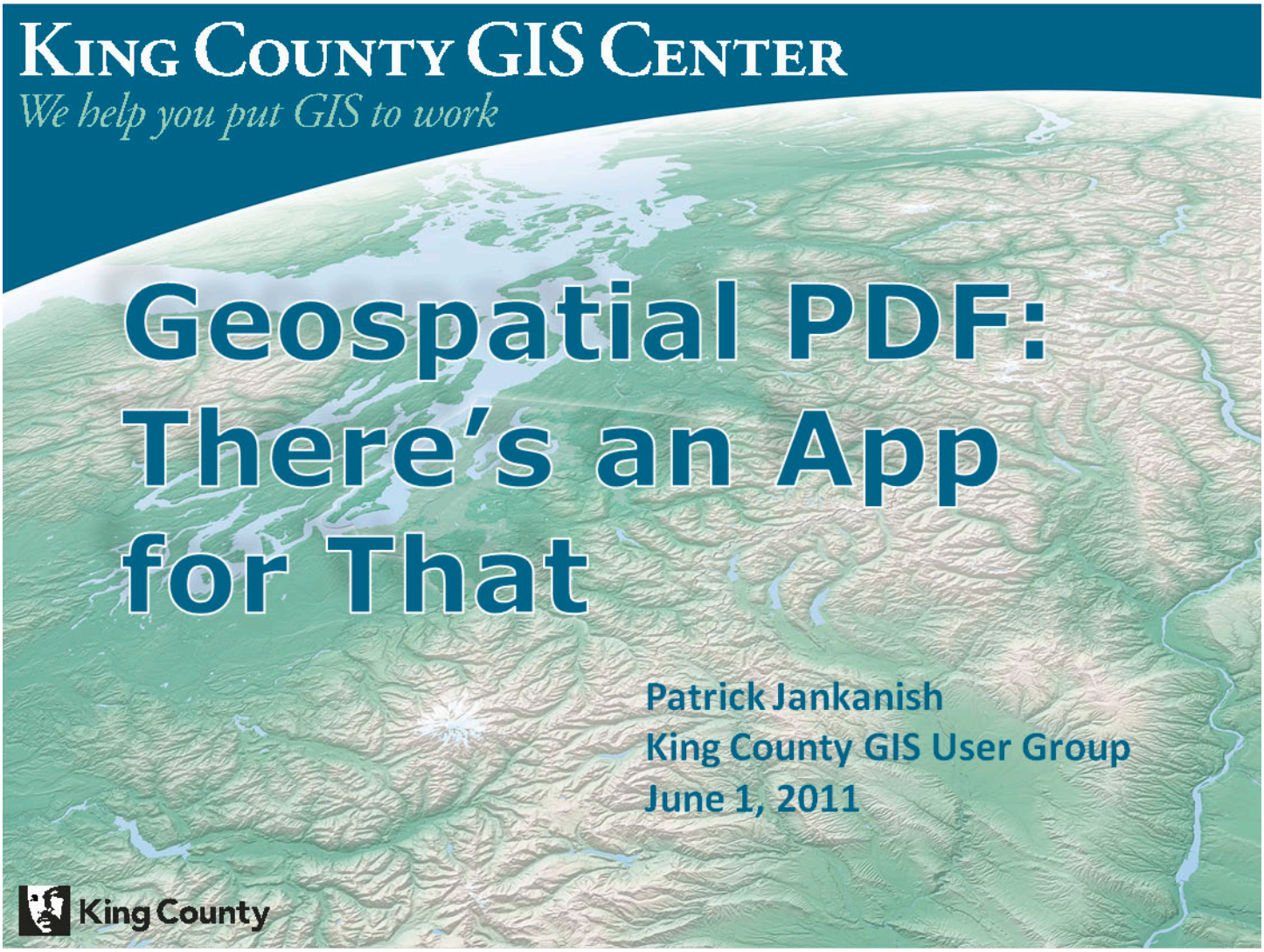
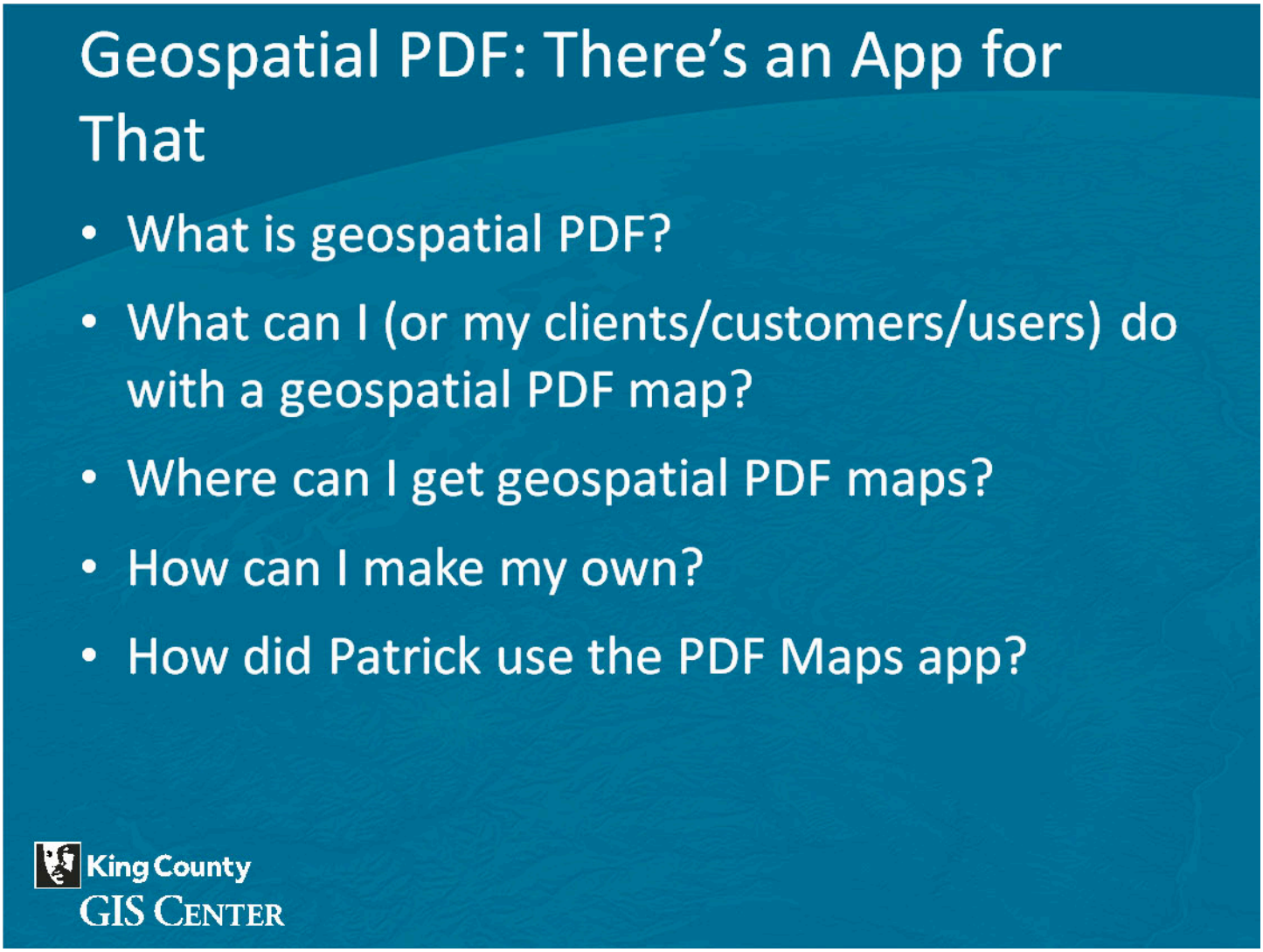


Slide notes added post-presentation by the author.

Abstract

The ability to create and interact spatially with georeferenced PDF maps has been around for a few years now. More recently, Avenza Systems, Inc., released PDF Maps, a geospatial reader for Apple iOS devices. The author presented a brief overview of products that can produce and consume geospatial PDF maps, and some map products that have been published as geospatial PDFs. He talked about his experience using both the geospatial PDF exporter that is part of the MAPublisher set of plug-ins for Adobe Illustrator, and the PDF Maps app, which allowed him to use his iPhone as a field tool to help locate and verify map features on the ground, and to collect and export point locations and field notes for the recently completed update to the U-District & North Capitol Hill Get Around guide maps.



Overview of the presentation topics.

What is geospatial PDF?

- In June of 2008, with the introduction of Acrobat version 9, Adobe added a "geospatial feature set" to both Acrobat and Reader, giving software developers the means to store map projection and coordinate system information in a PDF document.
  - blogs.adobe.com/acrobat/2008/07/acrobatreader_9_and_geospatial.html
  - www.digitalpreservation.gov/formats/fdd/fdd000315.shtml

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A very, very brief history of geospatial PDF.

These two web links are included along with others on the notes page of the last slide.

What is geospatial PDF?

- To put it simply:
  a geospatial PDF is an Adobe Acrobat document which contains georeferencing information that can be read by various applications.

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What is geospatial PDF?

- "Geospatial PDF" is a generic term.
  - Geospatial PDF ≠ GeoPDF®
  - "GeoPDF" is a registered trademark of TerraGo Technologies and is used to refer to documents created by their software products.

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TerraGo Technologies: www.terragotech.com

What can I do with a geospatial PDF map?

- View a digital map on a desktop in a ubiquitous format, PDF, that has been enhanced to enable some simple geospatial functions.
- Take digital maps out into the field on a common mobile device with the capability to perform even more geospatial functions, all of which are very easy to use.

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This and the next slide, which were not in the original presentation, speak to the general and overarching capabilities afforded by geospatial PDF.

What can I do with a geospatial PDF map?

- Of course iPhones and iPads, and other mobile phones and tablet computers, already have built-in map applications. But geospatial PDF, in conjunction with apps that can consume maps delivered in that format, gives map makers control over the content and design of mobile maps.

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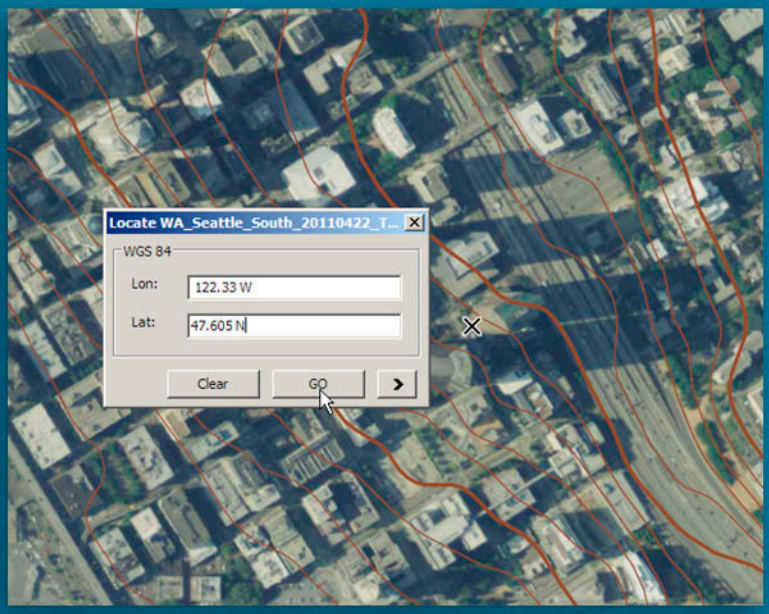
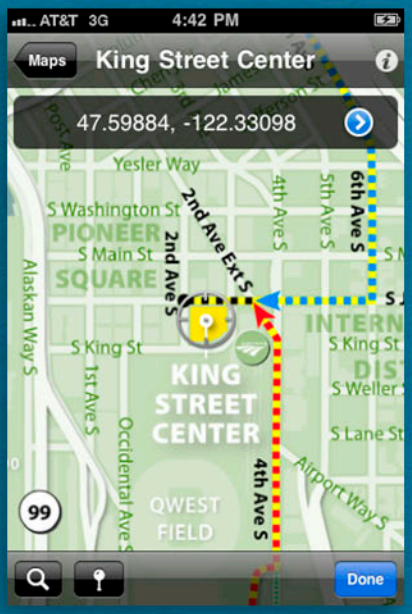
What can I do with a geospatial PDF map?

1. Identify and search for map coordinates.



TerraGo GeoTool
(in Acrobat Reader)



PDF Maps Find
Coordinates tool

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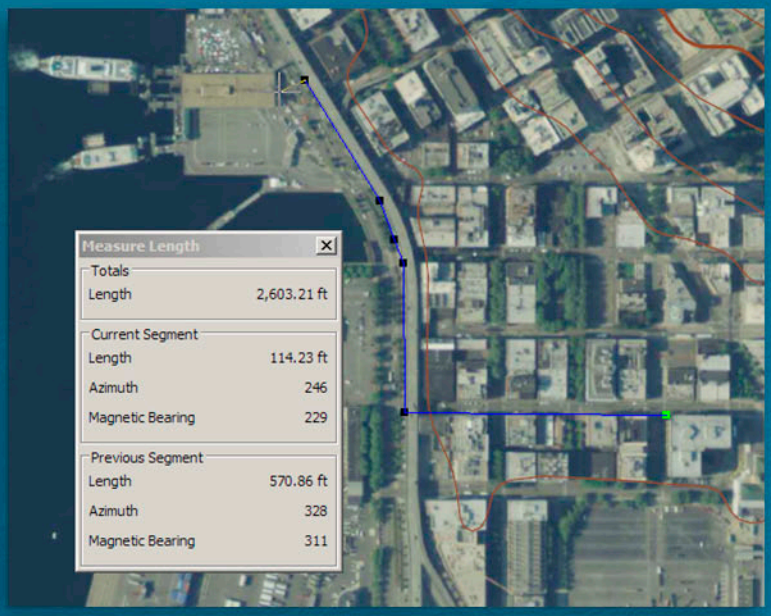
Now for some specific capabilities and functions.

The screen shot on the left (of a USGS digital topographic map saved as a GeoPDF) illustrates the use of a free TerraGo plug-in tool for Adobe Acrobat Reader. Reader also has its own Geospatial Location Tool.

