Estimating Probability of Success Rate

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Appalachian Search and Rescue Conference

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***

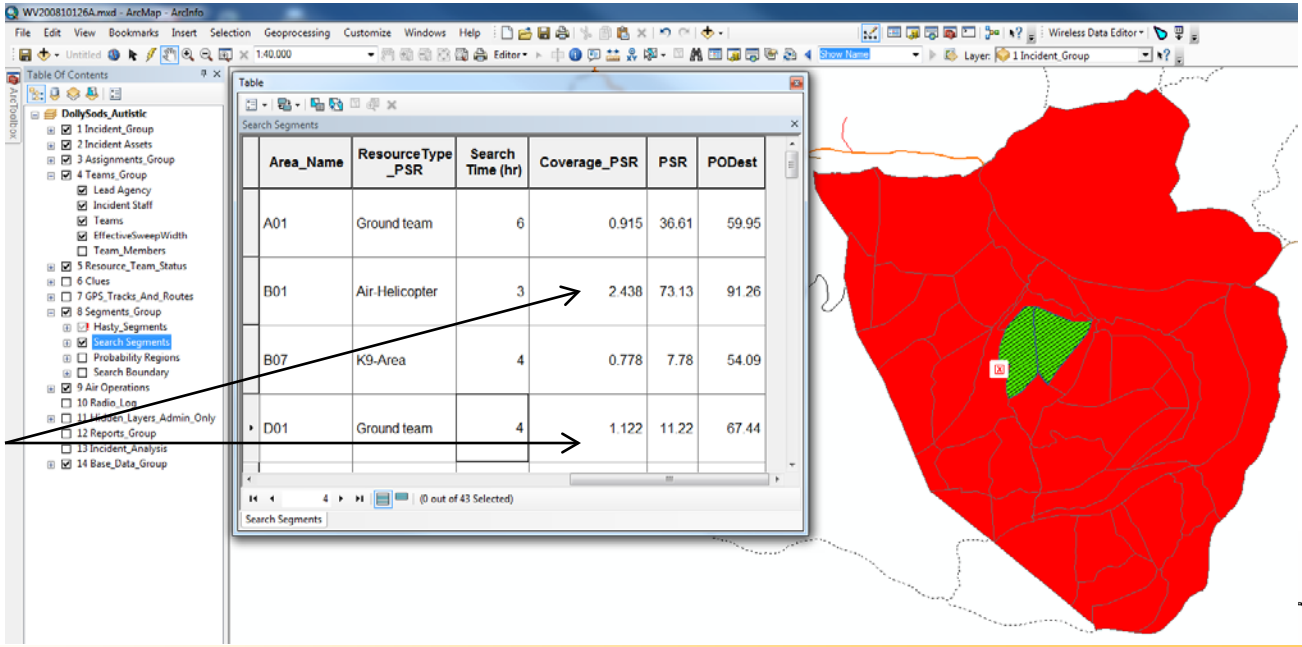
Resource Type Baseline Values for ESW

- 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

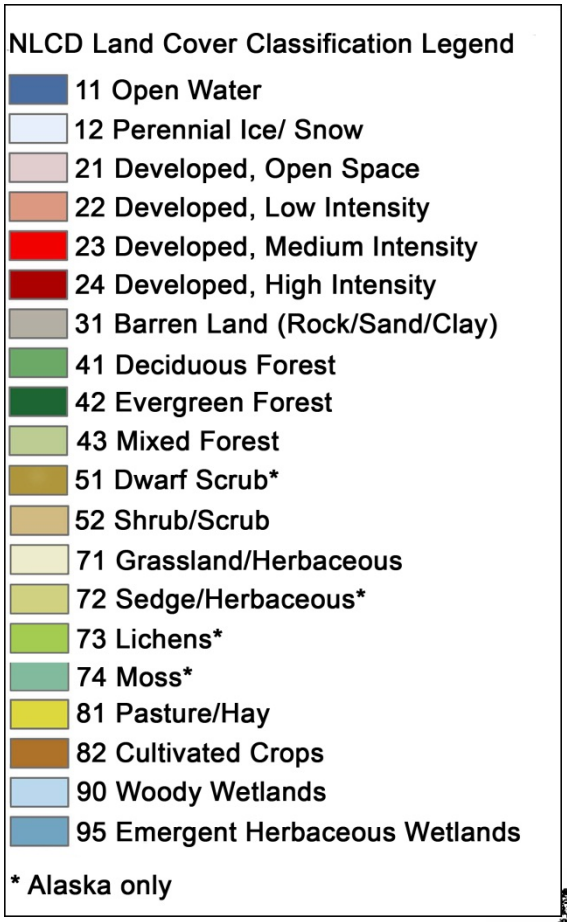
- Using terrain and environmental data to alter the Sweep Width (proportional to the baseline)
  - Develop a Proportionality Factor to alter the baseline ESW. Ideally utilize a multiple linear regression model
    - ESW = Baseline + B_1 * Slope + B_2 * LandCover + …
  - The current approach is to apply 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^o-6^o may have no impact on sweep width so it would receive a ESW_{factor} = 1.0
  - A slope of 45^o 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 90o 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

