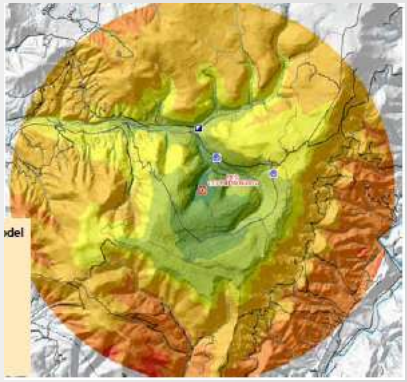
Search and Rescue - GIS



By: Don Ferguson

By:

Cole Brown, Search Manager

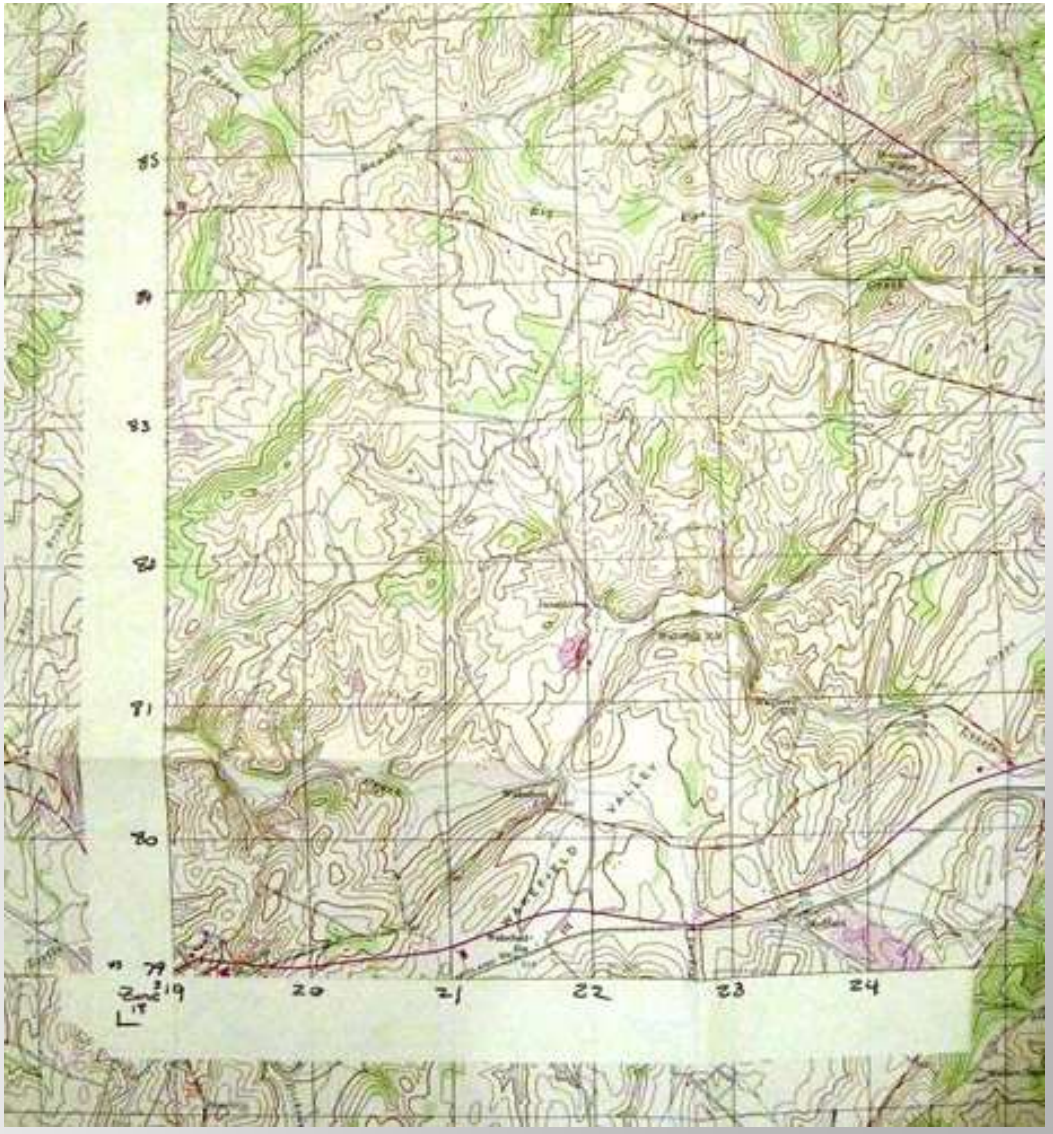
History of SAR Maps

- Most SAR Maps were Topographical Maps for USGS 7.5 Minute Quadrangle.

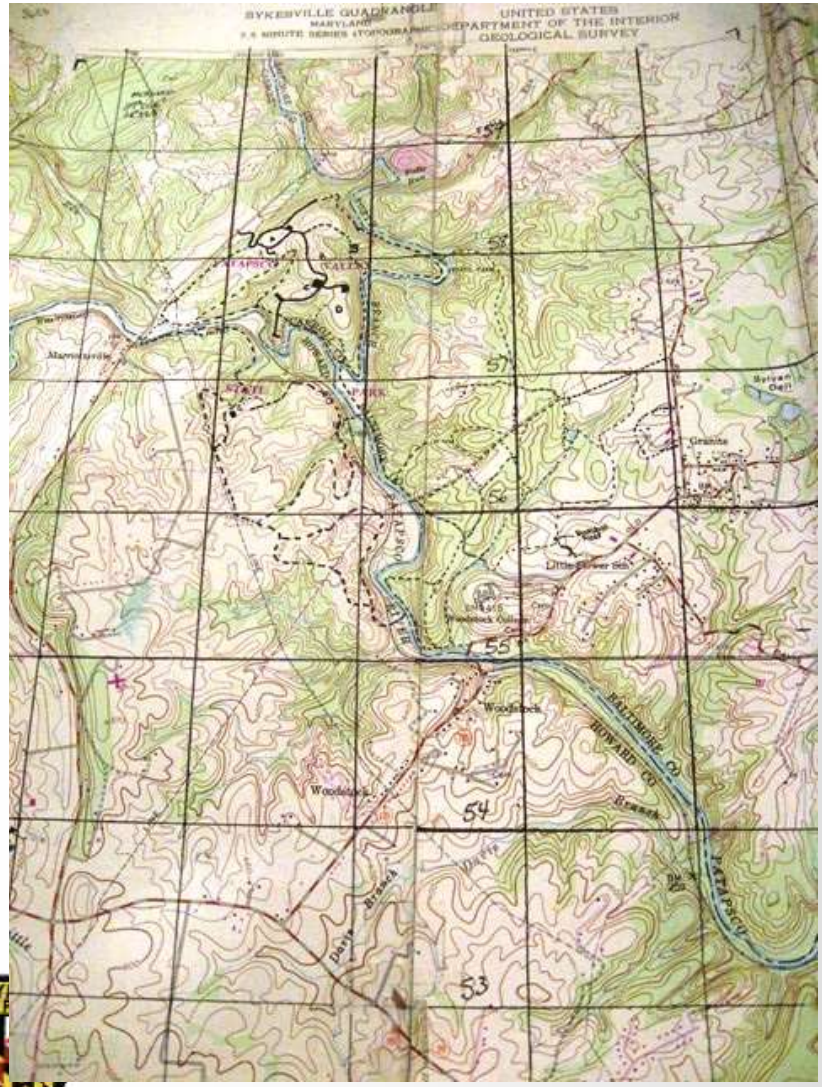
From 1987 to 2003

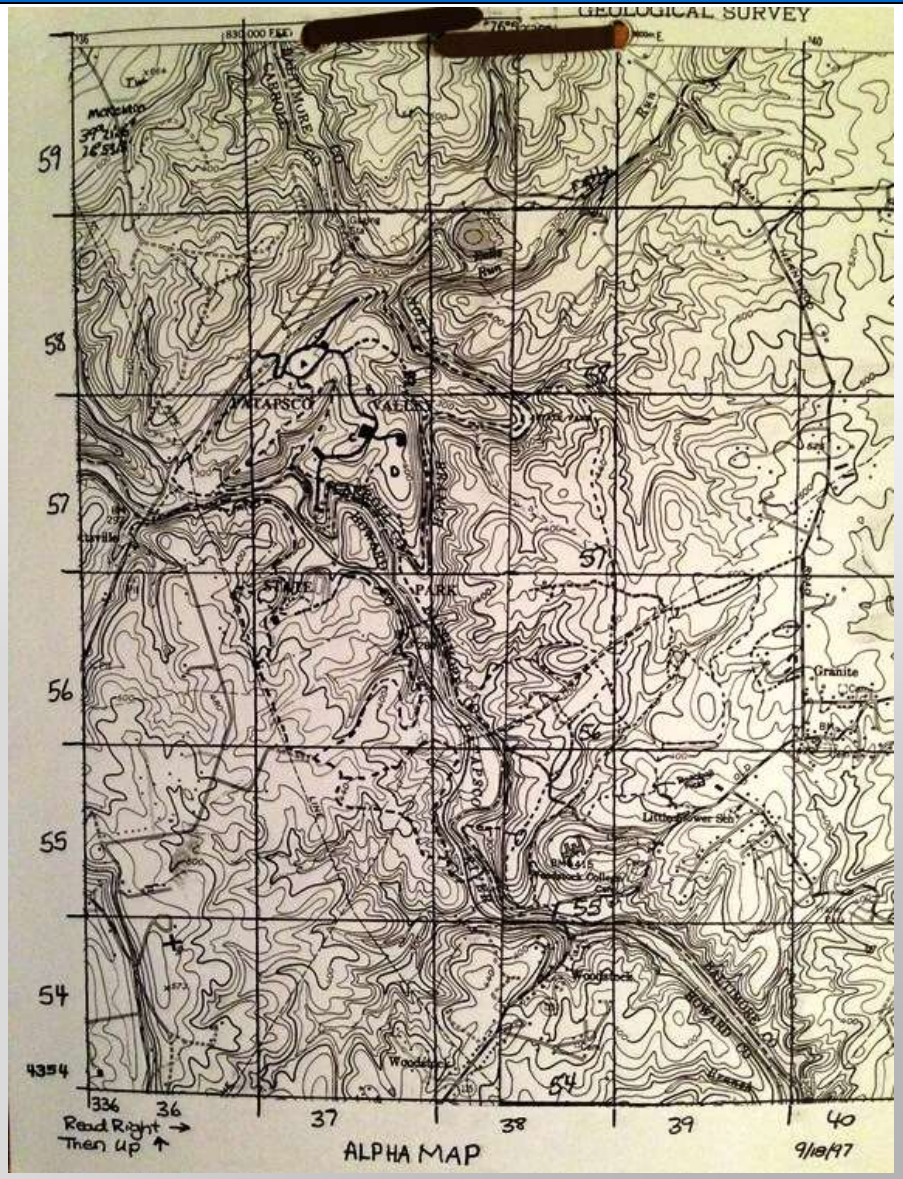
- Quads with no gridlines.
- Searchers with no GPS's
- No way to reproduce Maps
- Most searches occur across two maps.
- Some used a clear acetate Grid with no geo-reference.
- An ASTM Standard for Developing a Search Map was written and approved in 1997 using UTM for Geo-Reference.
- Search managers use to carry 450 quads for Maryland.

