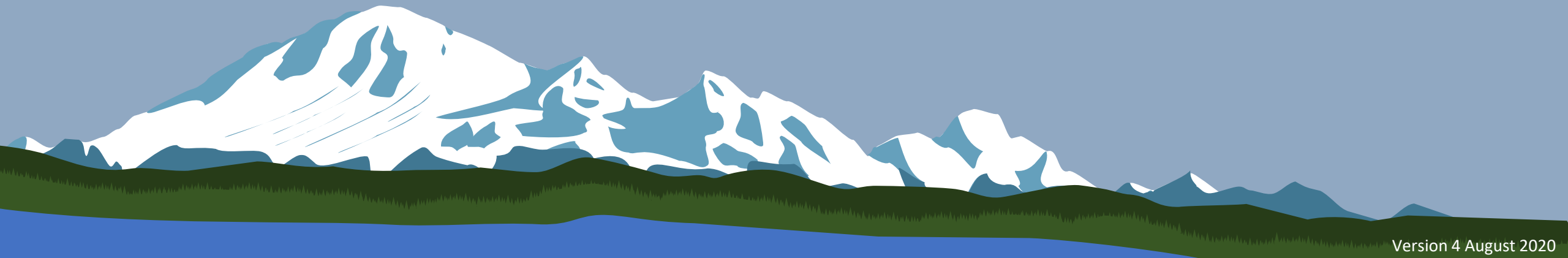
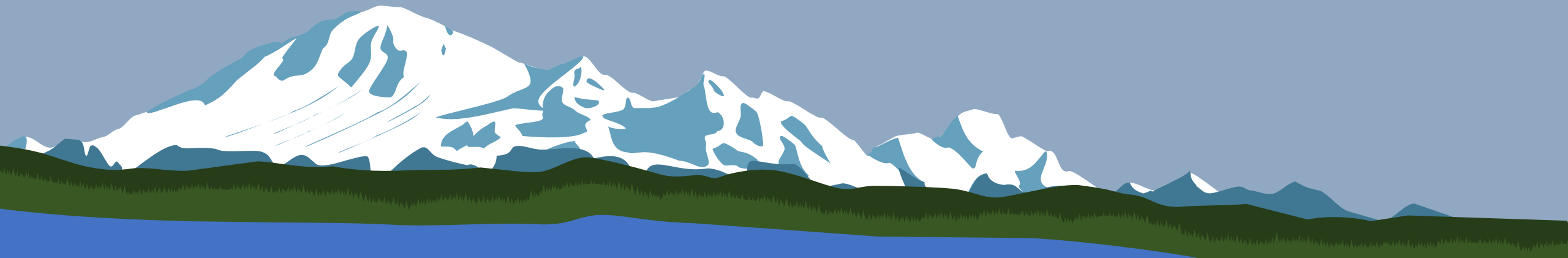


# Map Reading and Navigation Skills



# Index

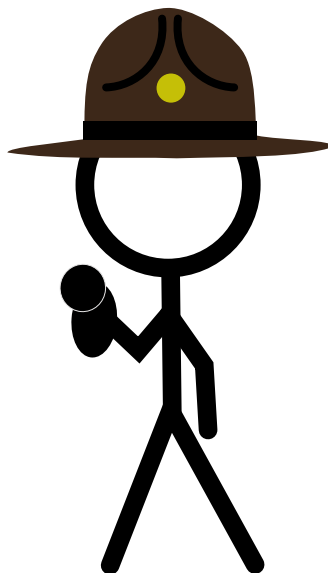
1. [Requirements](#)
2. [Navigation](#)
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6. [Measuring Distance](#)
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**This slide set was designed to aid Scouters and Scouts to work on Map Reading and Navigation Skills.**

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# Disclaimer

This PowerPoint slideshow was designed to be used to prepare scouts for the Map Reading and Navigation Requirements and nothing more.

Information here should help you complete your rank or merit badge requirements, but supervised real-life experience is needed to learn these skills.

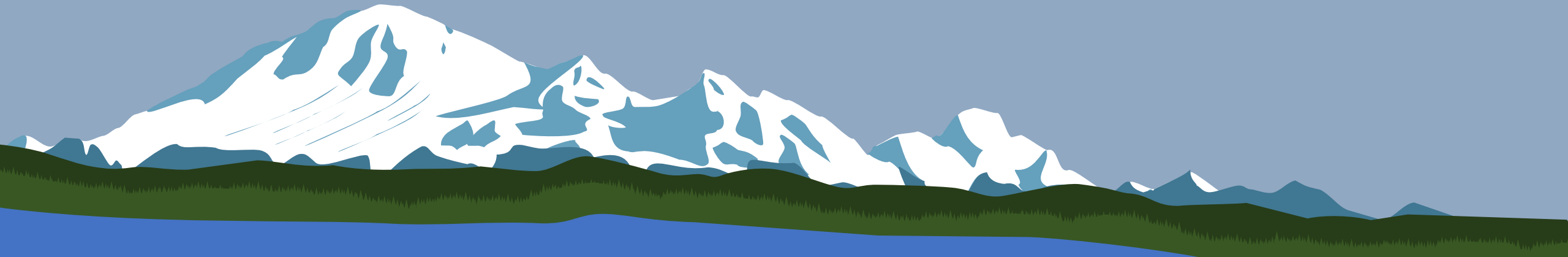
Navigation in urban and non urban areas is dangerous. Proceed at your own risk.

Examples used and opinions shared do not reflect policies of the BSA, your local council or any other person or entity related to this presentation.

1. Requirements	13. Reading Found
2. Introduction	14. Constructing Maps
3. Map Reading	15. Constructing Control Symbols
4. Locations	16. Constructing Contours
5. Map Orientation	17. General Topographic Mapmaker
6. Interpreting Evidence	18. Unit Conversions
7. Projections	19. A Student's Control Description
8. Fieldwork	20. Resources
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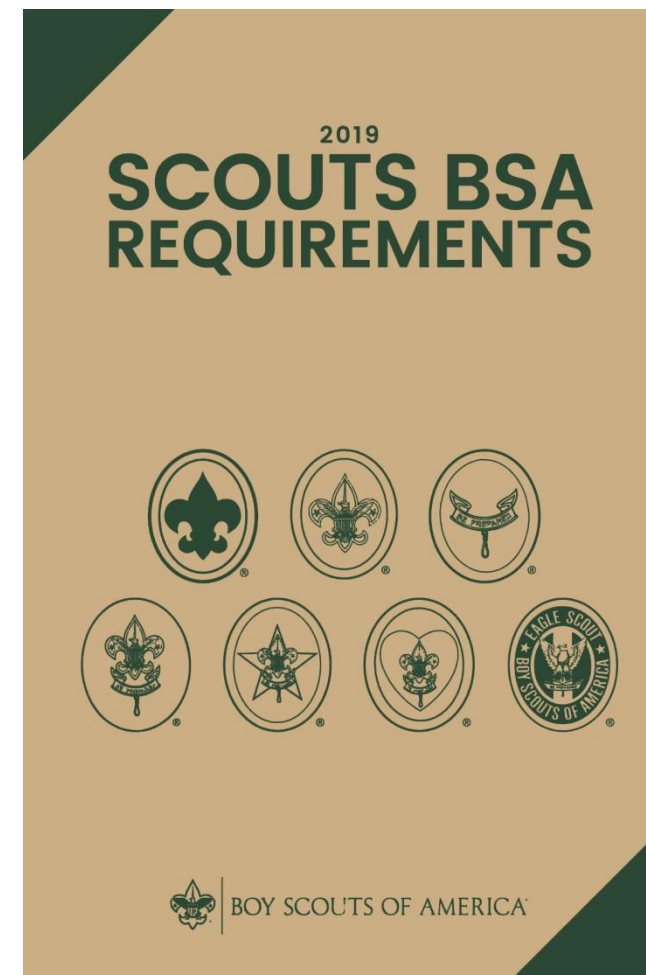
# Requirements



# Requirements

## Requirements

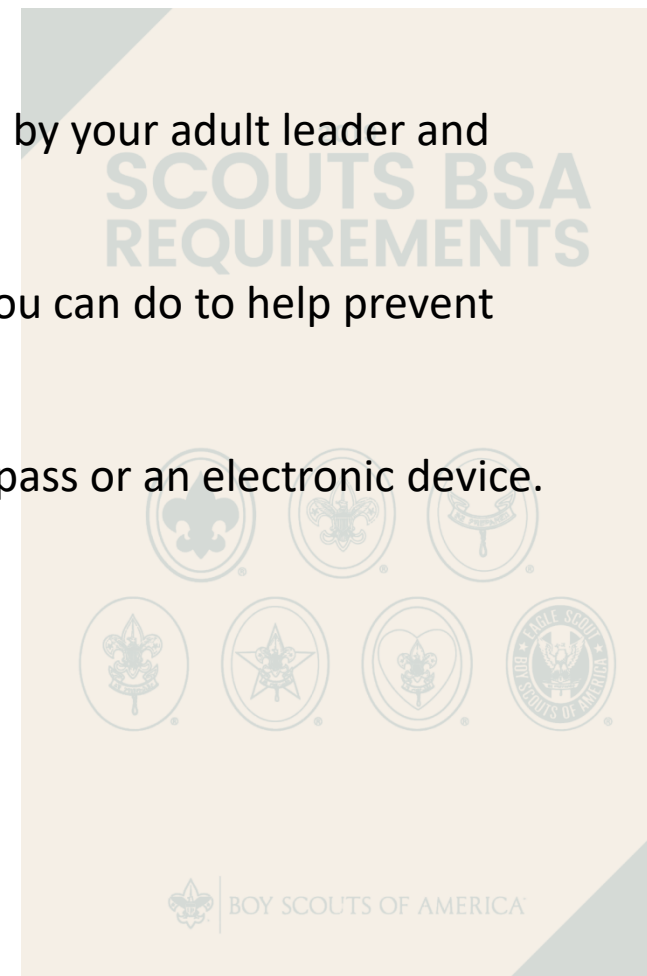
- Map Reading is required in:
- Orienteering Merit Badge
- Geocaching Merit Badge
- Backpacking Merit Badge
- Snow Sports Merit Badge
- Search and Rescue Merit Badge
- BSA Rank Requirements



# Requirements

## Requirements – Scout Rank – Second Class

- 3a. Demonstrate how a compass works and how to orient a map. Use a map to point out and tell the meaning of five map symbols.
- 3b. Using a compass and map together, take a 5-mile hike (or 10 miles by bike) approved by your adult leader and your parent or guardian.<sup>2</sup>
- 3c. Describe some hazards or injuries that you might encounter on your hike and what you can do to help prevent them.<sup>2</sup>
- 3d. Demonstrate how to find directions during the day and at night without using a compass or an electronic device.

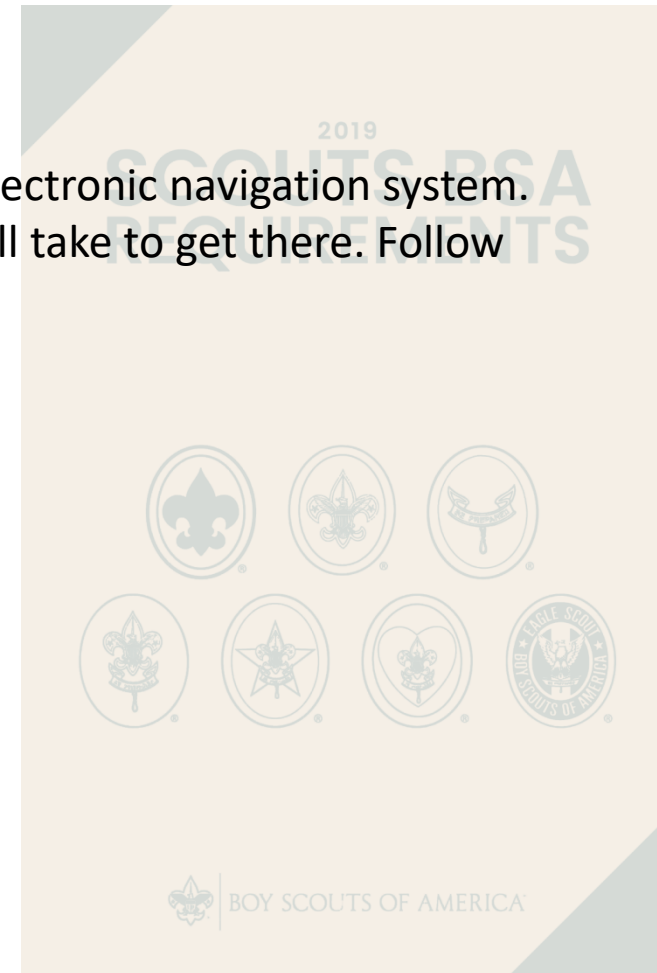


# Requirements

## Requirements – Scout Rank – First Class

4a. Using a map and compass, complete an orienteering course that covers at least one mile and requires measuring the height and/ or width of designated items (tree, tower, canyon, ditch, etc.).

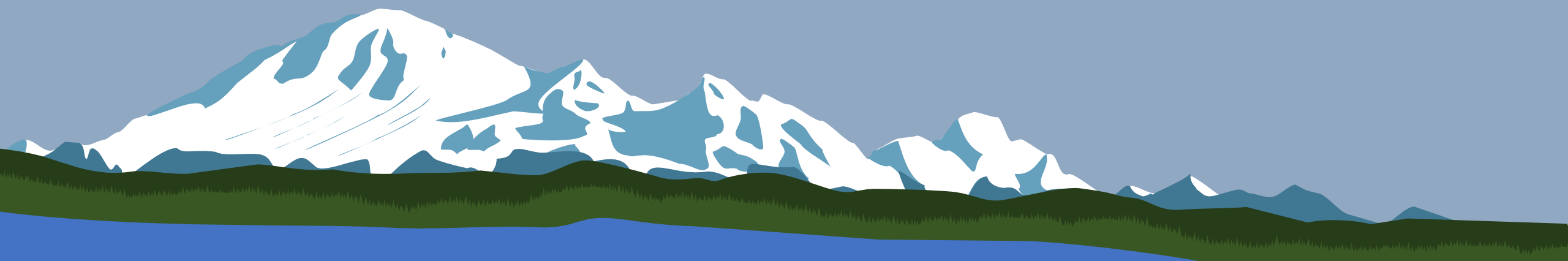
4b. Demonstrate how to use a handheld GPS unit, GPS app on a smartphone, or other electronic navigation system. Use GPS to find your current location, a destination of your choice, and the route you will take to get there. Follow that route to arrive at your destination.



1. Requirements	13. Mapping Fundamentals
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7. Projections	19. Geographic Coordinate Representation
8. Photo Control	17. Resolutions
9. Understanding Techniques	18. Instructor's Corner



# Navigation



# Navigation

## Map and Compass Skills

- Vital skill set required for backcountry adventures
  - Helps prevent you from getting lost
  - Helps you re-find your location when lost
  - Helps you plan out your trip
    - Good places to sleep
    - Good places for resources such as water and fish
    - Find places to explore or for view
    - Identify places to avoid

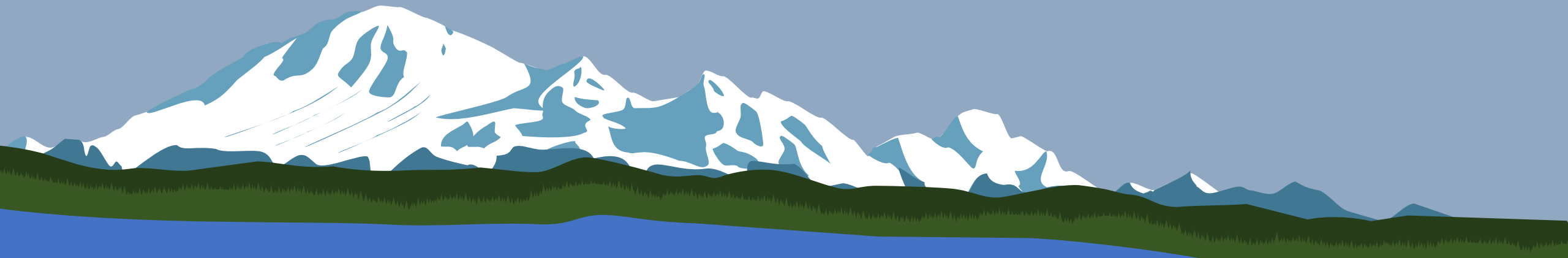




1. Requirements	13. Reading Found
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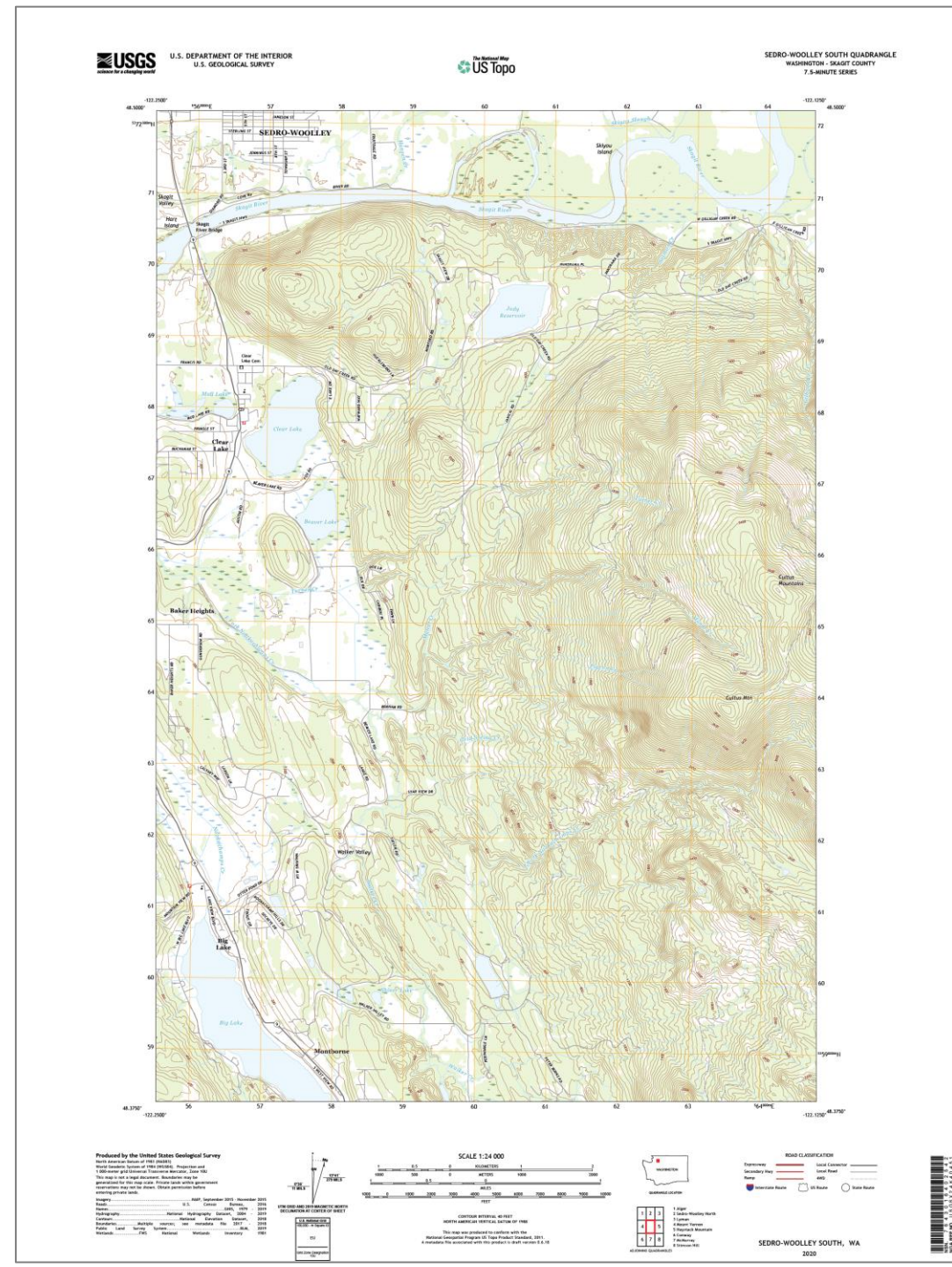


# Map Reading

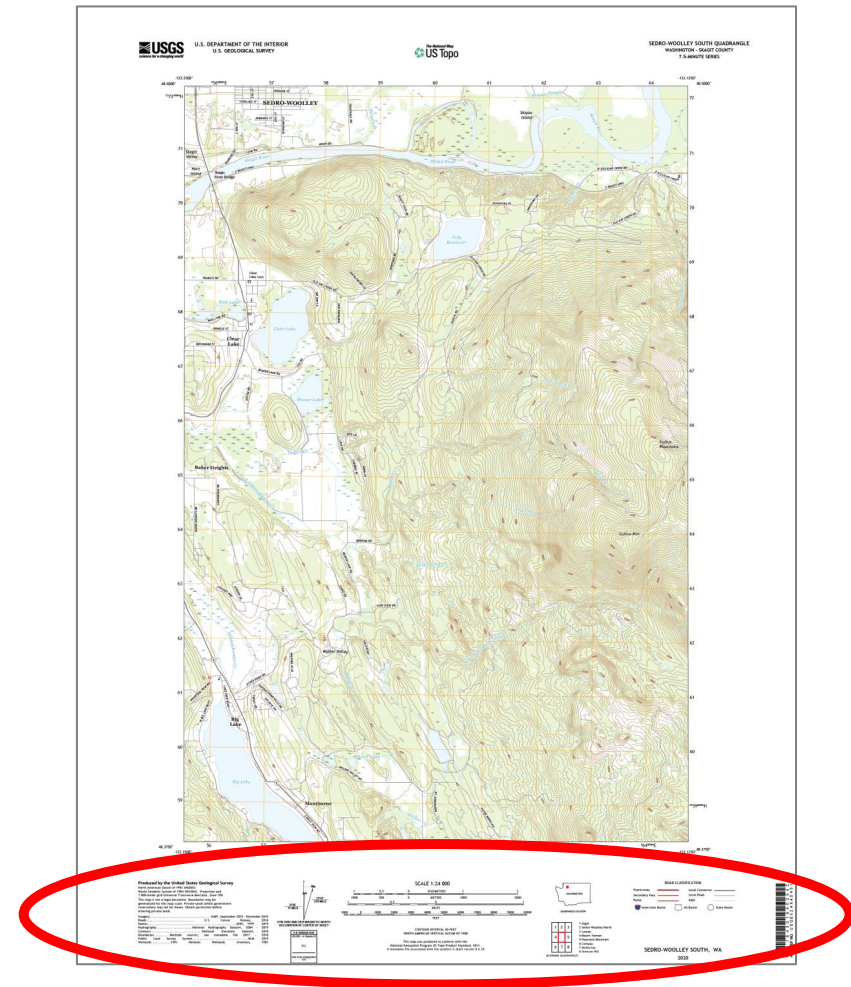


# USGS Topographical Map

[viewer.nationalmap.gov/basic](http://viewer.nationalmap.gov/basic)



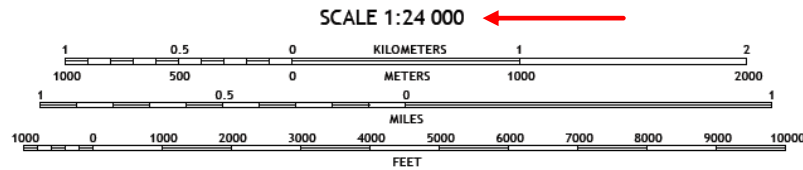
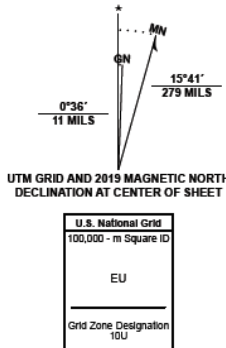
# Map Legend



**Produced by the United States Geological Survey**

North American Datum of 1983 (NAD83)  
 World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid: Universal Transverse Mercator, Zone 10U  
 This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, September 2015 - November 2015  
 Roads.....U.S. Census Bureau, 2016  
 Names.....GNIS, 1979 - 2019  
 Hydrography.....National Hydrography Dataset, 2004 - 2019  
 Contours.....National Elevation Dataset, 2018  
 Boundaries.....Multiple sources; see metadata file 2017 - 2018  
 Public Land Survey System.....BLM, 2019  
 Wetlands.....FWS National Wetlands Inventory 1981



CONTOUR INTERVAL 40 FEET  
 NORTH AMERICAN VERTICAL DATUM OF 1988

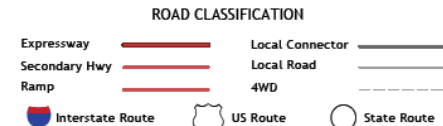
This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011. A metadata file associated with this product is draft version 0.6.18



1	2	3
4	5	6
7	8	

ADJOINING QUADRANGLES

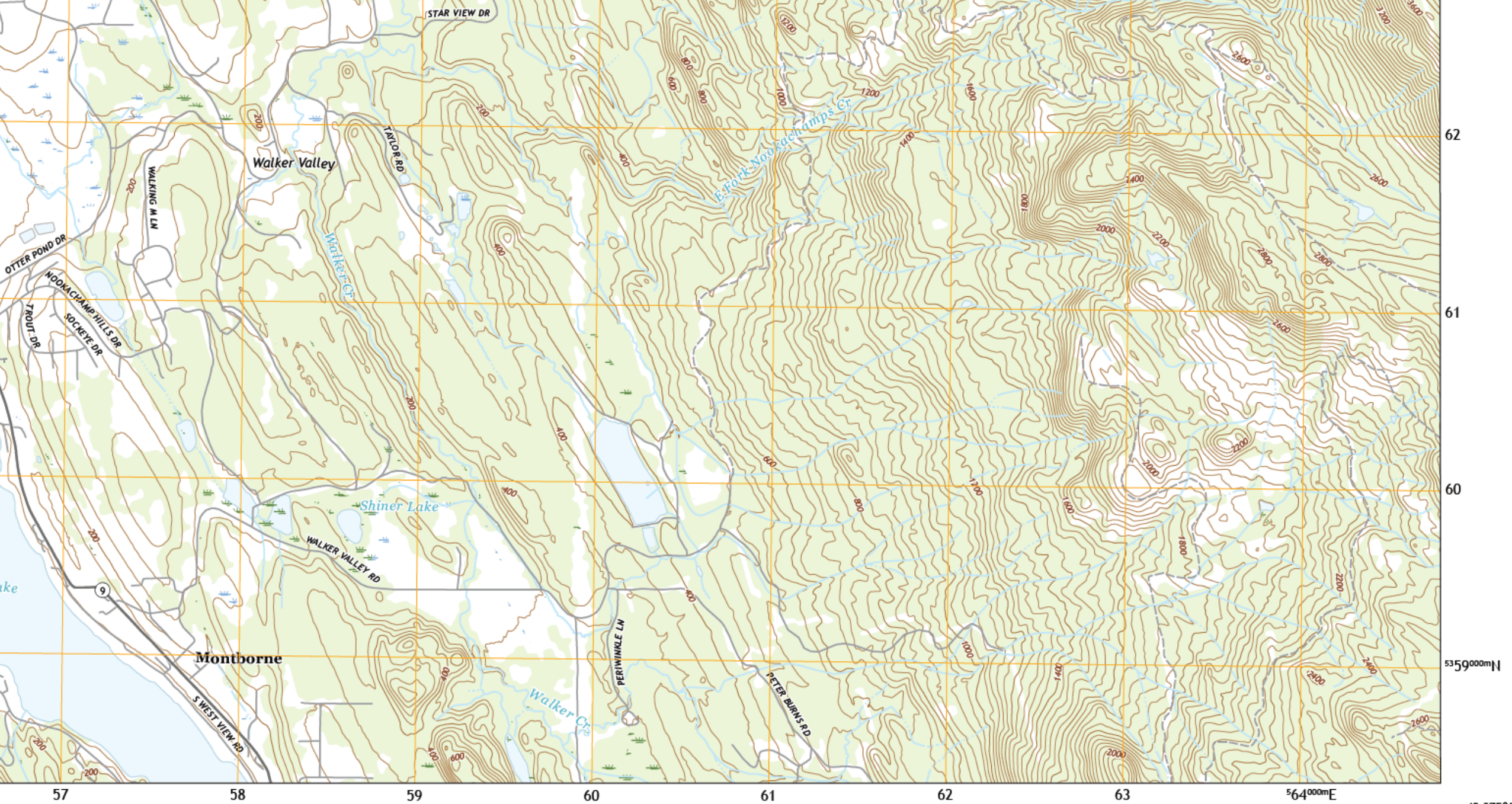
- 1 Alger
- 2 Sedro-Woolley North
- 3 Lyman
- 4 Mount Vernon
- 5 Haystack Mountain
- 6 Conway
- 7 McMurray
- 8 Stimson Hill



SEDRO-WOOLLEY SOUTH, WA

2020

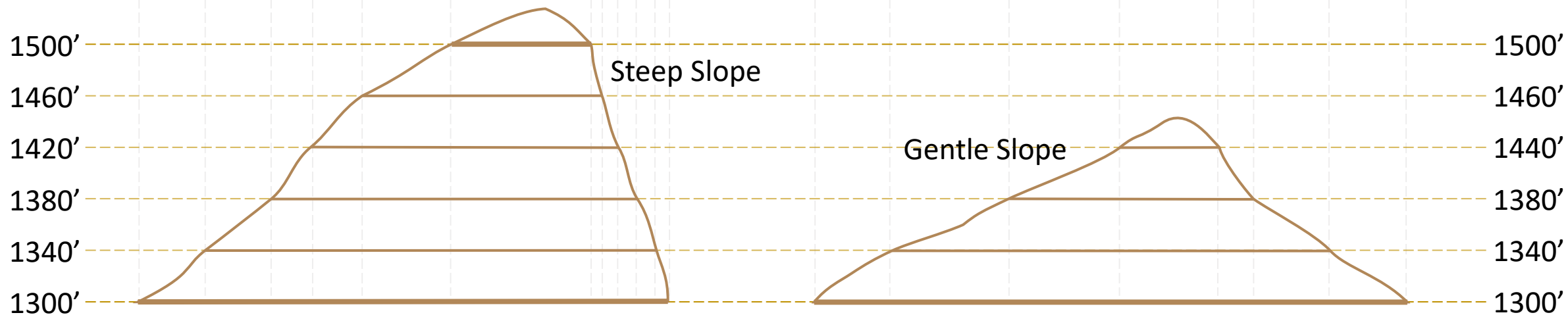
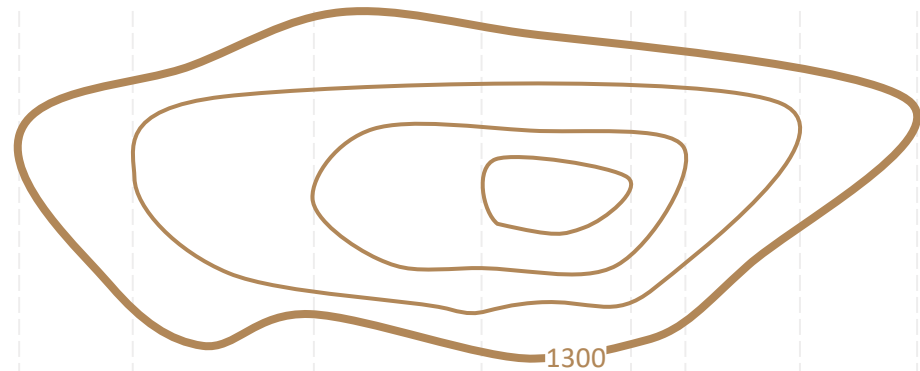
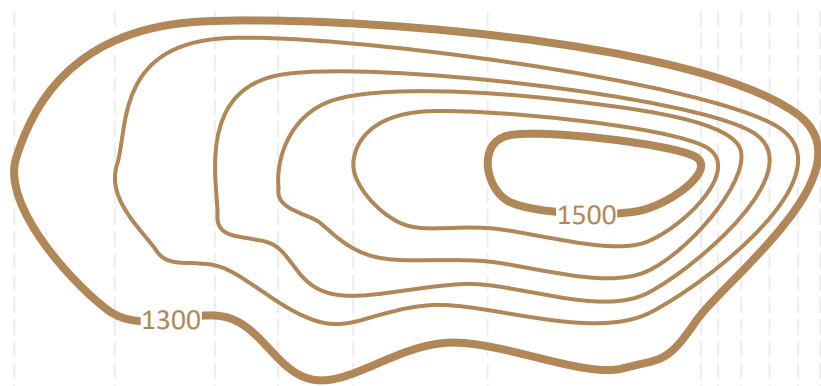




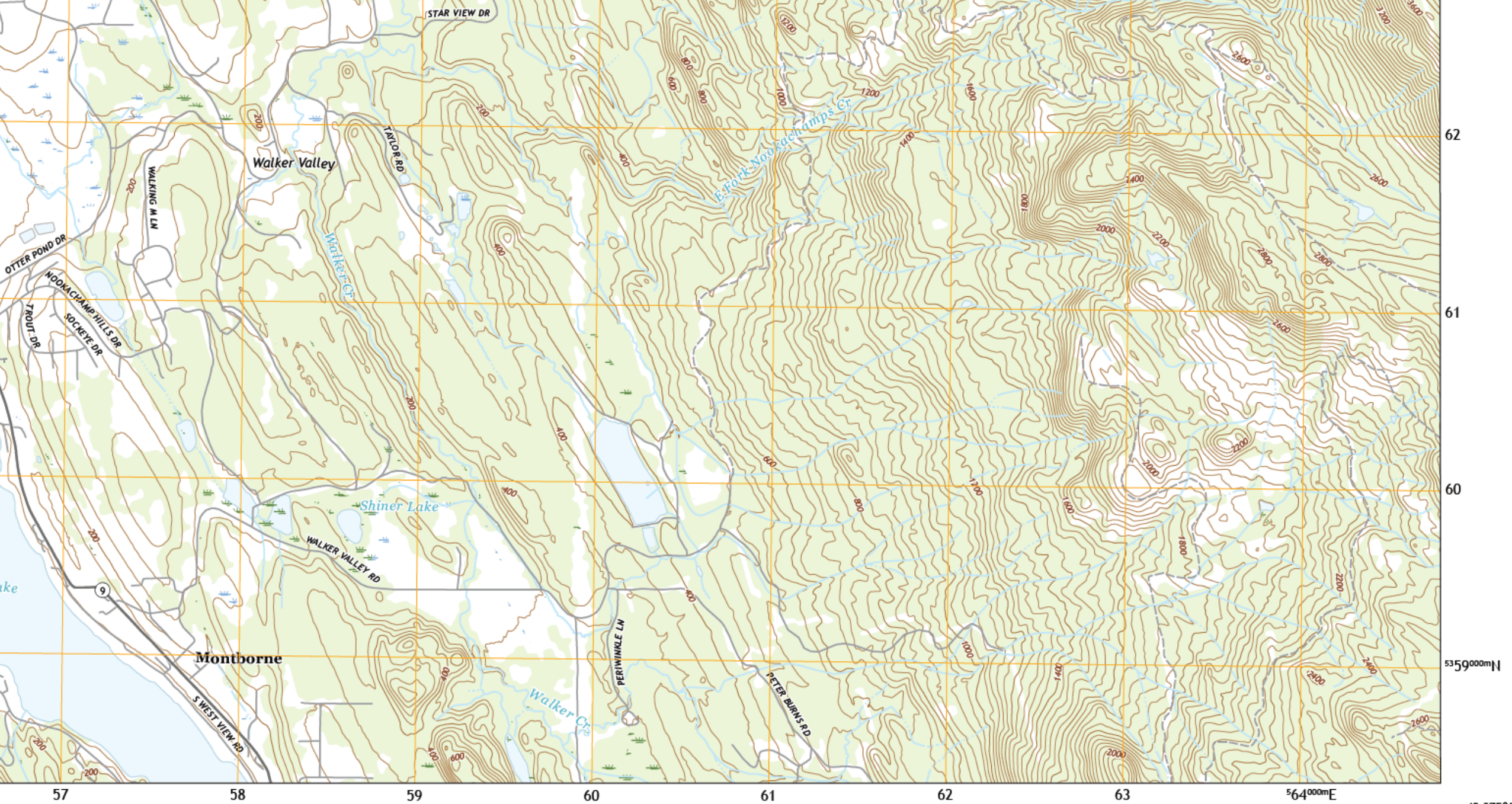
Map Originally 1:24,000 Scale

# Topographic Maps

## Contour Lines

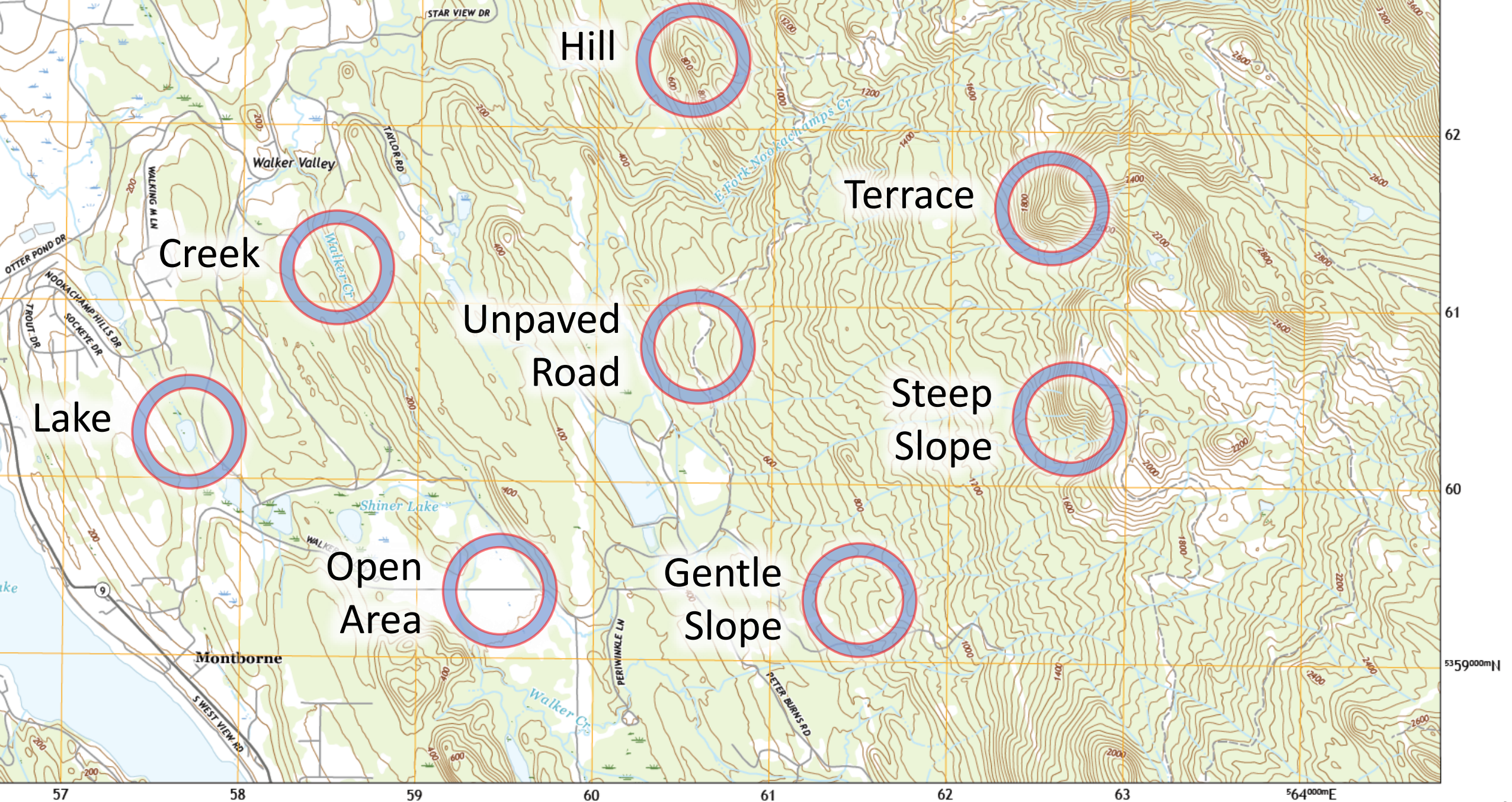






Map Originally 1:24,000 Scale





Map Originally 1:24,000 Scale



# USGS Map Symbols

[pubs.usgs.gov](https://pubs.usgs.gov)



## What is a Topographic Map?

A map is a representation of the Earth, or part of it. The distinctive characteristic of a topographic map is that the shape of the Earth's surface is shown by contour lines. Contours are imaginary lines that join points of equal elevation on the surface of the land above or below a reference surface, such as mean sea level. Contours make it possible to measure the height of mountains, depths of the ocean bottom, and steepness of slopes.

A topographic map shows more than contours. The map includes symbols that represent such features as streets, buildings, streams, and vegetation. These symbols are constantly refined to better relate to the features they represent, improve the appearance or readability of the map, or reduce production cost.

Consequently, within the same series, maps may have slightly different symbols for the same feature. Examples of symbols that have changed include built-up areas, roads, intermittent drainage, and some lettering styles. On one type of large-scale topographic map, called provisional, some symbols and lettering are hand-drawn.

# Topographic Map Symbols

## Reading Topographic Maps

Interpreting the colored lines, areas, and other symbols is the first step in using topographic maps. Features are shown as points, lines, or areas, depending on their size and extent. For example, individual houses may be shown as small black squares. For larger buildings, the actual shapes are mapped. In densely built-up areas, most individual buildings are omitted and an area tint is shown. On some maps, post offices, churches, city halls, and other landmark buildings are shown within the tinted area.

The first features usually noticed on a topographic map are the area features, such as vegetation (green), water (blue), and densely built-up areas (gray or red).

Many features are shown by lines that may be straight, curved, solid, dashed, dotted, or in any combination. The colors of the lines usually indicate similar classes of information: topographic contours (brown); lakes, streams, irrigation ditches, and other hydrographic features (blue); land grids and important roads (red); and other roads and trails, railroads, boundaries, and other cultural features (black). At one time, purple was used as a revision color to show all feature changes. Currently, purple is not used in our revision program, but purple features are still present on many existing maps.

Various point symbols are used to depict features such as buildings, campgrounds, springs, water tanks, mines, survey control points, and wells. Names of places and features are shown in a color corresponding to the type of feature. Many features are identified by labels, such as "Substation" or "Golf Course."

Topographic contours are shown in brown by lines of different widths. Each contour is a line of equal elevation; therefore, contours never cross. They show the general shape of the terrain. To help the user determine elevations, index contours are wider. Elevation values are printed in several places along these lines. The narrower intermediate and supplementary contours found between the index contours help to show more details of the land surface shape. Contours that are very close together represent steep slopes. Widely spaced contours or an absence of contours means that the ground slope is relatively level. The elevation difference between adjacent contour lines, called the contour interval, is selected to best show the general shape of the terrain. A map of a relatively flat area may have a contour interval of 10 feet or less. Maps in mountainous areas may have contour intervals of 100 feet or more. The contour interval is printed in the margin of each U.S. Geological Survey (USGS) map.

Bathymetric contours are shown in blue or black, depending on their location. They show the shape and slope of the ocean bottom surface. The bathymetric contour interval may vary on each map and is explained in the map margin.



<b>CONTOURS</b>	
<b>Topographic</b>	
Index	
Approximate or indefinite	
Intermediate	
Approximate or indefinite	
Supplementary	
Depression	
Cut	
Fill	
Continental divide	
<b>Bathymetric</b>	
Index***	
Intermediate***	
Index primary***	
Primary***	
Supplementary***	

<b>VEGETATION</b>	
Woodland	
Shrubland	
Orchard	
Vineyard	
Mangrove	

<b>SURFACE FEATURES</b>	
Levee	
Sand or mud	
Disturbed surface	
Gravel beach or glacial moraine	
Tailings pond	

<b>MINES AND CAVES</b>	
Quarry or open pit mine	
Gravel, sand, clay, or borrow pit	
Mine tunnel or cave entrance	
Mine shaft	
Prospect	
Tailings	
Mine dump	
Former disposal site or mine	

### ROADS AND RELATED FEATURES

Please note: Roads on Provisional-edition maps are not classified as primary, secondary, or light duty. These roads are all classified as improved roads and are symbolized the same as light duty roads.

Primary highway	
Secondary highway	
Light duty road	
Light duty road, paved*	
Light duty road, gravel*	
Light duty road, dirt*	
Light duty road, unspecified*	
Unimproved road	
Unimproved road*	
4WD road	
4WD road*	
Trail	
Highway or road with median strip	
Highway or road under construction	
Highway or road underpass; overpass	
Highway or road bridge; drawbridge	
Highway or road tunnel	
Road block, berm, or barrier*	
Gate on road*	
Trailhead*	

### BUILDINGS AND RELATED FEATURES

Building	
School; house of worship	
Athletic field	
Built-up area	
Forest headquarters*	
Ranger district office*	
Guard station or work center*	
Racetrack or raceway	
Airport, paved landing strip, runway, taxiway, or apron	
Unpaved landing strip	
Well (other than water), windmill or wind generator	
Tanks	
Covered reservoir	
Gaging station	
Located or landmark object (feature as labeled)	
Boat ramp or boat access*	
Roadside park or rest area	
Picnic area	
Campground	
Winter recreation area*	
Cemetery	

### TRANSMISSION LINES AND PIPELINES

Power transmission line; pole; tower	
Telephone line	
Aboveground pipeline	
Underground pipeline	

### RAILROADS AND RELATED FEATURES

Standard gauge railroad, single track	
Standard gauge railroad, multiple track	
Narrow gauge railroad, single track	
Narrow gauge railroad, multiple track	
Railroad siding	
Railroad in highway	
Railroad in road	
Railroad in light duty road*	
Railroad underpass; overpass	
Railroad bridge; drawbridge	
Railroad tunnel	
Railroad yard	
Railroad turntable; roundhouse	

**RIVERS, LAKES, AND CANALS**

Perennial stream	
Perennial river	
Intermittent stream	
Intermittent river	
Disappearing stream	
Falls, small	
Falls, large	
Rapids, small	
Rapids, large	
Masonry dam	
Dam with lock	
Dam carrying road	
Perennial lake/pond	
Intermittent lake/pond	
Dry lake/pond	
Narrow wash	
Wide wash	
Canal, flume, or aqueduct with lock	
Elevated aqueduct, flume, or conduit	
Aqueduct tunnel	
Water well, geyser, fumarole, or mud pot	
Spring or seep	

**MARINE SHORELINES**

Shoreline	
Apparent (edge of vegetation)***	
Indefinite or unsurveyed	

**COASTAL FEATURES**

Foreshore flat	
Coral or rock reef	
Rock, bare or awash; dangerous to navigation	
Group of rocks, bare or awash	
Exposed wreck	
Depth curve; sounding	
Breakwater, pier, jetty, or wharf	
Seawall	
Oil or gas well; platform	

**BATHYMETRIC FEATURES**

Area exposed at mean low tide; sounding datum***	
Channel***	
Sunken rock***	

**SUBMERGED AREAS AND BOGS**

Marsh or swamp	
Submerged marsh or swamp	
Wooded marsh or swamp	
Submerged wooded marsh or swamp	
Land subject to inundation	

*Max Pool 43!*

**GLACIERS AND PERMANENT SNOWFIELDS**

Contours and limits	
Formlines	
Glacial advance	
Glacial retreat	

**BOUNDARIES**

National	
State or territorial	
County or equivalent	
Civil township or equivalent	
Incorporated city or equivalent	
Federally administered park, reservation, or monument (external)	
Federally administered park, reservation, or monument (internal)	
State forest, park, reservation, or monument and large county park	
Forest Service administrative area*	
Forest Service ranger district*	
National Forest System land status, Forest Service lands*	
National Forest System land status, non-Forest Service lands*	

**PROJECTION AND GRIDS**

Neatline	
Graticule tick	
Graticule intersection	
Datum shift tick	

**State plane coordinate systems**

Primary zone tick	
Secondary zone tick	
Tertiary zone tick	
Quaternary zone tick	
Quintary zone tick	

**Universal transverse metcator grid**

UTM grid (full grid)	
UTM grid ticks*	

**LAND SURVEYS**

**Public land survey system**

Range or Township line	
Location approximate	
Location doubtful	
Protracted	
Protracted (AK 1:63,360-scale)	
Range or Township labels	
Section line	
Location approximate	
Location doubtful	
Protracted	
Protracted (AK 1:63,360-scale)	
Section numbers	
Found section corner	
Found closing corner	
Witness corner	
Meander corner	
Weak corner*	

**Other land surveys**

Range or Township line	
Section line	
Land grant, mining claim, donation land claim, or tract	
Land grant, homestead, mineral, or other special survey monument	
Fence or field lines	

**CONTROL DATA AND MONUMENTS**

Principal point**	
U.S. mineral or location monument	
River mileage marker	

**Boundary monument**

Third-order or better elevation, with tablet	
Third-order or better elevation, recoverable mark, no tablet	
With number and elevation	

**Horizontal control**

Third-order or better, permanent mark	
With third-order or better elevation	
With checked spot elevation	
Coincident with found section corner	
Unmonumented**	

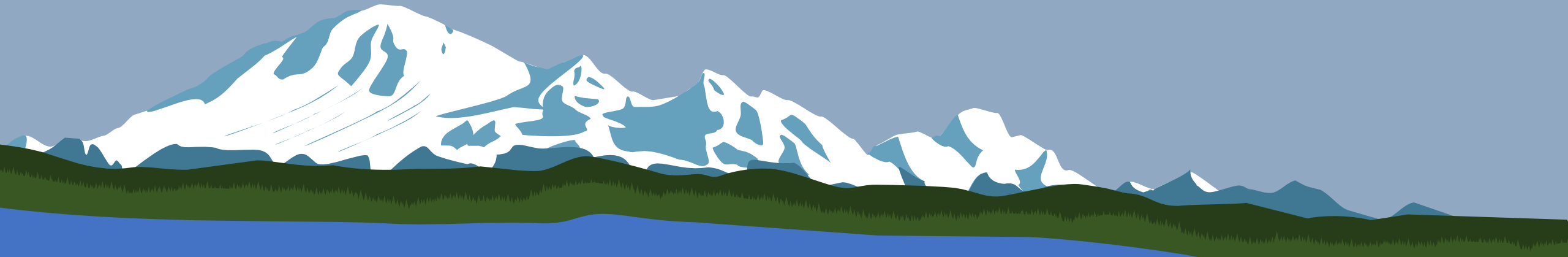
**Vertical control**

Third-order or better elevation, with tablet	
Third-order or better elevation, recoverable mark, no tablet	
Bench mark coincident with found section corner	
Spot elevation	

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9. Understanding Techniques	18. Instructor's Corner



# Compass



# Compass

## Surveying Compass



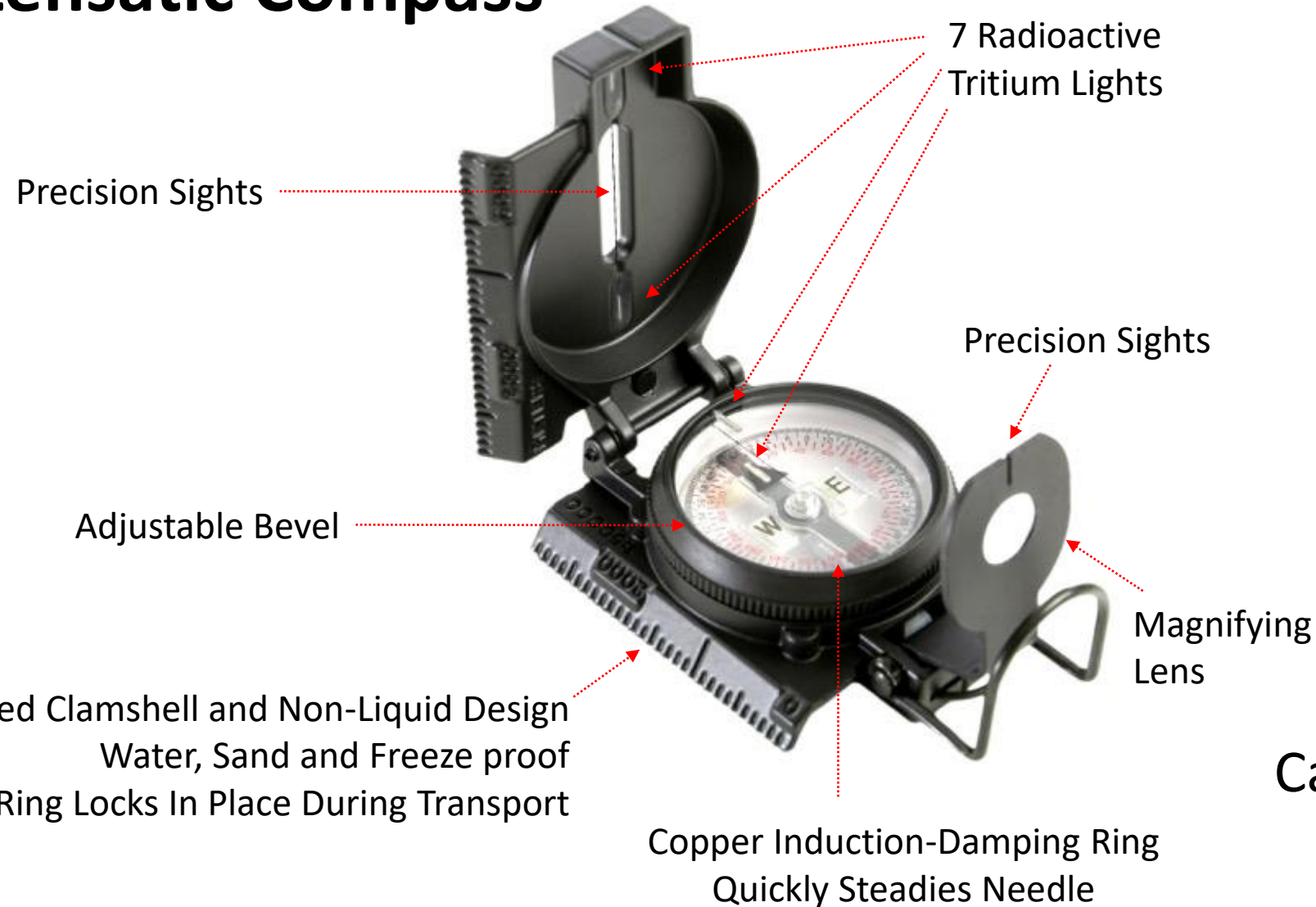
Brunton Transit

- Extremely accurate
  - Engineering
  - Surveying
  - Artillery
  - Caving
- NOT for Orienteering
  - NO Bearing ring
  - Bulky
  - Needs protractor
- Adjustable Declination
- Air filled needle housing
- Expedition Quality
- Needle lock
- Extremely Expensive



# Compass

## Lensatic Compass



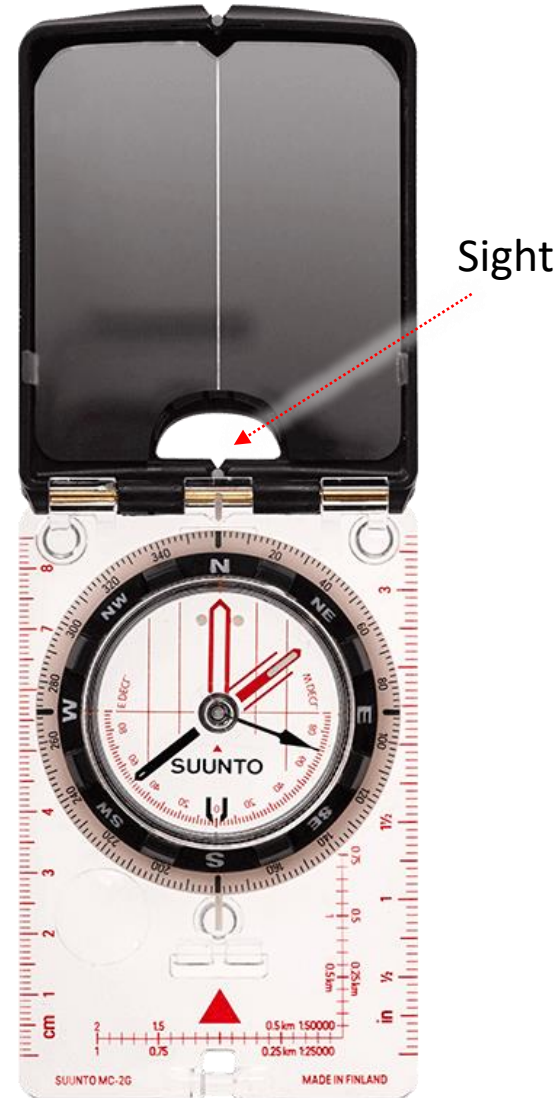
- Very accurate for measuring azimuths
- Glows at night
- Expedition durability
- Base NOT transparent
  - Need protractor
- NO declination adjustment
- Expensive
- Bulky

Cammenga Tritium 3H

# Compass

## Mirror Compass

- Excellent compass
  - Adjustable declination
  - Global option
    - Fast jewel bearing
    - Southern hemisphere usable
    - 20° tilt margin
- Mirror
  - Accurate long-range azimuth
  - Signaling device
- Magnifying Glass
  - Fire starter
  - First-aid
- Clinometer
- Made in Finland



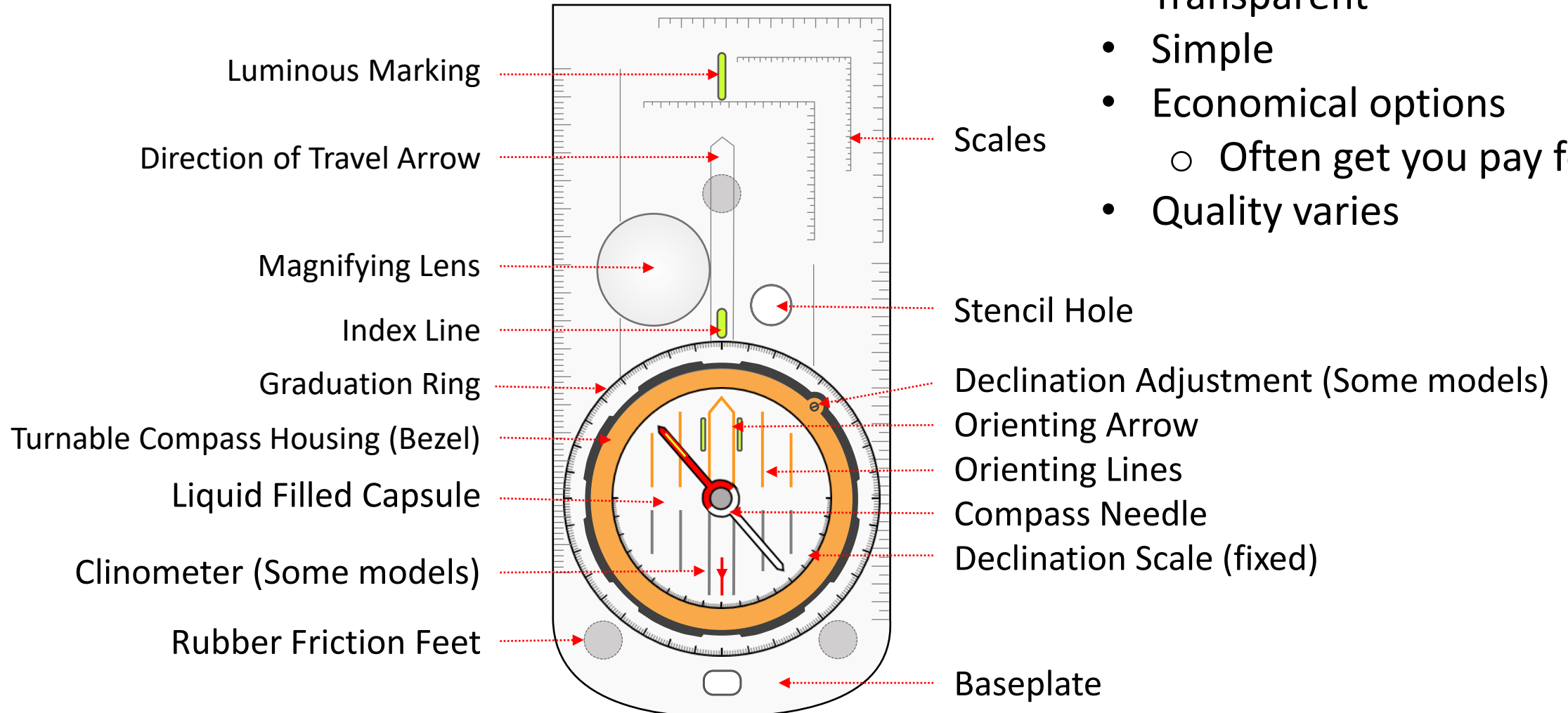
- Excellent Compass
- Expensive
- More than what you need for orienteering

SUUNTO MC-2 G



# Compass

## The Baseplate Compass



- Very versatile
- Transparent
- Simple
- Economical options
  - Often get you pay for
- Quality varies