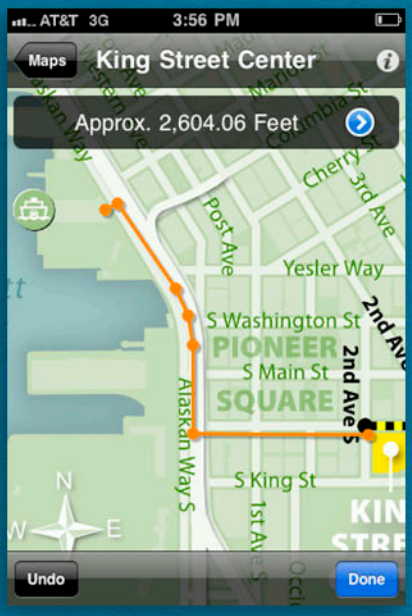
On the right is a screen shot of an iPhone display on which the free PDF Maps app from Avenza Systems, Inc., is running. In both Reader (using the TerraGo GeoTool) and PDF Maps, a user can search for coordinates and the map will pan to the coordinates. Also, a user can move a cursor (in Reader) or shift the map (in PDF Maps) and see a continuously changing readout of coordinates. The map on the iPhone screen is a King County GIS Center-produced map, which illustrates the advantage of being able to publish one's own maps in this format.

What can I do with a geospatial PDF map?

2. Measure **distances** and areas.



TerraGo GeoMeasure tool



PDF Maps Measure Distance tool

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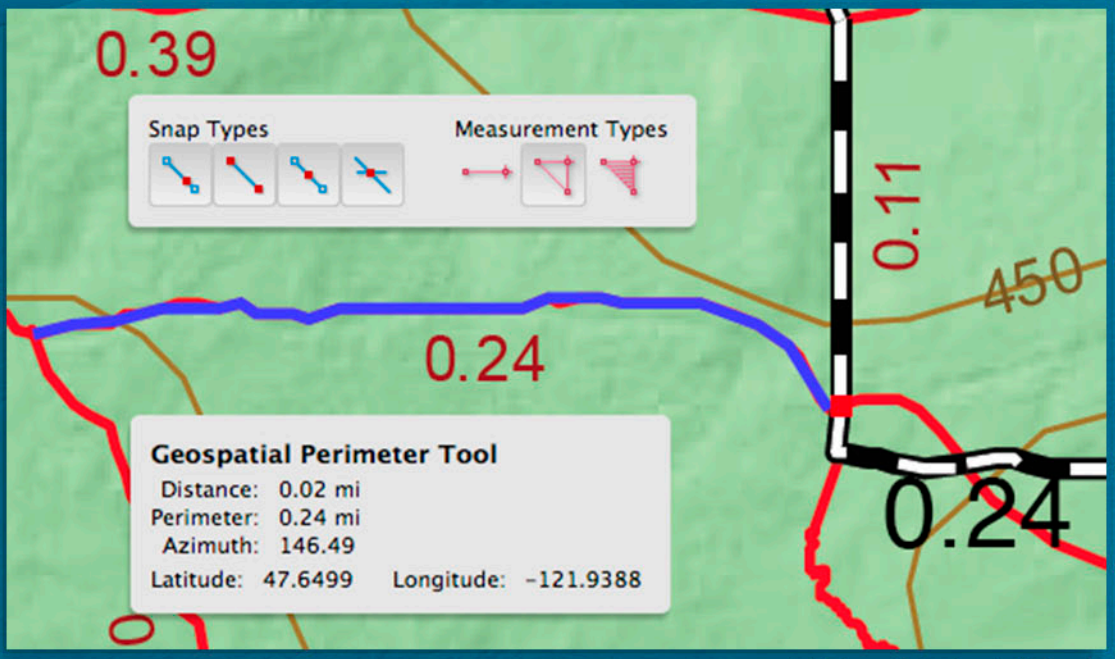
Tapping points on an iPhone screen (right) is more of a challenge for accuracy than clicking on a map with a precise cursor (left), but a user can zoom in and out on a map in PDF Maps while using the Measure Distance tool.

Measuring distances like this is pretty basic stuff, but remember, this isn't expensive or complex GIS software, these are free tools that are easy to access and use. And they can be used on maps that you make (although of course the map-*making* tools are not free and not easy for anyone to access and use).

What can I do with a geospatial PDF map?



Adobe Acrobat (Mac)

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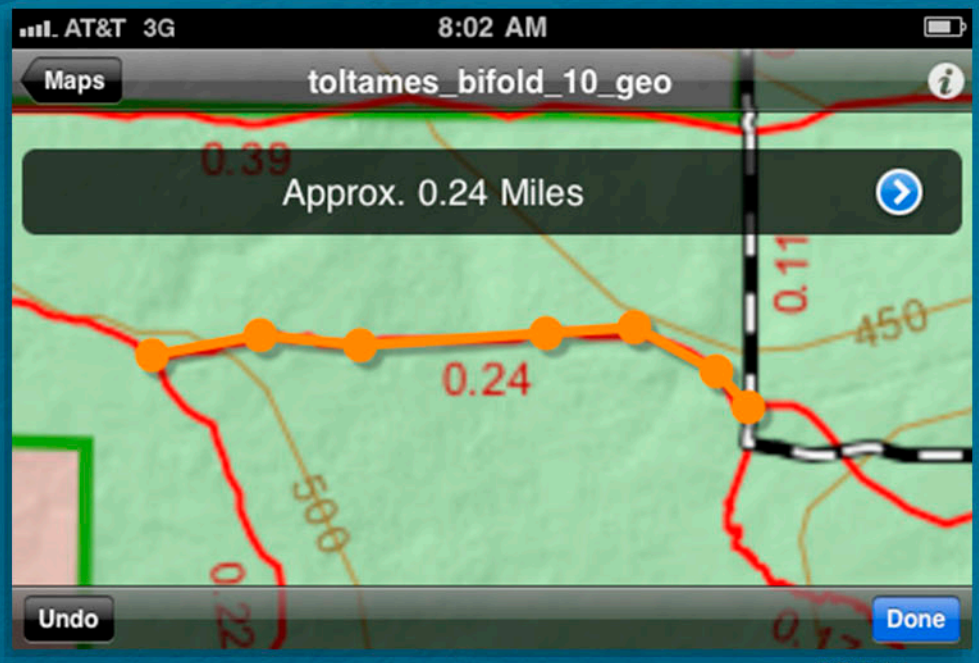
This is an example of what Acrobat's built-in measure tool looks like in the Mac version. (The dark-red-colored "0.24" near the center of the image is a trail distance label that is part of the map. The black "0.24" at the right is the dynamic, cumulative-distance, on-map readout generated by the measure tool. The red square at the far right of the blue line is the last clicked point.)

What can I do with a geospatial PDF map?



PDF Maps

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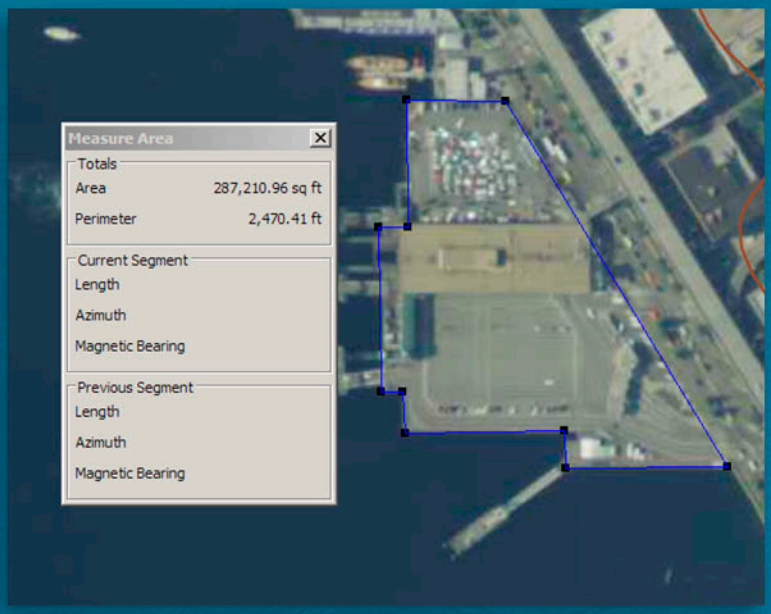
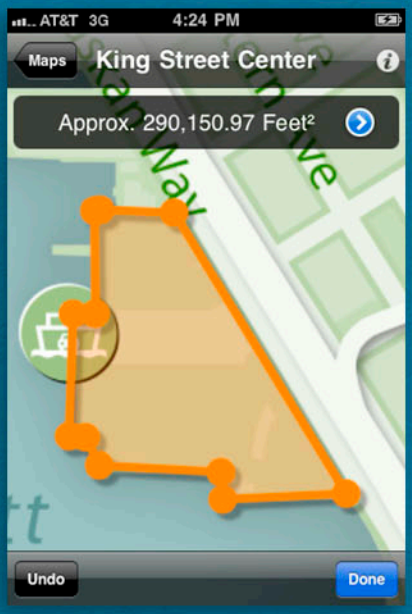
Yet another example of a measure tool in use on a geospatial PDF (in the PDF Maps app).

What can I do with a geospatial PDF map?

2. Measure distances and **areas**.



TerraGo GeoMeasure tool



PDF Maps Measure Area tool

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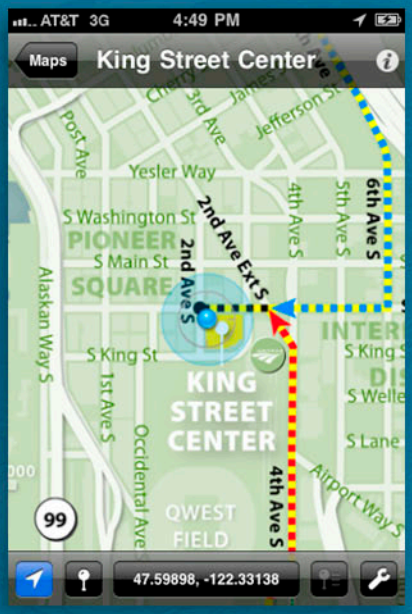
Here are the area measure tools that correspond to the distance measure tools illustrated on Slide 9.

What can I do with a geospatial PDF map?

3. In a mobile application, geo-locate.



PDF Maps

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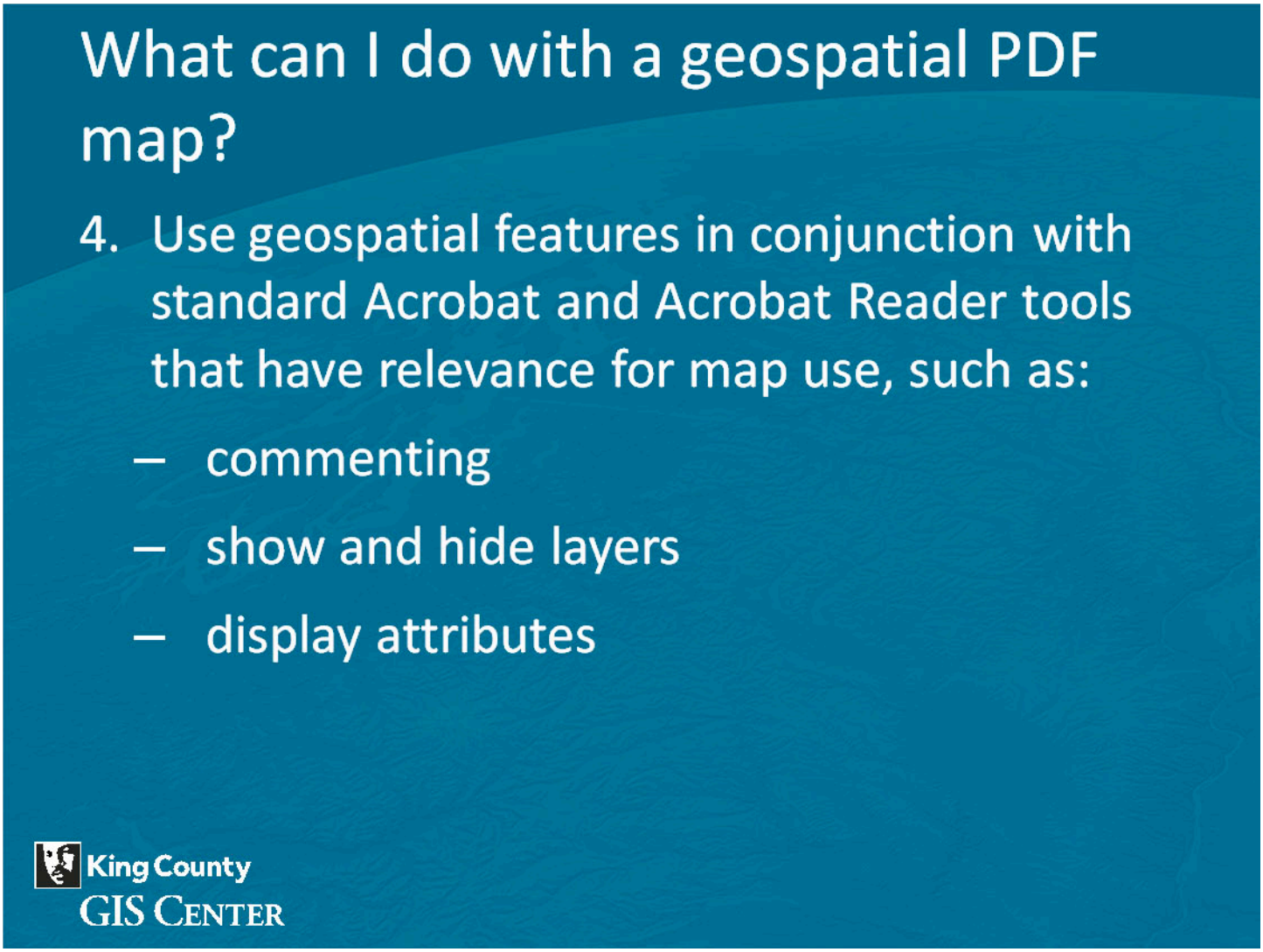
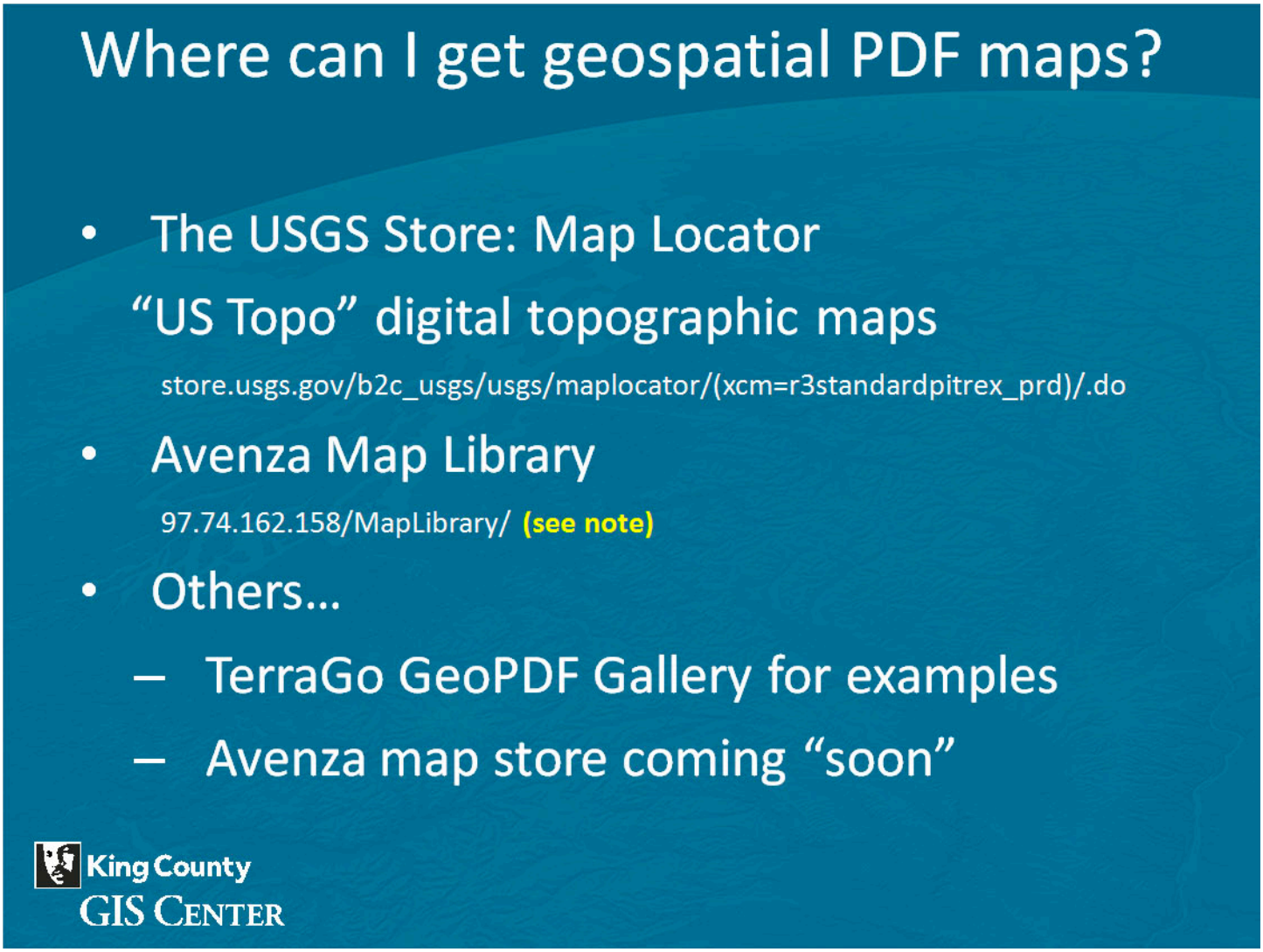
Both the live geo-location tool button in the lower left corner of this screen shot and the blue sphere symbol in the center of the map will be familiar to iPhone users from the iPhone's native Google Maps app.



