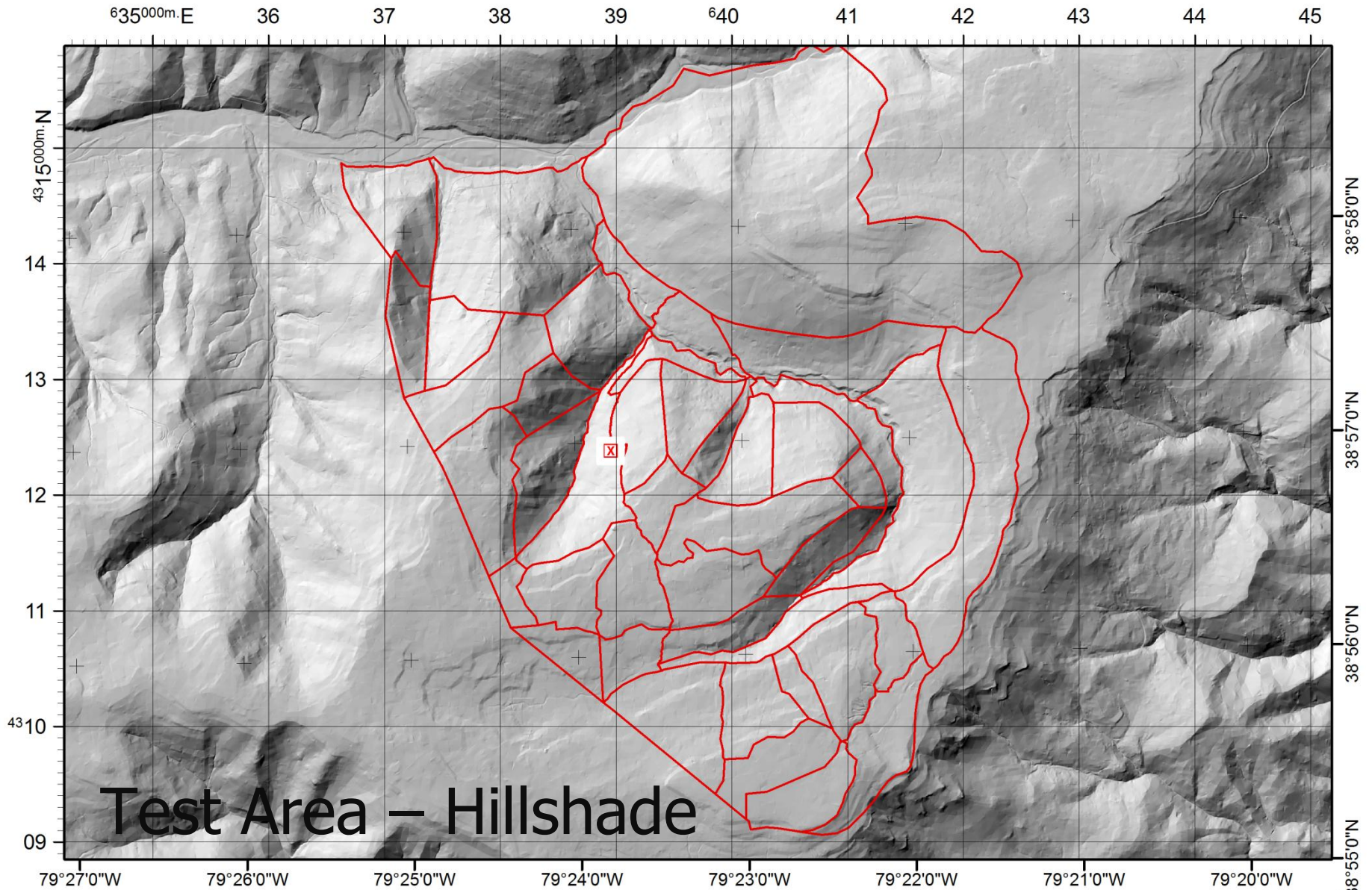


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