History of SAR Maps



History of SAR Maps

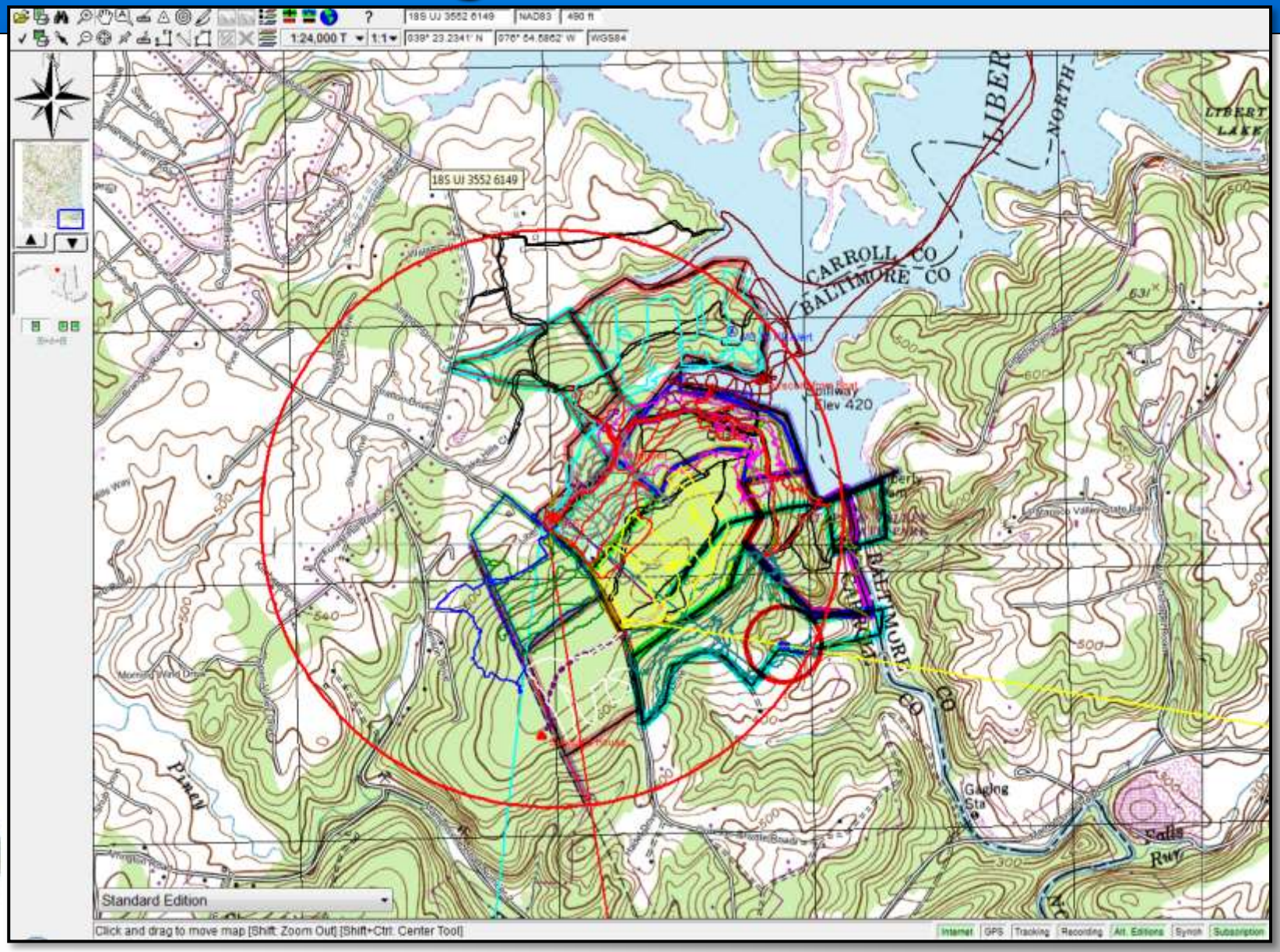




From 2002 to 2011

- A little company called Maptech, Inc. developed a GIS-lite application that had seamless topo's for all of Maryland.
- Terrain Navigator Pro – tnp terrainnavigator pro
- In 2002 TNP added Aerial Photo's at 1:12,000. But were black and white and later versions was color with leaf on.

Terrain Navigator Pro



Today

- All search managers have a Toughbook laptop with Terrain Navigator Pro and the Ortho's and topo's loaded
- They also have Cutewriter so they can make PDF maps for sending to the Barrack for Printing.
- They also have GPS's Fortrex 401
- We can download tracks from Searchers

Typical Search Needs

- Search map to mark the location for searchers to go and provide to searchers.
- Map to analyze the topography against the circumstances why they are missing and apply statistical information from Lost Person Behavior data.
- Plot the various clues and points of the map to determine if there is a pattern.

GIS in SAR is Expanding

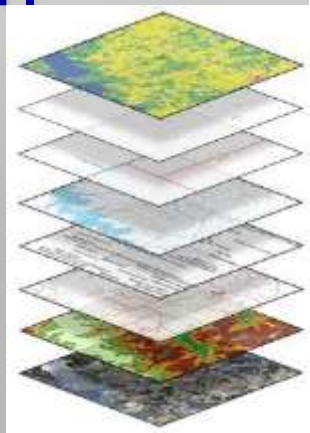
- Using ERSI ArcGIS and tools made for SAR we are able to make better maps and provide more analytics.
  - Field Mobility
  - Data Management
  - Planning and Analysis
  - Situational Awareness
  - Collaboration
  - Documentation

MAPSAR and IGT4SAR

- GIS Tool built on the ArcGIS platform created by a consortium of volunteer/professional SAR Personnel and software developers.
  - Effort was lead by Sierra Madre SAR Team, National Park Service and ESRI.
  - It allows for data collection, map generating, segmenting, tracking assets and assignments, and clue logging.
  - It also does behavioral and spatial analysis, automated form generation, probability theory and performance metrics.

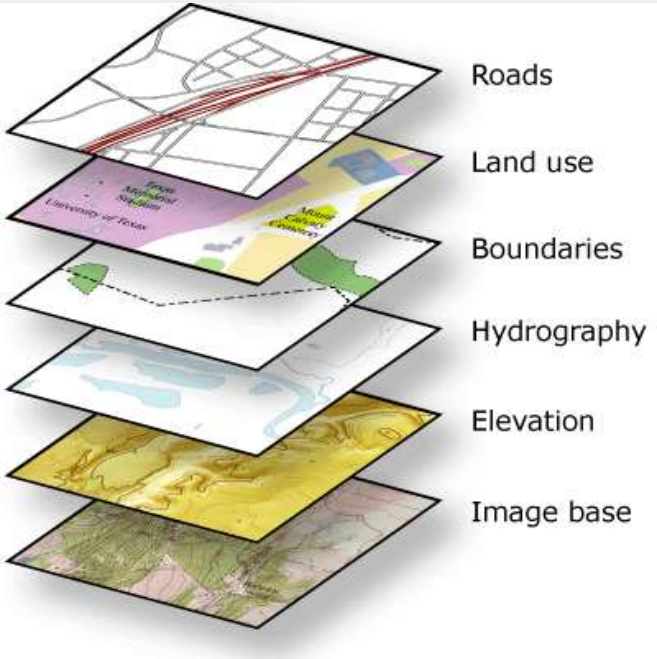
Minimal Essential Datasets (MEDS)

- For IGT4SAR to operate we need a good base map and a good internet connection.
- Base Map
  - USGS Topographical Map 1:24K
  - Ortho Color with Leaf off 1:12K or Better
  - Data Elevation Model (DEM) 6 or 3 meter.
  - National Land Cover Data 30 meter



Minimal Essential Datasets (MEDS)

– Feature Classes
- Road Centerlines
- Hydrology – Steams and Water Bodies
- Driveway
- Land Parcels
- Address Points
- City, County, State Boundary
- Cell Towers
- Trails
- Fence Lines



DEM and NLCD

- Cell Phone and Radio Propagation
- Communications Planning
- Mobility and Travel predictions
- Evaluate paths of least resistance
- Terrain analysis for collecting features
- Defining Search Segments boundaries

Currently

- We have access to 6” imagery via MD IMAP online.
  - *Need a disconnect statewide solution.*
- We have access to USGS Topo via ArcMap online.
  - *Need a disconnect statewide solution.*
- We have 75% access to DEM via Eastern Shore Regional GIS Cooperative.
  - *Need a disconnect statewide solution.*
- We have NLCD and Maryland Land Use Data

Standard Geo-Referencing in SAR

- United States National Grid
- NAD 83 – UTM Zone 18N or 17N

18S TJ 86985 57964

Federal Emergency Management Agency
Washington, D.C. 20472

APR 26 2001

Julie Binder Maitra
Standards Coordinator
US Geological Survey
590 National Center
Reston, Virginia 20192

Subject: FEMA's Recommendation on the Proposed US National Grid Standard

Dear Ms. Binder Maitra:

The Federal Emergency Management Agency (FEMA) supports the adoption of the US National Grid (USNG) as a standard for horizontal reference mapping in the United States. The FEMA program offices anticipate that use of this system for identifying locations among emergency management personnel and agencies will help save lives, reduce the costs of disaster, and enhance preparedness, response, recovery, and mitigation efforts. Particularly valuable is its compatibility with the system used by the National Guard and others, the Military Grid Reference System (MGRS). The USNG standard also appears reasonably compatible with current capabilities of the Global Positioning System (GPS), and has the potential to be quite effective as a locational tool if future GPS devices adopt the standard. FEMA recommends that the FGDC adopt the USNG system as the horizontal reference system for all general-purpose mapping.