# Compass

## Orienteering Compass

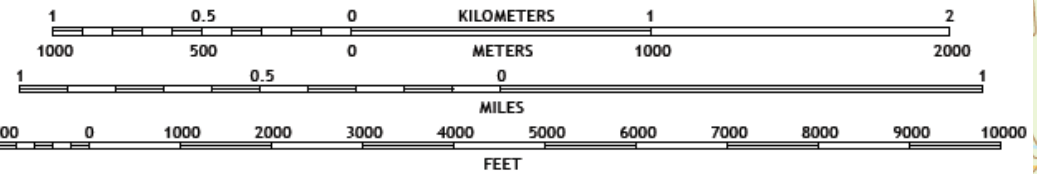


- Bare minimum for Orienteering
- Lightweight
- Hands free
- Lack versatility

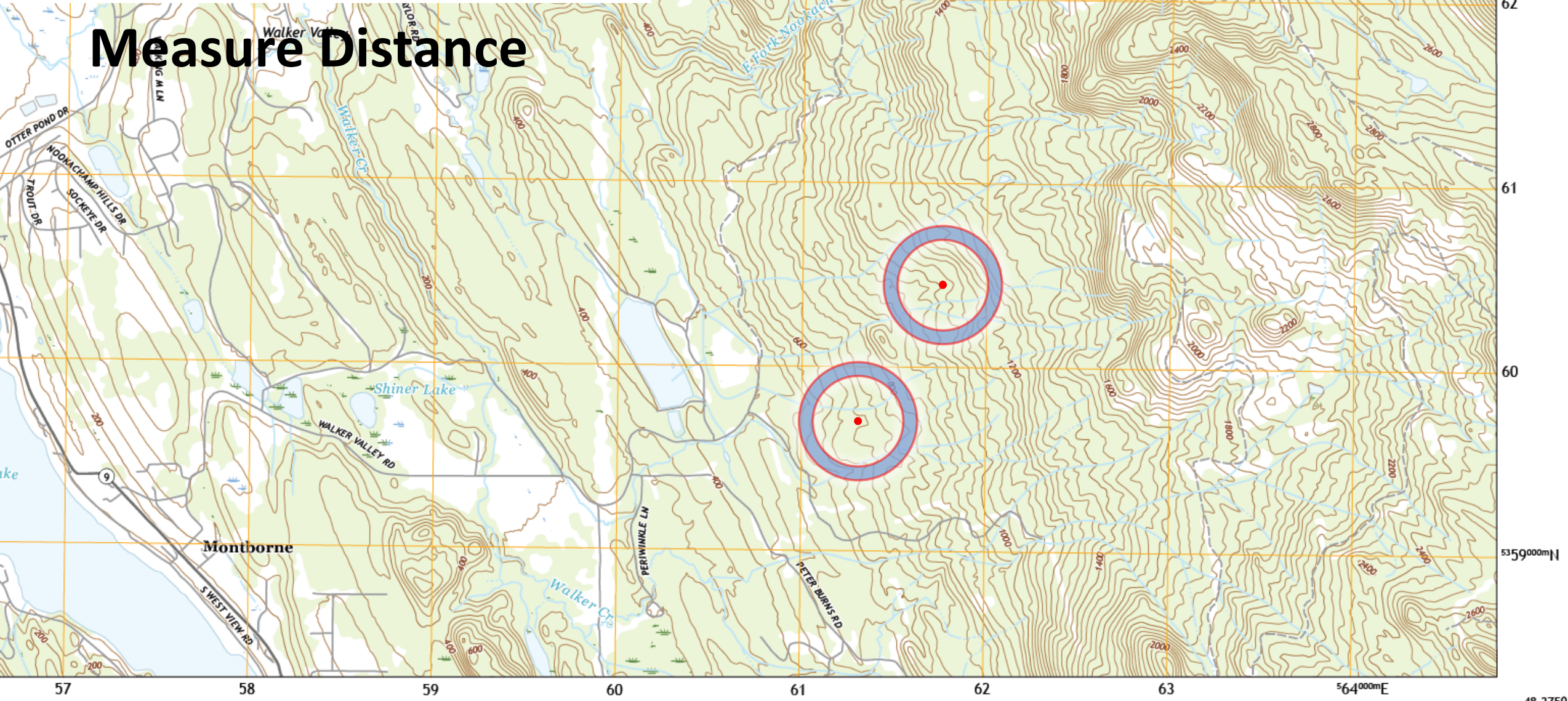
SUUNTO AIM-6 NH COMPASS



SCALE 1:24 000



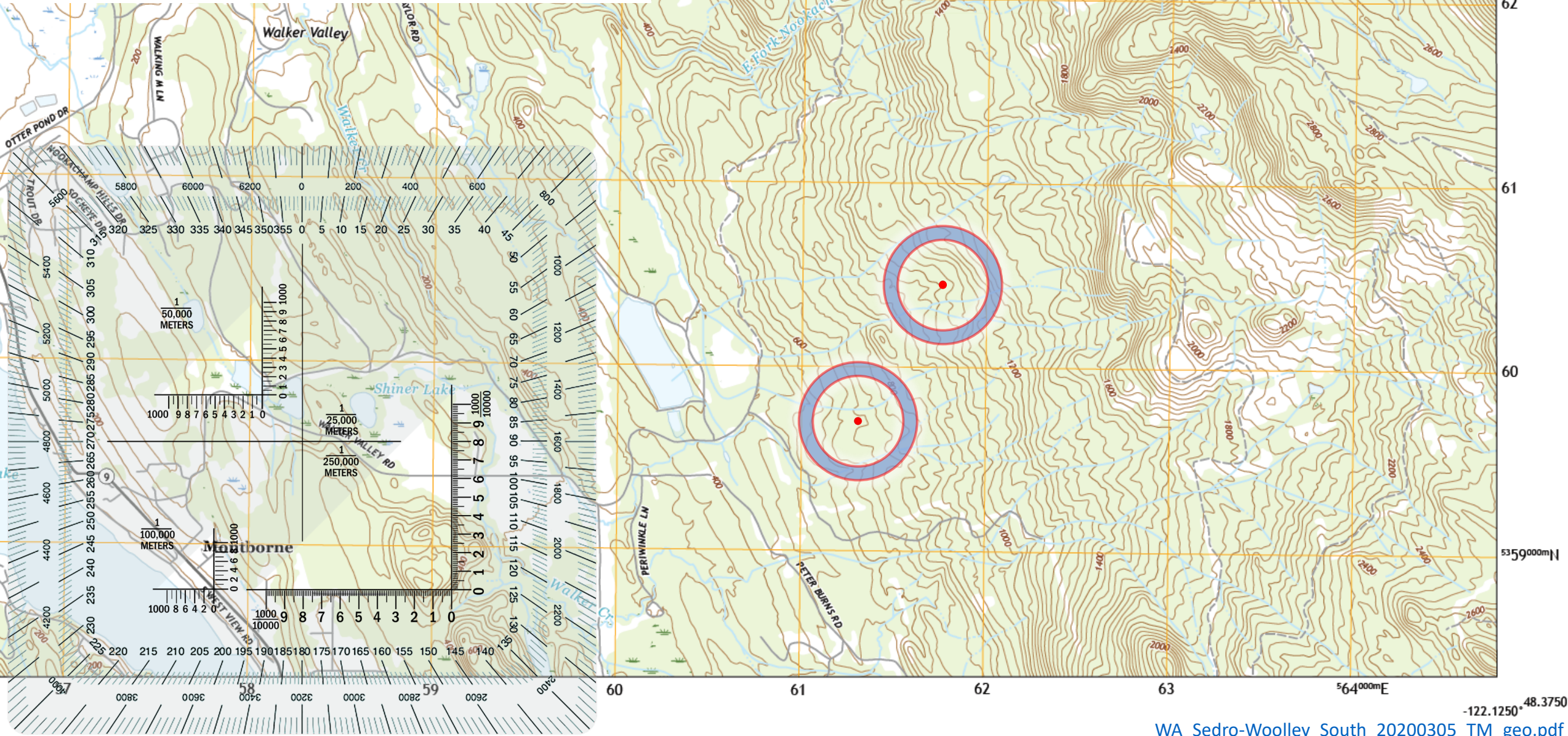
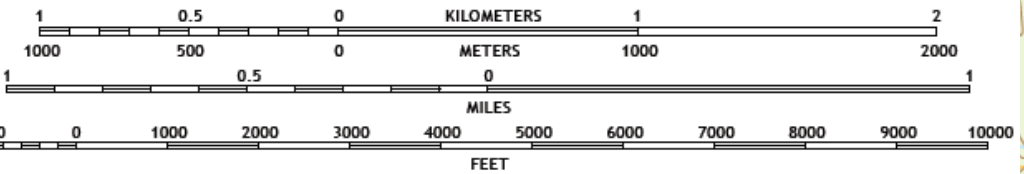
# Measure Distance



-122.1250° 48.3750°



SCALE 1:24 000

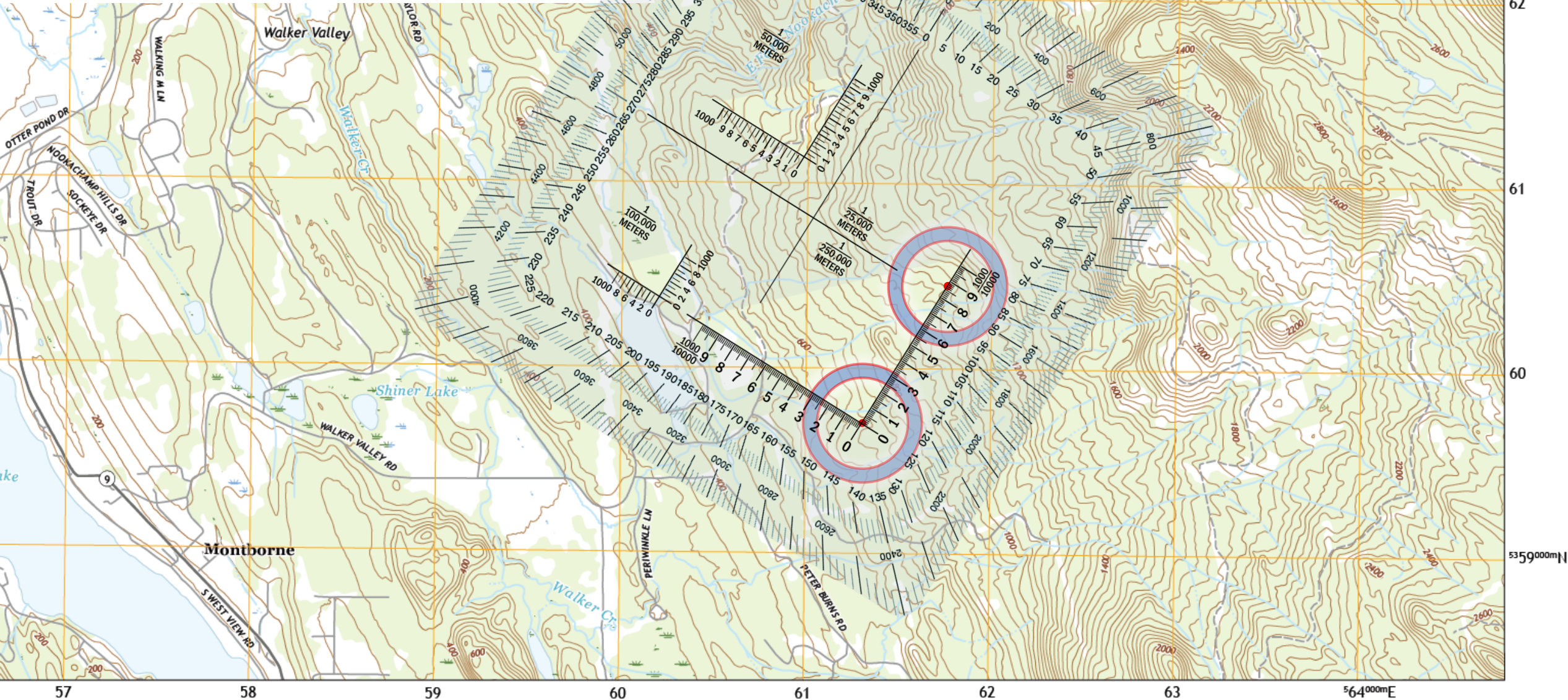
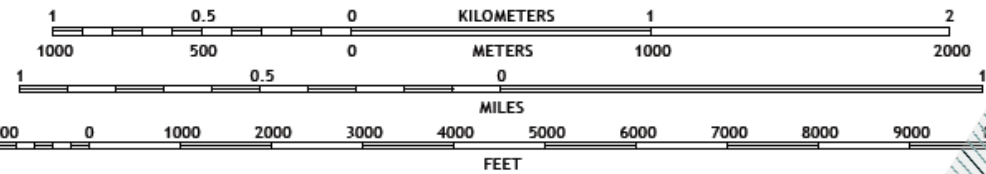


-122.1250° 48.3750°

WA Sedro-Woolley South 20200305 TM geo.pdf



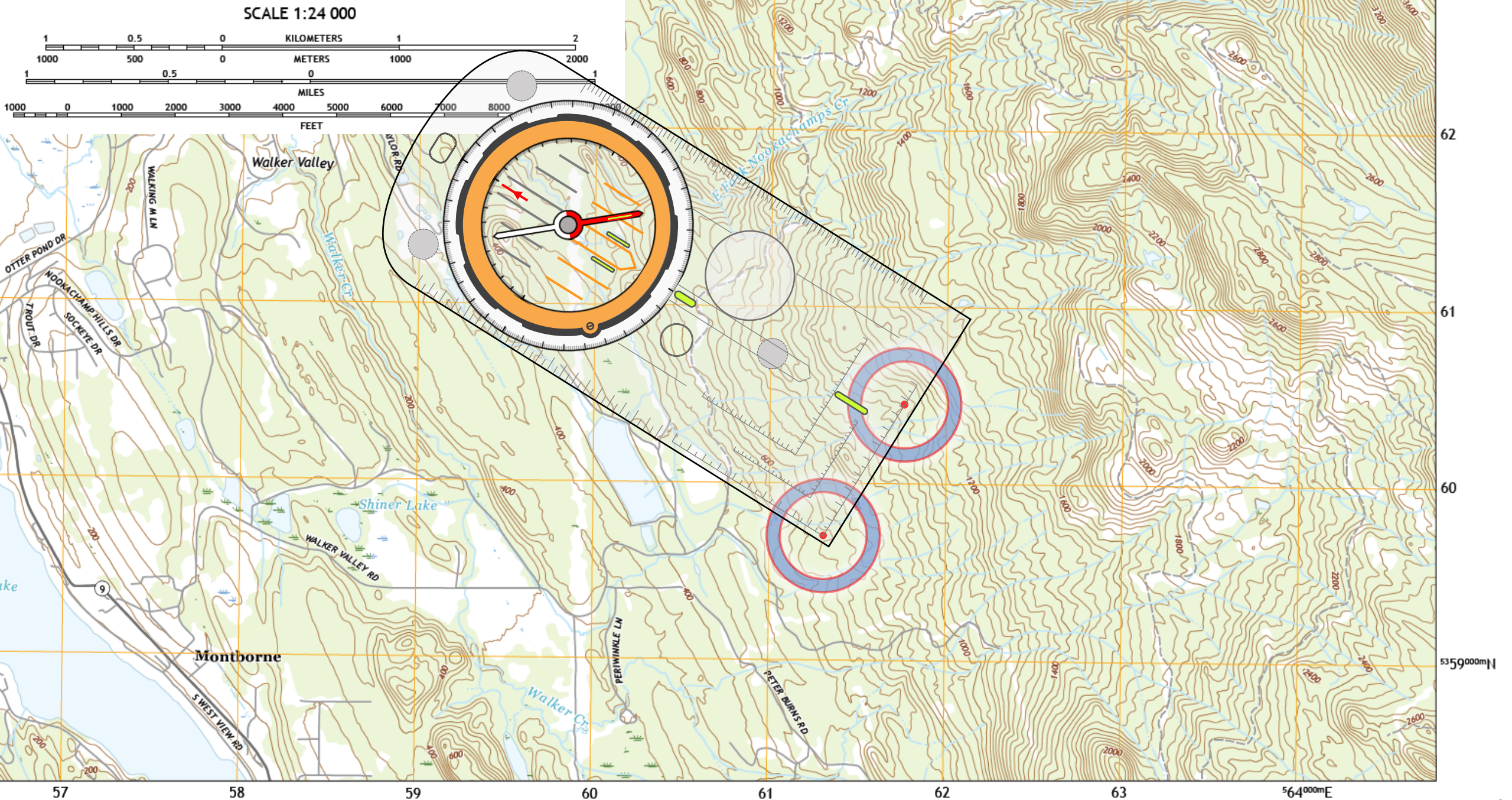
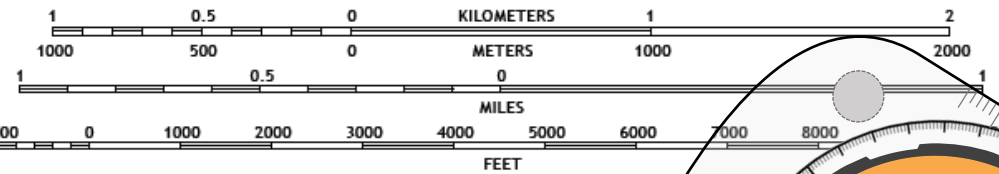
SCALE 1:24 000



-122.1250° 48.3750°



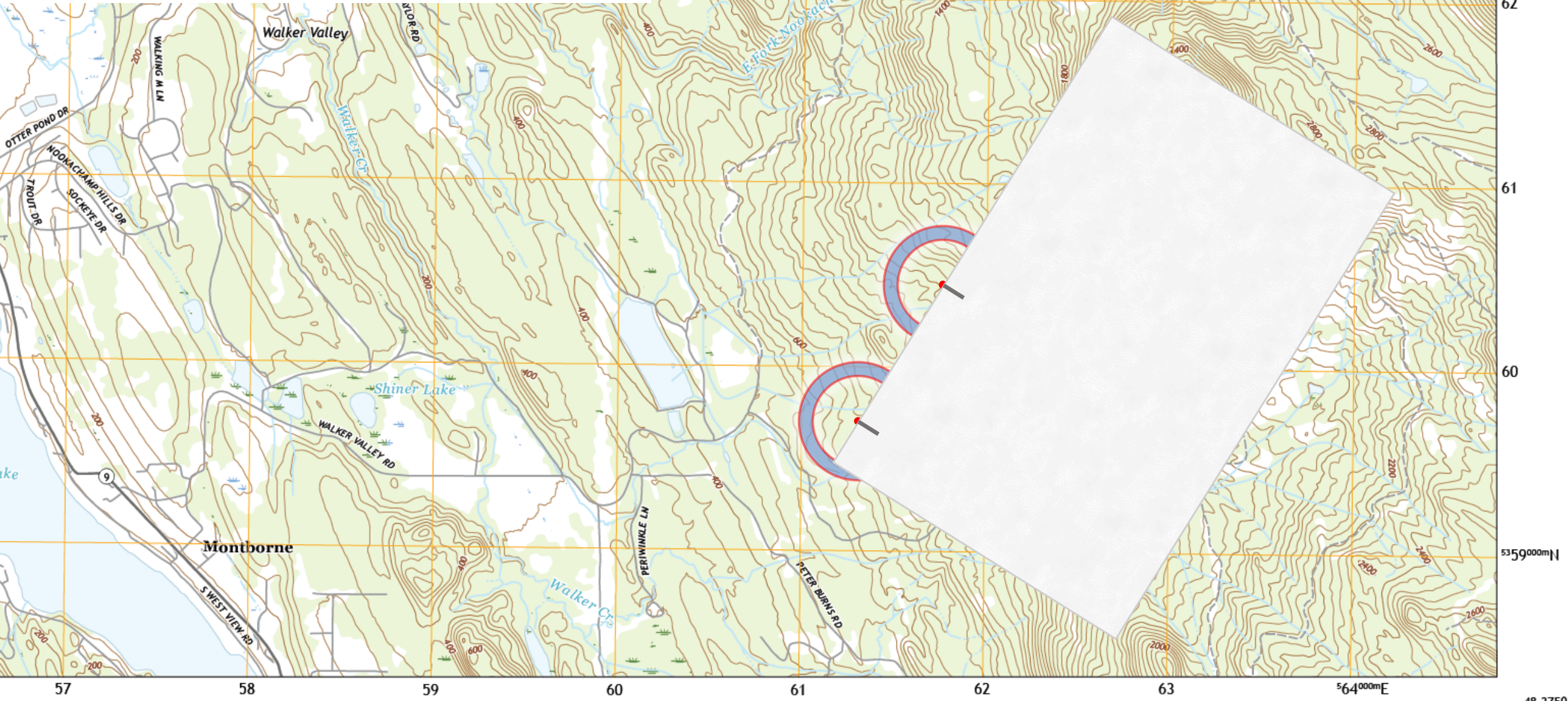
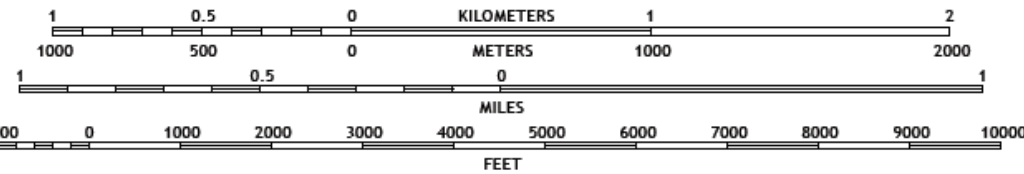
SCALE 1:24 000



-122.1250° 48.3750°



SCALE 1:24 000



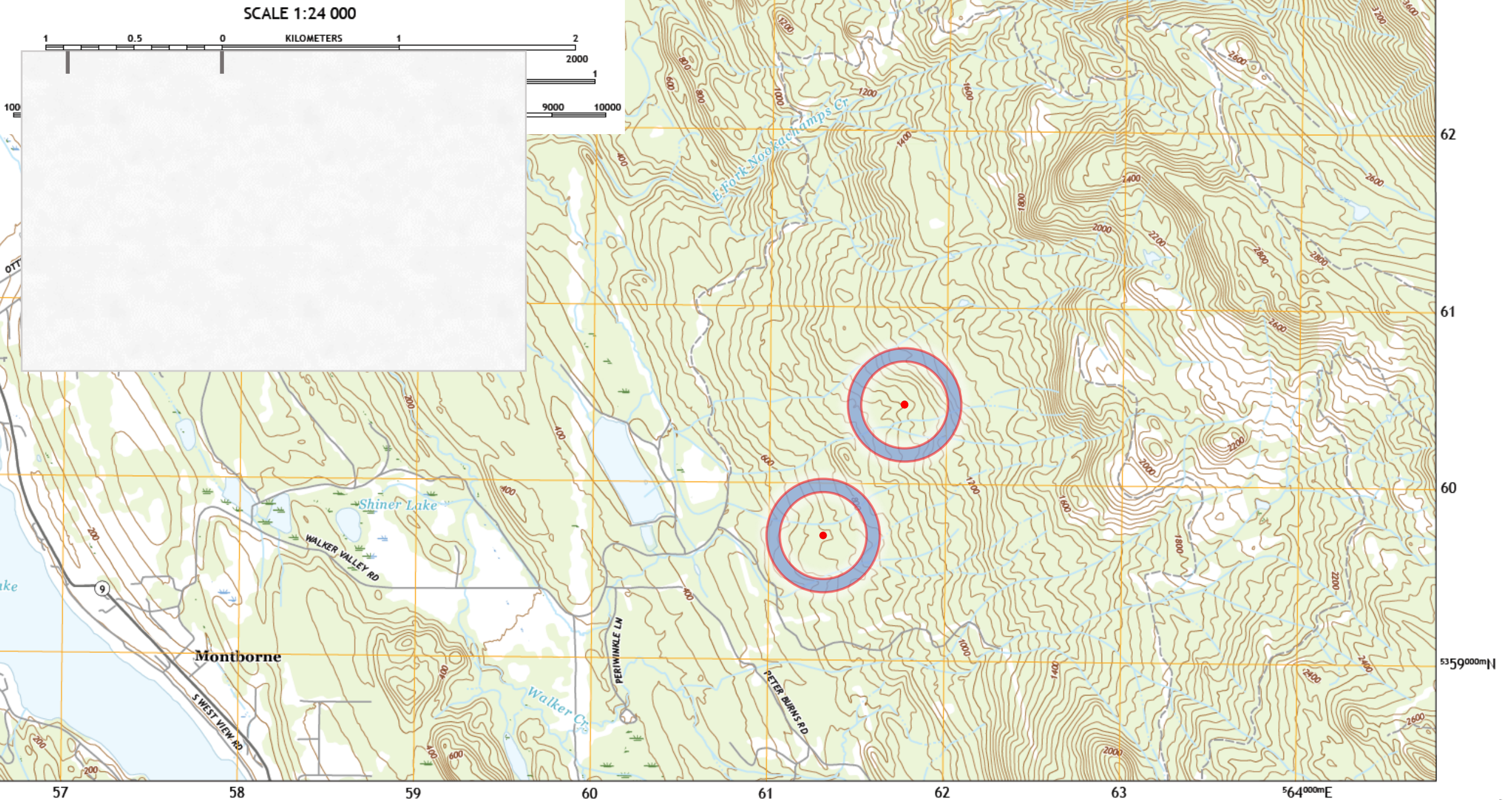
-122.1250° 48.3750°



SCALE 1:24 000

1 0.5 0 KILOMETERS 1 2

2000  
1  
9000 10000



-122.1250° 48.3750°



# Compass

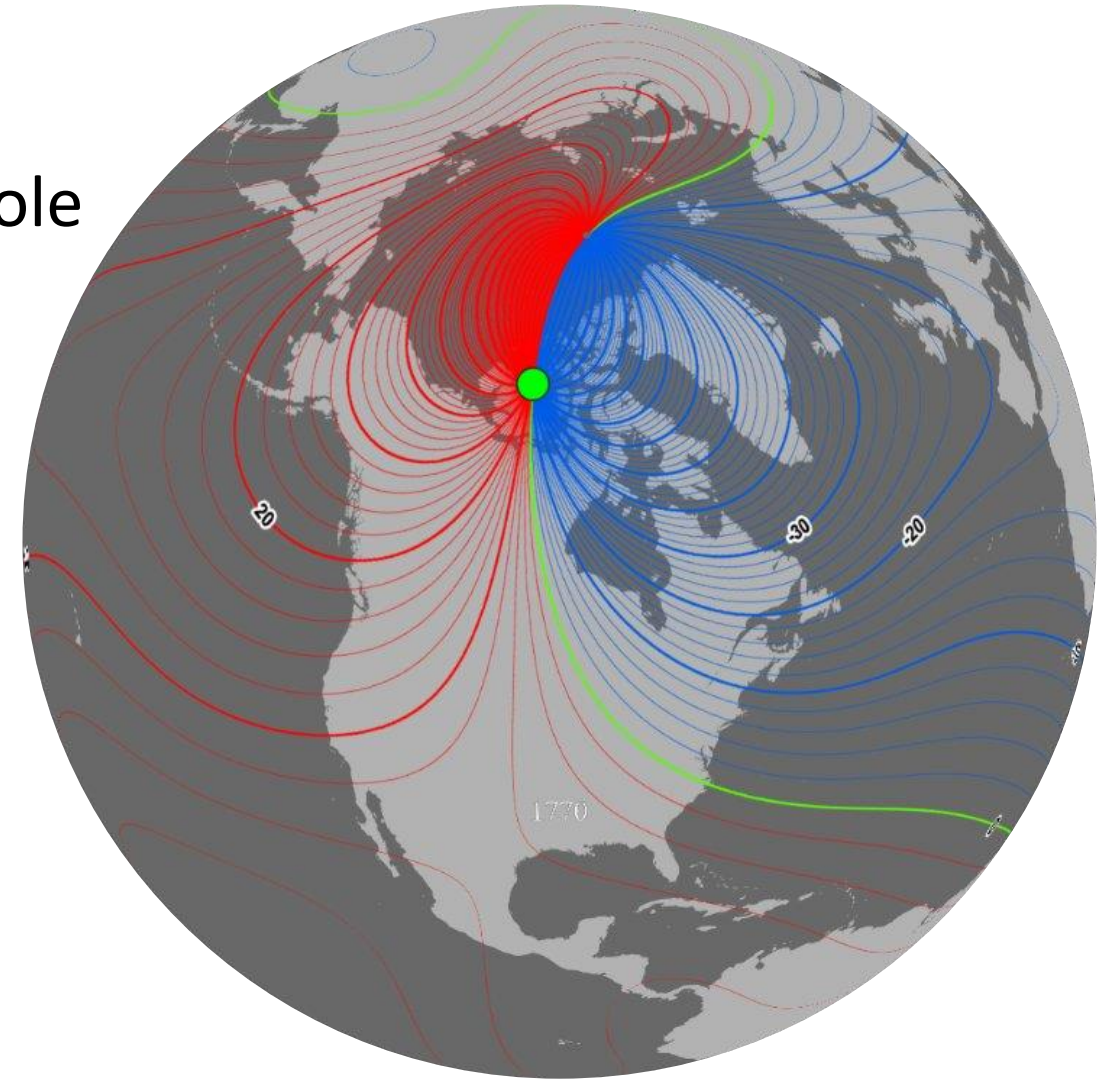
## **Magnetic Declination**

Magnetic declination is an important concept to understand when using a magnetic compass

# Compass

## Magnetic Declination

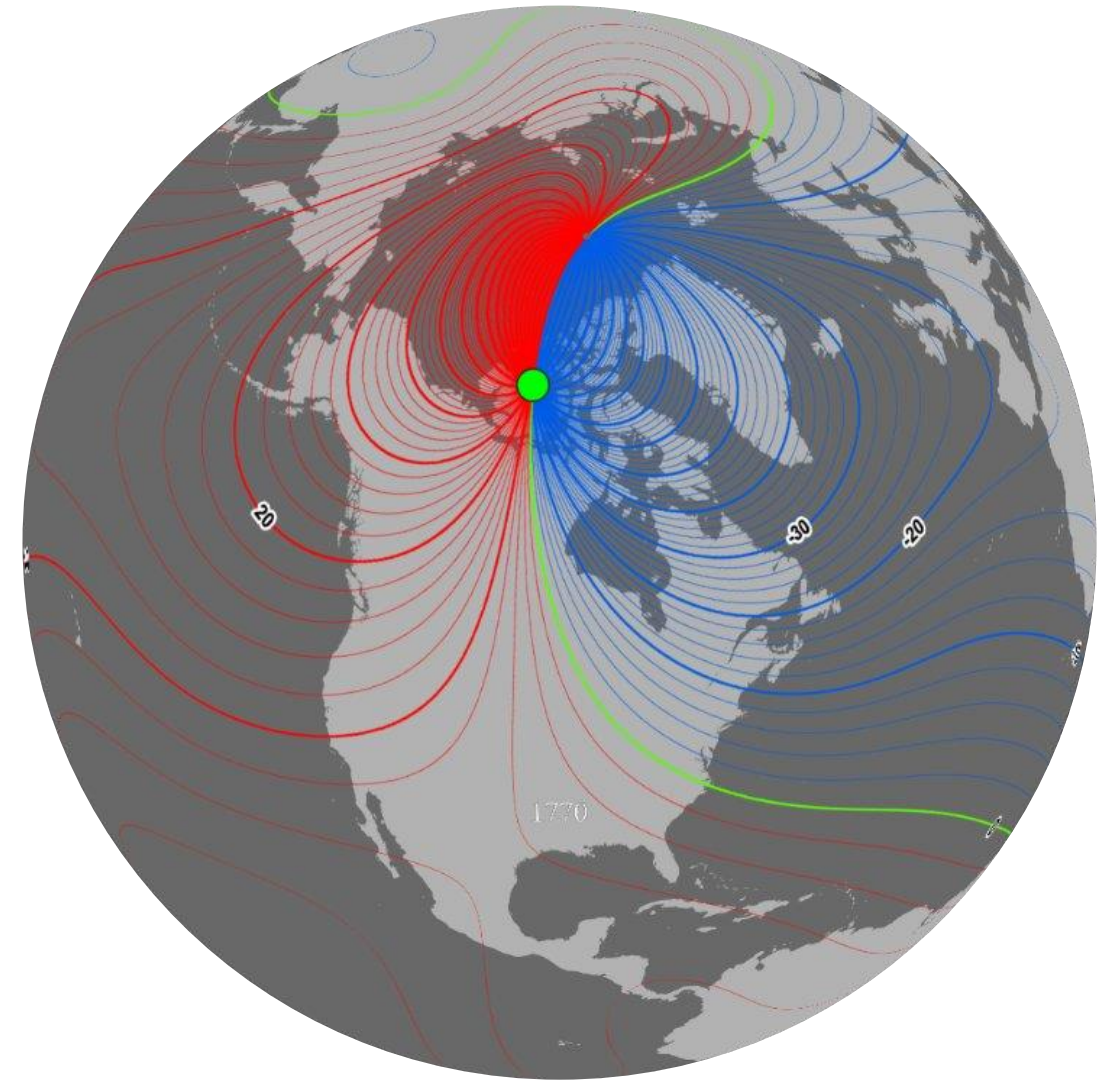
A compass doesn't point at the North Pole



# Compass

## Magnetic Declination

The Earth creates its own magnetic field from the electric currents created in the liquid iron-nickel core.

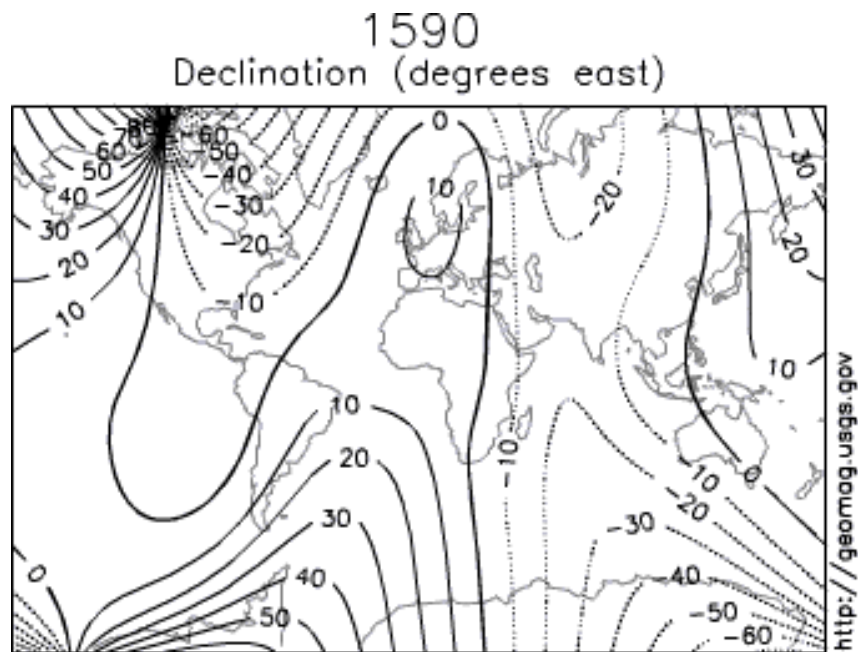


# Compass

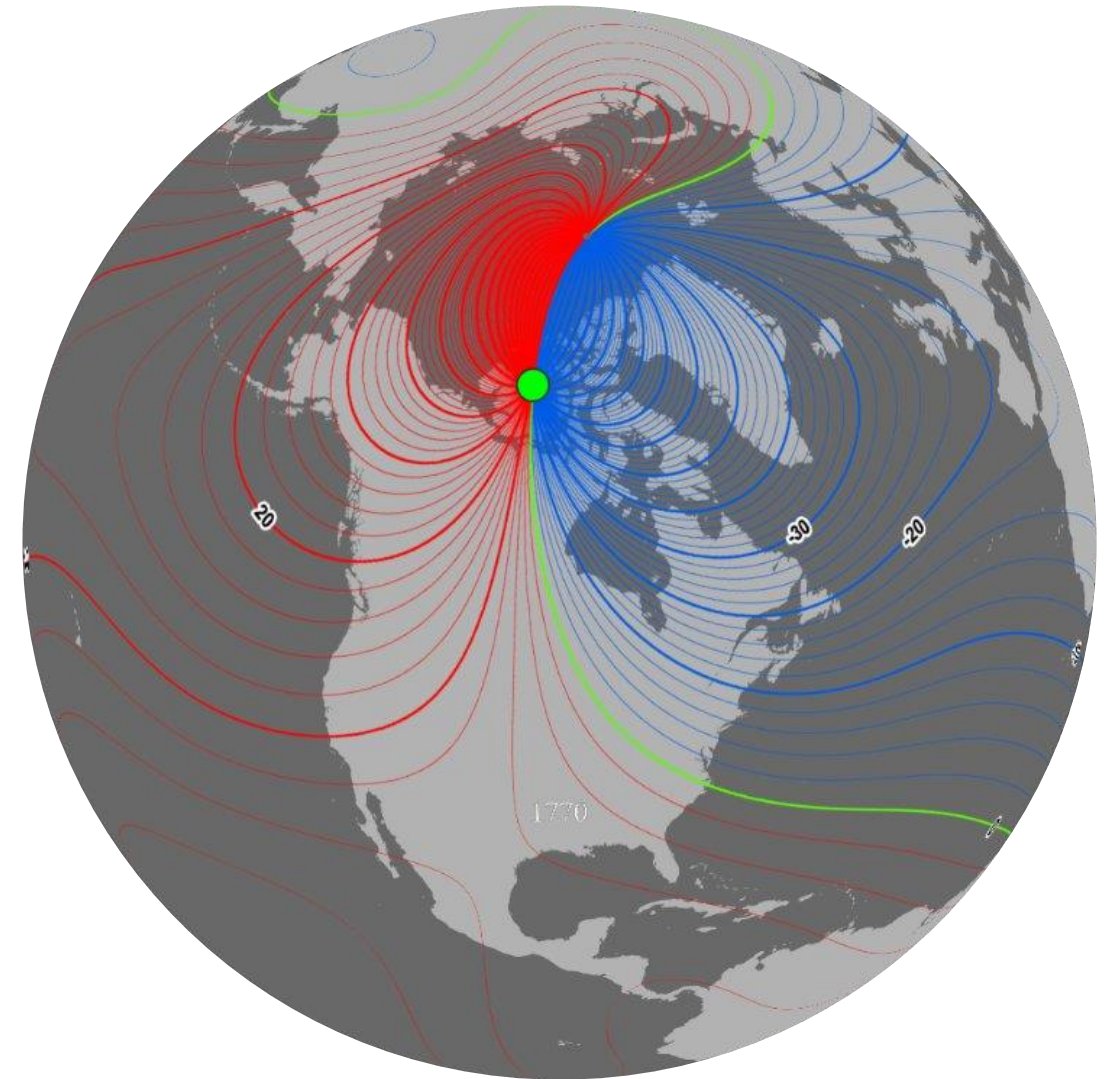
## Magnetic Declination

The poles also slowly move over time...

Now more than 30 miles per year

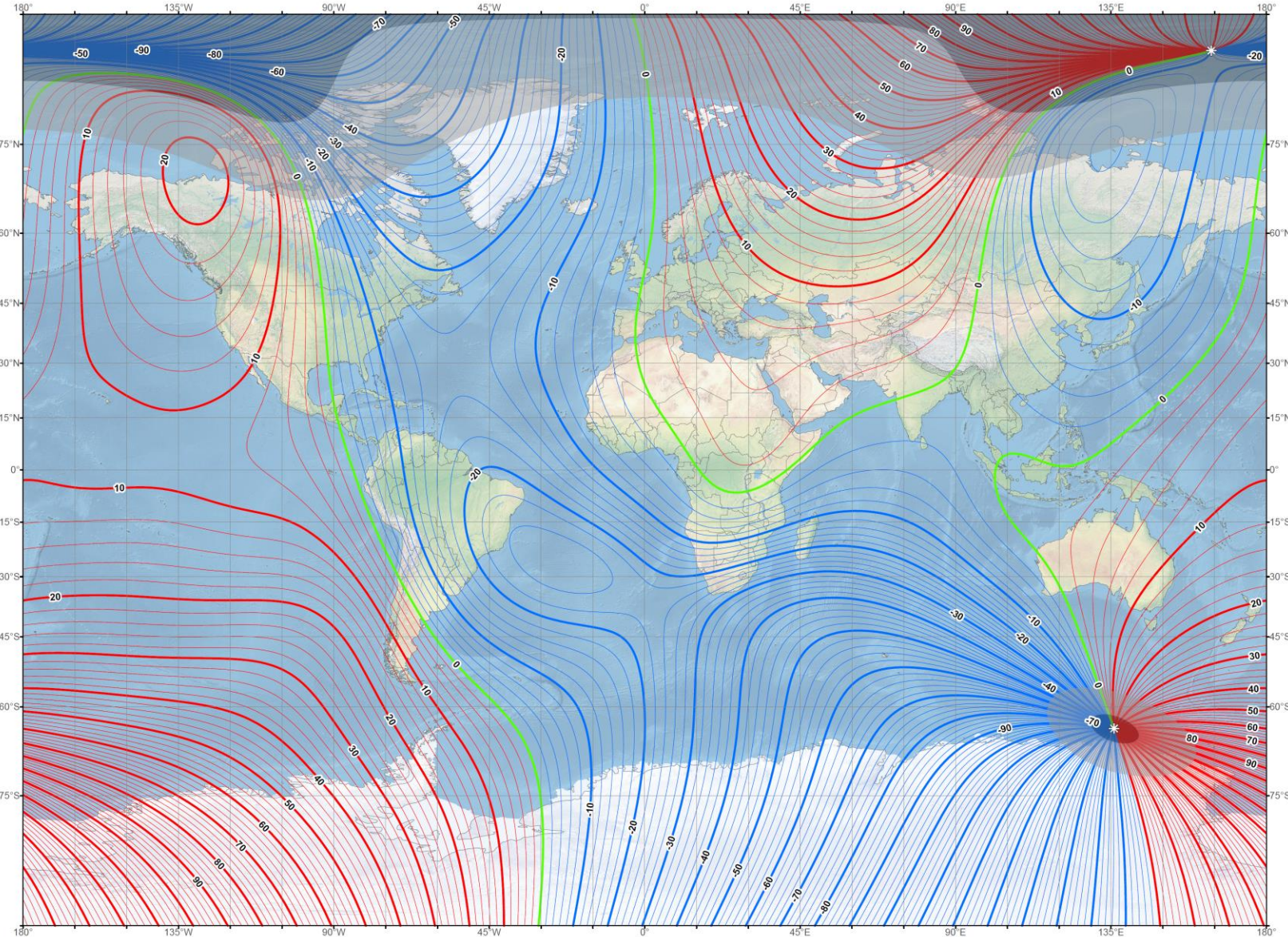


Model by A. Jackson, A. R. T. Jonkers, M. R. Walker,  
Phil. Trans. R. Soc. London A (2000), 358, 957-990.





# US/UK World Magnetic Model - Epoch 2020.0 Main Field Declination (D)



**Main Field Declination (D)**  
Miller Cylindrical Projection  
Contour interval: 2 degrees  
— Positive (east)  
— Negative (west)  
— Zero (agonic) line

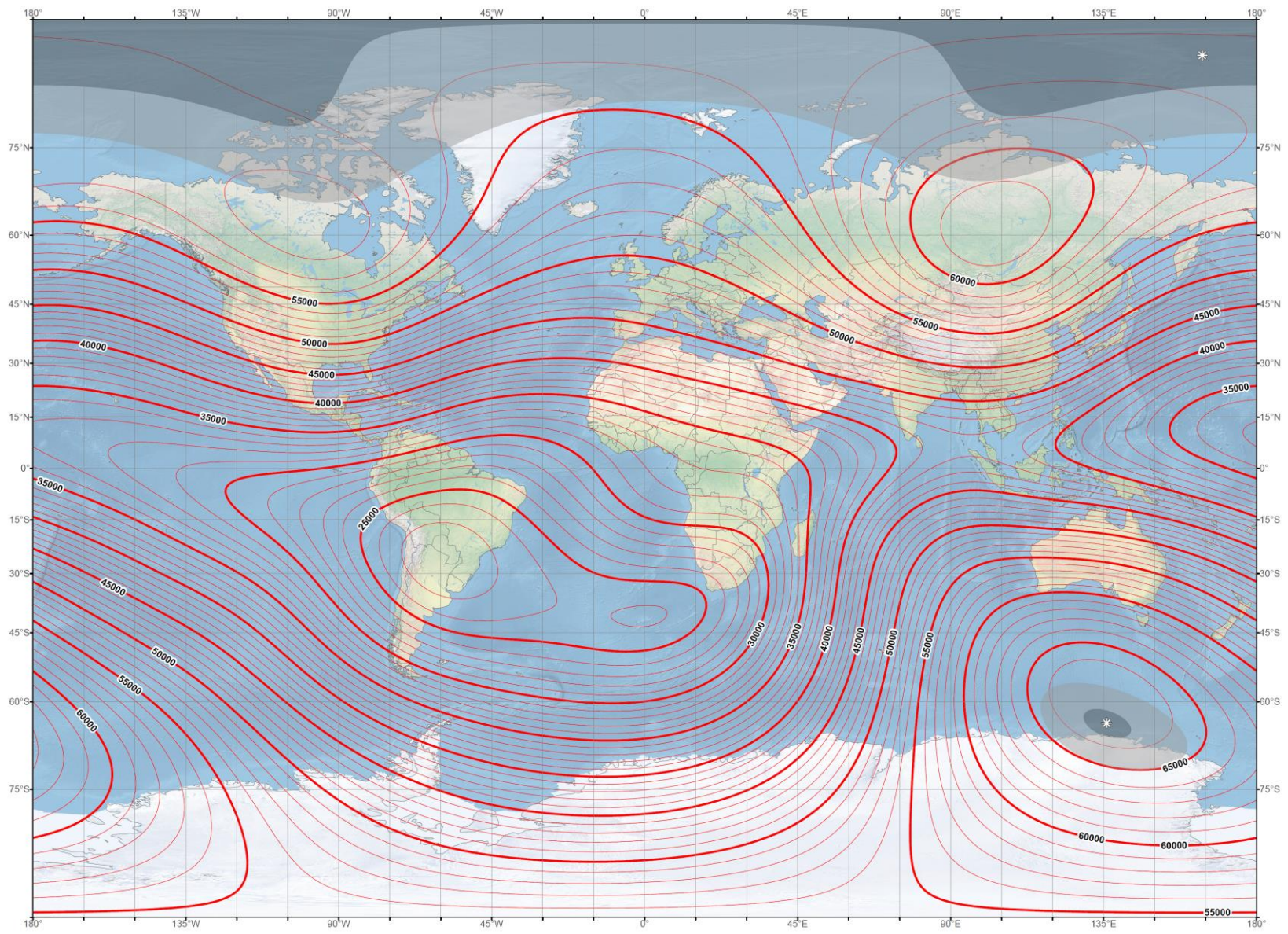
Position of Dip Poles

**Blackout Zones**  
Horizontal Field (H) Strength:  
■ 0-2000 nT (Unreliable Zone)  
■ 2000-6000 nT (Caution Zone)

Map developed by NOAA/NCEI and CIRES  
<https://ngdc.noaa.gov/geomag/WMM>  
Published December 2019



# US/UK World Magnetic Model - Epoch 2020.0 Main Field Total Intensity (F)



**Main Field Total Intensity (F)**  
 Miller Cylindrical Projection  
 Contour interval: 1000 nT

Position of Dip Poles

**Blackout Zones**  
 Horizontal Field (H) Strength:  
 0-2000 nT (Unreliable Zone)  
 2000-6000 nT (Caution Zone)

Map developed by NOAA/NCEI and CIRES  
<https://ngdc.noaa.gov/geomag/WMM>  
 Published December 2019

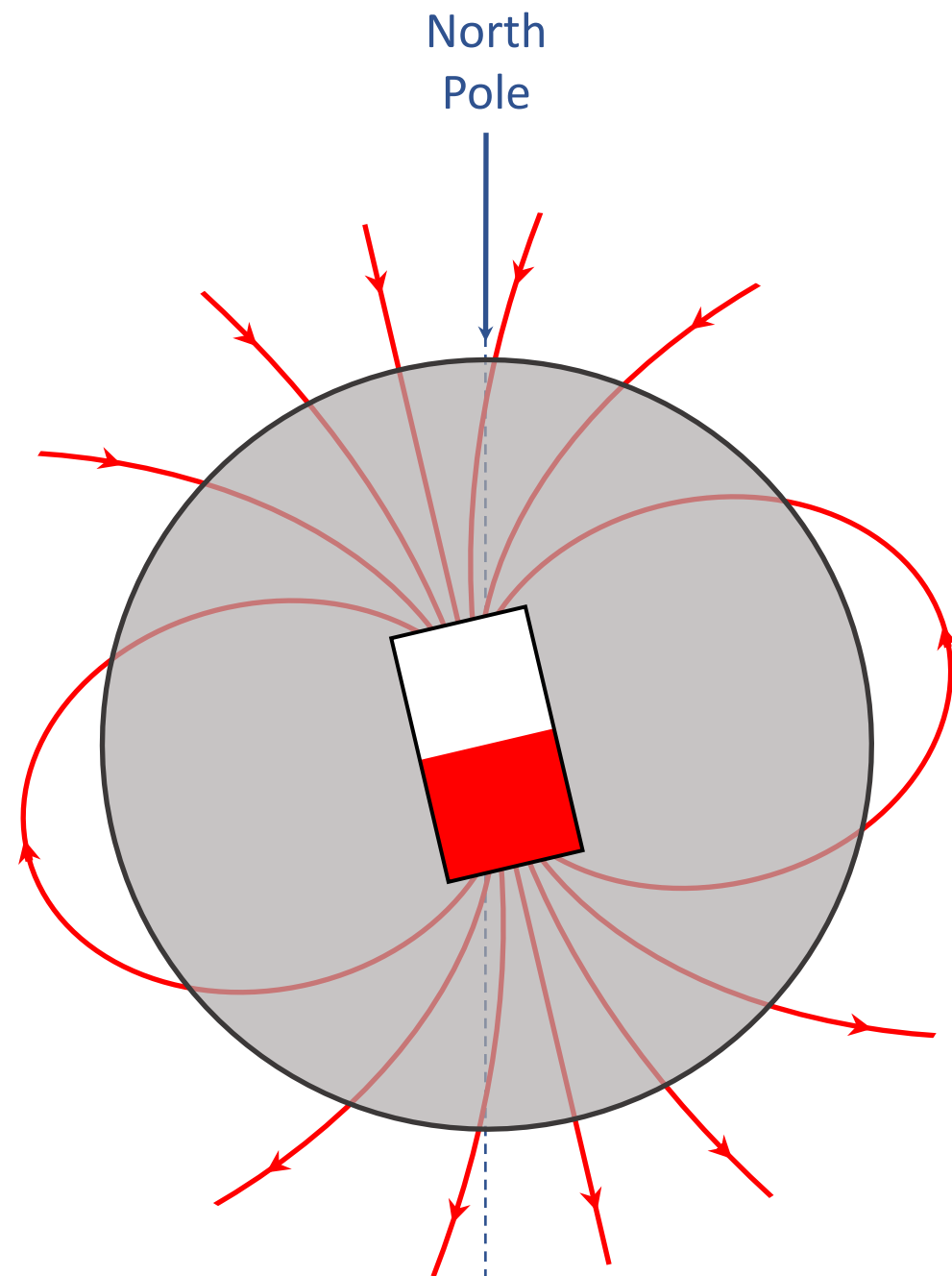


# Compass

## Magnetic Inclination

The earth's magnetic field is 3 dimensional

- Northern Zones – Needle dives
- Magnetic Equator – Needle balanced
- Southern Zones – Needle climbs



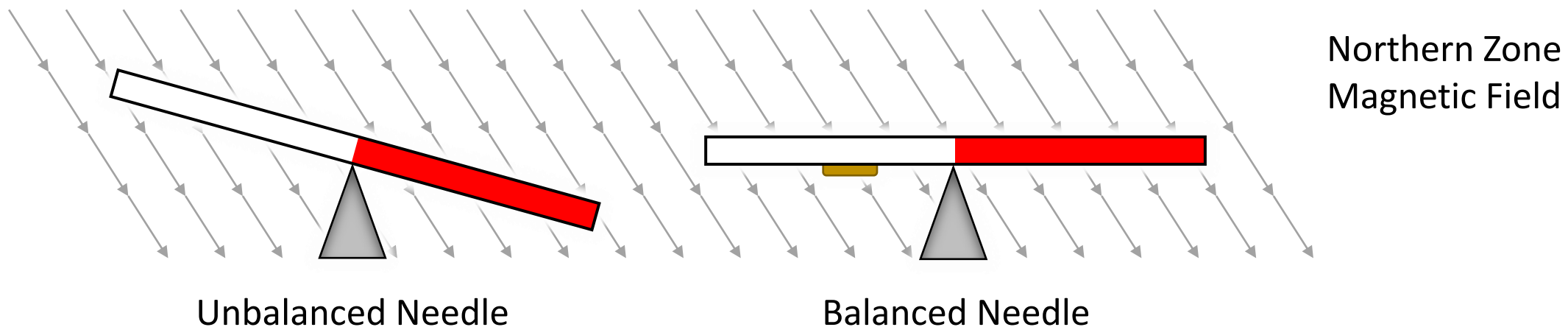


# Compass

## Magnetic Inclination

A needle on a compass will dip and rise with the Earth's magnetic field

- Most compasses are balanced to compensate for inclination
  - A compass balanced for the USA will drag in Australia
  - A compass balanced for Australia will drag in the USA



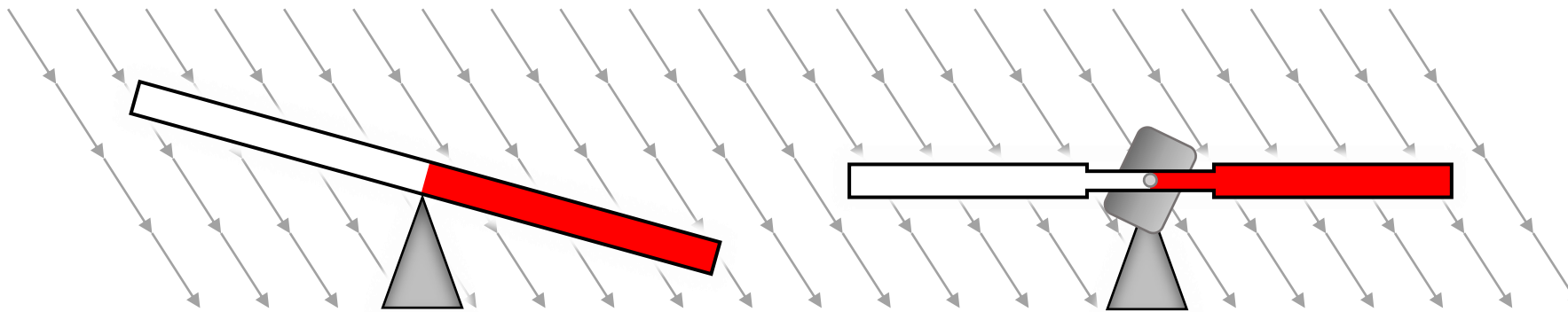




# Compass

## “Global” Compass

- RECTA and Suunto Global Needle System
  - Compass needle and magnet are built as separate units
  - Needle fixed at its pivot by means of a double bearing
    - Magnet rotates on a pivot with its own jeweled bearing
    - Needle does NOT dip with magnetic inclination



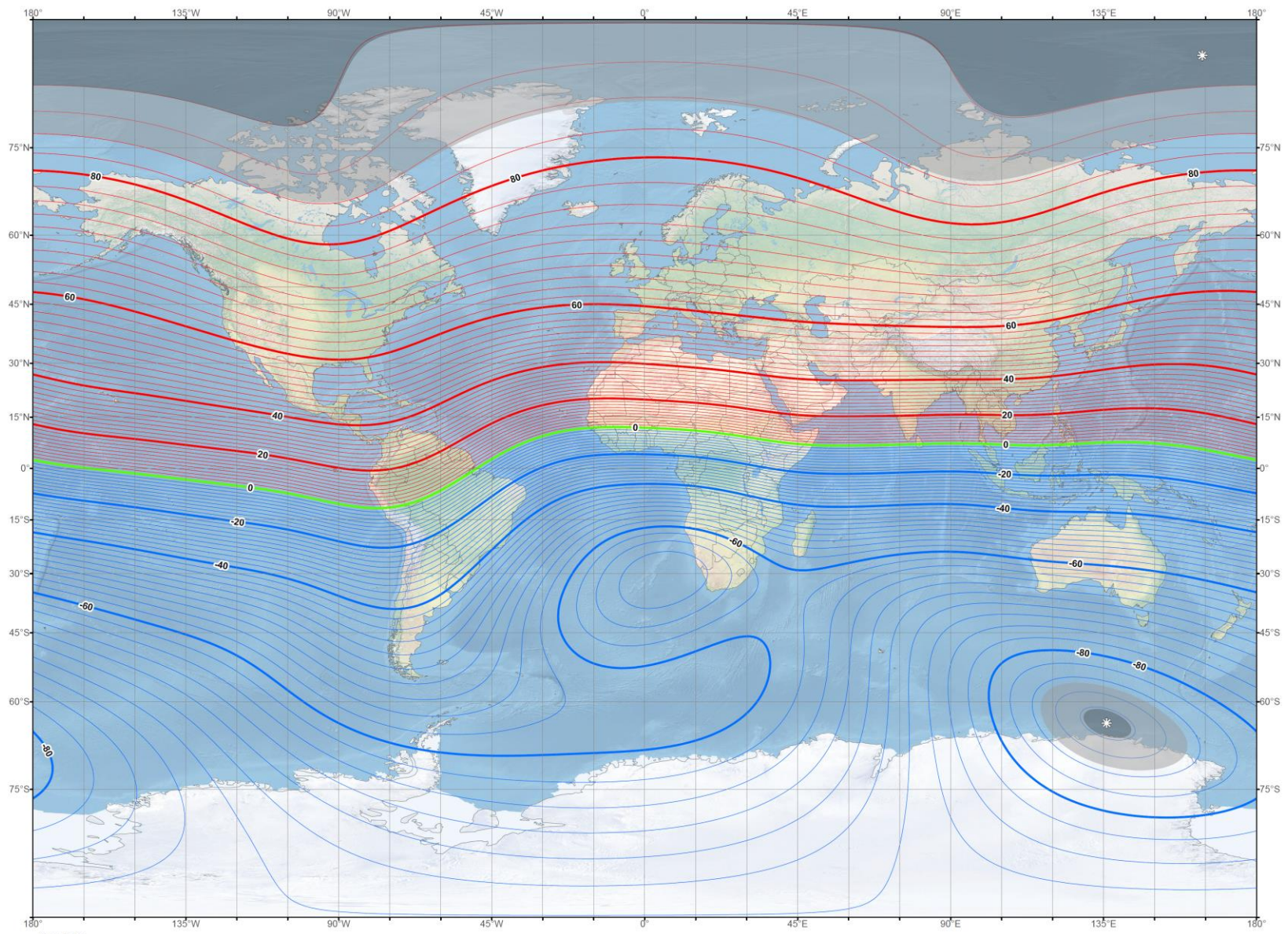
Unbalanced Needle

Global Needle



SUUNTO MC-2 G

# US/UK World Magnetic Model - Epoch 2020.0 Main Field Inclination (I)



**Main Field Inclination (I)**  
 Miller Cylindrical Projection  
 Contour interval: 2 degrees  
 Positive (down)  
 Negative (up)  
 Zero line

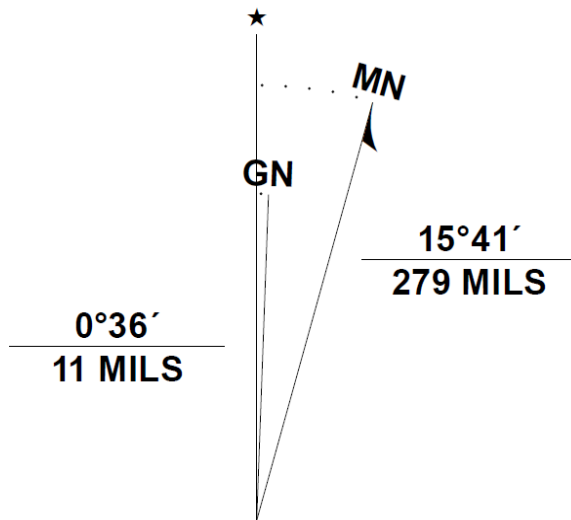
**Position of Dip Poles**

**Blackout Zones**  
 Horizontal Field (H) Strength:  
 0-2000 nT (Unreliable Zone)  
 2000-6000 nT (Caution Zone)

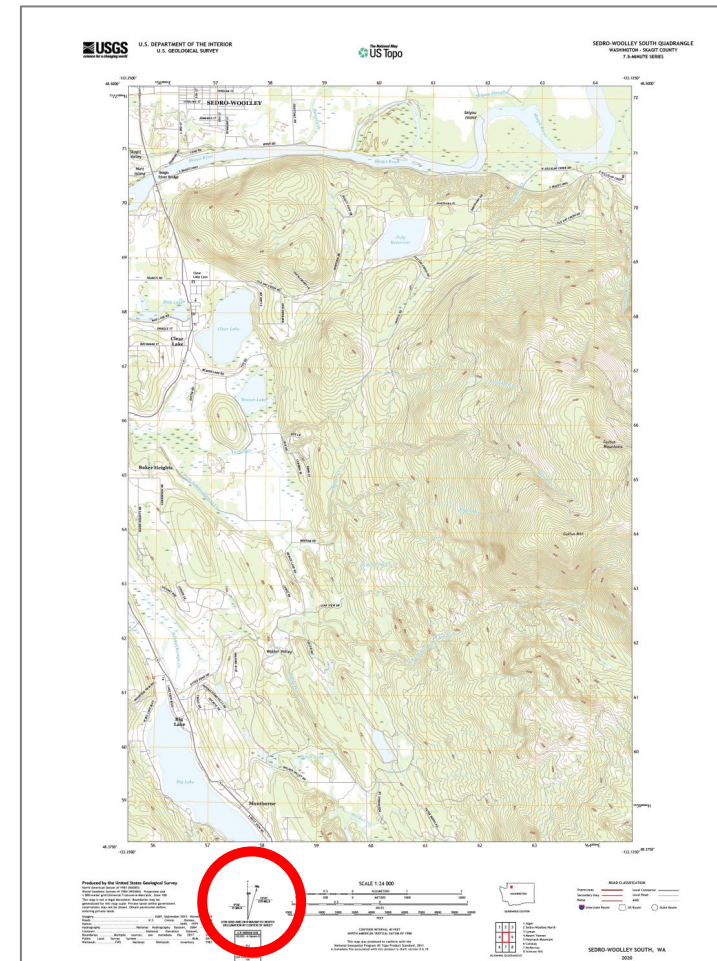
Map developed by NOAA/NCEI and CIRES  
<https://ngdc.noaa.gov/geomag/WMM>  
 Published December 2019



# Magnetic Declination



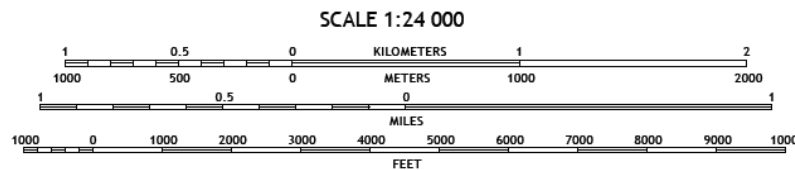
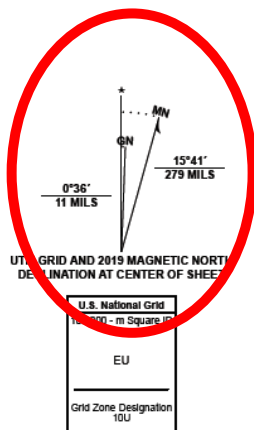
UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET



**Produced by the United States Geological Survey**

North American Datum of 1983 (NAD83)  
 World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid: Universal Transverse Mercator, Zone 10U  
 This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, September 2015 - November 2015  
 Roads.....U.S. Census Bureau, 2016  
 Names.....GNIS, 1979 - 2019  
 Hydrography.....National Hydrography Dataset, 2004 - 2019  
 Contours.....National Elevation Dataset, 2018  
 Boundaries.....Multiple sources; see metadata file 2017 - 2018  
 Public Land Survey System.....BLM, 2019  
 Wetlands.....FWS National Wetlands Inventory 1981



CONTOUR INTERVAL 40 FEET  
 NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011. A metadata file associated with this product is draft version 0.6.18



ADJOINING QUADRANGLES

1	2	3
4	5	6
6	7	8

1 Alger  
 2 Sedro-Woolley North  
 3 Lyman  
 4 Mount Vernon  
 5 Haystack Mountain  
 6 Conway  
 7 McMurray  
 8 Stimson Hill

ROAD CLASSIFICATION

Expressway		Local Connector	
Secondary Hwy		Local Road	
Ramp		4WD	
Interstate Route		US Route	
		State Route	

SEDRO-WOOLLEY SOUTH, WA

2020

# Magnetic Field Calculators

Declination

U.S. Historic Declination

Magnetic Field

Magnetic Field Component Grid

## Magnetic Declination Estimated Value ⓘ

Declination is calculated using the most recent [World Magnetic Model \(WMM\)](#) or the [International Geomagnetic Reference Field \(IGRF\)](#) model. For 1590 to 1900 the calculator is based on the [gufm1](#) model. A smooth transition from gufm1 to IGRF was imposed from 1890 to 1900. The [Enhanced Magnetic Model \(EMM\)](#) is a research model compiled from satellite, marine, aeromagnetic and ground magnetic surveys which attempts to include crustal variations in the magnetic field too fine to appear in the World Magnetic Model. Declination results are typically accurate to 30 minutes of arc, but environmental factors can cause magnetic field disturbances. The calculator provides an easy way for you to get results in HTML, XML, CSV, or JSON programmatically (API). For more information click the information button above.

### Calculate Declination

Latitude:   S  NLongitude:   W  EModel:  WMM (2019-2024)  IGRF (1590-2024)  
 EMM (2000-2019)Date: Year  Month  Day Result format:  HTML  XML  CSV  JSON  PDF

### Lookup Latitude / Longitude

Enter a street address, street name, or street intersection. For best results, include as much location information as possible with the street address in your search, such as city, state, zip code.