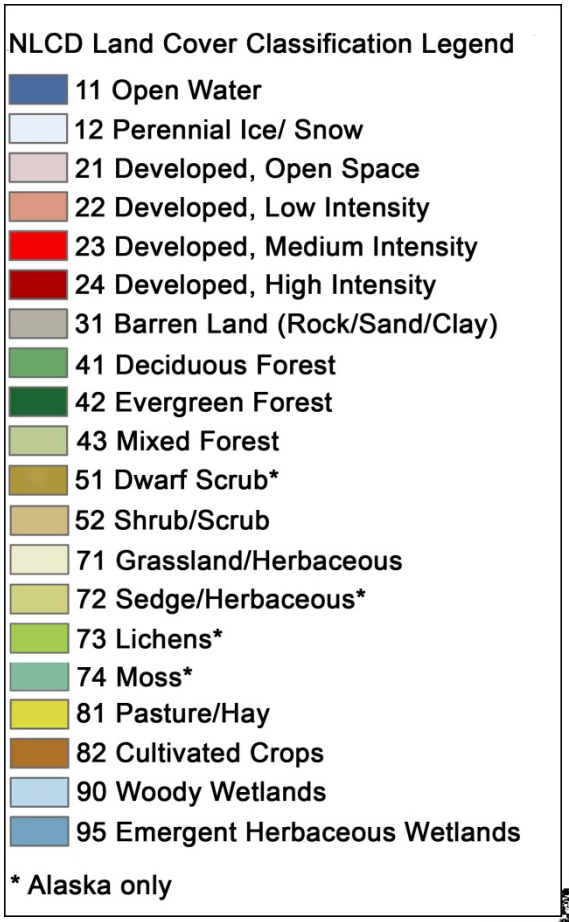
Reclassify Data Layers - NLCD

- 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”



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_{factor} = 1.0
  - For “Grassland/Herbaceous” the ESW_{factor} = 1.5
  - For “Open Water” the ESW_{factor} = 2.0 (looking for a floater).
  - For “Deciduous Forest” the ESW_{factor} = 0.5