Sincerely,

Michael K. Buckley, P.E., Director
Technical Services Division
Mitigation Directorate

CHAIRMAN OF THE JOINT CHIEFS OF STAFF INSTRUCTION

Directive current as of 8 July 2008

J-3
DISTRIBUTION: A, B, C, J

CJCSI 3900.01C
30 June 2007

POSITION (POINT AND AREA) REFERENCE PROCEDURES

Reference: DODD 5105.60, 11 October 1996, "National Imagery and Mapping Agency" (now known as the National Geospatial-Intelligence Agency).

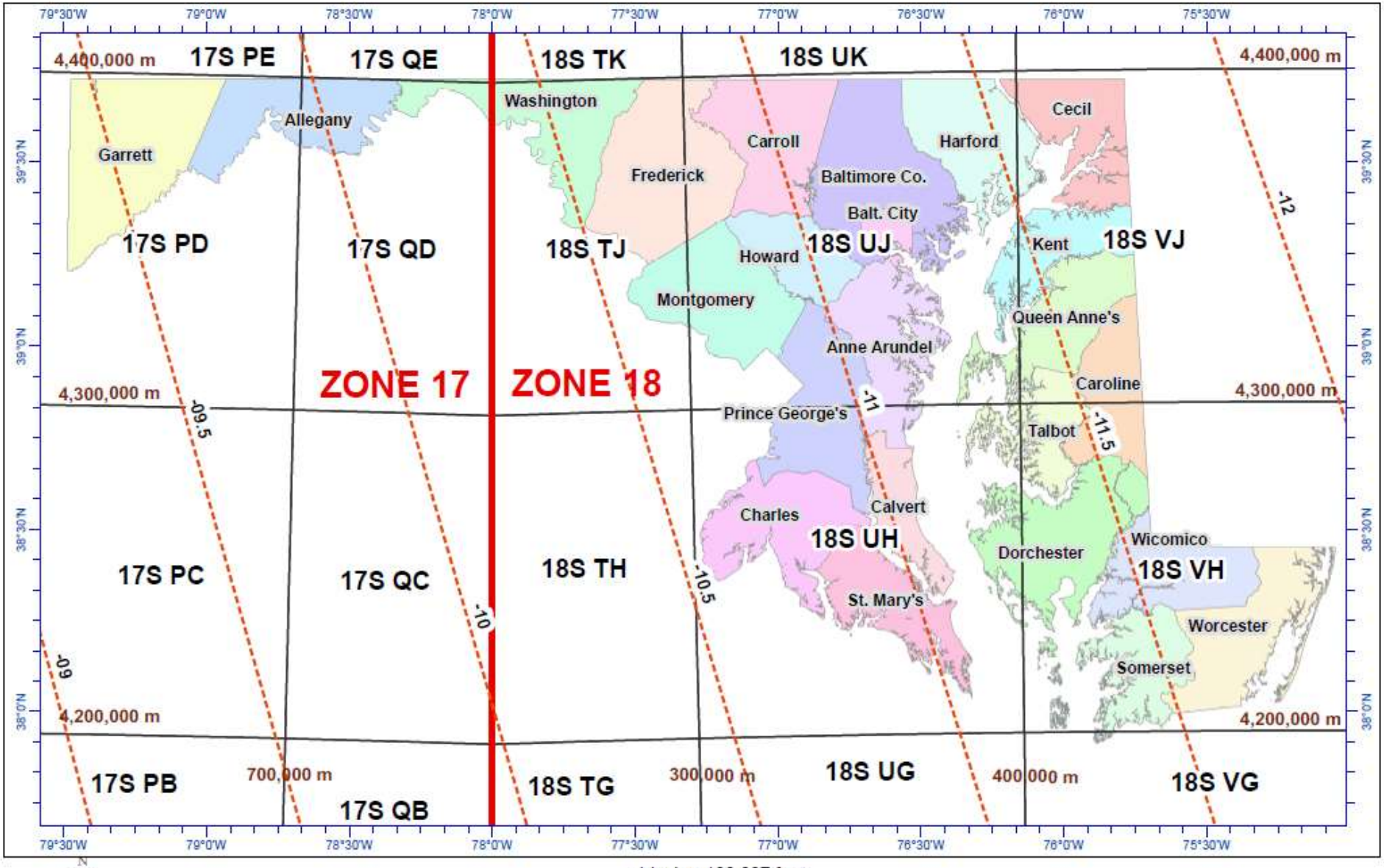
Standard Geo-Referencing in SAR

- Latitude and Longitude in Degree – Decimal Minute format
- Degrees, Decimal Minutes (to the Hundredth)

39° 20.85’ by 77° 28.45’

° = Degrees	**’ = Minutes**	**” = Seconds**	**. = Decimal**

Maryland US National Grid
100,000 Meter Grid with GZD Zone Designator



Developed by Cole Brown, 11/1/2007

1 inch = 166,667 feet

25 12.5 0 25 50 75 Miles

NSARC Geo-referencing Matrix for Catastrophic Incident SAR

Georeference System User	USNG	Latitude/Longitude DD-MM.mmm(1)	GARS
Land SAR Responder(2)	Primary	Secondary	N/A
Aeronautical SAR Responders (3)	Secondary	Primary	Tertiary
Air Space Deconfliction (4)	N/A	Primary	N/A
Land SAR Responder/ Aeronautical SAR Responder Interface (5)	Primary	Secondary	N/A
Incident Command:			
Air SAR Coordination	Secondary	Primary	N/A
Land SAR Coordination	Primary	Secondary	N/A
Area organization and accountability (6)	Secondary	Tertiary	Primary

International SAR GIS Standard

International Civil Aviation Organization

INFORMATION PAPER

ICAO/IMO JWG-SAR/17-IP.7
7 September 2010
ENGLISH ONLY

INTERNATIONAL MARITIME ORGANIZATION

Agenda item 4

IMO

**ICAO/IMO JOINT WORKING GROUP
ON HARMONIZATION OF AERONAUTICAL
AND MARITIME SEARCH AND RESCUE (ICAO/IMO JWG-SAR)**

SEVENTEENTH MEETING

Bremen, Germany, 27 September to 1 October 2010

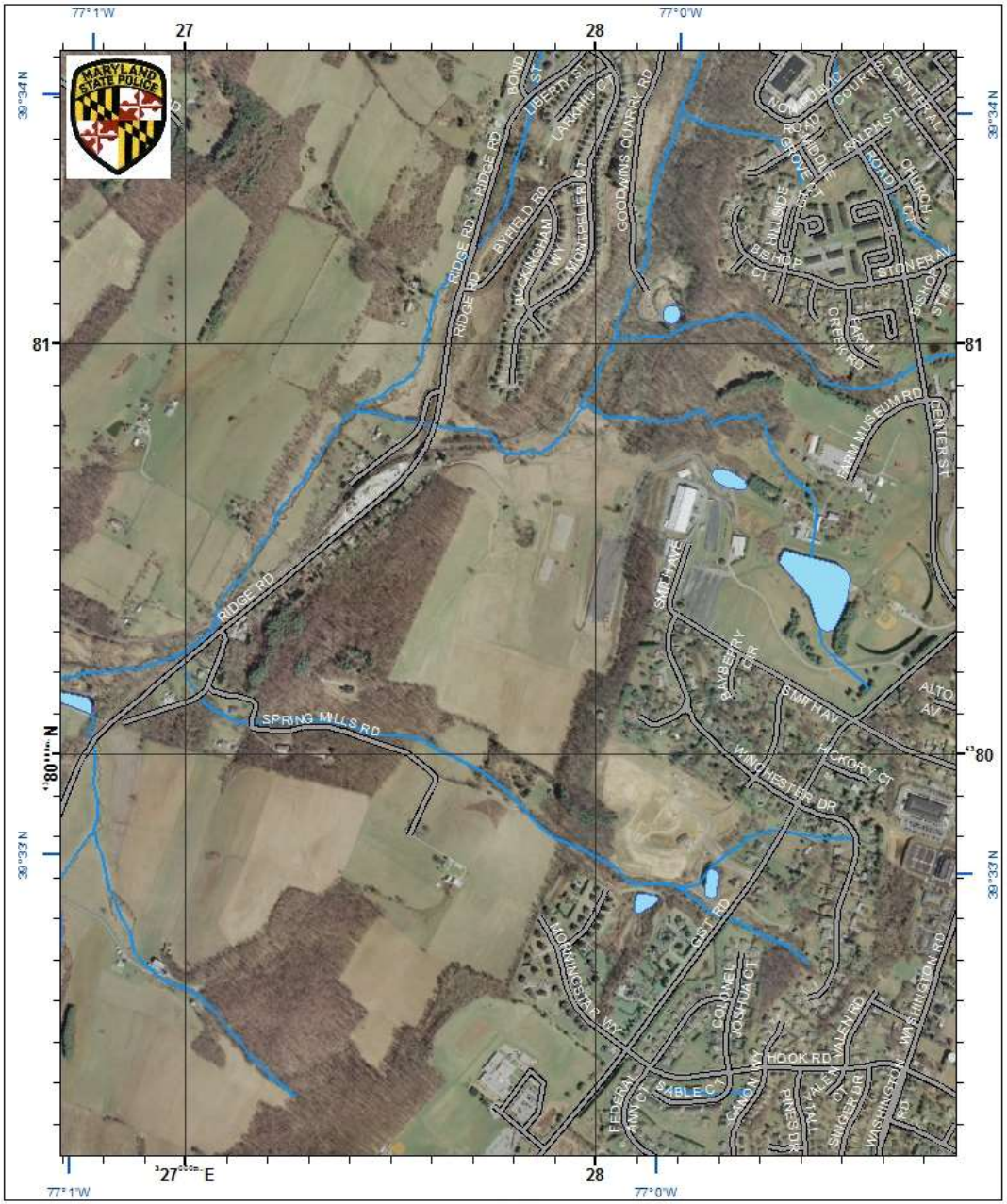
International SAR GIS Standard

3 Geo-Referencing Coordinates.

Aeronautical/Maritime SAR Responders – (USAF/USCG) - Aeronautical SAR responders use latitude and longitude for SAR response. The standard Latitude/Longitude format is Degrees, Decimal Minutes (DD° MM.mm'). Latitude is always read and written first noting "North" since the U.S. is North of the Equator. Longitude is always read and written last noting "West" since the U.S. is west of the Prime Meridian. *When speaking or reporting Latitude and Longitude use the following: For example, 39° 36.06'N by 76° 51.42'W, should be stated as per the following: "Three nine degrees, three six decimal zero six minutes North by seven six degrees, five one decimal four two minutes West." The words, "degrees," "minutes," and "decimal" must to be spoken.*