This presentation doesn't deal with these other PDF features, but one should be aware of them in order to take full advantage of publishing and distributing maps as PDF documents.



Note / partial correction: The author stated during his presentation that although the Avenza Map Library is designed to be accessed via Avenza's PDF Maps app, the URL shown can be entered into, and the destination page viewed in, a standard web browser. That is technically true, but depending on the browser, the library may not be readable because it has been designed specifically for display on the iPhone's browser, and even if it is, the download links use a protocol that is specific to the PDF Maps app.

TerraGo GeoPDF Gallery: www.terragotech.com/geopdf-gallery

Avenza PDF Maps: www.avenza.com/pdf-maps (for all information about the app, including any news of the map store)

Where can I get geospatial PDF maps?

- King County GIS Center Virtual Map Counter
  - "Get Around U-District & North Capitol Hill" guide maps
  - more to come…

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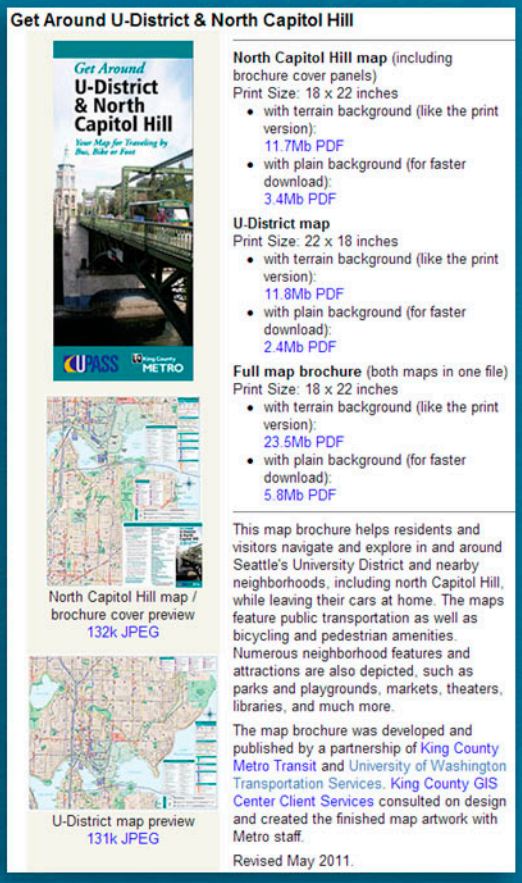
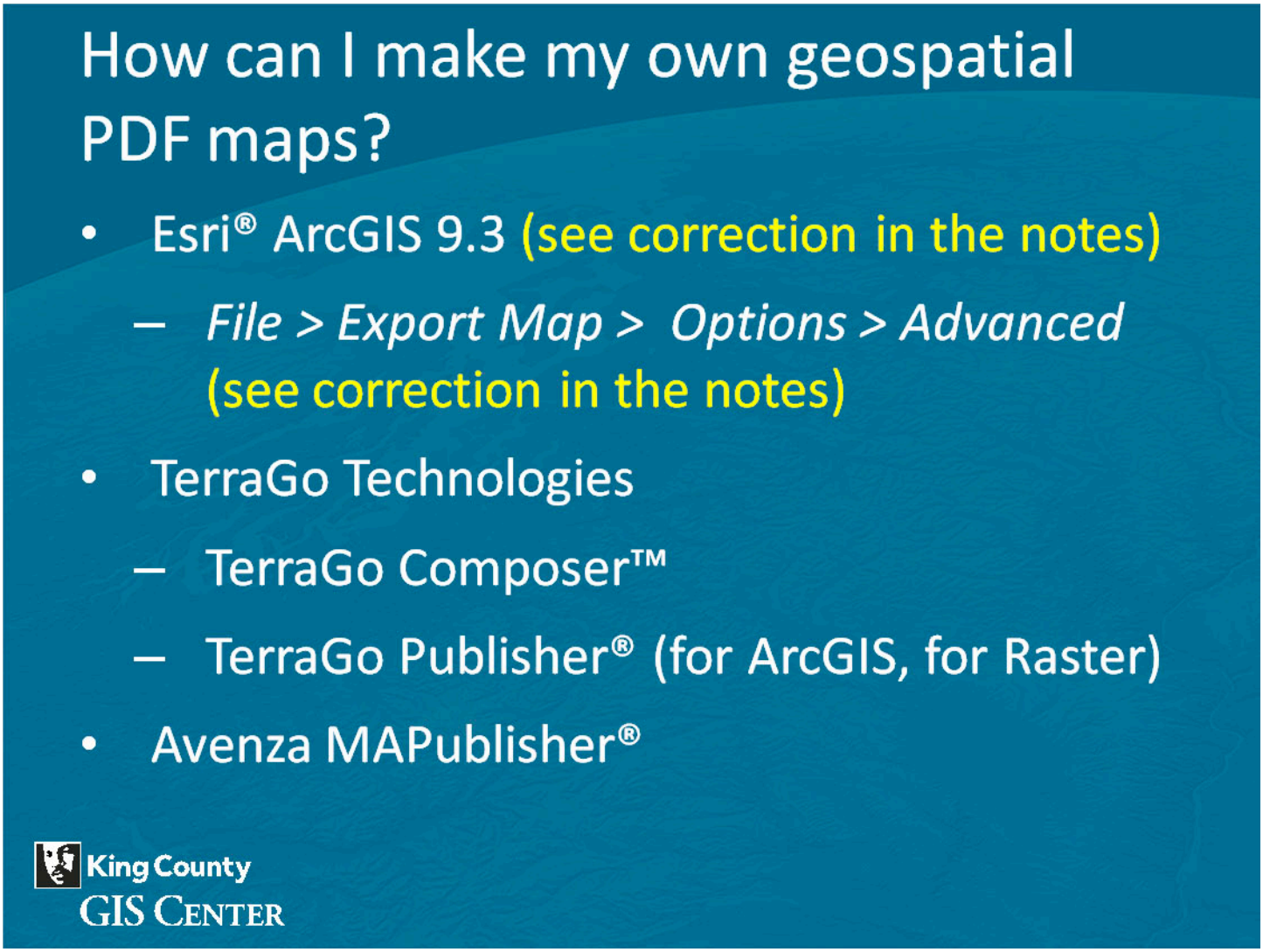


At the time of the presentation, the geospatial PDF versions of the Get Around maps had not yet been published. Now they have, and the web page shown in this screen shot has been revised.

See: www.kingcounty.gov/operations/GIS/Maps/VMC/Transportation.aspx



Although the functions that geospatial PDF enables are pretty basic, one of the main motivations behind this presentation is that those who are already publishing maps as PDFs should be aware of how they can get the most out of their maps. With geospatial PDF, map makers have a way to take advantage of the GPS and other capabilities of mobile devices with map designs and content that they produce and control themselves.

Correction: The original slide reflected an incorrect statement that the author made during the presentation. He said that the geospatial export function was added in ArcGIS 10. In fact, it was added to version 9.3, but not as part of the initial installation. It was available via a patch and subsequent service pack. For more information see the ArcGIS Desktop 9.3 online help: webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=Advanced_PDF_Features.

Correction: During the presentation, in response to a question about the use of the free TerraGo plug-in tools for Acrobat Reader, the author stated that those tools could be used with geospatial PDFs exported from ArcGIS. That is not true. The TerraGo tools can be used only with GeoPDFs created with TerraGo software. Also, in order to use Reader's native geospatial measurement tools with a geospatial PDF exported from ArcGIS, the PDF must first be resaved in Adobe Acrobat (version 9 or higher) to enable those tools. (This is not necessary for the Geospatial Location Tool.) For information about the free TerraGo Toolbar™ for Adobe Acrobat Reader, see: www.terragotech.com/products/terrago-toolbar.

How did Patrick use the PDF Maps app?

- PDF Maps is an app from Avenza (the MAPublisher folks) that runs on the Apple iOS platform
  - iPhone, iPad, iPod Touch
  - free download from the iTunes App Store

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The author makes many maps in Adobe Illustrator using Avenza's MAPublisher suite of plug-ins. So it was a natural extension of his process while working on the "Get Around U-District & North Capitol Hill" guide maps to employ and test Avenza's PDF Maps app.

How did Patrick use the PDF Maps app?

During map production

1. Exported georeferenced map drawings as geospatial PDFs from Adobe Illustrator using Avenza's MAPublisher plug-in.

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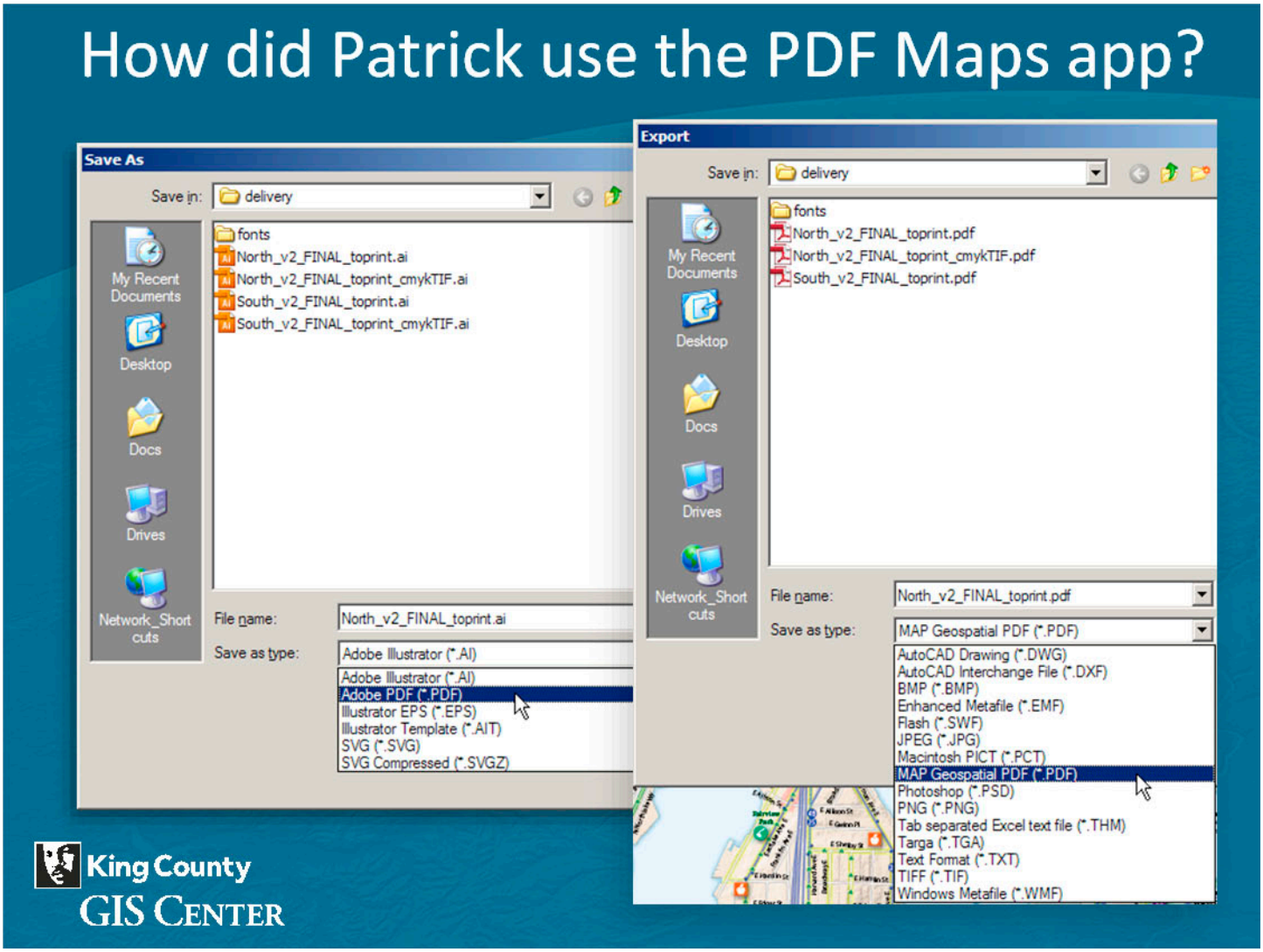
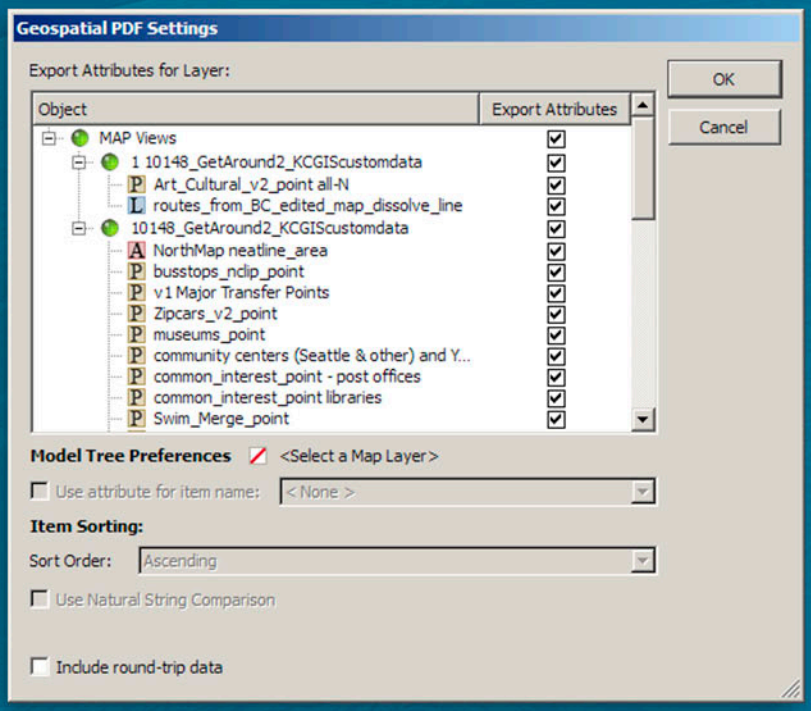
The first step was to generate a copy of a map that PDF Maps can consume. See the next two slides for illustrations.

