

Using the Trimble GeoXT (Windows Mobile 5/GeoExplorer 2005 Series) GPS unit in the field

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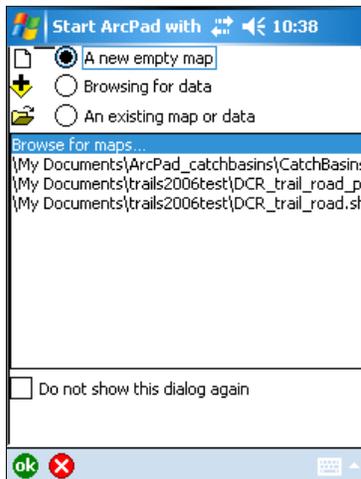
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This document describes using the Trimble GeoXT (or GeoXM) GPS unit in the field. It specifically refers to the GeoExplorer 2005 Series units running the Windows Mobile 5 operating system, using ArcPad 7 with GPScorrect 2. If your GPS unit doesn't have eleven buttons on the front you are using a different version of the GeoXT/GeoXM and should refer to the older version of this document.

Before using your GPS unit, make sure you install the software as detailed in the "Updating GeoXT Software (Windows Mobile 5)" document, and enter your settings as detailed in the "GeoXT Settings (Windows Mobile 5)" document.

Starting

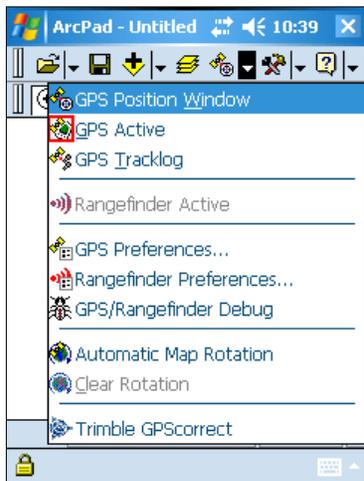
Press the power button (green button on front of unit) briefly to turn the unit on. A Windows-like desktop should appear. You can launch ArcPad in one of three ways: by tapping the word "GPS" at the lower right hand corner of the screen; by tapping Start (in the upper left corner of the screen) and then tapping "ArcPad 7"; or by tapping Start, tapping Programs, then tapping ArcPad 7. ArcPad will take a little while to launch, so be patient.



When ArcPad opens, you may be presented with a screen that asks if you want to start ArcPad with "A new empty map", "Browsing for data", or "An existing map or data". For now tap "A new empty map" and tap OK (green circle in the lower left hand corner). In the future you can try opening an existing map to save time, but for instructional purposes this document will describe starting with an empty map. In some cases a previous user may have disabled this startup window, and you may go directly to an empty map.

Now you should see the standard ArcPad window. It has two toolbars at the top and a large blank map area in the middle. First off we should make sure that GPS is active, which means that the GPS unit is looking for satellites. If you see a red circle icon in the middle of the map area (either a red circle with a line through the middle of it  or a red circle with a crosshair in the middle and a pointer

sticking out of one side () then GPS has already been activated. If not, you should tap the dropdown arrow



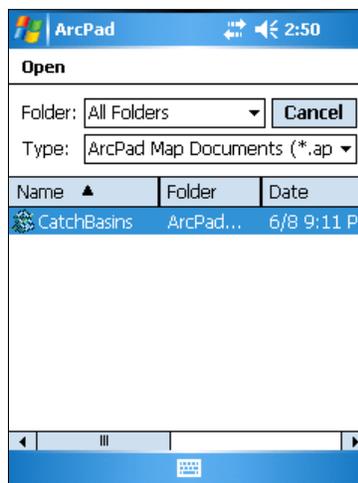
(small black triangle) next to the satellite icon on the top toolbar (between the three-yellow-pieces-of-paper icon and the hammer-and-wrench icon). Tapping this dropdown arrow will make a menu appear. In the menu should be a choice called “GPS Active”. If there is a red square around the icon next to “GPS Active” then GPS is already active, so tap the dropdown arrow again to make the menu go away. If there is no red square, tap on “GPS Active” to activate the GPS. This may take a few seconds, so resist the urge to tap it multiple times.



