GPS USERS MANUAL Ver 1.2

1 Creating Maps for the Garmin

Any polygon or line based data set we can see in ArcMap can be converted to a map for use in the Garmin. More than one data set can be combined in a Garmin map.

Limitations of course apply:

- Only one polygon layer per Garmin map. Multiple polygon layers, one on top the other, do not work well.

- Feature labels only work well on polygons.

- The Garmin feature coding set (colors, fills, line types) is limited. The Poles who cracked it assert that the symbol options they present are the full set of Garmin native symbols.

- The Garmin will work with large, complex data sets, but the redraw time becomes very s l o w. It is generally most efficient to have a set of map tiles that cover your various work areas, and to change the map tile in the GPS when you change work area.

We use the program GPSMapEdit to create Garmin maps.

GPSMapEdit has a variety of capabilities, but the one we use most is its ability to:
1. import and theme shape files,
2. combine a set of shape files in one Gamin map, and
3. write a map file that can be uploaded in to the Garmin.

The general process is:
1. Create or obtain shape files of what you want to see in the Garmin. A considerable number of shape files of polygon and line data have been are supplied for known Xaxli'p forest crew work areas.

   It is often helpful to review the shape files in ArcMap to see what they are and what they contain before importing them to GPSMapEdit, but this is not required.
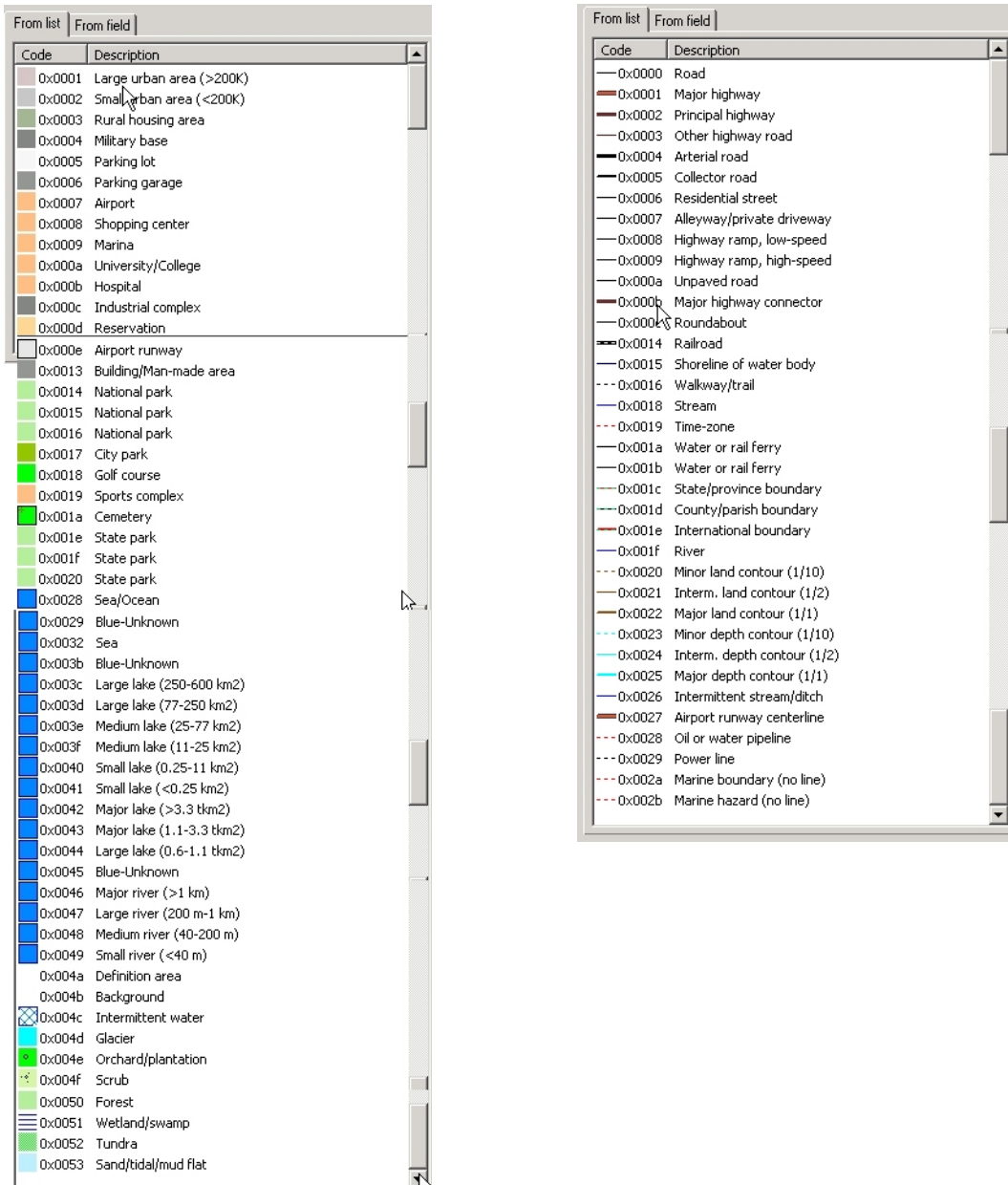2. Add the shapefiles you want on the map to GPSMapEdit by Importing them.
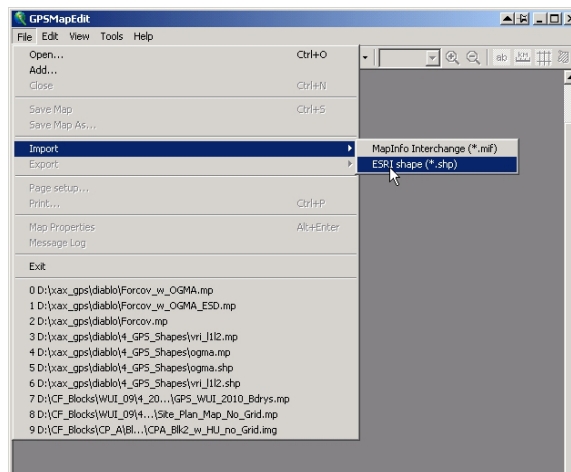
   Add the map you want on the bottom of the map stack first. (This is usually a polygon layer.) Add other layers in the order that makes the most sense to you.

Each new layer will be "on top of" earlier layers, and will partially or fully obscure any information it overlaps. It is like a set of clear overlay maps.

Occasionally GPSMapEdit will issue an alarming warning about "This action cannot be undone!" during import. Ignore it.

3. Theme each layer as you add it. The available patterns and colors are shown below.

Code	Description
0x0001	Large urban area (>200K)
0x0002	Small urban area (<200K)
0x0003	Rural housing area
0x0004	Military base
0x0005	Parking lot
0x0006	Parking garage
0x0007	Airport
0x0008	Shopping center
0x0009	Marina
0x000a	University/College
0x000b	Hospital
0x000c	Industrial complex
0x000d	Reservation
0x000e	Airport runway
0x0013	Building/Man-made area
0x0014	National park
0x0015	National park
0x0016	National park
0x0017	City park
0x0018	Golf course
0x0019	Sports complex
0x001a	Cemetery
0x001e	State park
0x001f	State park
0x0020	State park
0x0028	Sea/Ocean
0x0029	Blue-Unknown
0x0032	Sea
0x003b	Blue-Unknown
0x003c	Large lake (250-600 km2)
0x003d	Large lake (77-250 km2)
0x003e	Medium lake (25-77 km2)
0x003f	Medium lake (11-25 km2)
0x0040	Small lake (0.25-11 km2)
0x0041	Small lake (<0.25 km2)
0x0042	Major lake (>3.3 tkm2)
0x0043	Major lake (1.1-3.3 tkm2)
0x0044	Large lake (0.6-1.1 tkm2)
0x0045	Blue-Unknown
0x0046	Major river (>1 km)
0x0047	Large river (200 m-1 km)
0x0048	Medium river (40-200 m)
0x0049	Small river (<40 m)
0x004a	Definition area
0x004b	Background
0x004c	Intermittent water
0x004d	Glacier
0x004e	Orchard/plantation
0x004f	Scrub
0x0050	Forest
0x0051	Wetland/swamp
0x0052	Tundra
0x0053	Sand/tidal/mud flat

| Code	Description
0x0000	Road
0x0001	Major highway
0x0002	Principal highway
0x0003	Other highway road
0x0004	Arterial road
0x0005	Collector road
0x0006	Residential street
0x0007	Alleyway/private driveway
0x0008	Highway ramp, low-speed
0x0009	Highway ramp, high-speed
0x000a	Unpaved road
0x000b	Major highway connector
0x000c	Roundabout
0x0014	Railroad
0x0015	Shoreline of water body
0x0016	Walkway/trail
0x0018	Stream
0x0019	Time-zone
0x001a	Water or rail ferry
0x001b	Water or rail ferry
0x001c	State/province boundary
0x001d	County/parish boundary
0x001e	International boundary
0x001f	River
0x0020	Minor land contour (1/10)
0x0021	Interm. land contour (1/2)
0x0022	Major land contour (1/1)
0x0023	Minor depth contour (1/10)
0x0024	Interm. depth contour (1/2)
0x0025	Major depth contour (1/1)
0x0026	Intermittent stream/ditch
0x0027	Airport runway centerline
0x0028	Oil or water pipeline
0x0029	Power line
0x002a	Marine boundary (no line)
0x002b	Marine hazard (no line)

As noted, these are believed to be all of the available Garmin codes. Many are redundant or confusingly similar in color. Some suggestions:

- Use TimeZone for forest cover (VRI) polygon boundaries.
- Use International Boundary for the Community Forest boundary.
- Use Provincial Boundary for Xáxli'p Reserve boundaries.
- Use Major Highway for OGMA boundaries.

- Use Major Land Contour for Ecological Sensitivity polygon boundaries.
- Use Railroad for Cross Valley Corridor/Landscape Linkage boundaries.
- The Road_Gra shapefile is a patterned road line set. Use the thin black Road for it.
- Use Stream for water courses.

There are multiple themeing options:

- Choose a simple polygon theme, that will apply to all polygons in the data set. For example, use a 'Lake' theme for WAT_POLY - a coverage of lakes.
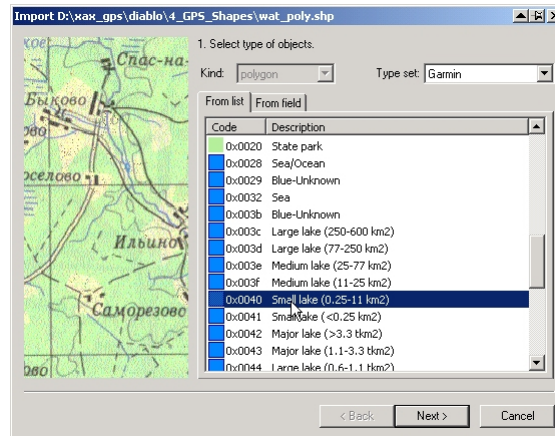

- Use a complex polygon theme, based on the contents of the field GARMIN in pre-coded data. The VRI_L1L2 (forest cover) polygon shape file is precoded.
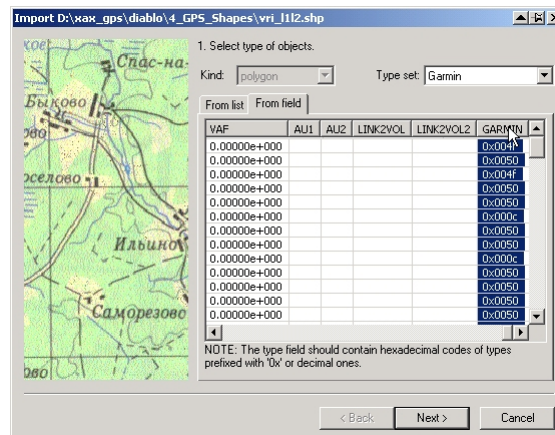
- Use a simple line theme, that will apply to all lines in a data set. For example, the "Stream" theme works well for WAT_VEC, a coverage of streams.
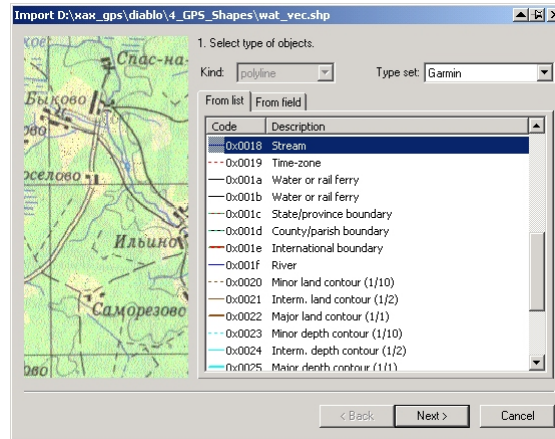
- Use a complex line theme, based on the contents of the field GARMIN in pre-coded data. The ROAG_GRA shape is coded to show roads and rail line differently.