How did Patrick use the PDF Maps app?



To create a PDF file from Illustrator, one usually uses the Save As command and chooses the Adobe PDF file format. But to create a geospatial PDF, one uses the Export command. “MAP Geospatial PDF” is an export option that is available only when MAPublisher is installed.

How did Patrick use the PDF Maps app?



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This is the geospatial PDF export dialog box. A MAP View in a MAPublisher-enabled Adobe Illustrator drawing is roughly comparable to a data frame in an ArcGIS map document.

PDF Maps does not currently have any tools or functions that can consume the GIS data attributes in a map layer, so there is no need to take up space with them in the exported file and Export Attributes can be unchecked. (However, if the PDF will be used in Acrobat Reader, which can access data attributes, the map maker will want to consider what attributes might be useful to the map audience.)

How did Patrick use the PDF Maps app?

2. Uploaded the exported maps to a web folder.
   - This makes the PDF files accessible to the PDF Maps app.
3. Downloaded and installed the maps via the PDF Maps app for use in the app.

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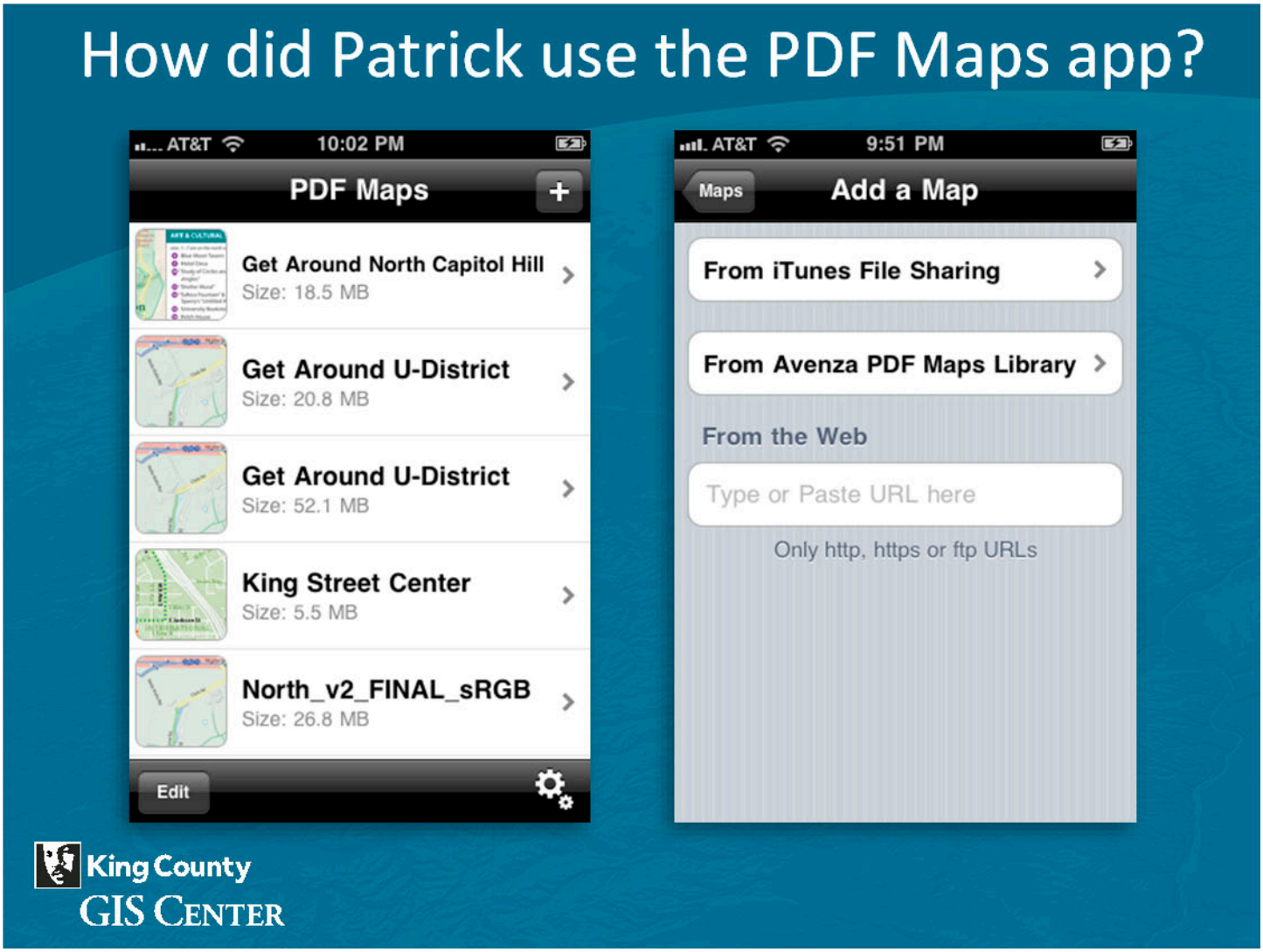
See the next slide for illustrations.

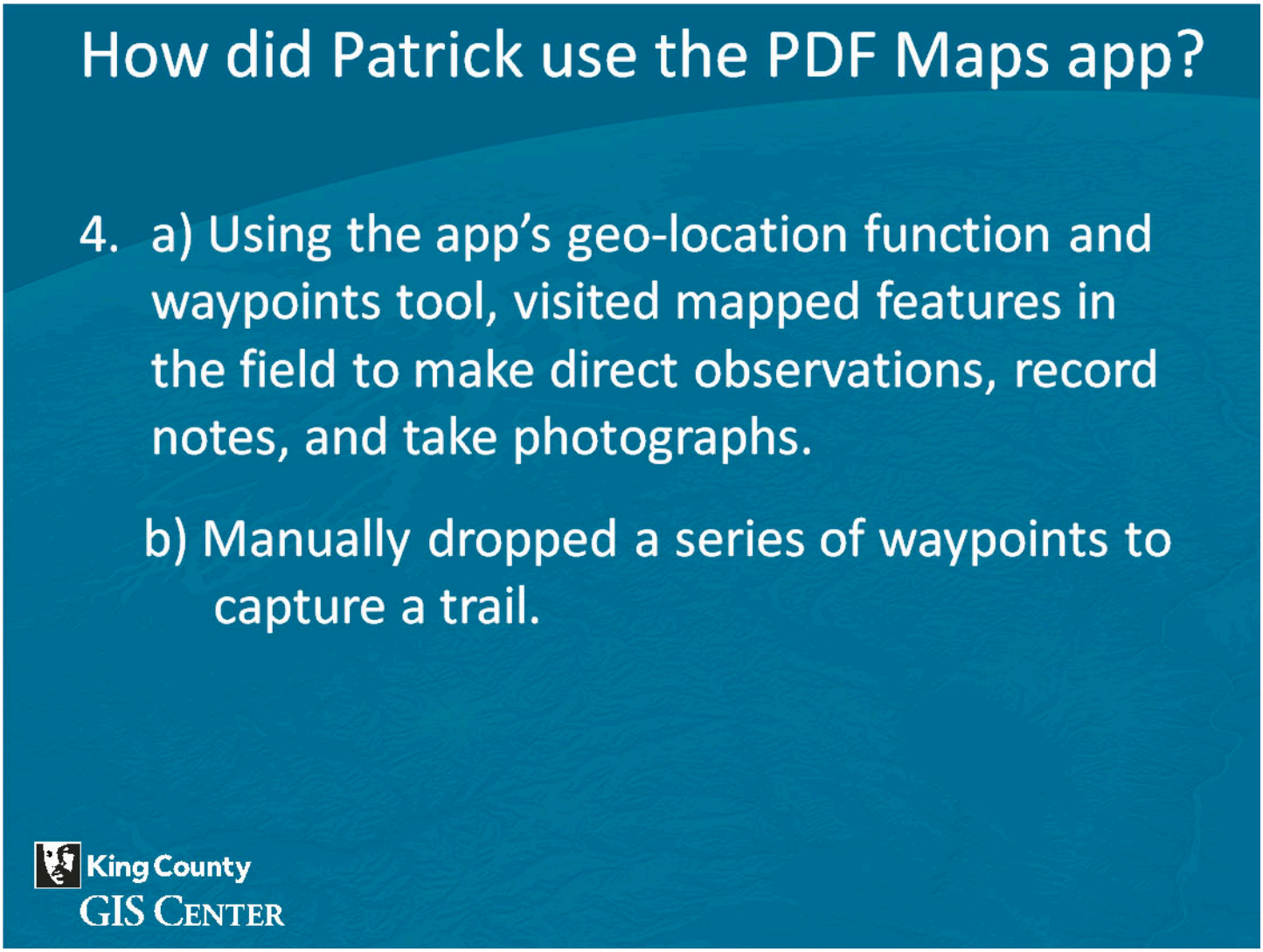


The app maintains a list of already loaded maps as shown in the screen on the left. Tapping the "+" button opens a screen that has three options for acquiring a geospatial PDF map.

Option 1) The author has no experience with iTunes file sharing and thus can't comment on it.

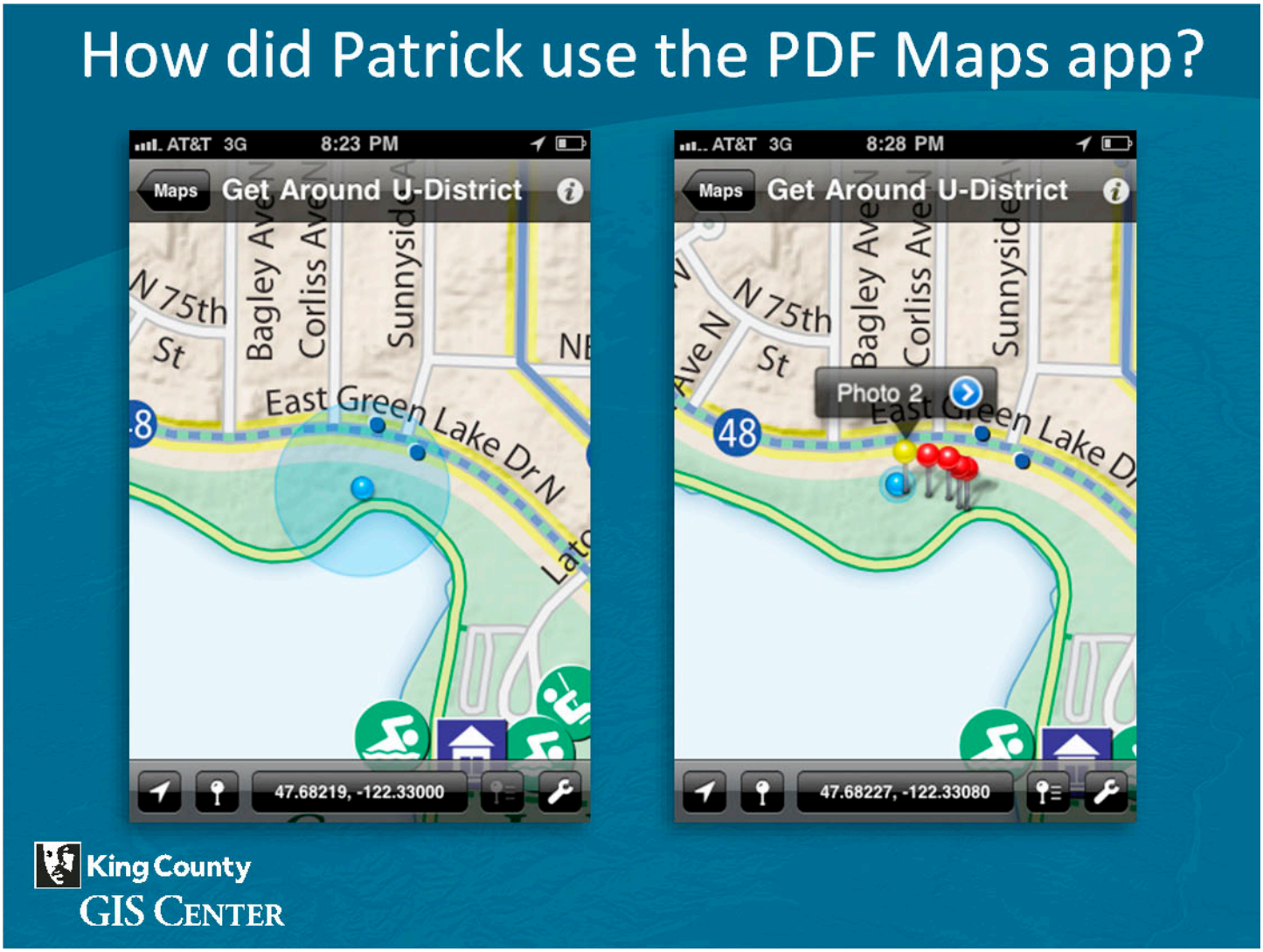
Option 2) Tapping the Avenza PDF Maps Library button will launch Safari and automatically navigate to the Library site. Map makers may submit their own maps to Avenza for inclusion in the library.