Location: 

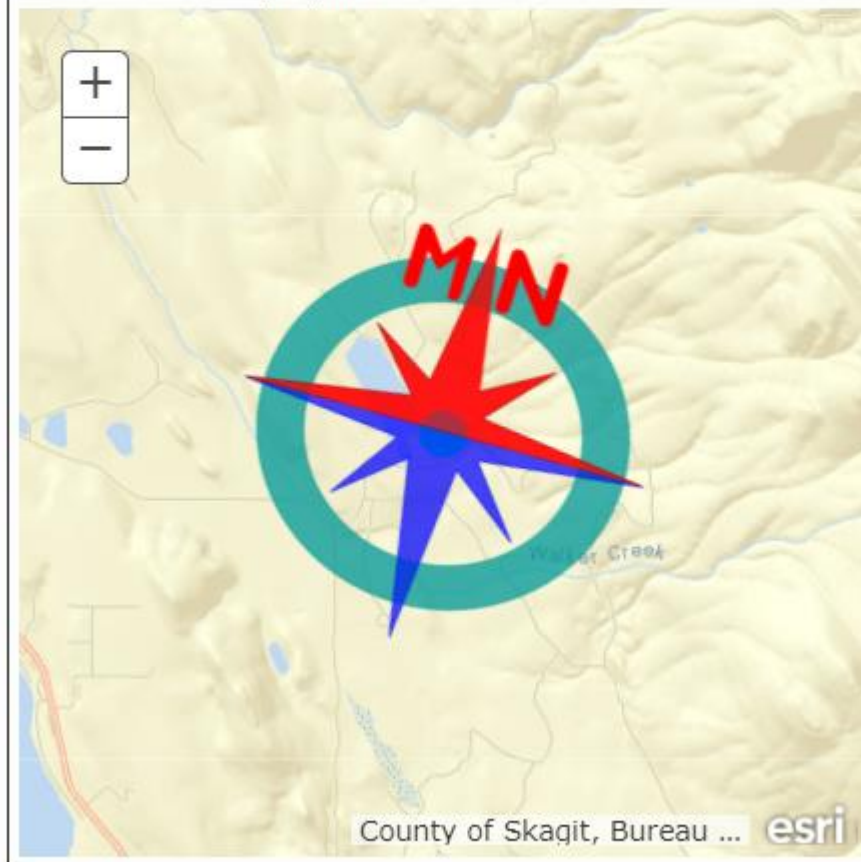

## Declination ✕

Model Used: WMM-2020

Latitude: 48° 23' 18" N ⓘ

Longitude: 122° 10' 55" W

Date	Declination
2021-01-09	15° 40' E ± 0° 24' changing by 0° 6' W per year



# Compass

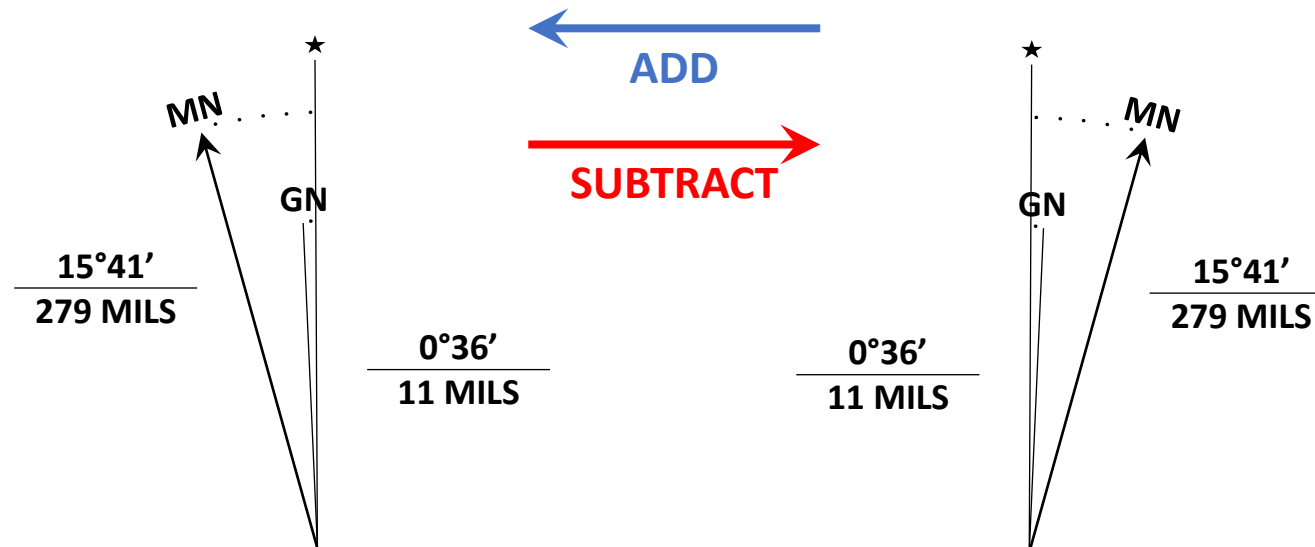
## Magnetic Declination – Conversions

Converting between Grid and Magnetic North requires a bit of math

To convert a  
Magnetic Azimuth to a  
Grid Azimuth

**SUBTRACT** angle

To convert a  
Grid Azimuth to a  
Magnetic Azimuth  
**ADD** angle



West Declination

East Declination

To convert a  
Magnetic Azimuth to a  
Grid Azimuth

**ADD** angle

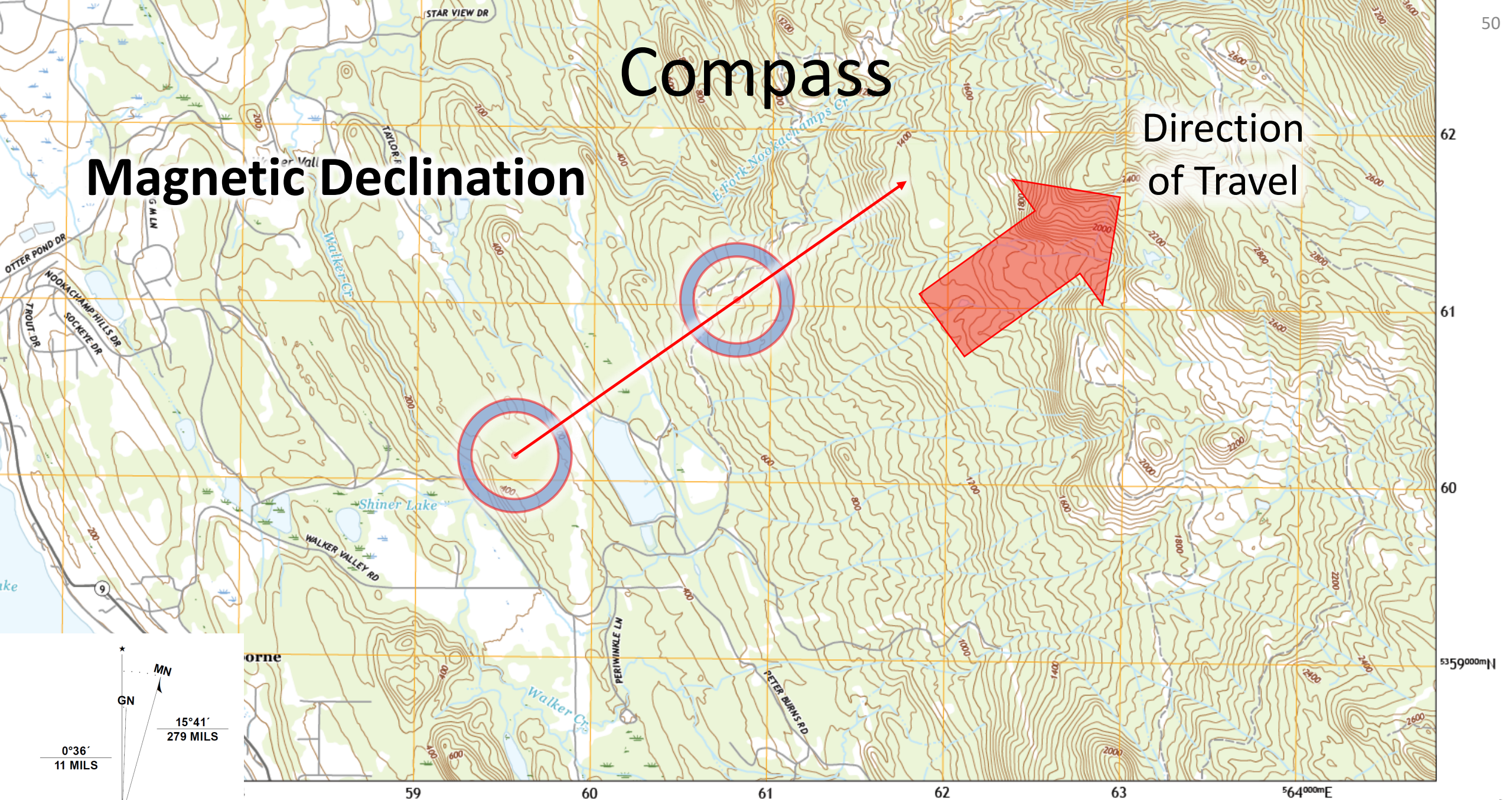
To convert a  
Grid Azimuth to a  
Magnetic Azimuth  
**SUBTRACT** angle



# Compass

## Magnetic Declination

Direction of Travel

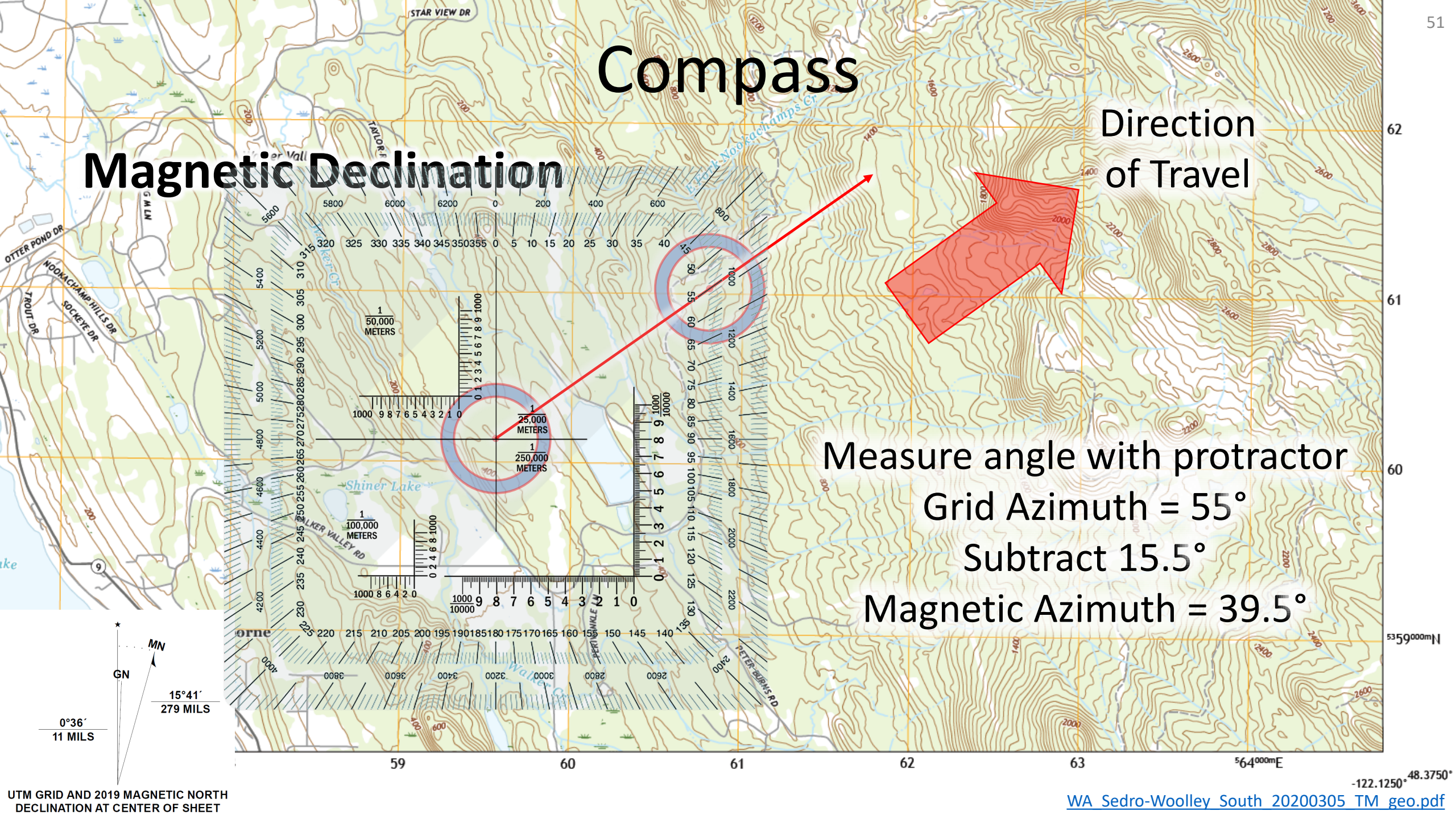




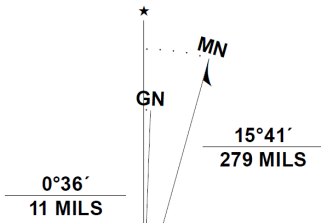
# Compass

## Magnetic Declination

Direction of Travel



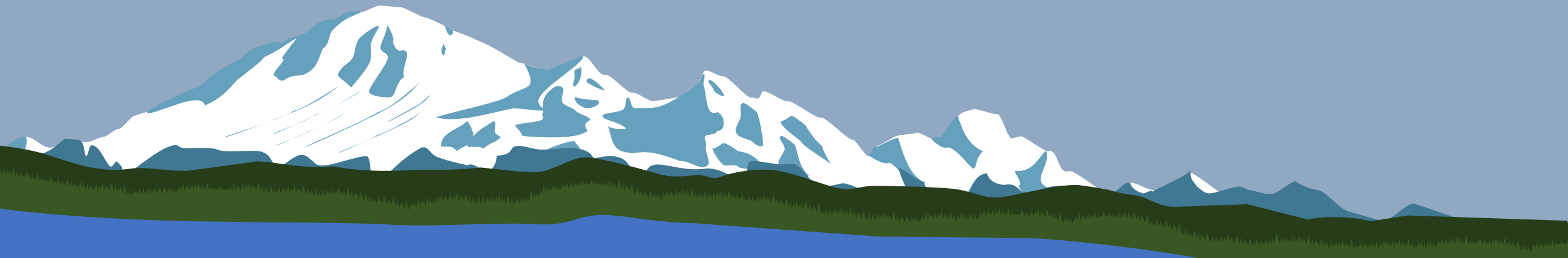
Measure angle with protractor  
 Grid Azimuth = 55°  
 Subtract 15.5°  
 Magnetic Azimuth = 39.5°



1. Requirements	13. Reading a Map
2. Introduction	14. Interpreting Map Symbols
3. Map Reading	15. Symbols and Contours
4. Locations	16. General Topographic Map
5. Map Orientation	17. Grid Coordinates
6. Interpreting Distance	18. Interpreting Elevation
7. Projections	19. Resources
8. Fieldwork	20. Instructor's Corner



# Map Orientation





# Map Orientation

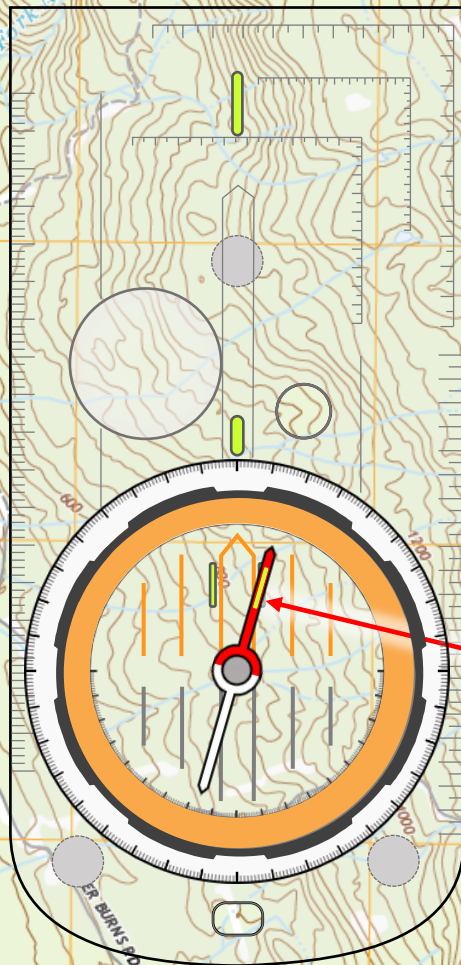
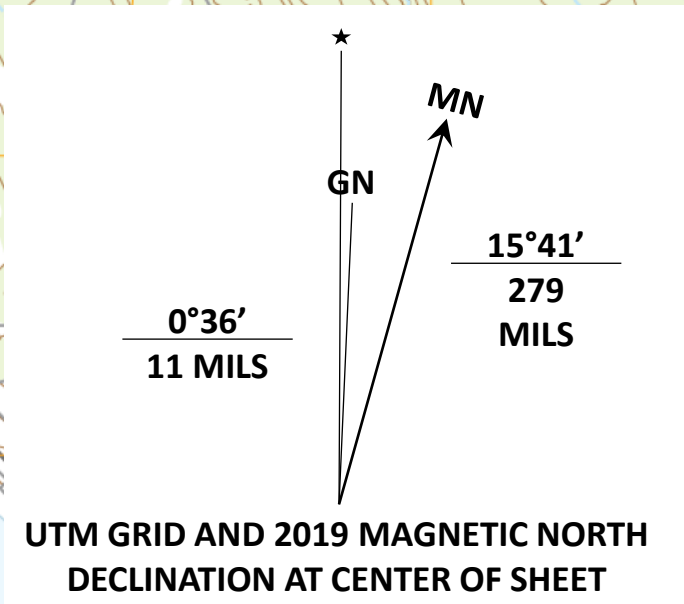
## **Map Orientation**

Show how to orient a map using a compass.

# Map Orientation

## Map Orientation

Line up  
Map and Needle  
Like Declination Diagram



Line up Needle with  
Orienting Arrow

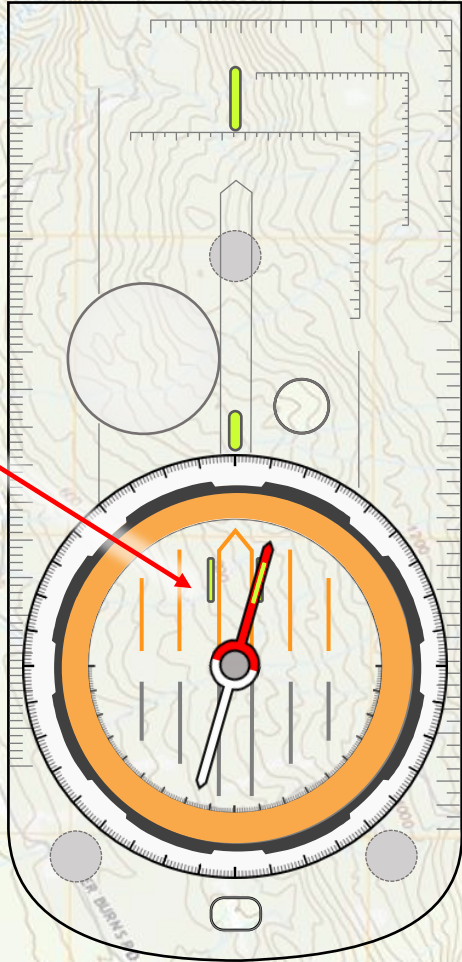
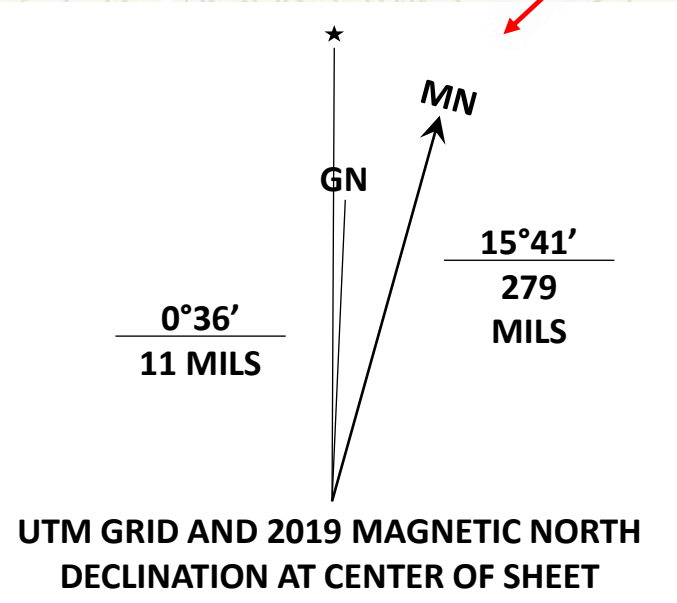
57 58 59 60 61 62 63 564000mE



# Map Orientation

## Map Orientation

Make these look like each other



57

58

59

60

61

62

63

564000mE

5359000mN

60

61

62



# Map Orientation

## Map Orientation

Direction of Travel

Line up Compass with points

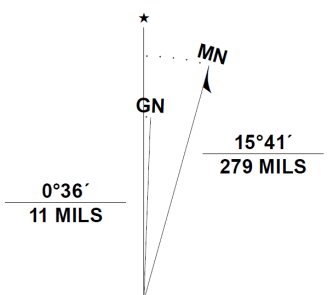
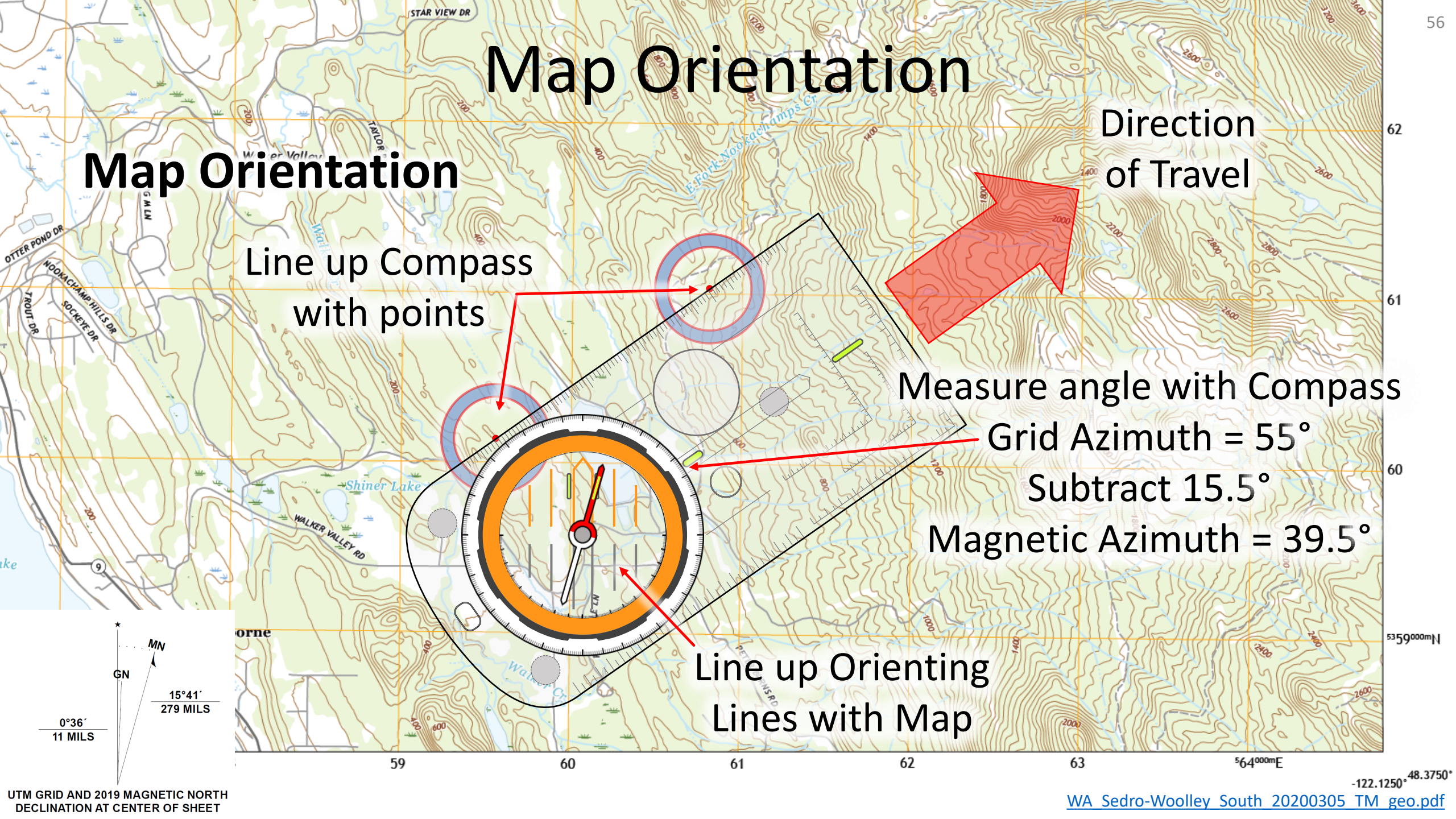
Measure angle with Compass

Grid Azimuth = 55°

Subtract 15.5°

Magnetic Azimuth = 39.5°

Line up Orienting Lines with Map

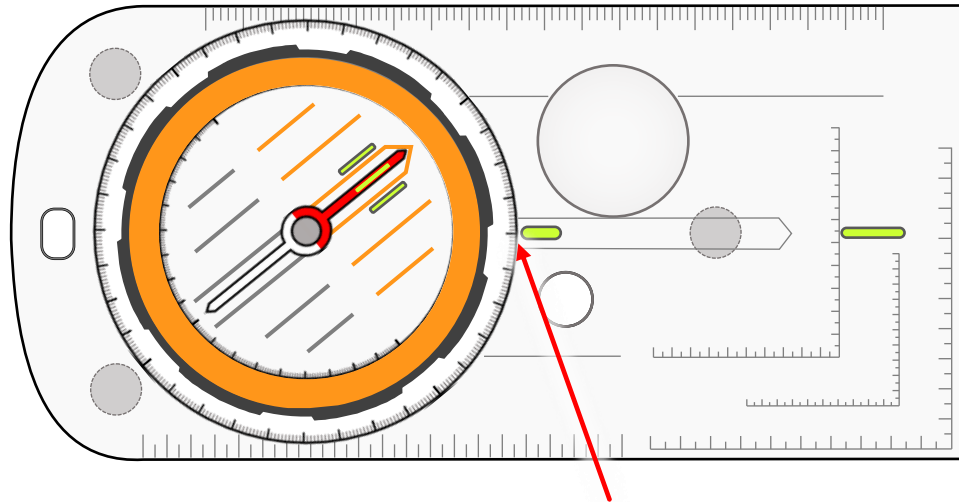


UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

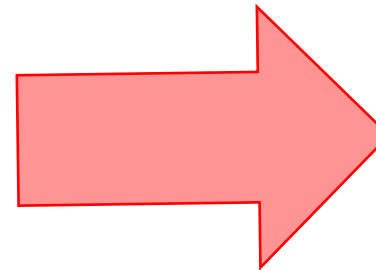
-122.1250° 48.3750°



# Compass Adjusted for Magnetic Declination



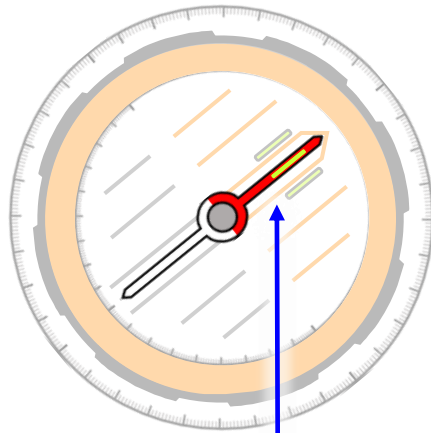
Set Bearing with  
Magnetic Declination  
 $55^\circ - 15.5^\circ = 39.5^\circ$



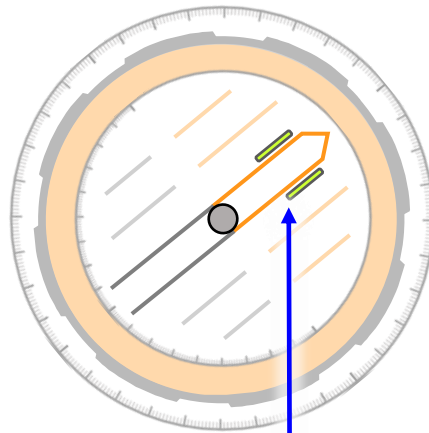
Direction  
of Travel

“Red in the Shed”  
Or  
“Dog in the Doghouse”

# Compass Adjusted for Magnetic Declination



Dog



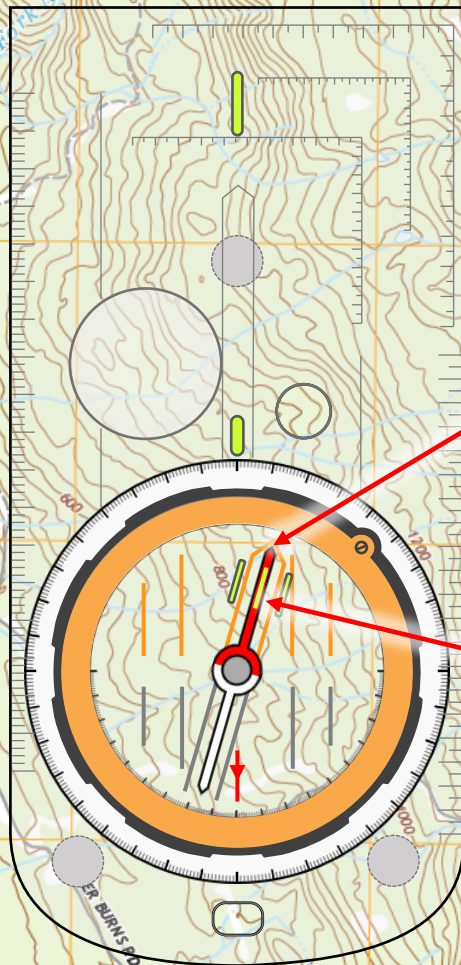
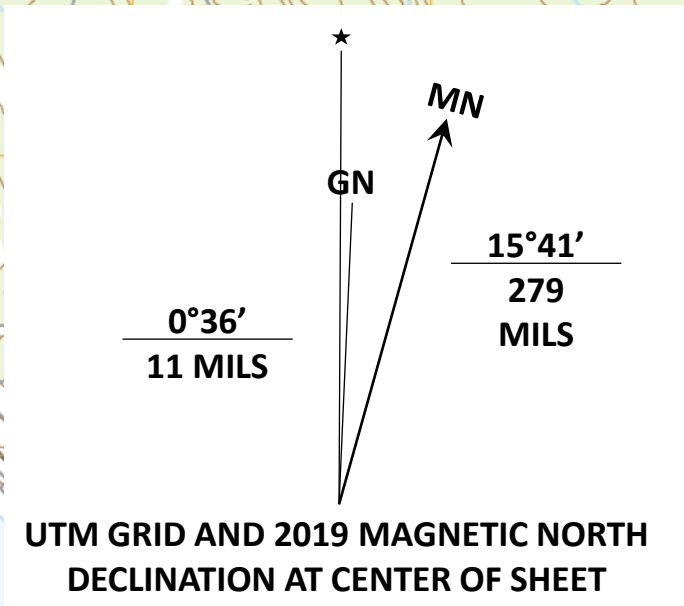
Doghouse

“Red in the Shed”  
Or  
“Dog in the Doghouse”

# Compass with Adjustable Declination

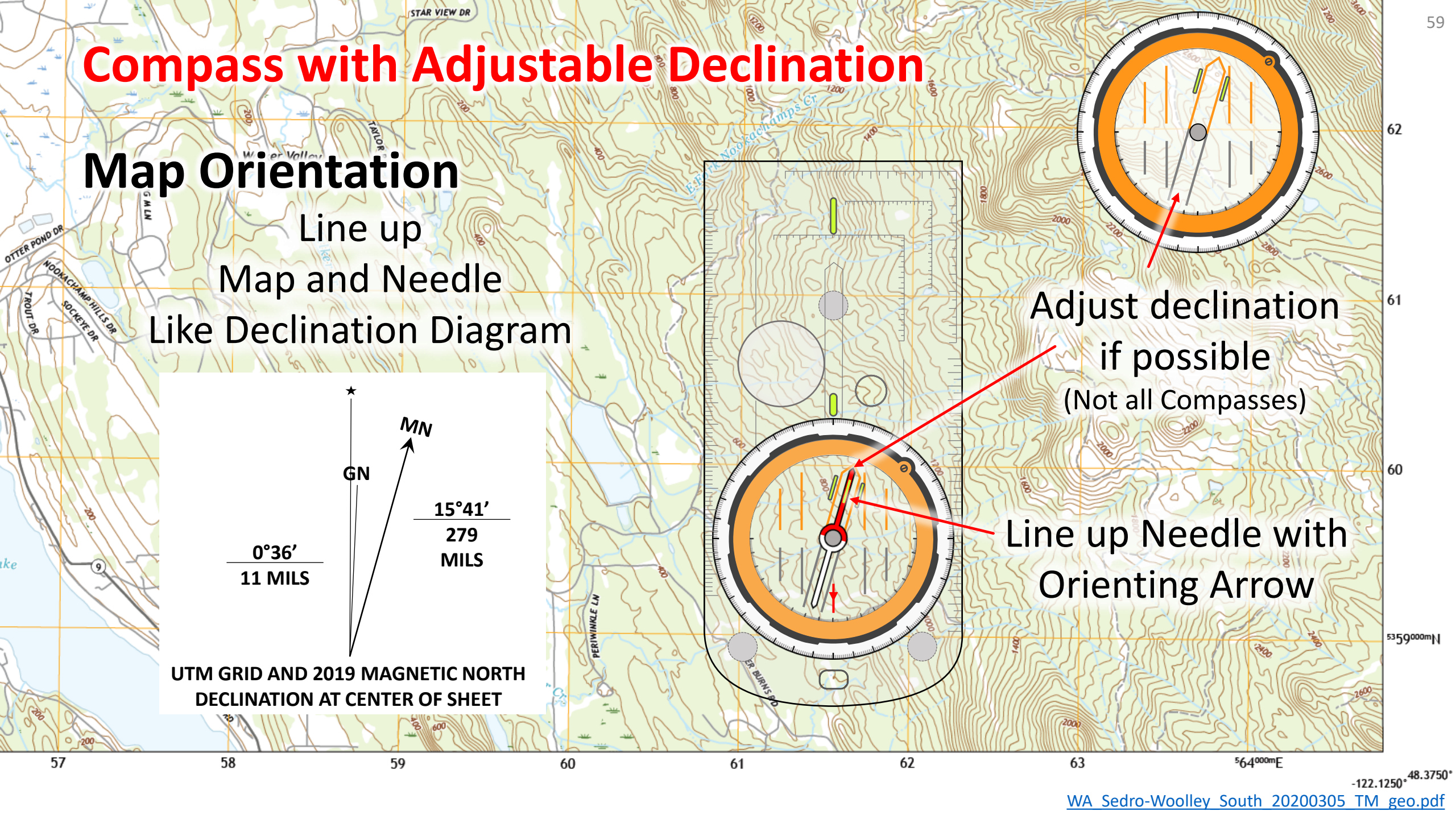
## Map Orientation

Line up  
Map and Needle  
Like Declination Diagram



Adjust declination  
if possible  
(Not all Compasses)

Line up Needle with  
Orienting Arrow

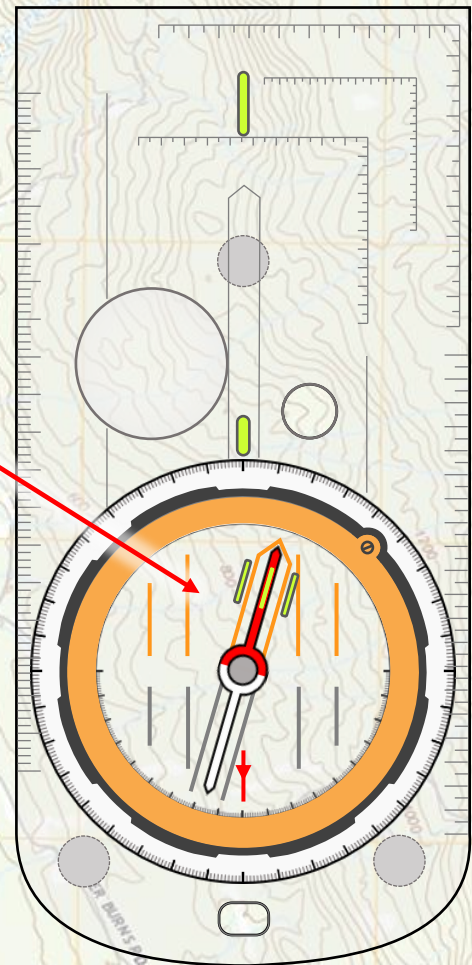
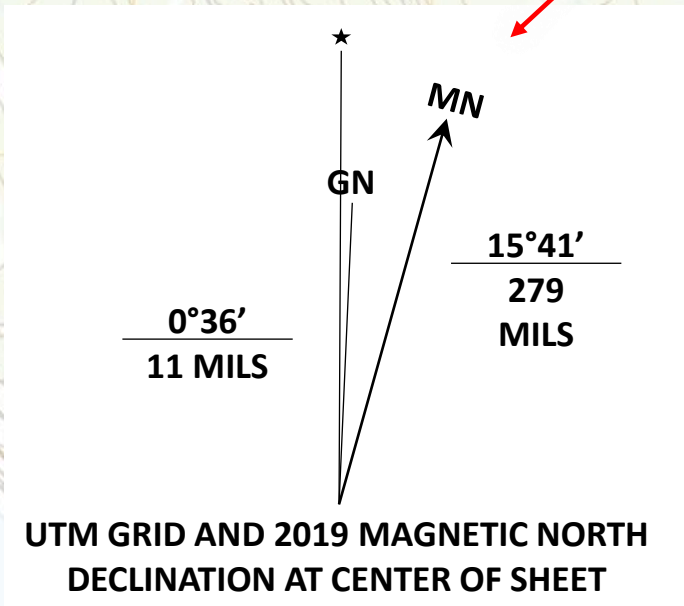




# Compass with Adjustable Declination

## Map Orientation

Make these look like each other

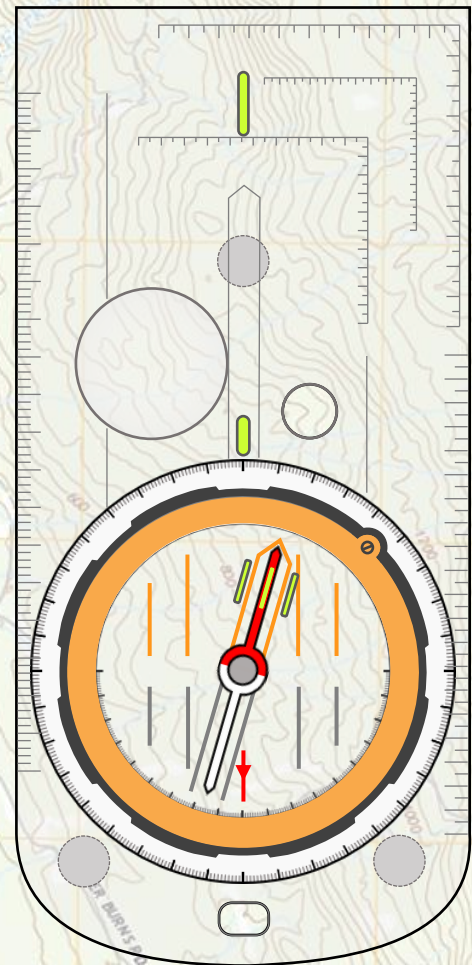
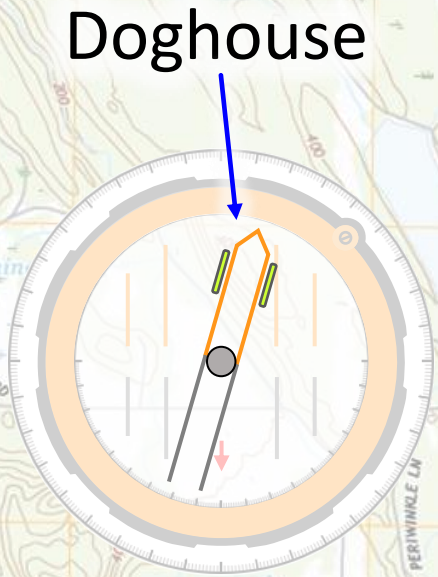
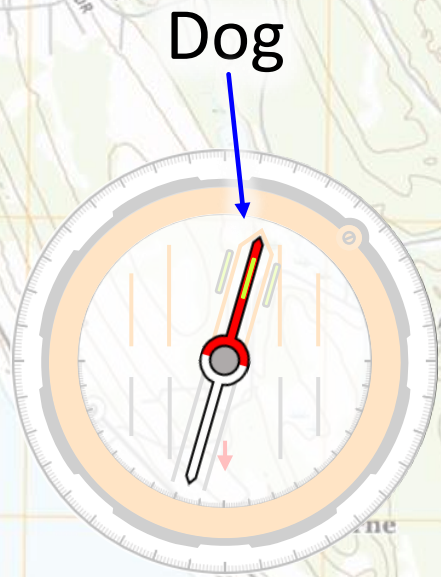


57 58 59 60 61 62 63 64<sup>000mE</sup>



# Compass with Adjustable Declination

## Important Terminology



Put the  
“Dog in the  
Doghouse”

or

“Red in the Shed”



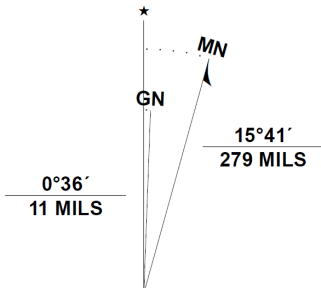
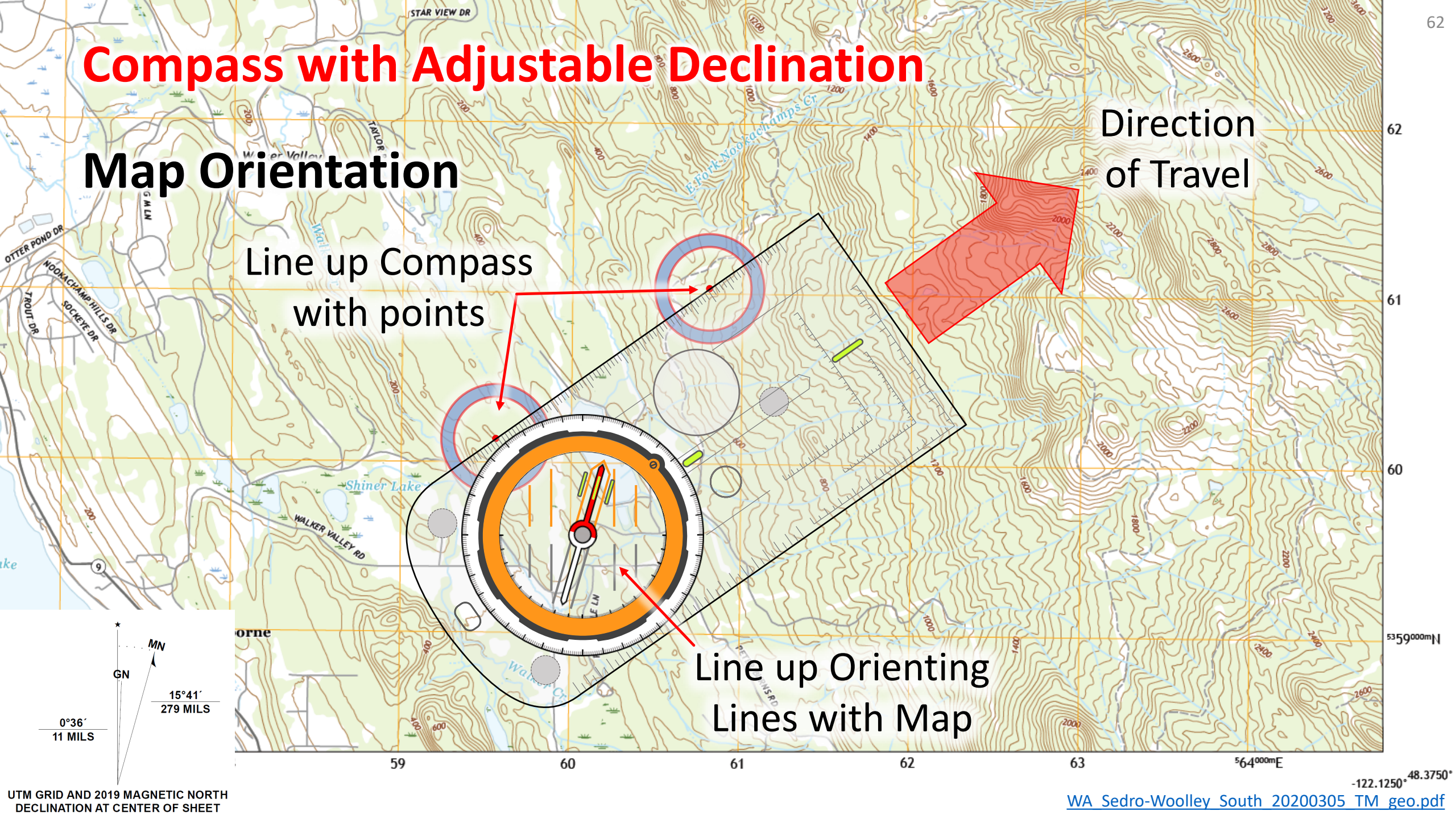
# Compass with Adjustable Declination

## Map Orientation

Line up Compass with points

Direction of Travel

Line up Orienting Lines with Map

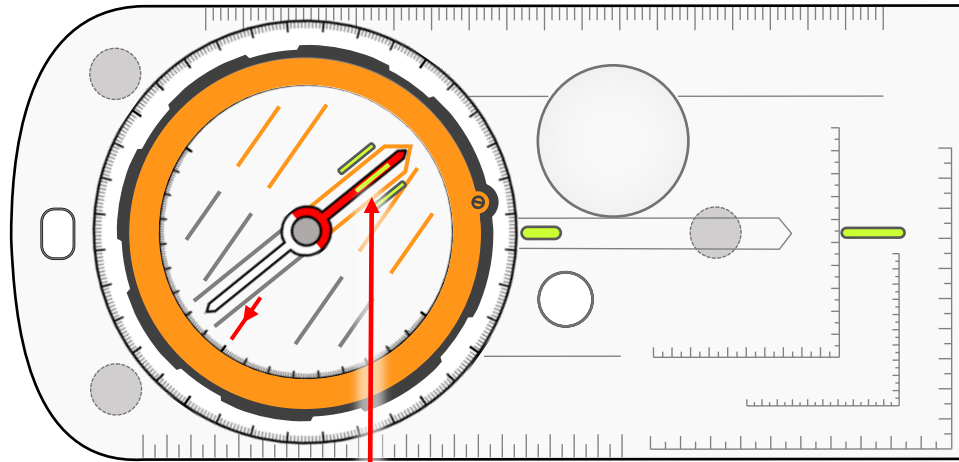


UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

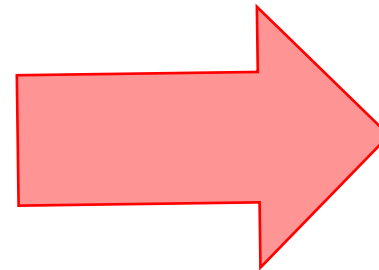


# Compass with Adjustable Declination

## Compass with Magnetic Declination Adjustment



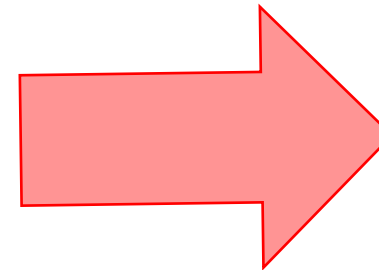
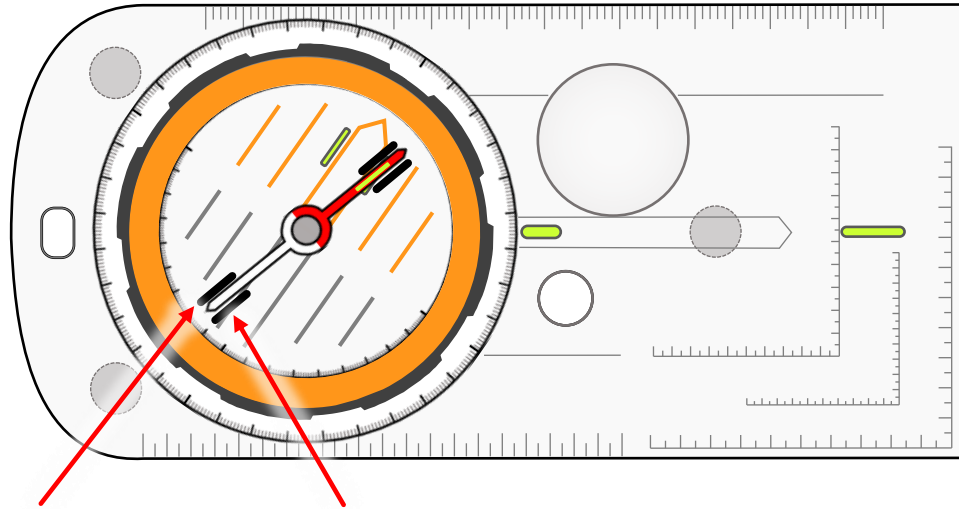
Keep Needle in  
Orienting Arrow



Direction  
of Travel

“Red in the Shed”  
Or  
“Dog in the Doghouse”

# Compass Hack – DIY Magnetic Declination Adjustment



Direction  
of Travel

Carefully use a Marker to make a  
“Doghouse”

Problem: angles change each year

“Red in the Shed”  
Or  
“Dog in the Doghouse”





# Topographical Map Hack

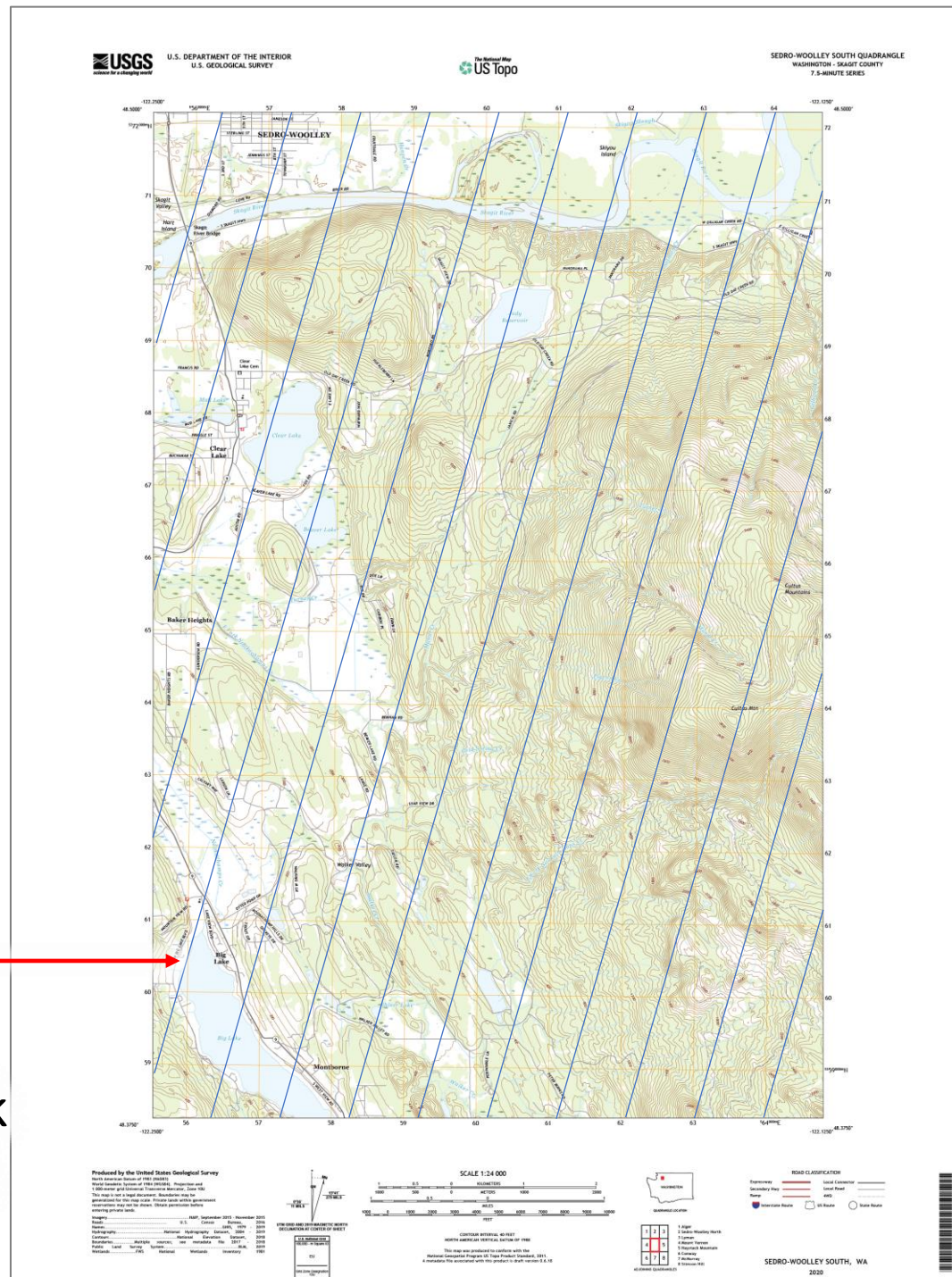
Map can be modified with  
Magnetic North Lines

Problem:

– angles change each year

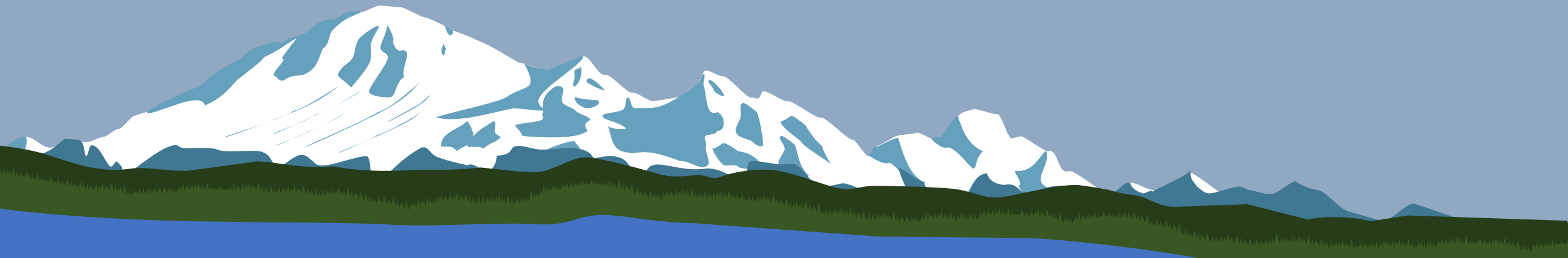
Magnetic North  
Lines Added

Use metal yardstick  
to copy and space  
out lines



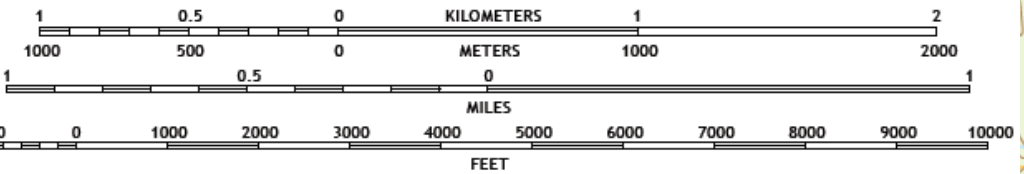


# Measuring Distance



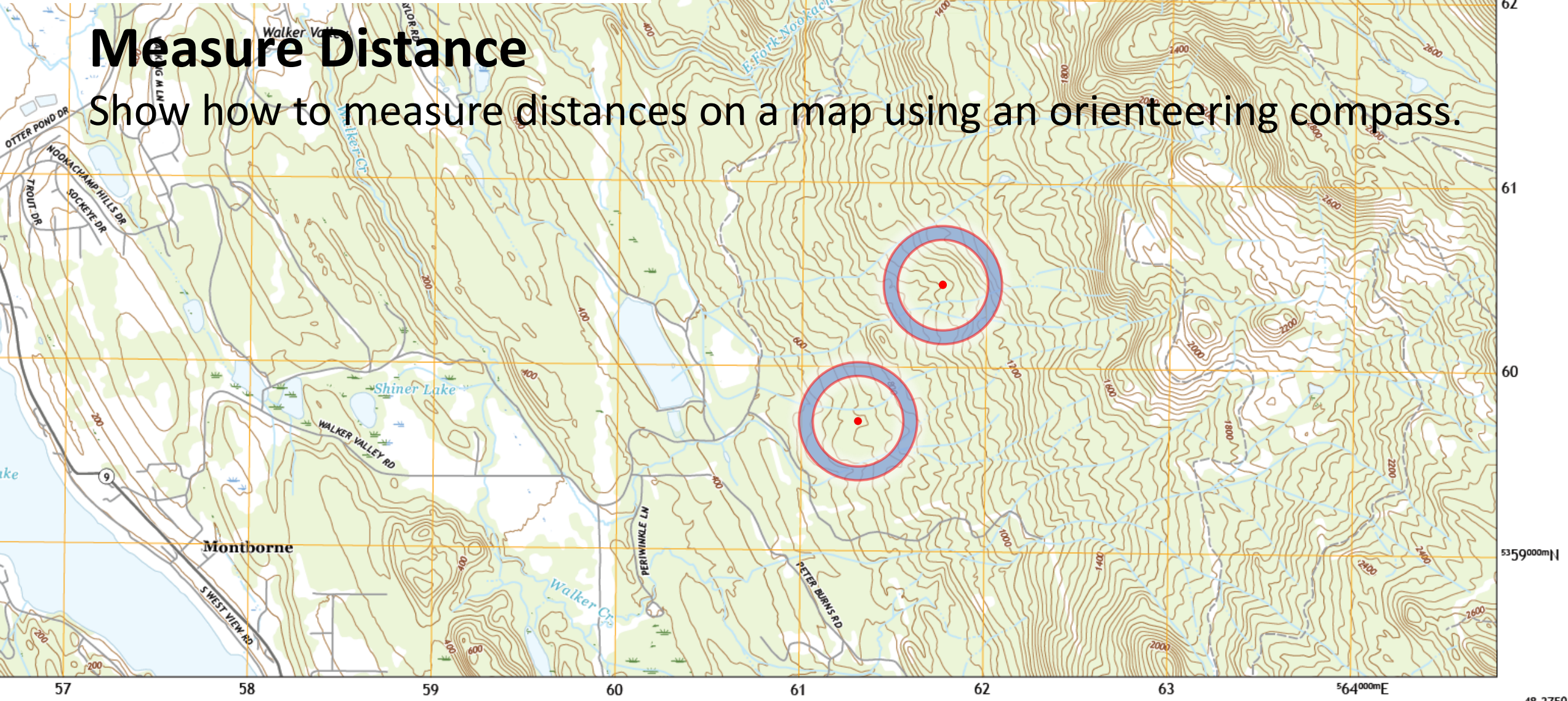


SCALE 1:24 000



# Measure Distance

Show how to measure distances on a map using an orienteering compass.