Land SAR Responders – (State/Local) - Land SAR responders primarily use U.S. National Grid/ Universal Transverse Mercator grid system for SAR Response. These systems are intended to create a more interoperable environment for developing location-based services within the United States and to increase the interoperability of location services appliances with printed map products by establishing a preferred nationally-consistent grid reference system. Standard Latitude/Longitude coordinates can be easily converted and relayed in USNG/UTM by using U.S. National Grid Conversion tool available at **http://www.ngs.noaa.gov/TOOLS/usng.shtml**

- This Map has:
  - Latitude / Longitude in the right format
  - US National Grid
  - Magnetic Declination
  - It has the right Datum NAD83 or WGS 84



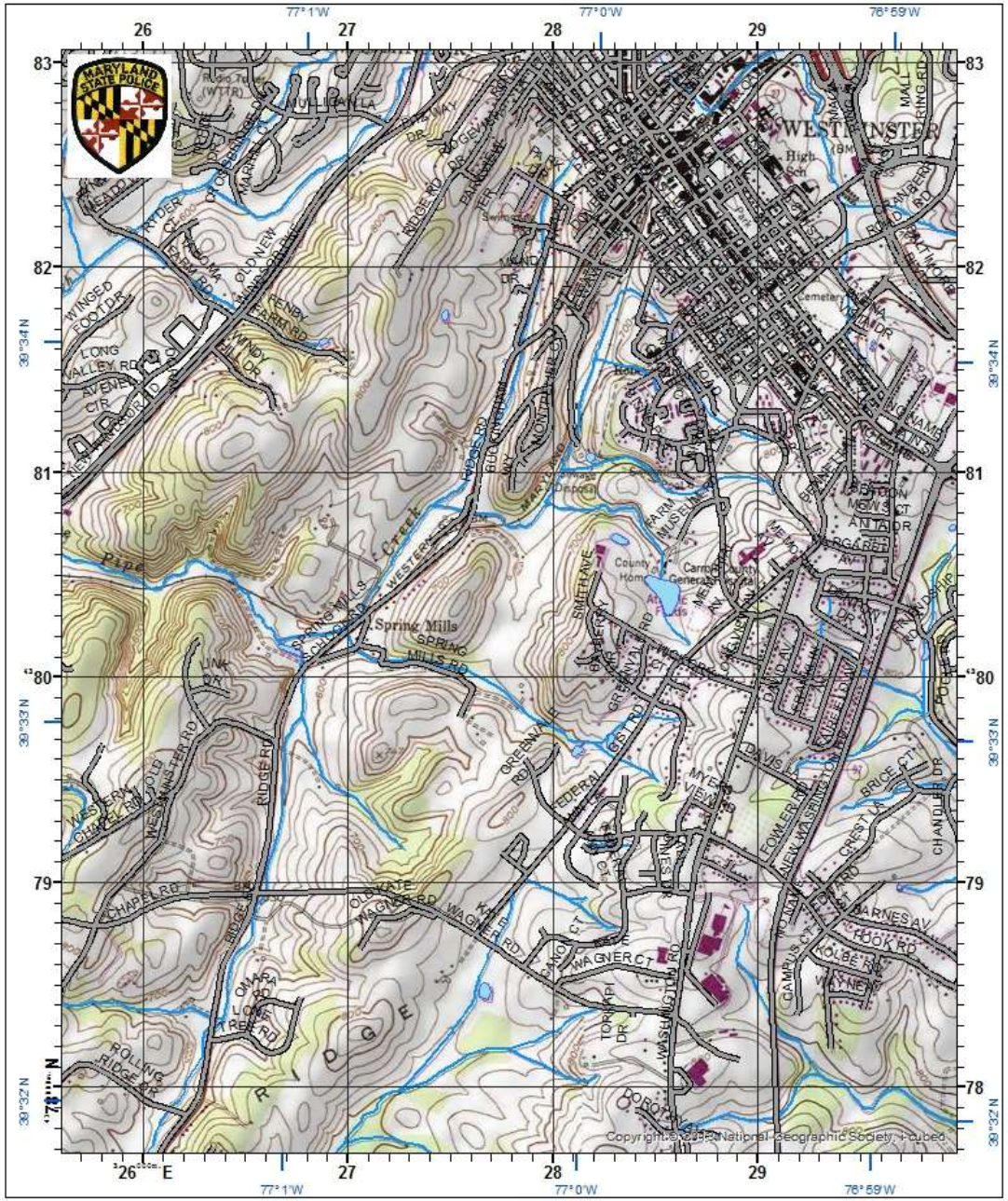
US National Grid
Grid Zone Designation
18S
100,000-m Square ID
UJ

1:12,000
1 inch = 1,000 feet
100 0 500 Meters
328 0 1,640 Feet

Revised Date: 1/10/2014

MN
Mag Dec (dd.dd E/W)
11.13 W

Coordinate System:
United States National Grid
NAD 1983 UTM Zone 18N
Datum: North American 1983



US National Grid
Grid Zone Designation
18S
100,000-m Square ID
UJ

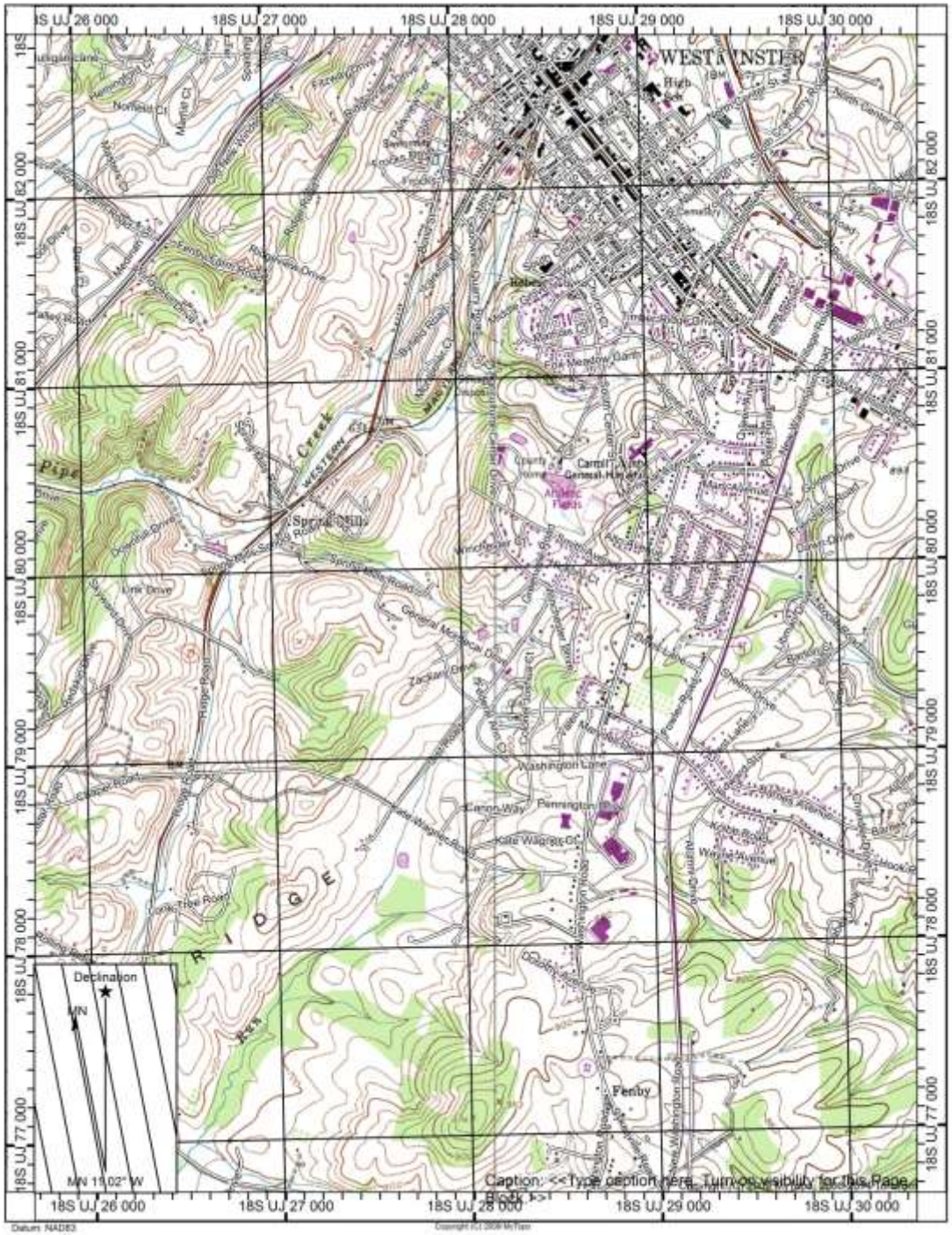
1:24,000
1 inch = 2,000 feet
200 0 1,000 Meters
656 0 3,280 Feet

Revised Date: 1/10/2014

MN

Mag Dec (dd.dd E/W)
11.13 W

Coordinate System:
United States National Grid
NAD 1983 UTM Zone 18N
Datum: North American 1983