Option 3) Map makers who have upload access to a website may post their maps to the site and then use the site's URL to download their maps to PDF Maps. This is the method that the author used, having first posted geospatial PDFs to a folder in the Virtual Map Counter on the King County GIS Center website.



The author visited a variety of sites with draft copies of the Get Around guide maps loaded onto his iPhone in PDF maps.

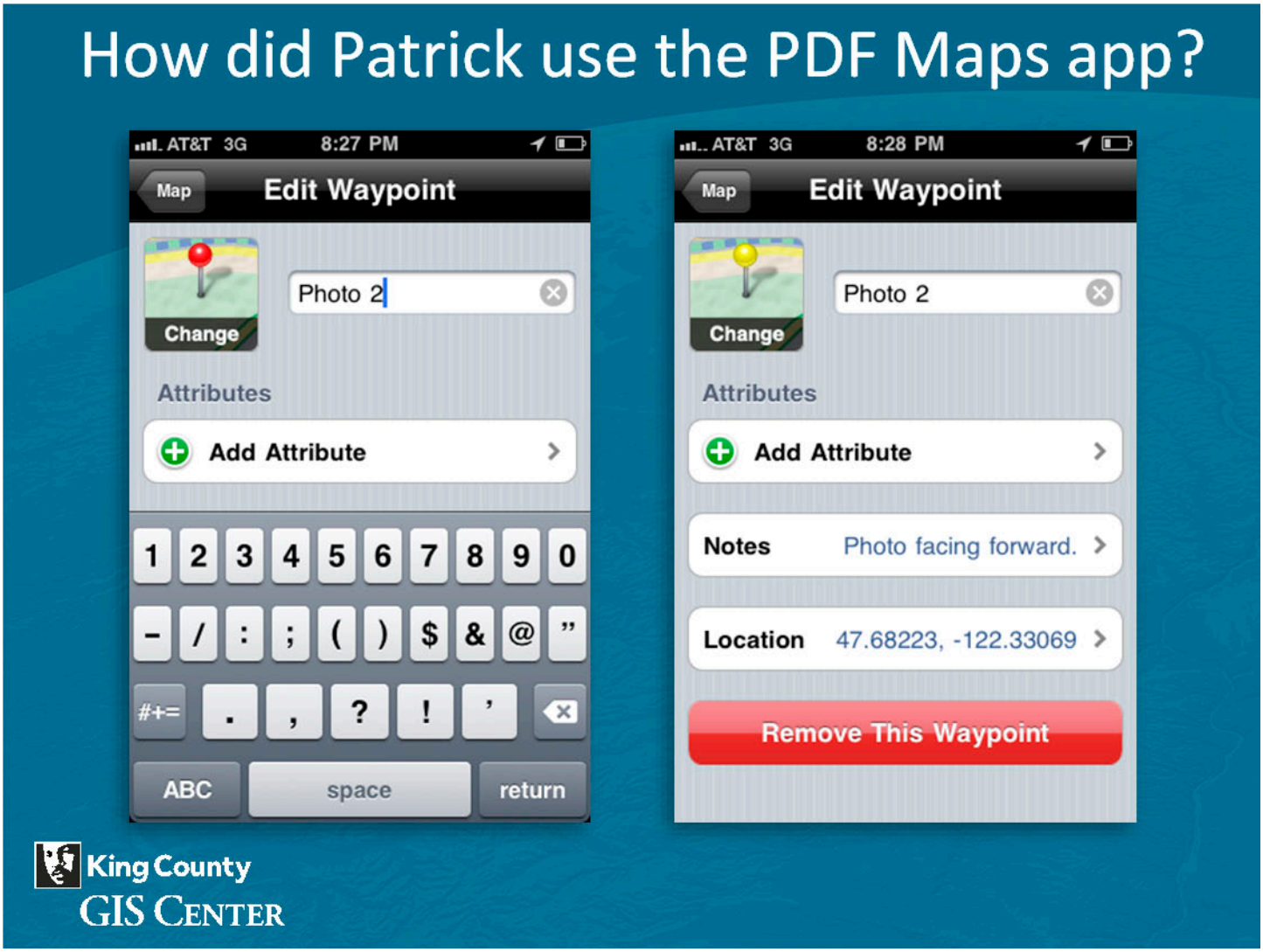
How did Patrick use the PDF Maps app?



These screen shots of the PDF Maps app are zoomed in on a portion of the Get Around map of the University District (and vicinity). The author decided to capture a narrow footpath that was not part of the trail and pedestrian features data layers used to build the draft map. The first step was to geo-locate on the map and the blue sphere symbol represents the author's location as automatically determined by the app using the iPhone's native GPS capability. Then the author walked along the trail, manually dropping waypoints on the map at approximately regular intervals—about every twenty paces. In PDF maps the user must tap the waypoint tool to drop a point, but the point is positioned automatically. (It is also possible to position waypoints manually anywhere on a map.)

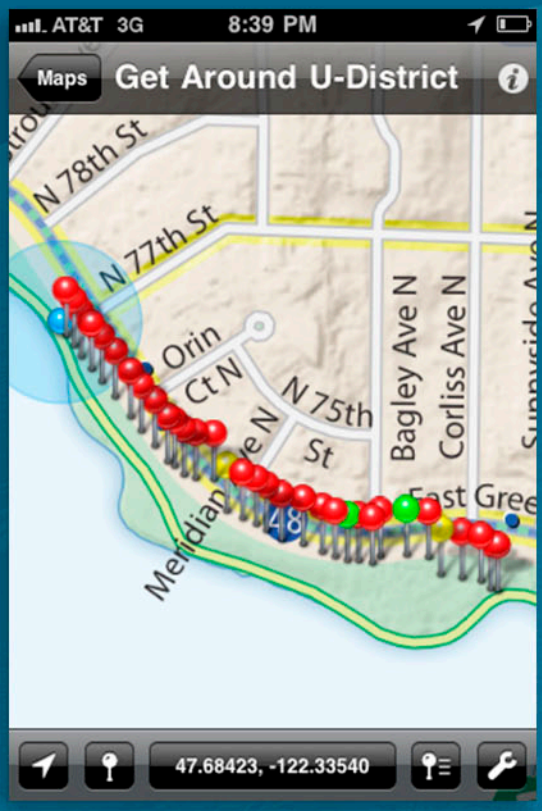
As shown in the screen on the right, the user may change the color of waypoints and give them custom labels. The author chose to specially identify points where he stopped to document the trail with photographs by making those waypoints yellow.

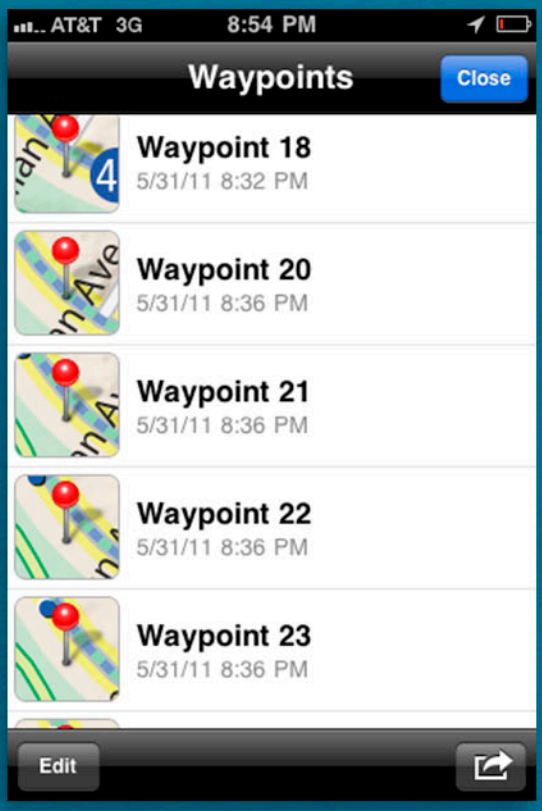
How did Patrick use the PDF Maps app?



The user can change waypoint symbol color, enter custom waypoint labels, create attributes, add notes, and see the coordinates of waypoint.

How did Patrick use the PDF Maps app?





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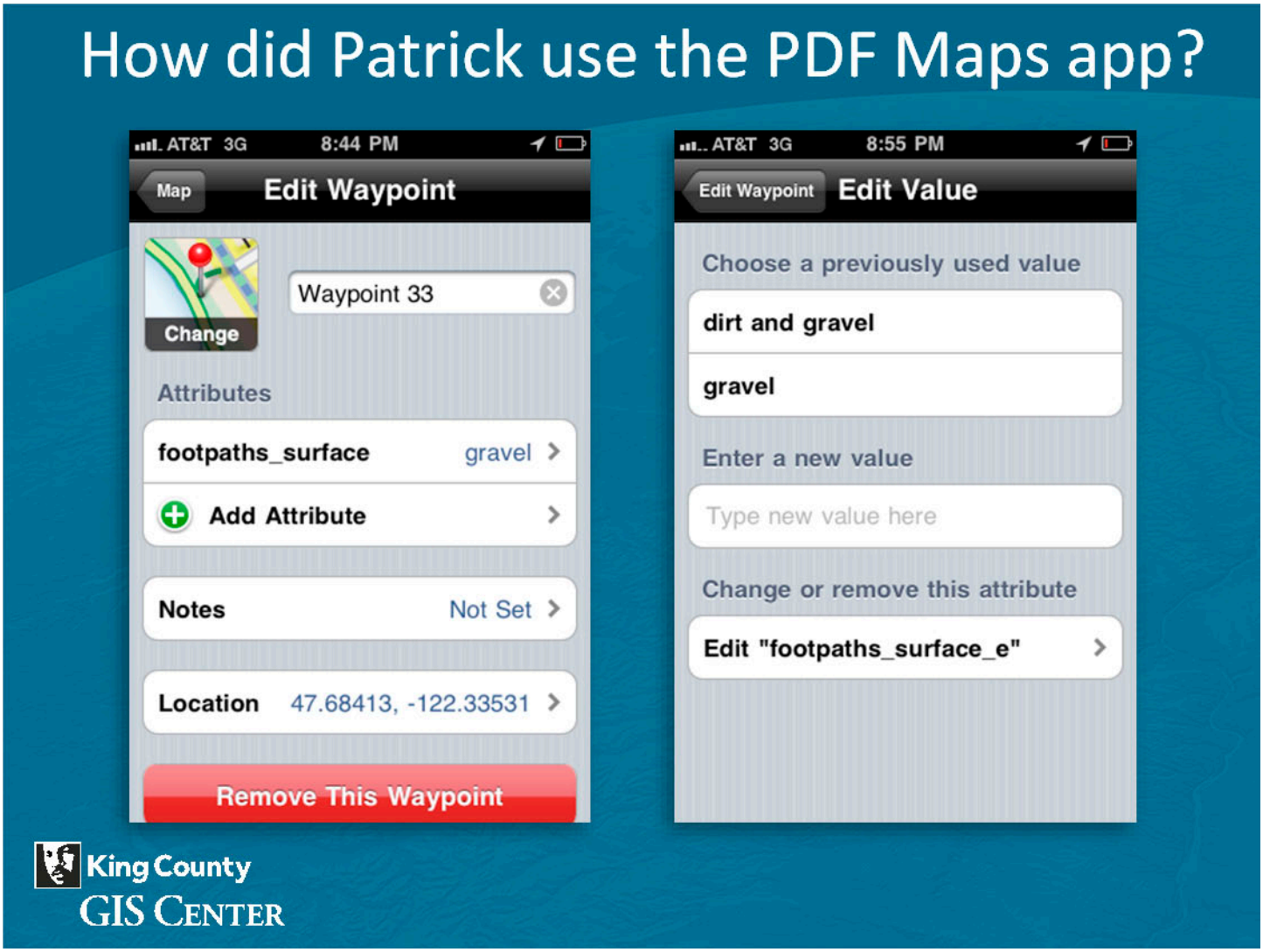
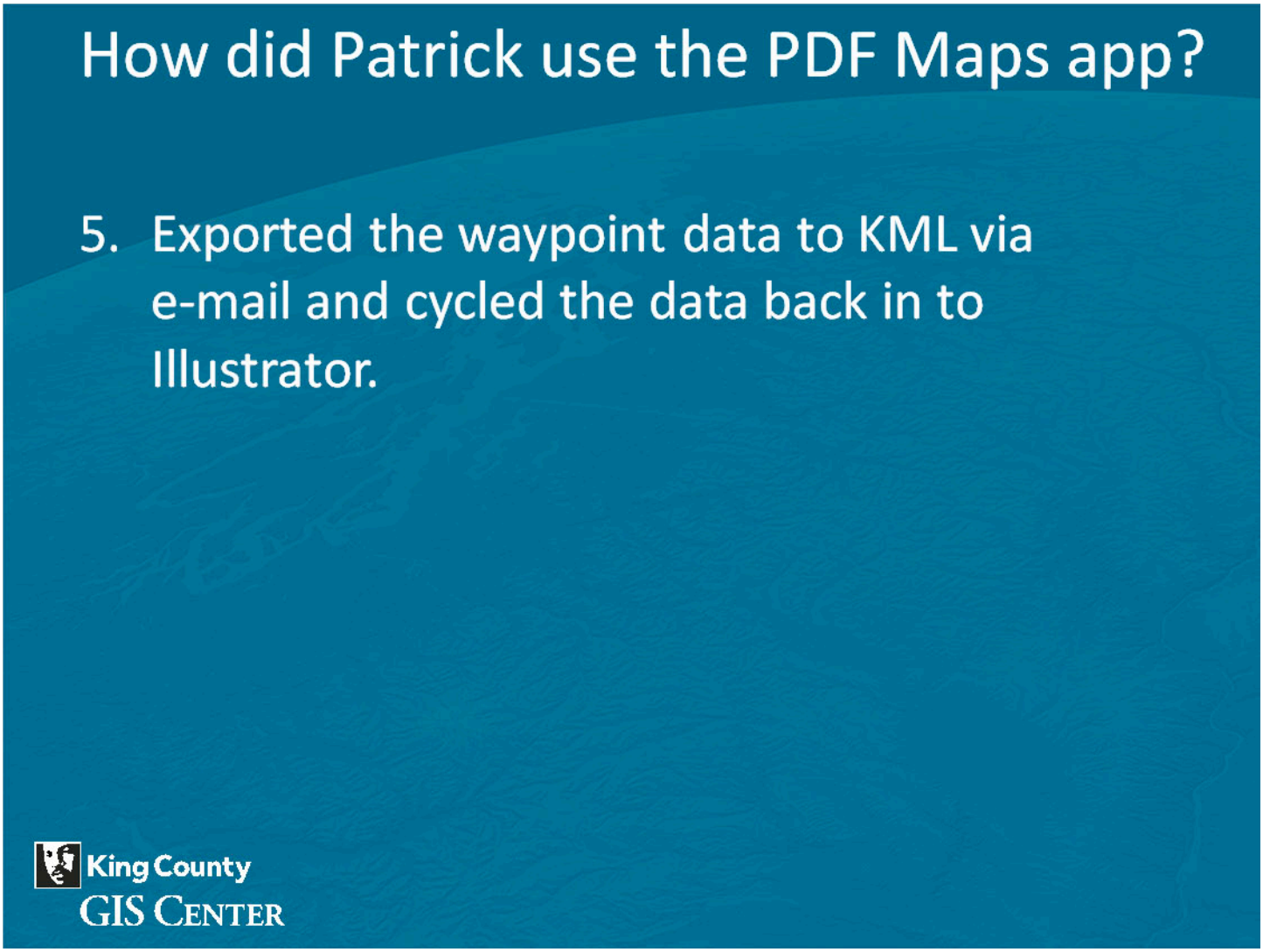
Here on the left is the whole traversed length of the footpath.