4. Choose a label field for your data, if you want. A key advantage of labeling is that is can be used to reference the GPS display to a paper map of the same polygons.

- Labeling works best on polygon coverages.
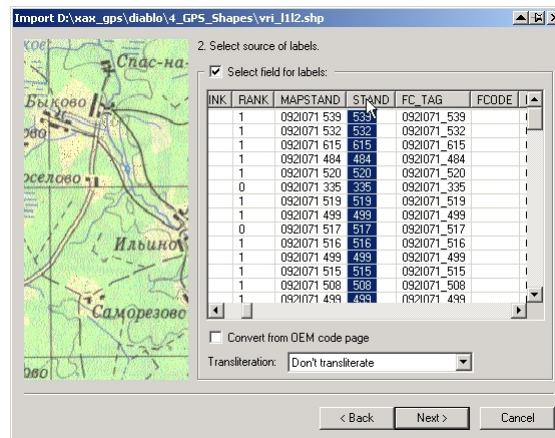
- Labels will only show for filled/colored polygons. Polygons left blank will not display a label.

- You do not have to label features if you do not wish to – just "uncheck" the Select Field for Labels box..

5. After you have selected information and set how to theme it, the program informs you of the projection it intends to use for the data.
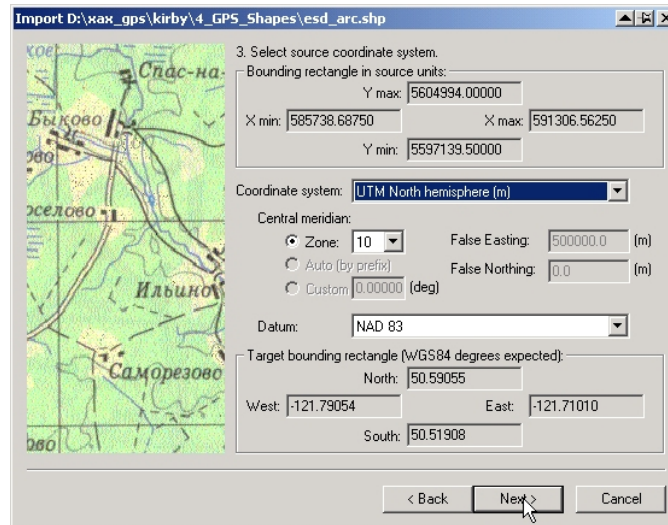
The Xáxli'p data sets are in UTM 10 NAD 83. This will be the default in most cases, but if it suggests something else, set it to UTM 10 NAD 83.

The bounding rectangles can be left as is.

If the data set imports poorly or does not align to other, known-to-be-good data sets, the shape file is likely in a projection other than UTM 10 NAD 83 and will require re-projection in ArcMap.

6. Repeat the steps above to bring in whatever data sets you want on the map. You can combine multiple vector (line) data sets, but are limited to one polygon data set per map.

7. Once you are happy with your GPS map, Save it. In "Polish" format. This is a large text file of names and X,Y data.

- Maintain a sensible directory structure. Do not put all your maps in one big directory – this generally leads to extreme confusion. Have subdirectories for various work areas, and have a GPS_Map sub-directory for every work area. Store your GPS maps for that work area in there.
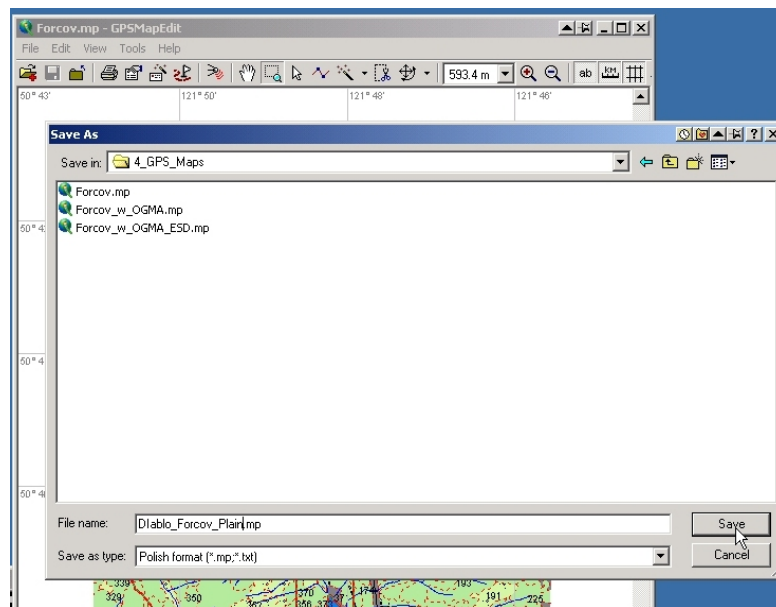
- Use long map names. Put in enough information that you can identify the map type and map contents from the map name. For example, Diablo_Forcov_w_ESD.IMG is generally preferable to FORCOV.IMG

8. Edit the map properties.
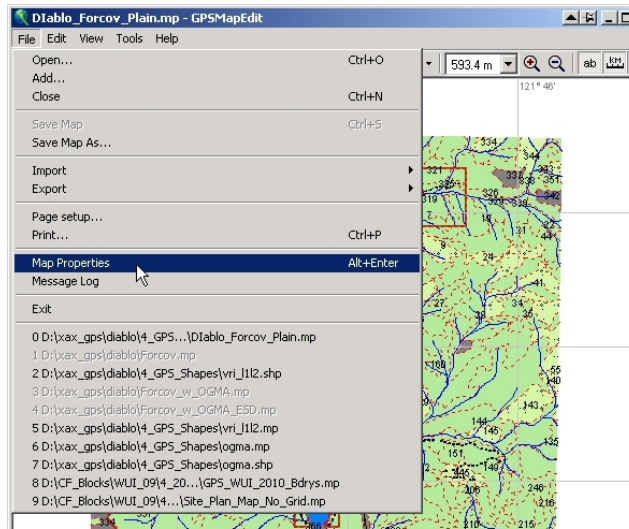
- In the Header tab, Enter a random 8 digit map code and a map name. Best to use the same map name as the file you just saved. Set code page and coding scheme as shown
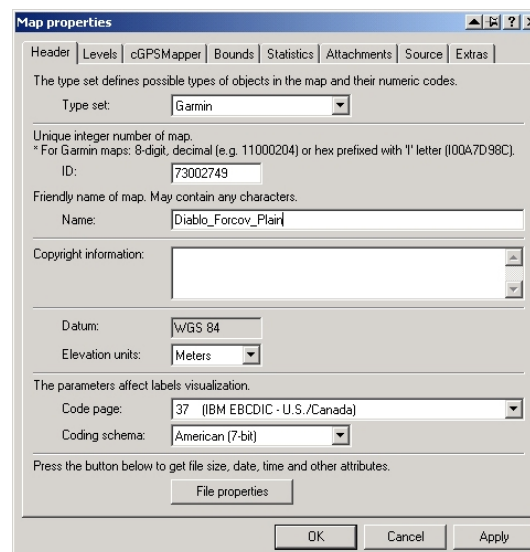
- In the cGPSMapper tab, in Set TRE to 550 and RGN to 650. Turn POI off.
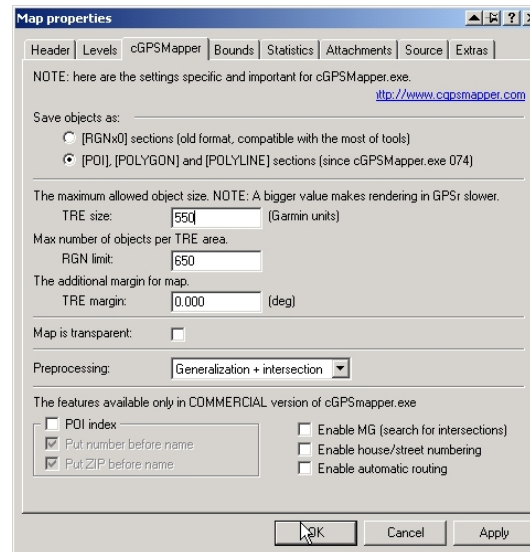
9. Save again, to keep your changes in the Polish Format map file.

10. Export the map to Garmin-IMG Format. Keep these files in the same subdirectory as the MapEdit files.
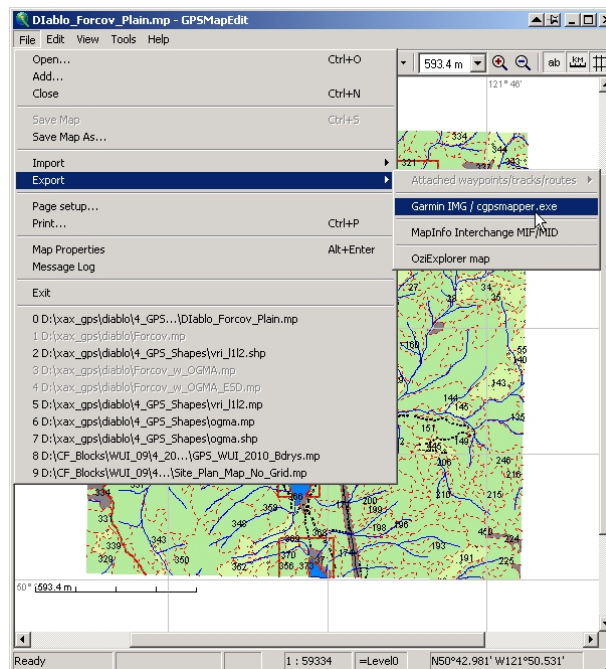
2   Loading Maps into the Garmin GPS

The first edition GPS map files for the Xáxli'p Community Forest are on the enclosed CD. They have an IMG file extension. You should probably copy the map files into a folder named something like "GARMIN_GPS" on your hard drive.