18S UJ 26 000
18S UJ 27 000
18S UJ 28 000
18S UJ 29 000
18S UJ 30 000
18S UJ 82 000
18S UJ 81 000
18S UJ 80 000
18S UJ 79 000
18S UJ 78 000
18S UJ 77 000
WESTMINSTER
Pipe
Creek
Spring Hill
Fox Meadow Farm
Washington Lane
Pennington Place
Fenby
RIDGE
Declination
MN
MN 19.02° W
Caption: <<Type caption here. Turn on visibility for this layer.>>
Datum: NAD83

Case Study

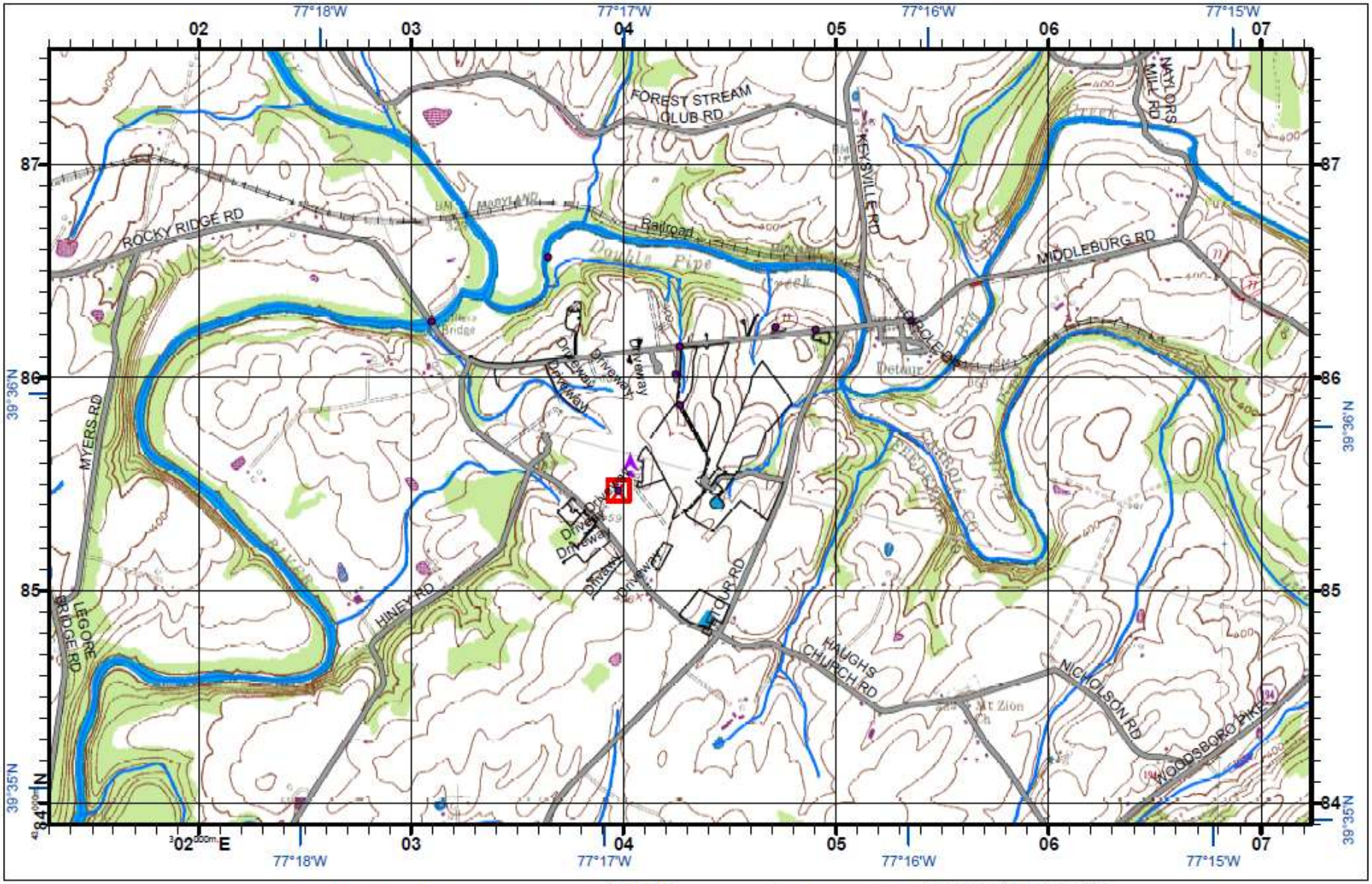
- Mr. Frank Sottile, 90 yr. old Male
- Was at a family Picnic at Family Farm in Keymar, MD.
- Went Missing 9/1/2012 at 16:00
- He was with his daughter and family.
- He walked out the driveway of the farm to review the farms condition. He was disappointed. In 10 min he was gone.
- They currently live in Montgomery County.
- Search started at 17:00 and ended at 09:00 over 16 hrs
- He was found alive and in good health approx. 1.5 miles away.

Map Name: Woods

Mission Name: Keymar 09-01-12
Mission Number: Keymar09012012

Planning #: 01-05
Task #: 01-05

Date: 10/25/2013



CONTOUR INTERVAL 20 FEET

ArcGIS provided by

0 120 240 480 720 960 1,200 Meters

1:24,000
1 inch = 2,000 feet

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

US National Grid	
Grid Zone Designation	
18S	
100,000-m Square ID	
UJ	

NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

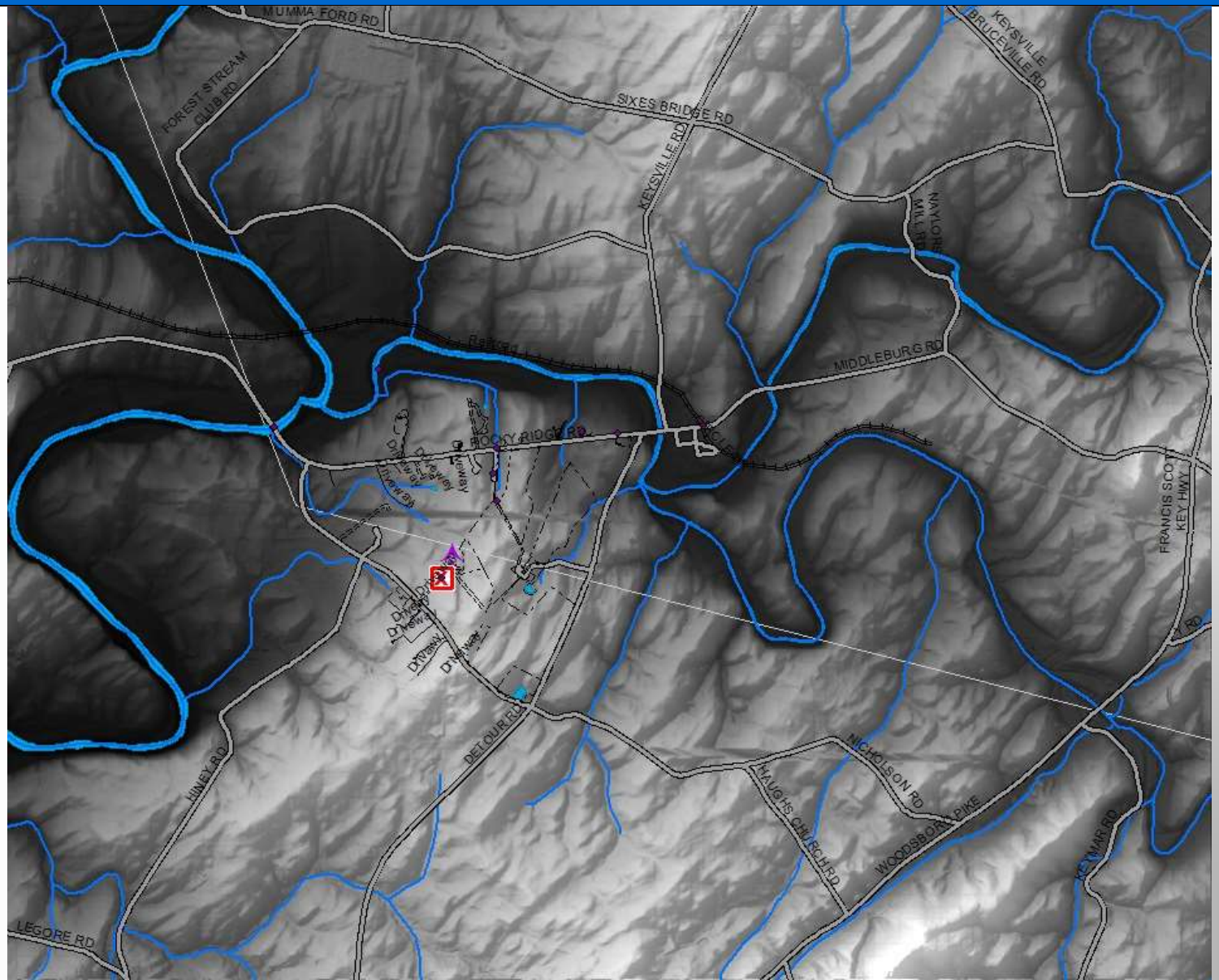
Mag Dec (dd.dd E/W)
9.0 W

NORTH

TO CONVERT FROM MAP TO COMPASS BEARING ADD MN ANGLE.