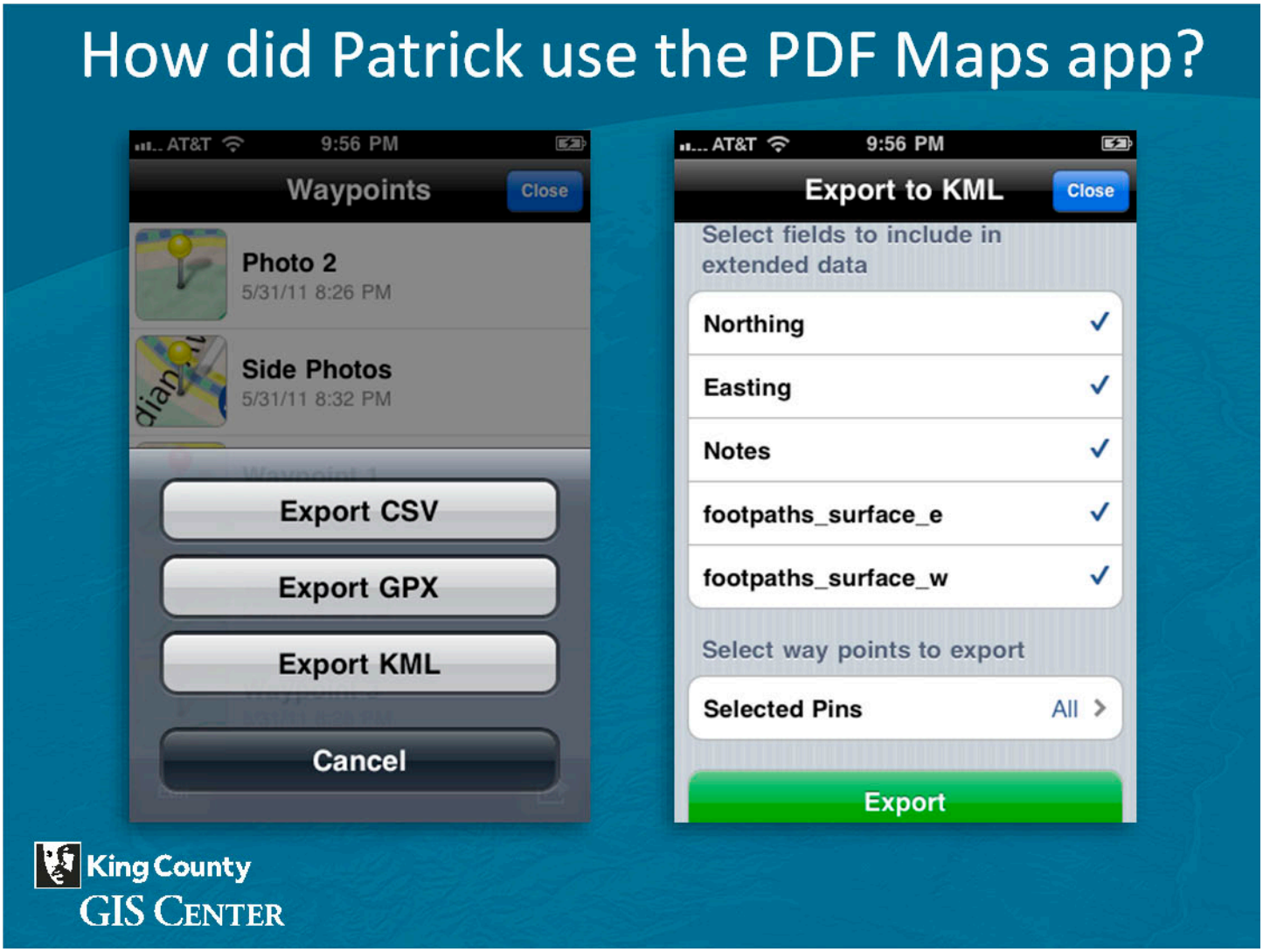
It can be difficult to tap-select a waypoint on a map when they are spaced so closely together (left screen), but it is always possible to select a specific waypoint from a list (right screen).



Here the author created an attribute called “footpaths_surface” (left screen) and as he entered attribute values, such as “gravel” and “dirt and gravel,” the app remembered them so that they don’t have to be re-typed (right screen).

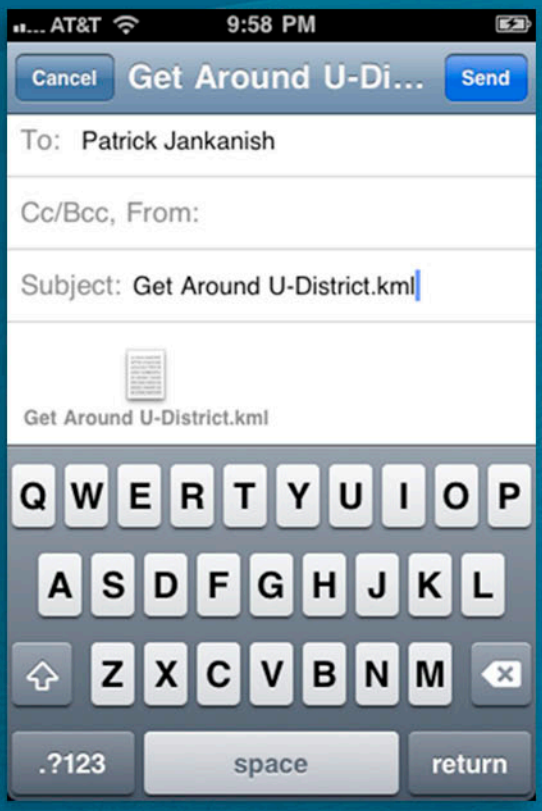


Seeing the waypoints and accessing their associated information on the iPhone is useful, but one really wants to be able to load the data into other applications, in this case the original Illustrator map. The export-import process is shown on the next five slides.



The author has tried the KML export only. The screen on the right shows the available data options for the exported file.

How did Patrick use the PDF Maps app?



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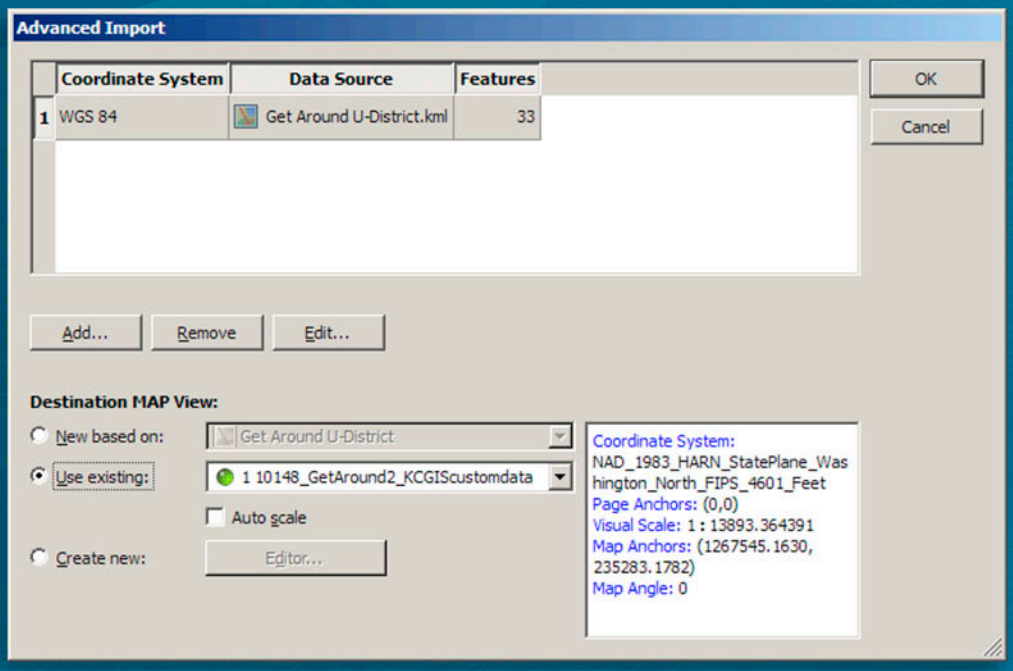
How quaint, delivering data by sending an e-mail to one's self with a file attachment. It's the only way to retrieve the exported data file, but it's easy.

How did Patrick use the PDF Maps app?



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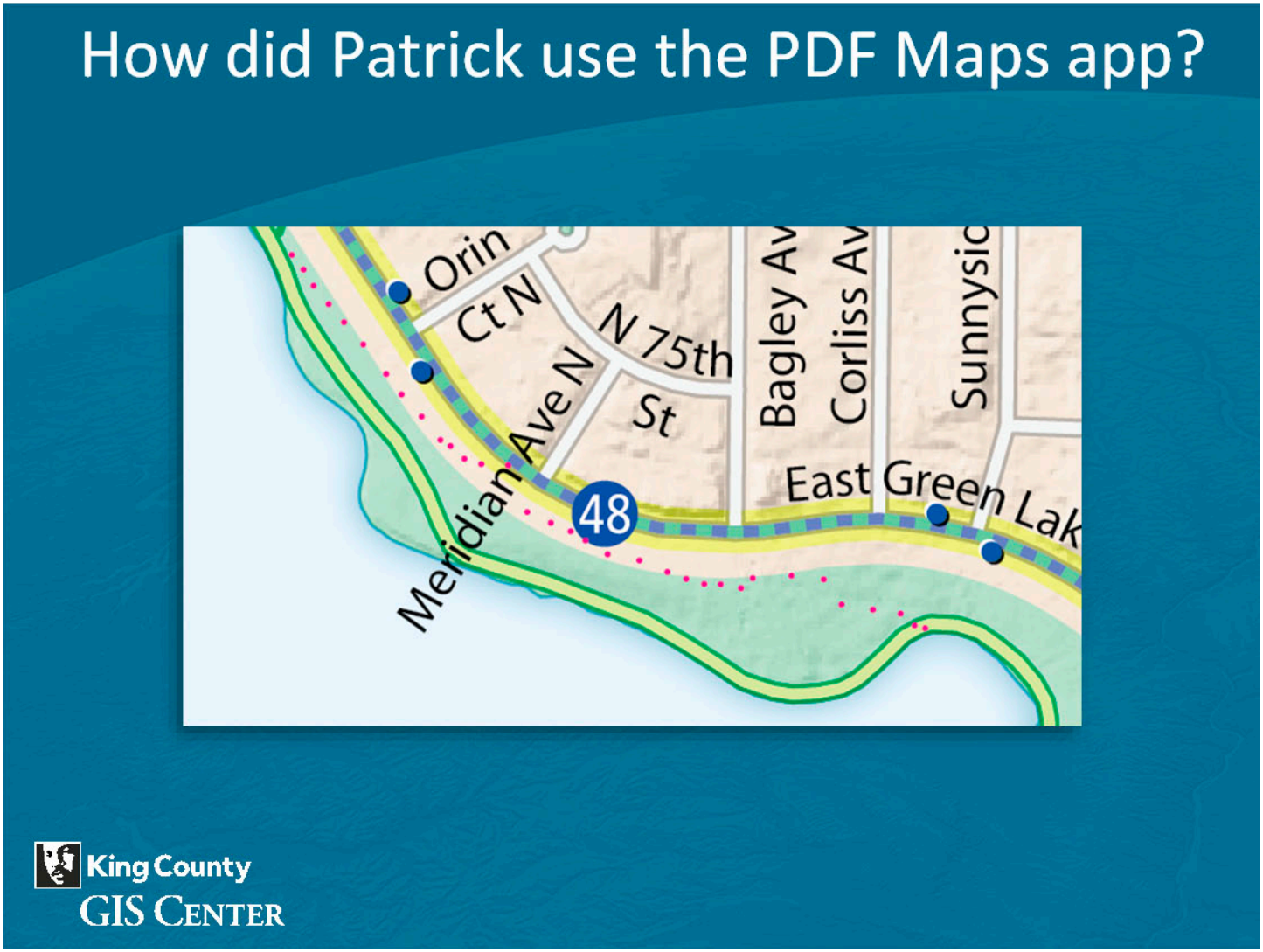
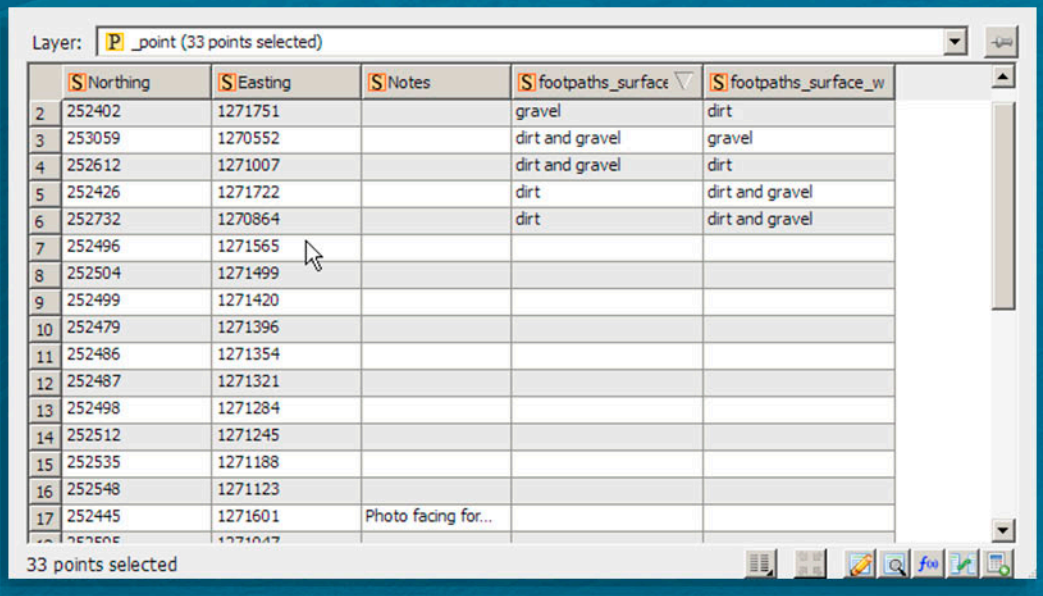
Back in Adobe Illustrator now–this is the MAPublisher data import dialog. Back at his workplace, the author saved the KML file from the e-mail he sent to himself from his iPhone to a project folder, and then he navigated to it using the MAPublisher import function.