The first edition map list is:

- Diablo Meadows:
    - Diablo_Forcov_Plain.img
    - Diablo_Forcov+OGMA.img
    - Diablo_Forcov+OGMA+ESD.img
    - Diablo_Forcov+OGMA+ESD+CVC.img
- Kirby Flats
    - Kirby_Forcov_Plain.img
    - Kirby_Forcov+OGMA.img
    - Kirby_Forcov+OGMA+ESD.img
    - Kirby_Forcov+OGMA+ESD+CVC.img
- IR 1
    - IR1_Forcov_Plain.img
    - IR1_Forcov+OGMA.img
    - IR1_Forcov+OGMA+ESD.img
    - IR1_Forcov+OGMA+ESD+CVC.img

The names indicate the list of features in each file, and are self explanatory.

You use the program IMG2GPS (on CD) to move maps (*.IMG files) from your computer to the GPS unit.

- Hook up the GPS unit to the USB connector cable while the unit is OFF.

- Turn the unit ON and press **Menu**. It will offer to "Use with GPS Off". Hit **Enter** to accept. This means that it will not frantically try and locate satellites while it is inside a building.

- This first time, your computer may have a bit of a cow about "New Device Found" etc, but it will eventually calm down.

- Start IMG2GPS. A boring screen appears:
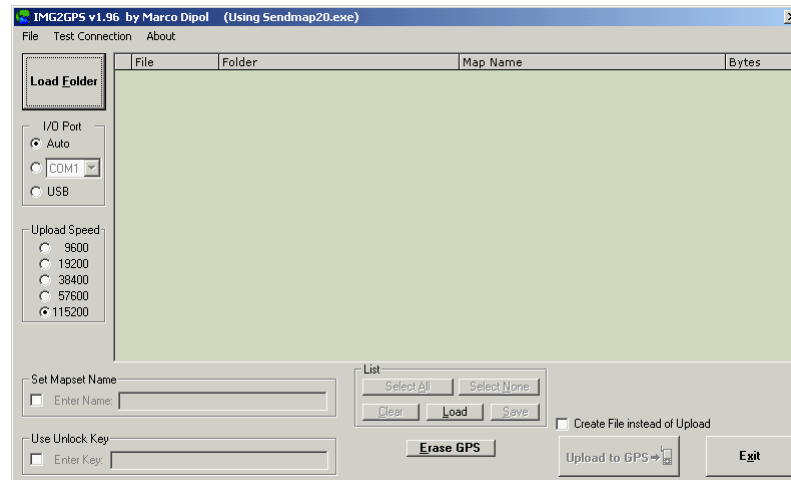
- Tell it to **Load Folder**, and point it at the folder where the IMG maps are stored. Screen should change to:
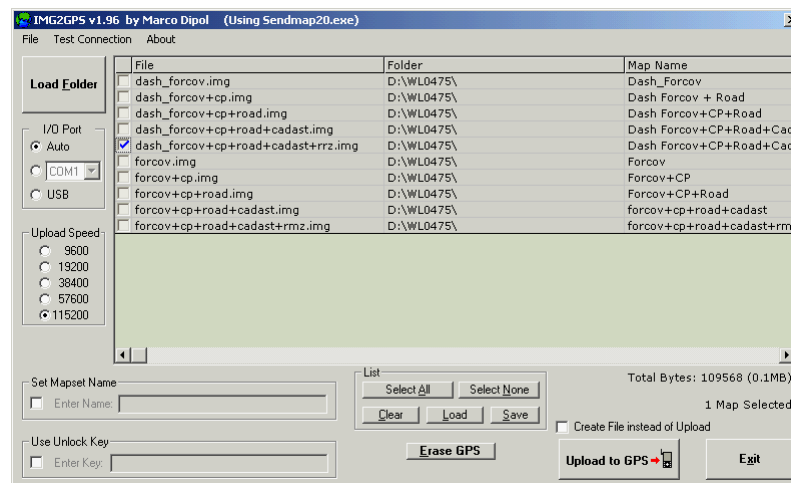
- Select the appropriate map, and tell it to **Upload to GPS**. It does its work, and the GPS beeps when it is complete.

(Note: IMG2GPS has show instability on some computers. If it will not work, switch to the old DOS program sendmap20.exe, which is found in the IMG2GPS folder. Double click sendmap20.exe to start it, or run it from the Start/Run window, or make it a shortcut. It has a simpler but very similar interface, and appears to be bullet proof.)

3   Field Work

3.1   Where Am I

- Turn the unit on (outside). It will take 2 to 10 minutes to orient itself and figure out where it is. This process happens best "in the open".

- The **Page** key cycles through some basic views. Press it until you are dropped into the **Map** page.

- The wee black triangle on the map page shows your current position. You use the **Zoom In** and **Zoom Out** buttons to control the map display scale.

- The **Satellites** page tells you how many satellites the unit can "see" at the moment, and gives you an estimate of raw accuracy levels. We are happiest with 8 meter or less accuracy.

3.2   Recording Data Points

You gather data about "feature locations" by collecting **Waypoints**. A waypoint is just a UTM reference with some optional attached text and a symbol. They show up in the GPS unit as soon as you collect them, and can be transferred back to maps and data sets in your home computer.

Plot locations are single waypoints. Road location traverses are strings of waypoints.

To collect a waypoint:

- Press and hold the **Enter** key. The unit beeps, and drops you into the **Waypoint** screen.

- If you have done this by accident, or if you make a mistake, press **Quit** to get back out with no harm done.

- Otherwise, watch the UTM coordinates on the display for a minute or so. Are they relatively stable? If you see continuous adjustments to the UTM coords, wait until they stabilize.

  On very unhappy occasions, the unit will suddenly go nuts and offset the UTM's by about 60 meters just as you were about to finalize the waypoint. This is a sign of declining reception quality (See Almanac). The new, wildly offset value is almost never correct. You likely are facing a long wait for it to get it's act together and revise the position (slowly) to a more realistic reading.

- While waiting for the Unit to stabilize, you can edit the waypoint symbol, key number, and/or note. You are free to collect all your waypoints with the same flag symbol and default names like 001, 002, 003, 004 if you wish. This works just fine if you are traversing a specific feature (road, block bdry) from start to end.

  Or you can keep a field notebook and write down what different waypoints mean:

  WP7 -> WP8 -> WP10 -> WP12 = Block Boundary

  WP9 = Fire Scarred Vet

  WP11 = CL of S6 Stream

On many days you will find yourself collecting a mix of data – such as 500 m of block boundary, a reach of ephemeral creek, and a potential spur road location. In these situations, it is best to take the time to at least use different symbols for different features, and often a great help to take the time to rename at least the POC and EOT waypoints of each data string.

- To edit symbol or text, highlight the relevant box and press **Enter**. You are dropped into an options menu. Entering text names is a complete pain – you highlight individual letters and press enter one at a time – but can be done. When you are happy with your text label, highlight **OK** and press **Enter**. **Quit** drops you out of either menu without saving changes.

- When you are happy that the UTM cords are stable, and you have done any renaming or resymbolizing that you want, highlight **OK** on the Waypoints main screen and press **Enter**. Your waypoint is now saved, and shows up on the Map page.

Alternate Approach - Averaging Data Points

The Garmin has the ability to average a string of readings. This will not "fix" things when reception is truly awful - those 60 m jags will trash any average - but can be nice on most other locations. Unlike an industrial GPS like a Trimble, the Garmin does not record every point it averages for later consideration. It just does it in real time while you stand still. If you move around at all, the average will generally go haywire as your motion causes one satellite to go behind a tree and a different one to become visible.