-122.1250° 48.3750°







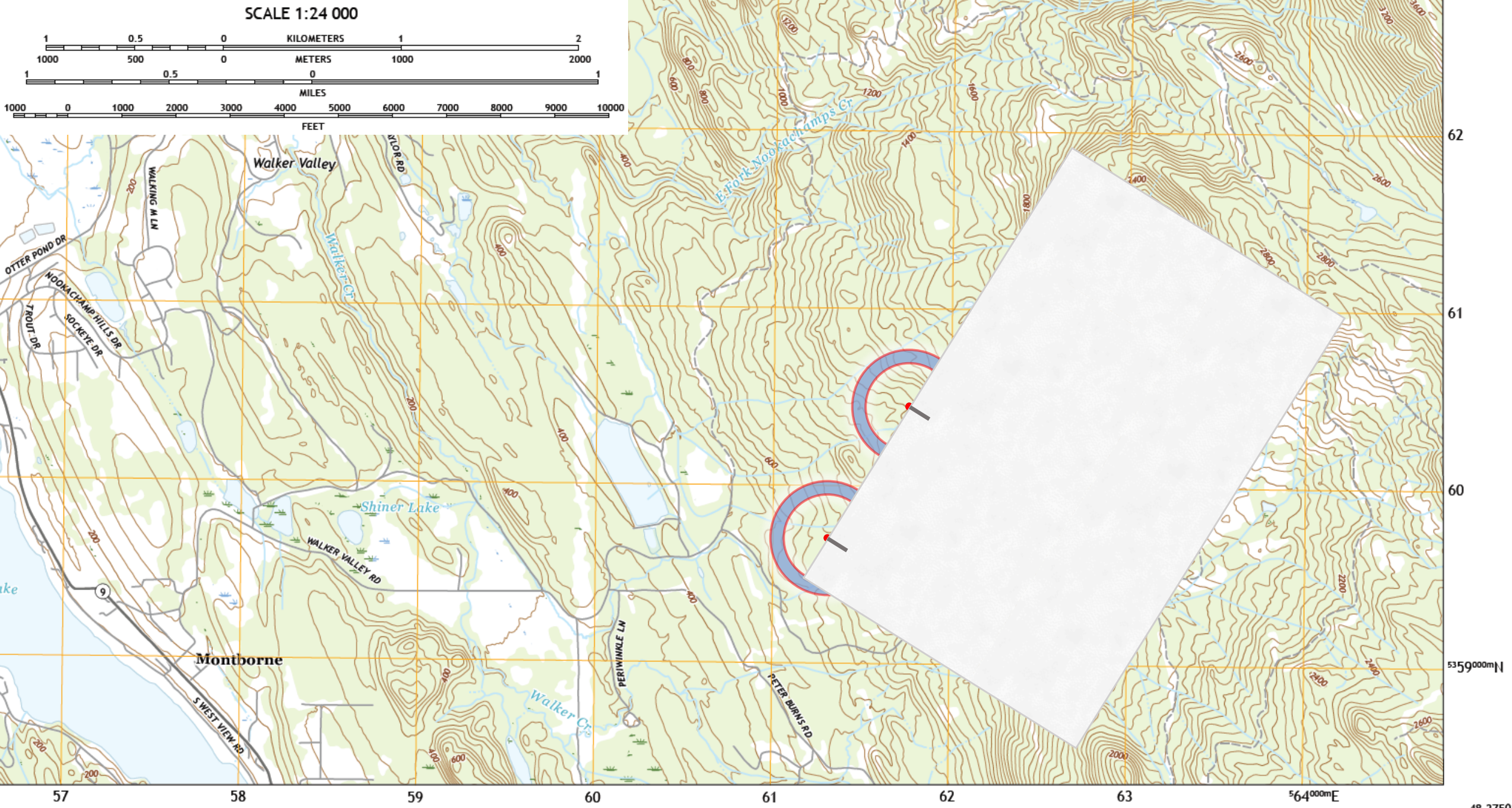
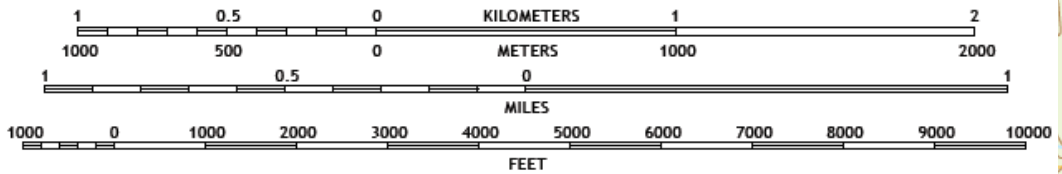








SCALE 1:24 000



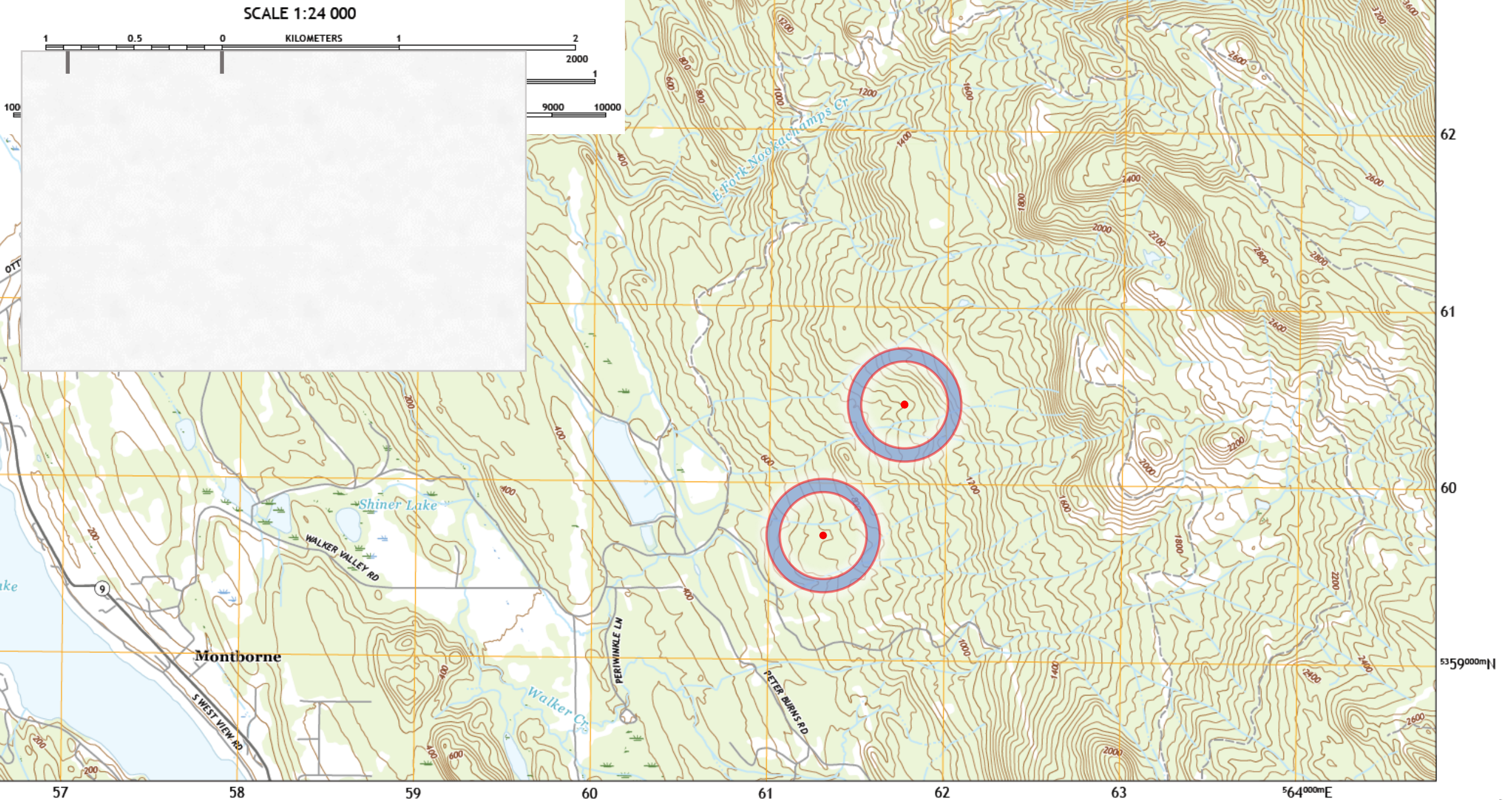
-122.1250° 48.3750°



SCALE 1:24 000

1 0.5 0 KILOMETERS 1 2

2000  
1  
9000 10000



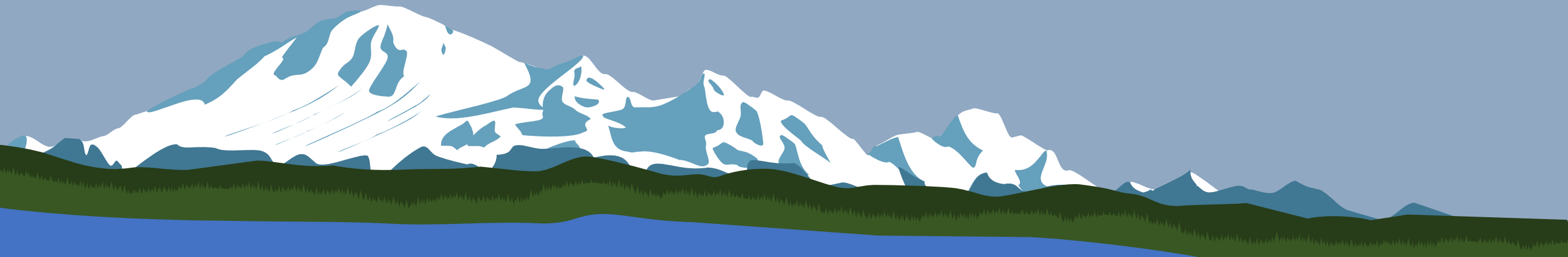
-122.1250° 48.3750°







# Resection





# Resection

## Establishing Location on a Map

- You should be able to use features on a map to pinpoint your location
  - Terrain features such as hills and lakes
  - Turn angles on paths and roads
  - Intersections between paths and roads and streams
  - Edge of tree lines

# Resection

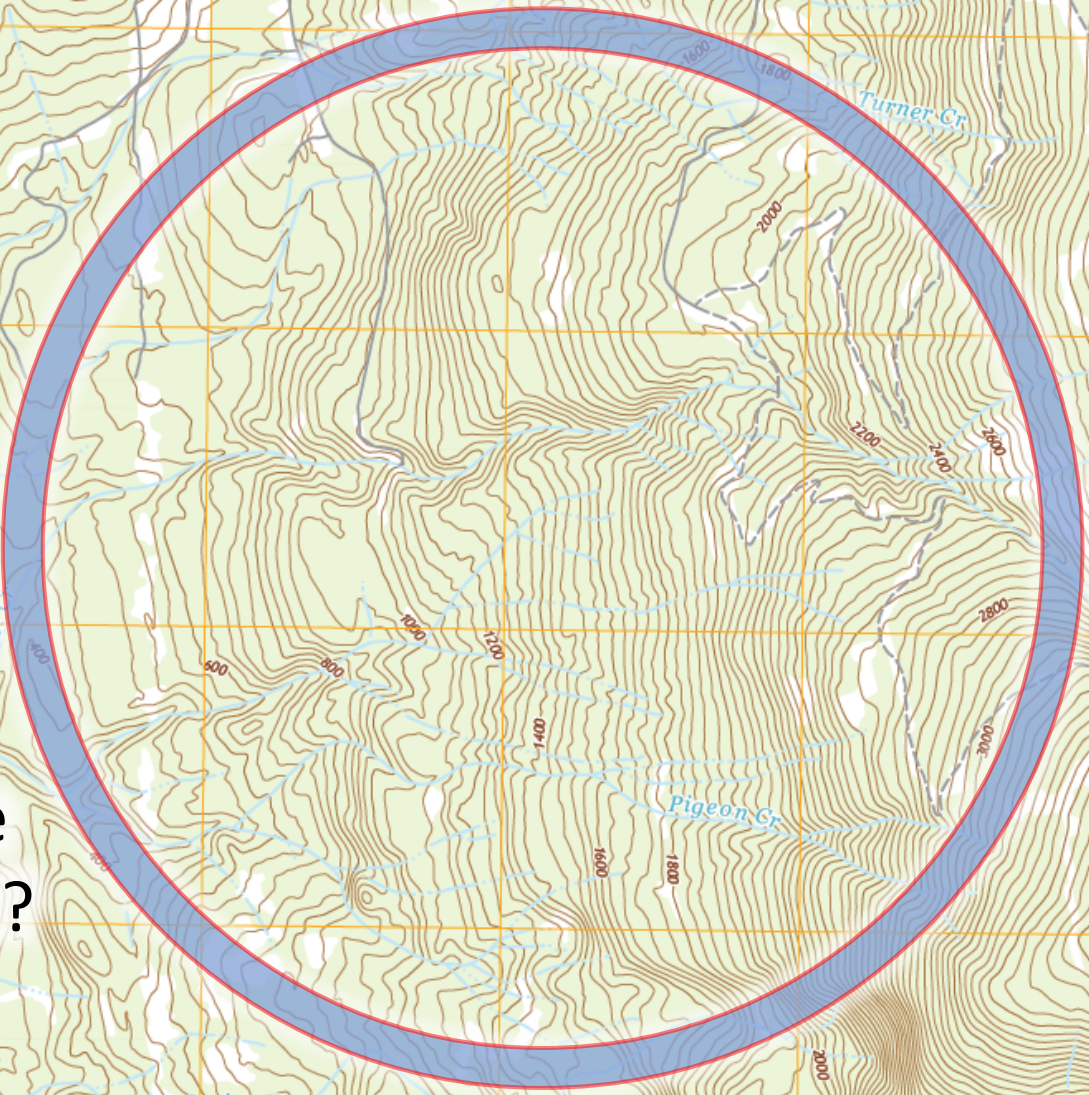
## Resection

- Resection is a method for determining an unknown geographic position by measuring angles with respect to known position(s)
- The more know positions you have, the more precise your calculation
- Better compass skills = better precision
- Type of compass used also affects your final result



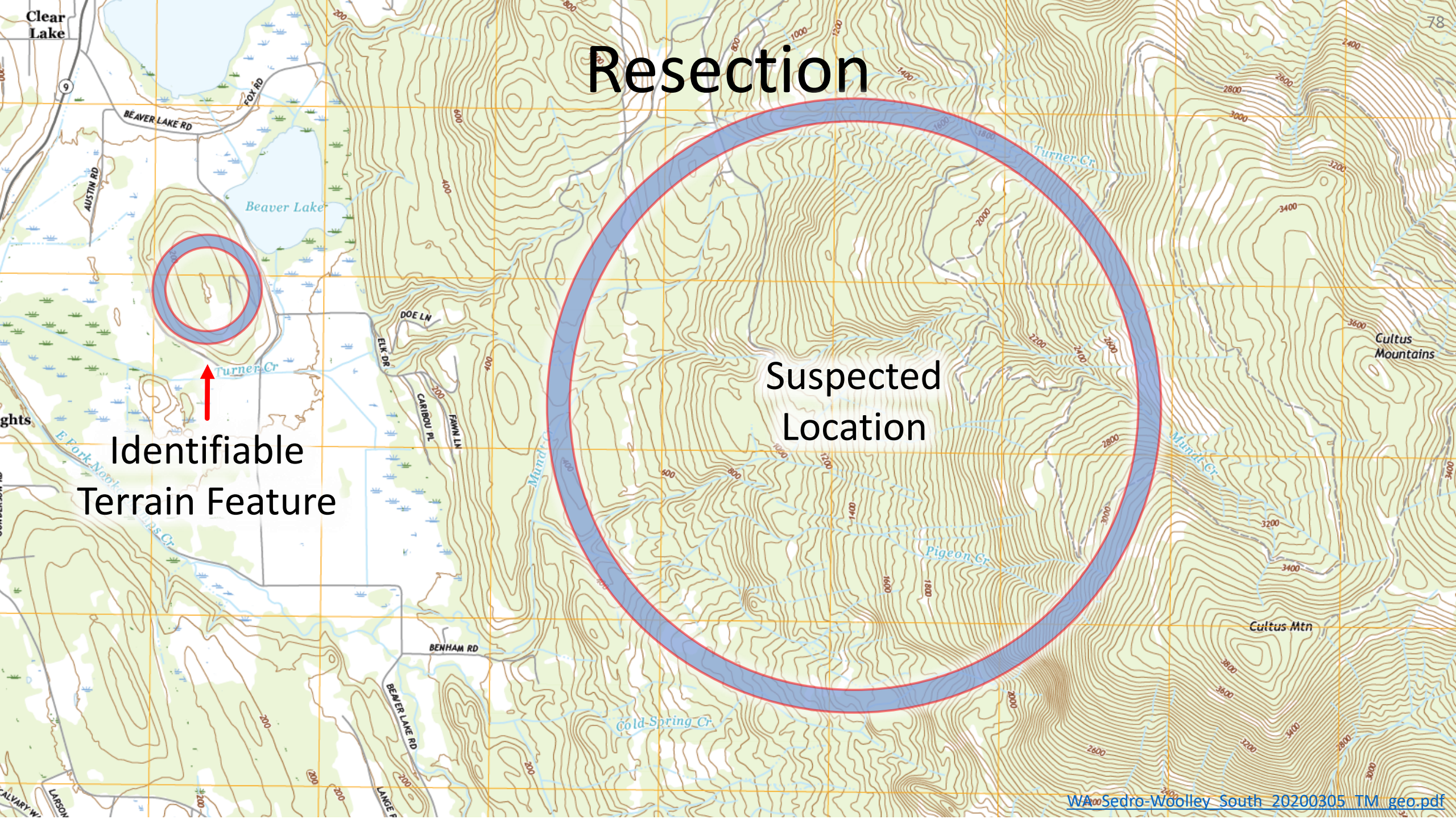
# Resection

Where  
Are We?





# Resection



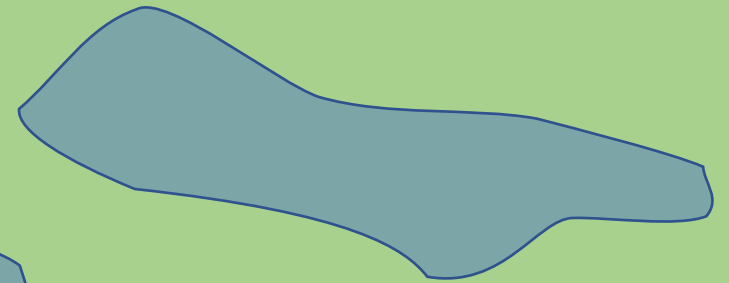
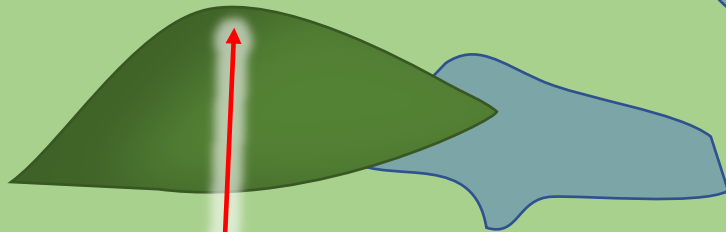
Suspected Location

Identifiable Terrain Feature

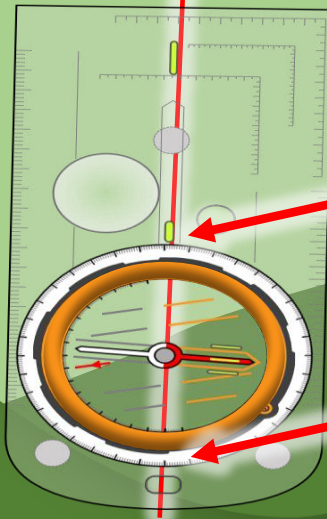


# Resection

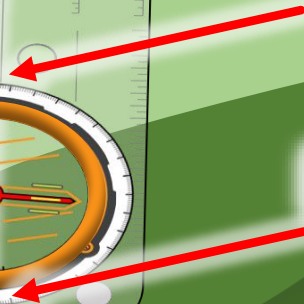
Aim at  
Terrain Feature



Azimuth



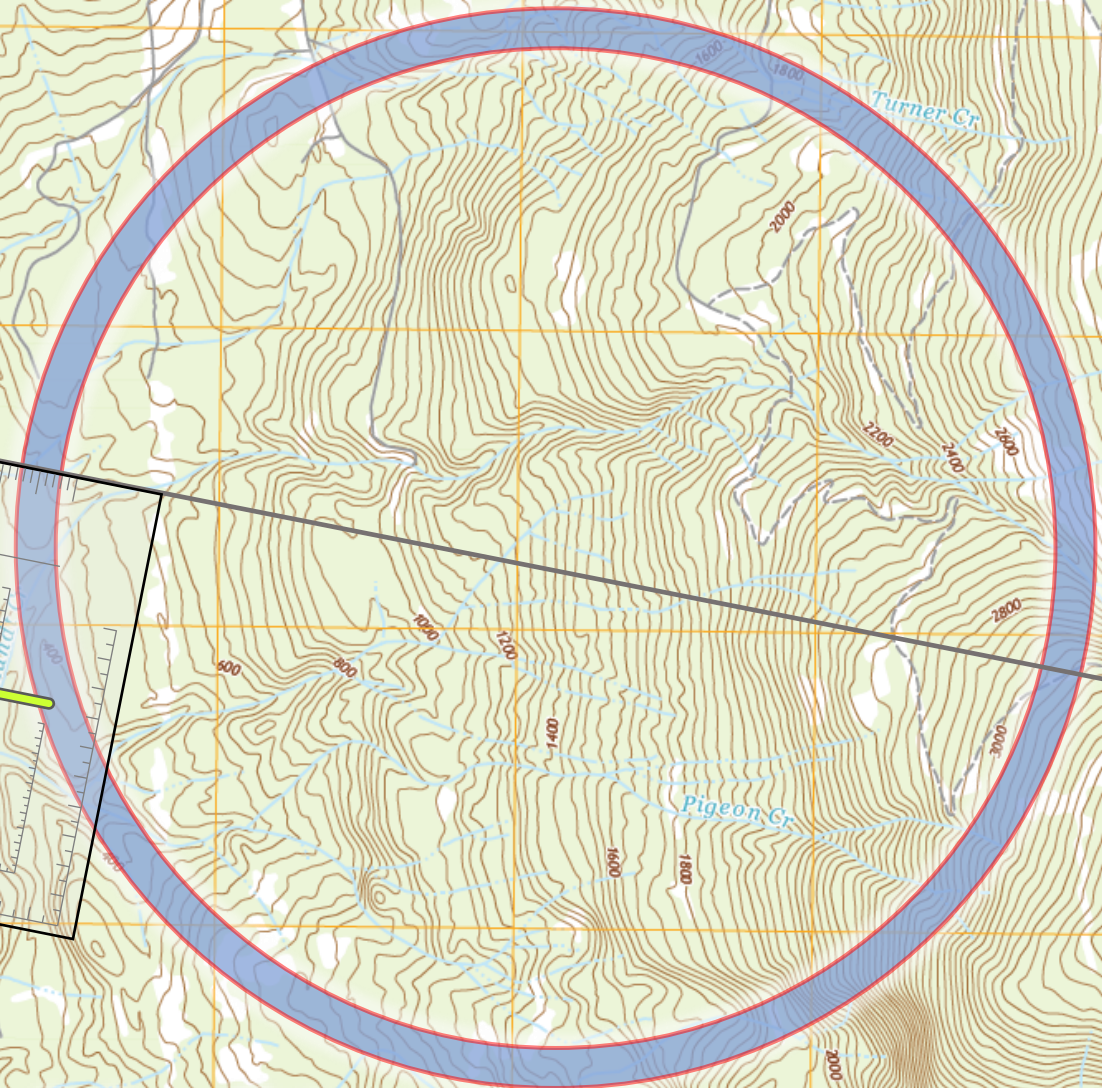
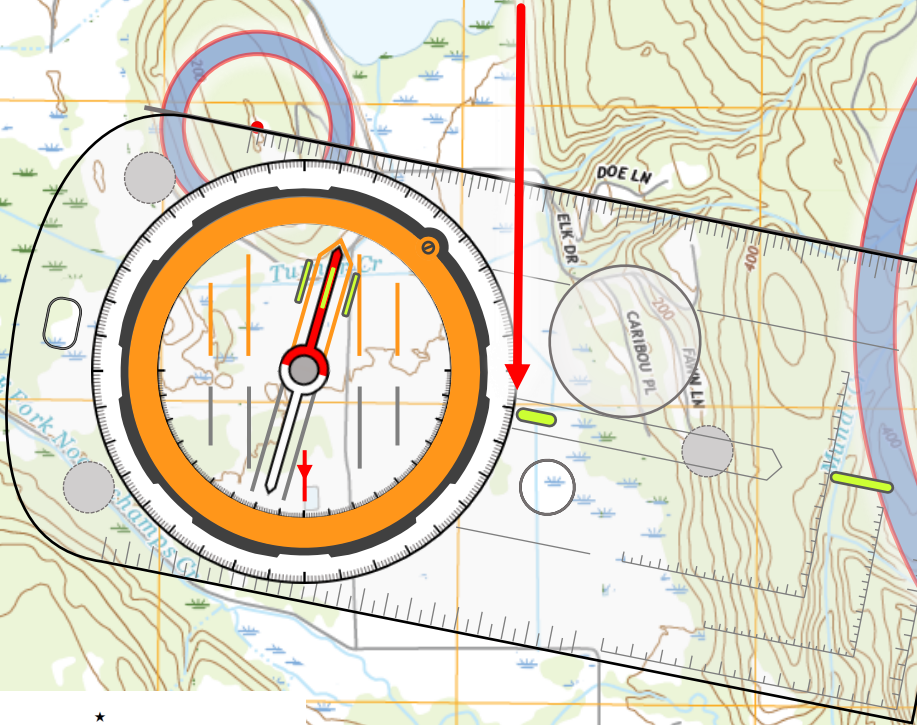
Back Azimuth



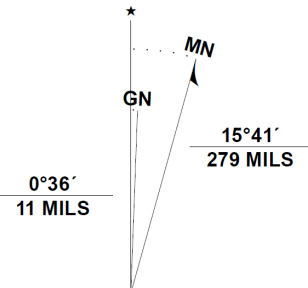


# Resection

Back Azimuth



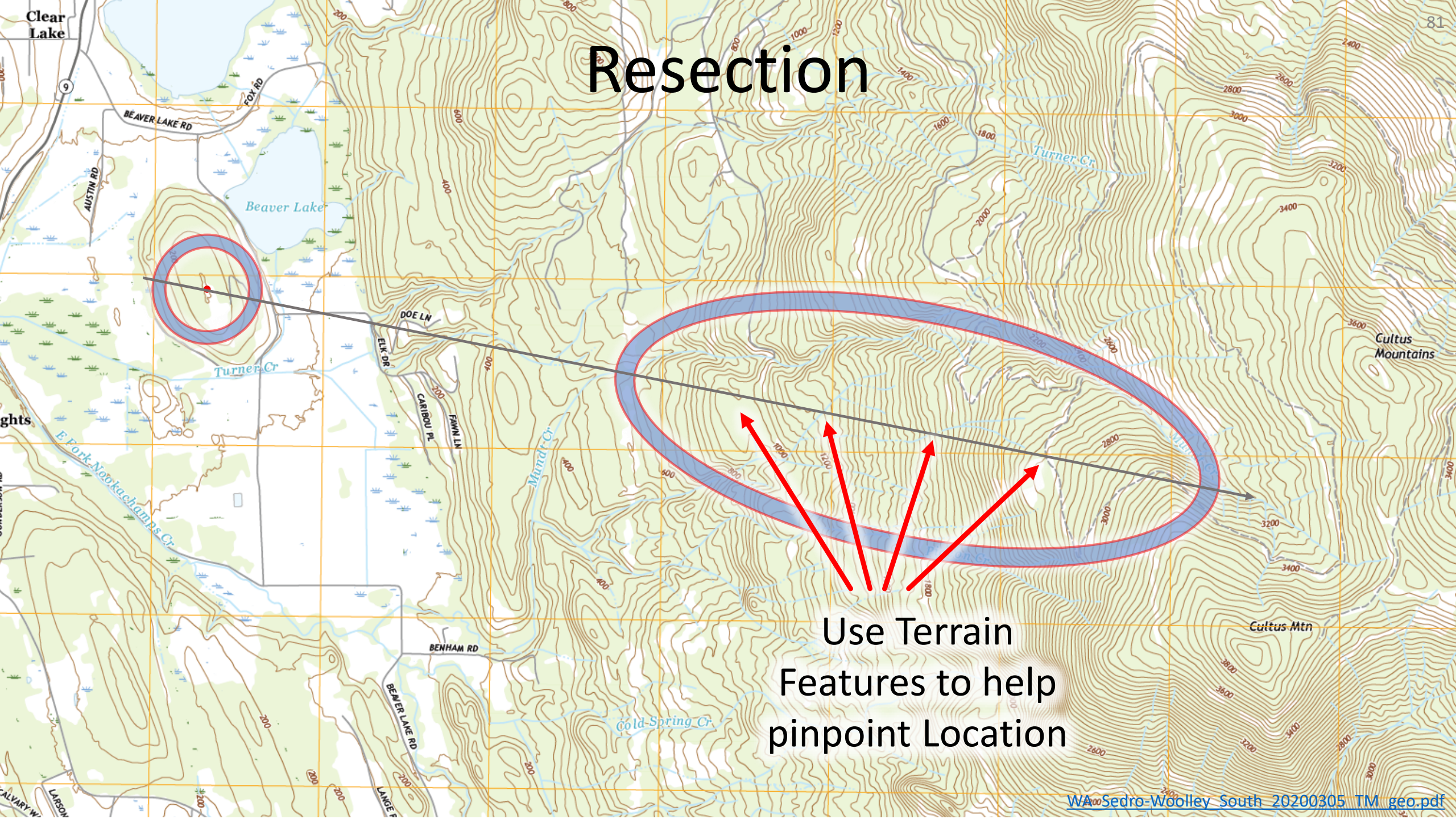
Convert Magnetic Azimuth to  
Grid Azimuth as needed



UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET



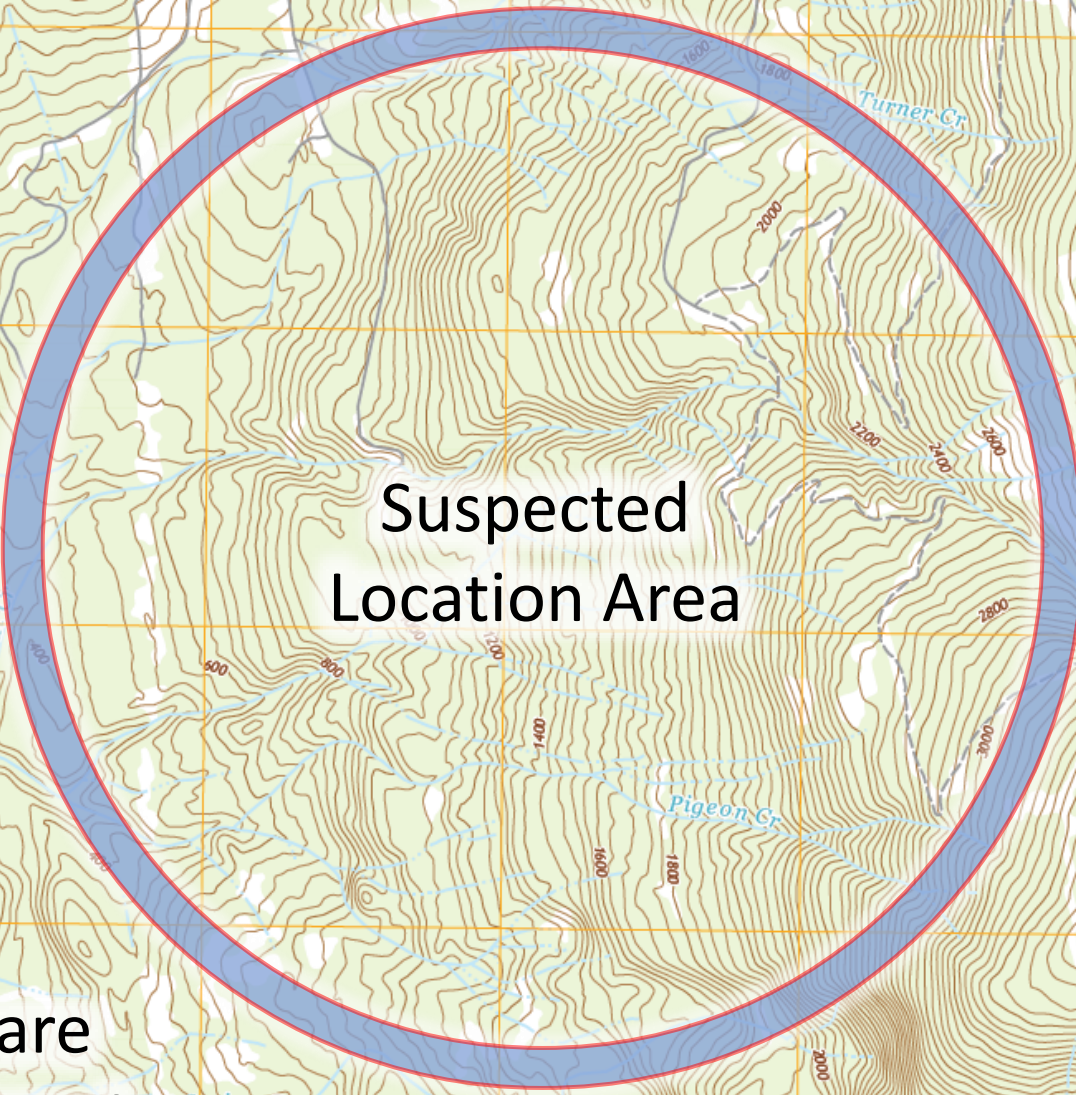
# Resection



Use Terrain  
Features to help  
pinpoint Location



# Resection

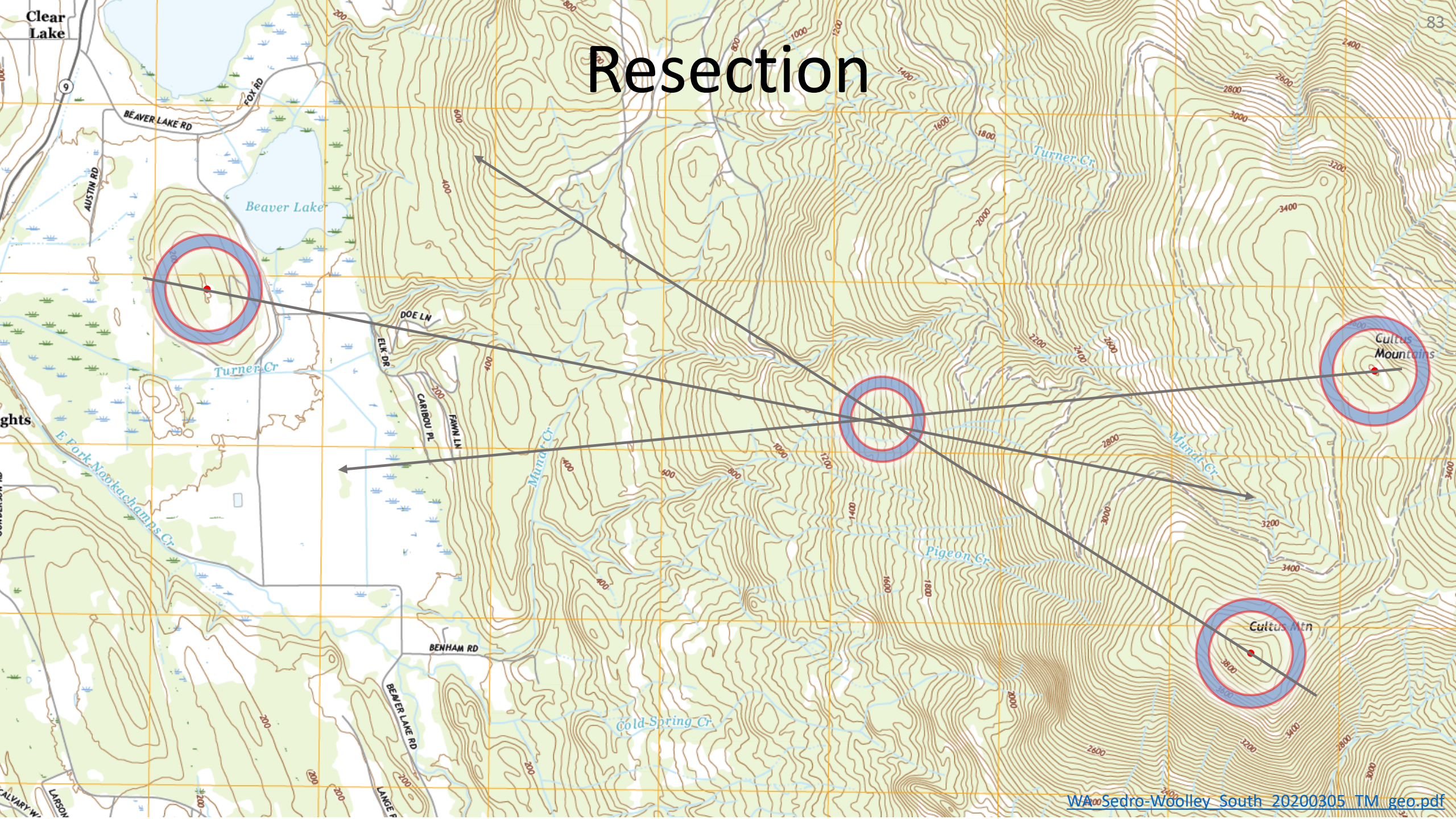


Suspected  
Location Area

3 Points are  
BETTER than 1



# Resection

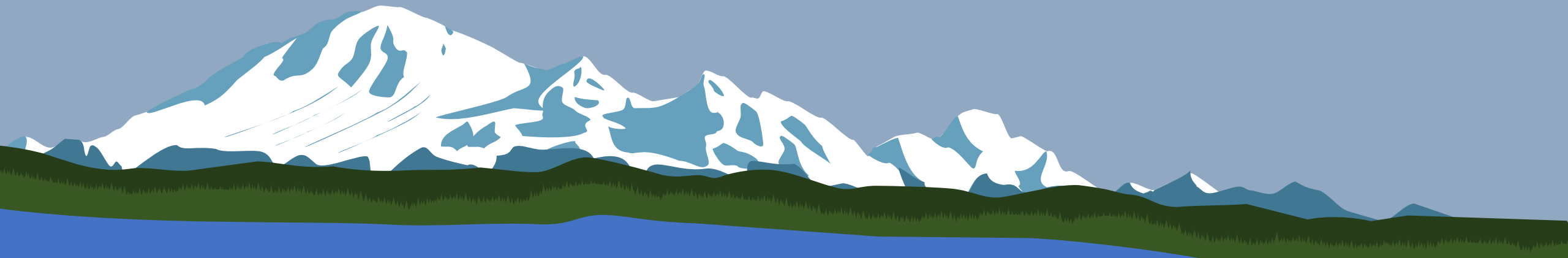




1. Requirements	13. Mapping Fundamentals
2. Introduction	14. Constructing a Map
3. Map Reading	15. Constructing Control Symbols
4. Locations	16. Constructing Contours
5. Map Orientation	17. Universal Transverse Mercator
6. Measuring Distance	18. Unit Conversions
7. Projections	19. Geographic Coordinate Representation
8. Pace Count	17. Resources
9. Understanding Techniques	18. Instructor's Corner



# Pace Count

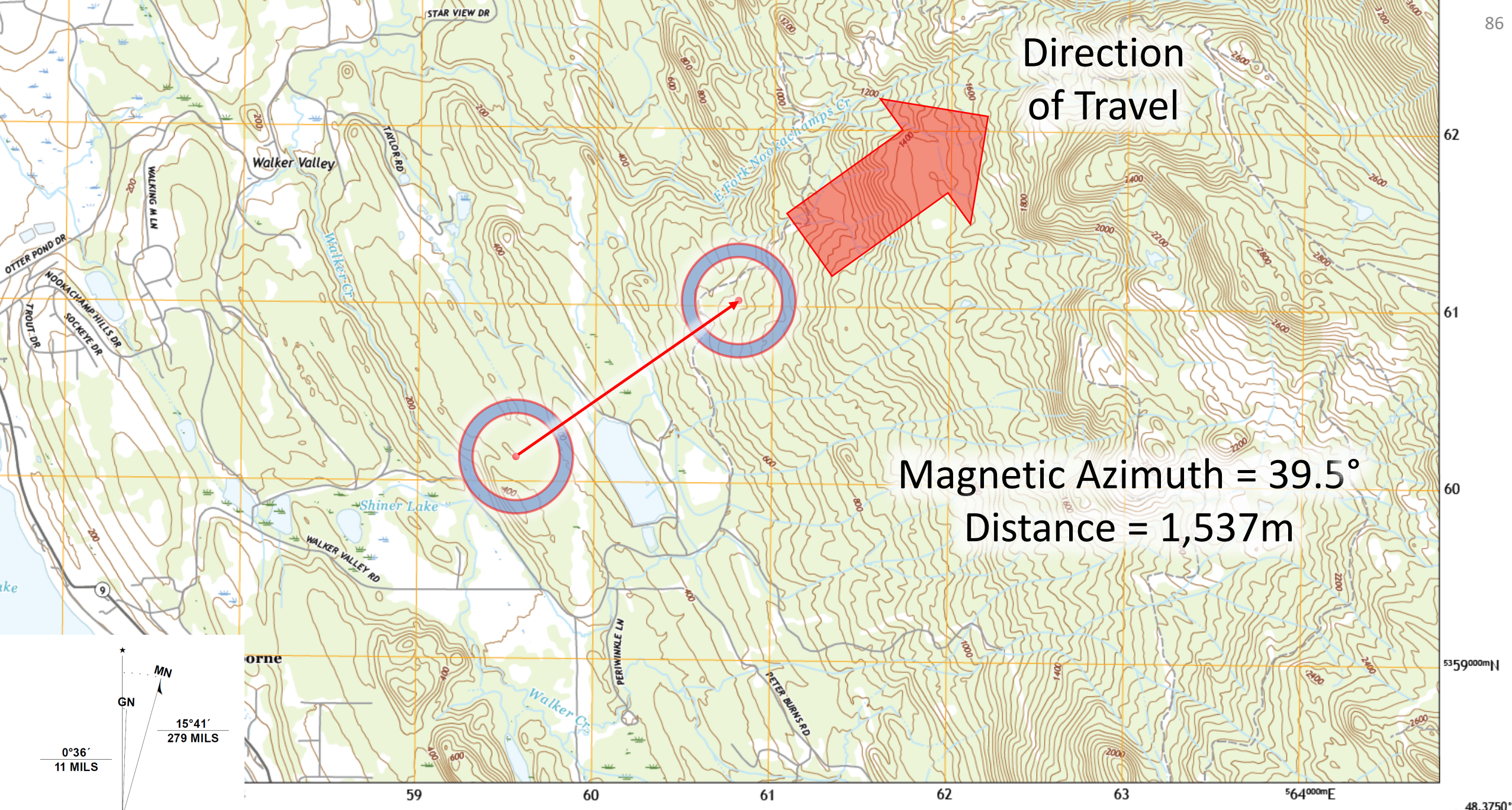




# Pace Count

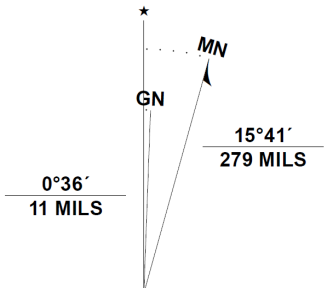
## **Orienteering Measurements**

Determining both Distance and Azimuth required in orienteering



Direction  
of Travel

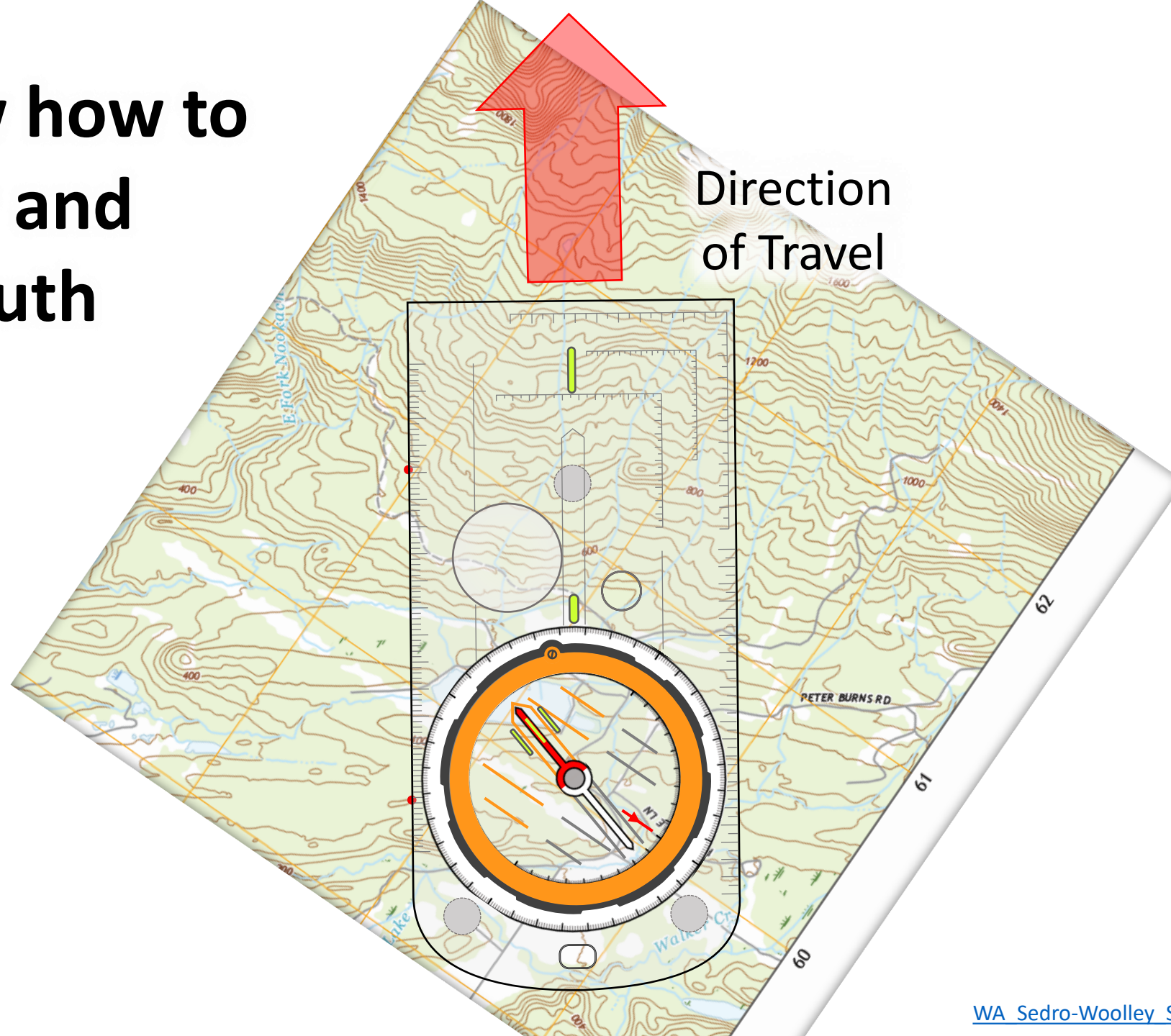
Magnetic Azimuth =  $39.5^\circ$   
Distance = 1,537m



UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET



# You know how to follow and Azimuth

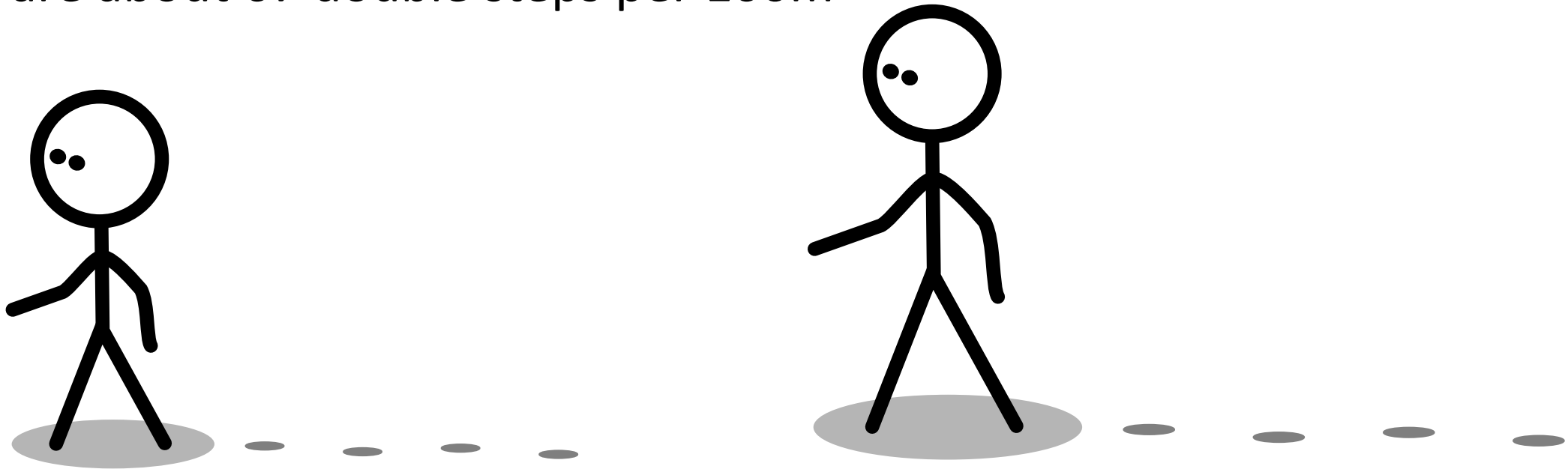


# Pace Count

## Pace Count

Allows you to track distance without a tape measure

- Everyone's pace count is different
- A normal stride is around 0.75m (30 inches)
- There are about 67 double steps per 100m

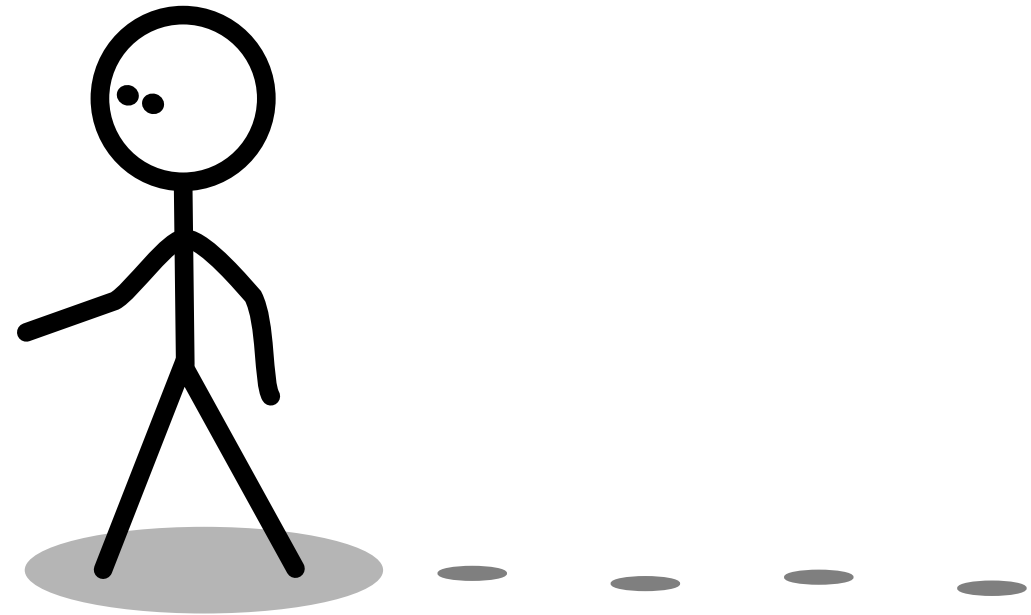
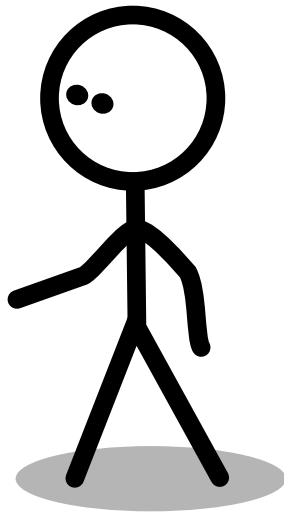




# Pace Count

## Pace Count

- Pace count is effected by
  - Leg length
  - Load (weight carried)
  - Traveling speed
  - Terrain (vegetation, rocks, ice, etc.)
  - Elevation change (uphill vs downhill)



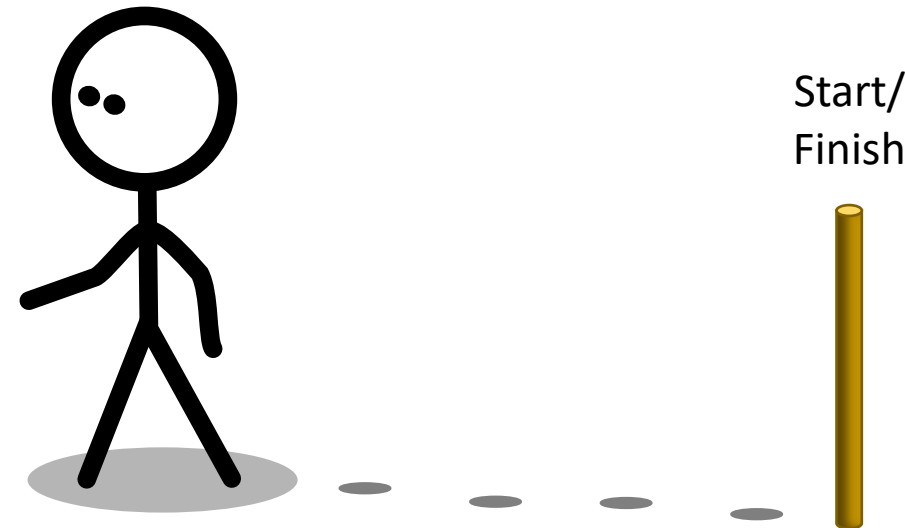
# Pace Count

## Pace Count – 100m Course

Set up a 100m Course in terrain you plan to traverse

- Measure pace out 100m and back 100m
- Determine average pace count

100m





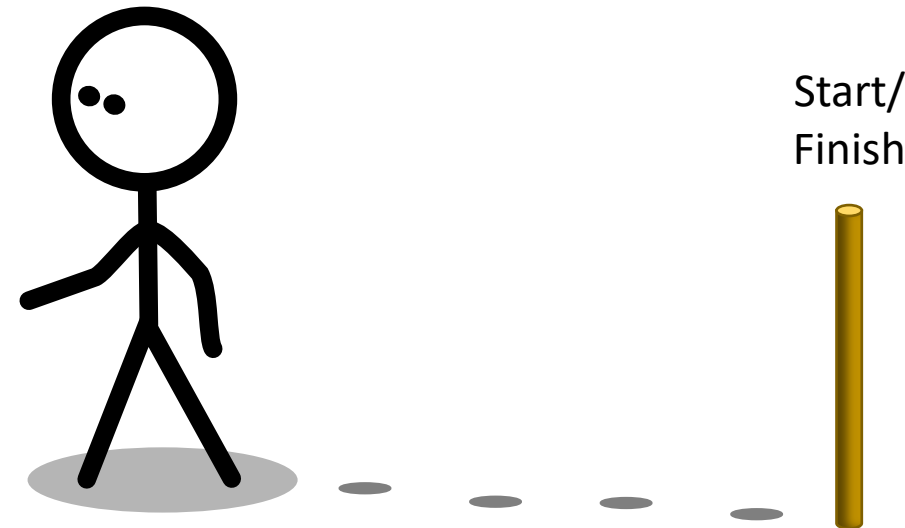
# Pace Count

## Pace Count – 100m Course Measuring

Pace can be measured several ways

- Single steps (over 100)
- Double steps (every time right foot hits ground)
- Time

100m

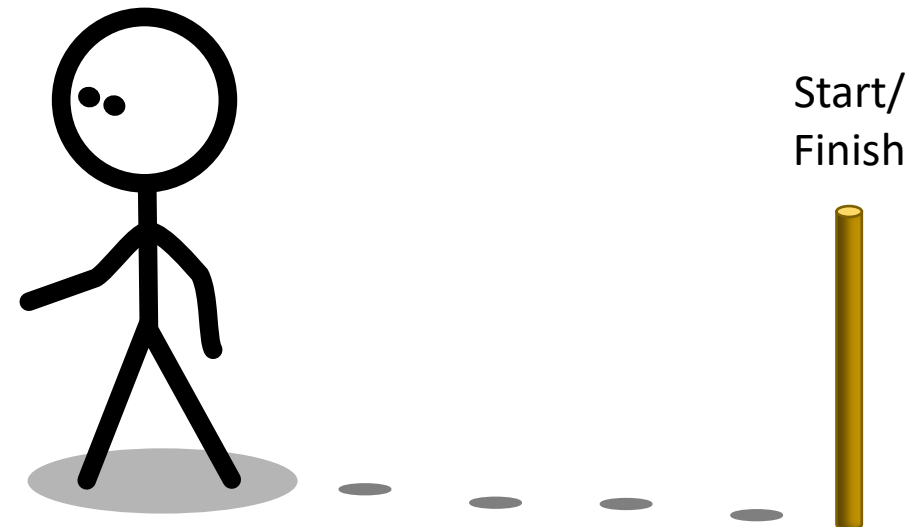


# Pace Count

## Pace Count – 100m Course Measuring

- Measure pace count for:
  - Walking
  - Running
  - Uphill
  - Downhill
  - Night

100m

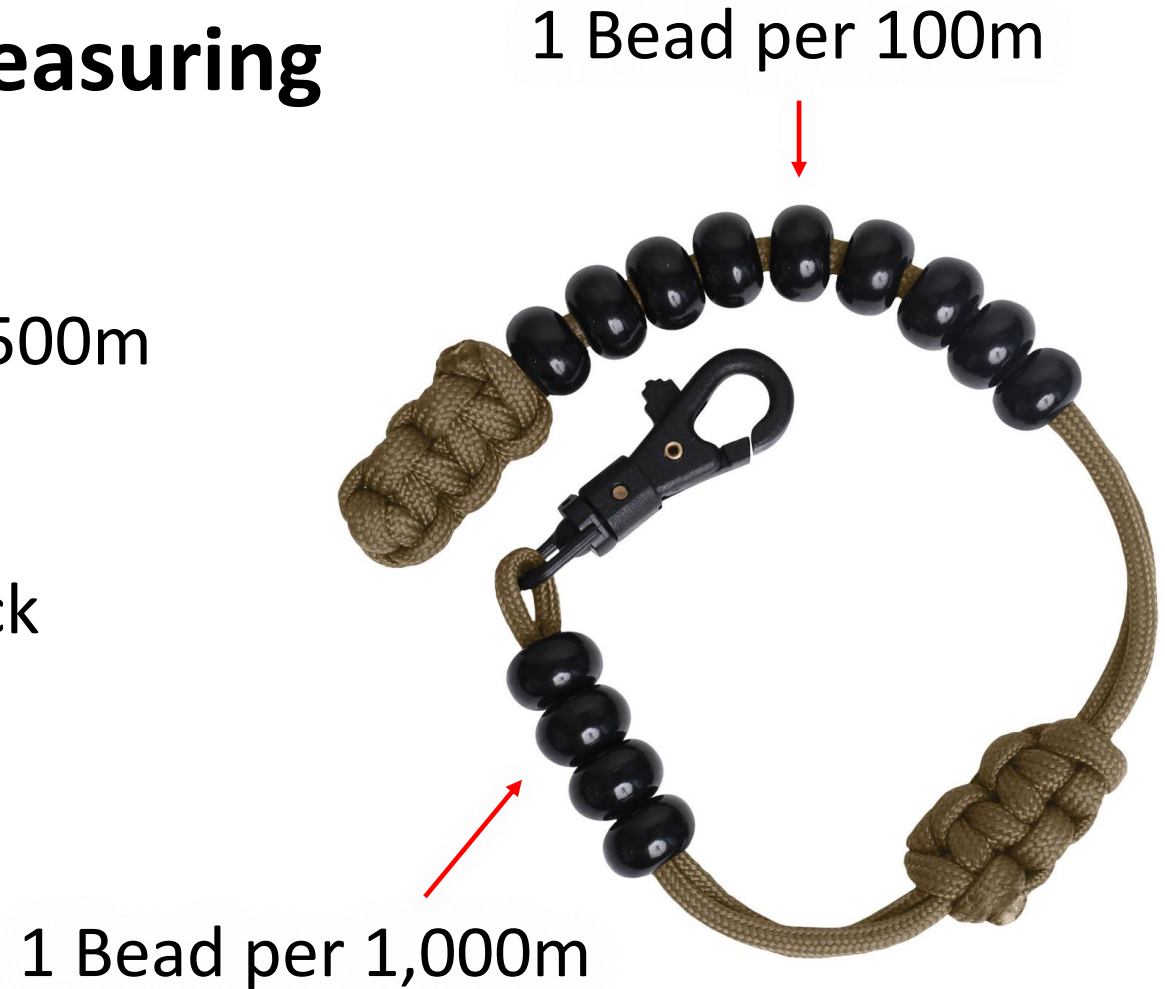




# Pace Count

## Pace Count – 100m Course Measuring

- When using pace count, keep track of each 100m you travel
  - Fingers might work up to about 500m
  - Mark tick marks on paper
  - Use “Ranger Beads”
  - Avoid depending on keeping track of long distances in your head

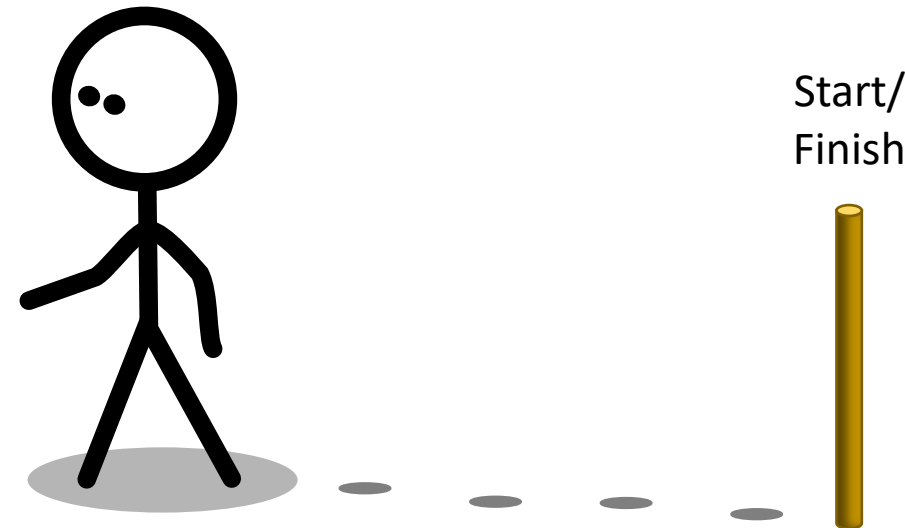


# Pace Count

## Requirement 5 – Pace Count

Set up a 100-meter pace course. Determine your walking and running pace for 100 meters. Tell why it is important to pace-count.