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	

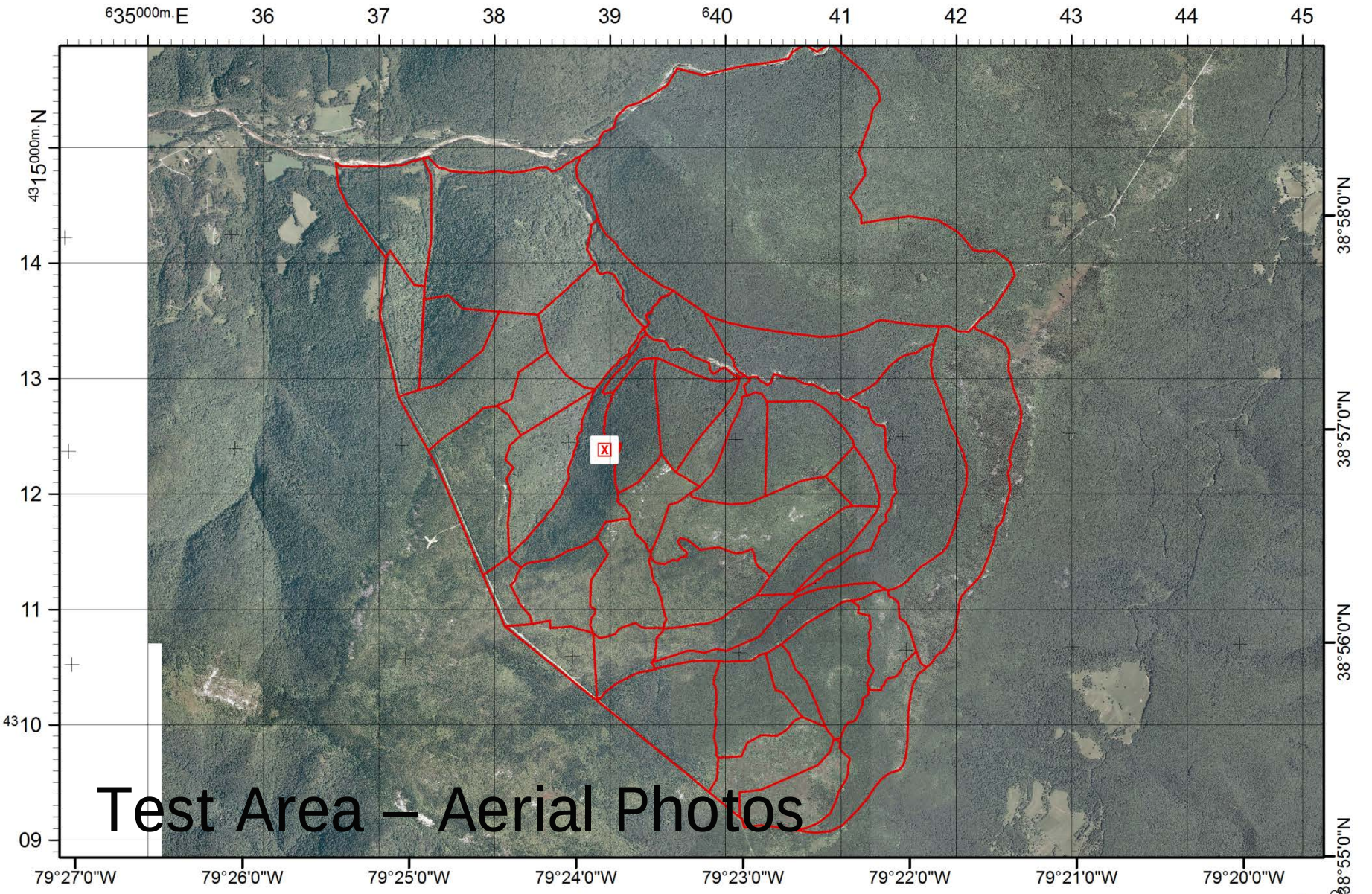
Classification	ESW_Factor
Mixed Forest	1.0
Dwarf Scrub	
Shrub/Scrub	
Grassland/Herbaceous	
Sedge/Herbaceous	
Lichens	
Moss	
Pasture/Hay	
Cultivated Crops	
Woody Wetlands	
Emergent Herbaceous Wetlands	

Map Name:

Mission Name: DollySods_Autistic
Mission Number: WV200810126A

Planning #:
Task #:

Date: 1/10/2012