- Press and hold the **Enter** key. The unit beeps, and drops you into the **Waypoint** screen.
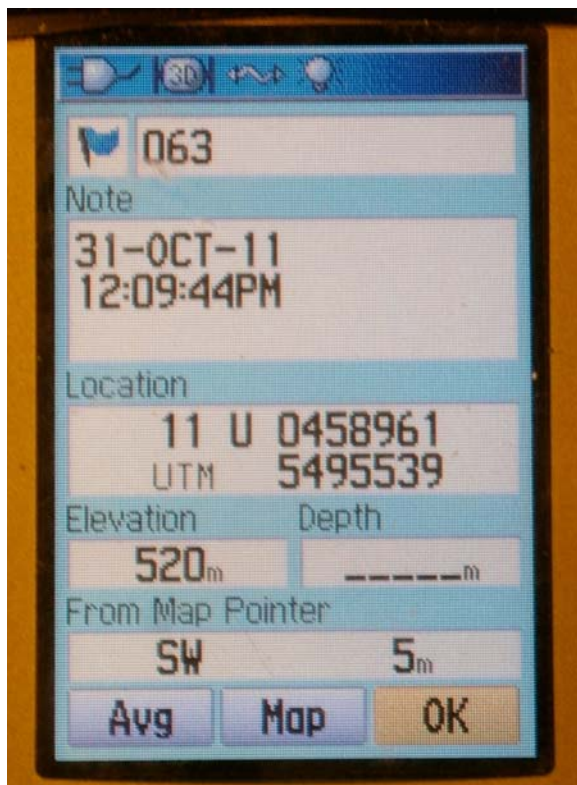
- Use the rocker pad to move the highlight from <OK> to <Avg> and then press enter.
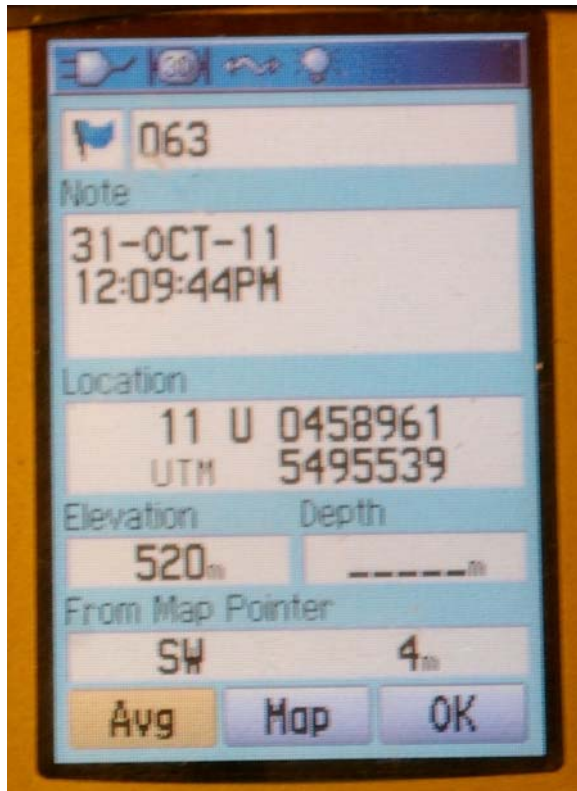
- It drops into a new screen and starts recording entries and averaging the results. Let it record about 50 entries and then press the <Enter> button to <Save>.
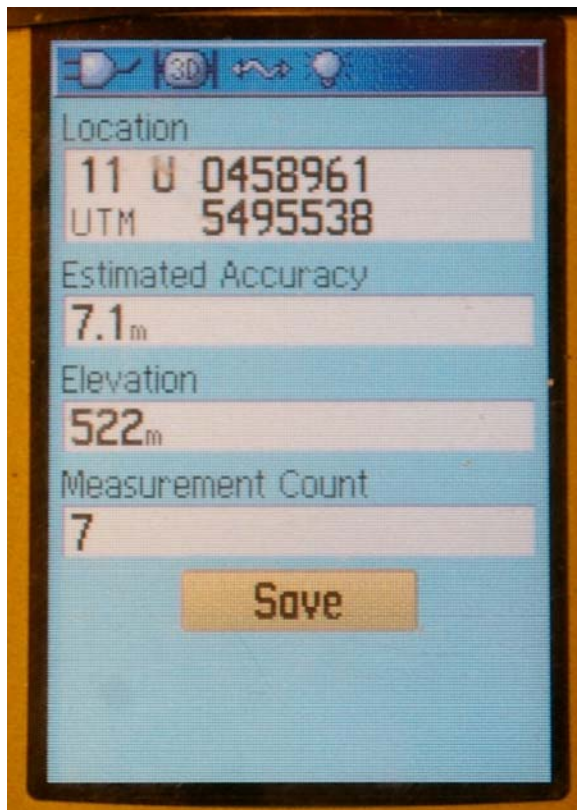
- It drops you back into the earlier screen.
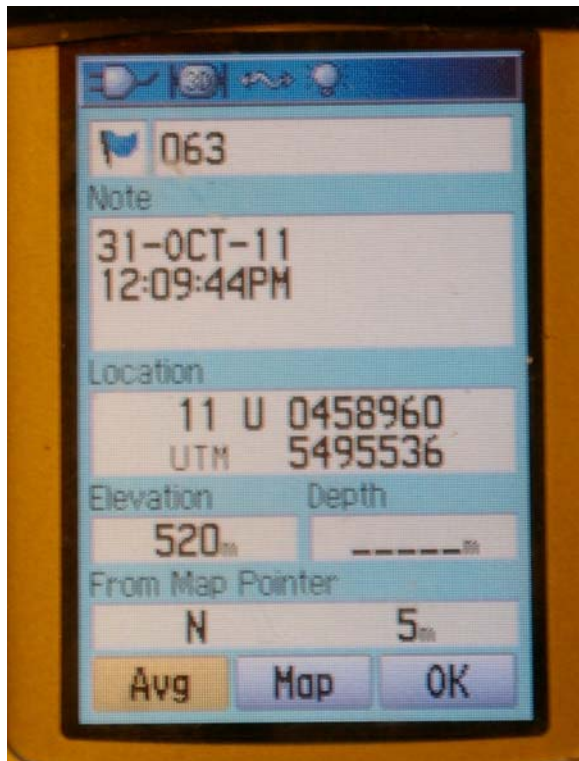
- You have to use the rocker pad to get the cursor back to <OK>, and press the <Enter> button to save your waypoint. Or, if you want to edit the waypoint attributes or name, you can do so by navigating about with the rocker pad, making your changes, and then <OK> <Enter>.
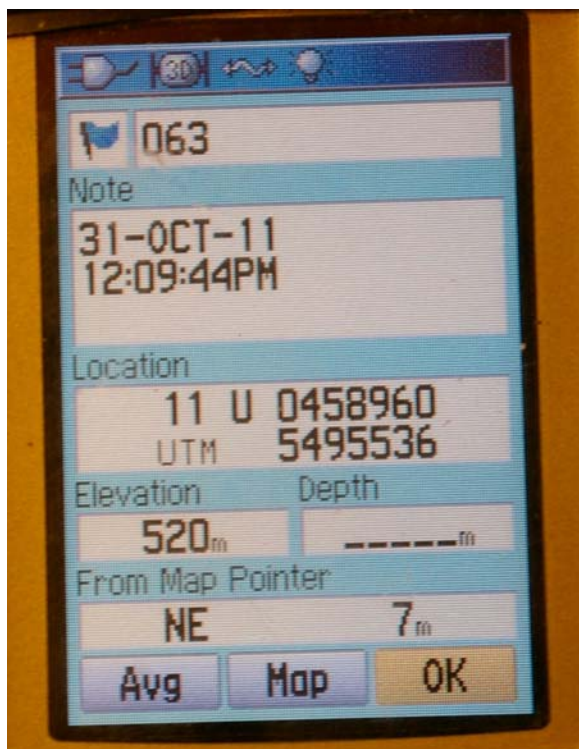
- A waypoint!
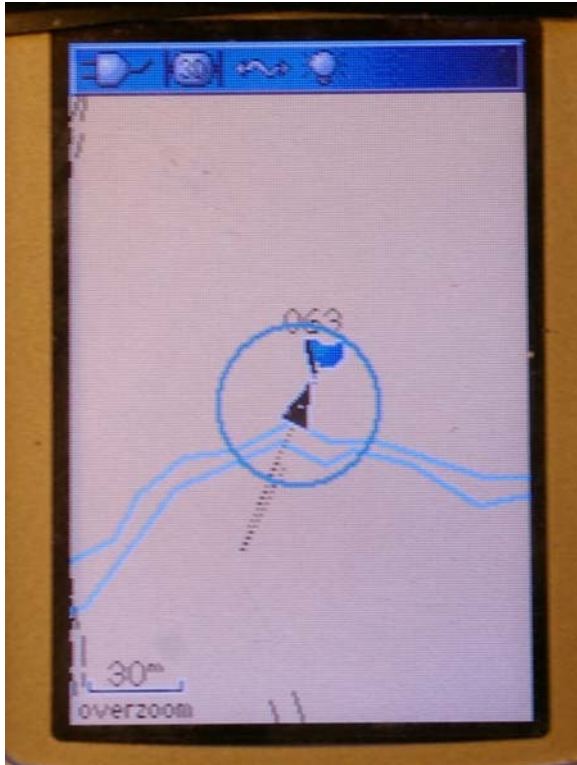
3.3   Erasing Data Points

After you have downloaded your Waypoints to your computer and saved them on the computer, you may (likely will) want to erase them from the GPS. To do this:

- Press **Find**. You drop into a menu screen. Likely with Waypoints option already highlighted. If not, highlight it.

- Press **Enter** to get into the Waypoints management screen

- Press **Menu** to bring up options

- Select **Delete** and press **Enter** to bring up more options

- Figure out how to tell it what Waypoints you want to delete (all of them, a specific symbol, whatever.) Then Delete.

3.4   Tracks

The Garmin "Record Track" feature is fun to use.

It is not useful for gathering field traverse data, as it runs all the time and you cannot tell when the GPS was "on" the traverse line and when it was elsewhere. Waypoints make for much clearer data traverse.

However, the track shows you where you have been in a day, tells you how far you have walked, and can easily answer the important question "Wait a second! Have I been here before?"

It also helps clarify the relationship between waypoints back in the office, if there is any confusion at the end of the day.

It is generally a good thing to turn the track on at the start of a day, and turn off and save at the end of a day.

3.5 General Interest

- You will notice that the pointer is always telling you "helpful things" like "Pipeline" or "Trail" when you are not near a trail or pipeline. There are only so many line symbols for a Garmin, and *none* specific to forestry. So we have to use lines that look relatively ok from other sources. Try and ignore the helpful information, irritating though it is. When you are not near a line, the cursor displays the polygon number you are within, which actually is quite useful.

- A set of disposable AA Alkaline batteries lasts about 1.5 days of continuous field use. Lithium batteries last 4 days or longer. Rechargables have a habit of lasting less than a day. The unit does not loose its memory when the batteries go dead or are changed.

- I rigged an attachment harness for the external antenna on a favourite pack. That way, you can take off the antenna to do other things.

- The connection on the GPS unit for the external antenna is a weak point. I lash the external antenna cable to the GPS with a long strip of electrical tape cut in half, and wrapped around the body of the unit between the Enter key and the screen. Clunky – you have to take it off to change the batteries – but effective.

   I also rigged an attachment point for the lanyard on the pack harness in such a way that the GPS is stopped by the lanyard when you drop it, not by the antenna cable.

- The unit senses the presence of the external antenna automatically.

4   Post-Field Office Work

4.1   Moving Data Points from Garmin to Computer

You need to have the Garmin MapSource software installed on your PC (from the CD that comes with the GPS unit). You should likely check the Edit: Preferences after install. For sure Position needs to be set to UTM and NAD83, and you should set File Location to a folder of your choice that you can find later on your hard drive. (Certainly not C:/Documents and Settings/Default User/Application Files/this tree/could go/on/for ever/etc).
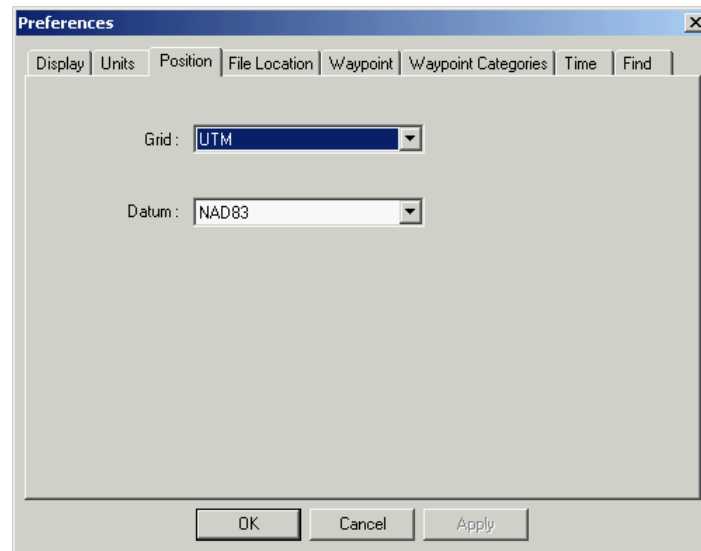
Now to business:

- Hook up the GPS unit to the USB connector cable while the unit is OFF.
- Turn the GPS unit on.
- Start MapSource.
- Click <Transfer> <Receive from Device>
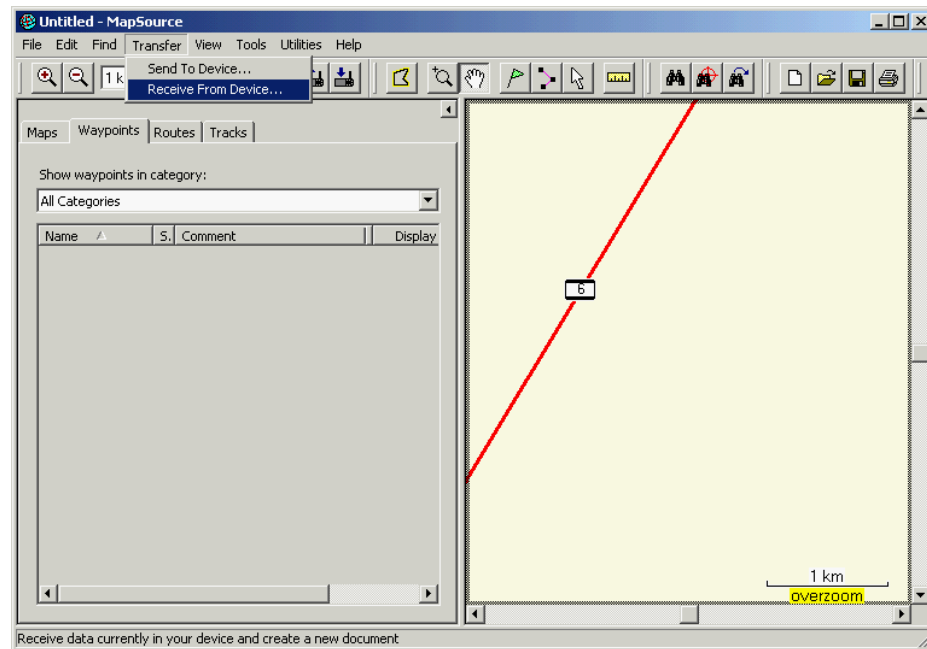
- It pops up a new screen and volunteers to receive your waypoints. Obviously, agree with it.