100m

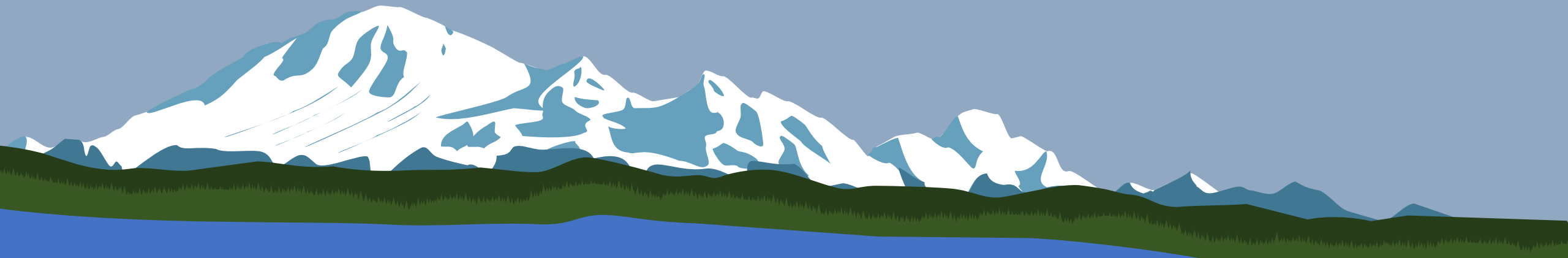




1. Requirements	13. Reading a Map
2. Introduction	14. Orienteering Control Symbols
3. Map Reading	15. Symbols and Landmarks
4. Landmarks	16. Universal Orienteering Map Color
5. Map Orientation	17. Control Descriptions
6. Orienteering Distance	18. Orienteering Control Descriptions
7. Routes	19. Resources
8. Orienteering Techniques	20. Instructor's Corner



# Orienteering Techniques



# Orienteering Techniques

## Requirement 6c – Orienteering Terminology

Explain the following terms and tell when you would use them:

- Attack point
- Collecting feature
- Catching feature
- Aiming off
- Contouring
- Reading ahead
- Handrail
- Relocation
- Rough versus fine orienteering

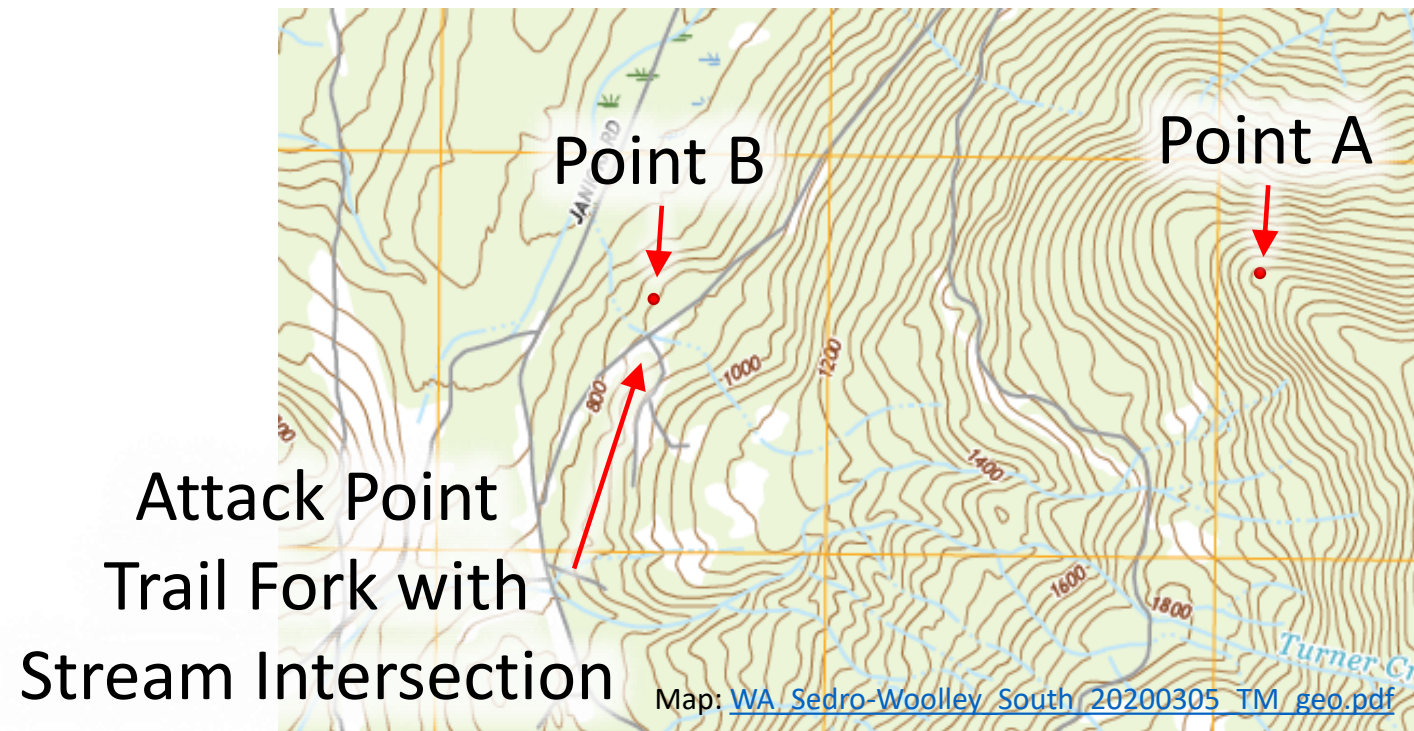


# Orienteering Techniques

## Requirement 6c – Attack Point

Large, easily recognized feature that is near the control

- Easier to locate than control
- Helps you determine your exact location and reach the control
- Can use more precise navigation from attack point
  - Pace count
  - Good compass bearing

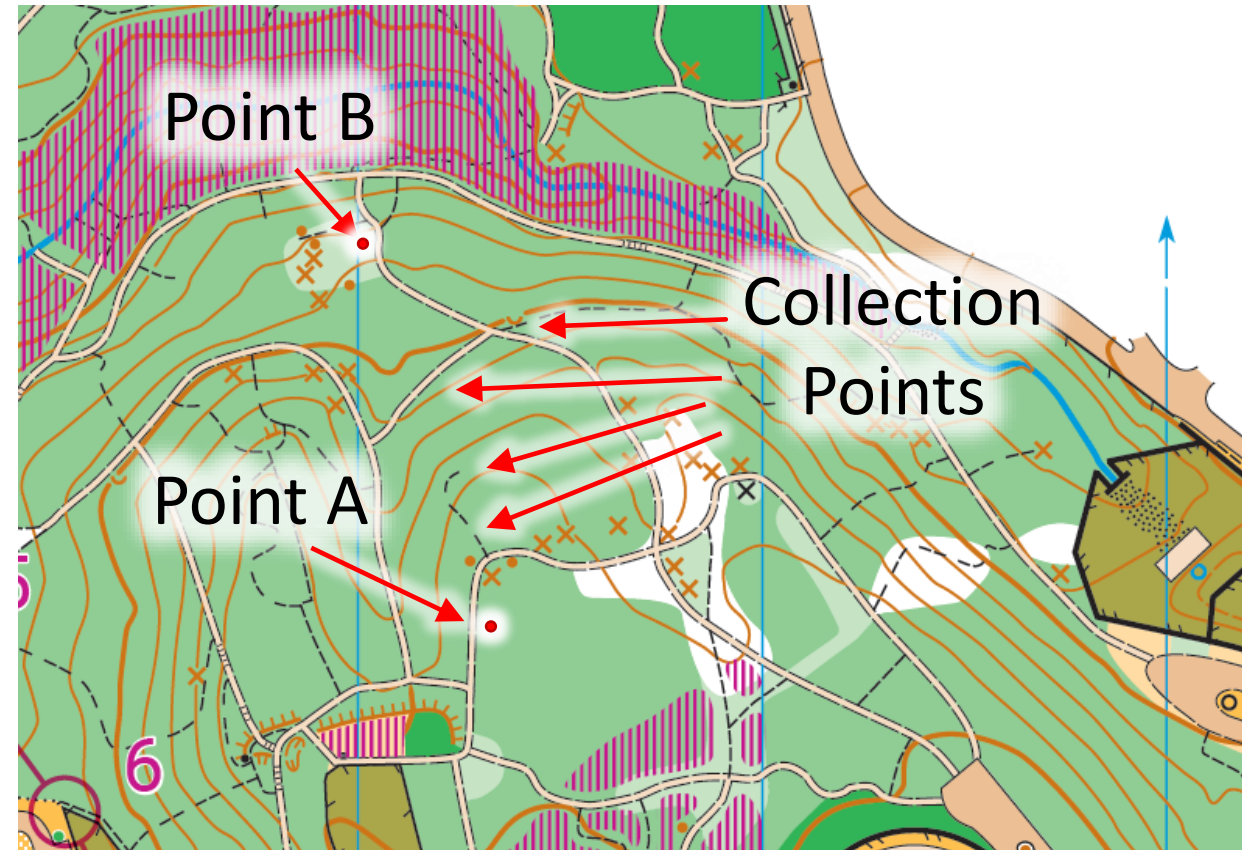


# Orienteering Techniques

## Requirement 6c – Collecting Feature

Obvious features along the route that will help guide you

- These lie *between* you and the control
- Such as a
  - Large pond
  - Small lake
  - Building
  - Sign
- Check-off features –
  - You see these along the way
  - Verify you are on the right route



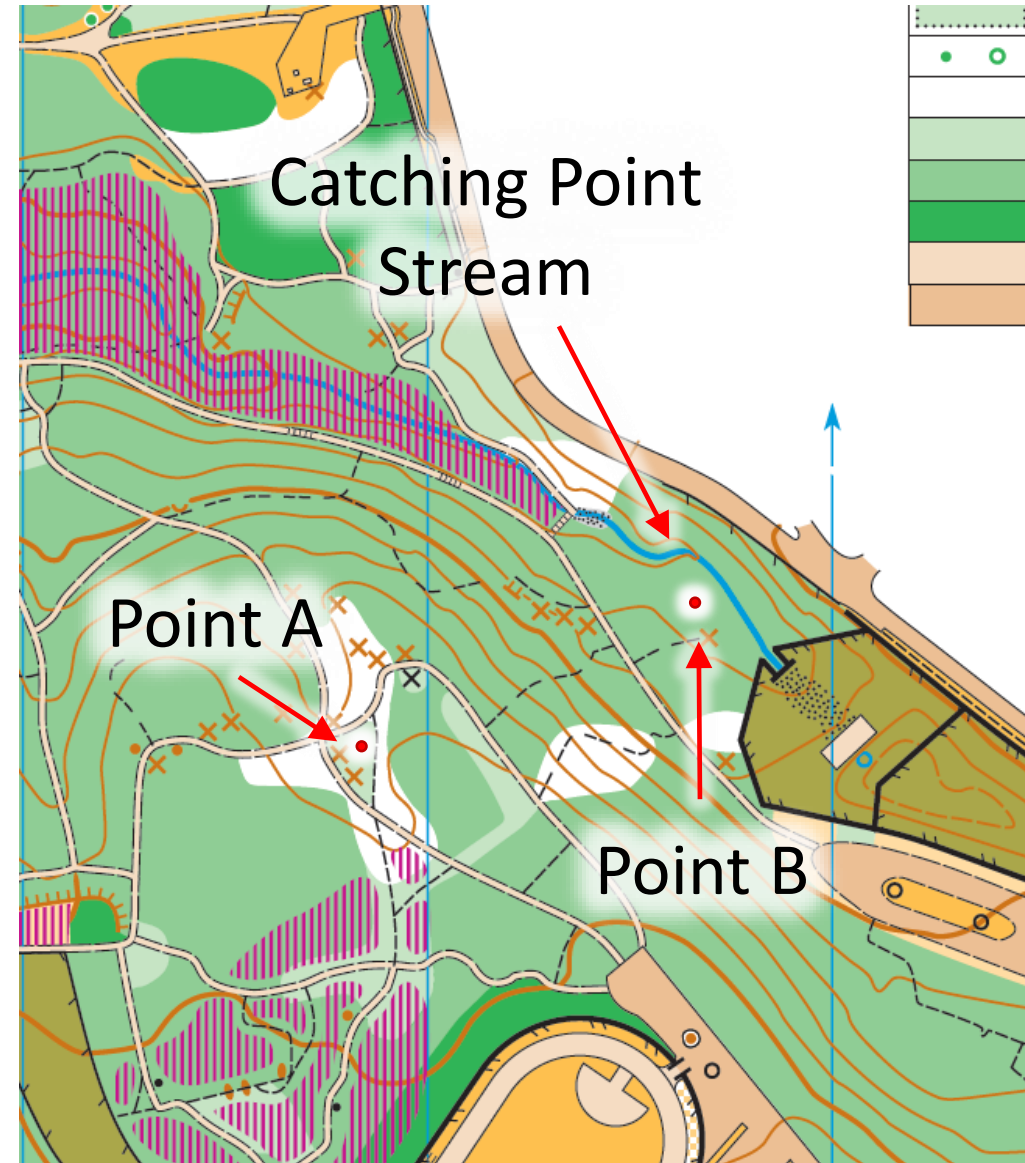


# Orienteering Techniques

## Requirement 6c – Catching Feature

*A catching feature lies beyond the control*

- Lets you know you went too far

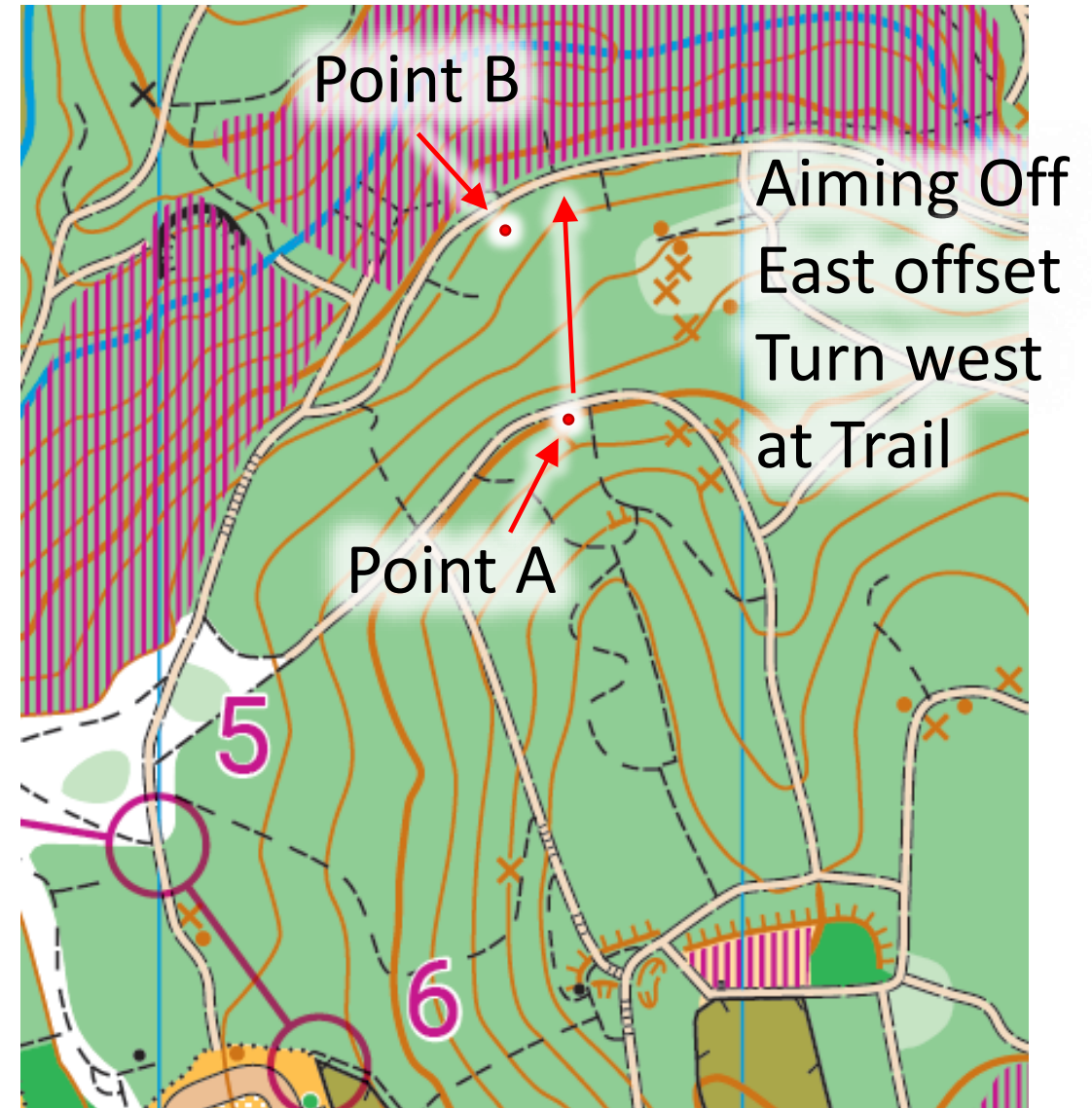


# Orienteering Techniques

## Requirement 6c – Aiming Off

Use for linear attack points

- Road
- Trail
- Stream
- Intentionally deviate to left or right
  - When you hit linear target, you know what direction to turn



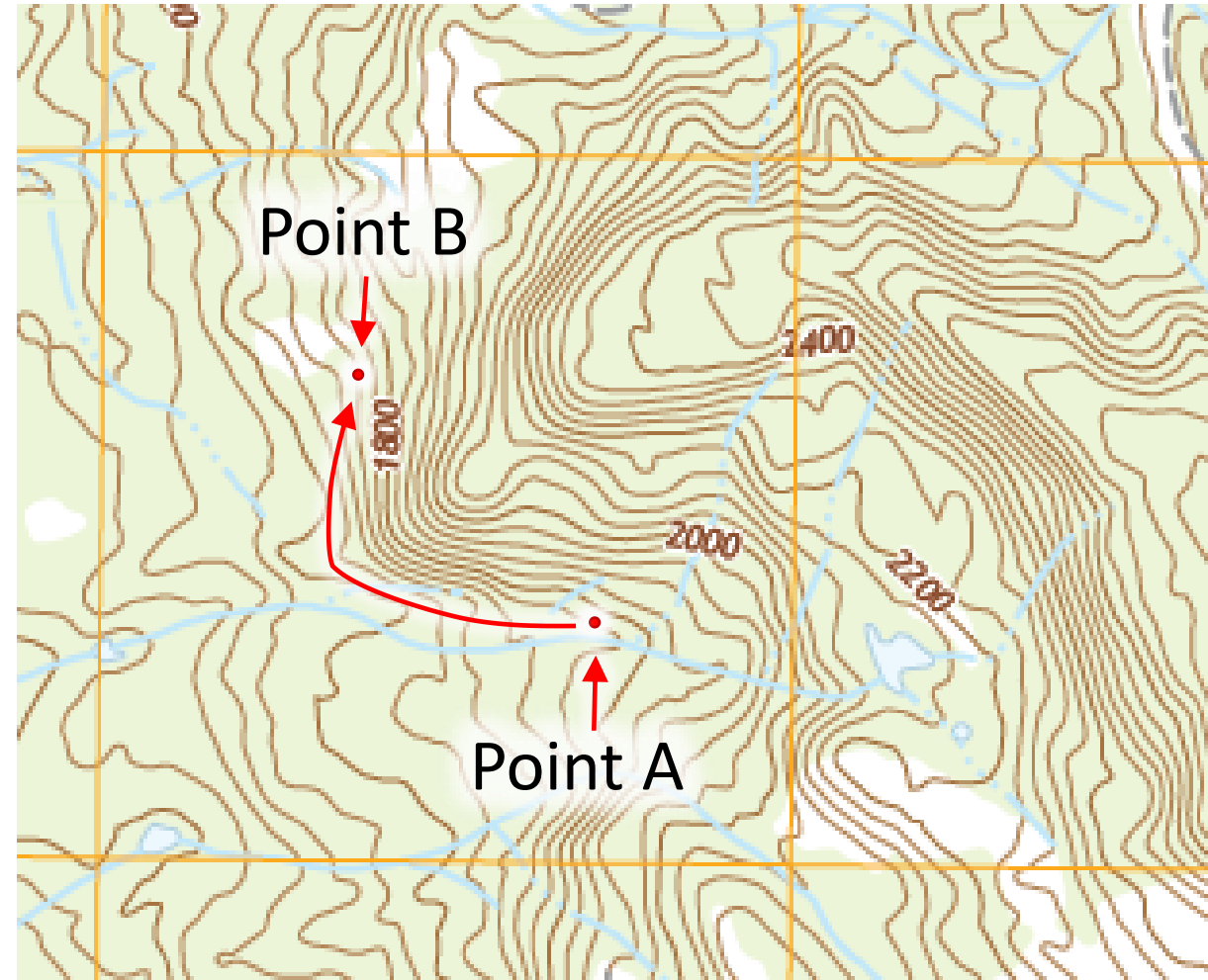


# Orienteering Techniques

## Requirement 6c – Contouring

Technique of following contour lines

- Follow same elevation
- Avoid lots of up and downs – often easier to go around hill
- Avoid steep and dangerous terrain
- Avoid densely vegetated low areas

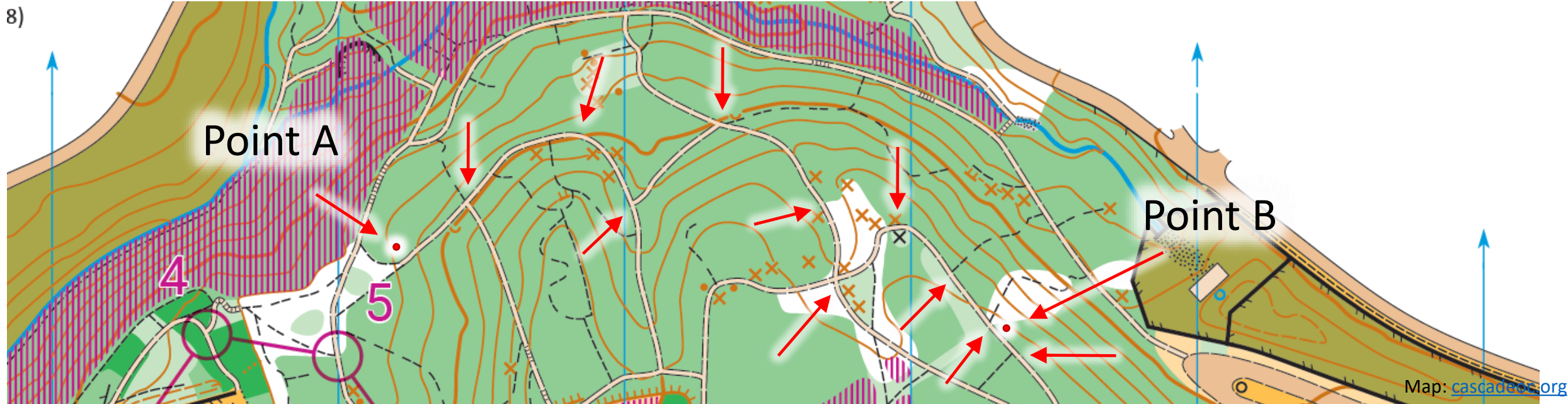


# Orienteering Techniques

## Requirement 6c – Reading Ahead

Keeping a clear mental picture of what should be coming up next

- Take time at control point to plan route
- Understand the what lies ahead
- Read map frequently to make sure you are on course
- What you see on the ground should match your map and route



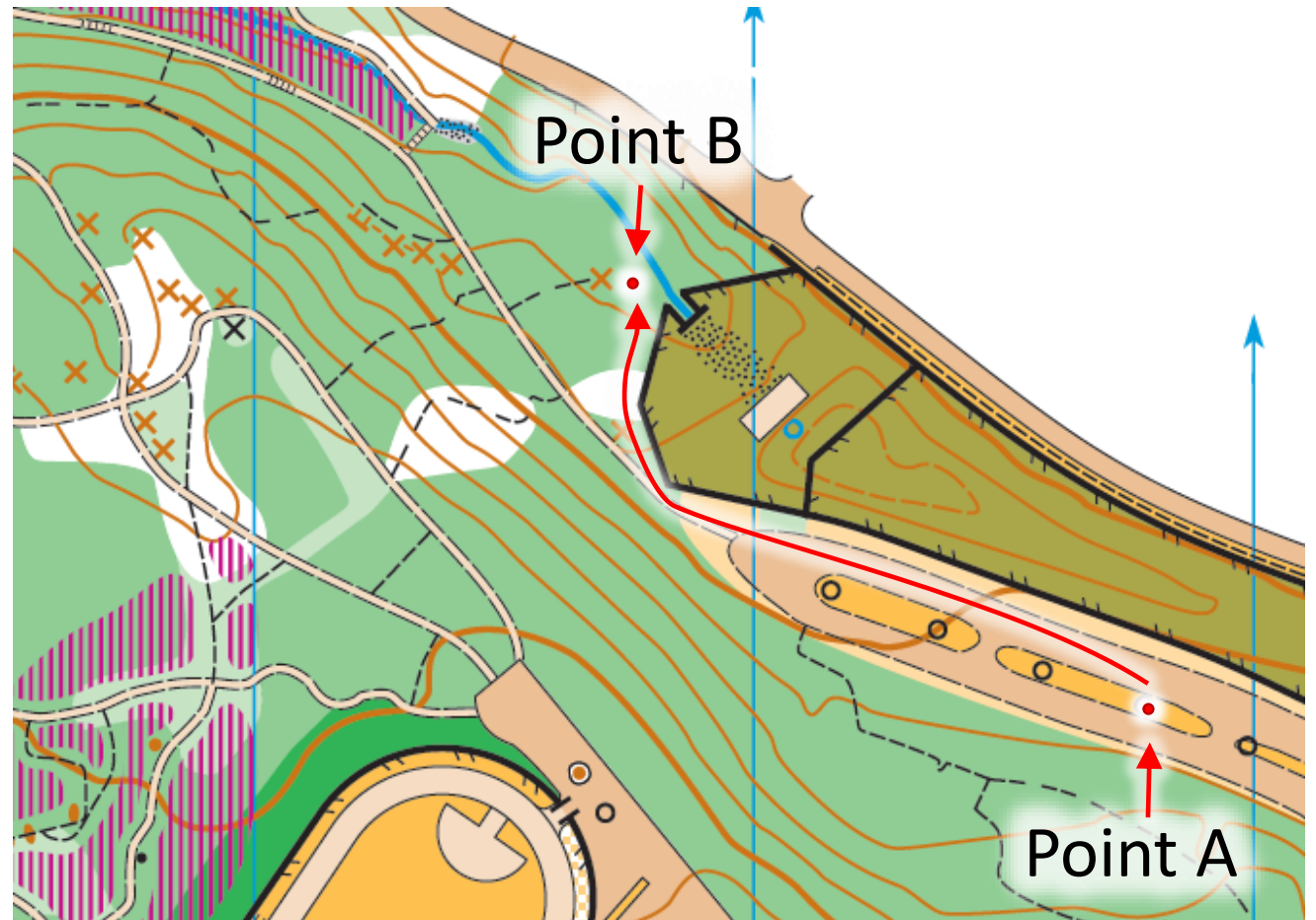


# Orienteering Techniques

## Requirement 6c – Handrail

Linear features along the leg of a course that help guide you

- Streams
- Trails
- Roads
- Fences
- Power lines
- Advanced Handrails:
  - Ridge lines
  - Valleys
  - Tree lines
  - Forest fire burns
  - Avalanche scars



# Orienteering Techniques

## Requirement 6c – Relocation

Determining location if you become potentially lost

- **STOP!** – further movement may make you more lost
- Use relocation features to determine your location
  - Lakes and ponds
  - Where stream forks
  - Bridge over stream

Retrace route  
if needed





# Orienteering Techniques

## Requirement 6c – Rough versus Fine Orienteering

### Rough Orienteering

- Use less precise movement to find collecting point
- Allows for speedy movement

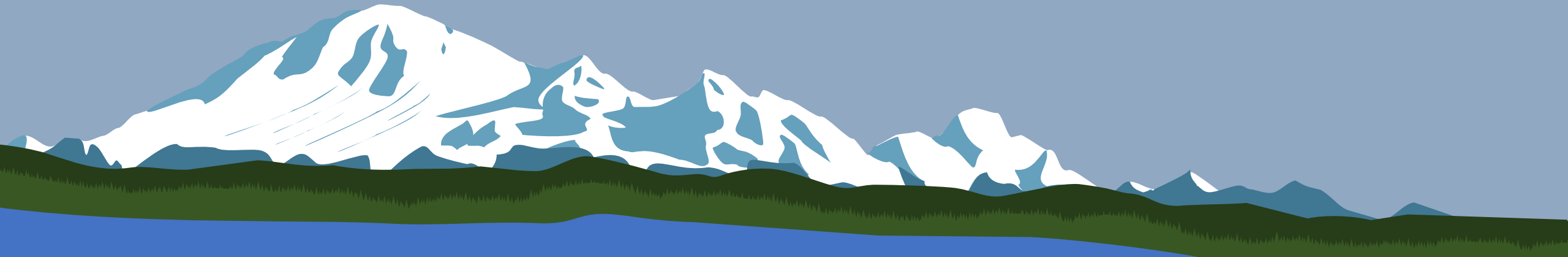
### Fine Orienteering

- More precise movement
- Use pace count and precise azimuth
- Slower movement
  
- Use Rough Techniques when feasible for speed
- Use Fine Techniques when necessary to find point

1. Requirements	13. Staying Found
2. Introduction	14. Constructing Maps
3. Map Reading	15. Constructing Control Symbols
4. Locations	16. Constructing Contours
5. Map Orientation	17. Universal Transverse Mercator
6. Measuring Distances	18. Unit Conversions
7. Projections	19. Electronic Control Revolution
8. Paper Maps	17. Resources
9. Understanding Techniques	18. Instructor's Corner



# Staying Found





# Staying Found

## Staying Found – Thumbnail Navigation

- Keep map in pocket and NOT in backpack
- Refer to map often to keep up with location
- Follow map as you move by placing thumb over location
  - Match features you see on the ground with those on the map
  - This keeps you on route
  - Keeps your map skills sharp
  - Unlikely you are going to get lost or stray too far off course

# Staying Found

## Staying Found – Disorientation

- If you find you are unsure of your location
  - STOP
  - Pull out map and sit down
  - Study map and look for landmarks
  - Discuss route with crew
  - Where was your last known point?



# Staying Found

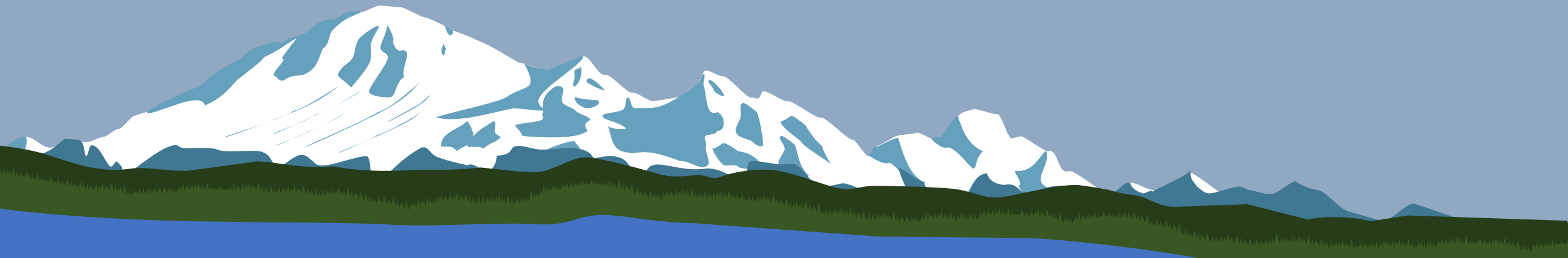
## Staying Found – Lost

- If you find you are truly lost
  - Movement will likely move you further off course
  - Set up shelter
  - Wait for search party to find you

1. Requirements	13. Reading a Road
2. Introduction	14. Orienteering Maps
3. Map Reading	15. Orienteering Control Symbols
4. Locations	16. Symbols and Contours
5. Map Orientation	17. Universal Transverse Mercator
6. Orienteering Distance	18. Unit Conversions
7. Positioning	19. Magnetic Declination
8. Pace Count	17. Resources
9. Orienteering Techniques	18. Instructor's Corner



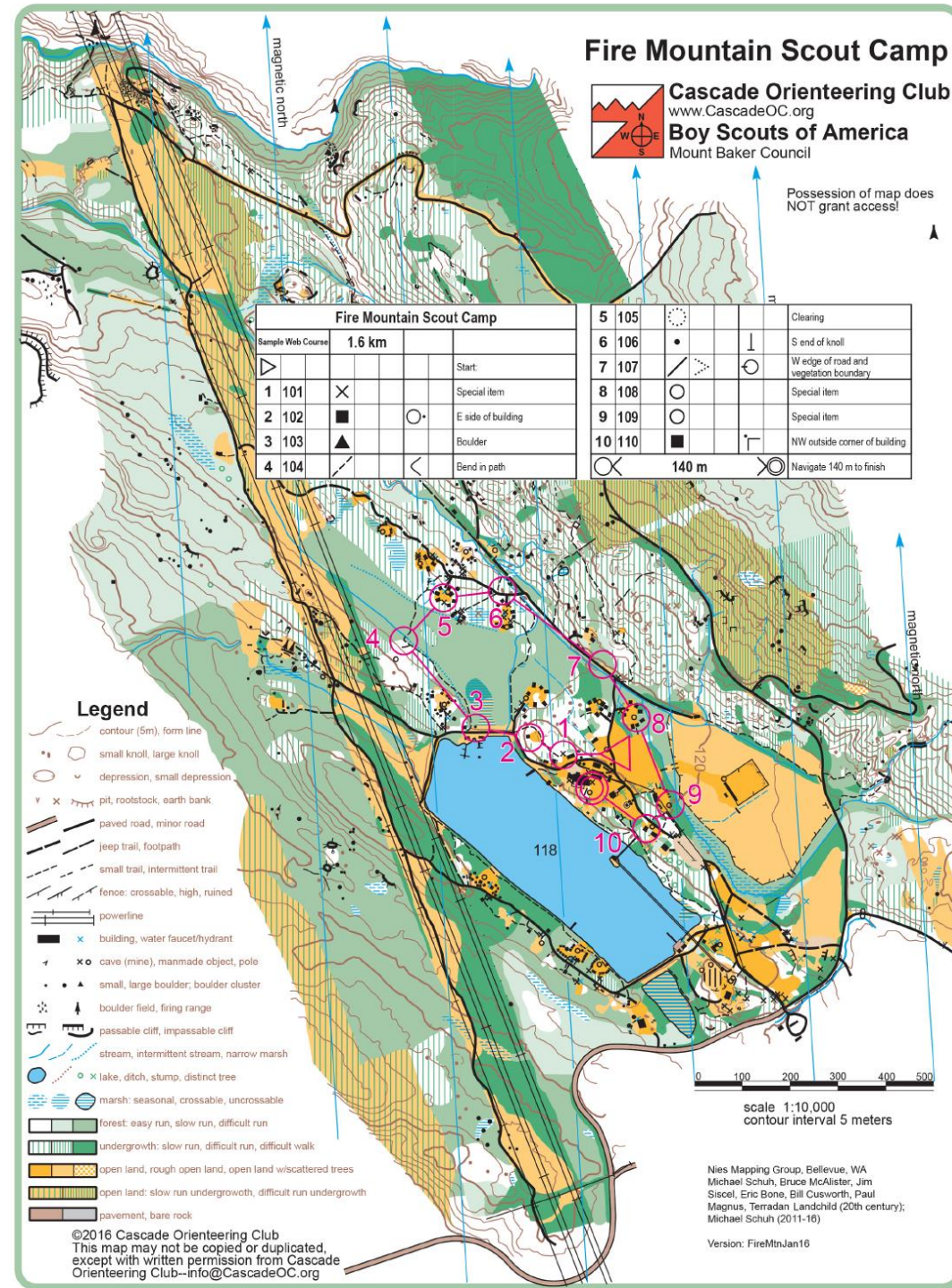
# Orienteering Maps





# Orienteering Map

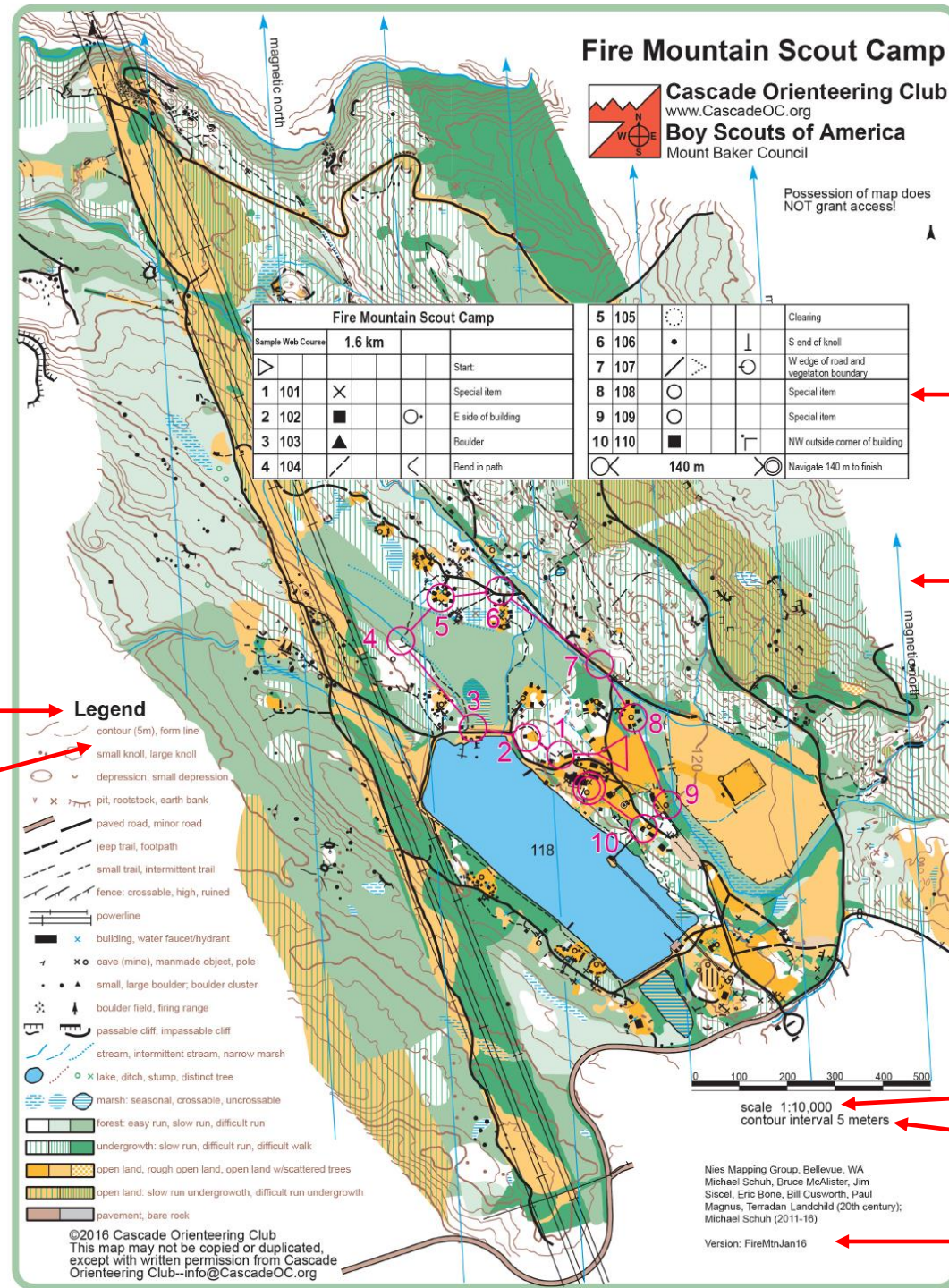
[cascadeoc.org](http://cascadeoc.org)





# Orienteering Map

[cascadeoc.org](http://cascadeoc.org)



Legend

contour (5m)

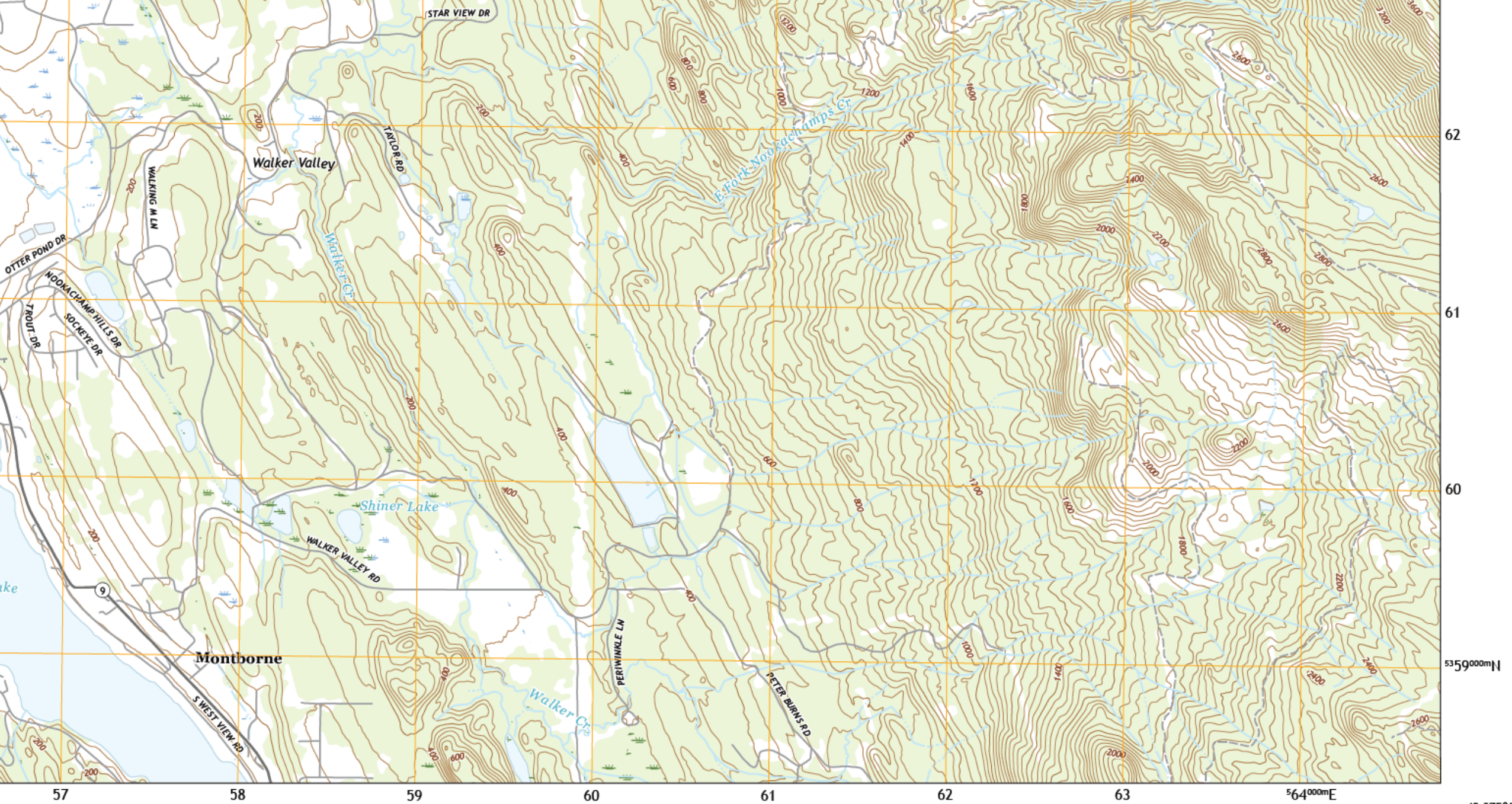
Control Descriptions

Magnetic North Line

Scale Contour Interval

Version



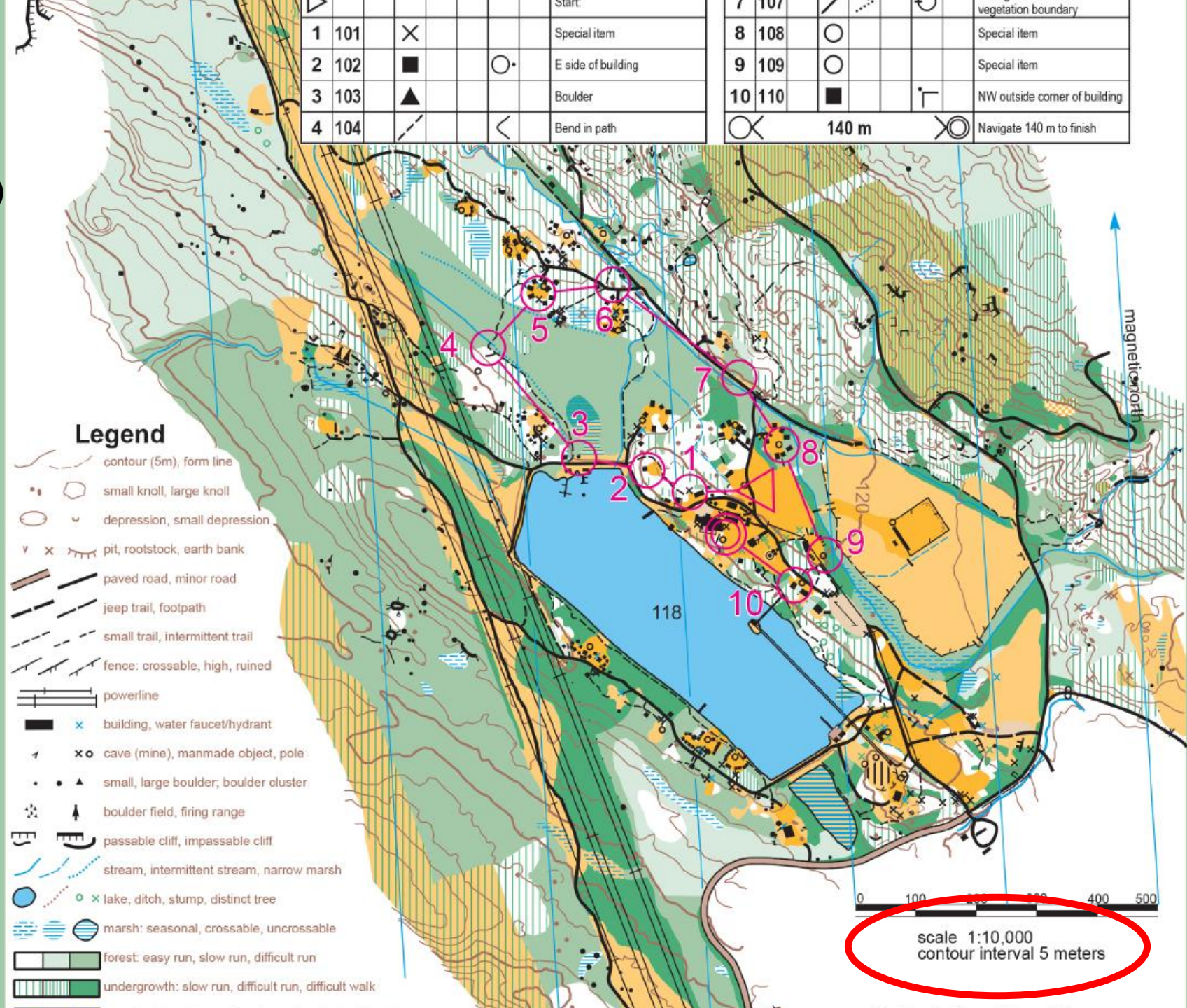


Map Originally 1:24,000 Scale



# Orienteering Map

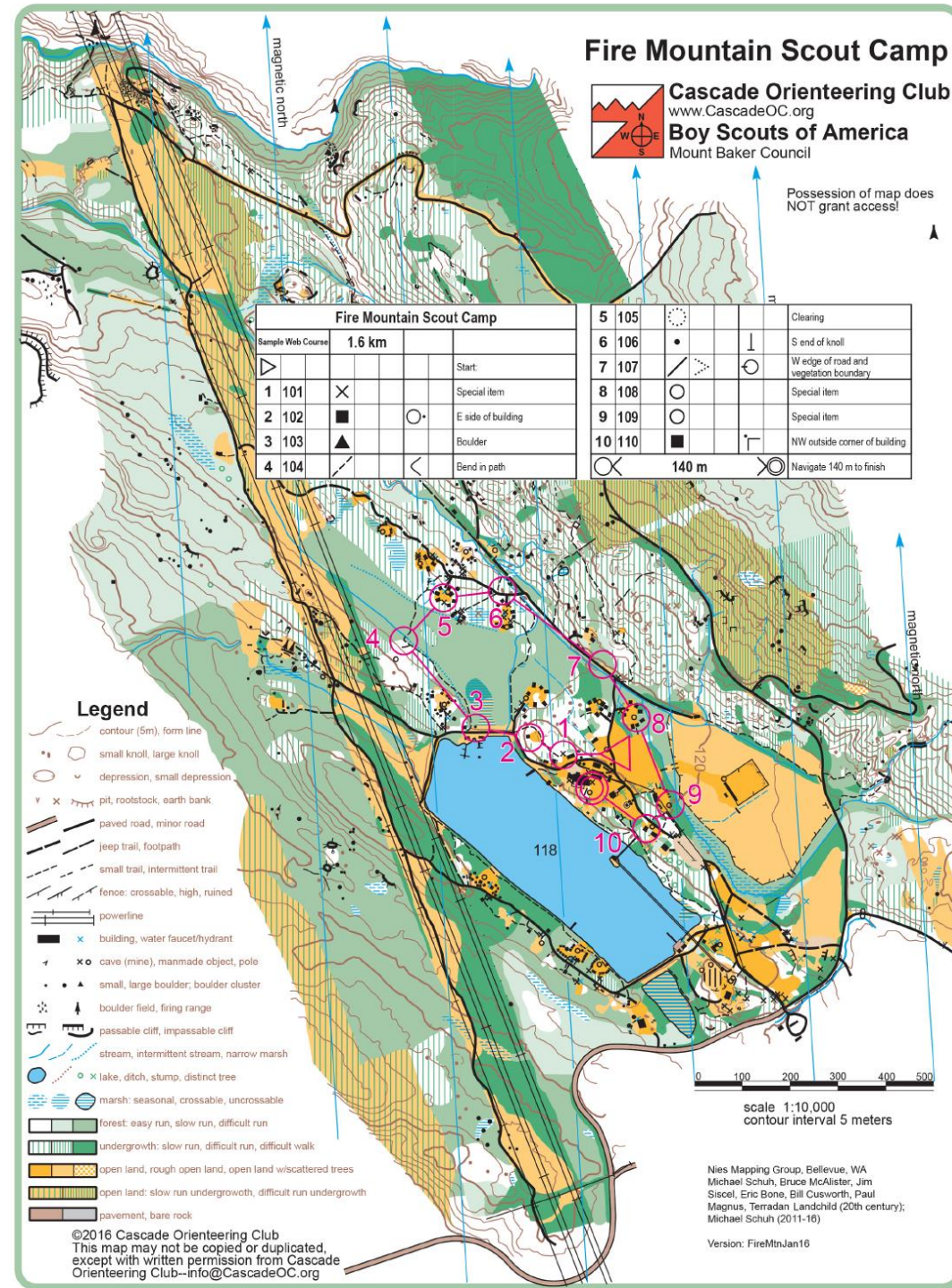
[cascadeoc.org](http://cascadeoc.org)





# Orienteering Map

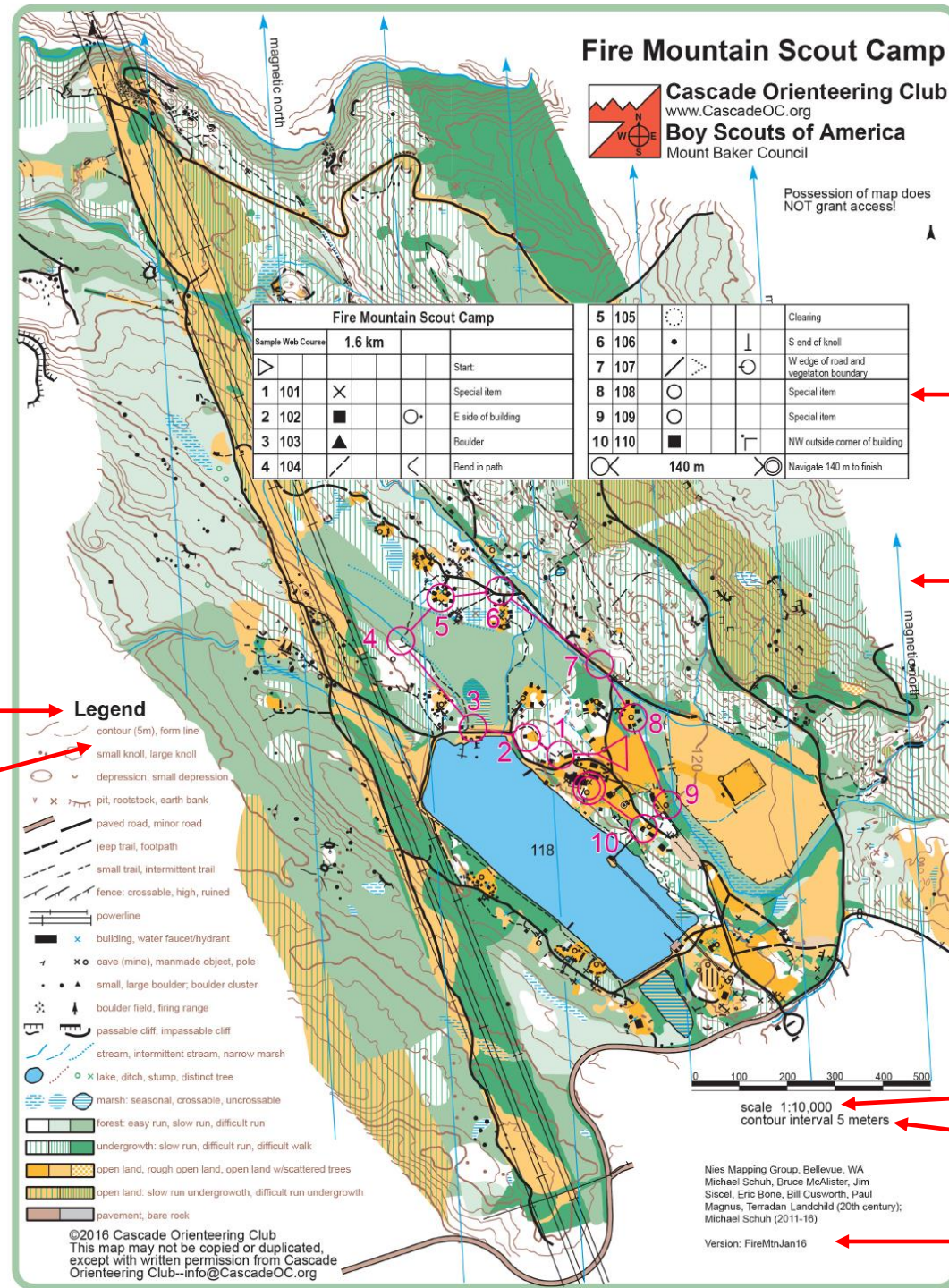
[cascadeoc.org](http://cascadeoc.org)





# Orienteering Map

[cascadeoc.org](http://cascadeoc.org)



Legend

contour (5m)

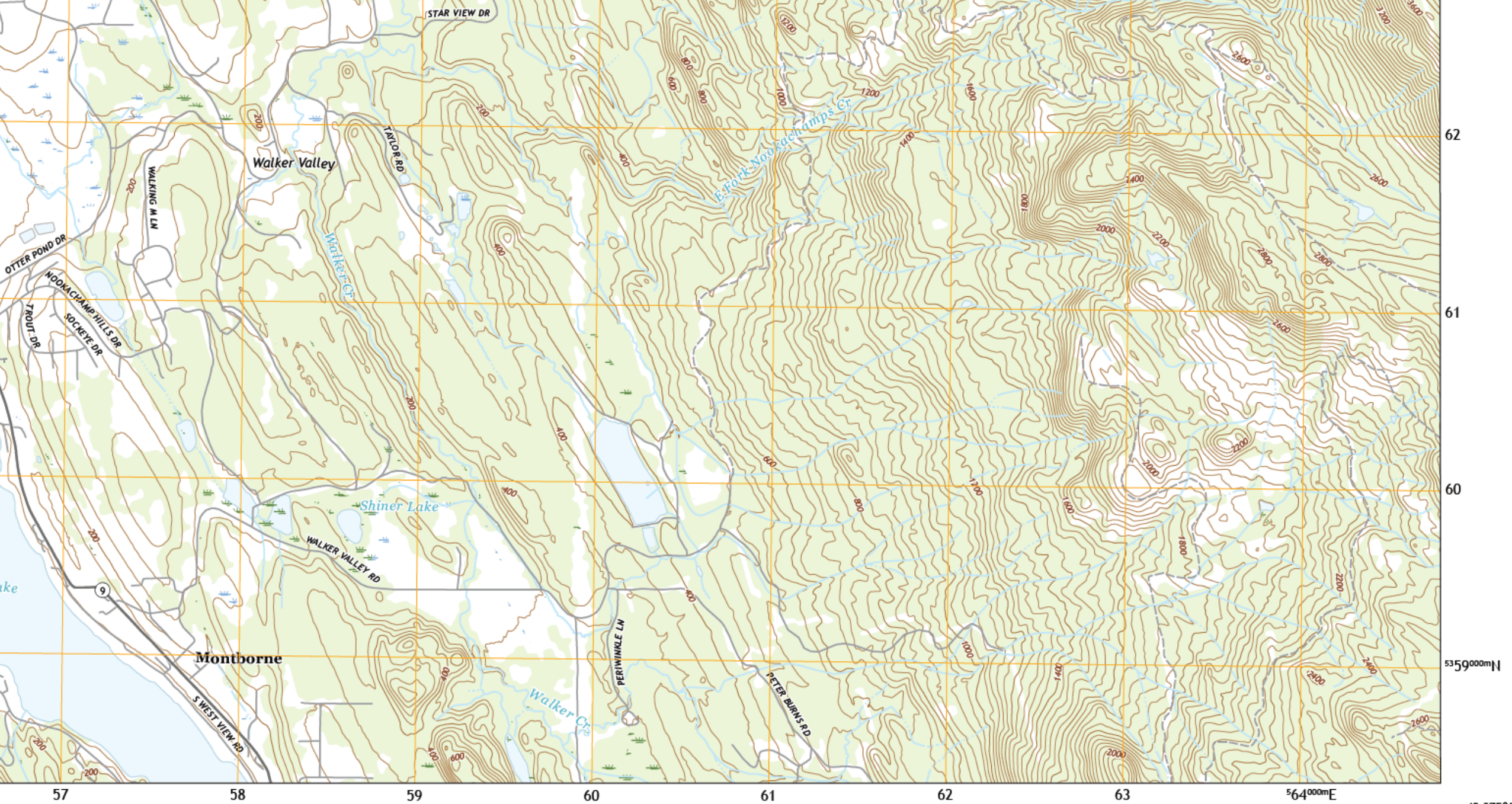
Control Descriptions

Magnetic North Line

Scale Contour Interval

Version



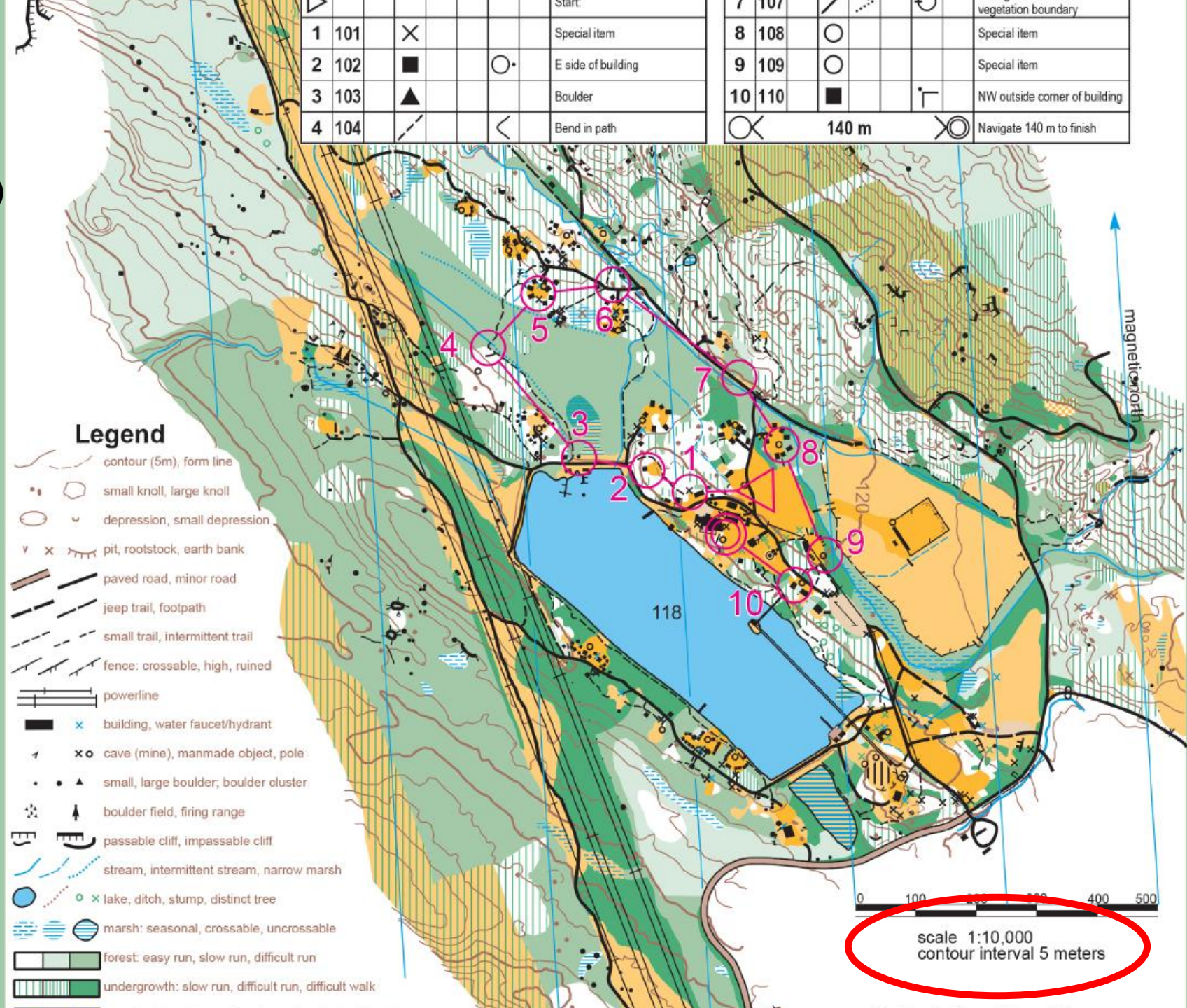


Map Originally 1:24,000 Scale



# Orienteering Map

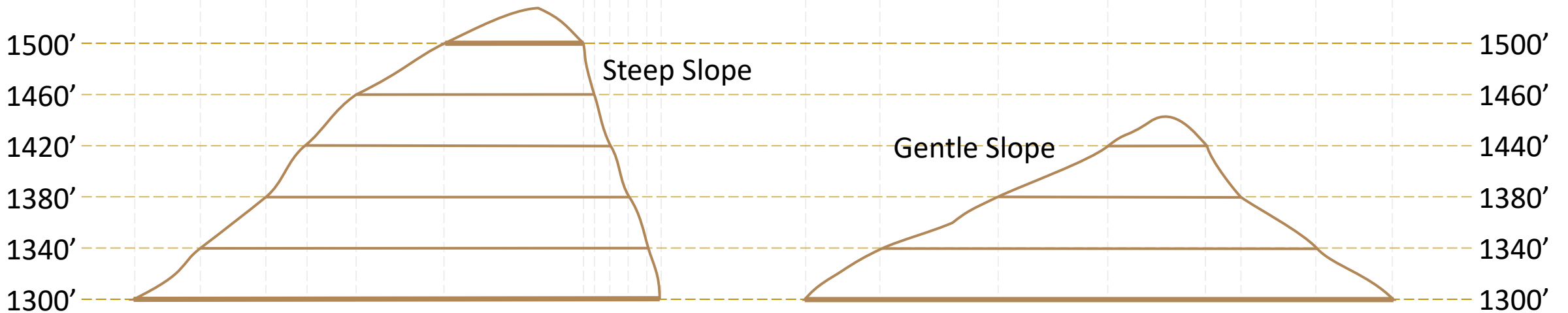
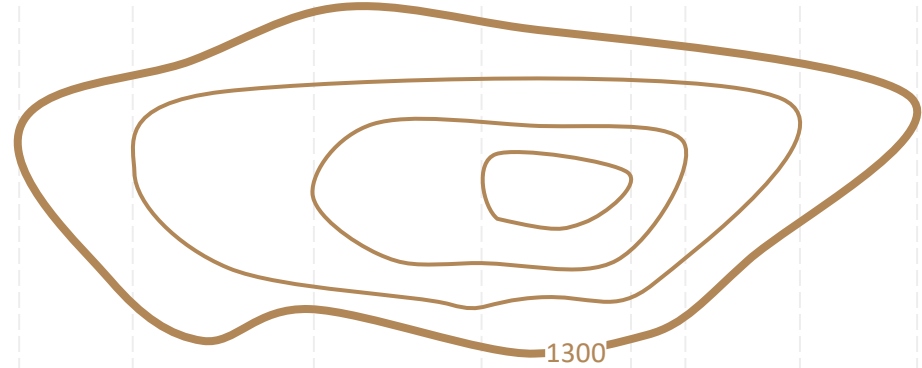
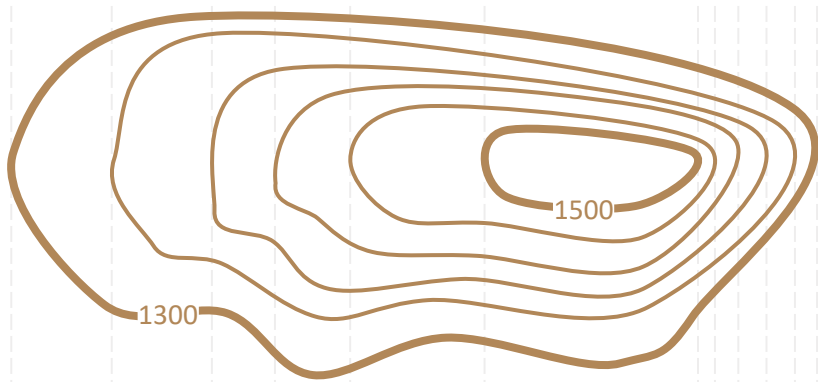
[cascadeoc.org](http://cascadeoc.org)

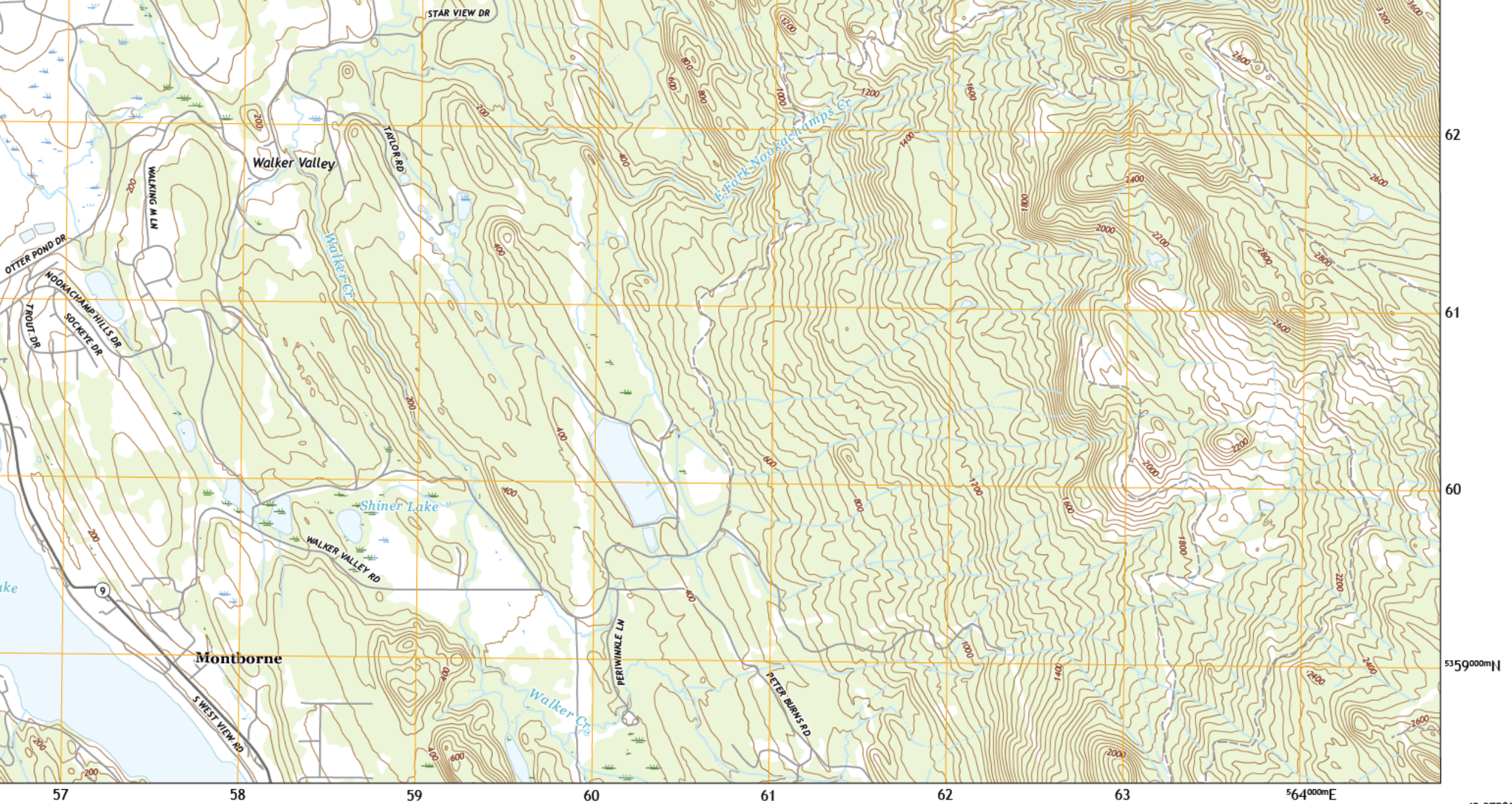




# Topographic Maps

## Contour Lines
























Map Originally 1:24,000 Scale



# Topographic Maps

## ISOM 2017 Orienteering Map Symbols















### Land forms

	Contour
	Index contour
	Form line
	Slope line
	Contour value
	Earth bank
	Earth wall
	Ruined earth wall
	Erosion gully
	Small erosion gully
	Knoll
	Small knoll
	Small elongated knoll
	Depression
	Small depression
	Pit
	Broken ground
	Very broken ground
	Prominent landform feature



