ArcGIS provided by

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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	Grid Zone Designation
100,000-m Square ID	
PD	17 S

Map Datum: WGS 1984

TO CONVERT FROM MAP TO COMPASS BEARING ADD MN ANGLE.

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

MN
9 DEG
GN

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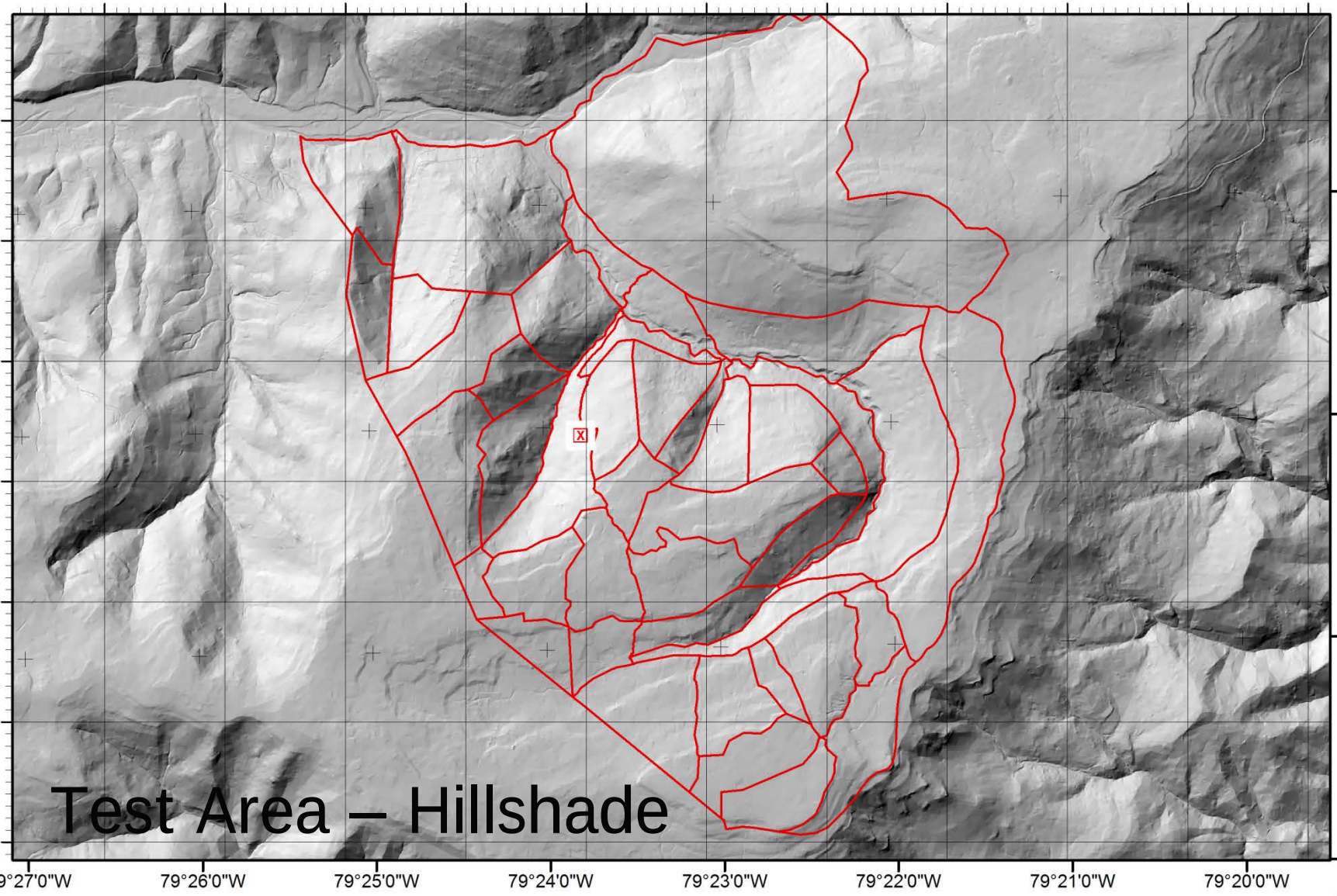