Opening an existing project



If you have an existing ArcPad project file loaded on your GPS unit, you can open it now. Tap on the Open Map button (it looks like a manila folder). You will be presented with a list of the available projects. Tap on the one you wish to open. Be patient – it may take some time to open.

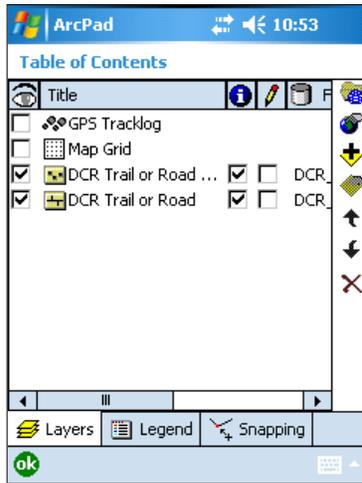


Adding data

If you do not have a preloaded project on your GPS unit, or you want to add additional datalayers (shapefiles or background image files) you can do so by clicking the Add Layer button, which looks like a black plus (+) symbol with a yellow background. This will bring up the Add Layer(s) dialog, which will let you browse for data. On the Windows Mobile 5 GPS units we keep our data in subfolders within the \My Documents\ folder (in the Add Layer(s) dialog, these folders may appear directly under “Main Memory”). Expand the directory tree by clicking the + signs until the datalayers you want appear, then check the checkboxes of the layers you want to add. Tap OK.



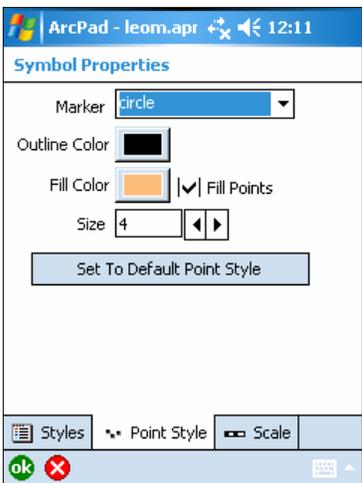
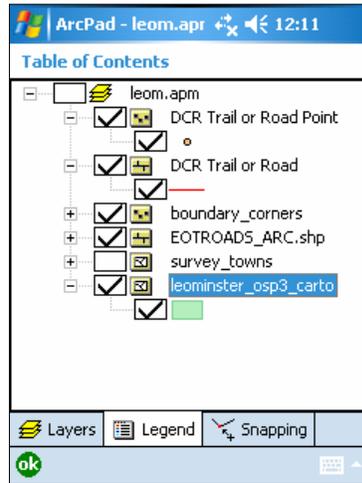
Once you have your layers added, tap the Table Of Contents button (looks like three yellow pieces of paper) to bring up the Table Of Contents dialog. In this dialog, you



can reorder the layers, turn layers on and off, and change the color of layers, among other things. The column of checkboxes under the eye icon control layer visibility. Tap a layer's name to select it, and tap the up and down arrows to move it up and down (the layers draw from the bottom up, so the higher-up layers will draw on top of the lower-down layers), or tap the Properties button (on the right, just above the up and down

arrows – it looks like a hand pointing to a yellow shape) to bring up a dialog where you can control many properties of the layer. You can also tap the Legend tab to change the color of the layer. Expand a layer by tapping the plus symbol to the left of it and tap its symbol. On the

Symbol Properties screen that comes up, tap the Point Style (or Line Style or Polygon Style) tab, and then adjust the symbol style (you may want to tap the Set To Default Point (Line/Polygon) Style button to start with a standard symbol).



Creating a new layer

ArcMap works by allowing you to edit and add GPS data to shapefiles (a GIS data format that stores map (location) and attribute (database) information). You can add data by drawing and manipulating it on the map, but you are more likely to add data from your physical position on the earth's surface, as taken from GPS readings. If you have worked with the Trimble GeoExplorer I, II, or 3, or the ProXR units, you will notice that ArcPad works much differently. Instead of logging GPS data to a rover file, you will be directly editing shapefiles—you're essentially doing GIS work in the field.