Notice that the coordinate system of the Destination MAP View is State Plane, which is the coordinate system of the original Illustrator map and thus of the geospatial PDF that was exported from it. (One can verify this in PDF Maps–the user can view and export a text file of a map's metadata, including projection and coordinate system parameters.) PDF Maps saved the KML in WGS 84 but MAPublisher will automatically project the imported data into the Lambert Conformal Conic projection/State Plane Washington North coordinate system of the original map so that it registers properly in the MAP view.



Voilà! The PDF Maps waypoints are now data points in the Illustrator map. It would be prudent to overlay some high-resolution aerial imagery for comparison. Photos taken and notes recorded at various waypoints could also be used to adjust the track of the footpath.

How did Patrick use the PDF Maps app?



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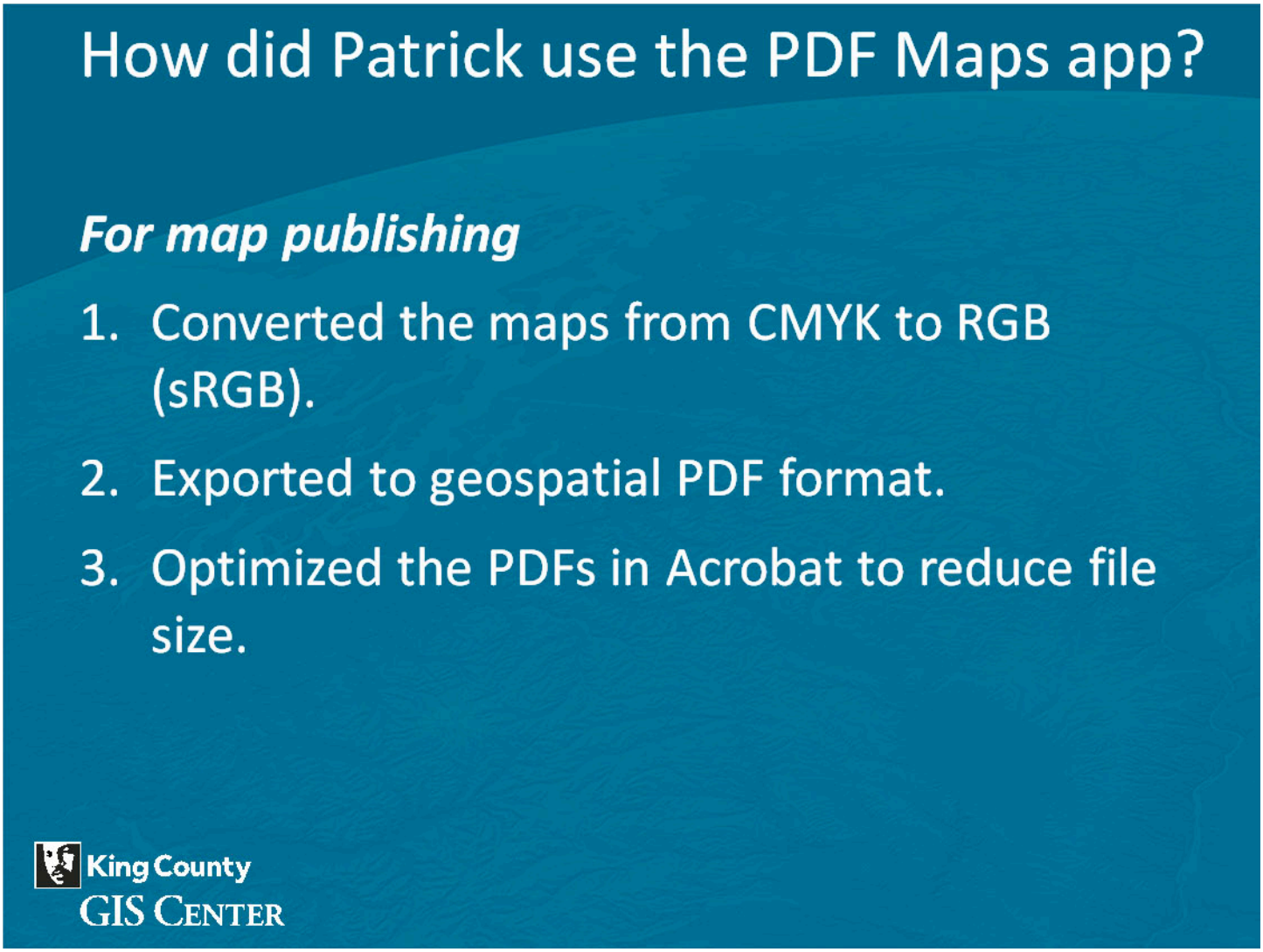
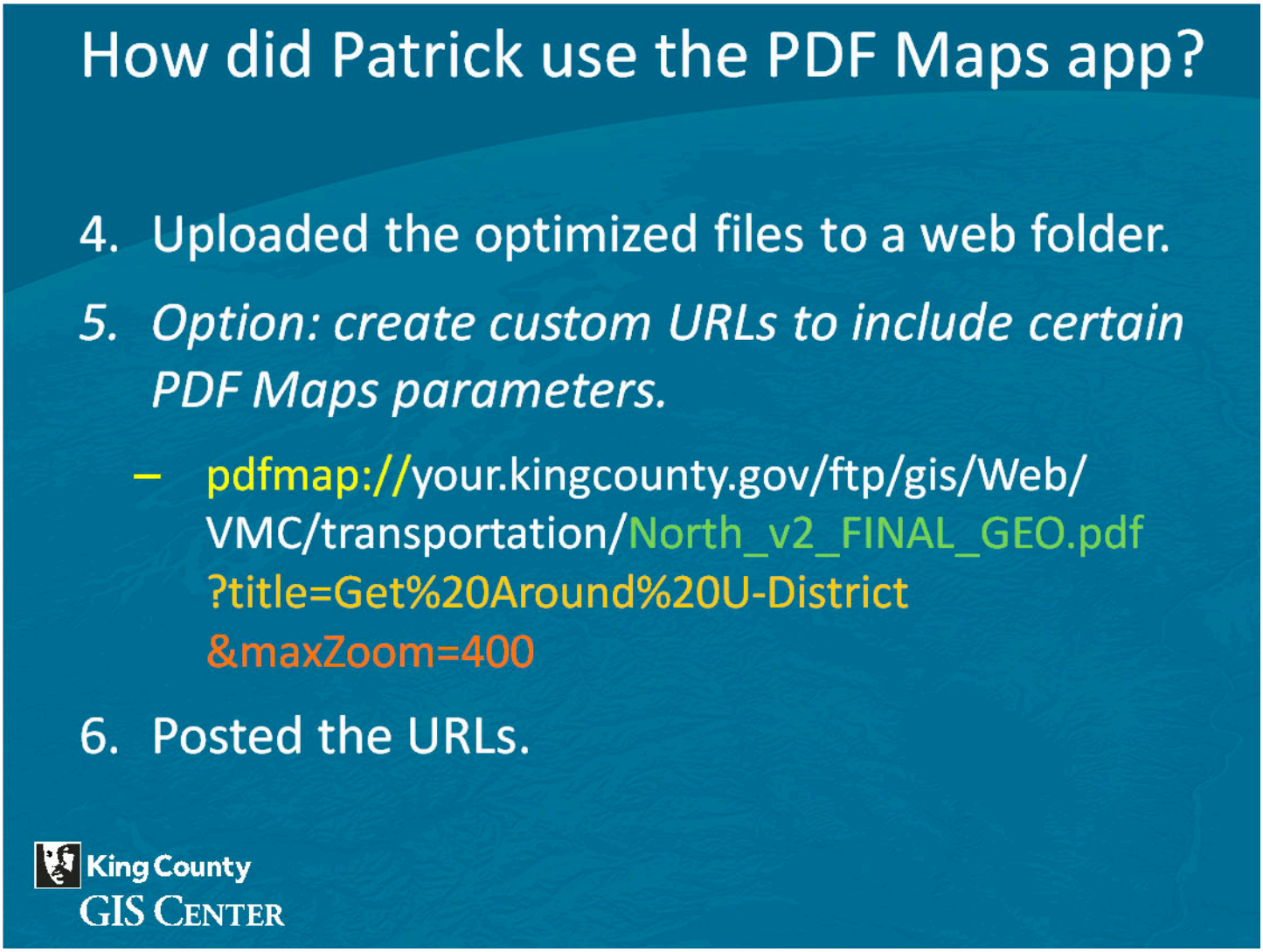
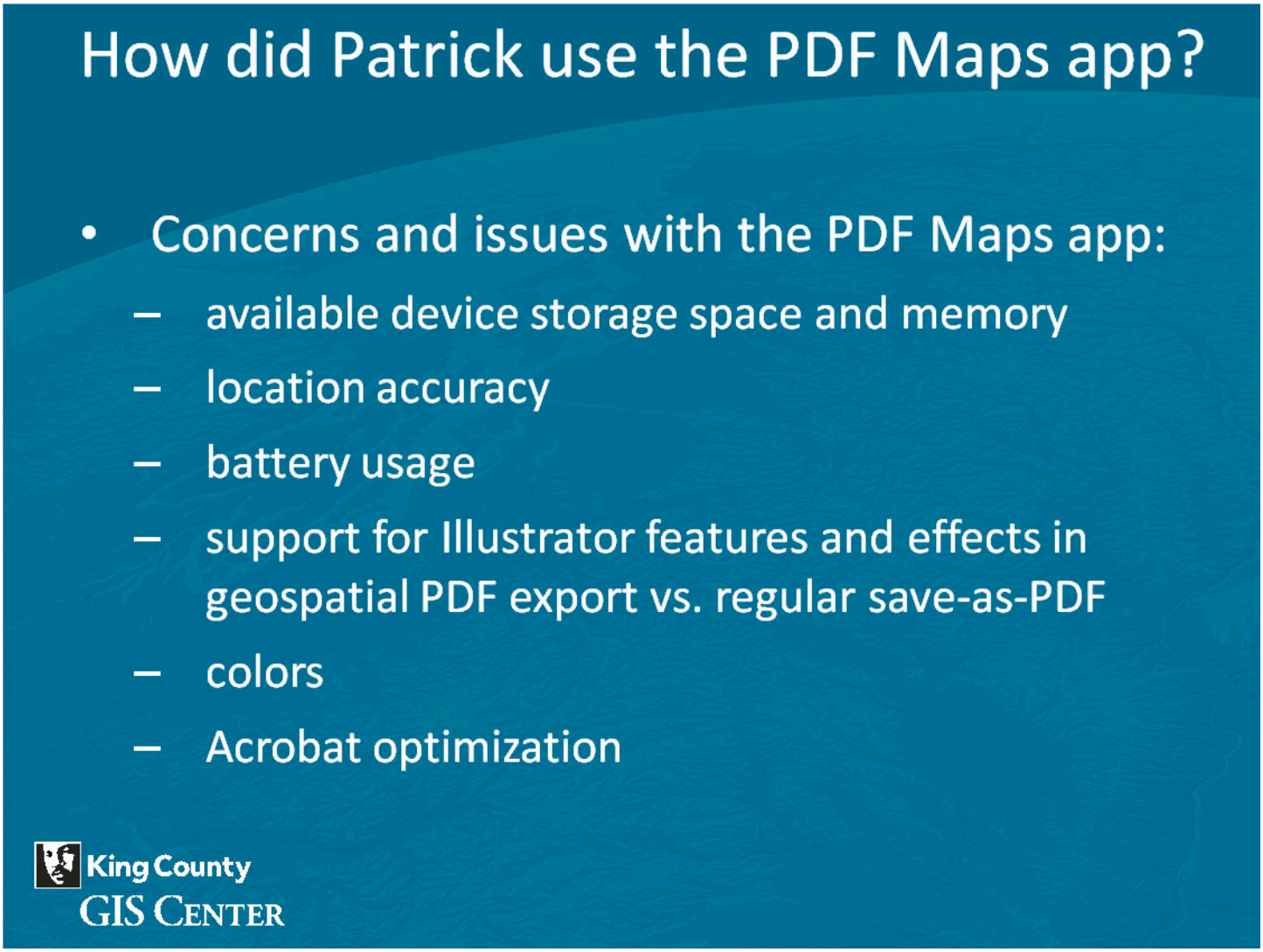
And here are the attributes of the waypoints, visible and operable in Illustrator thanks to MAPublisher.