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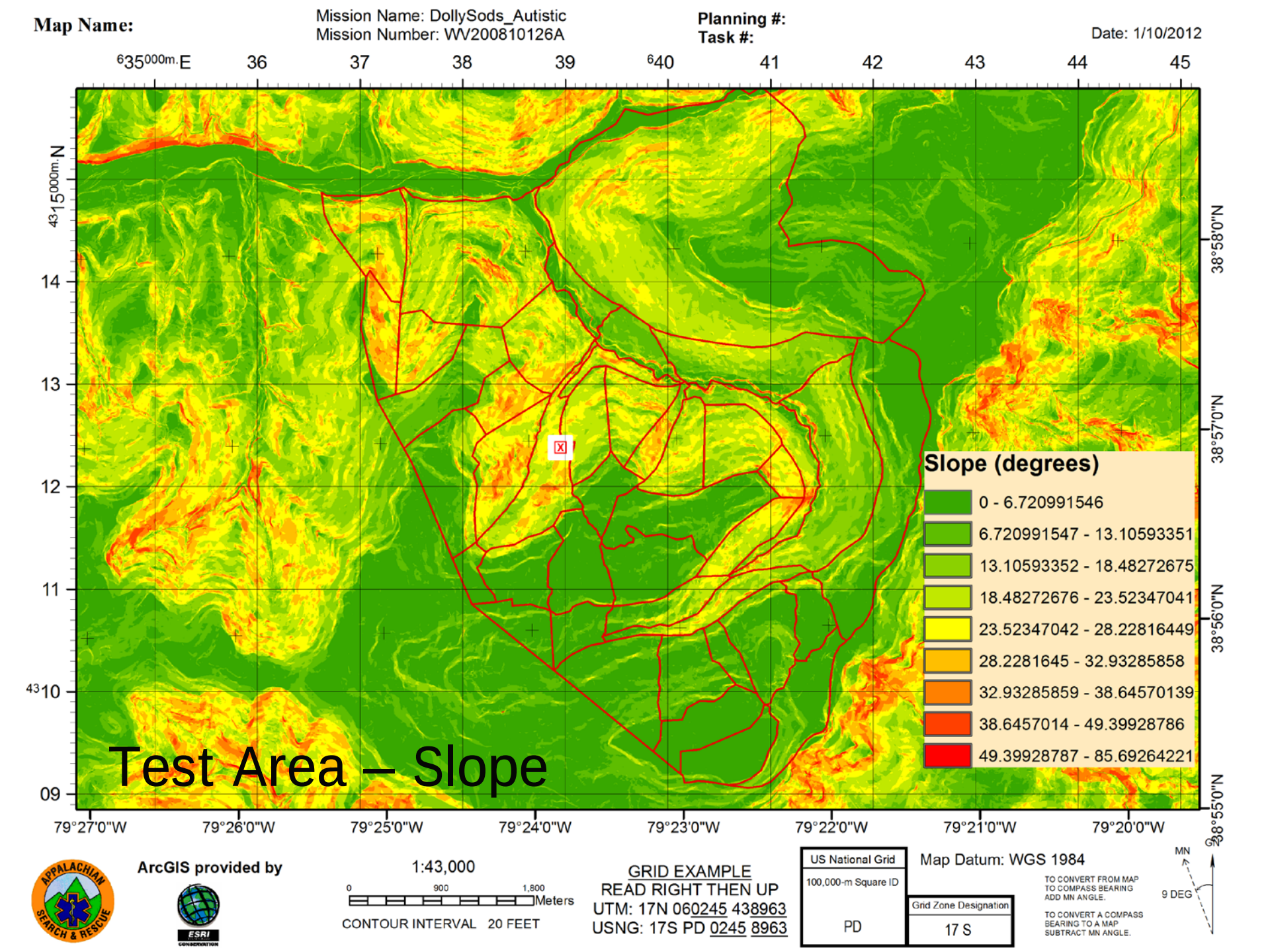
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635000m E
36
37
38
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640
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4315000m N
14
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12
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38°58'0"N
38°57'0"N
38°56'0"N
38°55'0"N
79°27'0"W
79°26'0"W
79°25'0"W
79°24'0"W
79°23'0"W
79°22'0"W
79°21'0"W
79°20'0"W
Slope (degrees)
0 - 6.720991546
6.720991547 - 13.10593351