In most cases GIS staff will prepare a shapefile for you to edit, with all the fields (database columns) you need for attribute entry, and in some cases a custom data entry

form. If the layer you want to edit does not already exist, you'll need to create a new layer (shapefile) to store your GPS data. Tap the dropdown arrow next to the Open Map button and tap New, then Shapefile. Choose Point, Polyline (line), or Polygon (closed shape) from the Type dropdown menu depending on what type of data you want to collect. For instance, if you want to create a layer for trails, choose Polyline. If you want to create a layer to store property boundary markers or soil sample sites, choose Point.

You'll want to add columns to the data table that is associated with your shapefile. If you have a similar shapefile on the GPS unit, you can import its fields (database table columns) by tapping Import... Otherwise you can manually add fields with the plus (+) button. Tap +, give your field a name*, choose the type of data the field will store (text, number, date, or True/False), and choose a length for the field (and a precision, or number of decimal places, if it is a number field). Tap OK when done. Add as many fields as you need, using the + button. Examples of fields would be Comments, Trail_Type, Name, Date, Took_Photo, Num_smpls, etc. It is a good idea to use a standardized set of fields wherever possible. If you have used a GeoExplorer or ProXR in the past, the fields essentially take the place of the Data Dictionary concept—they enable you to store information about each point or line or polygon you capture using GPS. You should always have at least one field, even if it's just a Comment field.

* To enter text into any text box, you need to use the keyboard, which appears on screen. If the keyboard doesn't appear automatically, you can bring it up by tapping the keyboard icon at the bottom of the screen. Just make sure the blinking cursor is in the correct input area. Close the keyboard when you are done by tapping on the keyboard icon again.

Click OK and choose a name for your new shapefile and what folder you want to store it in. If you are asked if you want to create a QuickForm, say no (if you want to learn how to create a QuickForm, refer to your ArcPad 7 manual). Now you have a new empty layer that you can add GPS location information to! When you create a new layer, it automatically becomes editable. You can change layers' edit status using the Start/Stop editing dropdown or the Table Of Contents button. You can simultaneously have one point, one line, and one polygon shapefile editable.

Moving around the map

ArcPad has fairly standard panning and zooming tools. They are on the second toolbar from the top. The first dropdown toolset has the Zoom In, Zoom Out, Pan, and Rotate Map tools. Tap the dropdown arrow and tap a tool to select it; it will appear pressed-in. Now tap or tap-and-drag on the map display to use the tool. The second and third dropdown toolsets on the second toolbar contain additional zooming buttons (these do not need to be selected and then used on the map display like the tools in the first dropdown toolset – they function immediately when tapped). If you use the Rotate Map tool and you want to set the map back to normal (North = up) rotation, you can tap the dropdown arrow next to the satellite icon on the top toolbar and choose Clear Rotation. If you want to zoom to a specific



scale (this was under the third dropdown on the second toolbar in ArcPad 6 and has been moved in ArcPad 7) you can tap the dropdown next to the Open Map button, select Map Properties, tap the Scale tab, and type the scale you want into the Scale box.

Finding your current GPS position

Before trying to collect data, make sure that you are receiving GPS positions. You can determine this in two ways: in ArcPad, there will be a red circle with a pointy end  that should be moving around slightly as it receives positions from the satellites. If this circle has a red slash through it  instead of a yellow crosshair and a pointy end, you are not receiving positions (if the circle is not visible at all, the GPS is not active – see “Starting,” above). Or, you can look at GPScorrect’s Skyplot screen; this will show you which satellites are in the sky and which you are receiving signals from, as well as whether you are receiving WAAS signals. If you are receiving enough signals, it will also tell you your location’s coordinates. See the Troubleshooting section at the end of the document for more information about GPScorrect. The GPS unit also uses a variety of sounds to indicate that it has lost or regained a position signal. The Troubleshooting section has a number of steps you can take if you are not receiving position data.