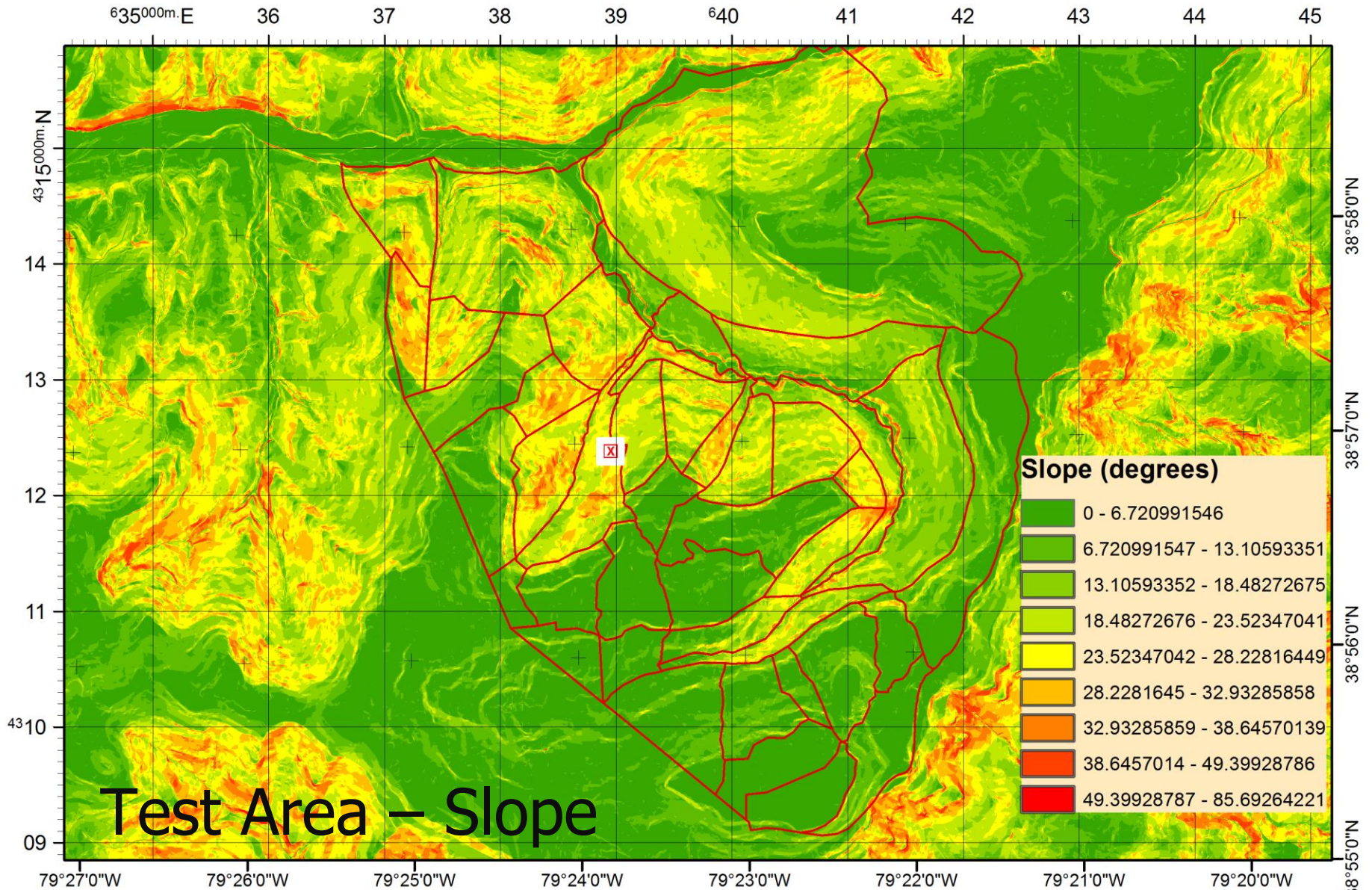


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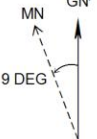