13.10593352 - 18.48272675
18.48272676 - 23.52347041
23.52347042 - 28.22816449
28.2281645 - 32.93285858
32.93285859 - 38.64570139
38.6457014 - 49.39928786
49.39928787 - 85.69264221
Test Area – Slope
ArcGIS provided by
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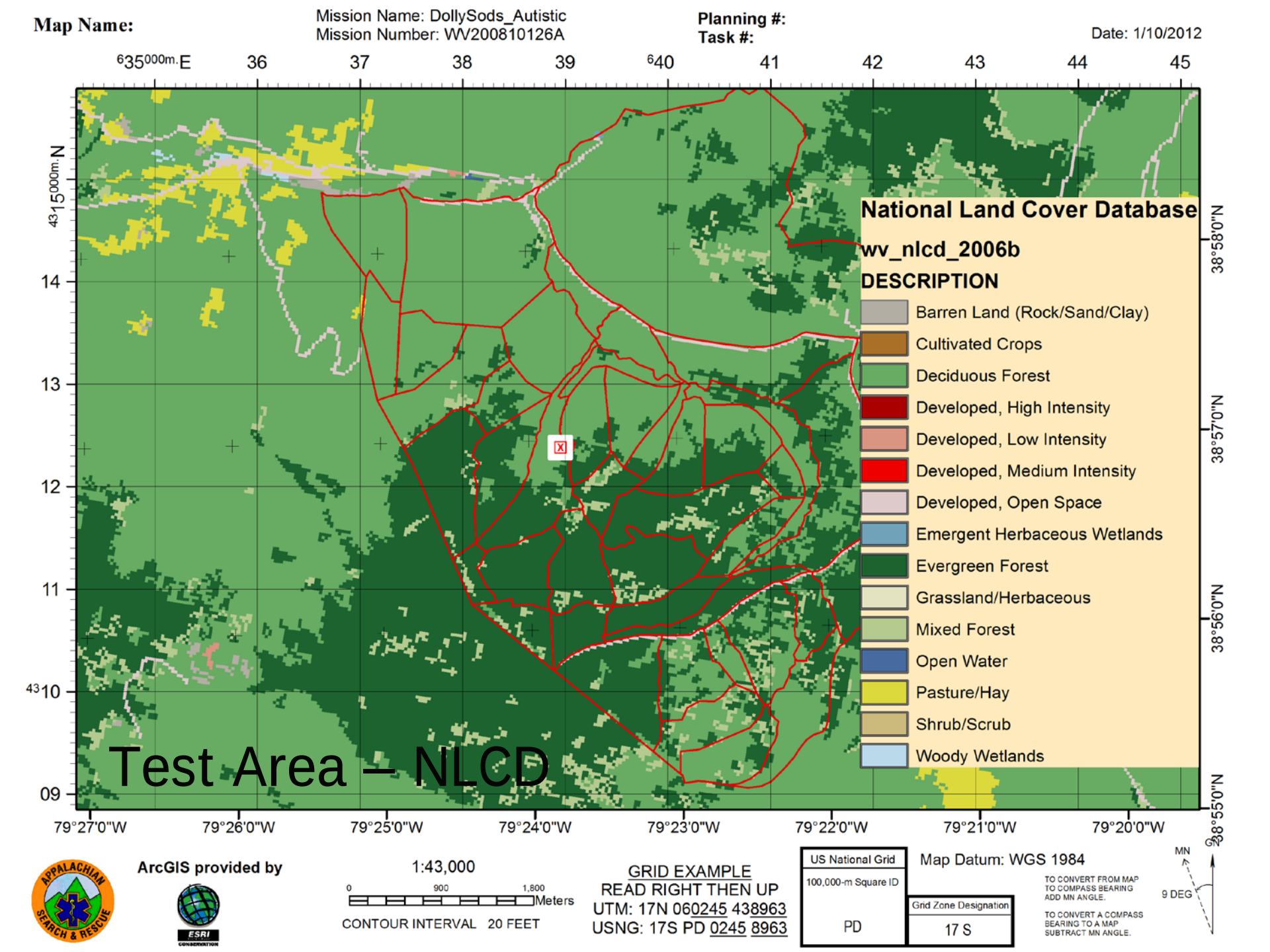
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79°24'0"W
79°23'0"W
79°22'0"W
79°21'0"W
79°20'0"W
National Land Cover Database
wv_nlcd_2006b
DESCRIPTION
Barren Land (Rock/Sand/Clay)
Cultivated Crops
Deciduous Forest
Developed, High Intensity