Making layers editable

To record GPS positions you need to make one or more of your shapefiles editable so you can add points or lines or polygons to it (a given shapefile can only hold one of the three). You can do this through the Table Of Contents dialog as mentioned above, or you can use the Start/Stop Editing tool, which is toward the right side of the second toolbar – it looks like a flying pencil. Tap the dropdown arrow to the right of this tool and tap the layer you want to edit from the list of shapefiles. Editable



layers will have a red box around their icon (the icons indicate whether the shapefile is point, line, or polygon). You can only edit one of each type at the same time. When you have a layer editable, the edit toolbar will appear. It will be the third toolbar from the top.

Adding a point from GPS

To add a GPS point at your current location, you must have a point shapefile editable. Stand still, holding the GPS unit at shoulder level, and tap the Capture Point Using GPS button, which is the third tool on the third toolbar. We normally have our GPS units set up to take 30 readings for a point, which gives a more accurate position by averaging the 30 position readings.



Stand still while the GPS unit collects the 30 readings (one per second). While this is happening, you can enter attributes for the point. If you have a custom shapefile, the form that pops up will have a tab or tabs of data entry fields. If you do not have a custom

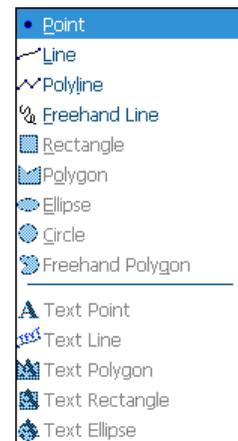
shapefile, you will have to type attributes in to the fields on the Attributes tab. Once you have finished entering attributes, scroll across to the Geography tab, which will indicate whether you have recorded all 30 readings yet (in ArcPad 7.0 this progress indicator does not appear at the top of the screen like it did in ArcPad 6). Tap OK (in the lower left hand corner) to save the point into the shapefile (or tap X to delete the point). Be careful as the OK and X buttons are very close to one another. Now your point is saved into your editable point shapefile.

Adding a line or polygon from GPS

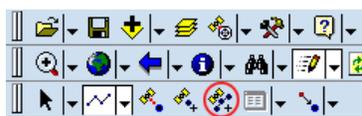
To add a GPS line you must have a line shapefile editable. Similarly, to add a GPS polygon, you must have a polygon shapefile editable. Lines and polygons are added in the same way, except for the tool chosen. A polygon will automatically have its last point joined to its first point to form a closed shape. All the instructions below work for both lines and polygons, although they are written for creating a line.



Stand at the beginning of the line (trail, sidewalk, etc.) you want to record. Tap the second dropdown arrow on the edit (third) toolbar. This will bring up the shape menu. For a line, choose Polyline (not Line, which is a single line segment connecting two points). For a polygon, choose Polygon. The shape you chose should now appear pressed-in on the third toolbar, to the left of the dropdown arrow you tapped.

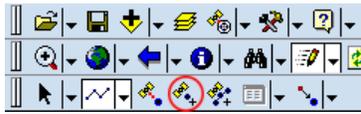


There are two ways to add GPS vertices to your line (or polygon). One is by streaming vertices, which will add a vertex to your line every few seconds (the interval is set in GPS Preferences; we usually have it set to 4 seconds for GPS collection while walking. If you are on a bike or vehicle, you may wish to set the interval to 1, 2, or 3 seconds since you



will be moving faster). Tap the Add Vertices Continually tool (it looks like a satellite with three connected dots and a plus sign). It will appear pressed-in, which means you are now adding vertices. Make sure that you are receiving positions from the GPS unit (see “Finding your current GPS position”) and start walking at a normal pace. Look at the screen occasionally and listen for sounds to make sure that you are continually receiving positions. If you stop receiving positions, you should slow down or stop until you are receiving them again. Otherwise, your line will have gaps that have no vertices (these will show up as long straight segments). Continue walking until you reach the end of your line. If you come to a sharp corner in the line, pause there for a few seconds to make sure you get a vertex there; otherwise the line may look like it “cuts off” that corner. When you get to the end of the line, pause for a few seconds to make sure you get a vertex at the end and then tap the Add Vertices Continually tool again so it no longer appears pressed-in. This will stop the adding of vertices. You can also pause the line at any time (if you want to reapply bug spray, tie your shoes, or take a look at interesting features along the line) by tapping this button, and then tap it again to restart.