- It then throws your waypoints into MapSource.
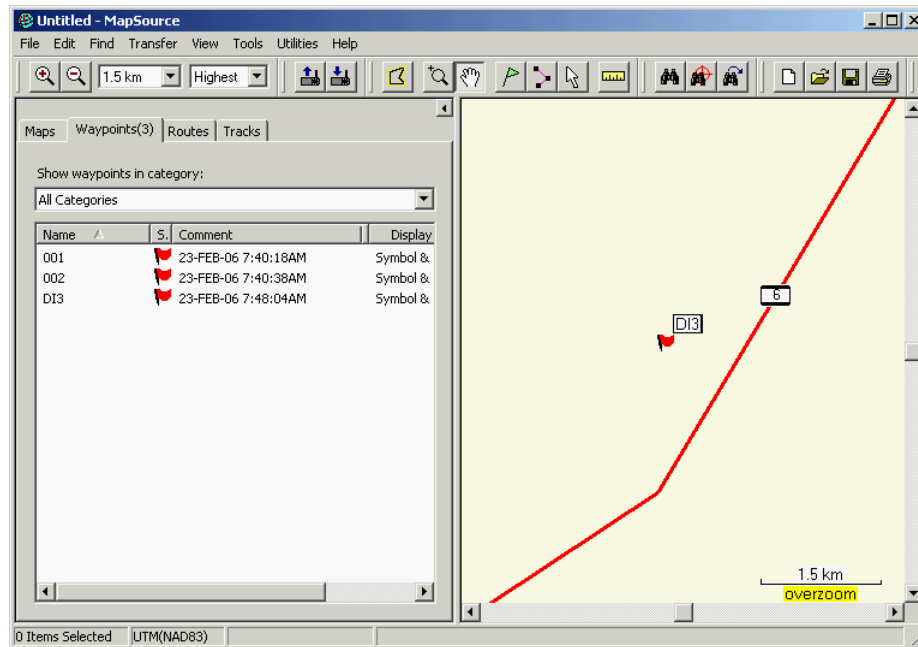
- If you don't actually see anything, adjust the View. Click a waypoint in the list to select it, then hit **View: Show Selected Waypoint on Map** and it will zoom to that waypoint location. You can zoom in or out on the map, and do lots of other things.

- At this point, Save As. You set the default folder it will save to in Preferences. But you will likely want to save it to a different specific workspace, and need to choose a file name. If it is a block boundary, something like CP_A_Blk_1_May7_10.GDB is probably good. If it is a mix of different features, you may want to go with just the date. Remember to try and name it so you will know what is in the file a year from now. But the key point is simple: save it NOW!

- After your data is saved, you can edit it. To edit, SAVE IT AGAIN WITH A NEW NAME. Then do unto the renamed copy of the data. This way, your original is always safe. If an editing disaster occurs, you have not lost the valuable original data.

- You can delete points at will. For example, if you had traversed a road and a stream in one day, you would make a copy of your raw data called Road_207_May7_10.GDB, and then edit that file and delete all of the stream waypoints. Then reload your master file of "all the data", save it as Stream_May7_10.GDB, and delete all the road data

- You can edit waypoint names and symbols as well, if you wish.

- If you go back out in the field and modify the road or add more road traverse at a later time, you can copy and paste the new waypoints between GDB files.

4.2   Making a Shape File from Your Garmin Field Data for GPSMapEdit

The point: After you traverse something, you may want to add it to a Garmin base map as a feature. There are several ways of doing this. The low cost option is described below.

1. Open Gamin MapSource. Load a Garmin *.GDB file containing the waypoints that you want to use to define your new Garmin map feature.
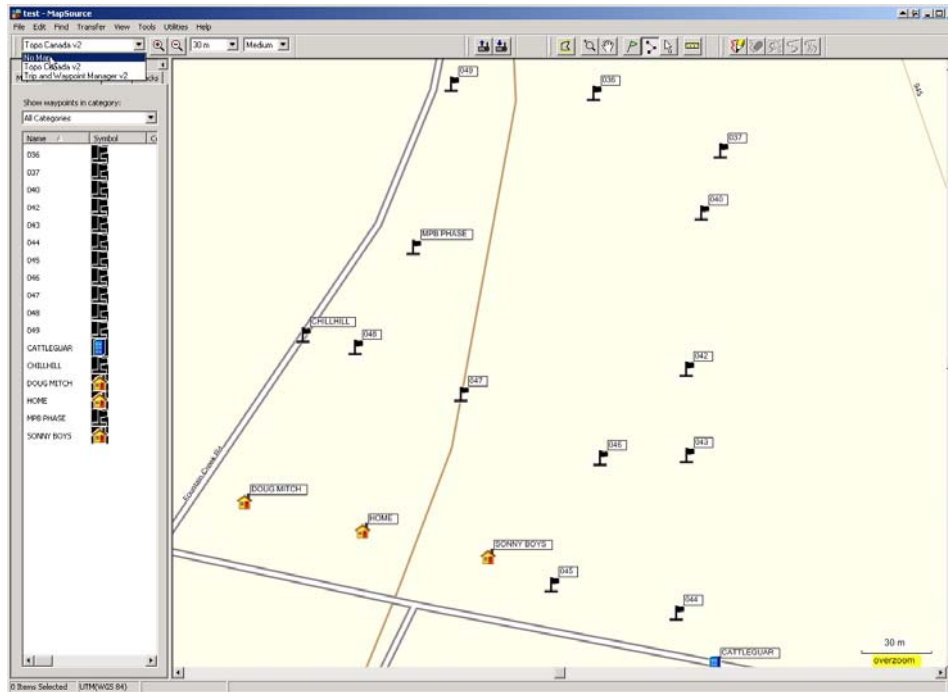
Turn off the background map, if any is in effect. A background map will cause trouble when you "draw" in a minute.