Developed, Low Intensity
Developed, Medium Intensity
Developed, Open Space
Emergent Herbaceous Wetlands
Evergreen Forest
Grassland/Herbaceous
Mixed Forest
Open Water
Pasture/Hay
Shrub/Scrub
Woody Wetlands
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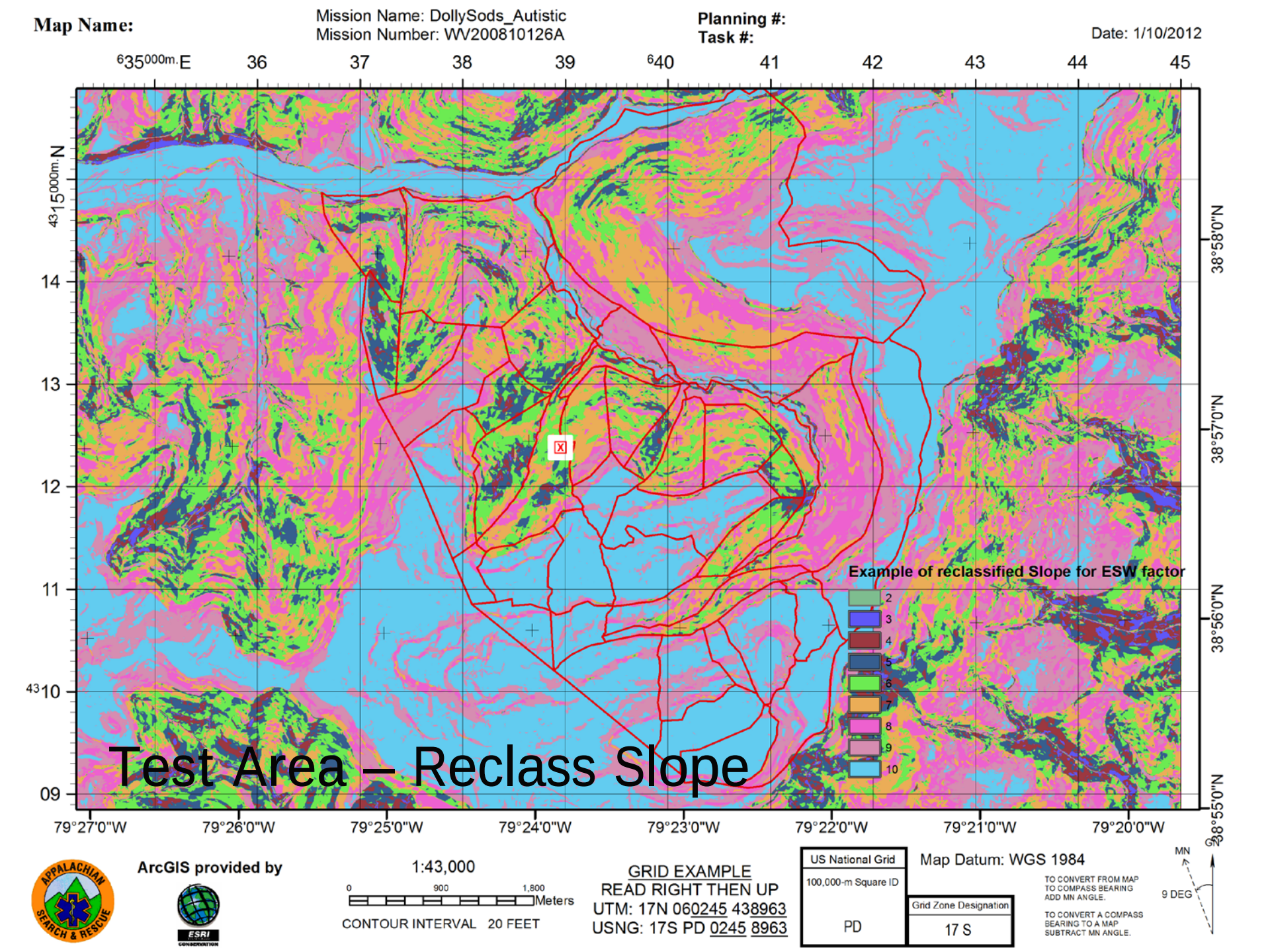
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79°23'0"W
79°22'0"W
79°21'0"W
79°20'0"W
Example of reclassified Slope for ESW factor
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Test Area – Reclass Slope
ArcGIS provided by