The other way to add GPS vertices to your line is by adding a single averaged vertex.



Stand at the place where you want to add a vertex and tap the Add A Single Vertex button. This will bring up a screen that shows the progress of the vertex. We typically have the units set to take 5 or 10 position readings to average them for a more accurate vertex – you can change this in GPS Preferences. Once the vertex is done, the screen will disappear. Now you can move to the next vertex and repeat the process for as many vertices as you want. It is also possible to combine the two techniques, streaming vertices for parts of the line and taking averaged vertices for especially important vertices (like the beginning or end or sharp corners). However, you will not easily be able to tell which vertices were streamed and which were averaged either in ArcPad or in your GIS program later.

If you wish to take a point at some location while you are recording the line (for instance, if you are mapping a road and you find a culvert) you can “nest” the point. If you are streaming vertices, tap the Add Vertices Continually tool so it no longer appear pressed-in (if you have been adding averaged vertices and are between vertices, you don’t need to do anything special). Now tap the Capture Point Using GPS button and proceed just as when taking a point normally. When the point is finished, make sure the Polyline (or Polygon if you were taking a polygon) button is pressed-in and then tap the Add Vertices Continually button again so it appears pressed-in, and continue as before. I recommend not using tools like the Select Feature tool (black pointer arrow) while a line is paused since it is possible to lose the line you were working on. You can use the zoom tools however; just make sure you tap the polyline button and check that the Add Vertices Continually button is pressed in again after you are done using them.

To finish the line, tap the icon at the bottom of the screen that looks like a green circle with an arrow in it (you need to have at least two vertices in your line for this button to be available). This will bring up the attribute form (either a custom form or the standard ArcPad form) that will let you enter attributes for the line. When you are done entering attributes, tap the OK button at the lower left. Again, be careful as the OK and X buttons are very close to one another. Now your line (or polygon) is saved into your line (or polygon) shapefile.



If you decide you want to delete a line that is in progress, you can tap the red circle with the X in it that is at the bottom of the screen at any time.



Custom data layers and forms

In many cases, GIS staff will have prepared a special custom shapefile or shapefiles for you to edit. Some existing examples are catchbasins, roads and trails, sidewalks, and forest boundaries. A custom shapefile will have several fields (database columns) to hold the attributes you need to record for your project, and they may also come with a custom data entry “form” that will automatically appear on the screen when you start to record a point or when you finish recording a line or polygon. These forms will contain a number of ways to input data, including text boxes that you can type into using the on-screen keyboard, checkboxes, drop-down menu choice boxes, and so on. In some cases they may have multiple pages or “tabs” of data entry. Custom forms are useful because they make data entry easier and they help to make sure that the data you enter is consistent and conforms to standards for that type of data. If the project you are working on doesn’t already have a custom shapefile, GIS staff can create one for you.



Navigating to a point

Navigation is a technique for finding your way to an existing GPS or background feature or location. For instance, you can use it to find your way back to your car at the end of the day, or you could use it to help find a property boundary corner that you loaded onto the GPS unit before going into the field. ArcPad has several tools related to navigation; refer to the ArcPad manual for instructions (there is an entire chapter on Navigation).

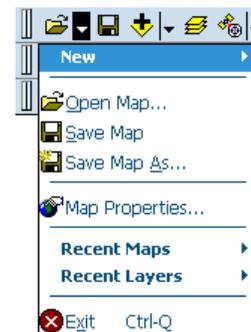
Because ArcPad is a mapping application, we have found that often the easiest way to navigate to a point is simply to watch the map. You can watch as the red circle that indicates your position moves towards the point you want to navigate towards, adjusting your walking direction by paying attention to the direction in which the red circle moves.

Closing down

At the end of the day you should close ArcPad and turn off the GPS unit. People often tap the “X” in the upper right hand corner and think they have closed ArcPad. This actually just minimizes it so you can see the desktop. You can tell that ArcPad is still open because there will be a little ArcPad icon in the lower right part of the screen (you can tap this to bring ArcPad back).