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

DEM with Hillshade



Slope


FOREST STREAM CLUB RD
SIXES BRIDGE RD
KEYSVILLE BRUCEVILLE RD
MAYLORS MILL RD
KEYSVILLE RD
Railroad
MIDDLEBURG RD
GRIDDOCK RIDGE RD
Driveway
DETOUR RD
HINEY RD
NICHOLSON RD
HAUGHS CHURCH RD
WOODSBORO PIKE
FRANCIS SCOTT KEY HWY
KEYMAR RD
LEGORE RD

Track Offset

Map Name: Woods

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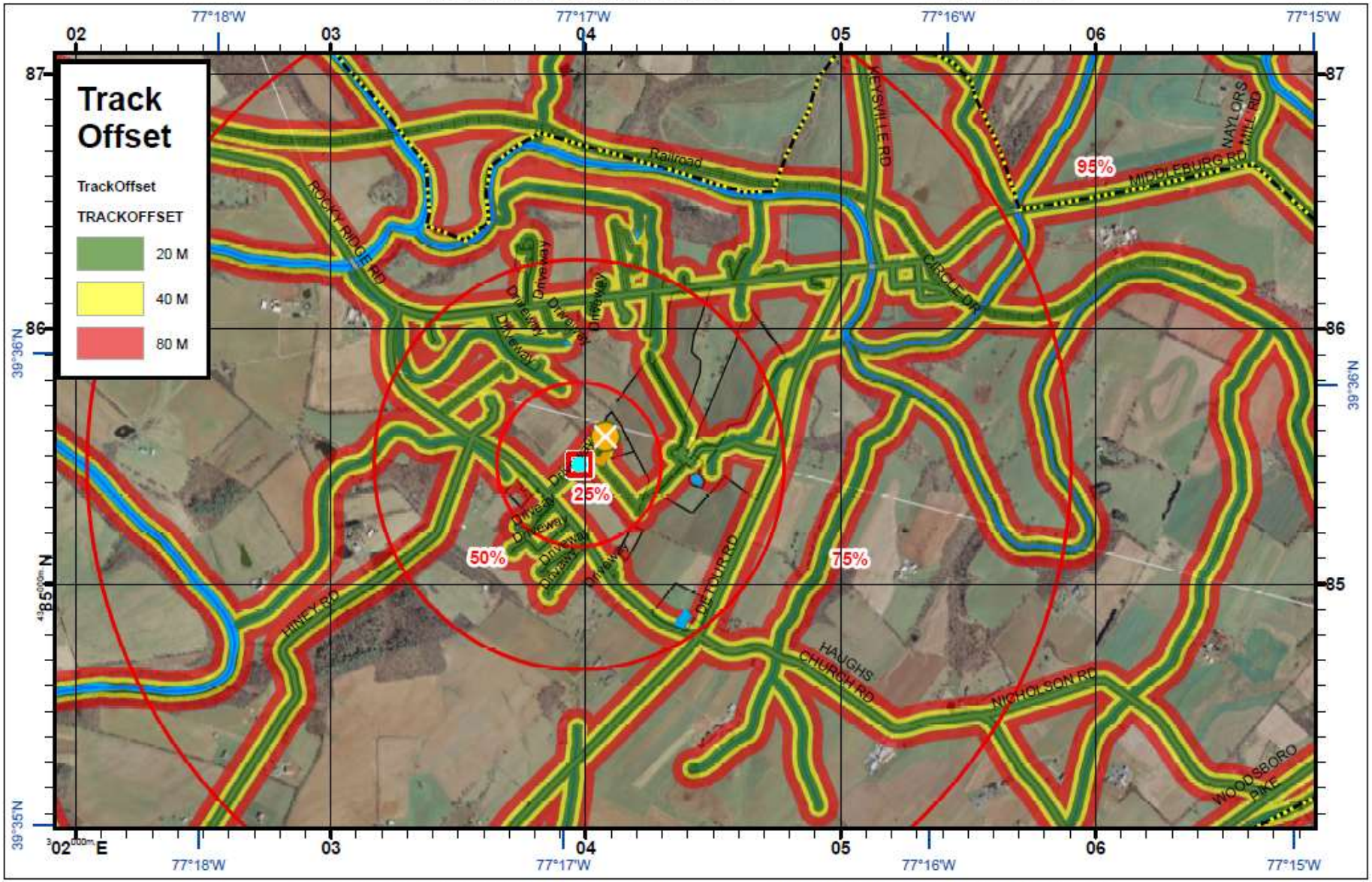
Task #: 01-05

Date: 10/13/2013



ArcGIS provided by

CONTOUR INTERVAL 20 FEET

0 100 200 400 600 800 1,000 Meters

1:20,000
1 inch = 1,667 feet

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

US National Grid	
Grid Zone Designation	
18S	
100,000-m Square ID	
UJ	

NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

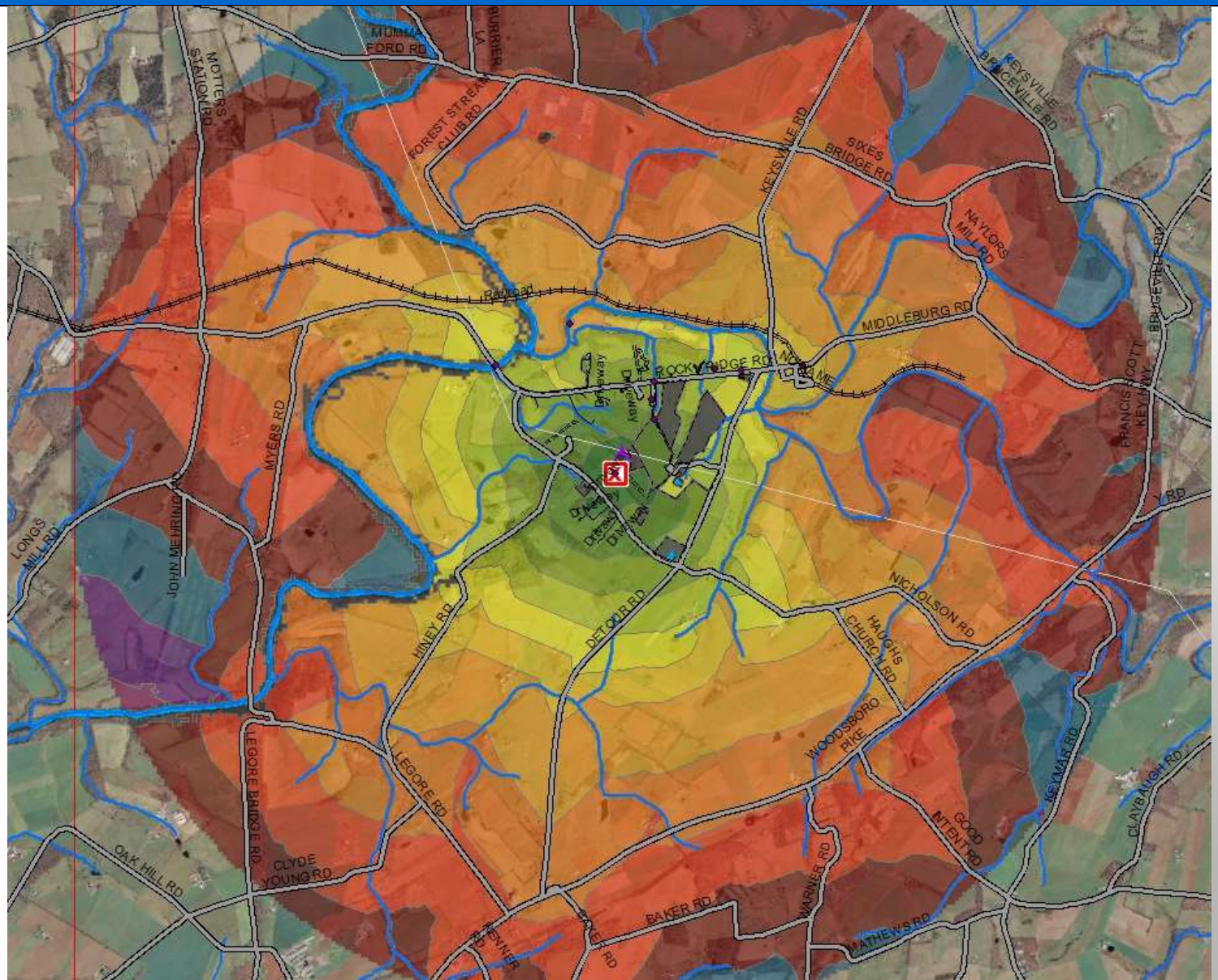
Mag Dec (dd.dd E/W)
9.0 W

NORTH

TO CONVERT FROM MAP TO COMPASS BEARING ADD MN ANGLE.