2. Switch to the Routes tab and select the Routes tool.
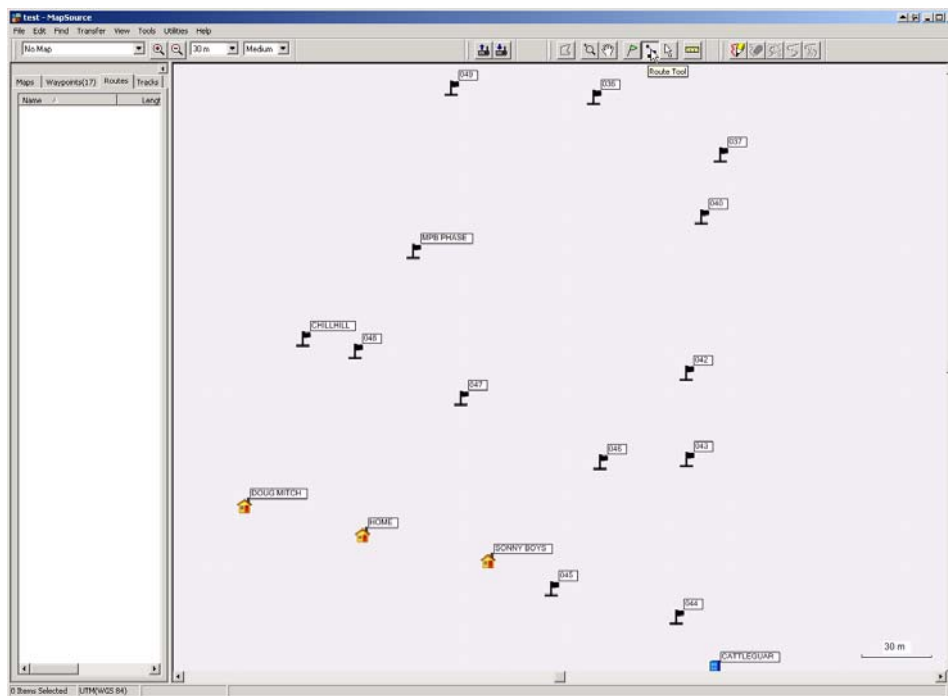
3. Draw your polygon (closed shape) or line (open shape). The route tool snaps to waypoints, which is very useful. The waypoint is surrounded by a small circle when the route is snapped to it.
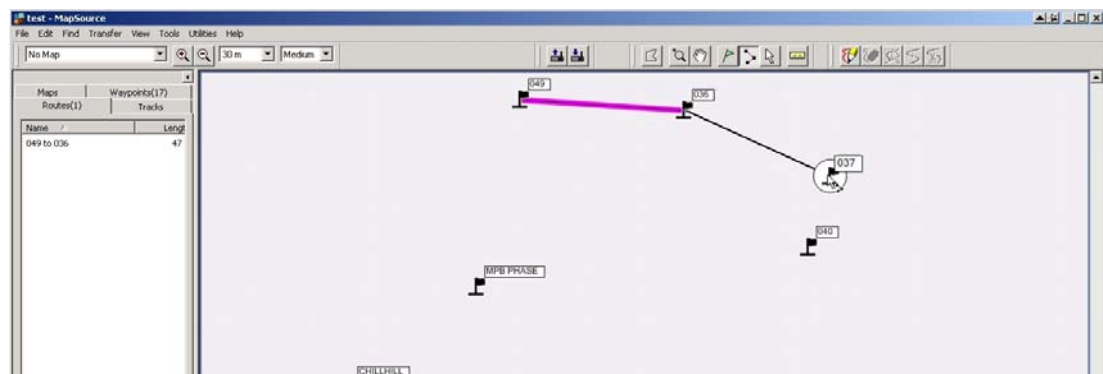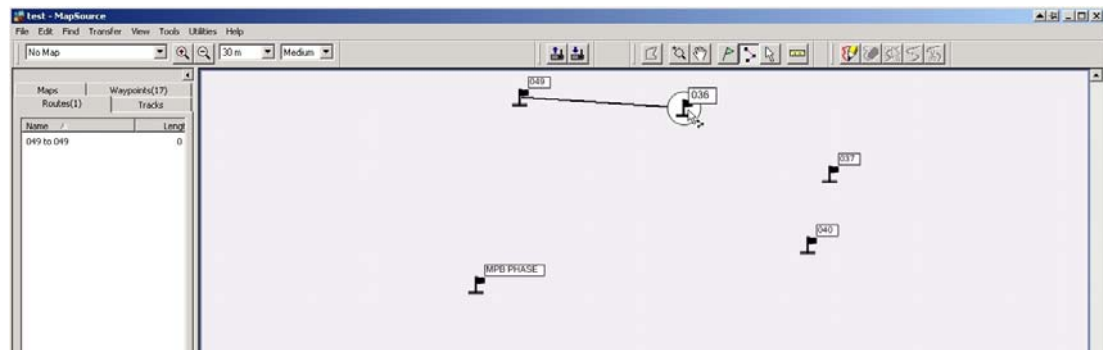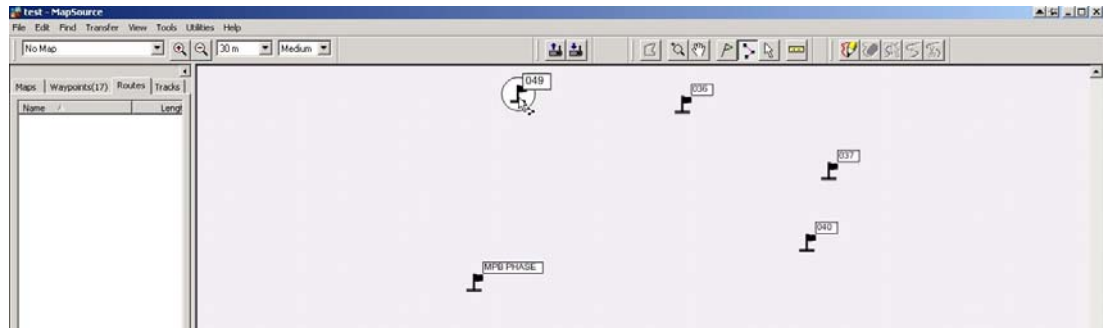
4. To close a polygon, snap the last line segment to the starting point, and double click.
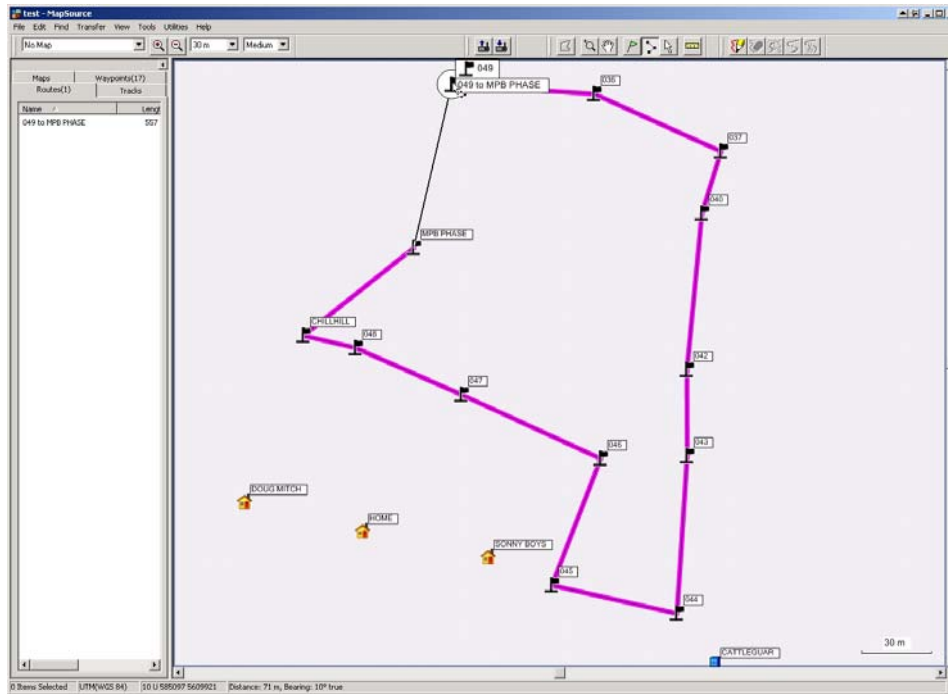
5. Go up to the menu bar and select some other tool to turn off the Route tool.
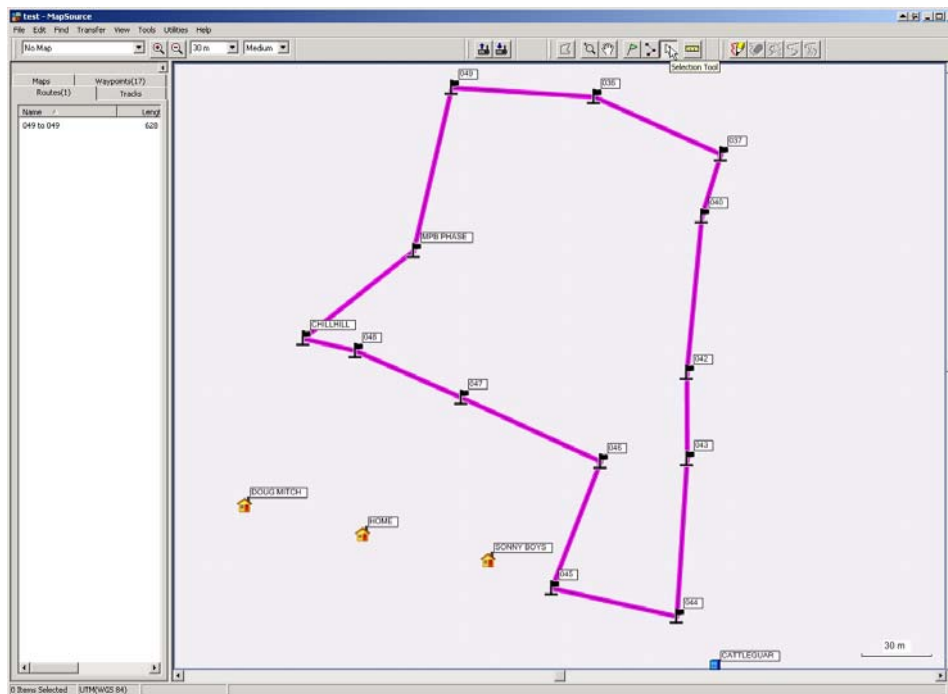
6. Save the *.GDB file to save your new route, and then Save As a *.GPX file.
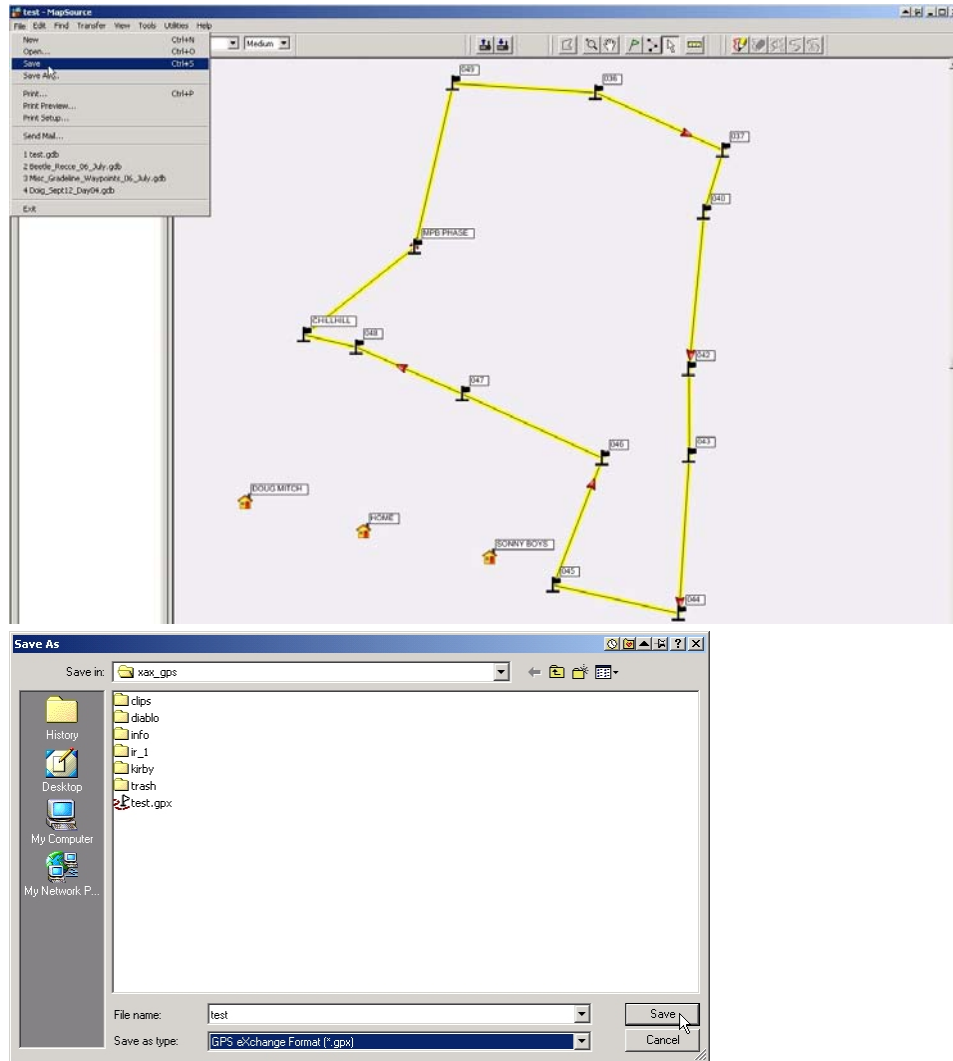
7. Open DNRGarmin. It will complain if the GPS unit is not attached to the computer and turned on. Ignore it.
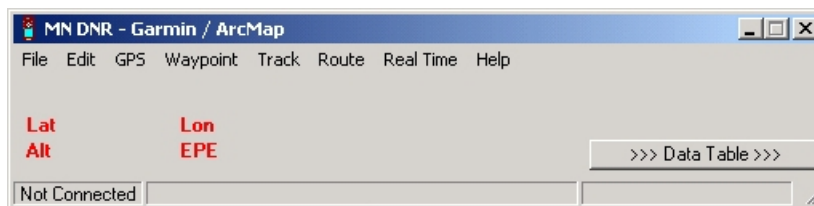
8. Load the GPX file you just saves from MapSource, and tell DNRGarmin it is a Route file when it asks.
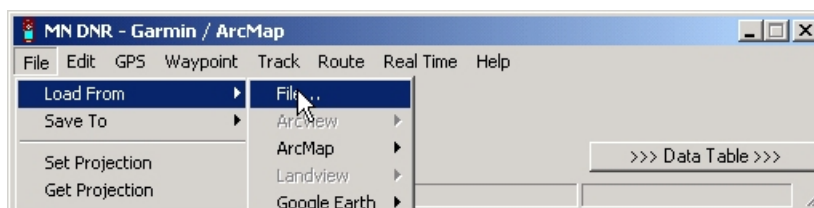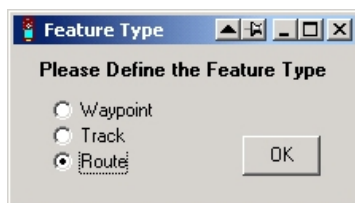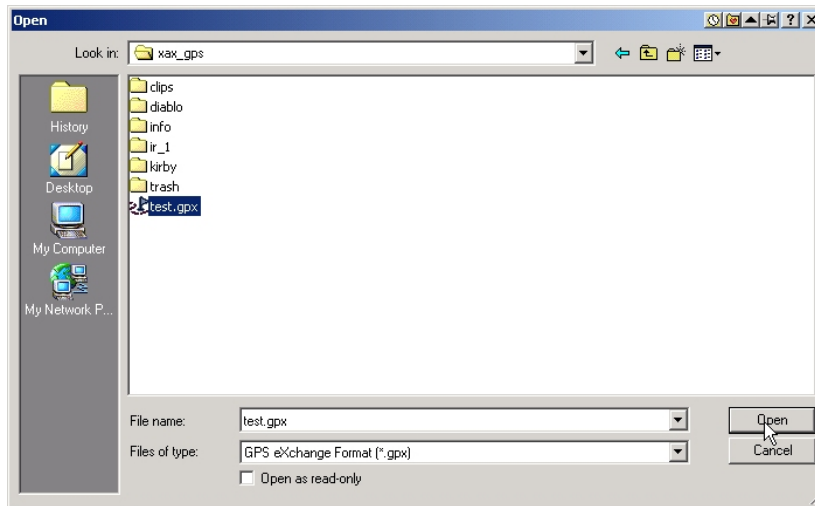
9. A table of data (your GPX file) shops up in DNRGarmin in the Route tab. Very nice, but you can't do anything with it. Go to the Track tab.

10. Use the standard Windows method – click on first record, hold down shift key, click on last record – to select all of the track records. A Select All button would be very nice, but does not seem to exist….

11. Send the Track off to ArcMap as a shape file. There are two paths to do this, but they have the same end result. Use either one.