The only way to actually close ArcPad is to tap the first dropdown arrow on the top toolbar and then choose “Exit.” This will close ArcPad. You may be asked if you wish to save the project. All the GPS features you collected are already saved, so saving the project just saves things like your zoom extent and which layers are showing and what color they are, etc. Feel free to save the project,



but it is usually not important.

Tap the green power button briefly to turn the unit off (actually this just puts the unit to sleep). Do not hold the power button down.

Back at the office...

If you are doing a short-term project, you will probably return the GPS unit to GIS staff either every day or once a week. We will download your data, differentially correct it, and do some quality control to make sure the data is OK. Then we will replace your edited shapefiles with empty ones so the next time you go out, you will be editing fresh, empty shapefiles. In some cases we will include your previously collected data as a background layer so you can see where you have already been.

If you are keeping the GPS unit overnight, we will assign you a gray charger cradle with a power cord. It is essential to keep the GPS unit on the charger cradle overnight, plugged into an electrical outlet in a secure location (preferably in a locked cabinet, drawer, or room) so it can maintain its battery charge. Make sure the green light at the bottom of the charger is lit up to make sure there is electrical power to the cradle. Place the top of the GPS unit in the top of the cradle, and press down on the bottom until it clicks. To release the GPS unit, press the lever at the bottom of the cradle until the unit pops out. The GPS unit should be kept on the charger whenever not in use or in transit. If you store the unit off the charger, the battery will slowly drain, which can endanger your data and the stability of the unit.

For long-term projects, in some cases you will be downloading and managing the data yourself. We will give you a USB cable and detailed instructions on how to manage the data.

Troubleshooting

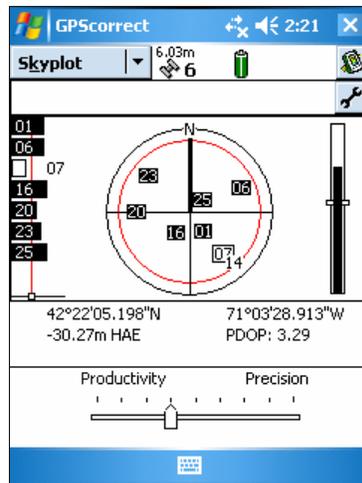
If you are having trouble receiving GPS positions, go through the following checklist in order, trying each option until one works. In ArcPad, if you are receiving valid GPS locations you will see a red circle with a pointy end in the map window.  If you don't see this icon or it has a slash through it,  you are not receiving positions.

If you are receiving GPS data (the red circle on the map seems OK) but you can't seem to get vertices added to your line or polygon feature, make sure that the Polyline tool is pressed-in and that the streaming vertices button is also pressed-in.

- 1) Make sure the GPS is active: tap the dropdown arrow to the right of the satellite icon on the top toolbar. There should be a red square around the icon next to "GPS Active". If not, tap on "GPS Active".



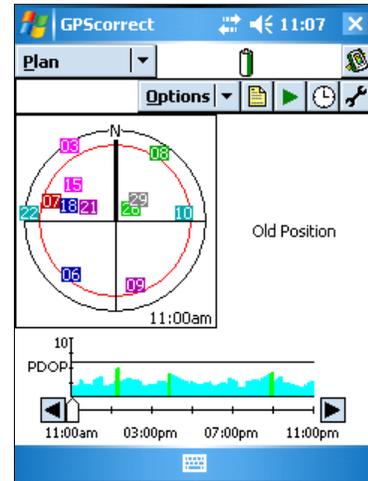
- 2) Open GPSCorrect and see if it is receiving GPS information. Tap on the same dropdown arrow mentioned in (1) and choose "Trimble GPSCorrect." In GPSCorrect, make sure you are on the Skyplot screen (available from the upper left dropdown). You should see several solid black satellites in the circular skyplot. This screen will also show you the PDOP, your GPS position (if receiving data) and some other graphics that indicate various reception conditions. If you see a message that says "Attempting to connect to GPS receiver" you may need to adjust your settings in ArcPad and GPSCorrect; see the GeoXT Settings document. To return to ArcPad, tap the "X" at the upper right hand corner of the GPSCorrect screen.