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

Mobility Model

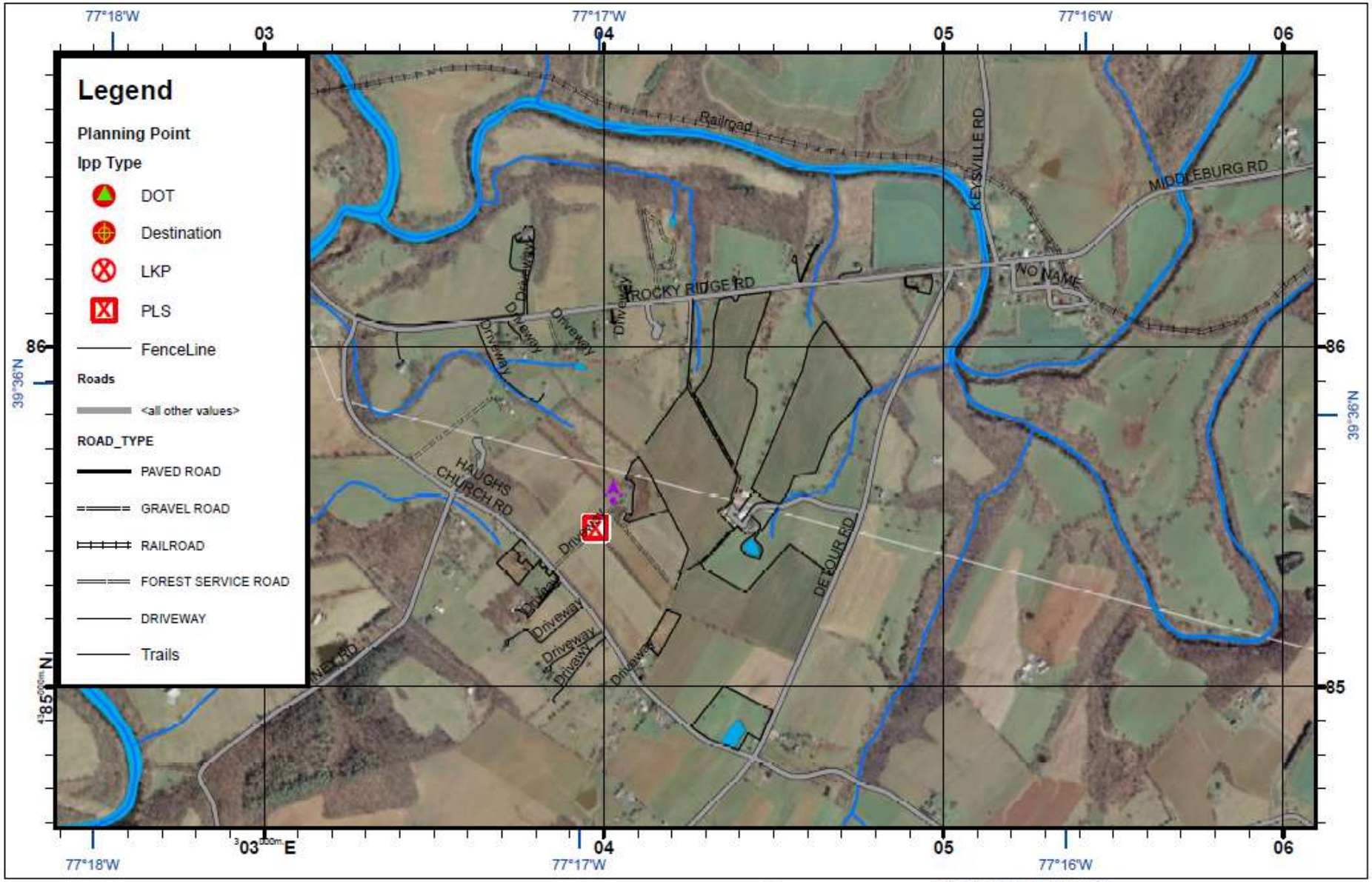


Map Name: Woods

Mission Name: Keymar 09-01-12
Mission Number: Keymar09012012

Planning #: 01-05
Task #: 01-05

Date: 10/13/2013



ArcGIS provided by

CONTOUR INTERVAL 20 FEET

0 75 150 300 450 600 750 Meters

1:15,000
1 inch = 1,250 feet

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

US National Grid	
Grid Zone Designation	
18S	
100,000-m Square ID	
UJ	

NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

Mag Dec (dd.dd E/W)
9.0 W

NORTH

TO CONVERT FROM MAP TO COMPASS BEARING ADD MN ANGLE.

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

Map Name: Woods

Mission Name: Keymar 09-01-12
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Planning #: 01-05
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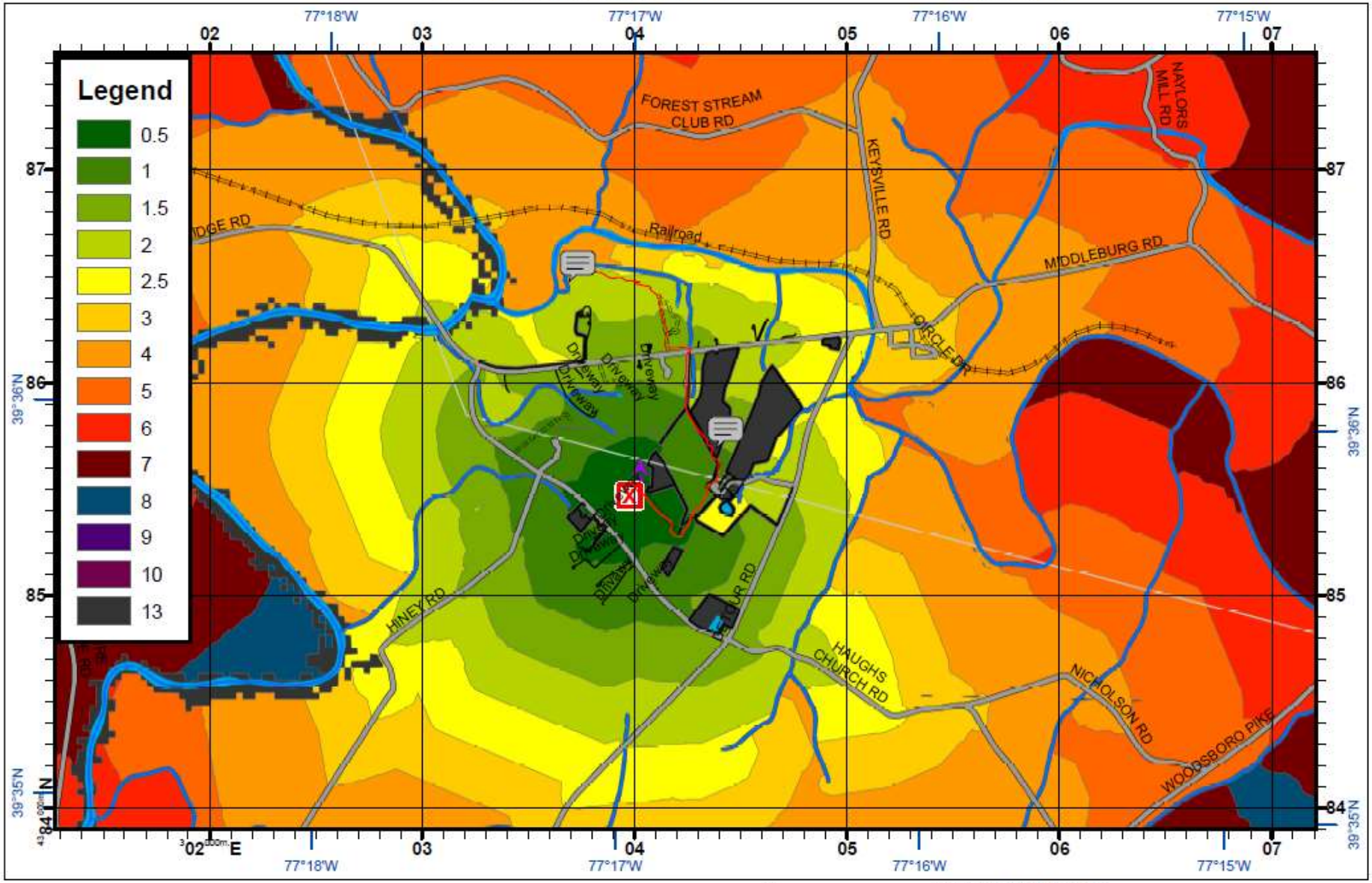