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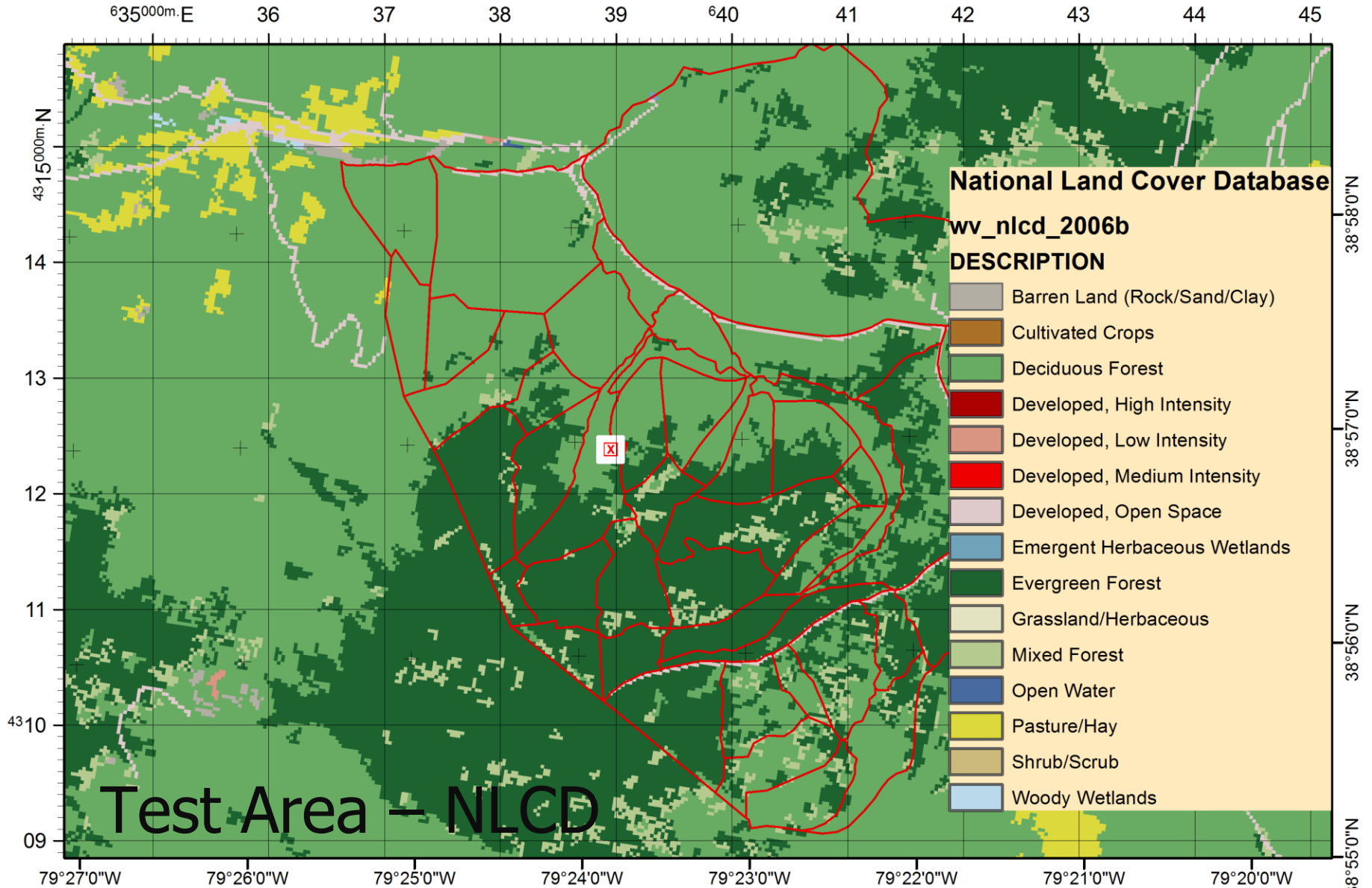