    Path 1:

Path 2:

You have to tell DNRGarmin what sort of feature you are making: a polygon or a line. Point features are not useful for us.
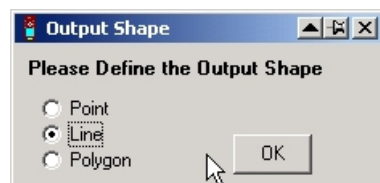

12. Unfortunately, "Same End Result" also means both approaches fail to do what they say they will: Neither one creates a *projected* Arc Shape File. They make a shape file, they just fail to make a projection file for the shape. Regardless, the fix is simple.

A directory listing including our new Test_Polygon shape is below. As you can see, other shape files have a *.prj file, but Test_Polygon does not.
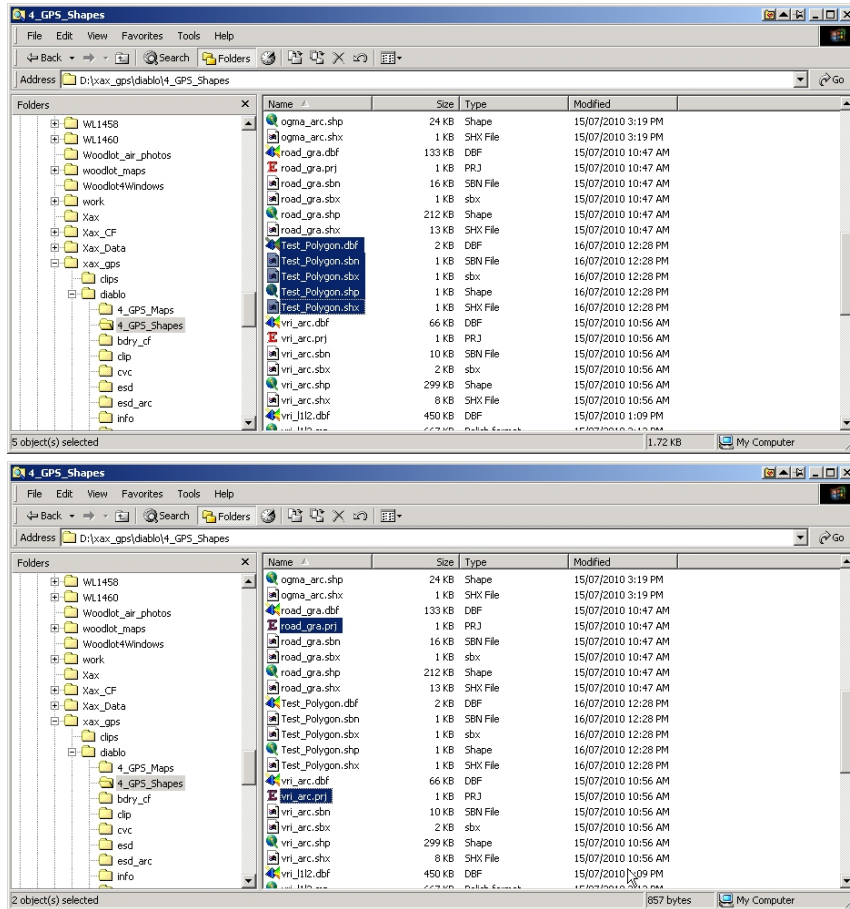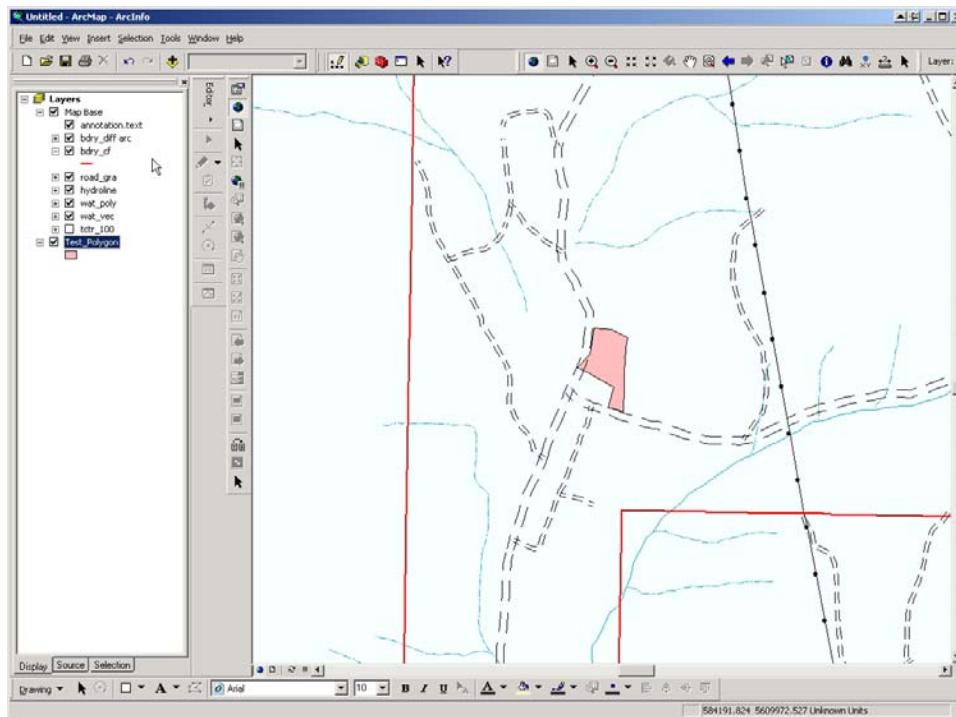
The fix is to copy one of the other *.PRJ files and then rename it to Test_Polygon.PRJ
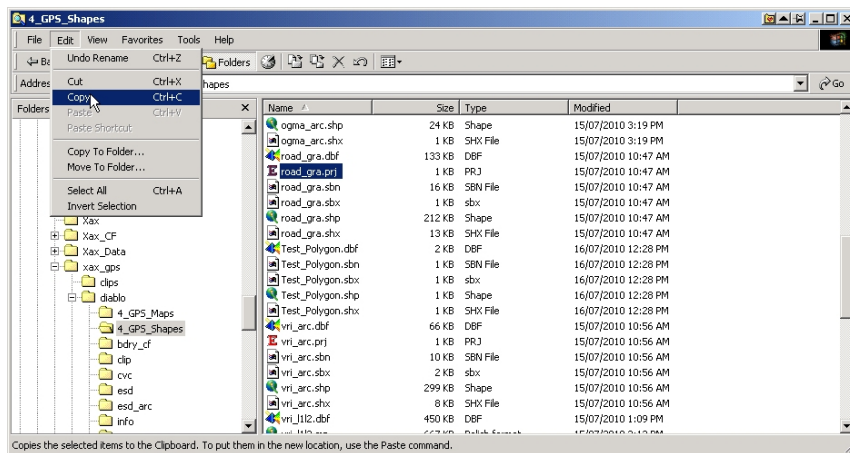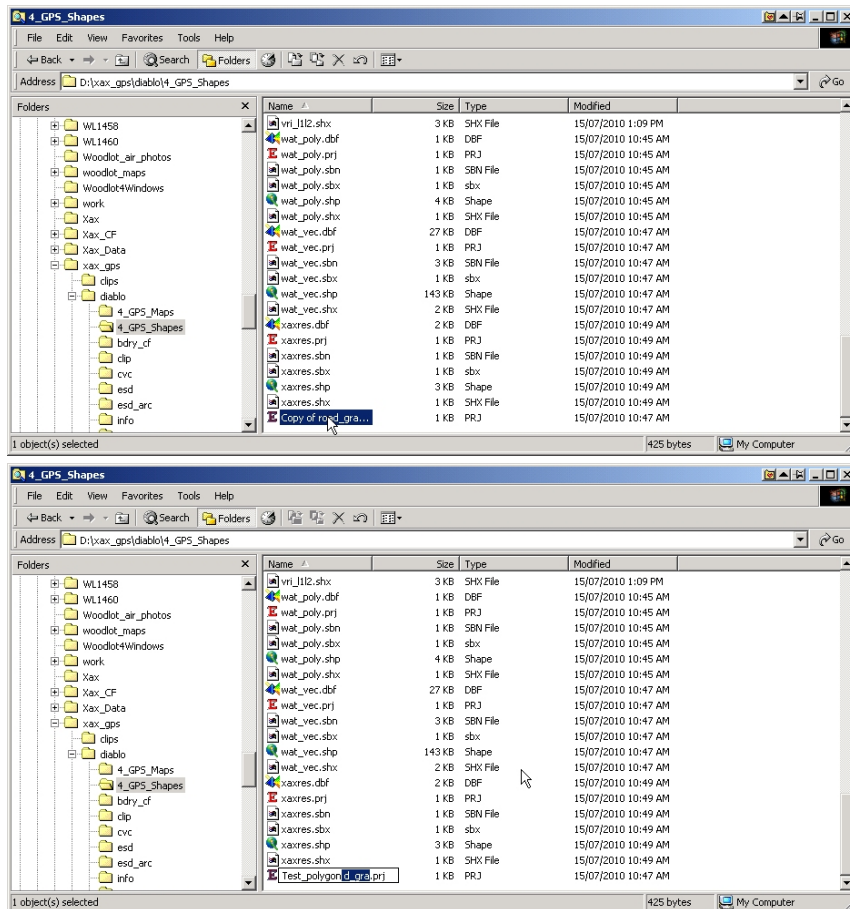
13. And that is about it. Here is our new polygon loaded into ArcMap:

There seem to be a few issues around the road, but other than that, it looks fine.
That is why we are moving to an external antenna!

Because it is a shape file, it can now be moved into GPSMapEdit and then to the Garmin as part of the base map. Exactly the same thing could be done with a line feature.

4.3   Almanac - Planning

You will need to become familiar with the Satellite Almanac. The full Almanac is a very complex data set of satellite information. Fortunately, what we are interested in is a simple subset: how many satellites are overhead at any given time?

The number of satellites changes constantly as the network of navigation satellites orbits the earth. The reliability and accuracy of the GPS fall off dramatically when too few satellites are available. You will likely notice that *something* is wrong if you are using the unit at such a time – the unit will start beeping and announcing that is has "lost reception", and/or accuracy levels will decline to 20 meters, then 32 meters, etc.

Use the almanac to plan your day – no sense going out to GPS right at the start of a 45 minute "lousy reception" window.
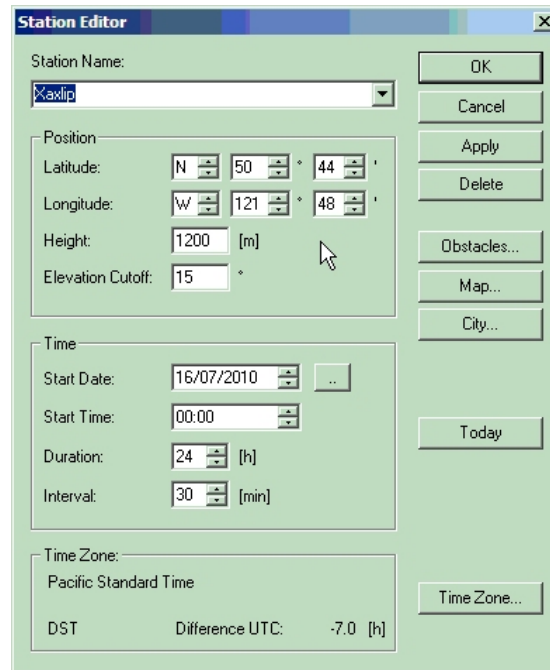
One source is for almanacs is http://www.trimble.com/planningsoftware_ts.asp This is not "Garmin Specific", but I have found it reasonably predictive of reception gaps. A current copy is included on the enclosed CD. The Almanac changes over time, so downloading a new copy every month or so is required.

