Welcome to the Beginner GPS Training for Nutrient Management Planners

DCR
Virginia Department of Conservation & Recreation

Objectives for Today

- Learn how to use the various functions of the GPS unit.
- Apply GPS to various field activities that you use in nutrient management planning
- Learn to map using free computer software.

What is GPS?

- **GPS is short for Global Positioning System**
- **GPS is a SYSTEM made up of**
  - Satellites (Space Segment)
  - Ground Control Stations
  - GPS Receivers (or units)

Satellites
(Space Segment)

- The space segment is an earth-orbiting constellation of 24 active and five spare GPS satellites circling the earth in six orbital planes.
- The satellites continuously send radio signals towards earth
- These radio signals are picked up by GPS receivers

Ground Control Stations (Control Segment)

- The Control segment is made up of a Master Control Station (MCS) & four monitor stations.

- Monitor Stations continuously receive GPS satellite transmissions, and relay this information in real time to the Master Control Station in Colorado.

GPS Receivers (User Segment)

- GPS Units are referred to as “receivers”

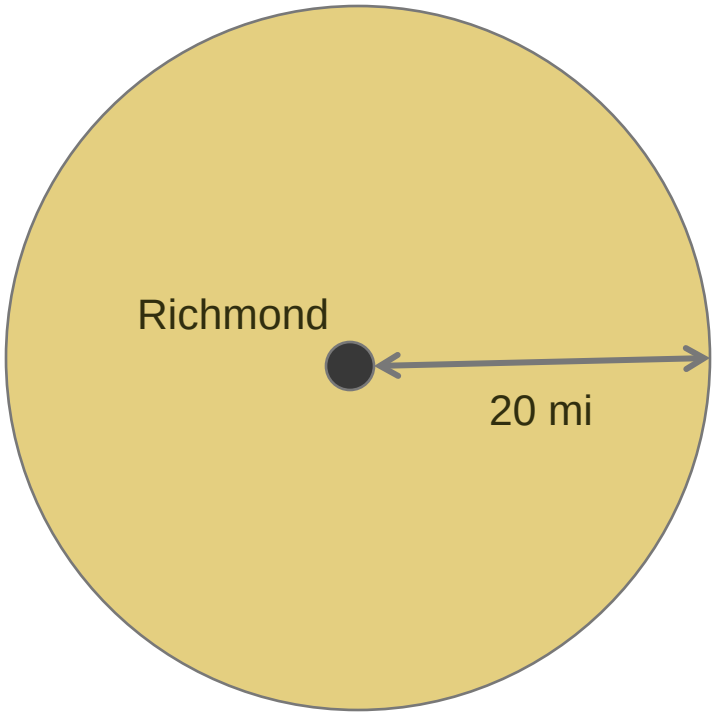
- They receive information (radio signals) from satellites.

How GPS Works

- **GPS uses trilateration (compare to triangulation)**
  - You can find any point if given distances from 3 other points
  - Actually need 4 points with GPS