### Water and marsh

	Uncrossable water
	Shallow water
	Waterhole
	Uncrossable river
	Crossable watercourse
	Small crossable watercourse
	Minor/seasonal water channel
	Narrow marsh
	Uncrossable marsh
	Marsh
	Indistinct marsh
	Well, fountain or water tank
	Spring
	Prominent water feature

### Rock and boulders

	Impassable cliff
	Cliff
	Rocky pit, Cave
	Boulder, Large boulder
	Gigantic boulder
	Boulder cluster
	Boulder field
	Dense boulder field
	Stony ground: slow
	Stony ground: walk
	Stony ground: fight
	Sandy ground
	Bare rock
	Trench
















### Vegetation

















	Open land
	Open land with scattered trees/bushes
	Rough open land
	Rough open land with scattered trees/bushes
	Forest: easy running
	Vegetation: slow running
	Undergrowth: slow running
	Vegetation: walk
	Undergrowth: walk
	Vegetation: fight
	Vegetation: impassable
	Forest runnable in one direction
	Cultivated land
	Orchard
	Vineyard
	Distinct cultivation boundary
	Distinct vegetation boundary
	Prominent large tree
	Prominent bush or tree
	Prominent vegetation feature

# Topographic Maps











## ISOM 2017 Orienteering Map Symbols

### Man-made features




	Paved area
	Wide road
	Road
	Vehicle track
	Footpath
	Small footpath
	Less distinct small path
	Narrow ride
	Visible path junction
	Indistinct junction
	Railway
	Power line, cableway or skilift
	Major power line
	Bridge/tunnel
	Footbridge

	Wall
	Ruined wall
	Impassable wall
	Fence
	Ruined fence
	Impassable fence
	Crossing point
	Area that shall not be entered
	Building
	Canopy
	Ruin
	High tower, Small tower
	Cairn, Fodder rack
	Prominent line feature
	Prominent impassable line feature
	Prominent man-made feature

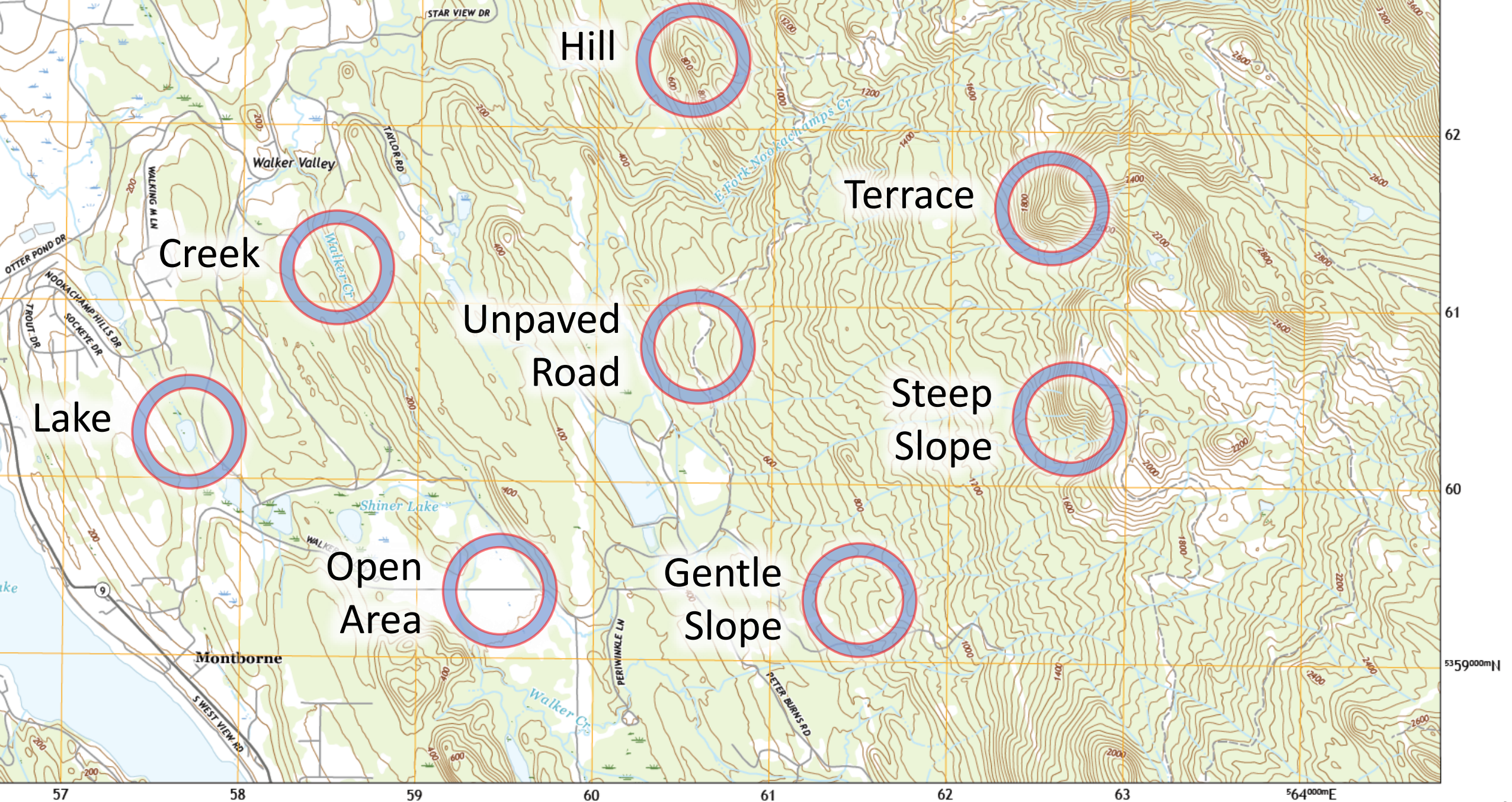
### Overprinting symbols

	Start
	Control point
	Control number
	Marked route
	Finish
	Out-of-bounds boundary
	Crossing point
	Out-of-bounds area
	Out-of-bounds route
	First aid post, Refreshment point

### Technical symbols

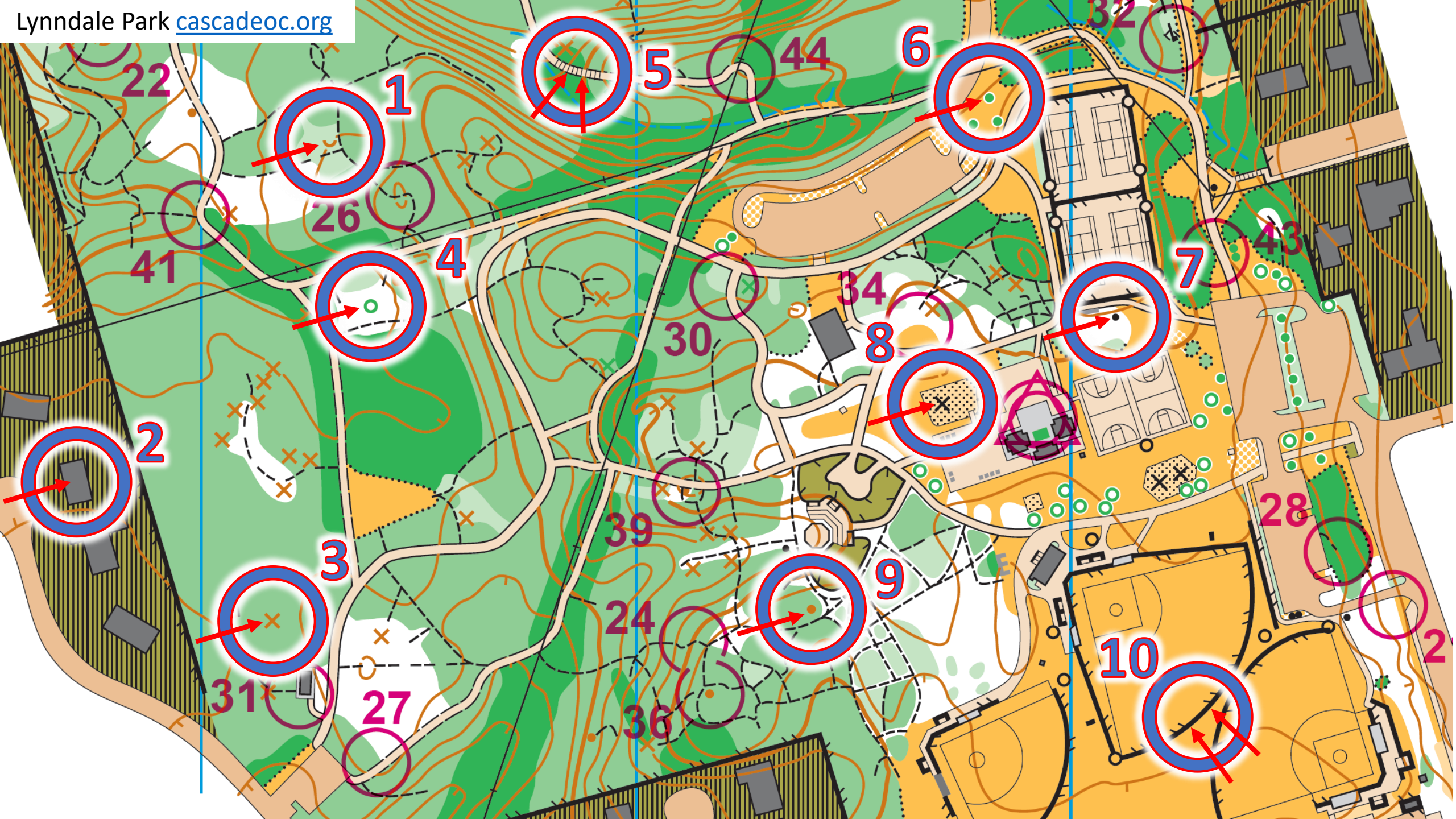
	Magnetic north line
	Registration mark
	Spot height





Map Originally 1:24,000 Scale

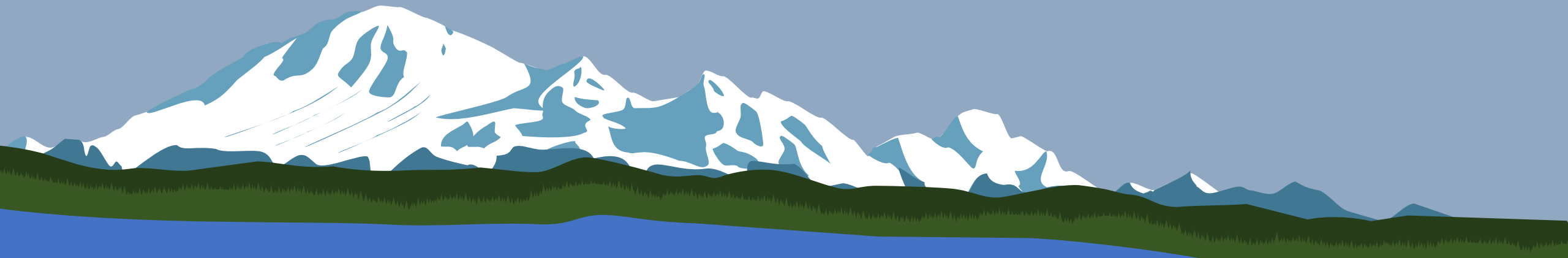








# Orienteering Control Symbols



# Orienteering Control Symbols

## **Orienteering Control Symbols**

Identify 20 international control description symbols. Tell the meaning of each symbol.



# Orienteering Cont

## Control Descriptions

Describe where control markers are found

Lynndale Park Permanent						
Beginner	0.9 km	30 m				
▷						Start:
1	30	↘		<		Bend in path
2	44	↘		<		Bend in path
3	32	↗		⊥		S end of fence
4	21	↗		○		S side of road
5	37	⋯		○		E edge of vegetation boundary
		⊗	180 m	⊗	Navigate 180 m to finish	

Intermediate 1						
2.0 km	90 m					
▷						Start:
1	43	↘		○		W side of path
2	33	⋯		○		SW edge of vegetation boundary
3	42	⊗		○		S side of root stock
4	35	↘	Y			Path junction
5	26	○	~	⏏		Top of low hill
6	31	■		⊥		SW outside corner of building
7	20	○	~			Low hill
8	25	↗		⊥		E end of fence
9	28	↘		⊥		S end of path
10	24	↘		<		Bend in path
11	30	↘		<		Bend in path
		⊗	120 m	⊗	Navigate 120 m to finish	

Intermediate 2						
2.4 km	75 m					
▷						Start:
1	28	↘		⊥		S end of path
2	40	X		○		W side of special item
3	39	•				Knoll
4	41	↘	Y			Path junction
5	27	⋯		○		S edge of vegetation boundary
6	36	•		○		W side of knoll
7	26	○	~	⏏		Top of low hill
8	22	○	~			Low hill
9	35	↘	Y			Path junction
10	38	↘	Y	○		E side of path junction
11	29	↘	X			Path crossing
12	42	⊗		○		S side of root stock
13	23	▲				Boulder
14	32	↗		⊥		S end of fence
15	44	↘		<		Bend in path
16	34	⊙		○		N edge of clearing
		⊗	50 m	⊗	Navigate 50 m to finish	

Control descriptions may look like hieroglyphics, but they are designed that way because orienteering is an international sport. By learning the symbols found on control descriptions, you'll be able to orienteer anywhere in the world!

There are eight available columns of information. But don't worry about understanding them all, because the first three columns have the most essential information, and are also the easiest to learn. For Beginner level courses we provide the meaning of the symbols in each column.

The FIRST COLUMN denotes what order you must find the controls. The SECOND COLUMN denotes the number that you will find on the physical control. So if you see "2, 33," that is the second control you must find and you will see the number 33 on the control when you find it.

The THIRD COLUMN describes the physical feature where the control will be located. You should see this feature on your map in the center of the control circle.

The SEVENTH COLUMN tells you what side of a feature the control is on. So if the control is on a boulder, this column will tell you which side of the boulder the control is located. These symbols are the most intuitive to learn, as well as are very helpful to know.

The OTHER COLUMNS take more time to learn, but don't show you much information that the map doesn't show you already. Fortunately, the columns that are the most challenging to learn are the least essential ones.

Learning control description symbols may feel intimidating, but don't let that stop you from orienteering. You can have fun and complete an orienteering course by reading just the first three columns. You can learn the symbols in the other

columns over time. A control description legend can be found at [cascadeoc.org](http://cascadeoc.org), or through a quick Google search.

# Orienteering Control Symbols

## International Control Description Symbols

IOF Event Example					
M45 M50 W21					
5		7.6 km		210 m	
----- 150 m ----->△					
▷		/	↗	Y	
1	101	⋯		<	
2	212	↖	●	1	○•
3	135	⊗	⊗		⊖
4	246		⊖		⊖
5	164	→	□		•○
○----- 120 m ----->					
6	185	↗	↪		└•
7	178	⌋			└○
8	147	⊖	⊖	2	
9	149	/	/	X	
○----- 250 m ----->⊙					



# Orienteering Control Symbols

## International Control Description Symbols

IOF Event Example		
M45 M50 W21		
5	7.6 km	210 m
----- 150 m ----->△		
▷		/ ↗ Y
1	101	⋯ <
2	212	↖ ● 1 ○•
3	135	⊗ ⊗  •
4	246	⊖ ○•
5	164	→ □ ○•
○----- 120 m ----->		
6	185	↗ ↻ ↙
7	178	⌋ ○
8	147	≡ ≡ 2
9	149	/ / X
○----- 250 m ----->⊙		

A	B	C	D	E	F	G	H	
2	225	↘	⋯	⊗	8x4	<	⤴	A Control number
								B Control code
								C Which of any similar feature
								D Control feature
								E Appearance
								F Dimensions / Combinations / Bend
								G Location of the control flag
								H Other information

# Orienteering Control Symbols

## International Control Description Symbols

IOF Event Example					
M45 M50 W21					
5	7.6 km	210 m			
----- 150 m ----->△					
▷		/	↗	Y	
1	101	⋯		<	
2	212	↖	●	1	○•
3	135	⊗	⊗		⊖
4	246		⊖		⊖
5	164	→	□		○•
○----- 120 m ----->					
6	185	↗	↪		└
7	178	⌋			⊖
8	147	⊖	⊖	2	
9	149	/	/	X	
○----- 250 m ----->⊖					






IOF Event Example		
Classes M45 M50 W21		
Course number 5	Length 7.6 km	Height climb 210 m
Distance to Start Triangle 150 m		
Start	Road, wall junction	
1	101	Narrow marsh bend
2	212	North western knoll, 1m high, east side
3	135	Between thickets
4	246	Middle depression, east part
5	164	Eastern ruin, west side
Follow taped route 120 m away from control		
6	185	Stone wall, ruined, south east corner (outside)
7	178	Spur, north west foot
8	147	Upper cliff, 2m high
9	149	Path crossing
Follow taped route 250 m from last control to finish		



# Orienteering Control Symbols

## International Control Description Symbols - Column C

Which of any similar feature

Ref.	Symbol	Name	Description
0.1		Northern	The more northern of two similar features, or the northern-most of several similar features.
0.2		South eastern	The more south eastern of two similar features, or the south-eastern-most of several similar features.
0.3		Upper	Where the control feature is directly above a similar feature.
0.4		Lower	Where the control feature is directly below a similar feature.
0.5		Middle	Where the control feature is the middle one of a number of similar features.

# Orienteering Control Symbols

## International Control Description Symbols - Column D

### The Control Features - Landforms






Ref.	Symbol	Name	Description	ISOM
1.1		Terrace	A level area on a slope.	101
1.2		Spur	A contour projection or "nose" rising from the surrounding ground.	101
1.3		Re-entrant	A contour indentation; a valley; the opposite of a spur.	101
1.4		Earth bank	An abrupt change in ground level which can clearly be distinguished from its surroundings.	104
1.5		Quarry	Gravel, sand or stone working in flat or inclined ground.	104
1.6		Earth wall	A narrow wall of earth projecting above the surrounding terrain; may be partially stone faced, usually man-made.	105 106
1.7		Erosion gully	An erosion gully or trench, normally dry.	107
1.8		Small erosion gully	A small erosion gully or trench, normally dry.	108
1.9		Hill	A high point. Shown on the map with contour lines.	101
1.10		Knoll	A small obvious mound or knoll.	109 110
1.11		Saddle	The low point between two higher points.	101
1.12		Depression	A depression or hollow from which the ground rises on all sides. Shown on the map with contour lines.	101
1.13		Small depression	A small, shallow, natural depression or hollow from which the ground rises on all sides.	111
1.14		Pit	A pit or hole with distinct steep-sides. Usually man made. Used with symbol 8.6 to indicate a rocky pit.	112 203
1.15		Broken ground	Clearly disturbed ground with features too small or too numerous to be mapped individually; including animal earths.	113 114
1.16		Ant hill (termite mound)	The mound made by ants or termites.	








# Orienteering Control Symbols

## International Control Description Symbols - Column D

### The Control Features - Rocks












Ref.	Symbol	Name	Description	ISOM
2.1		Cliff, Crag	A cliff or rock face. May be passable or impassable.	201 202
2.2		Rock Pillar	A high, natural rock projection.	206
2.3		Cave	A hole in a rock face or hill side, often leading to underground workings.	203
2.4		Boulder	A prominent free-standing block of rock or stone.	204 205
2.5		Boulder field	An area covered by so many boulders that they cannot be individually mapped.	208 209

2.6		Boulder cluster	A small distinct group of boulders so closely clustered together that they cannot be individually mapped.	207
2.7		Stony ground	An area covered with many small stones or rocks.	210 211 212
2.8		Bare rock	A runnable area of rock with no earth or vegetation cover.	214
2.9		Narrow passage	A gap between two cliffs or rock faces that face each other.	201 202
2.10		Trench	A rocky or artificial trench.	215

# Orienteering Control Symbols

## International Control Description Symbols - Column D

### The Control Features – Water and Marsh











Ref.	Symbol	Name	Description	ISOM
3.1		Lake	A large area of water, normally mapped as uncrossable.	301
3.2		Pond	A small area of water, may be shallow or seasonal.	302
3.3		Waterhole	A water-filled pit or depression.	303
3.4		River, Stream, Watercourse	A natural or artificial watercourse with either moving or standing water.	301 304 305
3.5		Minor water channel, Ditch	A natural or man made minor water channel which may contain water only intermittently.	306
3.6		Narrow marsh	A narrow marsh or trickle of water, too narrow to be shown on the map with the marsh symbol.	309
3.7		Marsh	A permanently wet area with marsh vegetation.	307 308
3.8		Firm ground in marsh	A non-marshy area within a marsh, or between two marshes.	307 308
3.9		Well	A shaft containing water or a captive spring, clearly visible on the ground. Often with some form of man-made surround.	311
3.10		Spring	The source of a watercourse with a distinct outflow.	312
3.11		Water tank, Water trough	A man made water container.	311



# Orienteering Control Symbols

## International Control Description Symbols - Column D









### The Control Features – Vegetation









Ref.	Symbol	Name	Description	ISOM
4.1		Open land	An area with no trees. Grassland, a meadow or a field.  Also heath or moorland.	401 403
4.2		Semi-open land	An area of open land with scattered trees or bushes.	402 404
4.3		Forest corner	The corner or tip of a forested area projecting into open land.	
4.4		Clearing	A small area of land free from trees within the forest.	401 403
4.5		Thicket	A small area of forest where the tree cover or undergrowth is so dense that it is difficult to pass. May also be used for an individual bush (typically in Sprint competitions).	408 410 411
4.6		Linear thicket	A man-made line of trees or bushes that is difficult to cross. May also be used for a hedge (typically in Sprint competitions).	410 411
4.7		Vegetation boundary	A distinct boundary between different types of trees or vegetation.	416
4.8		Copse	A small area of trees in open ground.	405 406
4.9		Prominent tree	An unusual or prominent tree in either open land or forest; frequently information is also given as to its type.	417 418
4.10		Root stock, Tree stump	The upturned root of a fallen tree, with or without the trunk.  The stump of a tree.	

# Orienteering Control Symbols

## International Control Description Symbols - Column D

### The Control Features – Man-Made Features

Ref.	Symbol	Name	Description	ISOM
5.1		Road	A metalled/asphalt surfaced or dirt road, suitable for vehicles in normal weather conditions.	502-503
5.2		Track / Path	A visible route made by people or animals. Tracks may be driven by rugged vehicles.	504-507
5.3		Ride	A forest ride or a prominent trace through the terrain which does not have a distinct runnable path along it.	508
5.4		Bridge	A crossing point over a watercourse or other linear feature.	512
5.5		Power line	A power or telephone line, cableway or ski lift.	510 511
5.6		Power line pylon	A support for power or telephone line, cableway or ski lift.	510 511
5.7		Tunnel	A way under roads, railways, etc.	512
5.8		Wall	A wall wall of stone or other materials. Used with symbol 8.11 to indicate a ruined wall.	513 515 514








5.9		Fence	A wire or wooden boundary. Used with symbol 8.11 to indicate a ruined fence.	516 518 517
5.10		Crossing point	A way through or over a wall, fence, or other linear feature, including a gate or stile.	519
5.11		Building	A standing brick, wood or stone structure.	521
5.12		Paved area	An area of hard standing used for parking or other purposes.	501
5.13		Ruin	The remains of a building that has fallen down.	523
5.14		Pipeline; bobsleigh/skeleton track	A prominent line feature such as a pipeline (gas, water, oil, etc.) or a bobsleigh/skeleton track which is above ground level.	528 529
5.15		Tower / Pylon	A metal, wooden or brick tower or pylon.	524 525
5.16		Shooting platform	A structure attached to a tree where a marksman or observer can sit.	525



# Orienteering Control Symbols

## International Control Description Symbols - Column D

### The Control Features – Man-Made Features

5.17		Boundary stone, Cairn	A man made stone or pile of stones. A cairn, memorial stone, boundary stone or trigonometric point.	526
5.18		Fodder rack	A construction for holding feed for animals.	527
5.19		Charcoal burning ground Platform	The clear remains of an area where charcoal was burned.  A small level man made area on a slope (a platform).	530 115
5.20		Monument or Statue	A monument, memorial or statue.	530 531
5.21		Canopy	An accessible area with a roof. A canopy or a covered passageway through a building.	522
5.22		Stairway	A stairway of at least two steps.	
5.23		Out of Bounds area	Out of Bounds area. Typically a flower bed or similar feature.	520

# Orienteering Control Symbols

## International Control Description Symbols - Column D







### The Control Features – Prominent Features /Special Items






Ref.	Symbol	Name	Description	ISOM
6.1	×	Prominent feature / Special item	If used, an explanation of its meaning must be supplied to competitors in the pre-race information.	115 313 419 531
6.2	○	Prominent feature / Special item	If used, an explanation of its meaning must be supplied to competitors in the pre-race information.	115 313 530



# Orienteering Control Symbols

## International Control Description Symbols - Column E Appearance

Ref.	Symbol	Name	Description
8.1		Low	Where the control feature is particularly low or flat but this is not indicated on the map; e.g. Hill, low.
8.2		Shallow	Where the control feature is particularly shallow but this is not indicated on the map; e.g. Re-entrant, shallow.
8.3		Deep	Where the control feature is particularly deep but this is not indicated on the map; e.g. Pit, deep.
8.4		Overgrown	Where the feature is partially covered in undergrowth or bushes that are not indicated on the map; e.g. Ruin, overgrown.
8.5		Open	Where the feature is in an area where the tree cover is less than the surroundings but this is not indicated on the map; e.g. Marsh, open.
8.6		Rocky, Stony	Where the feature is in an area of rocky or stony ground not indicated on the map; e.g. Pit, rocky.

8.7		Marshy	Where the feature is in an area of marshy ground not indicated on the map; e.g. Re-entrant, marshy.
8.8		Sandy	Where the feature is in an area of sandy ground; e.g. Spur, sandy.
8.9		Needle leaved	Where the tree or trees associated with the control feature have needle shaped leaves; e.g. Prominent tree, needle leaved.
8.10		Broad leaved	Where the tree or trees associated with the control feature are broad-leaved; e.g. Copse, broad leaved.
8.11		Ruined	Where the feature has fallen to ground level; e.g. Fence, ruined.

# Orienteering Control Symbols



## International Control Description Symbols - Column F Dimensions / Combinations / Bend

Ref.	Symbol	Name	Description
9.1	2.5	Height or Depth	Height or Depth of the feature in metres.
9.2	8 x 4	Size	Horizontal dimensions of the feature in metres.
9.3	$\frac{0.5}{3}$	Height on slope	Height of the feature on a slope in metres.
9.4	2 3	Heights of two features	Heights of two features with the control between them.



# Orienteering Control Symbols

## International Control Description Symbols - Column F Dimensions / Combinations / Bend




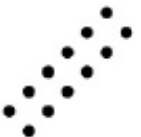











Ref.	Symbol	Name	Description
10.1		Crossing	The point at which two linear features cross.
10.2		Junction	The point at which two linear features meet; or where a linear feature meets the side or edge of an areal feature.

If used, the two features which either cross or meet must be shown in columns D and E

# Orienteering Control Symbols

## International Control Description Symbols - Column F


### Dimensions / Combinations / Bend

D	E	F		
			Path crossing	The point at which two similar linear features cross.
			Ride / Stream crossing	The point at which two different linear features cross.
			Road junction	The point at which two similar linear features meet.
			Stream / Narrow marsh junction	The point at which two different linear features meet.
			Fence / Building junction	The point at which a linear feature meets the side of an areal feature.



# Orienteering Control Symbols




## International Control Description Symbols - Column F Dimensions / Combinations / Bend






Ref.	Symbol	Name	Description
11.1		Bend	Used where a linear feature makes a smooth change of direction; e.g. Path bend; River bend.

# Orienteering Control Symbols

## International Control Description Symbols - Column G

### Location of Control Flag

Ref.	Symbol	Name	Description
12.1		North east Side	Used where: a) The feature extends above the surface of the ground; e.g. Boulder, north east side; Ruin, west side. A control on the side of a raised feature will not usually be visible from the opposite side. b) The control is located on a linear feature but not at a corner, e.g. Track, east side; Stream bend, south west side.
12.2		South east Edge	Used where: a) The feature extends down from the surface of the surrounding ground and the control is situated on the edge at ground level; e.g. Depression, south east edge. b) The feature extends over a significant area and the control is situated on the border of that area; e.g. Marsh, west edge; Clearing, north west edge.
12.3		West Part	Used where the feature extends over a significant area and the control is located neither at the centre, nor on any of the edges; e.g. Marsh, west part; Depression, south east part.







12.4		East Corner (inside)	Used where: a) The edge of a feature turns through an angle of 45-135 degrees; e.g. Open land, east corner (inside); Ruin, north west corner (outside). b) A linear feature turns a corner; e.g. Fence, south corner (inside); Stone wall, south west corner (outside).
12.5		South Corner (outside)	Note: The side of a building may be treated as a linear feature and hence "building, east corner (inside)" does not mean "inside the building". The orientation of the symbol indicates the direction in which the corner points.
12.6		South west Tip	Used where the edge of a feature turns through an angle of less than 45 degrees; e.g. Marsh, south west tip.
12.7		North west End	The point at which a linear feature ends or starts; e.g. Ride, north west end; Stone wall, south end.
12.8		Upper Part	Where the feature extends over two or more contours and the control is located near the top; e.g. Erosion Gully, upper part.



# Orienteering Control Symbols

## International Control Description Symbols - Column G




### Location of Control Flag

12.9		Lower Part	Where the feature extends over two or more contours and the control is located near the bottom; e.g. Re-entrant, lower part.
12.10		Top	Where the control is located at the highest point of the feature and this is not the default location; e.g. Cliff, top; Stairway, top.
12.11		Foot (no direction)	Where the control is located at the lower junction of the slope of the feature and the surface of the surrounding area and this is not the default location; e.g. Earth bank, foot; Stairway, foot.
12.12		North east Foot	As above, but where the feature is large enough for the control to be placed in more than one location around it; e.g. Hill, north east foot.
12.13		Beneath	Where the control is located underneath the feature; e.g. Pipeline, beneath.
12.14		Between	Where the control is located between two features; e.g. Between thickets; Between boulder and knoll.

When symbol 12.14 'Between' is used in Column G, the two features which the control is between must be shown separately in columns D and E.

# Orienteering Control Symbols

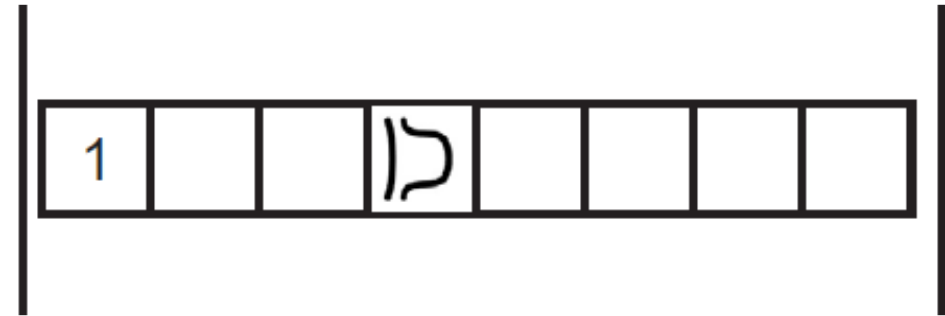
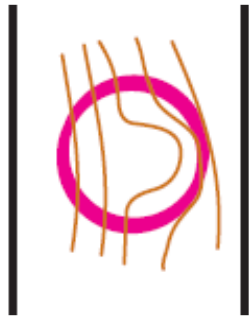
## International Control Description Symbols - Column H Other Information

Ref.	Symbol	Name	Description
13.1		First Aid post	Control site where First Aid is available.
13.2		Refreshment point	Control site where Refreshments are available.
13.3		Manned control	Manned control site.



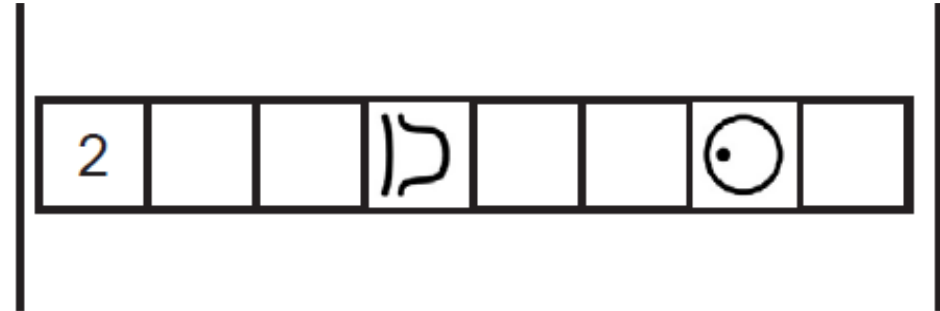
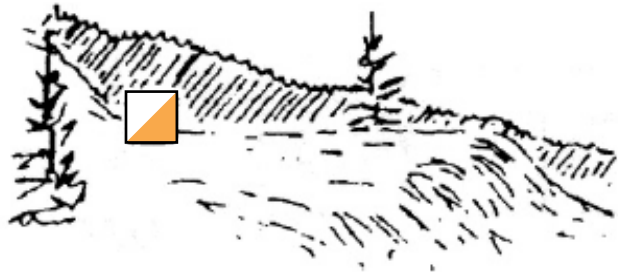
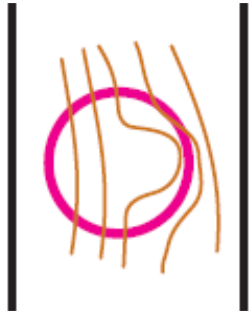
# Orienteering Control Symbols

## International Control Description Symbols – Examples



# Orienteering Control Symbols

## International Control Description Symbols – Examples





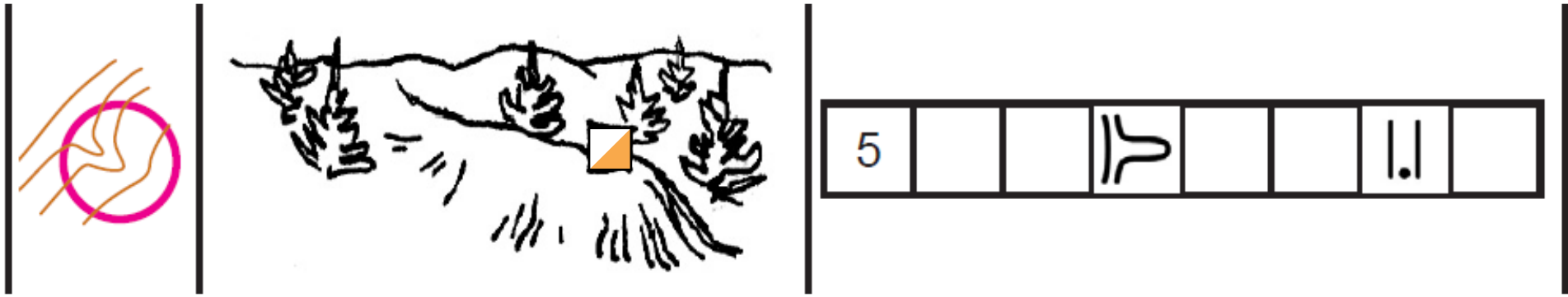
# Orienteering Control Symbols

## International Control Description Symbols – Examples



# Orienteering Control Symbols

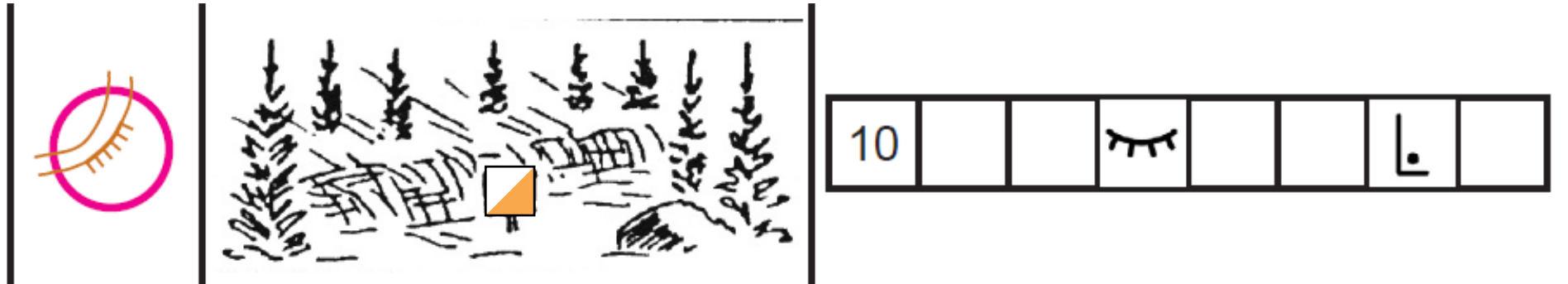
## International Control Description Symbols – Examples





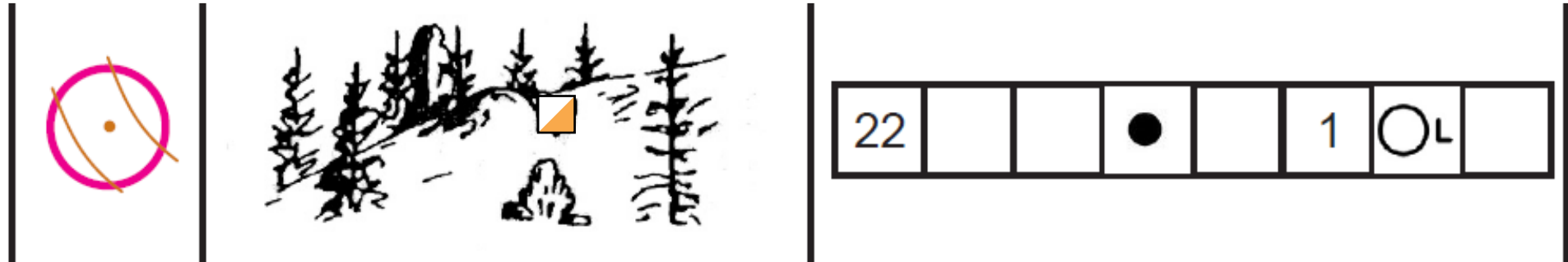
# Orienteering Control Symbols

## International Control Description Symbols – Examples



# Orienteering Control Symbols

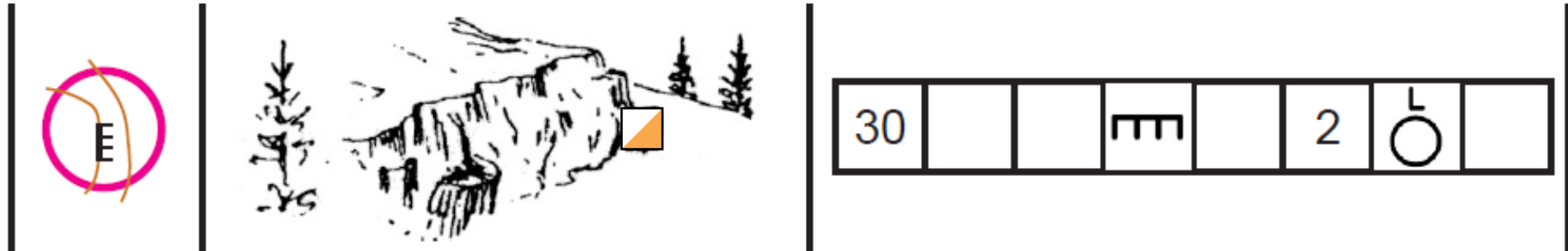
## International Control Description Symbols – Examples





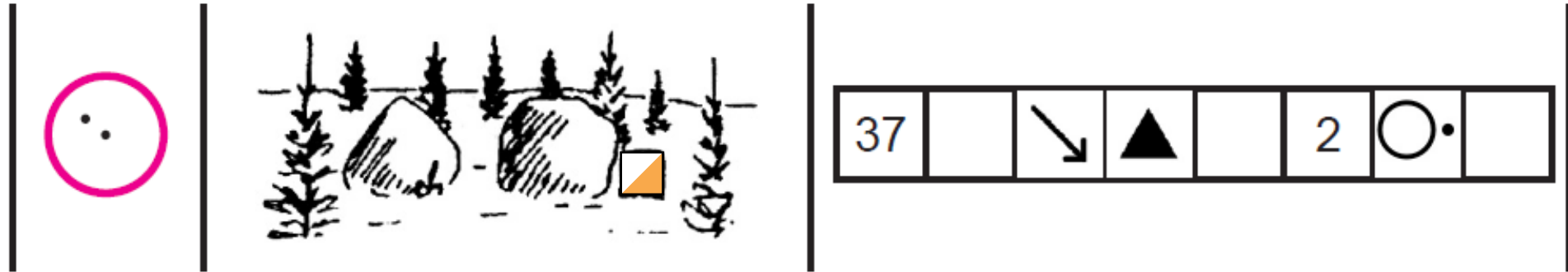
# Orienteering Control Symbols

## International Control Description Symbols – Examples



# Orienteering Control Symbols

## International Control Description Symbols – Examples



# Orienteering Control Symbols

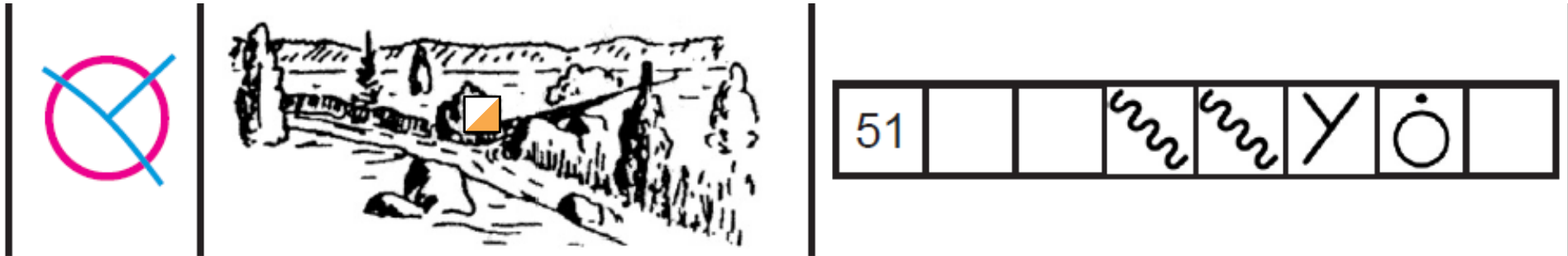
## International Control Description Symbols – Examples





# Orienteering Control Symbols

## International Control Description Symbols – Examples



# Orienteering Control Symbols

## Requirement 6a – Orienteering Map

Identify 20 international control description symbols. Tell the meaning of each symbol.

Please ID the following:

1. 

2. 

3. 


4. 

5. 

6. 

7. 

8. 

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10. 

11. 

12. 

13. 

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15. 

16. 

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18. 

19. 

20. 

# Orienteering Control Symbols

## Orienteering Map

Show a control description sheet and explain the information provided.

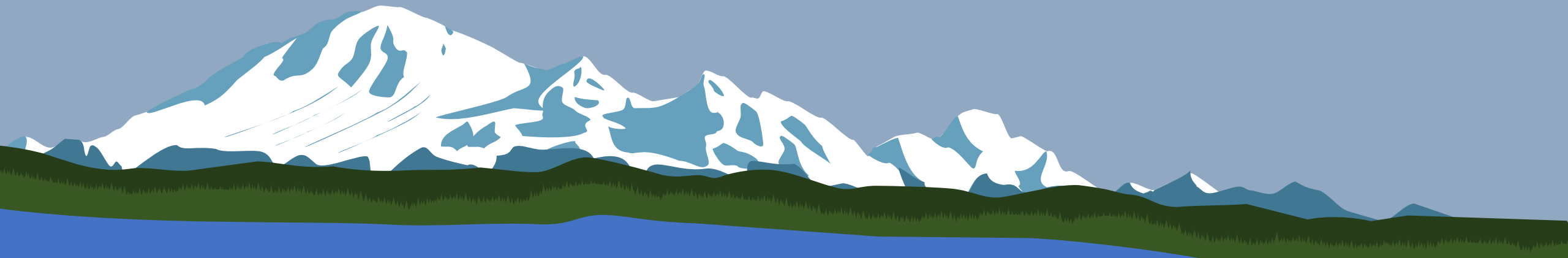
Shoreview Park									
Sample Web Course									
Adv. Beginner		1.5 km							
1	101								
2	102								
3	103								
4	104								
5	105								
6	106								
7	107								
8	108								
9	109								
10	110								
		60 m							



1. Requirements	13. Reading a Map
2. Introduction	14. Orienteering Control Symbols
3. Map Reading	15. Symbols and Landmarks
4. Landmarks	16. Universal Symbols & Markers
5. Map Orientation	17. Control Descriptions
6. Orienteering Distance	18. Orienteering Control Descriptions
7. Bearings	19. Resources
8. Pace Count	20. Instructor's Corner
9. Orienteering Techniques	



# Orienteering Compass



# Orienteering Compass

## Orienteering Maps and Compasses

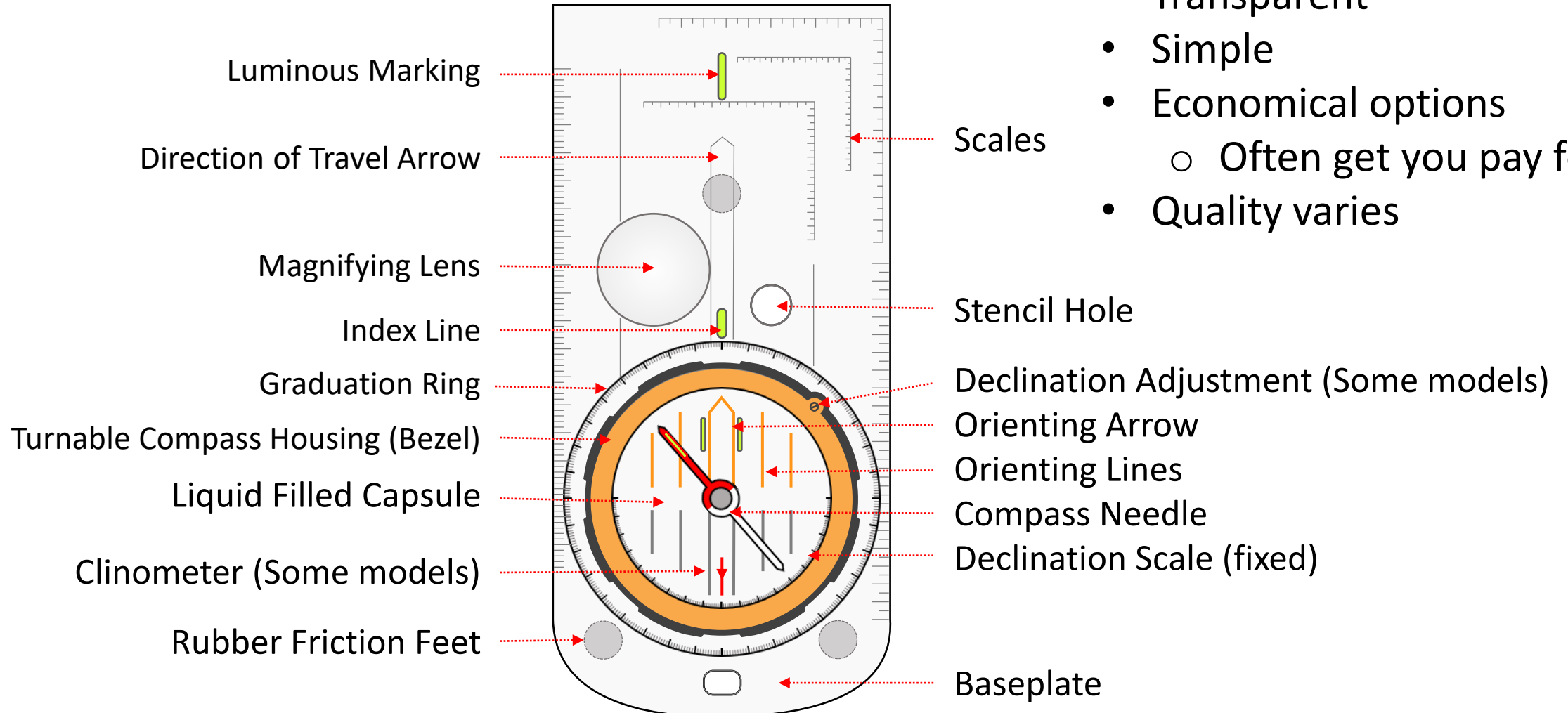
Orienteering competitions generally use special maps that use Magnetic North instead of Grid North

These maps are used differently than that maps you may accustomed to using

There are also specialized Thumb Compasses designed for competition  
These compasses aren't required to complete, but it's good to know about them

# Orienteering Compass

## The Baseplate Compass



- Very versatile
- Transparent
- Simple
- Economical options
  - Often get you pay for
- Quality varies



# Orienteering Compass

## Orienteering Compass

- Bare minimum for Orienteering
- Lightweight
- Hands free
- Lack versatility

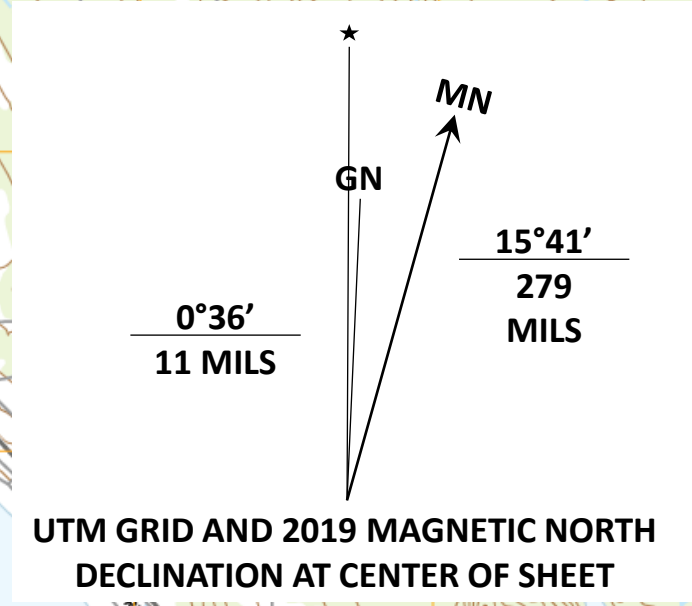


SUUNTO AIM-6 NH COMPASS

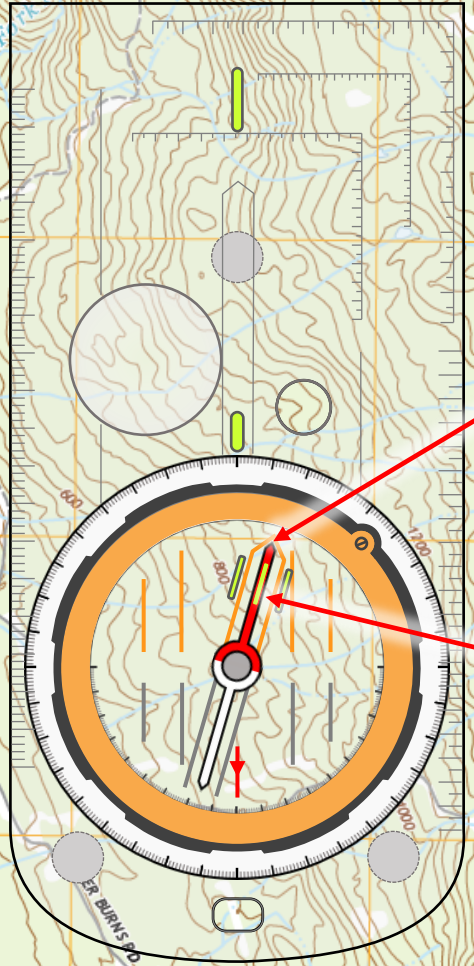
# Orienteering Compass

## Map Orientation

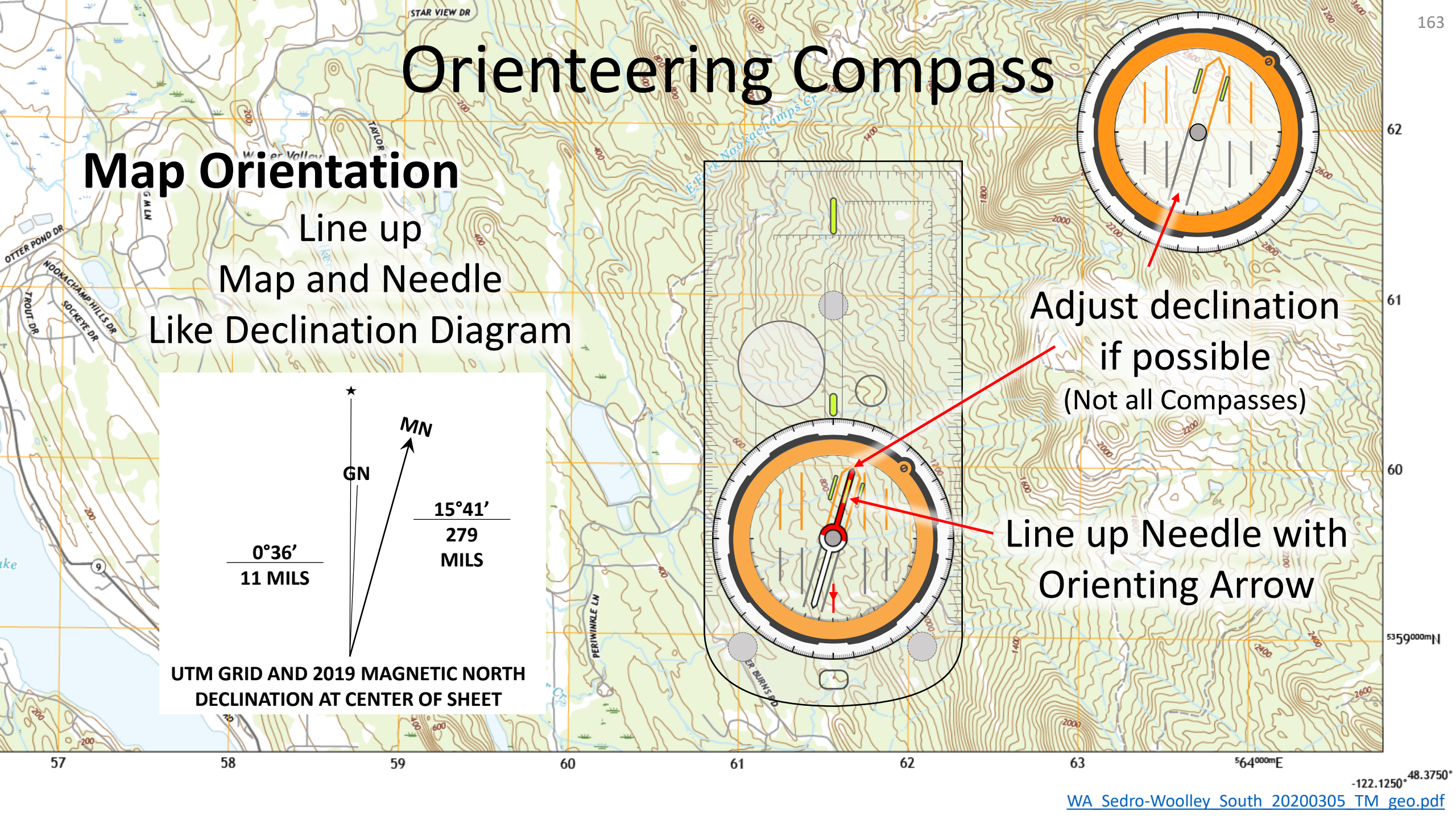
Line up  
Map and Needle  
Like Declination Diagram



Adjust declination  
if possible  
(Not all Compasses)



Line up Needle with  
Orienting Arrow



535000mN

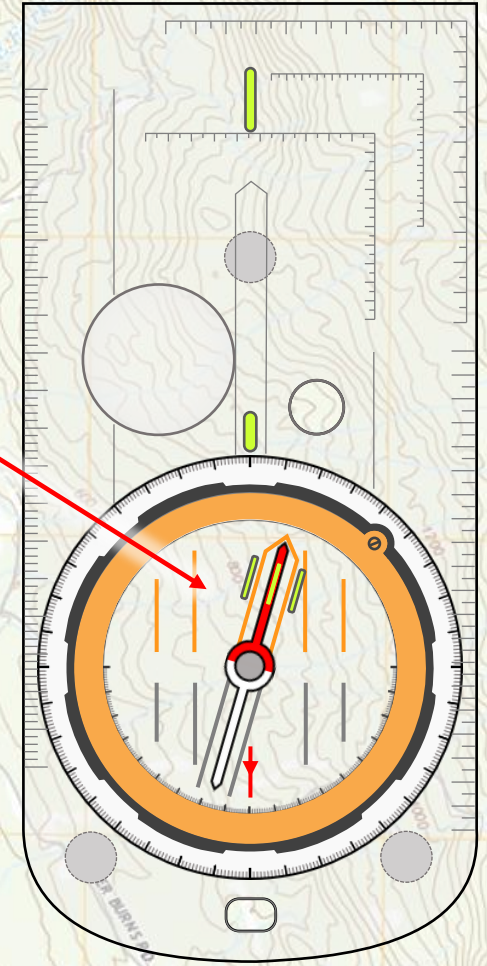
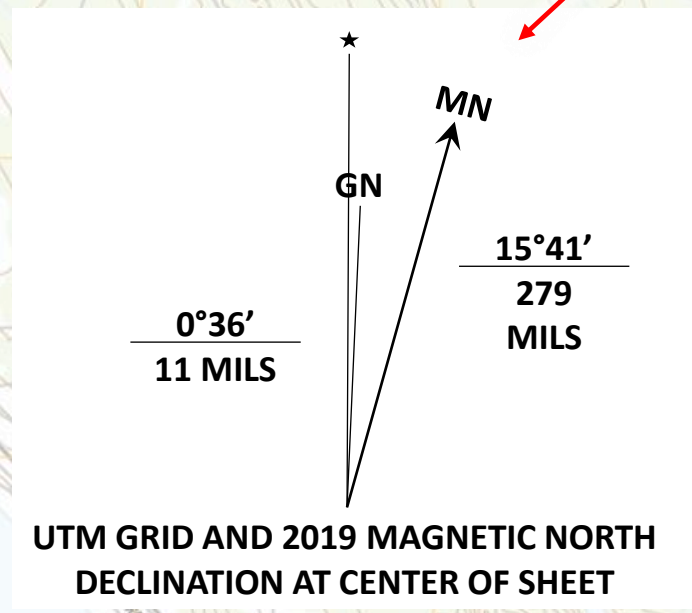
-122.1250° 48.3750°



# Orienteering Compass

## Map Orientation

Make these look like each other

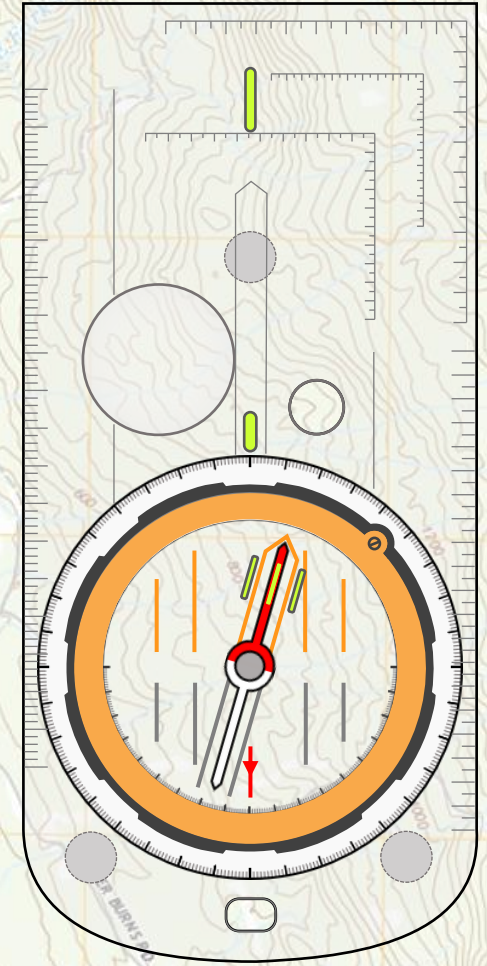
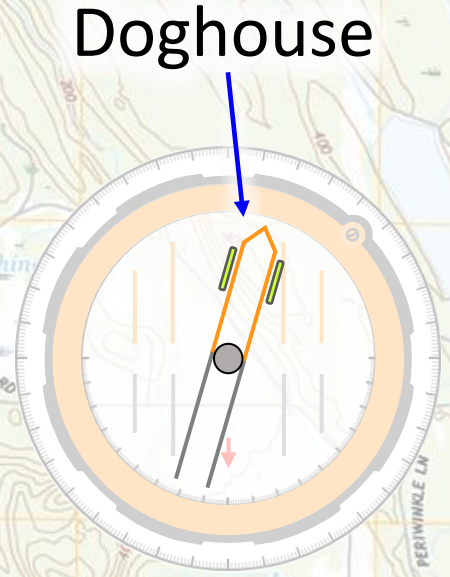
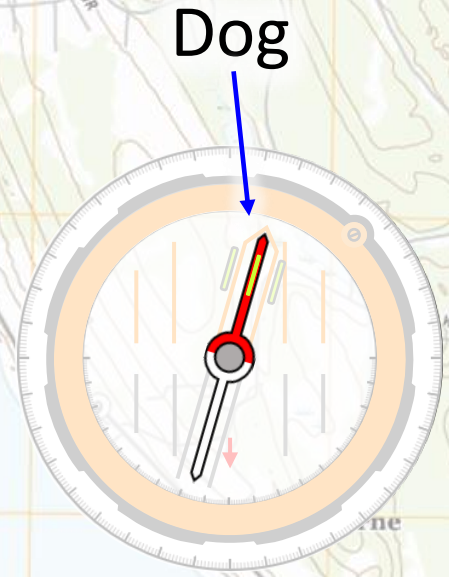


57 58 59 60 61 62 63 64<sup>000mE</sup>



# Orienteering Compass

## Important Terminology



Put the  
 “Dog in the  
 Doghouse”  
 or  
 “Red in the Shed”



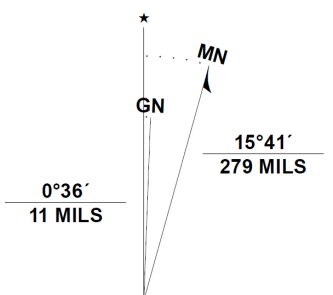
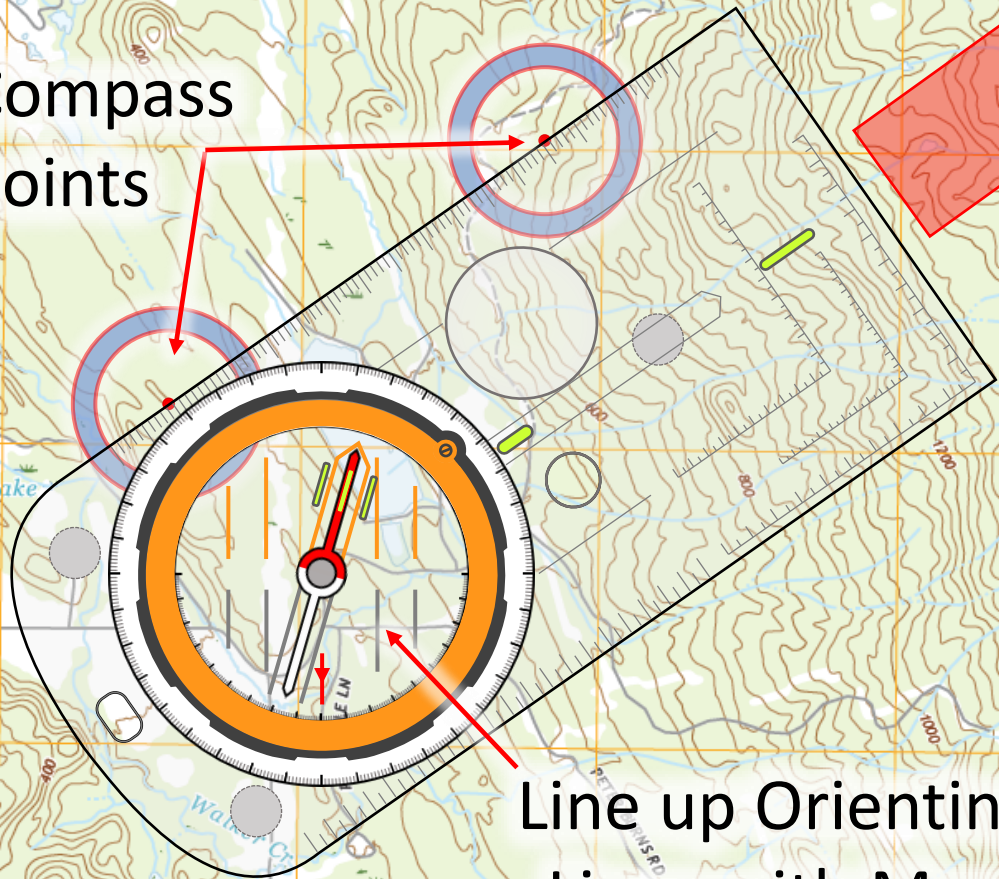
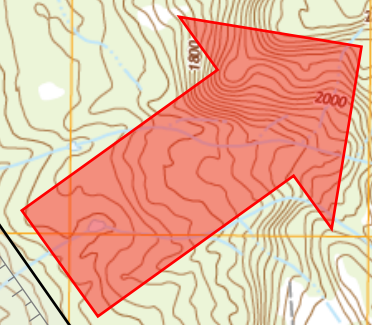
# Orienteering Compass