Once you have to downloaded and installed the Almanac software, you need to set it up.

Open the program and go to File/Station.
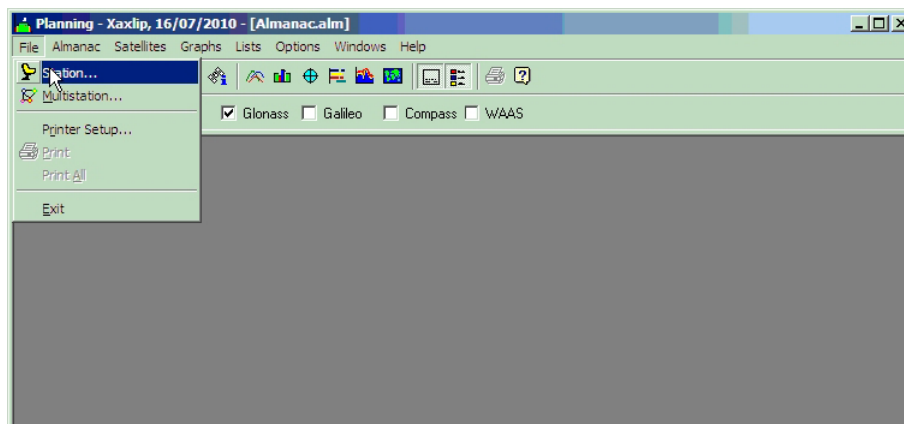
Fill in the information below:

That "time zone" is hours later or earlier than Greenwich Mean Time. Be sure to have daylight savings time set correctly as well.

Elevation Cutoff refers to how high above the equator the satellites need to be to even hope to see them. 15 degrees is standard for southern BC. However, mountains can block off satellites, especially in a place like the Fountain Valley. Experience may show that a higher angle is more representative of actual local conditions.
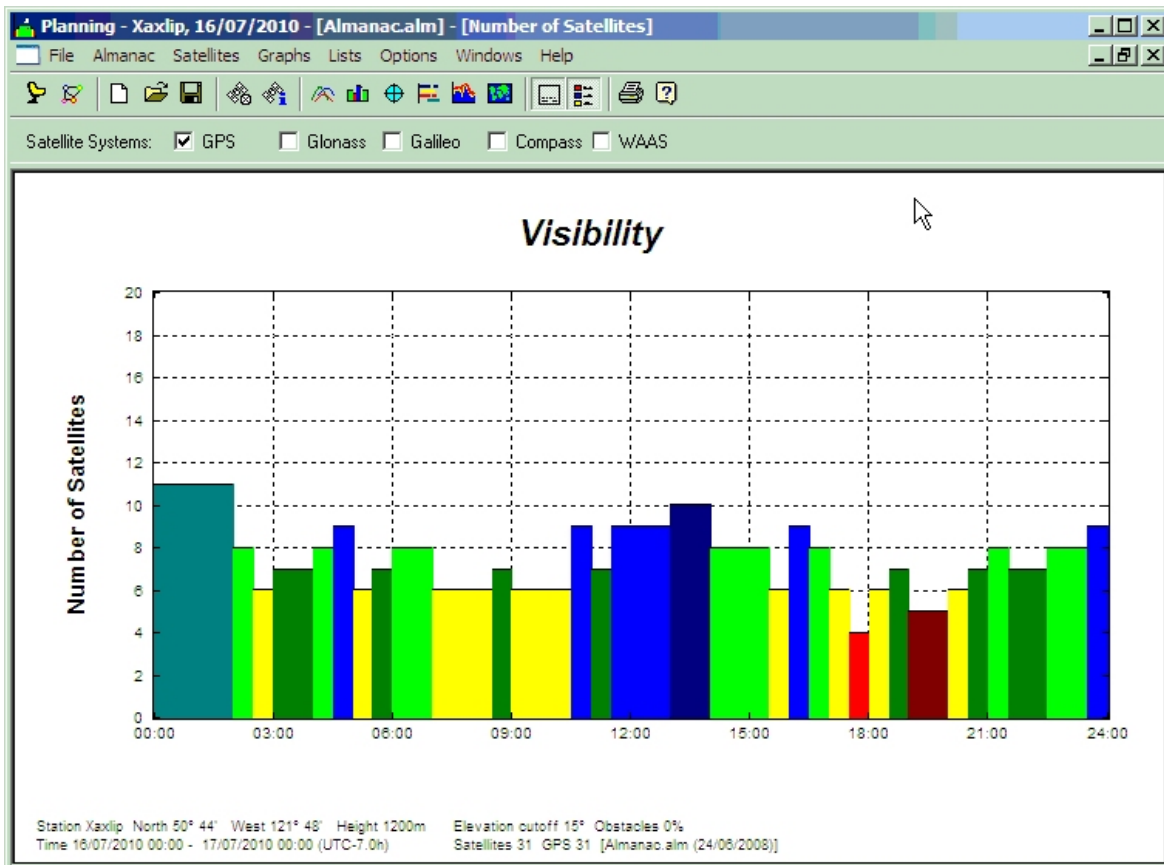
Go back to the main screen and turn Glonass off. It seems to default to "on".
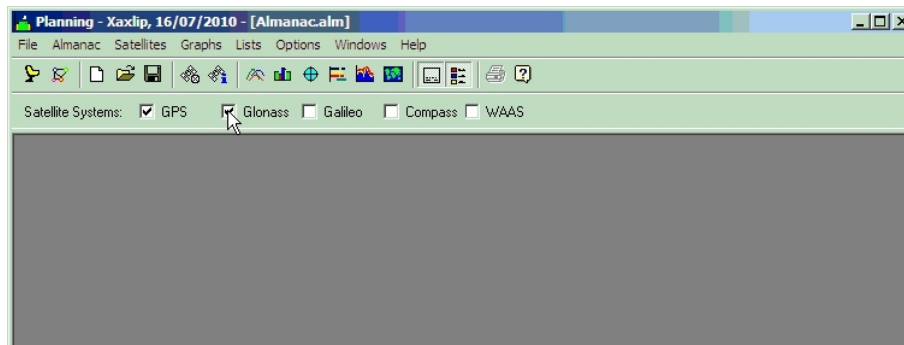
And then run the Number of Satellites tool.
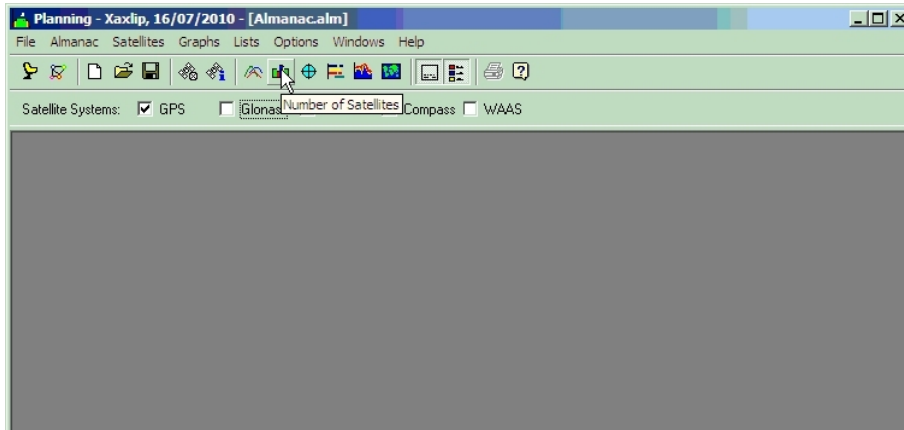
Which produces a colorful bar chart:

The more satellites, the merrier. Less than 5 satellites is "hopeless", so you certainly would not plan to be out getting data at 17:30. Things also look challenging at 19:00, but we will assume you are not generally at work at that time.

Remember that most of the time the GPS will not "see" all the alleged satellites, even if technically speaking they are up there. One of the satellites may be a bit low in the sky, another could be blocked by a tree. The almanac is a guide only, not a guarantee. Reception for the morning should be fair to middling, but excellent in the afternoon. Locate stuff in the a.m., traverse it in the p.m.

Here is a copy of the same satellite visibility chart, except the elevation cutoff is set to 20 degrees, to model potential terrain interference with satellite reception.
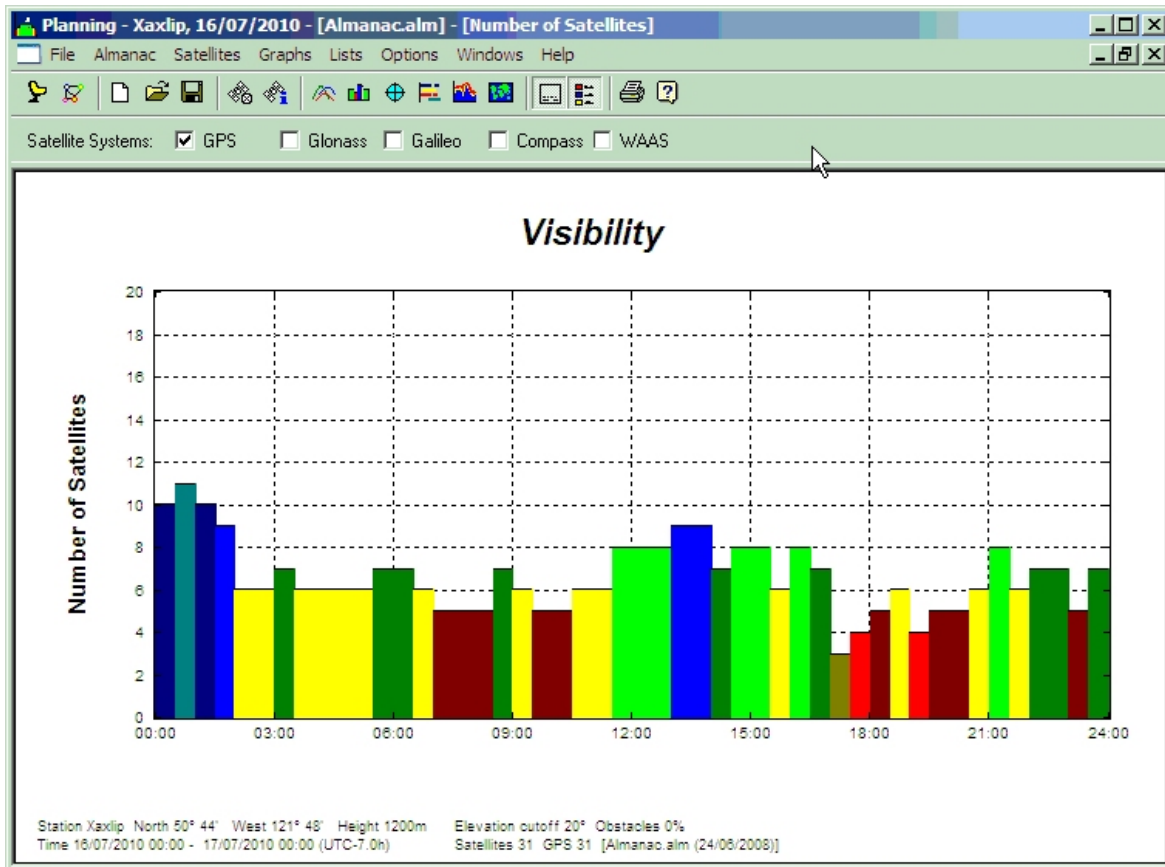
The increased elevation cutoff reinforces the points made by the first chart: morning reception will be spotty, afternoon reception will be good, evening reception will be unusable.