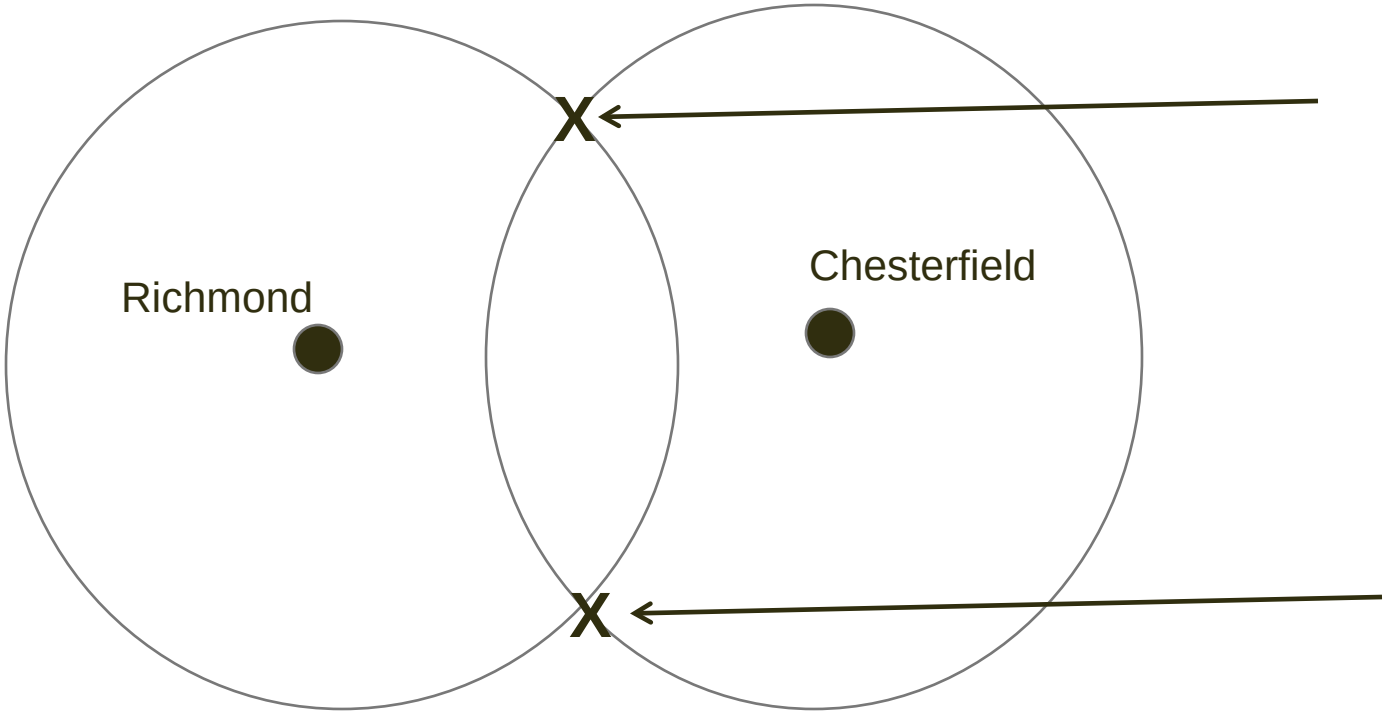
Simply Trilateration Example

- Satellite #1 tell you that you are 20 miles from Staunton, VA.



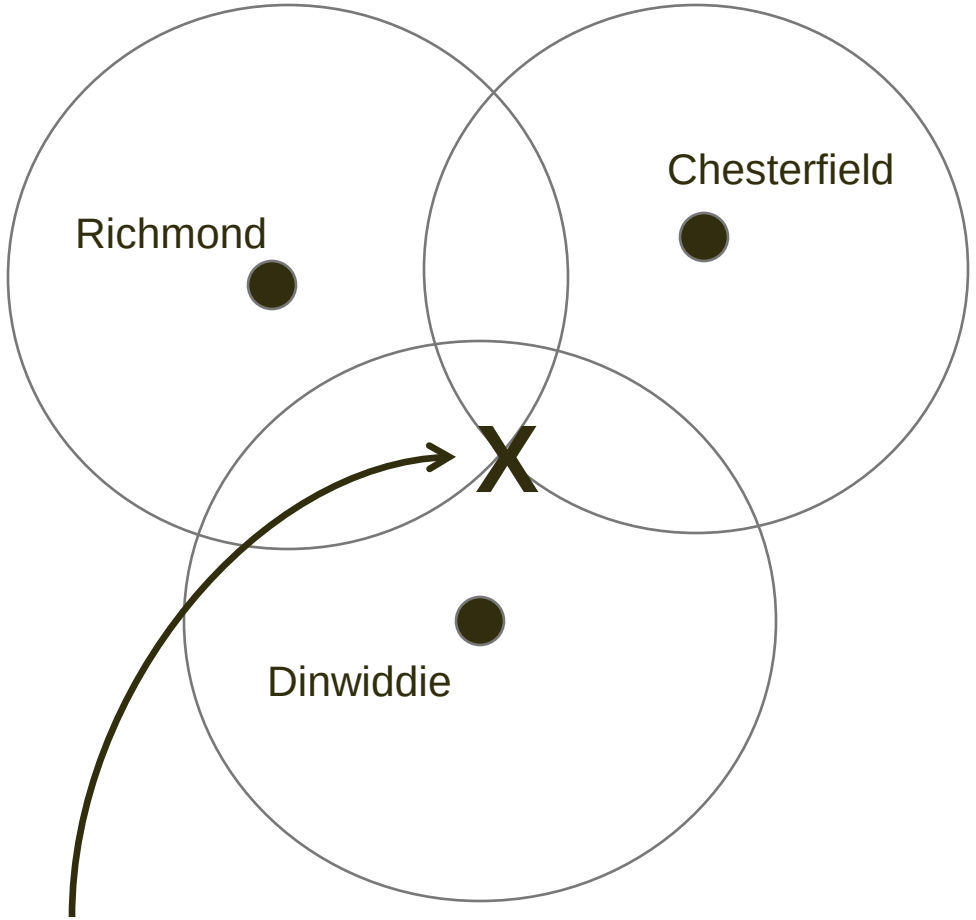
Simply Trilateration Example

- If the GPS receiver obtains #2 satellite, it tell you that you are also 20 miles from Chesterfield, VA