- 3) If the GPSCorrect Skyplot screen says "Too few satellites," you will need to either reposition yourself or wait for several minutes (if you just turned on the unit it may need to initialize itself for a few minutes—longer if it hasn't been used in a while). If you think that the satellite signals are blocked by trees, hills, buildings, etc., try holding the unit up higher or moving around slightly. If absolutely necessary you can take a point nearby and make a note that the actual point is (for example) 10 meters north of the GPS point.
- 4) If you are getting enough satellites but your PDOP is too high (it is shown on the Skyplot screen - PDOP (Percentage Dilution of Precision) is a numerical measurement of the accuracy of the data you are getting, based on the "constellation," or arrangement of satellites in the sky), you may need to wait a few minutes for the satellite constellation to change, move your location slightly to try to pick up some new satellites, or, if that doesn't work, raise your PDOP mask. The default PDOP mask setting is 6 (any PDOP value below 6 will be accepted) but you can raise the mask to 7 or 8 (never above 10!) if the values you are getting are just slightly above 6. If the values are very high (above 10) you should not raise the PDOP mask to attempt to include them; you will sacrifice too much quality. Make sure you move the PDOP down to 6 or 7 again later to make sure you are getting high accuracy data. Most people prefer to use the quality slider rather than adjusting the PDOP mask and other settings manually. We usually keep the slider one notch to the left of center, or at the center if we are working in an open environment. You can move the slider one or two notches further left towards "Productivity" temporarily (move it back within half an hour), but never all the way to the left.
- 5) It is possible that you are trying to work during one of the rare times of day when the satellite constellation is poor. You can see a graph of these times on the Plan screen in GPSCorrect. Tap the dropdown (it usually says Skyplot) and choose Plan. A new screen will appear that can show

you the positions of the satellites over the course of the entire day. At the bottom of the screen there is a graph that shows the hours of the day on the X-axis and the PDOP on the Y-axis. Most of the day should show a blue-green color with low PDOP values but there may be some spikes colored green or red. At these times, you may find it impossible to get a decent position reading. Your only option is to wait; these spikes tend to last only 10 or 20 minutes, a good time to eat lunch!

- 6) Call GIS staff if you still can't figure out how to get data! Our phone numbers are listed at the end of this document.



Other problems:

I get a message saying something about another application using the COM port, and it won't let me connect to the GPS receiver.

You will need to reset the GPS unit. Hold down the power button for 6 or 7 seconds to perform a soft reset. Then try running ArcPad again to see if the problem is resolved. If not, try a hard reset (make sure you are using a 2005 series unit first! These have 11 buttons on the front of the unit. If you do a hard reset on an older, 2-button unit, you will cause serious problems). Hold down the power button for more than 15 seconds (until the screen goes dark), then wait a few seconds and press the power button briefly to restart the unit. If this does not resolve the problem, you will have to return the GPS unit to GIS staff for further troubleshooting.

Everything looks normal but when I try to tap on the screen, it just beeps and my taps don't do anything.

You have probably inadvertently tapped the "lock" button. In ArcPad, this appears at the lower-left corner of the screen (it also appears near the middle of the desktop if the desktop is showing). Tap this button again to unlock the screen. If the screen is frozen and you do not get beeps when you tap, and tapping the lock icon doesn't do anything, the software may have crashed. Try a soft reset as detailed above, and if that doesn't work, try a hard reset.



I tap in one location on the screen but my tap seems to register in another location.

Try recalibrating the screen. Press the screen button (round blue button with star) and the Windows button (leftmost gray button with Windows flag logo) briefly at the exact same time to bring up the align screen. Follow instructions. Even when the touch screen is aligned properly, you can sometimes get misplaced taps. Make sure you tap firmly with a stylus (not with a regular pen or pencil!).

The GPS unit won't turn on.

If pressing the green power button firmly and briefly doesn't turn the GPS unit on, try placing it on the charger cradle overnight to recharge the battery. If it still won't turn on, return the GPS unit to GIS staff for further troubleshooting.

If you have additional problems, don't hesitate to call GIS staff:

David Kimball: 617-626-1447

Nathanael Lloyd: 617-626-1381 or 617-259-0501