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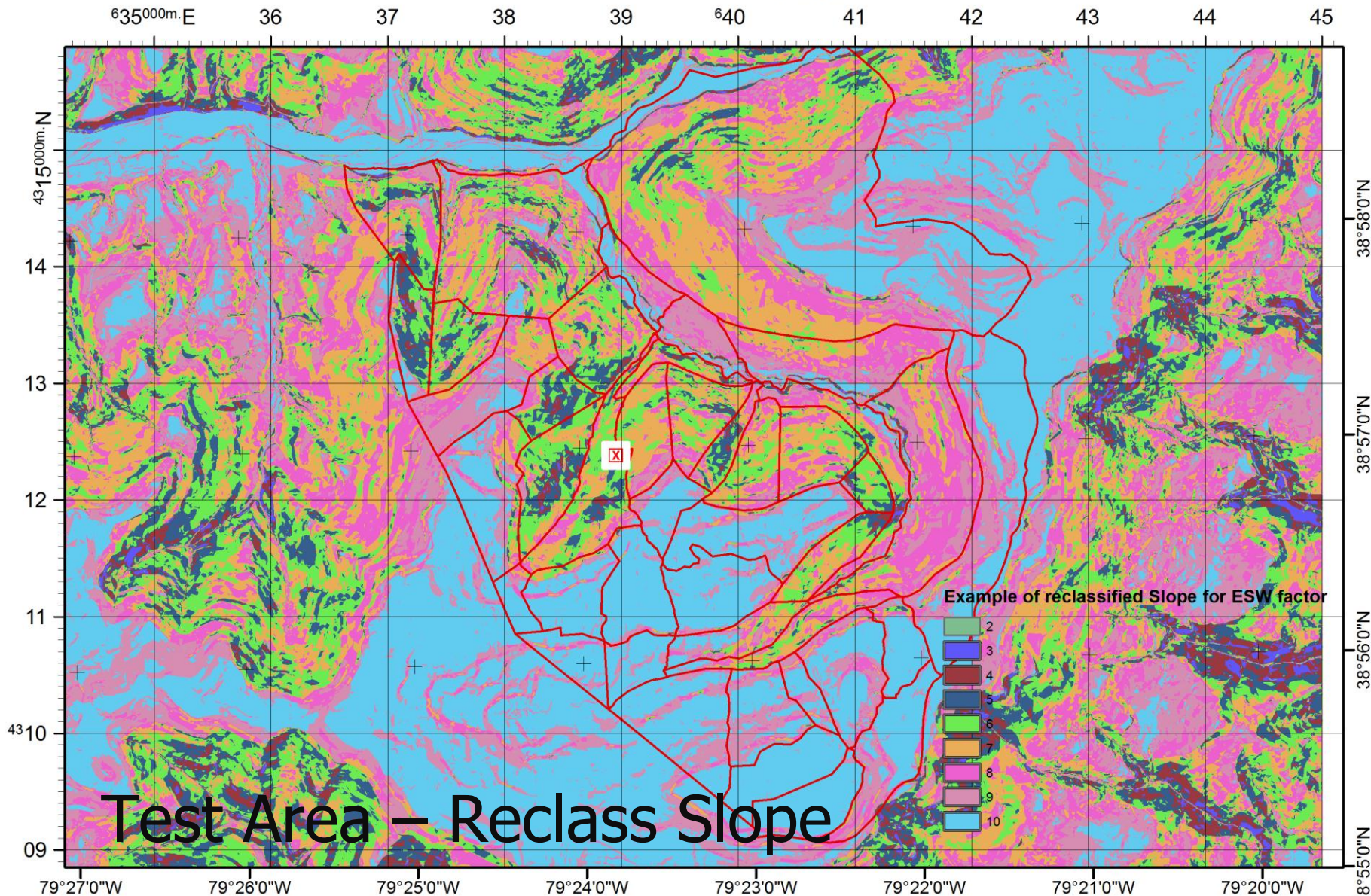


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