Simply Trilateration Example

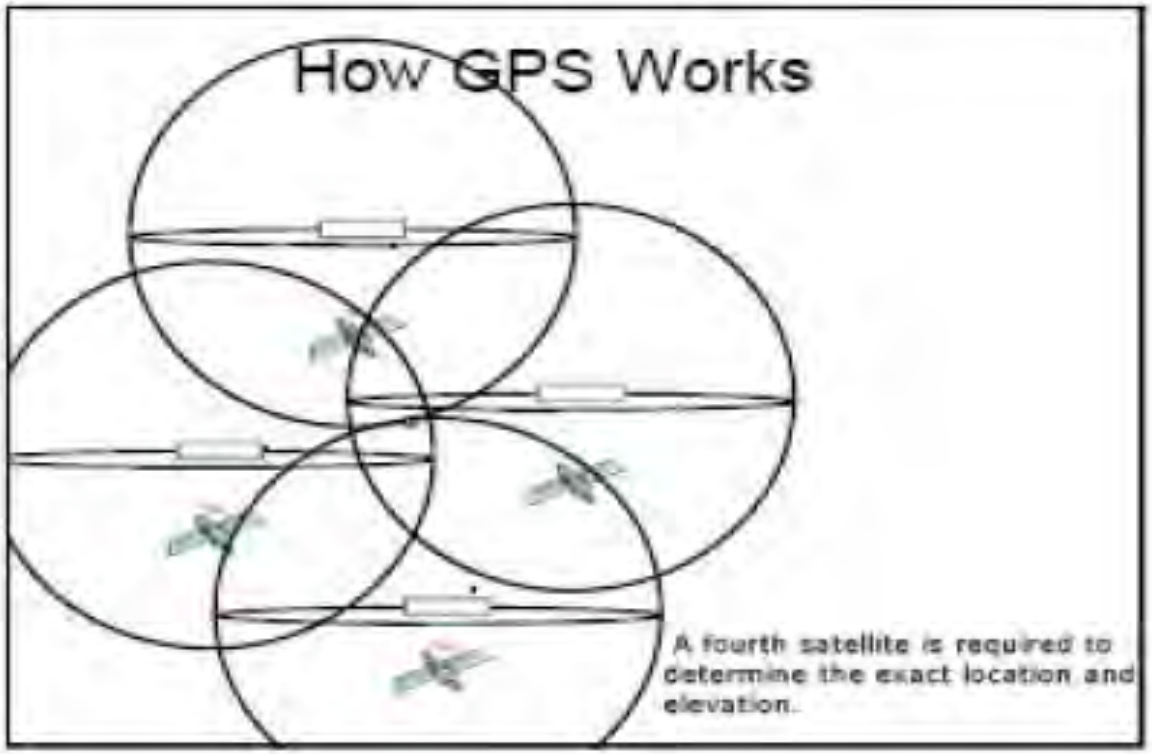
The GPS receiver obtains #3 satellite & tells you that you are 20 miles from Dinwiddie, Va.



I know I am somewhere within these 3 spheres

Simply Trilateration Example

- **Satellite #4 is required to determine <u>exact location</u> and <u>elevation.</u>**



Basic Information Provided by the GPS Receivers

- Position and waypoint coordinates.
- The distance and direction between a receiver's position and a stored waypoint, or between two remote waypoints.
- Accurate time measurement: GPS has become the universal timepiece, allowing any two receivers to be precisely synchronized to each other anywhere in the world.

What can you do with GPS?