## Map Orientation

Direction of Travel

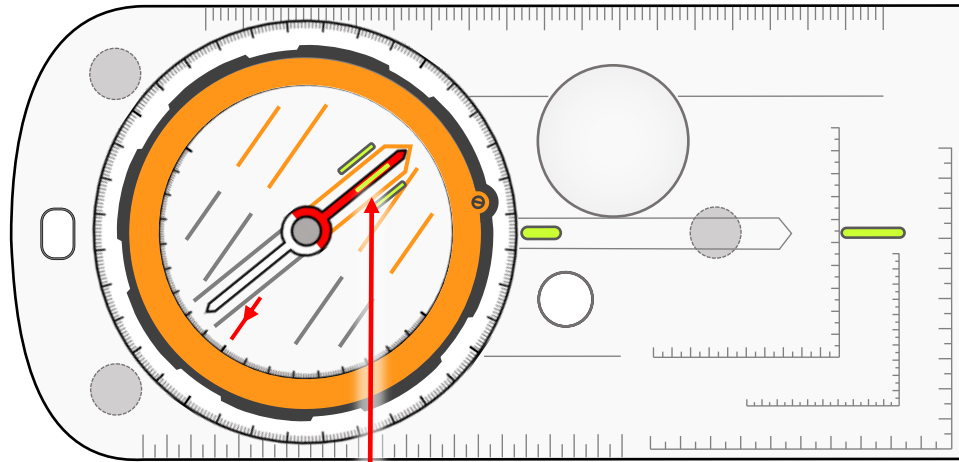
Line up Compass with points

Line up Orienting Lines with Map

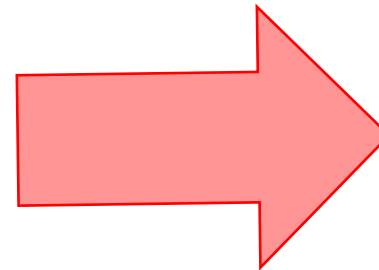


UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

# Compass with Magnetic Declination Adjustment



Keep Needle in  
Orienting Arrow



Direction  
of Travel

“Red in the Shed”  
Or  
“Dog in the Doghouse”

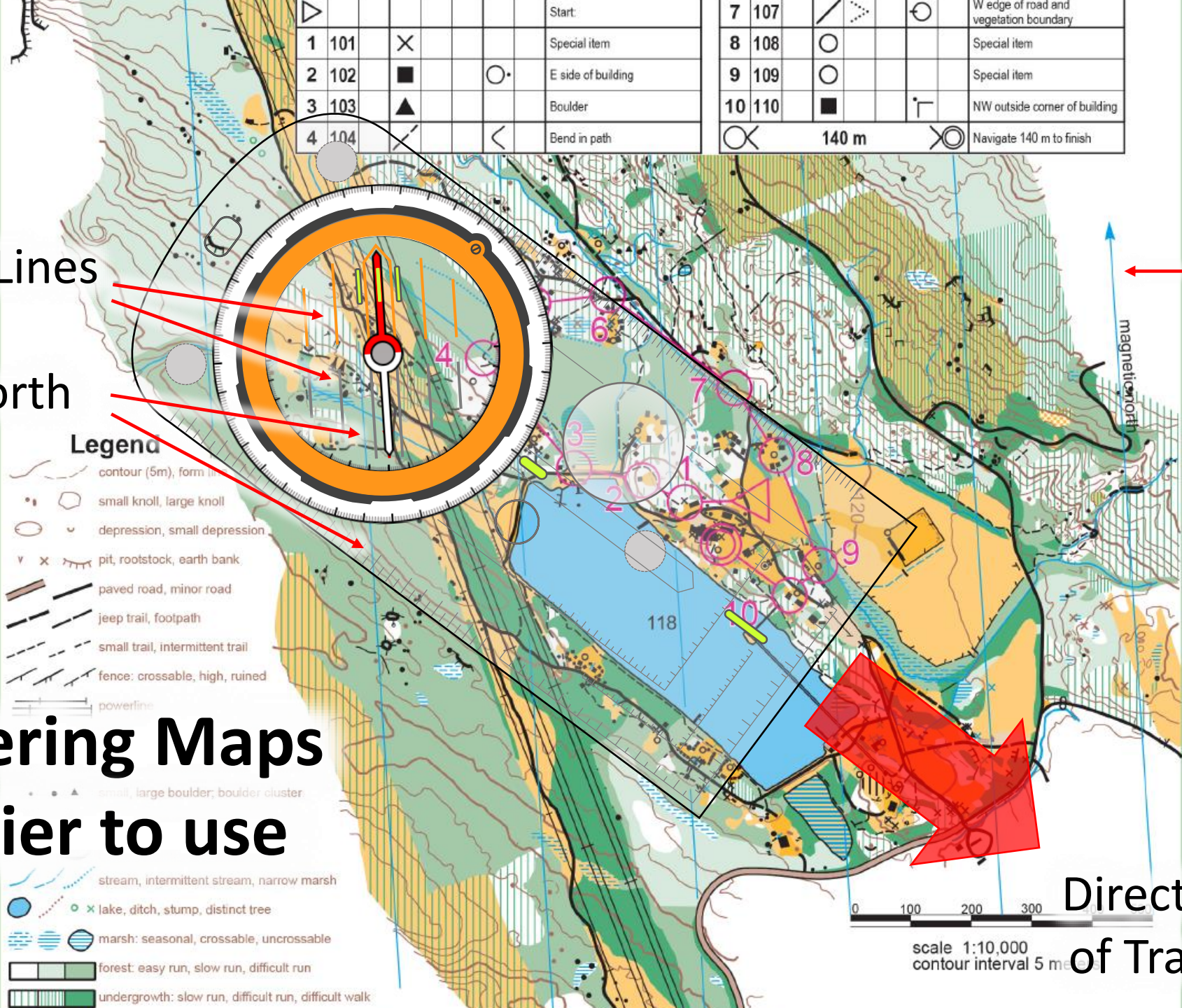


Start:								W edge of road and vegetation boundary	
7 107		∕	∕	∕	∕	∕	∕	Special item	
8 108		○						Special item	
9 109		○						Special item	
10 110		■		└				NW outside corner of building	
140 m								⊗	Navigate 140 m to finish

Line up  
Orienteering Lines  
with  
Magnetic North  
Lines

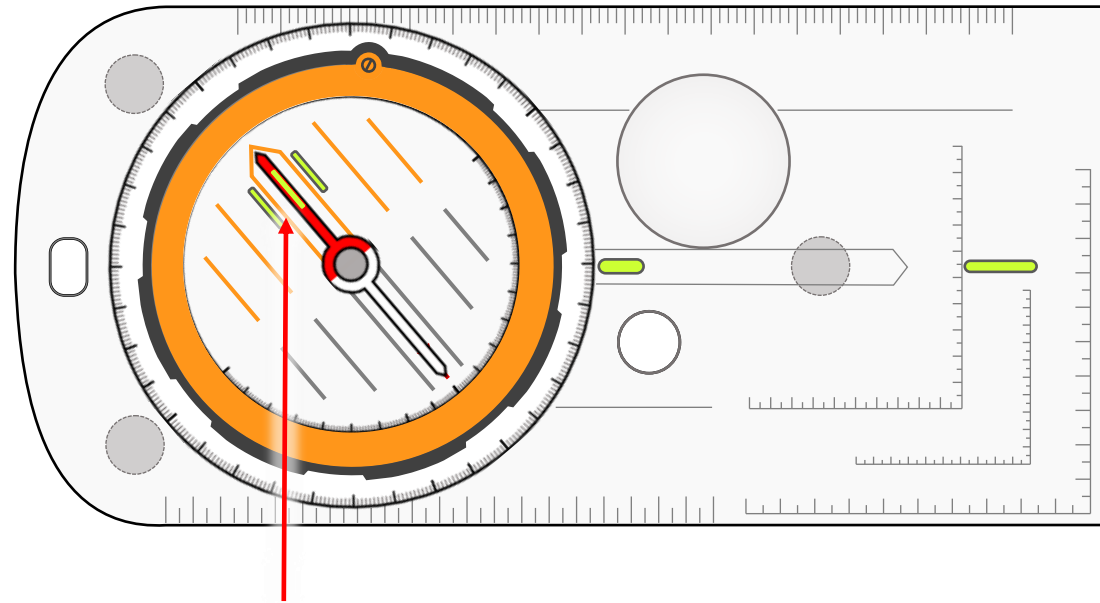
Magnetic  
North Lines

# Orienteering Maps are easier to use

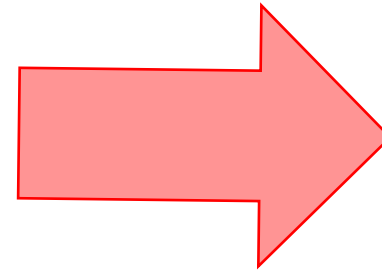


0 100 200 300  
scale 1:10,000  
contour interval 5 m  
Direction  
of Travel

# Compass using Magnetic North Adjusted Map



Keep Needle in  
Orienting Arrow



Direction  
of Travel

“Red in the Shed”  
Or  
“Dog in the Doghouse”



1	101	×		Special item	7	107	⚡	⌚	W edge of road and vegetation boundary
2	102	■	○	E side of building	8	108	○		Special item
3	103	▲			9	109	○		Special item
4	104				10	110	■	└	NW outside corner of building

140 m  Navigate 140 m to finish

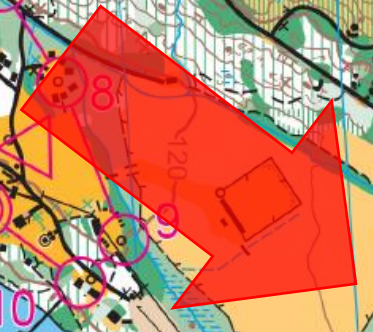


Line up  
Orienteering Lines  
with  
Magnetic North  
Lines

Magnetic  
North Lines

**Legend**

- contour (5m), form line
- small knoll, large knoll
- depression, small depression
- pit, rootstock, earth bank
- paved road, minor road
- jeep trail, footpath
- small trail, intermittent trail
- fence: crossable, high, ruined
- powerline
- building, water faucet/hydrant
- cave (mine) manmade object, pole
- passable cliff, impassable cliff
- marsh: seasonal, crossable, uncrossable
- forest: easy run, slow run, difficult run
- undergrowth: slow run, difficult run, difficult walk



Direction  
of Travel

**Orienteering Compasses  
are also quicker to use**

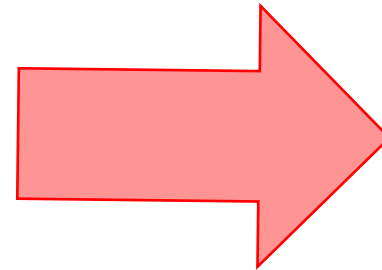
0 100 200 300 400 500  
scale 1:10,000  
contour interval 5 meters



# Compass using Magnetic North Adjusted Map



Keep Needle in  
Orienting Arrow



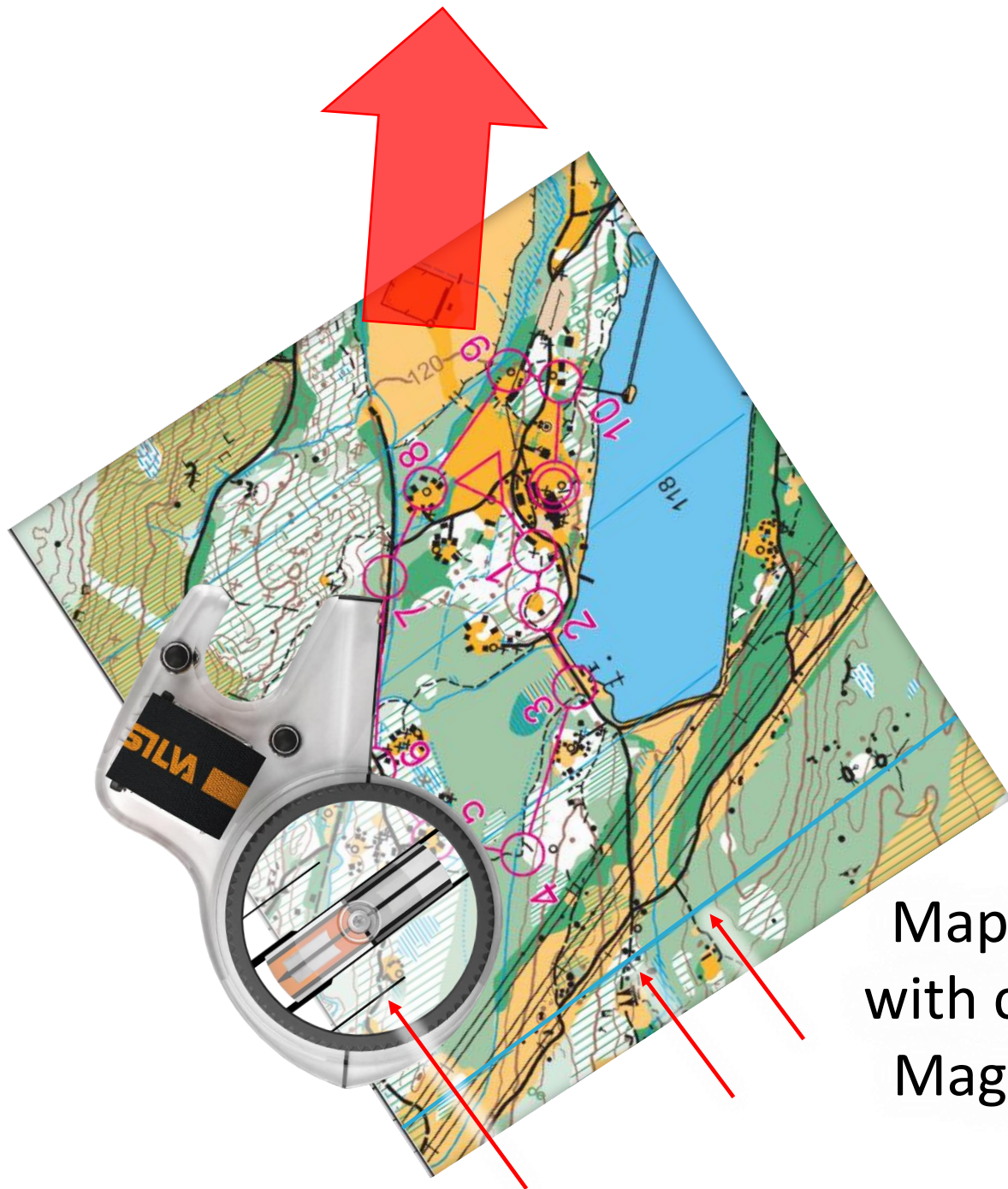
Direction  
of Travel

“Red in the Shed”

Or

“Dog in the Doghouse”

# Fold up Map and Face Map in Direction of Travel

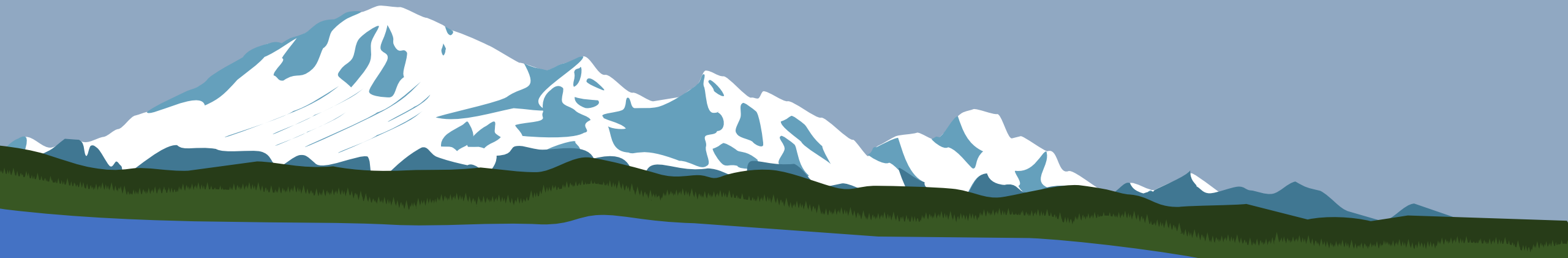


Map Orientated  
with compass and  
Magnetic North  
Lines

1. Requirements	13. Mapping Fundamentals
2. Introduction	14. Coordinate Maps
3. Map Reading	15. Coordinate Central Symbols
4. Coordinates	16. Coordinate Calculations
5. Map Orientation	17. Universal Transverse Mercator
6. Measuring Distances	18. UTM Coordinates
7. Projections	19. Universal Transverse Mercator
8. False Color	17. Resources
9. Understanding Techniques	18. Instructor's Corner



# Universal Transverse Mercator





# Search and Rescue Merit Badge

## Requirement 7 – Universal Transverse Mercator

7. Discuss the Universal Transverse Mercator (UTM) system, latitude, and longitude. Then do the following:

- a. Using a 1:24,000 scale USGS topographic map, show that you can identify a location of your choice using UTM coordinates.
- b. Using a 1:24,000 scale map, ask your counselor to give you a UTM coordinate on the map, then identify that location.
- c. Show that you can identify your current location using the UTM coordinates on a Global Positioning System (GPS) unit and verify it on a 1:24,000 scale map.
- d. Determine a hypothetical place last seen, and point out an area on your map that could be used for containment using natural or human-made boundaries.

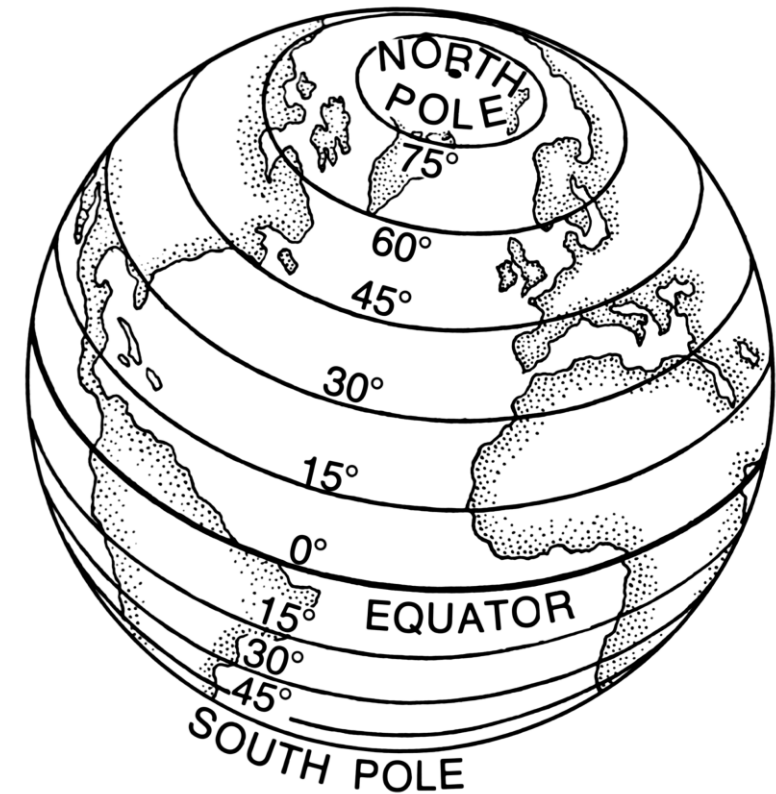
# Universal Transverse Mercator

## Latitude

7. Discuss the Universal Transverse Mercator (UTM) system, latitude, and longitude.

### Latitude

- Geographic coordinate that specifies the north–south position of a point on Earth
- Angle which ranges from  $0^\circ$  at the Equator to  $90^\circ$  (North or South) at the poles



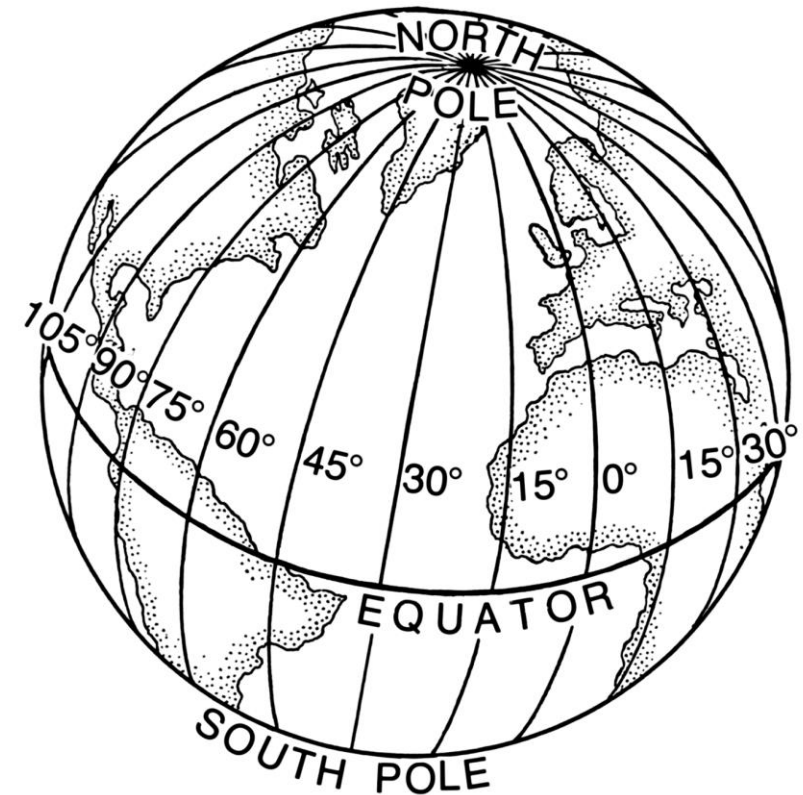
# Universal Transverse Mercator

## Longitude

7. Discuss the Universal Transverse Mercator (UTM) system, latitude, and longitude.

### Longitude

- Geographic coordinate that specifies the east–west position of a point on Earth
- Approximately the angle between the local vertical and the equatorial plane





# Universal Transverse Mercator

## Universal Transverse Mercator

7. Discuss the Universal Transverse Mercator (UTM) system, latitude, and longitude.

Universal Transverse Mercator (UTM) system

- System for assigning coordinates to locations on the surface of Earth
- Divides earth into 60 zones
- Most zones in UTM span 6 degrees of longitude
- Each zone is segmented into 20 latitude bands(8 degrees high)
- Location = specifying the zone and the x, y coordinate in that plane

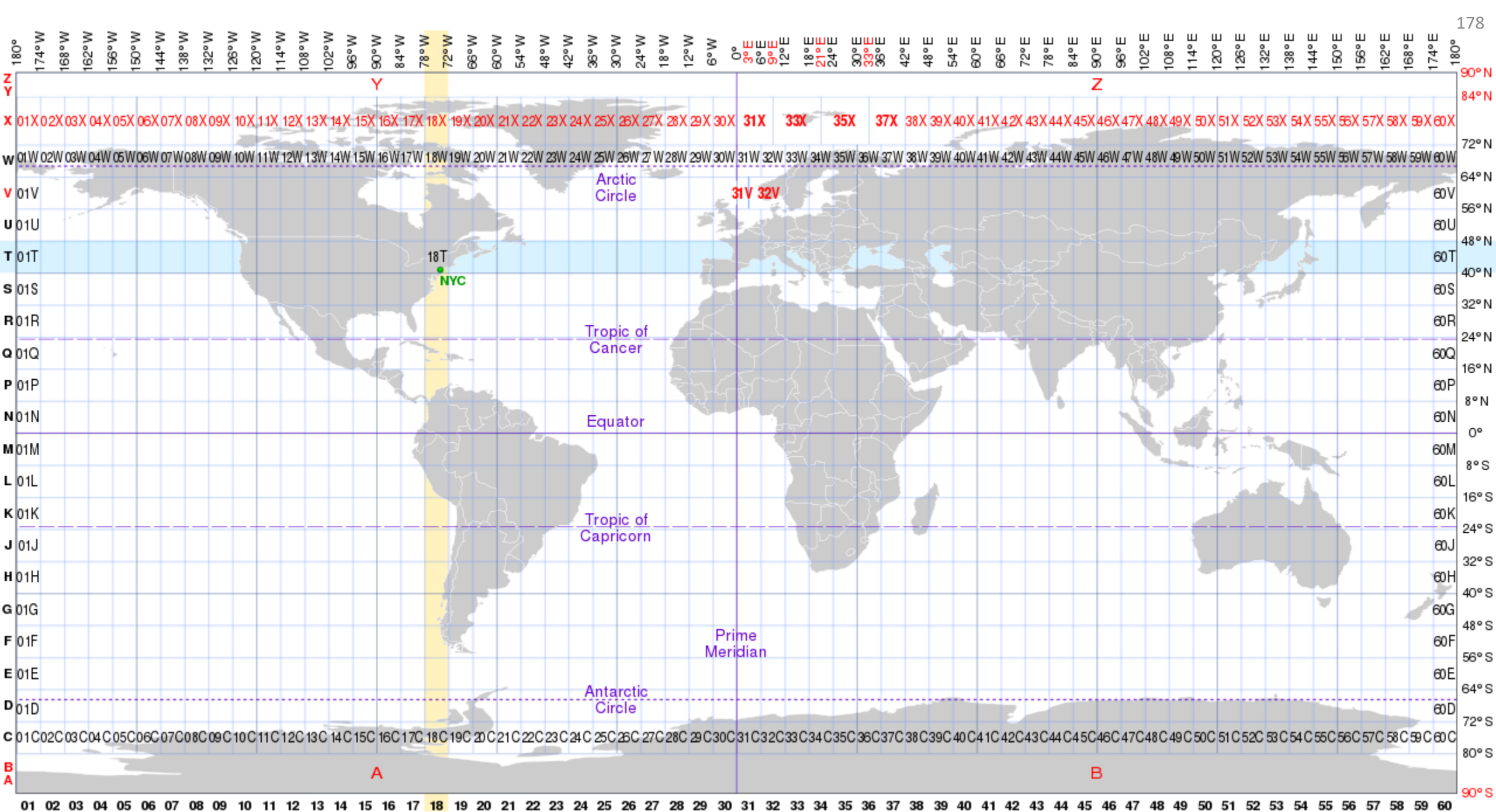
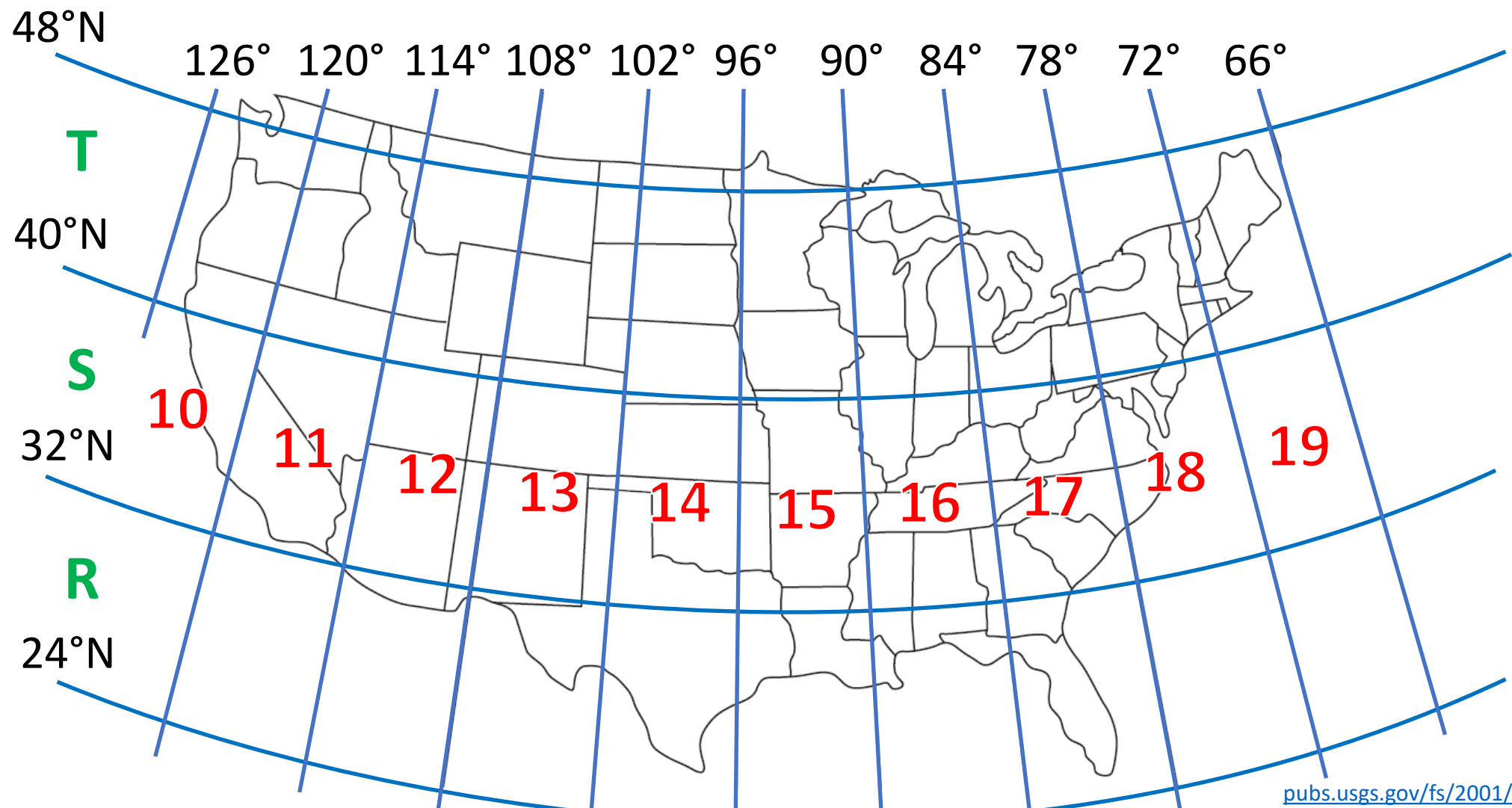


Image source: cmglee STy, Wikialine and Goran tek-en [commons.wikimedia.org/wiki/File:Universal\\_Transverse\\_Mercator\\_zones.svg](https://commons.wikimedia.org/wiki/File:Universal_Transverse_Mercator_zones.svg)

# Universal Transverse Mercator

## Universal Transverse Mercator

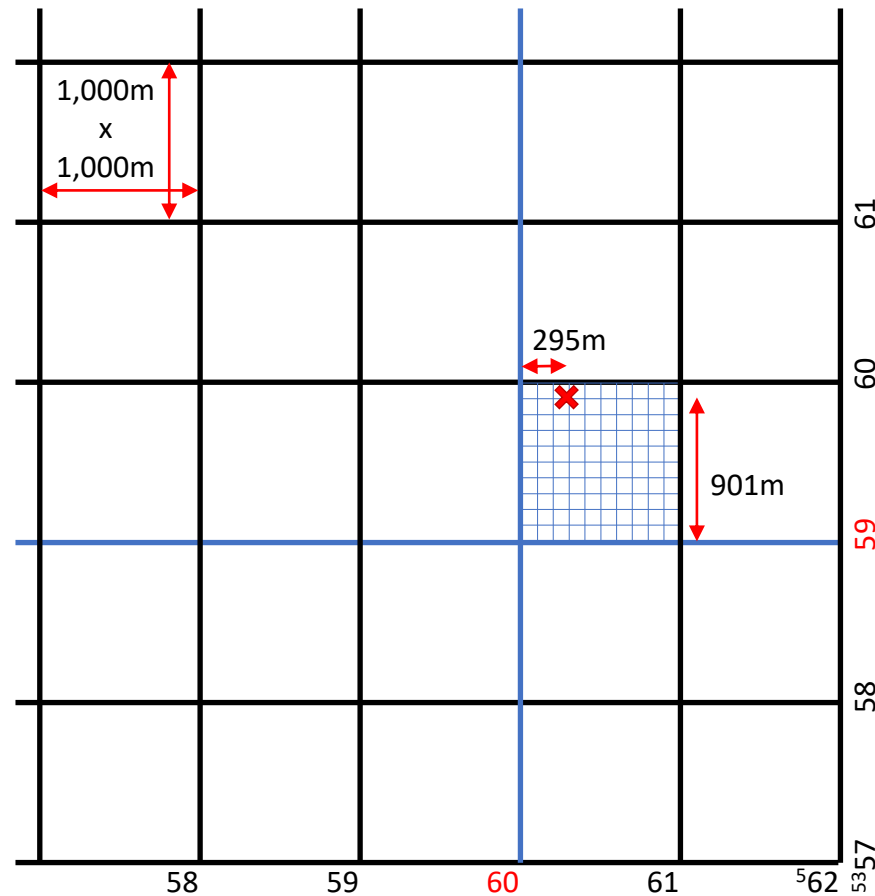




# Universal Transverse Mercator

## Requirement 7 – Universal Transverse Mercator

<b>U.S. National Grid</b>
100,000 - m Square ID
EU
<hr/>
Grid Zone Designation 10U



**UTM Location**  
10U 0560295 mE 5359901 mN  
1m Precision

**Latitude Longitude**  
48.3893900°, -122.1855500°



# Universal Transverse Mercator

## Universal Transverse Mercator

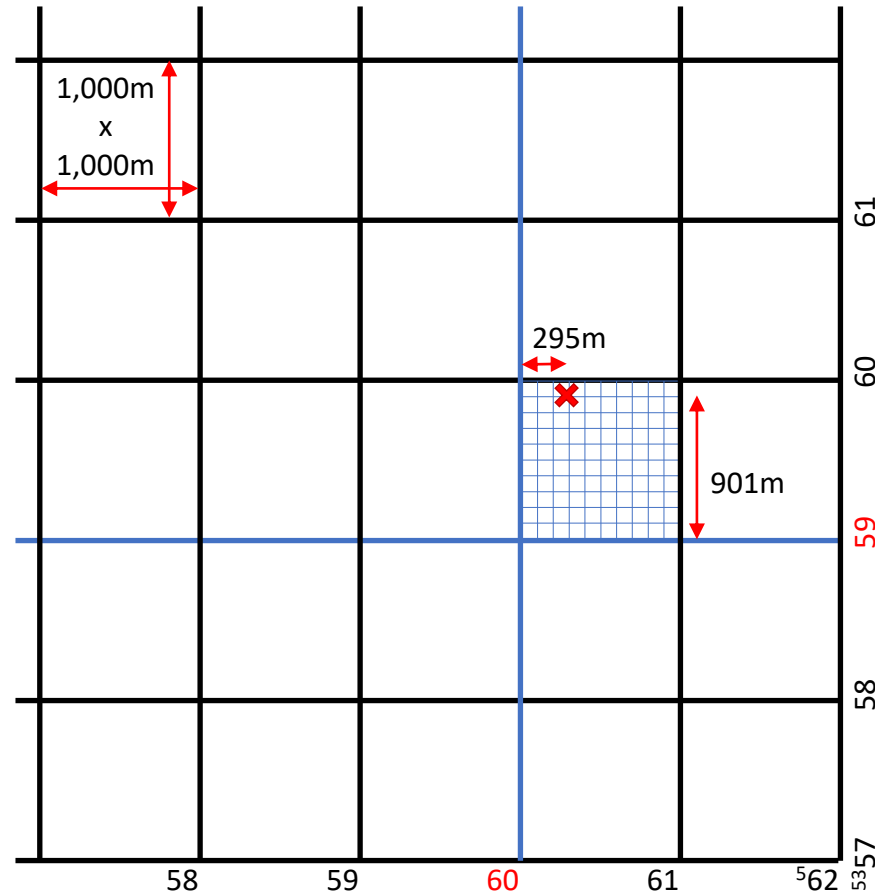
- The northing values are measured continuously from zero at the Equator, in a northerly direction
  - South of the Equator - the Equator is assigned a northing value of 10,000,000 meters
- A central meridian through the middle of each 6° zone is assigned an easting value of 500,000 meters
  - Grid values to the west of central meridian are less than 500,000
  - Grid values to the east of central meridian are more than 500,000



# Universal Transverse Mercator

## Universal Transverse Mercator

U.S. National Grid
100,000 - m Square ID
EU
Grid Zone Designation 10U



**UTM Location**  
10U 0560295 mE 5359901 mN  
1m Precision

**0560295 mE**  
60km east of center of zone 10U  
(In this case, center is  $-123^\circ$  Long)

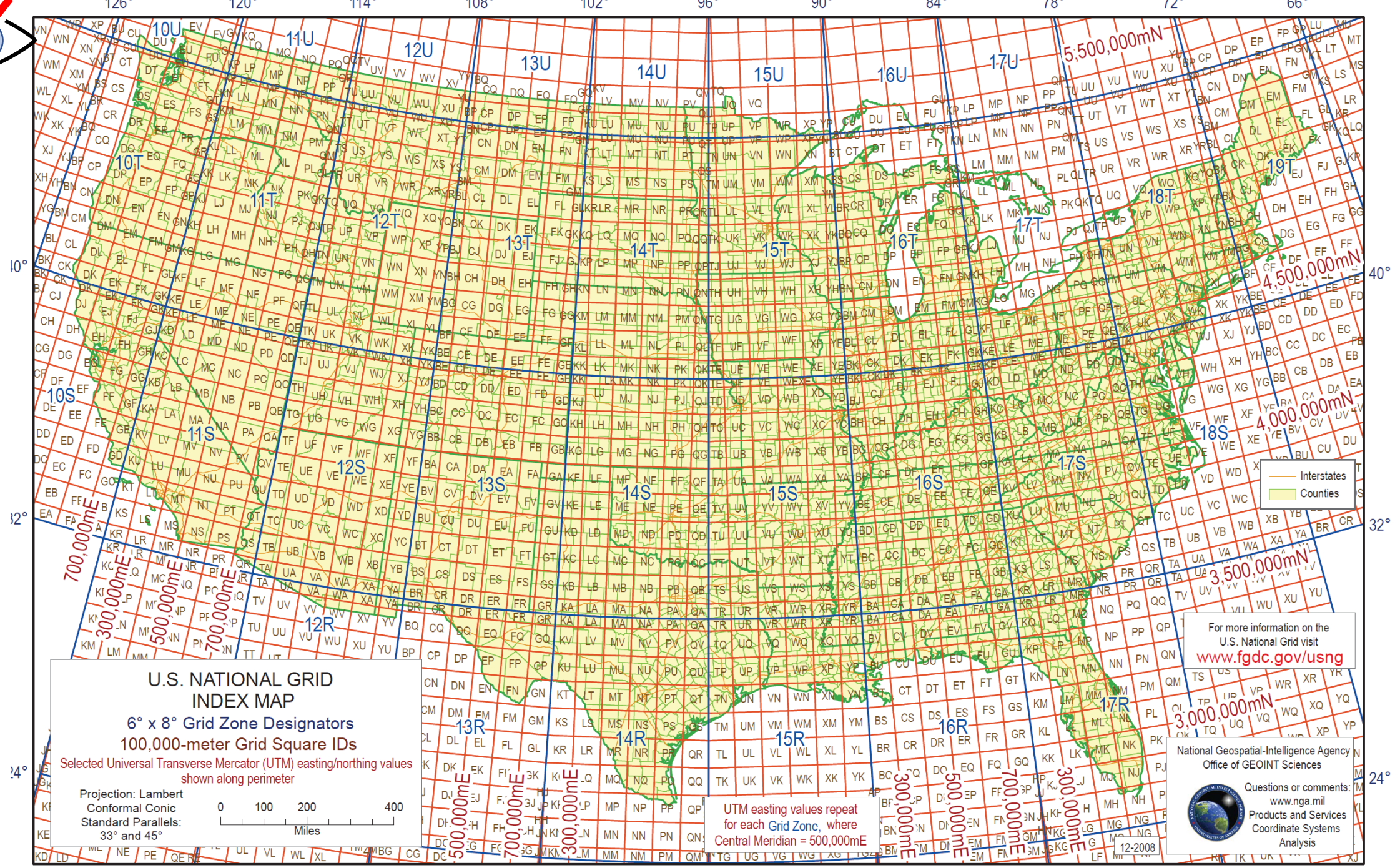
**5359901 mN**  
5,359 km north of Equator

**Latitude Longitude**  
 $48.3893900^\circ, -122.1855500^\circ$





# Military Grid Reference System



**U.S. NATIONAL GRID INDEX MAP**  
**6° x 8° Grid Zone Designators**  
**100,000-meter Grid Square IDs**  
 Selected Universal Transverse Mercator (UTM) easting/northing values shown along perimeter

Projection: Lambert Conformal Conic  
 Standard Parallels: 33° and 45°

0 100 200 400 Miles

UTM easting values repeat for each Grid Zone, where Central Meridian = 500,000mE

For more information on the U.S. National Grid visit [www.fgdc.gov/usng](http://www.fgdc.gov/usng)

National Geospatial-Intelligence Agency  
 Office of GEOINT Sciences

Questions or comments: [www.nga.mil](http://www.nga.mil)  
 Products and Services  
 Coordinate Systems Analysis

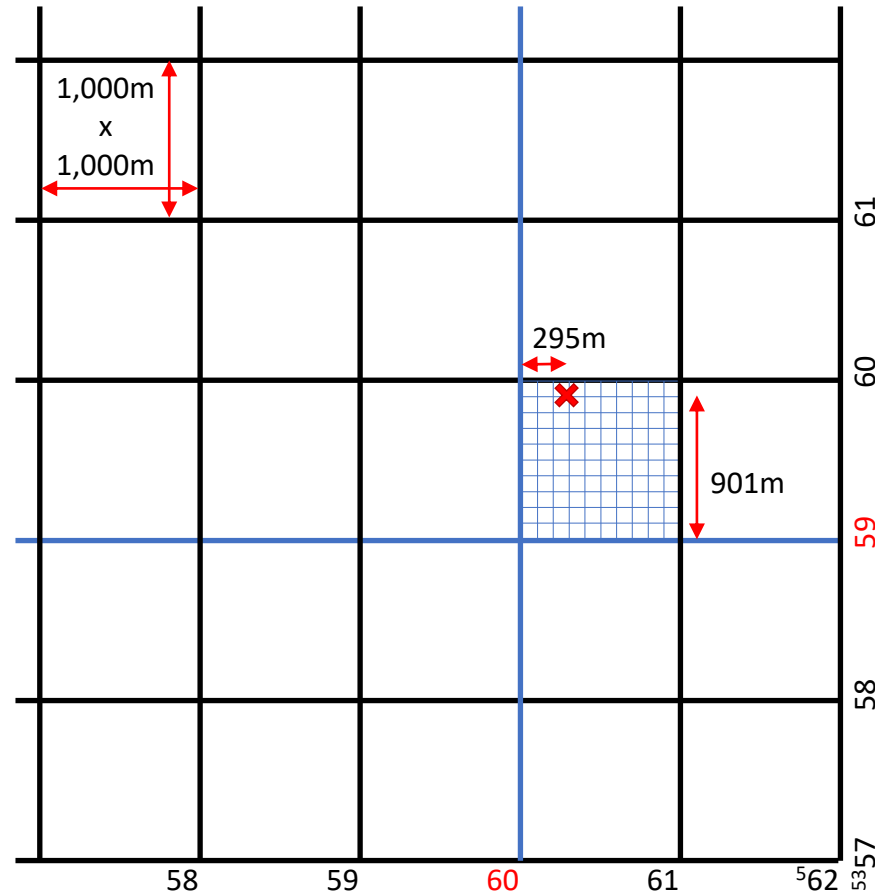
12-2008



# Universal Transverse Mercator

## Universal Transverse Mercator

U.S. National Grid
100,000 - m Square ID
EU
Grid Zone Designation 10U



**UTM Location**  
10U 0560295 mE 5359901 mN  
1m Precision

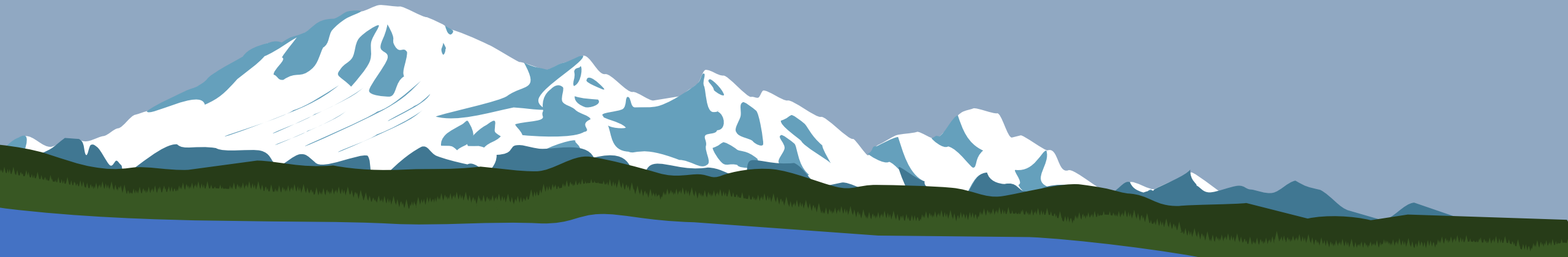
**MGRS 6 Digit Grid**  
10UEU 602 599  
100m Precision

**MGRS 8 Digit Grid**  
10UEU 6029 5990  
10m Precision

**Latitude Longitude**  
48.3893900°, -122.1855500°



# Grid Coordinates





# Grid Coordinates

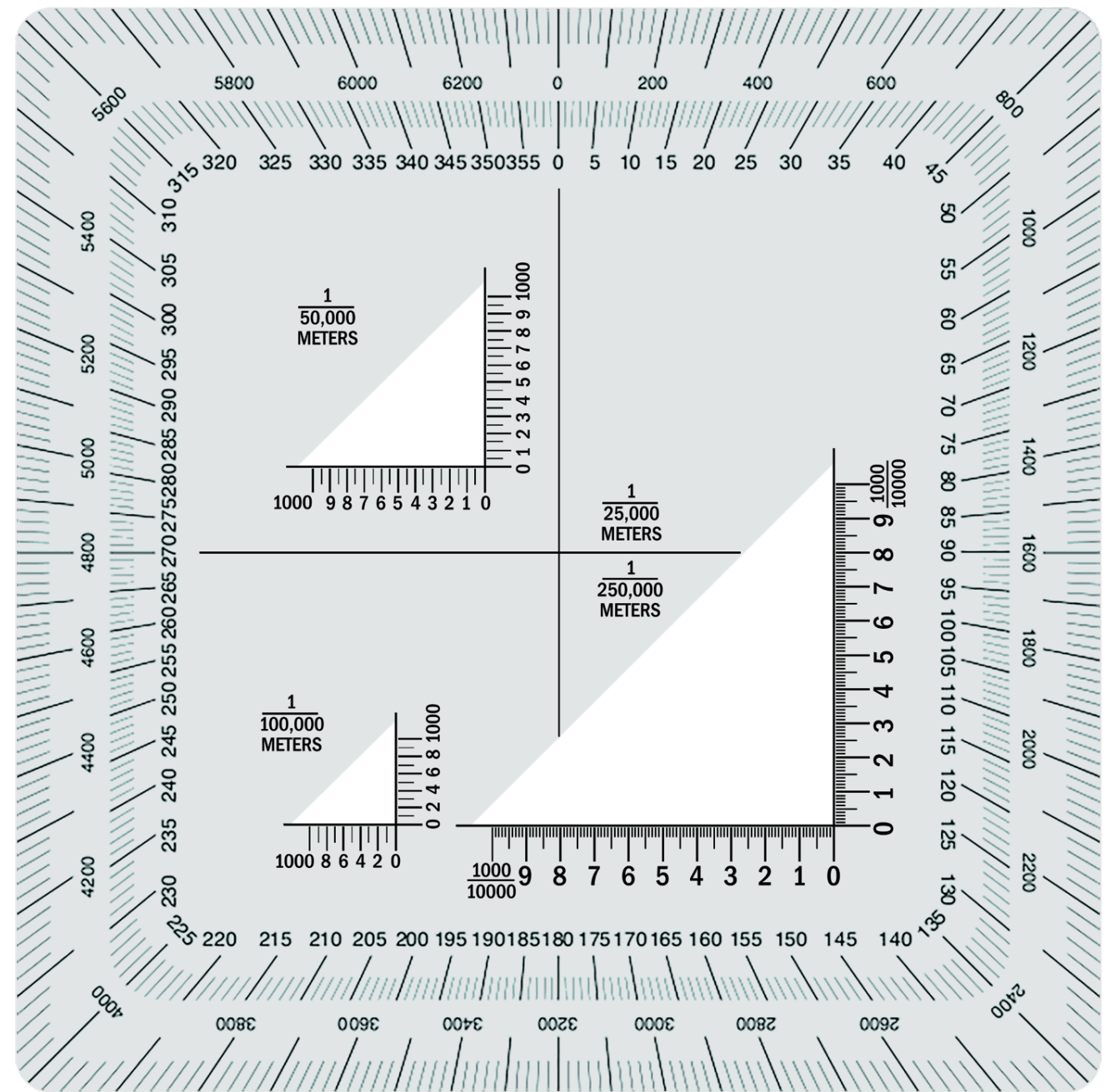
## **Finding Coordinates**

A vital skill is you ever need to communicate your location.

Very useful in Search and Rescue and Military operations

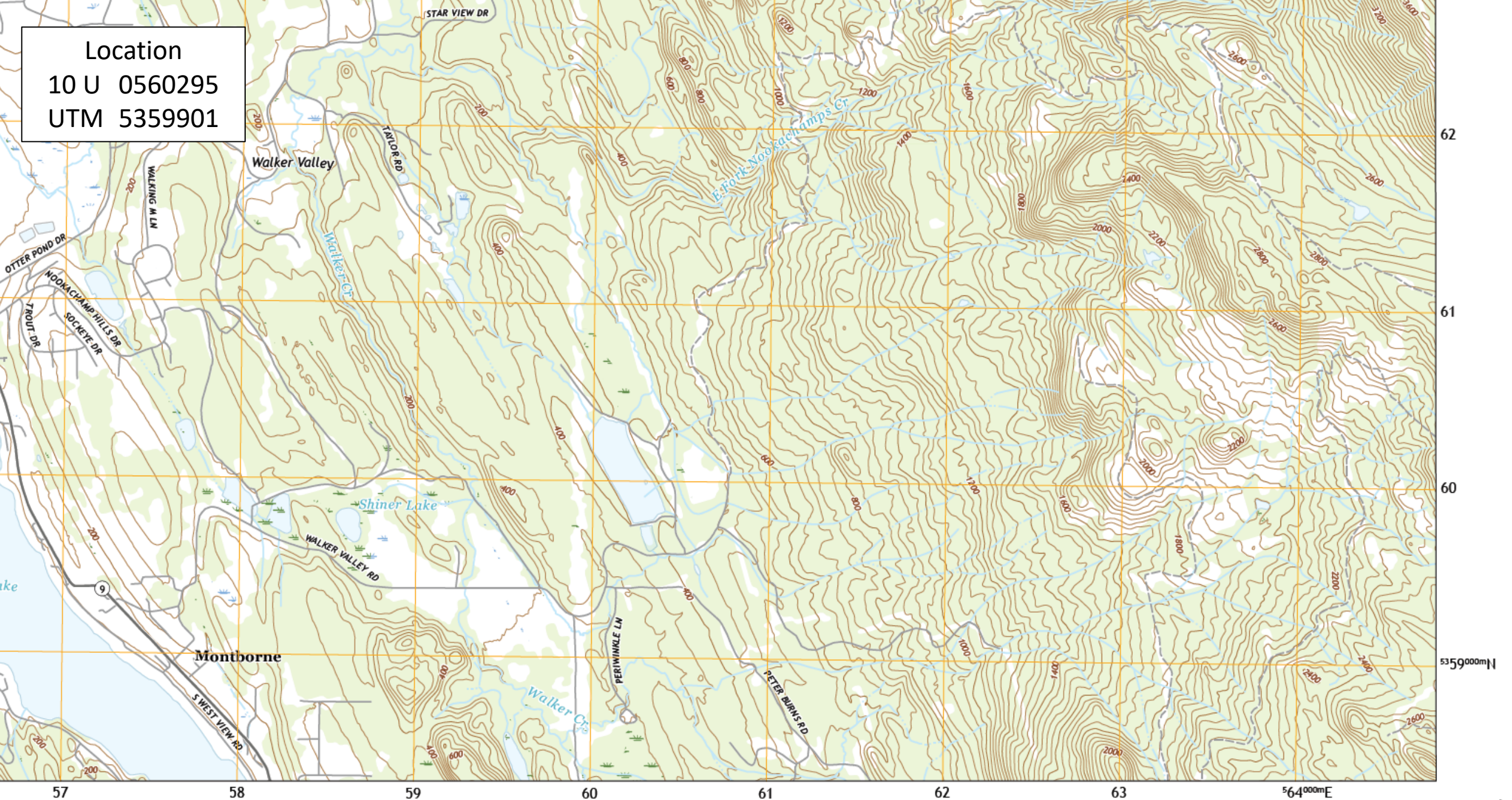
Required in the Search and Rescue Merit Badge

# Map Protractor





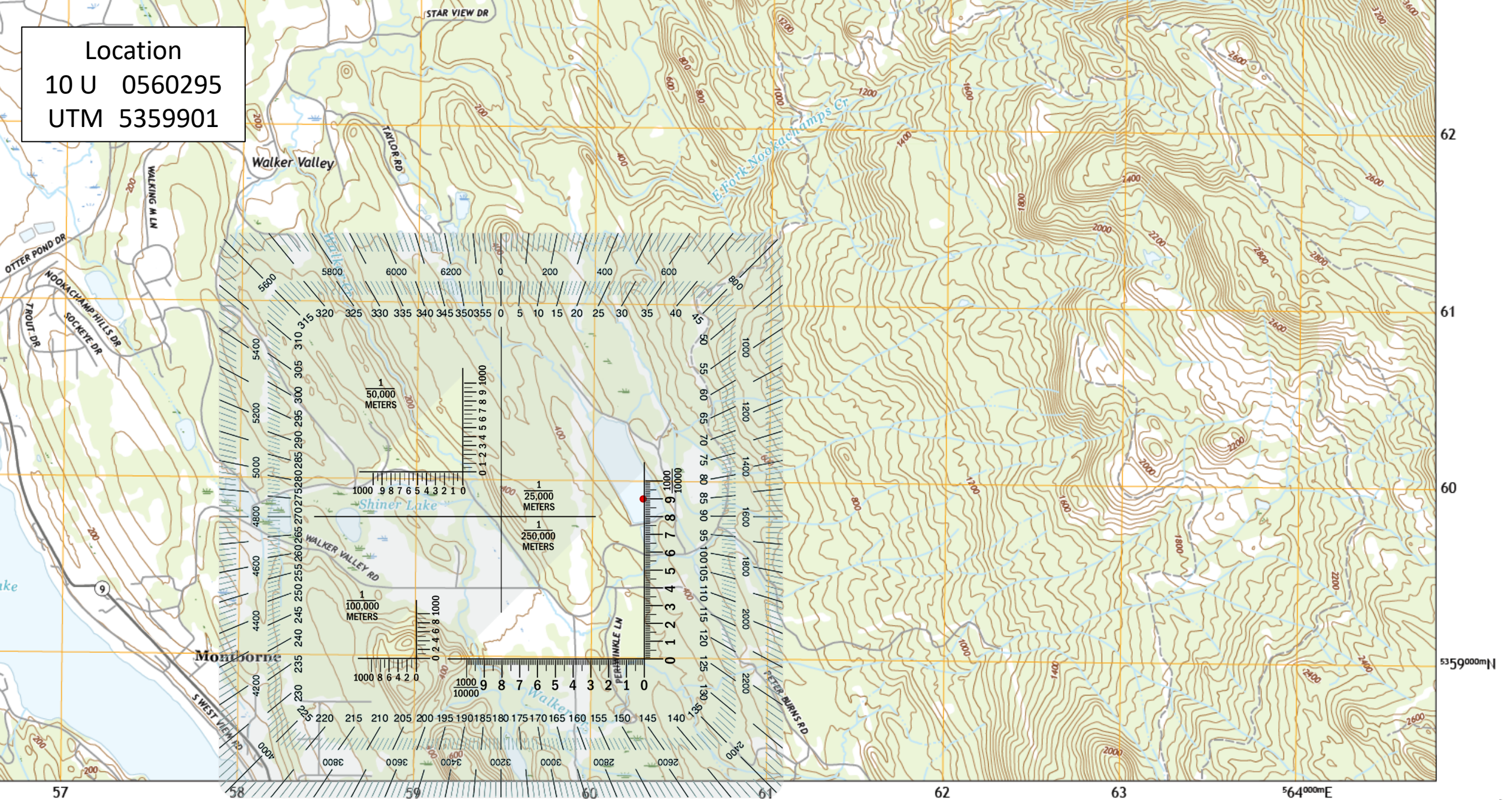
Location  
10 U 0560295  
UTM 5359901



-122.1250° 48.3750°



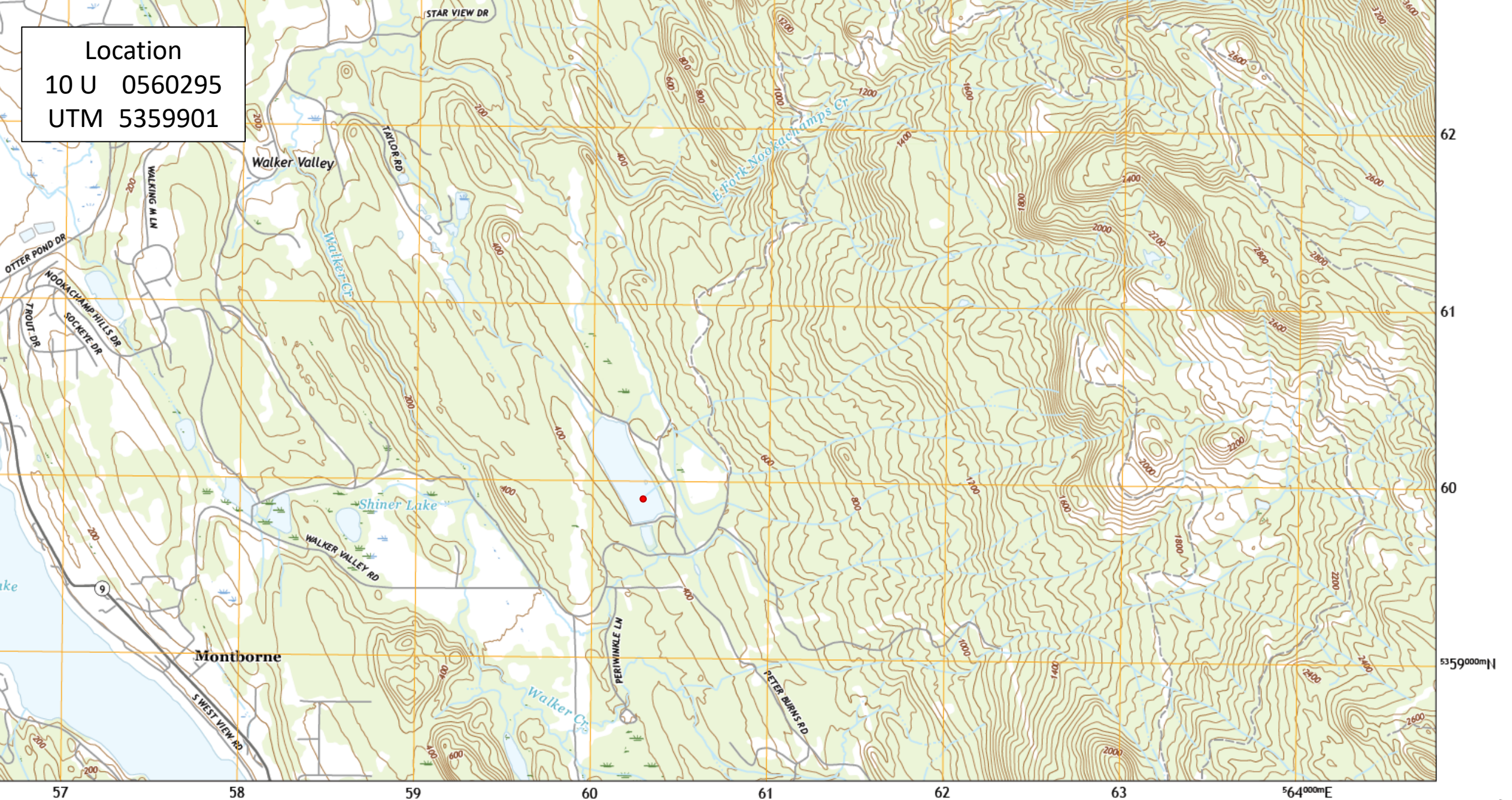
Location  
10 U 0560295  
UTM 5359901



-122.1250° 48.3750°



Location  
10 U 0560295  
UTM 5359901



-122.1250° 48.3750°



Location  
10 U 0560290  
UTM 5359900



Camp Fire Mountain



# Search and Rescue Merit Badge

## Requirement 7b – Universal Transverse Mercator

Using a 1:24,000 scale map, ask your counselor to give you a UTM coordinate on the map, then identify that location.