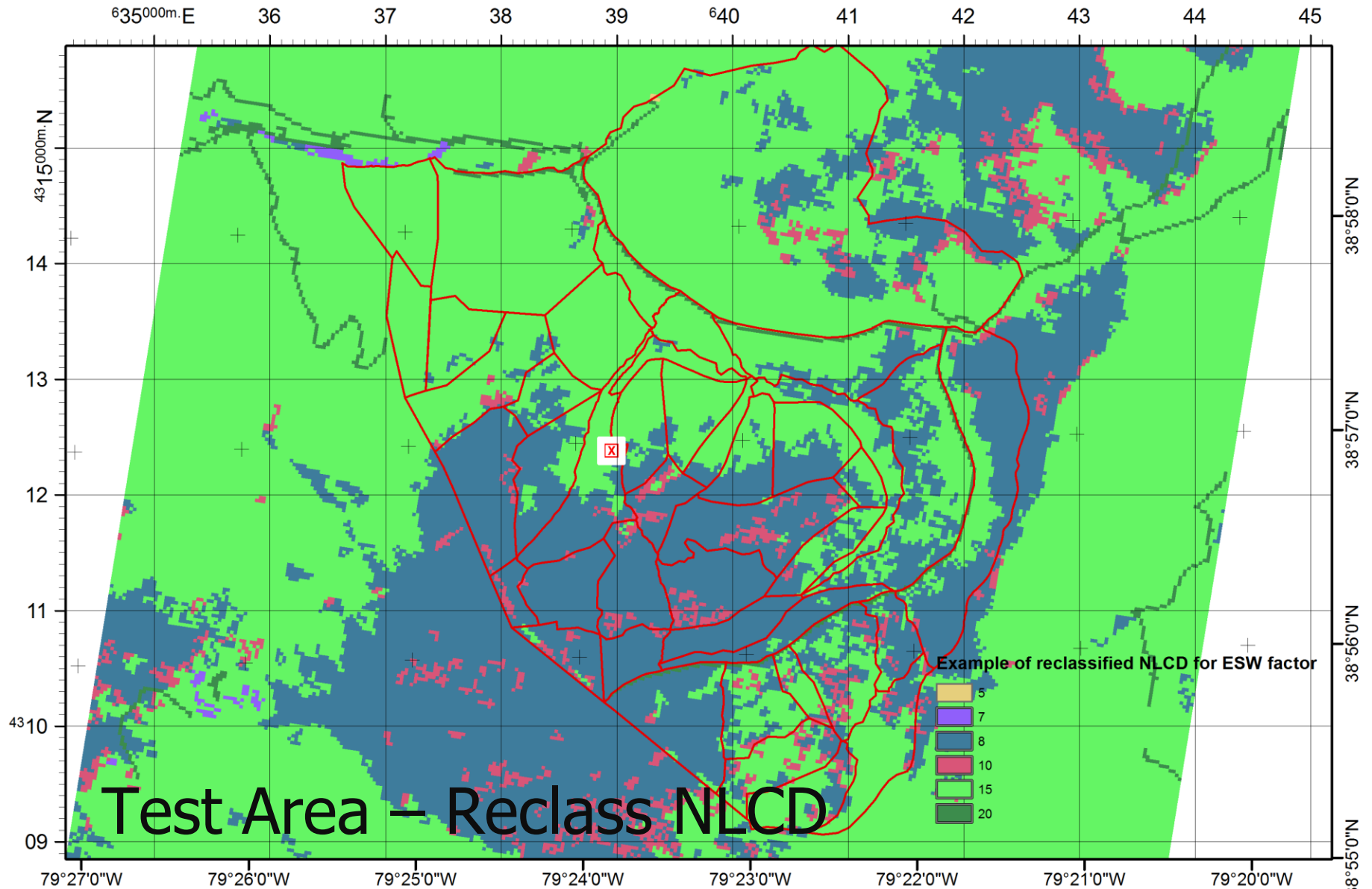


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