- **Collect and store waypoints (positions)**
  - Field corners
  - Insect infestation areas
  - Soil, leaf, or corn stalk sample
  - Wells
  - Manure storage areas
  - Houses
  - Point source pollutions
- **Download the points onto your computer and integrate them with other mapping programs**

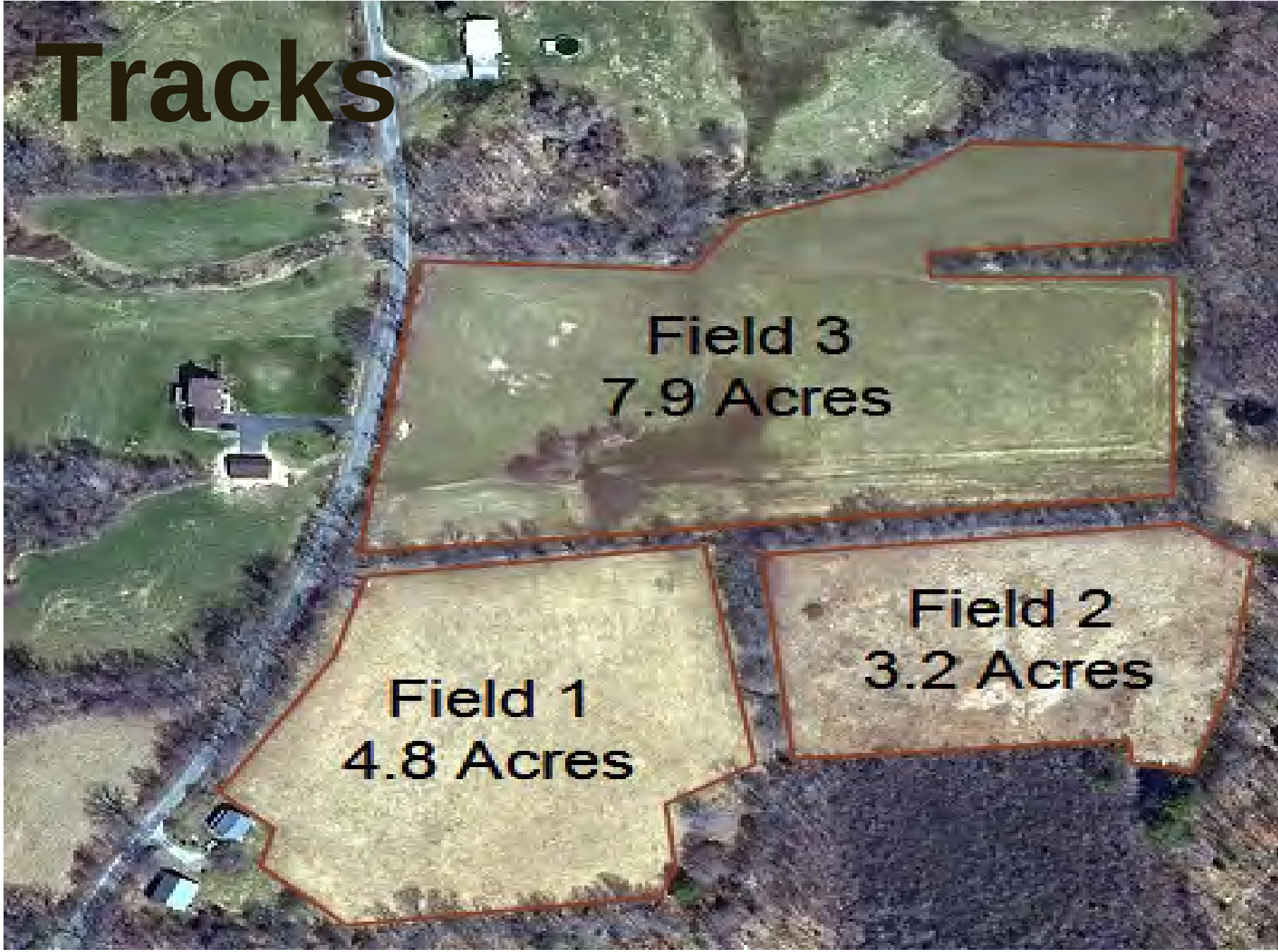
What can you do with GPS?

- Collect and store the path that you have walked/driven. (Tracks)
- Calculate the distance of a track.
- Calculate area measurements within a track. (measure area of a pasture or field of corn)
- Save and download tracks into your computer.

Tracks

- **Tracks are made up of data gathered automatically from your motion while the GPS is turned ON.**
- **They provide a record of where you've been.**
- **There may be hundreds or thousands of such points in a track, but they are all anonymous. They don't have names and you can't easily get the location of any particular one.**

Tracks



What can you do with GPS?

- Collect and store Routes
- Routes are similar to tracks, but are created by waypoints
- Routes are handy for measuring square fields and straight lines.
- You can measure the length and acreage of a route.

Routes

- Routes are generally made up of a series of significant points along your path. A route is just a sequence of waypoints.