USGS US Topo 7.5-minute map for Morse Creek, WA 2020

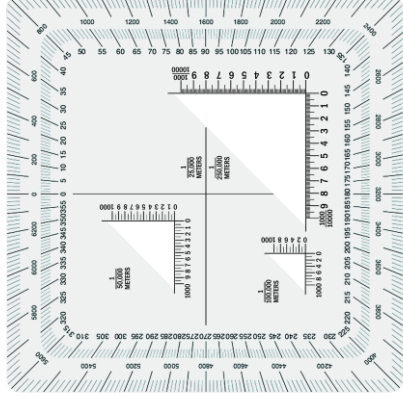
Published Date: 2020-02-26

[WA Morse Creek 20200226 TM geo.pdf](#)

Location	
10 U	0475850
UTM	5320410

Homework

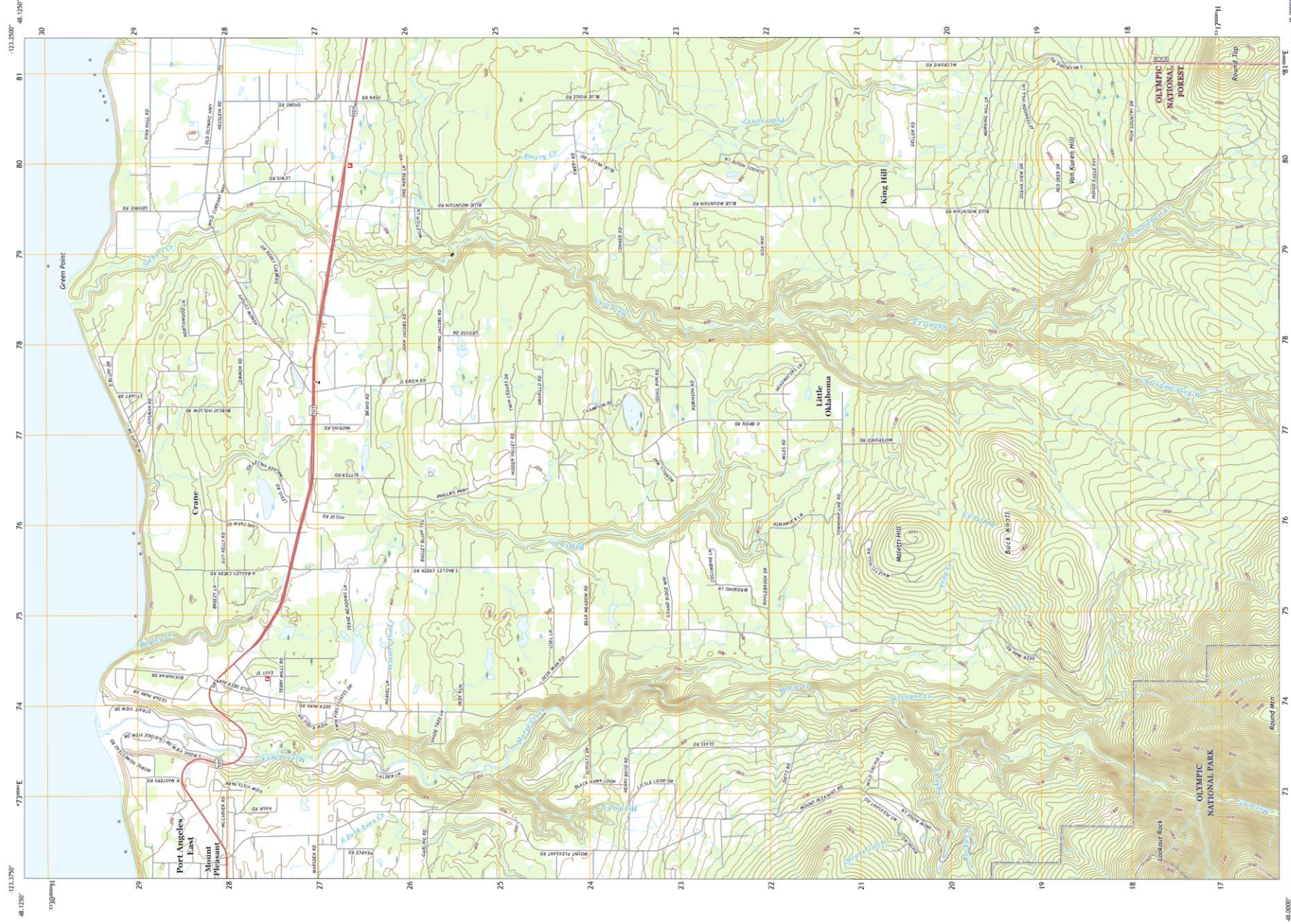
Location  
 10 U 0475850  
 UTM 5320410



U.S. DEPARTMENT OF THE INTERIOR  
 U.S. GEOLOGICAL SURVEY



MORSE CREEK QUADRANGLE  
 WASHINGTON - CLALLAM COUNTY  
 7.5-MINUTE SERIES



Produced by the United States Geological Survey  
 North American Datum of 1983 (NAD83)  
 8,000-meter grid (Universal Transverse Mercator, Zone 10U) GCS  
 This map is not a legal document. Boundary map information may not be shown. Obtain permission before reproduction.

Map Series: 7.5-Minute Series, November 2015  
 Base: 1:50,000  
 Data: 1:50,000  
 Scale: 1:24,000  
 Projection: UTM  
 Datum: NAD83  
 Contour Interval: 40 Feet  
 Vertical Datum: NAVD83  
 Horizontal Datum: NAD83  
 UTM Zone: 10U  
 UTM Easting: 5320410  
 UTM Northing: 4758500



SCALE 1:24,000



CONTOUR INTERVAL: 40 FEET  
 100% VERTICAL EXAGGERATION  
 This map was produced in conformance with the National Map Accuracy Standards, Edition of 2011.  
 A metadata file associated with this product is available at [www.fgdl.gov](http://www.fgdl.gov).



ROAD CLASSIFICATION

Expressway	Local Connector	4WD	US Route	FS Footprint	Clearance Route
Secondary Hwy	Local Road	Interstate Route	FS Primary Route	FS Footprint	Clearance Route
Ramp	Interstate Route	FS Primary Route	FS Footprint	FS Footprint	Clearance Route

Check with Local Forest Service with  
 for Current Road Conditions and Restrictions.

1. 800' Peak  
 2. 600' Peak or Face (40' Water)  
 3. 400' Peak  
 4. 200' Peak  
 5. 100' Peak  
 6. 50' Peak  
 7. 25' Peak  
 8. 12.5' Peak

ADDITIONAL SYMBOLS

MORSE CREEK, WA  
 2020



# Search and Rescue Merit Badge

## **Requirement 7c – Universal Transverse Mercator**

Show that you can identify your current location using the UTM coordinates on a Global Positioning System (GPS) unit and verify it on a 1:24,000 scale map.

[viewer.nationalmap.gov/basic](https://viewer.nationalmap.gov/basic)

Homework



# Search and Rescue Merit Badge

## **Requirement 7d – Universal Transverse Mercator**

Determine a hypothetical place last seen, and point out an area on your map that could be used for containment using natural or human-made boundaries.

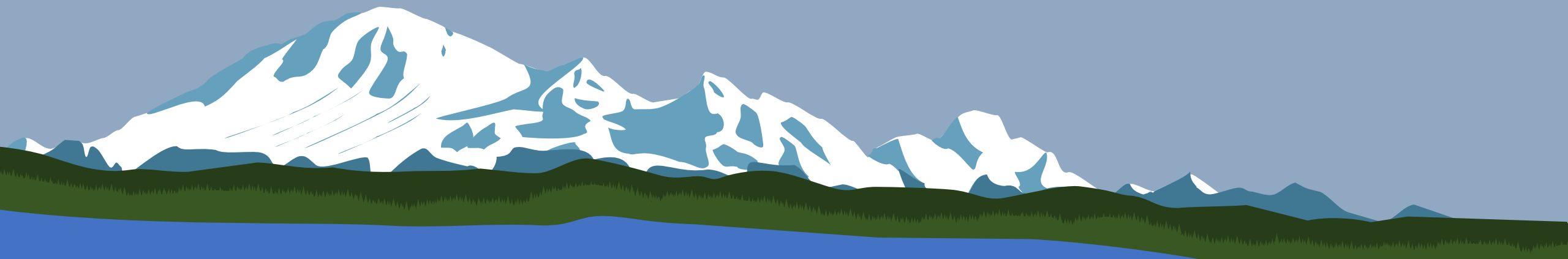
[viewer.nationalmap.gov/basic](https://viewer.nationalmap.gov/basic)

Homework

1. Requirements	13. Mapping Found
2. Orientation	14. Interpreting Maps
3. Map Reading	15. Interpreting Control Symbols
4. Locations	16. Symbols and Contours
5. Map Orientation	17. Universal Transverse Mercator
6. Interpreting Contours	18. UTM Coordinates
7. Resection	19. Wilderness Survival Navigation
8. Pace Count	17. Resources
9. Understanding Techniques	18. Instructor's Corner



# Wilderness Survival Navigation



# Wilderness Survival Navigation

## **Direction Finding**



# Wilderness Survival Navigation

## Direction Finding

- So you know where you are at?
  - What is the safest or quickest way to get where we are going?
  - What direction to we head in?
  - Which way is North?

# Wilderness Survival Navigation

## Direction Finding - Ability

- Some people are just better at direction finding
  - Some are just better at navigating
    - They likely honed those skills early on
    - They keep this talent sharp since others depend on them
  - Many lack natural talent
    - They know they lack talent so depend on GPSs and others
    - They can not be trusted in a survival situation
    - They can develop this skill – ideally before it is needed

# Wilderness Survival Navigation

## Direction Finding

- The compass is the generally the best method to use
- Know how to really use a compass
- Carry a compass on you
- Carry two compasses
- If you don't have a compass, there are a few ways to get by



# Wilderness Survival Navigation

## **Celestial Navigation**

# Wilderness Survival Navigation

## **Celestial Navigation – Basics**

- The Sun, moon and stars travel across the sky in a very specific way
- Understanding the relationship of these will help you find your way

# Wilderness Survival Navigation

## Celestial Navigation – Sun and Shadows

- From a person's perspective, the sun moves from east to west
- Likewise, shadows move from west to east through the day
- In the Northern Hemisphere
  - When the sun at its highest point in the sky
    - Shadows point north
    - At lower latitudes, this may not be appreciable
  - Shadows will move clockwise
- In the Southern Hemisphere
  - When the sun at its highest point in the sky
    - Shadows point south
    - At lower latitudes, this may not be appreciable
  - Shadows will move counterclockwise



# Wilderness Survival Navigation

## Celestial Navigation – Sun and Shadows

- There are two basic shadow direction finding techniques
  - Shadow-Tip Method
  - Watch Method

# Wilderness Survival Navigation

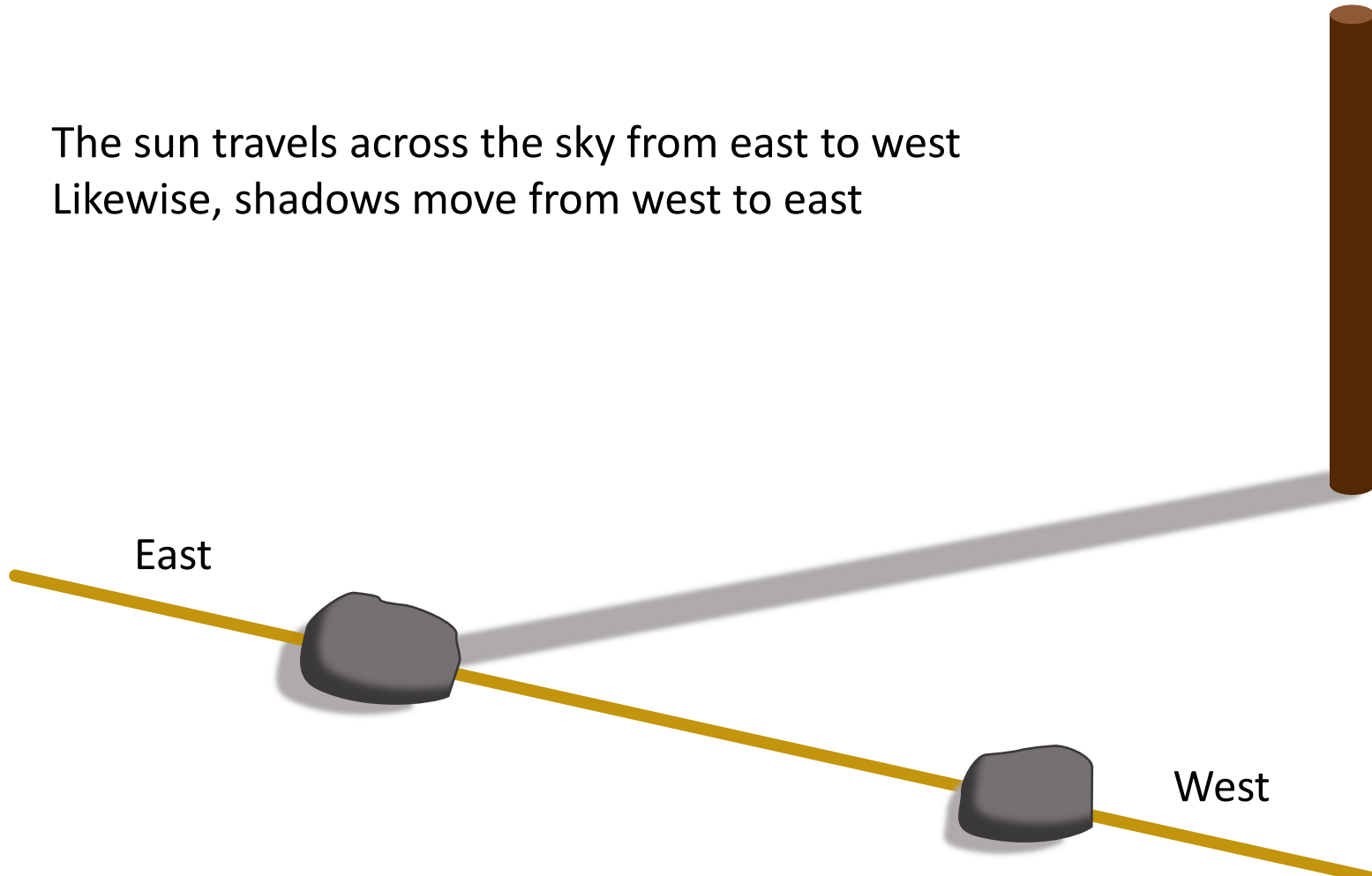
## Celestial Navigation – Shadow-Tip Method

- Find a relatively flat and open area exposed to the sun
  1. Place a 1 meter tall stick into level ground
  2. Mark the shadow's tip with a rock or twig
    - This is your West Point
  3. Wait 10 to 15 minutes for shadow to move a few centimeters
  4. Mark the shadow tips new position
    - This is your East Point
  5. Draw a straight line between the two marks
    - This is an East-West line
  6. If you stand facing your line with the first mark to your left and second to your right, you are facing north

# Wilderness Survival Navigation

## Celestial Navigation – Shadow-Tip Method

The sun travels across the sky from east to west  
Likewise, shadows move from west to east

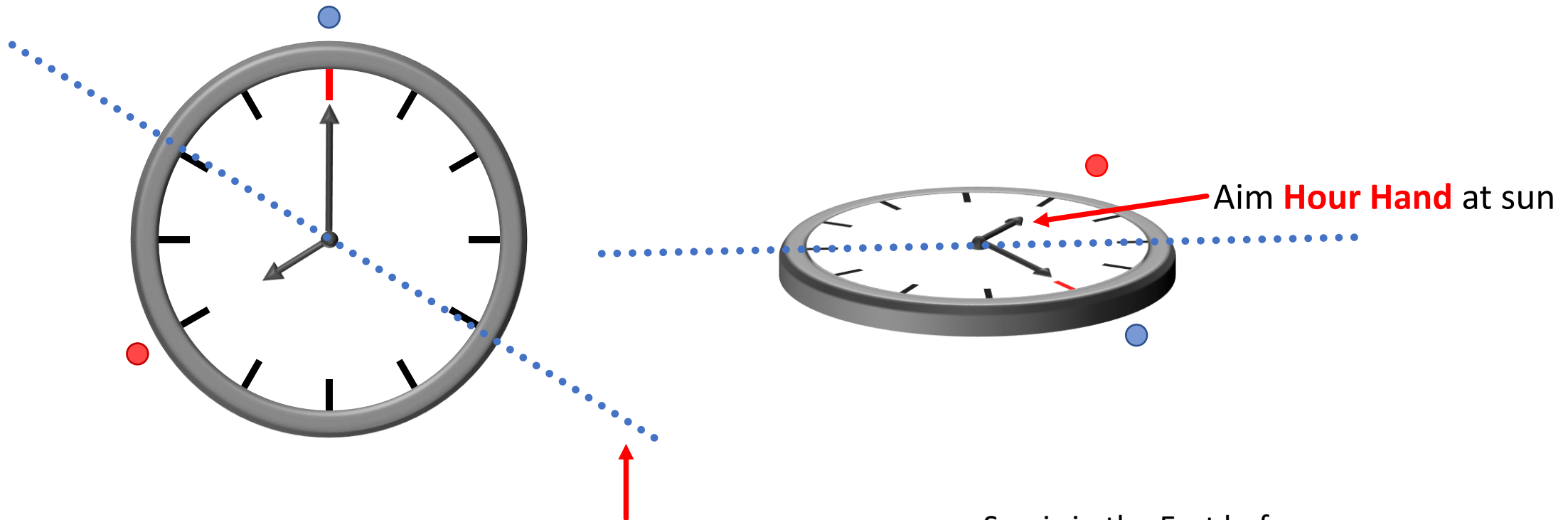




# Wilderness Survival Navigation

## Celestial Navigation – Watch Method

- In the **Northern Hemisphere** – Point Hour Hand at Sun



Bisecting **North-South Line**  
Between Hour Hand and 12

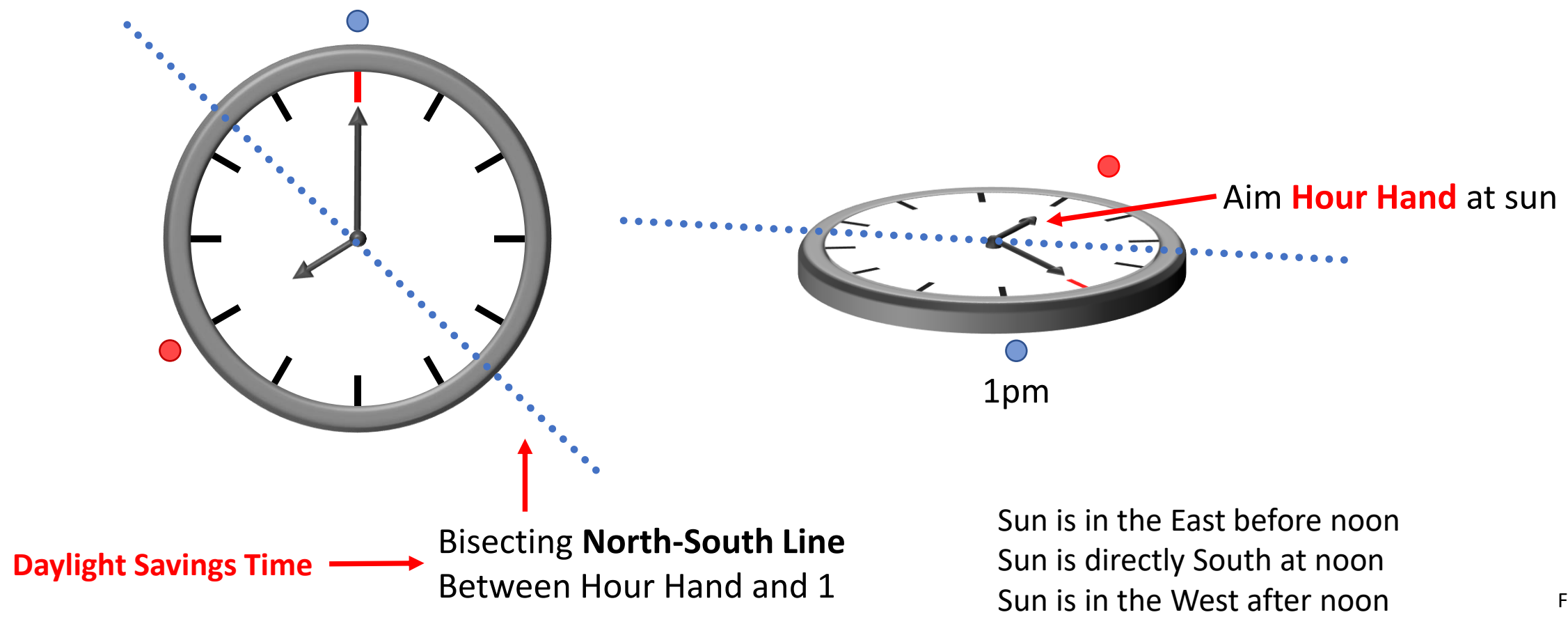
Sun is in the East before noon  
Sun is directly South at noon  
Sun is in the West after noon



# Wilderness Survival Navigation

## Celestial Navigation – Watch Method – Daylight Savings

- In the **Northern Hemisphere** – Point Hour Hand at Sun
- **Daylight Savings Time?** – North-South Line between Hour Hand and 1

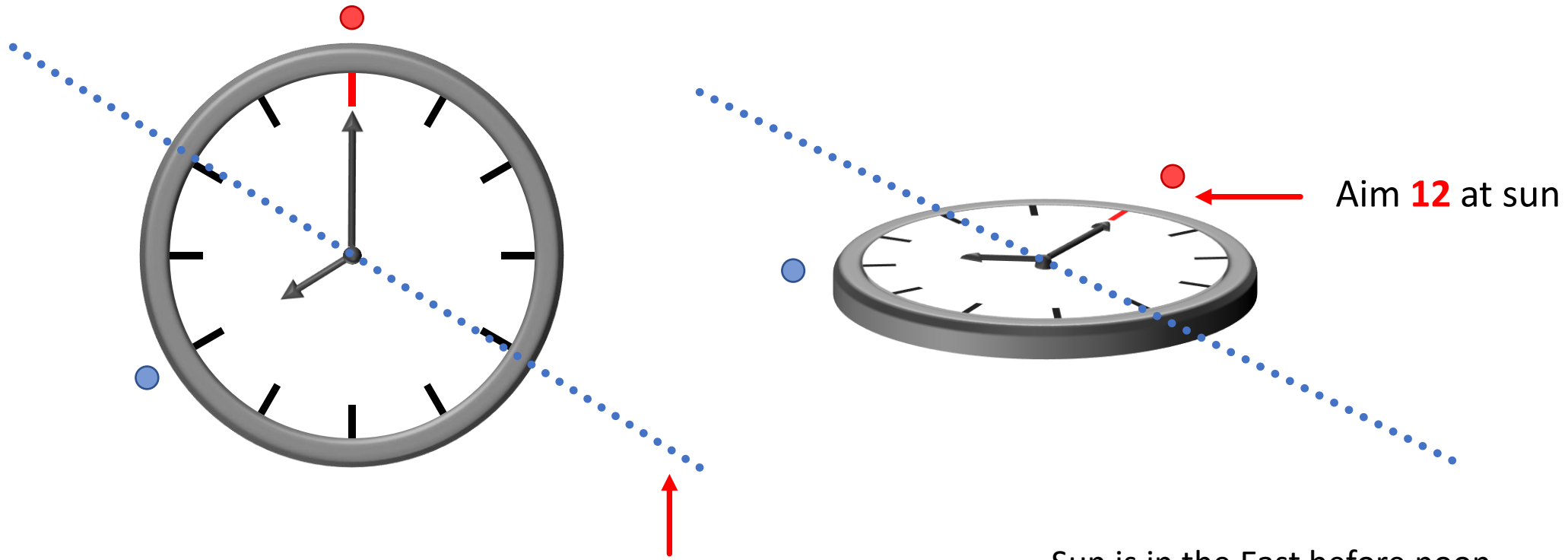




# Wilderness Survival Navigation

## Celestial Navigation – Watch Method

- In the **Southern Hemisphere** – Point 12 at Sun



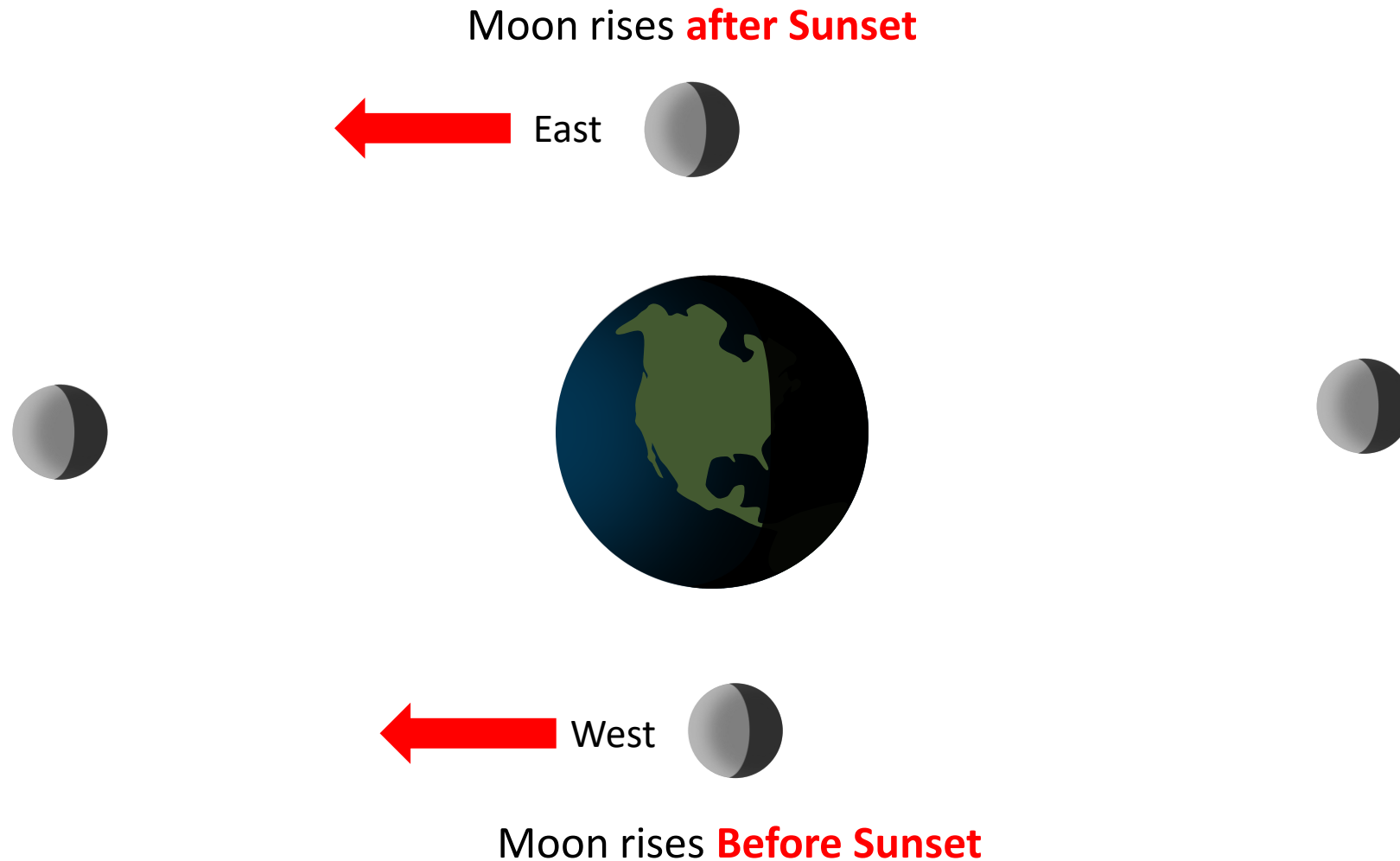
Bisecting **North-South Line**  
Between Hour Hand and 12

Sun is in the East before noon  
Sun is directly South at noon  
Sun is in the West after noon



# Wilderness Survival Navigation

## Celestial Navigation – Using the Moon



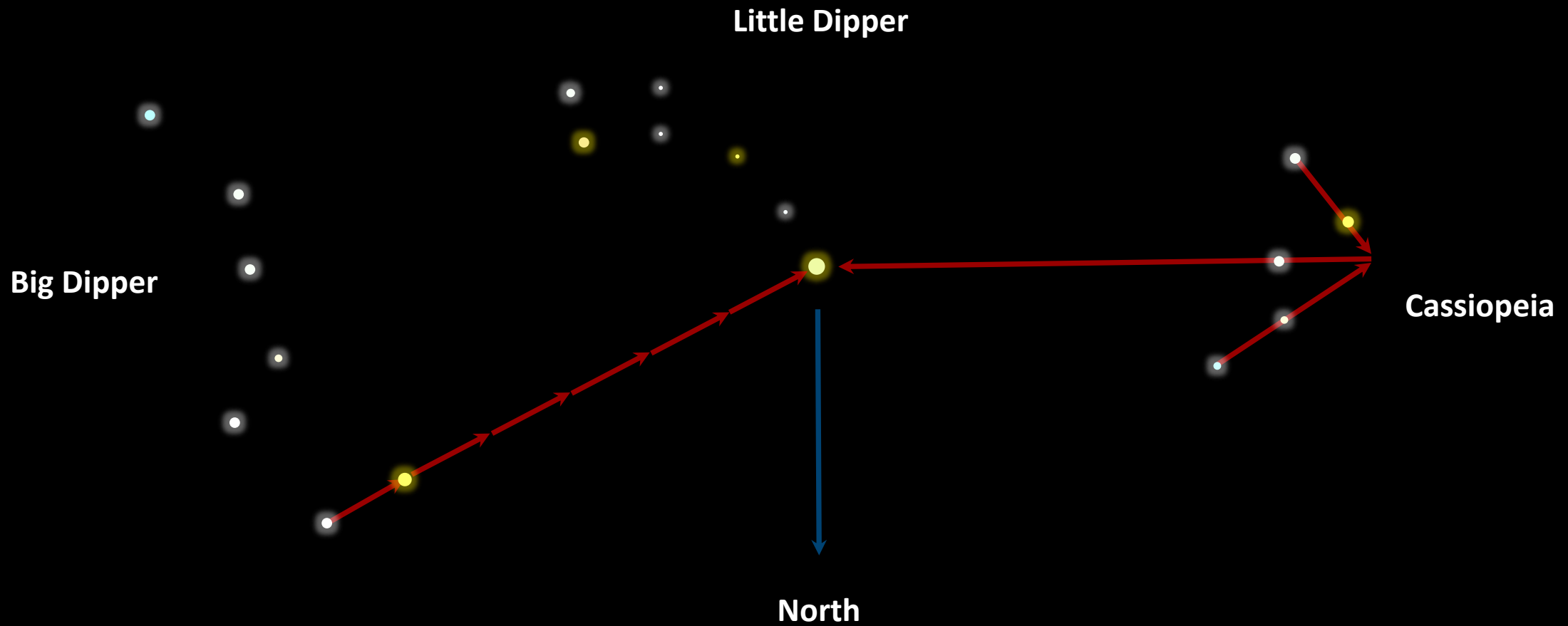
# Wilderness Survival Navigation

## Celestial Navigation – Using the Stars – Northern Skies

- In the North, one star marks True North
  - Polaris aka Polar Star and North Star
  - Bright star centered over northern pole of earth (within 1-2.5°)
  - Seen at 1° North of equator and above
  - Above latitude 70° - too high in the sky to be useful
- To find Polaris
  - Find the Big Dipper
  - Draw an imaginary line from the bottom outer to upper outer star
  - Extend the distance 5x the distance between these stars
- This line points to Polaris
- Opposite the Big Dipper sits Cassiopeia
- The center of Cassiopeia points at Polaris

# Wilderness Survival Navigation

## Celestial Navigation – Using the Stars





# Wilderness Survival Navigation

## Celestial Navigation – Using the Stars – Southern Skies

- There isn't a Polaris for the Southern Hemisphere
- There is a Southern Cross
  - aka Crux
  - Cross points to a spot over horizon that is generally south
  - Made up of 4 stars, it resembles a Christian Star with small tilt
  - Don't confuse with other "Crosses" (Diamond and False Crosses)
    - Pointer Stars point at the peak of the Southern Cross
- To use the Southern Cross
  - Draw through the top and bottoms stars of the cross
  - Extend this imaginary line  $\sim 5x$  (4.5) the length between these stars
  - This point sits over the horizon south of you

# Wilderness Survival Navigation

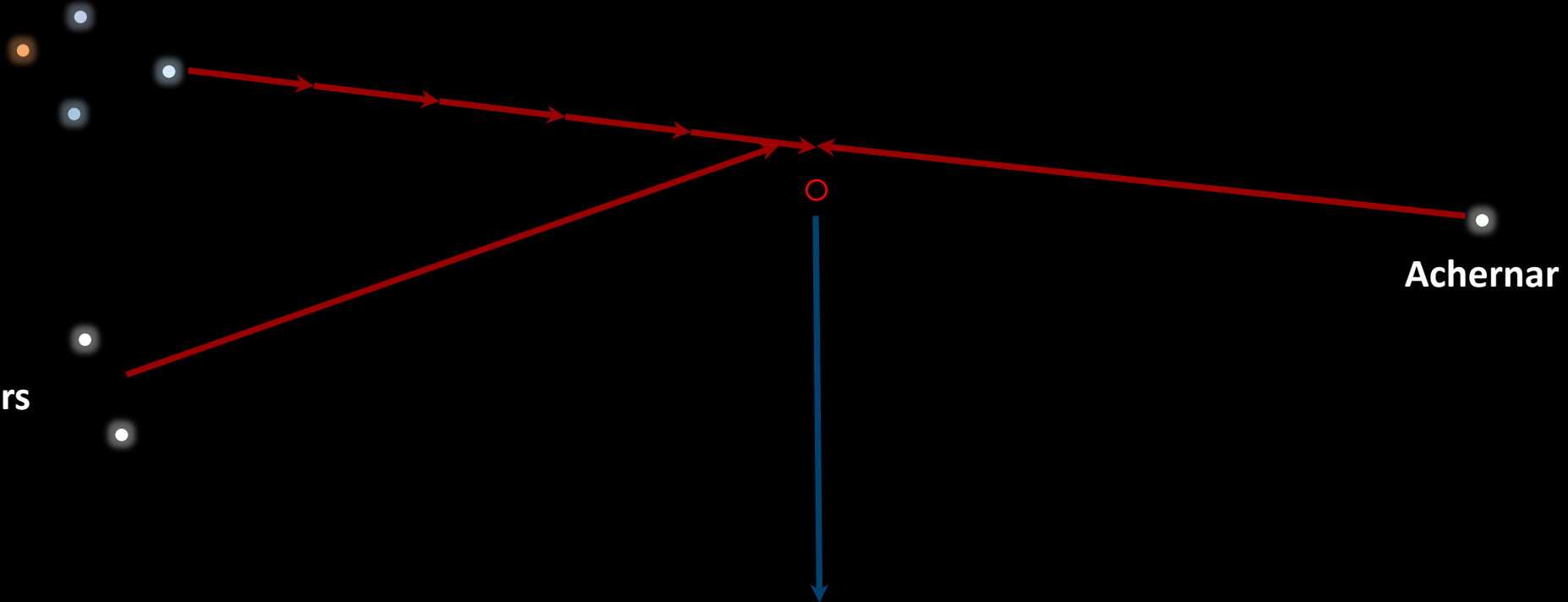
## Celestial Navigation – Using the Stars

Southern Cross

Pointer Stars

Achernar

South



# Wilderness Survival Navigation

## **Celestial Navigation – Using the Stars – Bearings**

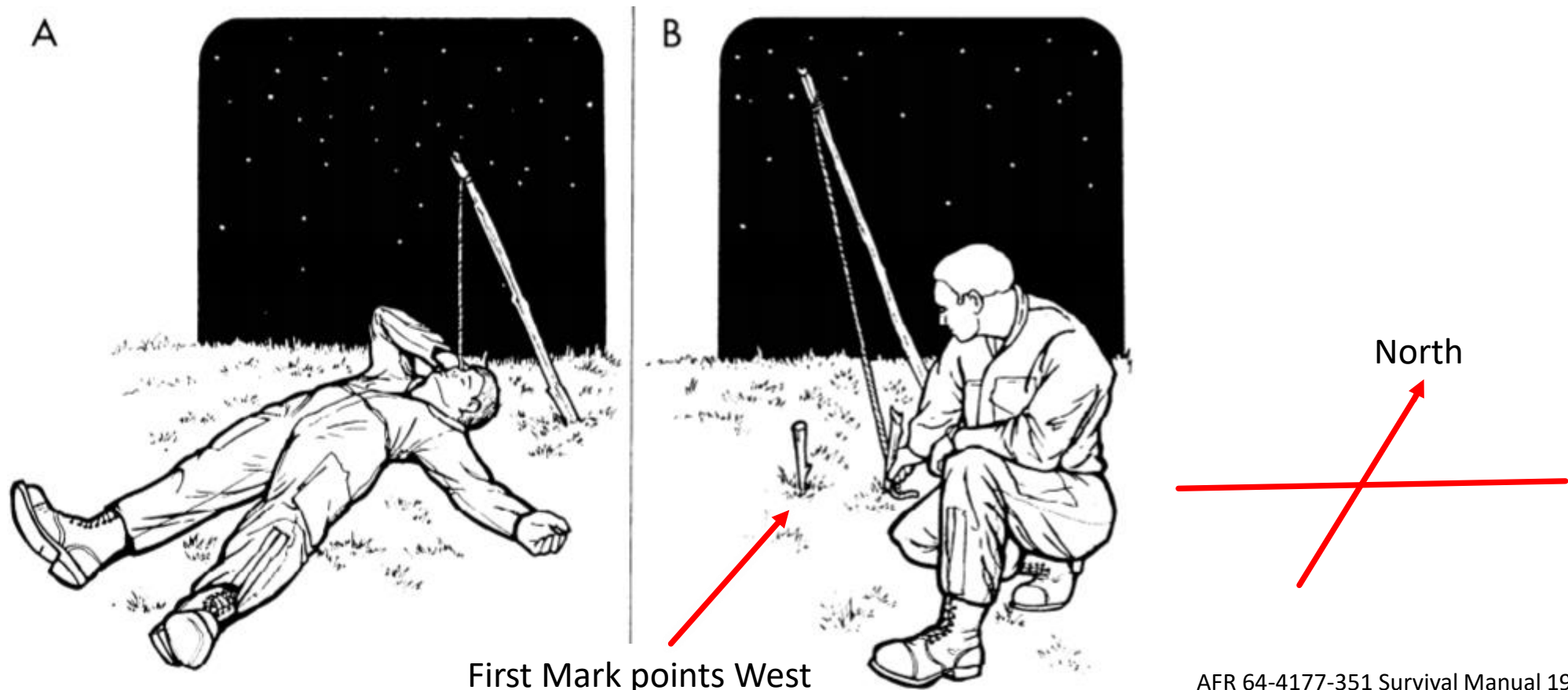
- You can use Stars as bearing points if you have a compass
- Note that Stars move across the sky over time
  - Norther stars are useful for about 30 minutes
  - Southern stars are only useful for about 15 minutes
  - After this time period, you will need to pick a new star



# Wilderness Survival Navigation

## Celestial Navigation – Using the Stars – Star “Shadow”

- Simulate a shadow from a star or planet using a taut line
- Mark first “shadow” and wait 15-20 minutes and mark a second point



# Wilderness Survival Navigation

## **Natural Navigation**

# Wilderness Survival Navigation

## Natural Navigation – Plant Growth

- In the Northern Hemisphere the sun hit plants from the south
  - Lone evergreen trees will always be more bushy on the south side
  - Birch and poplar tree bark is
    - Whitest on the south side
    - Darkest on the north side
- In the Southern Hemisphere the sun hit plants from the north



# Wilderness Survival Navigation

## Natural Navigation – Plant Growth

- **Moss** grows on the North Side of the tree? (Northern Hemisphere)
  - Nope
  - Sometimes it grows all around it depending on moisture
  - Often the greener side points south at sun
  - Of note, tree moss is a potentially great Firestarter
    - Unfortunately, where there is abundant moss, generally everything is wet

# Wilderness Survival Navigation

## Natural Navigation – Plant Growth

- **Stumps**
  - Growth is generally more vigorous on side of sun exposure
  - Rings are more spread out on sunny side
  - Rings closer together on shade side

# Wilderness Survival Navigation

## Natural Navigation – Plant Growth and Snow

- **Slopes**
  - In the Northern Hemisphere
    - North facing slopes receive less sun
      - Cooler and moister
      - In summer there may be patches snow
    - South facing slopes receive more sun
      - Warmer and drier
      - In Winter, trees are first to lose snow
      - Snowpack is generally shallower due to sun melt



# Wilderness Survival Navigation

## Natural Navigation – Winds

- Some places have Prevailing Winds
- Knowing the prevailing winds of certain areas can prove helpful
  - Trees will be bent in the direction the wind is blowing

Tracking

**Tracking**

# Tracking

## Tracking and Counter-Tracking

In a survival situation you may need to be able to

- Track and find a person
- Follow tracks to civilization or help
- Track an animal
- Avoid being tracked and employ counter-tracking techniques
- Track someone who is using counter-tracking techniques



# Tracking

## Clue Awareness

### Clue Awareness

- All kinds of clues can be helpful
  - Subject – best clue you might find
  - Tracks or altered condition of vegetation caused by the subject
  - Articles of clothing or equipment
  - Tissue paper
  - Food or beverage wrappers
  - Fire pits
  - Crushed grass where a subject slept or walked
  - Blood or scrape marks on a hill side or cliff where a subject fell
- Absence of clues in area is also important information

# Tracking

## Evidence Preserve

### Evidence Preservation

- We are all track erasers
  - We can destroy tracks
  - We add extra tracks
- Minimize impact on area
  - Stay off obvious tracks and other clues
  - Stay off the soft dirt parts of trails where tracks can be found
  - Walk in the lead member's footprints to both reduce tracks

# Tracking

## Tracking

### Tracking the Subject

- Seems really cool, especially in fantasy stories and movies
- In real life, not for everybody
  - Requires a lot of patience
  - Requires a lot of teamwork
  - Requires a lot of kneeling

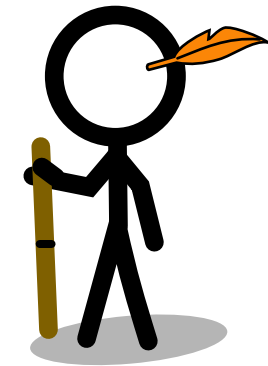


# Tracking

## Tracking

### Tracking the Subject

- Average stride length is about 18 to 20 inches long
- Resulting in over 3000 steps taken for each mile of travel
- This leaves thousands of clues behind
  
- Everyone makes a different track
  - Knowing sole pattern of subject is very valuable
  - Knowing how to read a track is even more vital

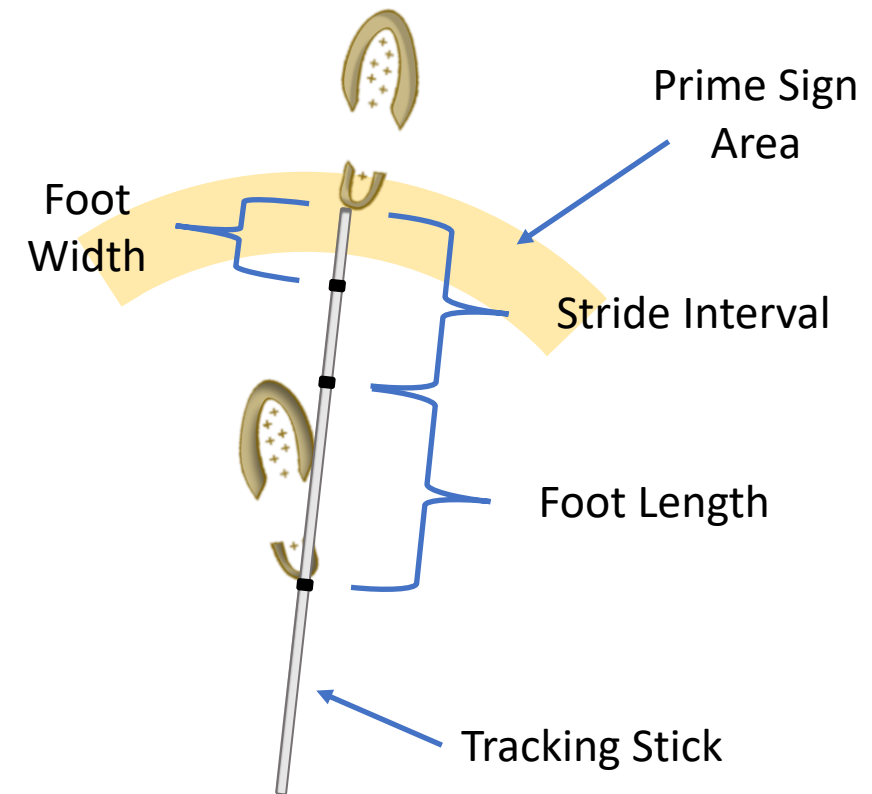


# Tracking

## Tracking

### Tracking the Subject

- **Tracking Stick** allows measurement of
  - Length of the shoe or boot
  - Width of shoe or boot
  - Stride of steps
  - This helps you eliminate following non-relevant clues

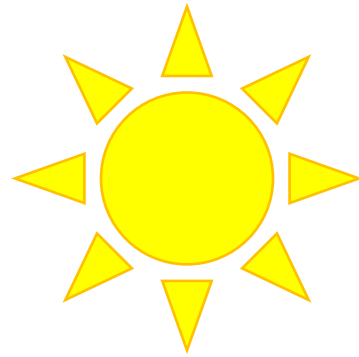
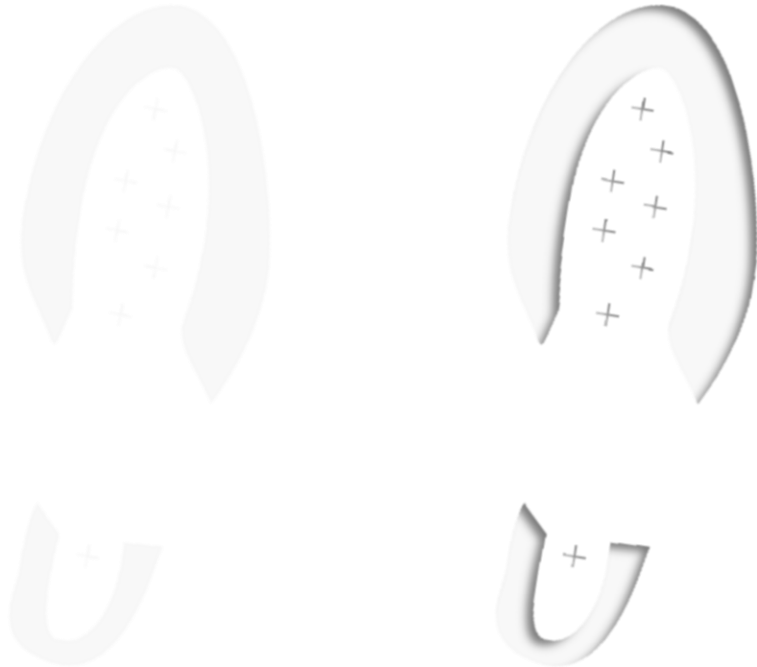


# Tracking

## Tracking

### Tracking the Subject

- Angle of light helps make tracks stand out
- You want a light source coming at you at a low angle





# Tracking

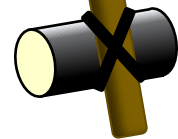
## Tracking

### Tracking the Subject

- Angle of light helps make tracks stand out
- You want a light source coming at you at a low angle



Fancy LED  
Light Mod

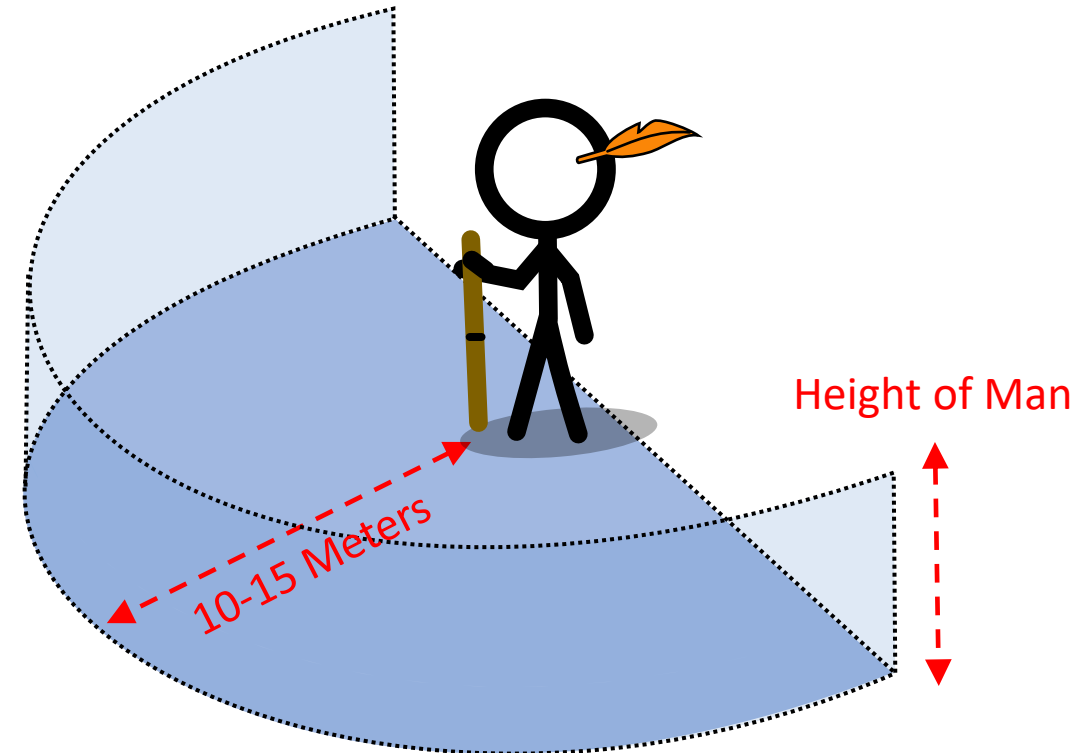


# Tracking

## Tracking

Tracking the Subject

- **Tracking Indicators**
  - Regularity
  - Flattening
  - Transfer
  - Discards
  - Color Change
  - Disturbance

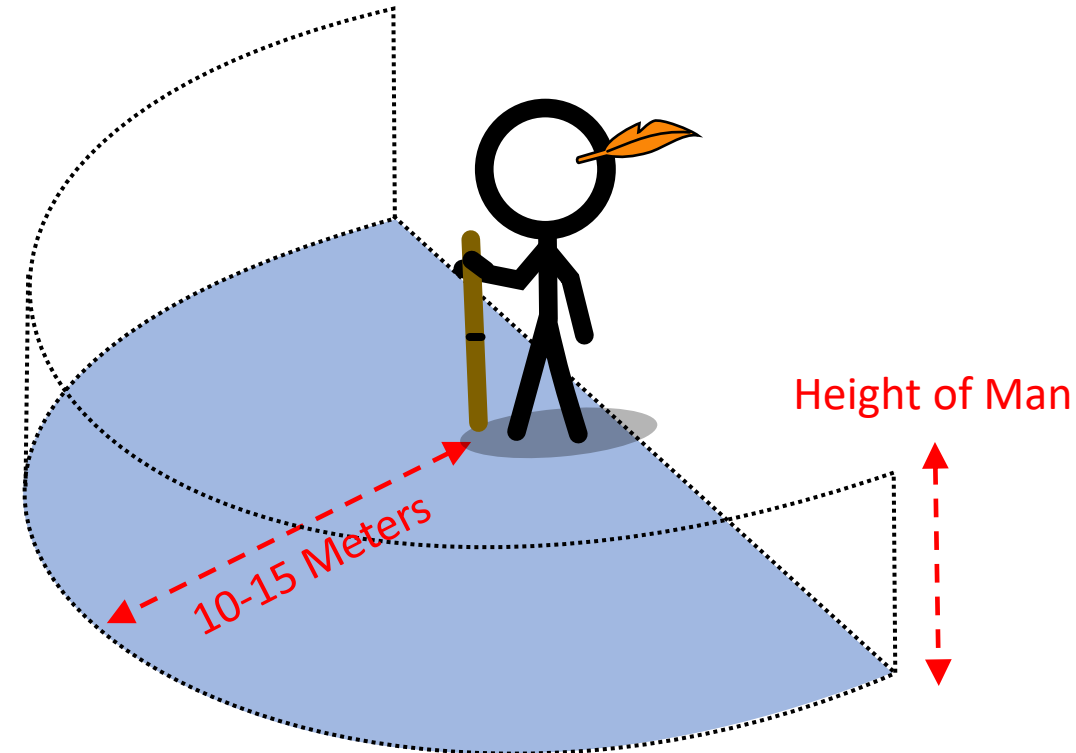


# Tracking

## Tracking

### Tracking the Subject

- **Ground Signs**
  - Ground level
  - Footprint fragments
  - Grains of sand on plants
  - Dirt prints on an asphalt road
  - Dislodged or crushed stones
  - Flattening of a surface area
  - Mud cloud at stream crossing
  - Discarded Trash
  - Cigarette butts



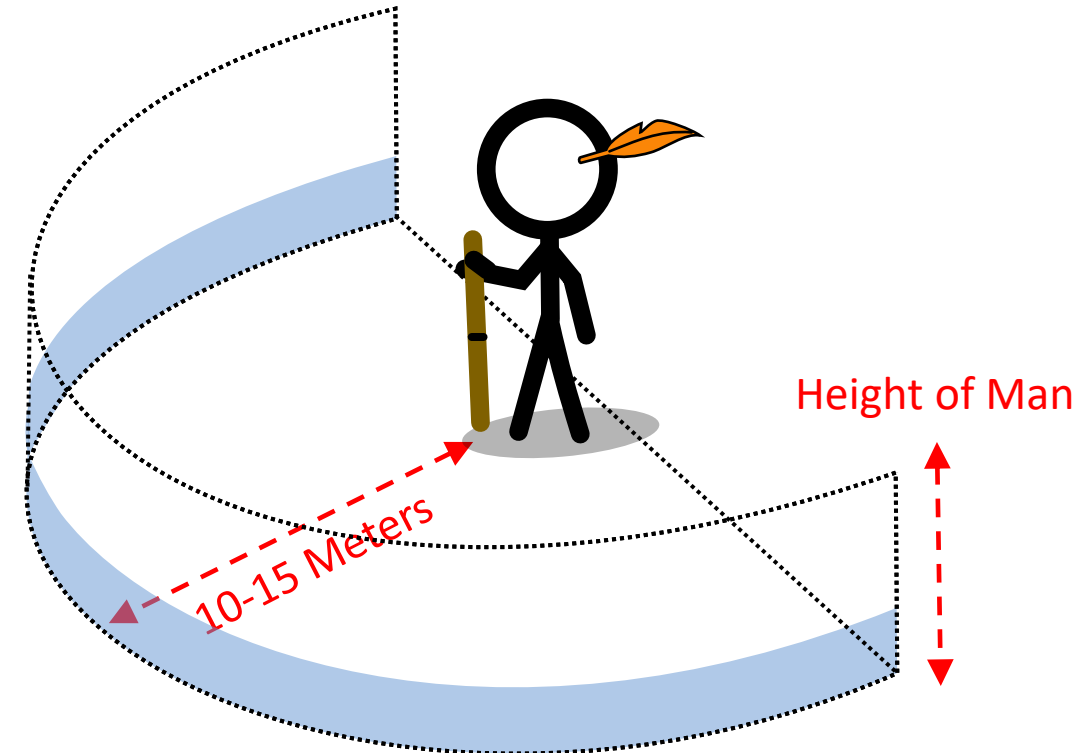


# Tracking

## Tracking

### Tracking the Subject

- **Low/Bottom Signs**
  - Below knee height
  - Short grass pushed in same direction
  - Broken and bruised vegetation

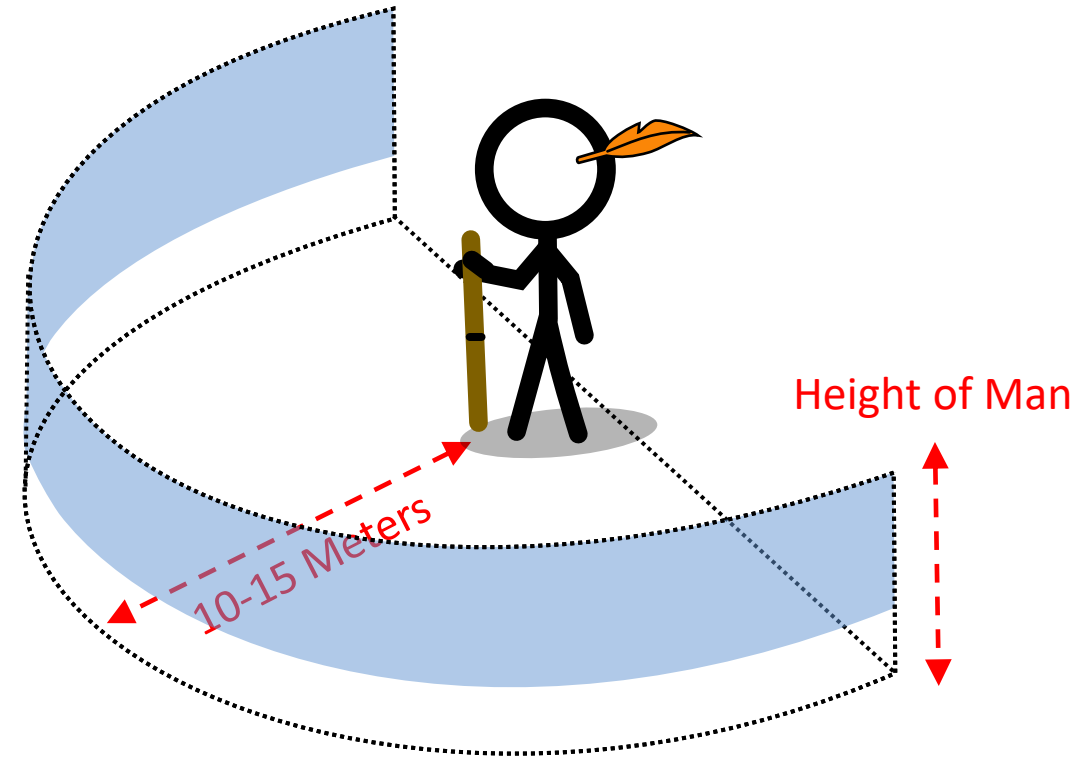


# Tracking

## Tracking

Tracking the Subject

- **High/Top Signs**
  - Above knee height
  - Broken branch
  - Damaged bark



# Tracking

## Tracking

### Tracking the Subject

- **Track Pursuit Drill** (Use at Last Definite Sign - LDS)
  1. Assessment of general direction
  2. Eliminate openings and finalize general direction
  3. Look for farthest sign and connect it back to LDS
  4. Look through the vegetation for the subject (quarry)
  5. Check to left and right for counter-tracking tactics (Military/Police)
  6. Plan and memorize your next footsteps
  7. Move forward with stealth (Military/Police)

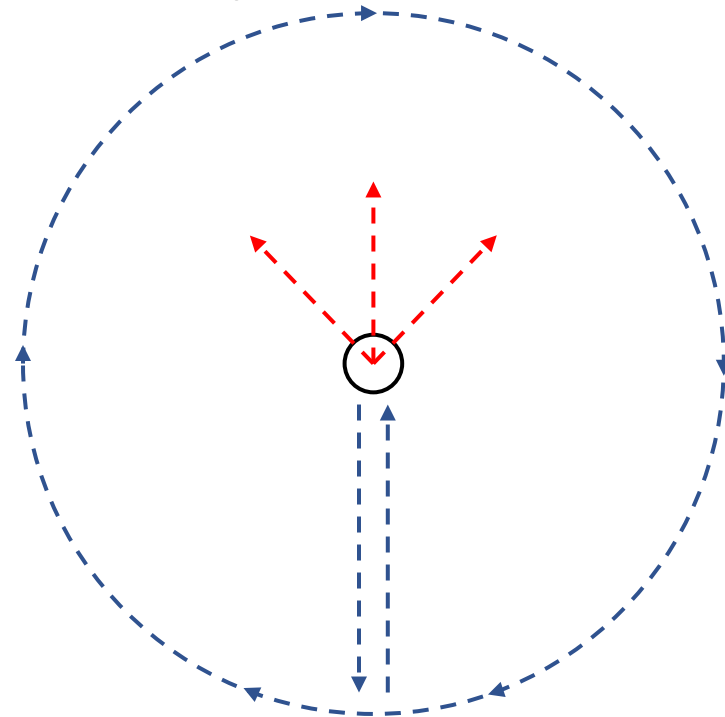


# Tracking

## Tracking

### Tracking the Subject

- Track Casting Drill (Reestablish track)
  1. **Initial Probe** – probe 3-5 meters from LDS
  2. **Initial Cast** – 10-15 meters back from LDS; probe 10-15m radius
  3. Extended Search
  4. Most Probable Search Area
    - Shelter
    - Natural lines of drift



# Tracking

## Tracking

### Tracking the Subject

- Two basic tenets of an effective tracker
  - Do not advance beyond the last print until the next one is found
  - Do not destroy clues

# Tracking

## Attraction

Locating the Subject using Attraction

- Sound sweeps using whistles
  - Make sound at a prescribed time
  - Then are all quiet and listening during a second prescribed time
- Sound sweeps using vehicle horns
  - Used to waken sleeping subject
  - Coordinated using radios
- Calling out name – you can only yell for so long
- Smoke
- Lights





# Tracking

## Attraction

Locating the Subject using Attraction

- Only works if Subject is
  - Alive
  - Conscious
  - Willing to be found

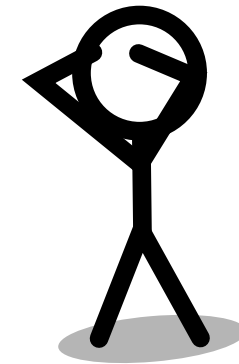


# Tracking

## Trial Sweep

Locating the Subject using Trail Sweep

- Visual Sweep takes much longer than a Sound Sweep
- Requires a lot of focus and attention to detail
- Used to find clues as well as unresponsive subjects



# Tracking

## Trial Sweep

Locating the Subject using Trail Sweep

- Sweeps commonly fall into the following categories:
  - Road or trail
  - Cross-country
  - Mixture of both



# Tracking

## **Trial Sweep**

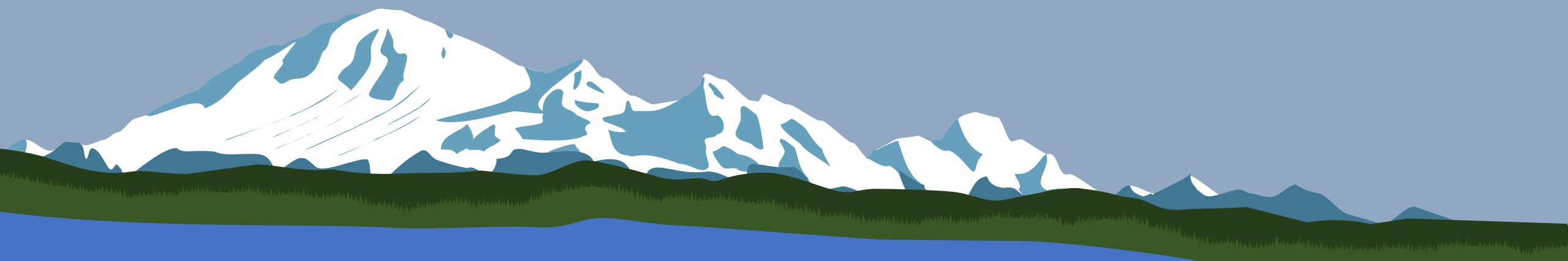
Locating the Subject using Trail Sweep

- Trail/road sweeps include searching of adjacent vegetation and terrain

1. Requirements	13. Mapping Found
2. Introduction	14. Constructing Maps
3. Map Reading	15. Constructing Control Symbols
4. Locations	16. Constructing Contours
5. Map Orientation	17. Universal Transverse Mercator
6. Measuring Distances	18. Unit Conversions
7. Projections	19. Geographic Coordinate Representation
8. Photo Control	17. Resources
9. Understanding Techniques	18. Instructor's Corner



# Resources



# Resources

## Resources

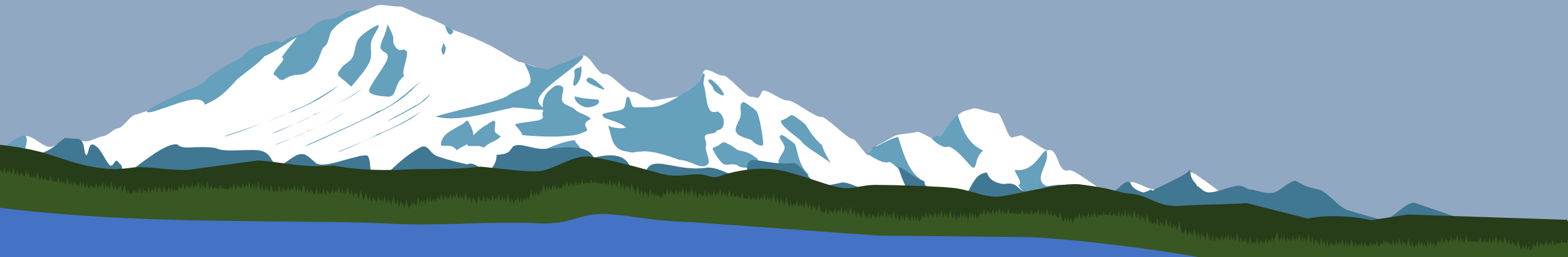
- Merit Badge Pamphlets
  - Backpacking
  - Search and Rescue
  - Orienteering
- Maps
  - [apps.nationalmap.gov](https://apps.nationalmap.gov) USGS Maps
  - [National Geographic Quad Maps](#) – In more printer friendly format
- Military Manuals
  - [FM 3-25-26 Map Reading and Land Navigation](#)



1. Requirements	13. Reading Found
2. Introduction	14. Constructing Maps
3. Map Reading	15. Constructing Control Symbols
4. Locations	16. Constructing Contours
5. Map Orientation	17. General Topographic Mapmaker
6. Interpreting Evidence	18. List of Contributors
7. Resources	19. Acknowledgments
8. Photo Credits	20. Instructor's Corner
9. Understanding Techniques	



# Instructor's Corner



# Instructor's Corner

## **Instructor's Corner**

- Thank you for teaching our scouts the Map and Navigation Skills.