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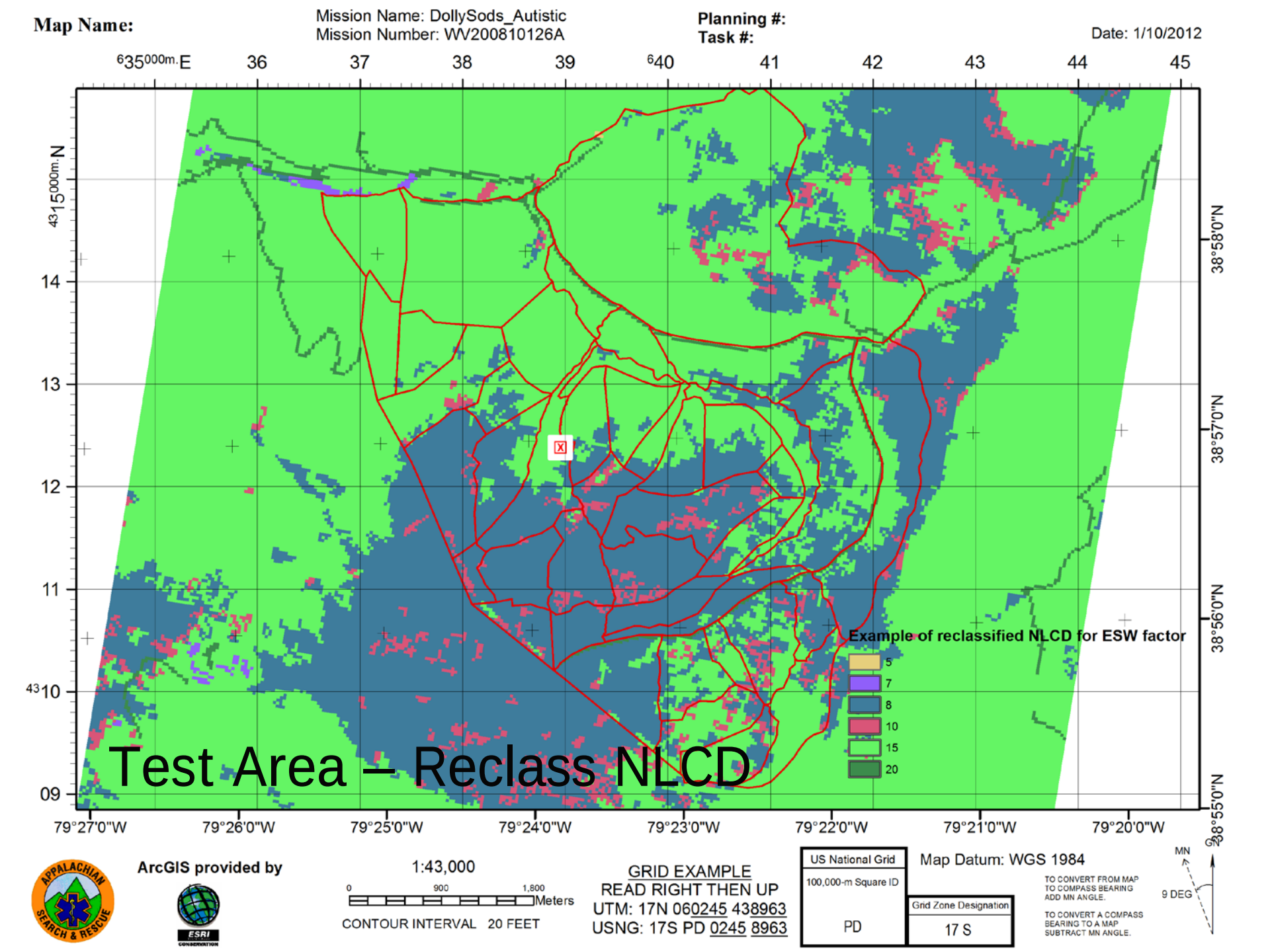
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79°26'0"W
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79°22'0"W
79°21'0"W
79°20'0"W
Example of reclassified NLCD for ESW factor
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Test Area – Reclass NLCD
ArcGIS provided by
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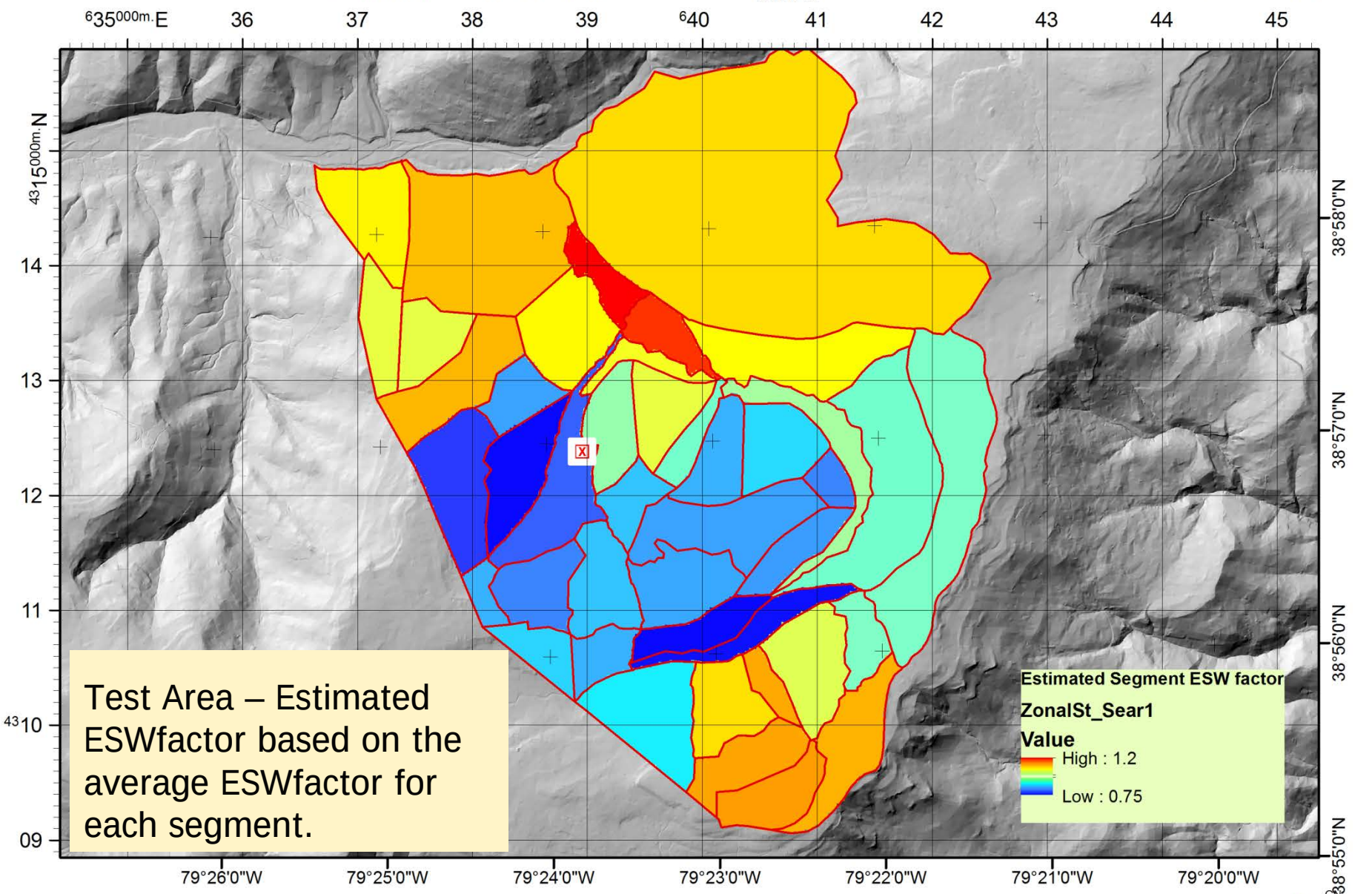

Test Area – Estimated ESWfactor based on the average ESWfactor for each segment.

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