Routes

Notice the 4 waypoints at each field corner

What can you do with GPS?

- **The “GOTO” function**
  - Using the GOTO function, the GPS will guide you to a predefined Waypoint you choose.
  - The GOTO/FIND function is like autopilot. The GPS will beep when you are within a certain distance of a selected waypoint.
  - Corn Stalk Nitrate testing

Different “Grades” of GPS Receivers

- **Recreational Grade ~ $100-$800**
  - Accurate to w/in 5 meters

- **Mapping Grade~ $5,000-$7,000**
  - Accurate to w/in 1 meter

- **Survey Grade ~$20,000**
  - accurate to within 1cm

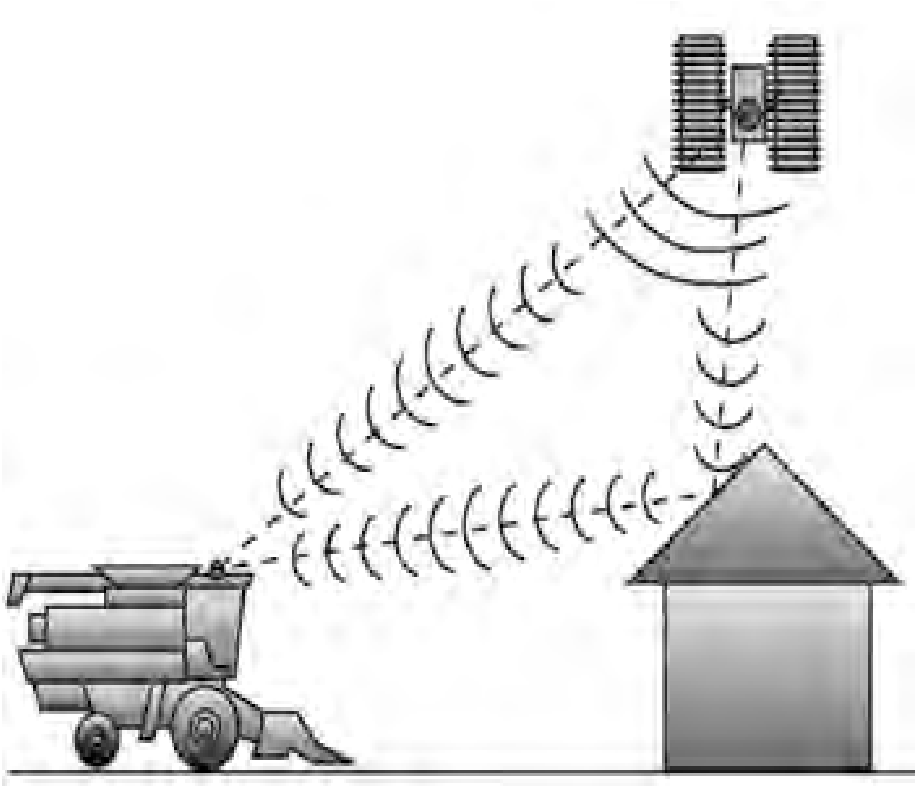
Sources of Signal Error

Control Segment blunders - computer glitches or human error.

User mistakes - account for most GPS errors.

human body - Holding a GPS receiver close to the body can block some satellite signals and hinder accurate positioning.