CONTOUR INTERVAL 20 FEET

0 120 240 480 720 960 1,200 Meters

1:24,000
1 inch = 2,000 feet

ArcGIS provided by ESRI

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

US National Grid	
Grid Zone Designation	
18S	
100,000-m Square ID	
UJ	

NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983

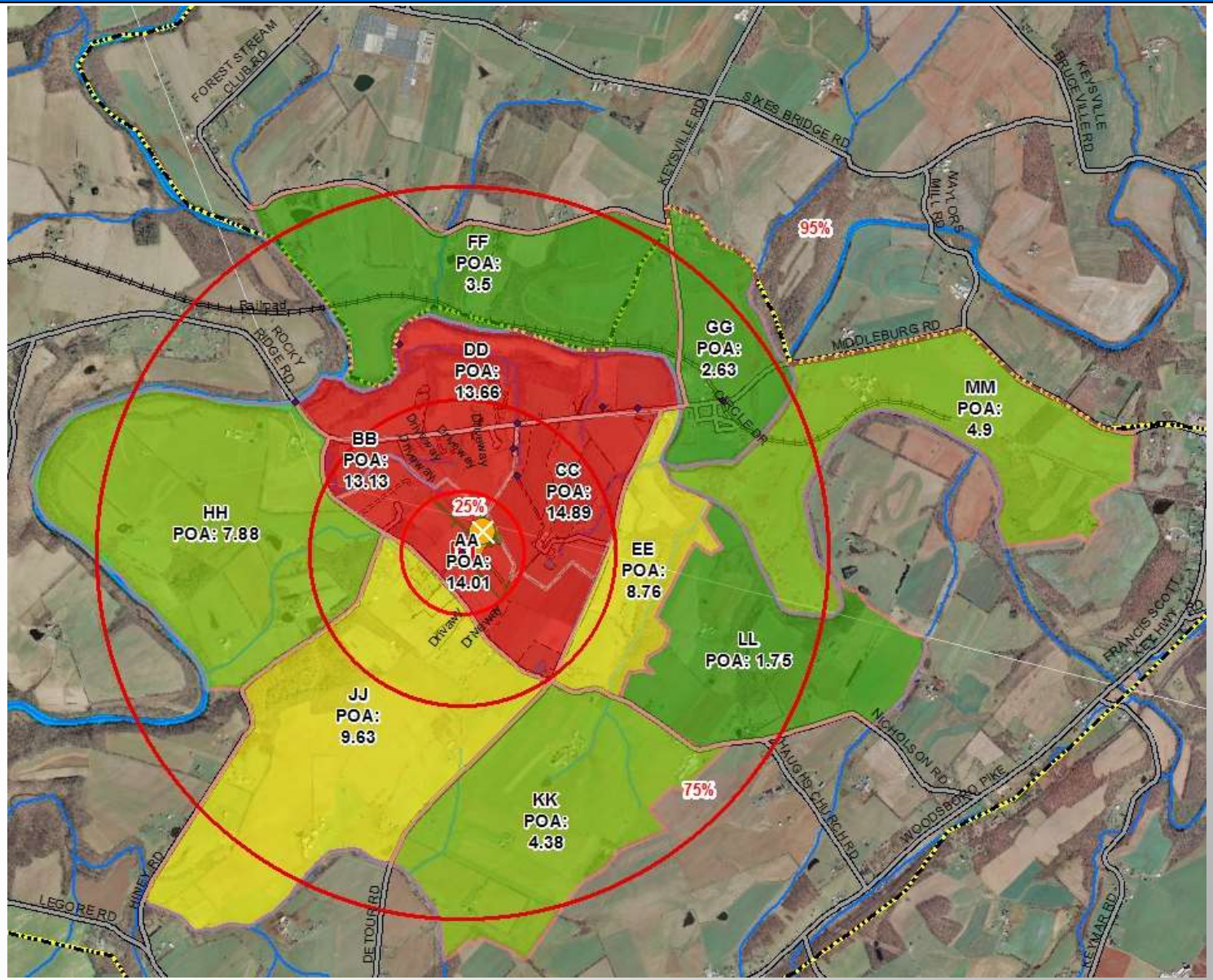
Mag Dec (dd.dd E/W)
9.0 W

NORTH

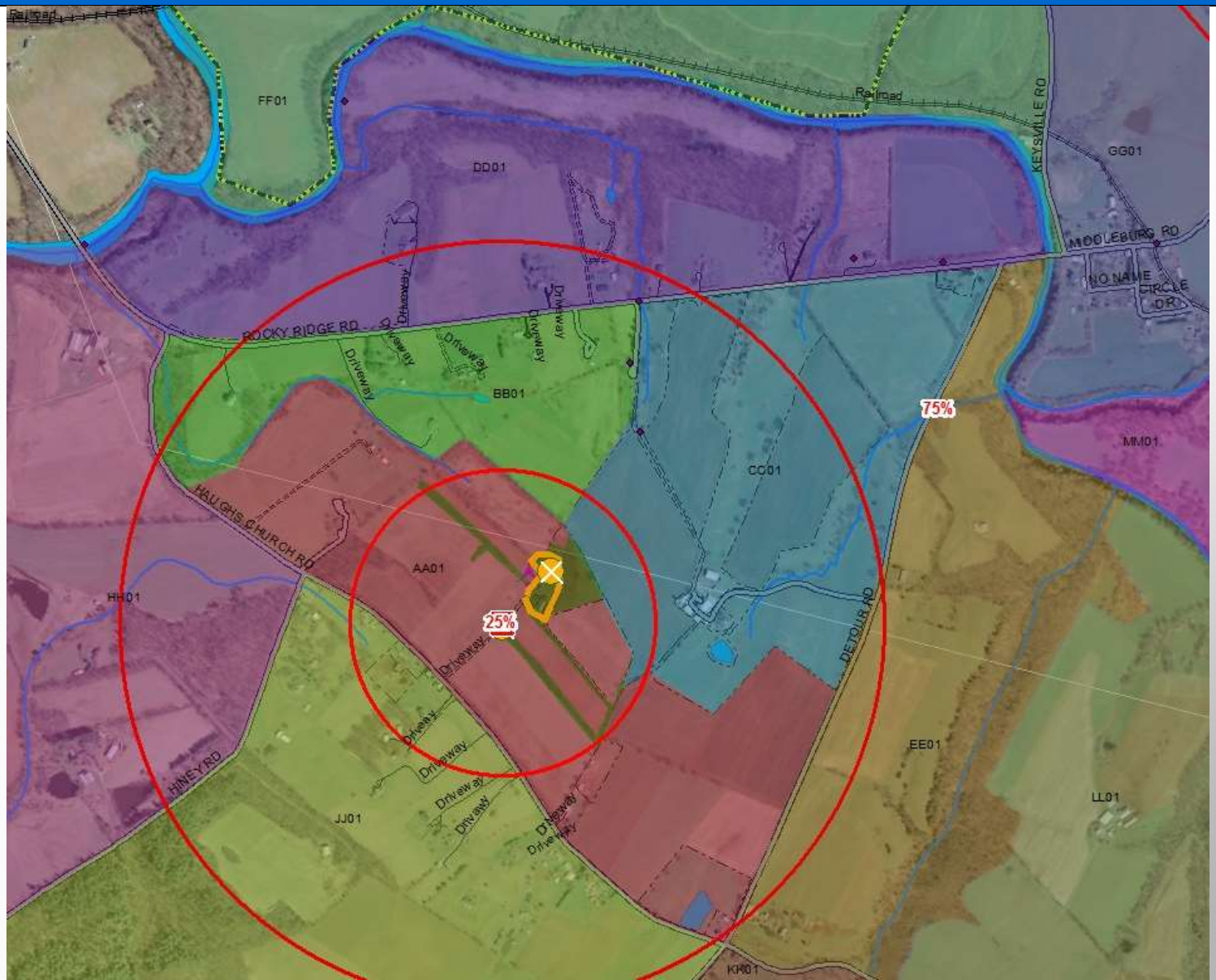
TO CONVERT FROM MAP TO COMPASS BEARING ADD MN ANGLE.

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

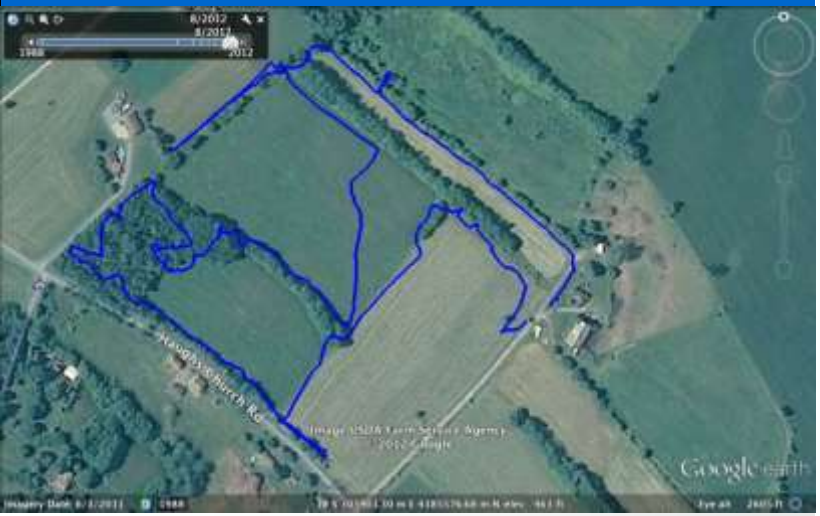
Search Probability Map



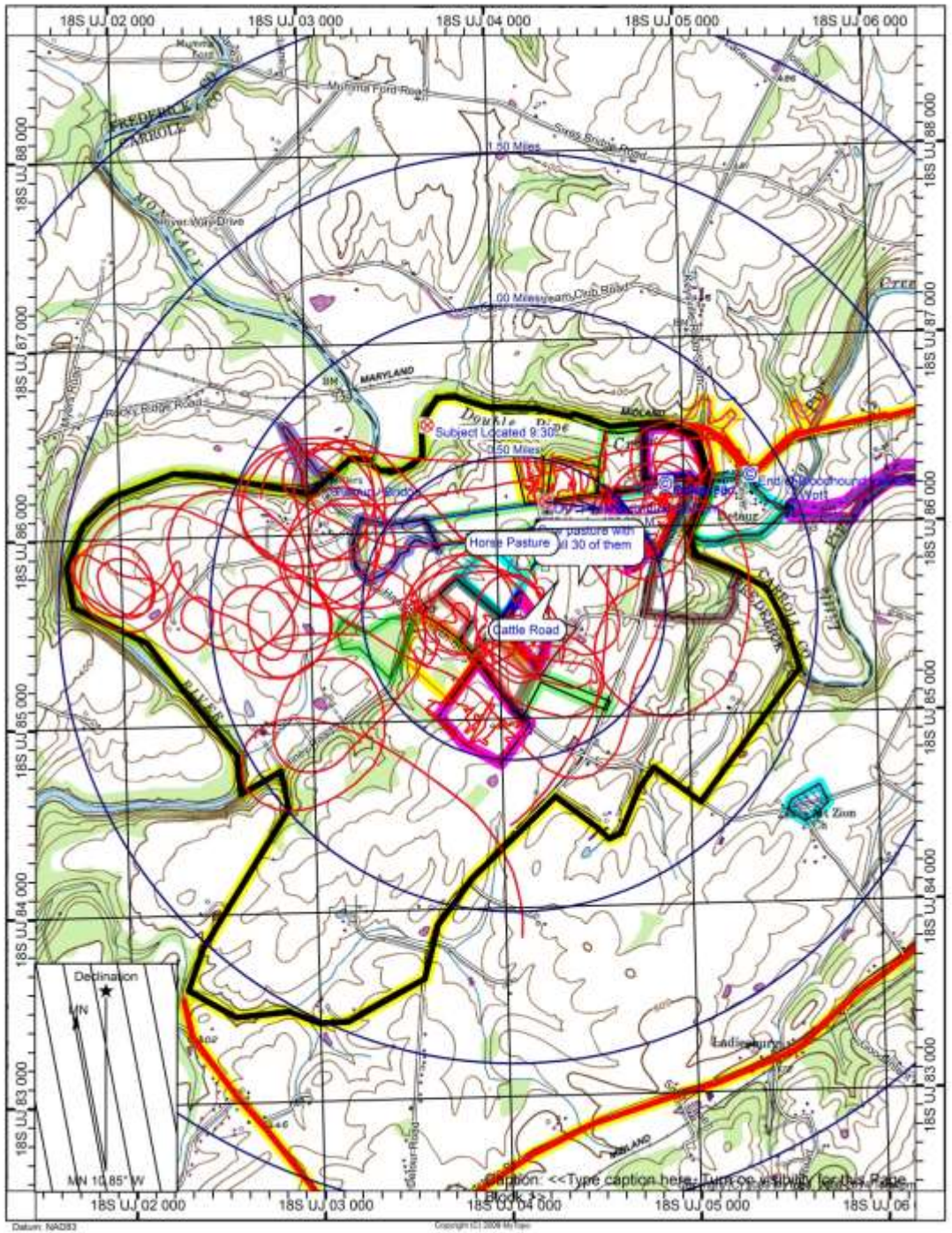
Segments


Railroad
FF01
DD01
Railroad
KEYSVILLE RD
GG01
MOOLEBURG RD
NO NAME CIRCLE DR
ROCKY RIDGE RD
Driveway
BB01
75%
MM01
CC01
HAUGHS CHURCH RD
AA01
HH01
25%
DETOUR RD
HINEY RD
EE01
LL01
JJ01
KK01

With Tracks


Google earth


Google earth


18S UJ 02 000
18S UJ 03 000
18S UJ 04 000
18S UJ 05 000
18S UJ 06 000
18S UJ 88 000
18S UJ 87 000
18S UJ 86 000
18S UJ 85 000
18S UJ 84 000
18S UJ 83 000
1.50 Miles
Subject Located 9:30
Horse Pasture
Cattle Road
Declination
MN
MN 10.85° W
Caption: <<Type caption here. Turn on visibility for this layer.
Datum: NAD83

Thank you

- Cole Brown
  - Coleman.Brown@Maryland.gov
  - 410 404-8962