Multipath Interference –



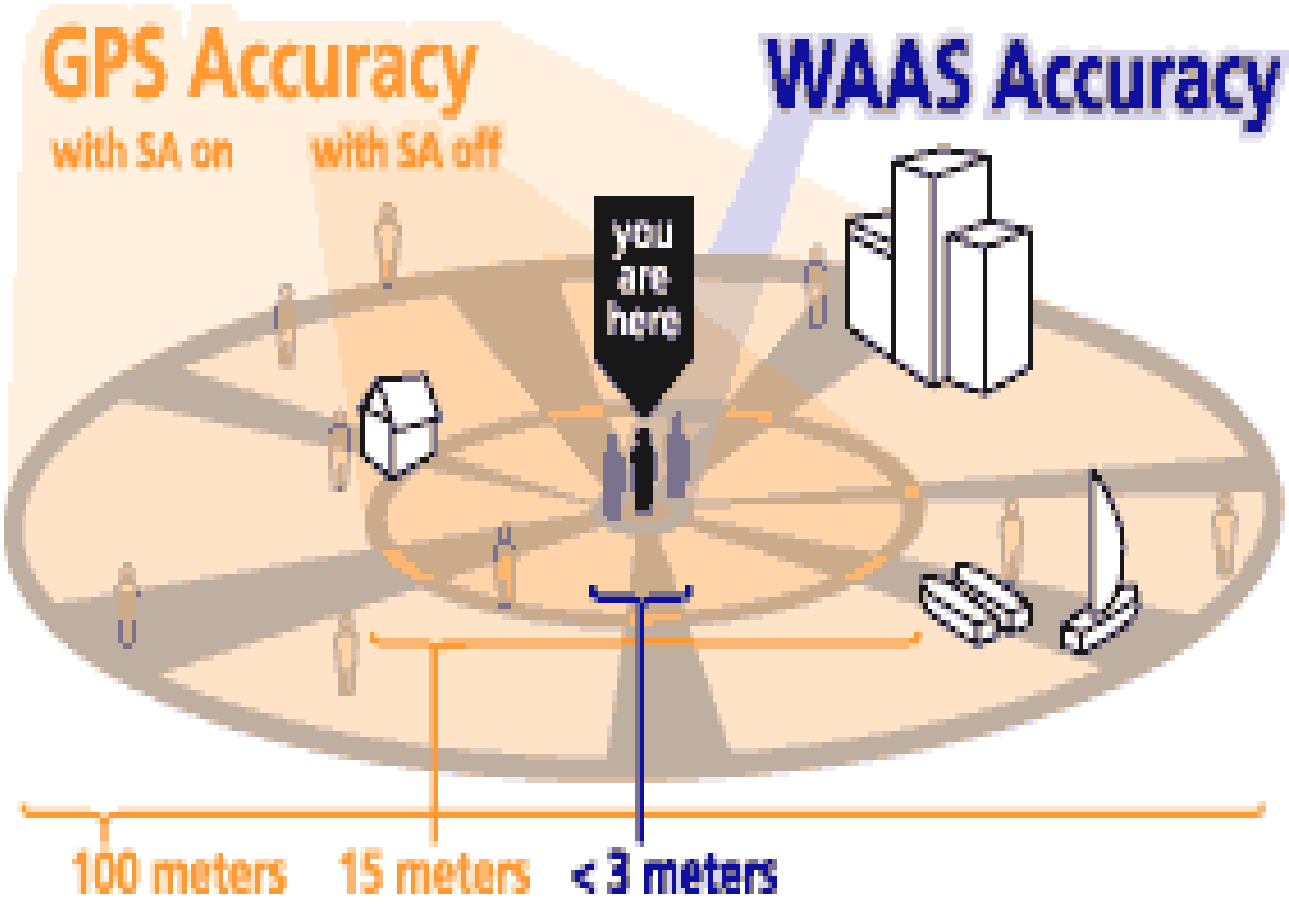
You can lose satellite coverage in areas with dense foliage, deep valleys, gorges, etc.

Line of Site is Essential!

WAAS
(Wide Area Augmentation System)

- Basically, it's a system of satellites and ground stations that provide GPS signal corrections, giving you even better position accuracy.
  - How much better?
    - Try an average of up to five times better.
    - A WAAS-capable receiver can give you a position accuracy of better than three meters 95 percent of the time.
    - The GPS receivers we are using are WAAS Compatible

WAAS
(Wide Area Augmentation System)



Map Datums

- **WGS84 – World Geodetic System 1984**
  - Default datum on Garmin. Used by Google Earth.
- **NAD27 – North American Datum1927**
  - Older but used on most USGS topogrpahic maps.
- **NAD83 – North American Datum 1983**
  - Very Similar to WGS84. Used in newer USGS maps.

~ and hundered of others!

Coordinate Systems

- **Latitude/Longitude (angular)**
  - Degrees – minutes –seconds
- **UTM/UPS (rectangular, metric)**
  - Universal Transverse Mercator
- **MGRS (UTM using alphanumeric I.D.)**
  - Military Grid Reference System
    - Others: Township & Range, State Plane Coordinate, ETC.

Purchase Considerations

- **Physical attributes**
  - Size
  - Weight
  - Waterproof
  - Battery life!!
  - Screen: color vs b/w
- **WAAS enabled: for accuracy under cover**
- **Memory – internal & expandable**

Things to remember

- GPS can serve as an accurate data collection tool for GIS applications;
- GPS applications are becoming increasingly prevalent in our society, and support a variety of applications;
- With GPS receivers, you get what you pay for.
- What it is not…..Perfect