1. When the map is completed it's time to publish. The map was designed for offset printing using the standard four-color process inks: cyan (C), magenta (M), yellow (Y), and black (K), and was thus built using Illustrator's CMYK drawing mode. Since the iPhone display, like any light-producing display, is an RGB (red-green-blue) device, if the geospatial PDF is exported and published as a CMYK file, some undesirable CMYK-to-RGB color translations can occur when it is opened on an iPhone. So prior to exporting the map, the author converted a copy of the finished map drawing from CMYK mode to RGB mode, and applied the sRGB color profile. "sRGB," or Standard RGB, is a color standard that was created to help establish consistency among different computer monitors and other display devices, and it is the iPhone display's color model. While some software applications can display CMYK images with a good translation of colors to RGB, the author has seen some very dramatic shifts for certain hues and values when viewing CMYK PDFs on an iPhone. Also, tints of CMYK color swatches in Illustrator can look very different when those swatches are converted to RGB even if the swatches themselves convert well.
2. The export to geospatial format for the finished map was the same as for the draft map.
3. Not mentioned earlier, however, is a very important step for managing file size for any PDF map, and it's especially important for maps that will be downloaded, processed, and stored on a mobile device. Optimizing a PDF is an advanced function of Adobe Acrobat (it can't be done in Reader). Optimization involves choosing and applying various options for reducing the content contained in a PDF file and compacting its structure. Especially important optimizing factors for maps that contain raster images are image resolution and image compression. Depending on the content of the original PDF and the optimization options that are applied, a PDF document's file size can be reduced sometimes up to 90%, although 25% to 75% is more typical.



4. Just like before, the PDF file needs to be made accessible via a web URL.
5. For download to PDF Maps, Avenza has provided for the ability to create custom URLs that contain various PDF Maps parameters. In the example on this slide, the "pdfmap" protocol, which Avenza has provided for downloading geospatial PDF files to PDF Maps, replaces "ftp" or "http." The address "your.kingcounty.gov/ftp/gis/Web/VMC/transportation/" is that of a folder in the KCGIS Center Virtual Map Counter. "North_v2_FINAL_GEO.pdf" is a file name. "title=Get%20Around%20U-District" is a parameter that will reset the name of the map in PDF Maps from the default, which is the file name, to a more natural-appearing map title. ("%20" is a placeholder for a space in a URL.) "maxZoom=400" is a parameter that allows the map maker/publisher to determine how much a user can enlarge a map. It may be worthwhile to set this parameter if the map maker knows that the level of detail in the map won't support a great deal of enlargement.
6. With the maps posted (and maybe custom URLs created for them), all that is left is to make links to the maps so users can access them.



The author has not done extensive testing of the PDF Maps app, but has encountered and is otherwise aware of factors that can affect optimal map production for, and display in, PDF Maps. Some brief comments about each follow.

- The user of any mobile device should monitor available storage space. As an example, the Get Around U-District map, which was optimized down to a file size of about 5Mb, was first processed in PDF Maps to have, by default, three image-tiled zoom levels (see Avenza's PDF Maps documentation on the topic of map rendering in the app). That resulted in a map size of about 20Mb as stored on the phone. As an experiment, the author re-rendered the map in the app to have four image-tile levels in order to produce greater sharpness and clarity when viewing the map at the maximum zoom level. The result was a map size of about 50Mb. The 50Mb map generally performs well, but the author has encountered low-memory messages (on an iPhone 3GS). As with any memory intensive app, it is best to close other apps that are open in the background, even if, theoretically, they are "asleep."

- The accuracy of the geo-location is a property of the device, not the map, although it is possible, just as it is with any map in any medium, to somehow mis-register map content. For example, in Illustrator, one can inadvertently shift the contents of a MAPublisher MAP View by using Illustrator's move tools instead of modifying the MAP View properties when a geospatial translation is required. The author has tried geo-location with a GeoPDF version of a scanned USGS topographic map and found that it was off by several city blocks, whereas the typical displacement as shown on a properly registered map, as well as the native iPhone maps app, at locations around the city of Seattle, is less then half of a city block (usually less than the width of a street). If one is within the map extent, the registration of a geospatial map can be checked in PDF Maps by simply comparing the live geo-location as shown on the map to on-the-ground features, or to the native iPhone maps app (PDF Maps includes the ability to automatically make the switch—it opens the iPhone's Google Maps app to the same geographic extent–see Slide 40). The coordinates of known features could also be checked in PDF Maps or in Reader. This would be a good "best practice" to establish for publishing geospatial PDF maps—always verify the maps spatial coordinates.

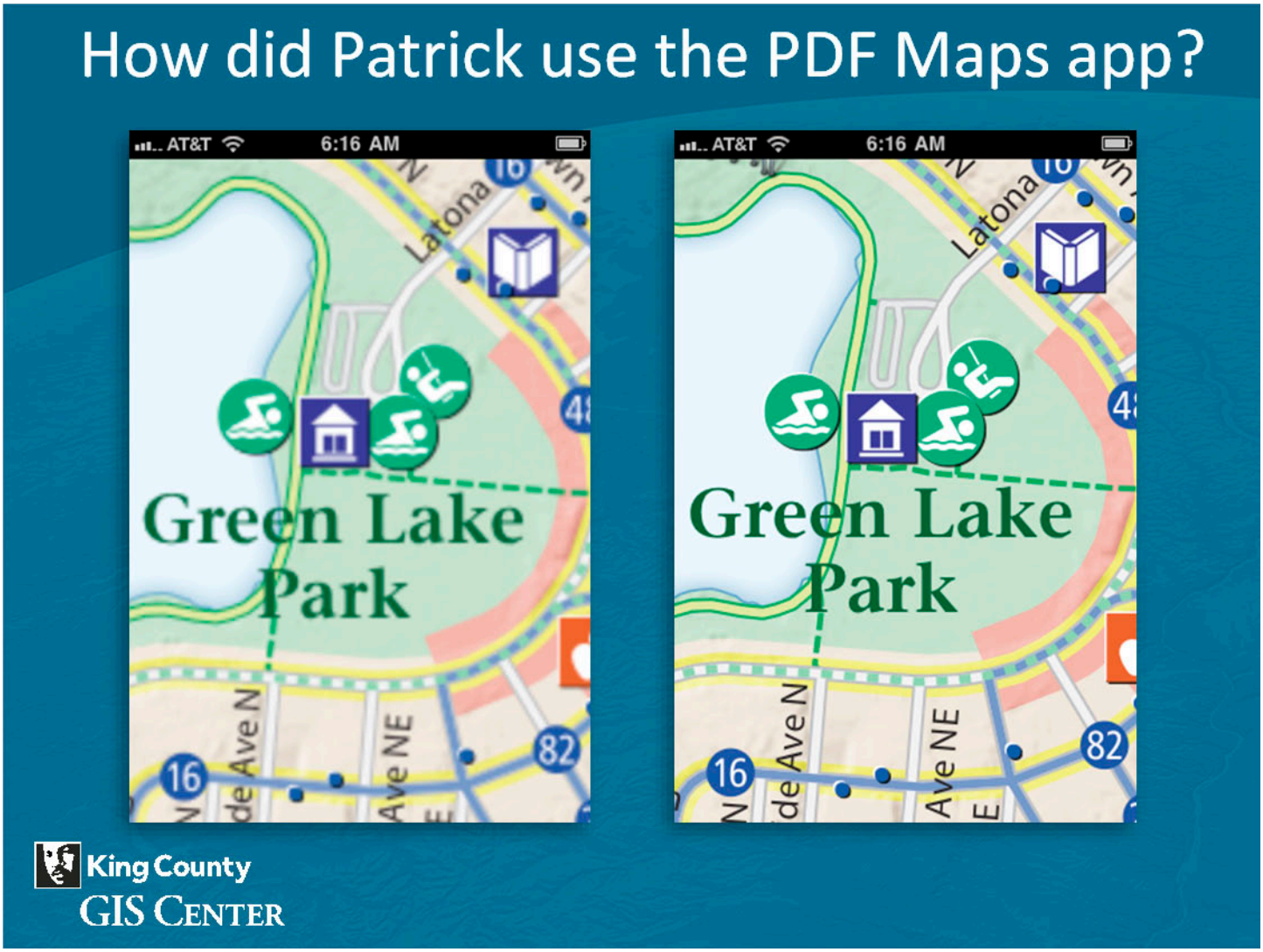
- The author does not know of any benchmark data for battery usage while using the PDF Maps app, but any iPhone user should be mindful that highly functioning apps can use a lot of battery power. The constant updating of the phone's geo-location while using a map is a potential battery drain.

- MAPublisher documentation includes information about Illustrator features that are not supported by the MAPublisher geospatial PDF export function. As with map output to any export format, Illustrator users should be aware of features and special effects that may not export well, or at all.

- "Colors" here refers to the kind of color shifts already mentioned in the notes for Slide 35.

- Acrobat PDF file optimization was also mentioned in the notes for Slide 35. The author has not tested all of the optimization options but suspects that one or more of them might strip out the geospatial content, which suggests a good topic for further investigation.

How did Patrick use the PDF Maps app?



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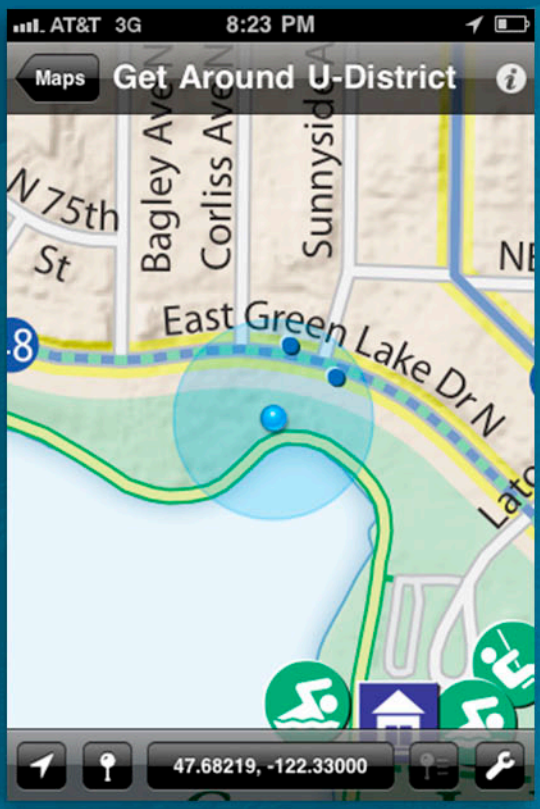
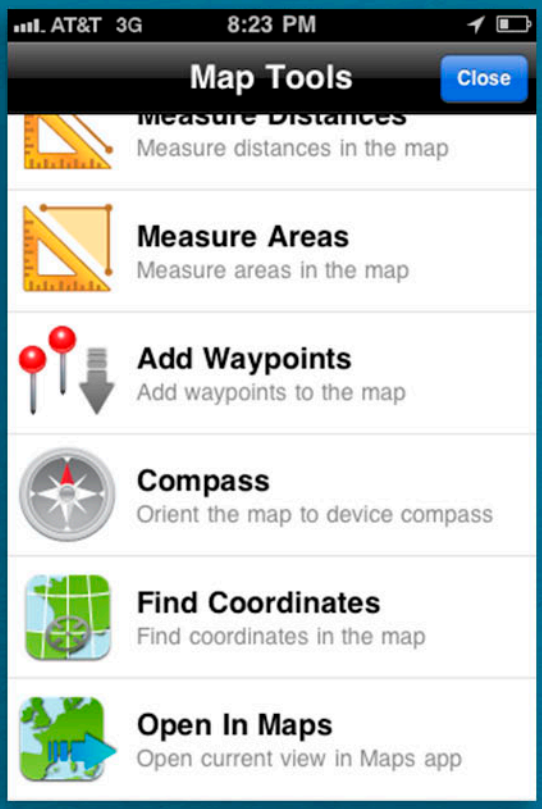
This and the next few slides further illustrate some aspects of the PDF Maps app.

The screen on the left shows a map rendered for three image-tile levels (i.e., tile depth = 3) at a zoom level of 400%. What you are seeing is the largest-scale set of image tiles from that rendering enlarged to twice the scale they were rendered at. The screen on the right shows the same map rendered at four image-tile levels (tile depth = 4). Although the image is vastly sharper, the map with a tile depth of four is 52Mb while the same map rendered to a tile depth of three is only 20Mb. Given the inherent map detail conveyed by the symbology (line widths, etc.), the optimal viewing size for this particular map is less than 400%. Thus, it might be more prudent to render to a tile depth of three instead of four, and perhaps to even limit the maximum zoom to, say, 300%. Recall (from Slide 36) that maximum zoom can be set as a parameter in a custom URL for the map (although, if a user chooses to re-render the map, the maximum zoom setting will be lost, and there is no way to set maximum zoom within the app itself).

How did Patrick use the PDF Maps app?





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The screen on the left represents the main PDF Maps display, while the screen on the right is what the user sees after tapping the Map Tools (wrench) icon in the lower right corner of the main screen.

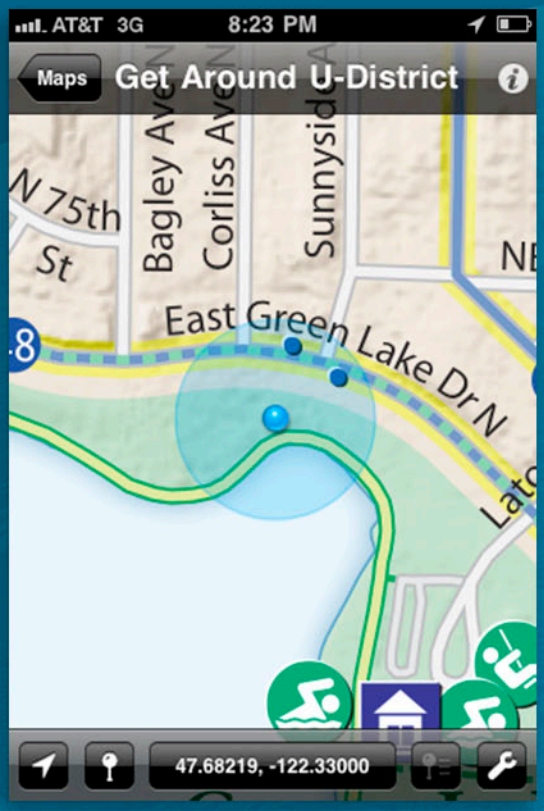
The measure and waypoints tools have already been discussed on earlier slides. But not mentioned earlier is the fact that the drop-waypoint button on the main map display will be inactive if the user is not geographically located within the map extent. Whether or not the user is in the map extent, the Add Waypoints tool on the Map Tools screen can be used to manually position waypoints anywhere on a map, not just at the user's location as demonstrated earlier.

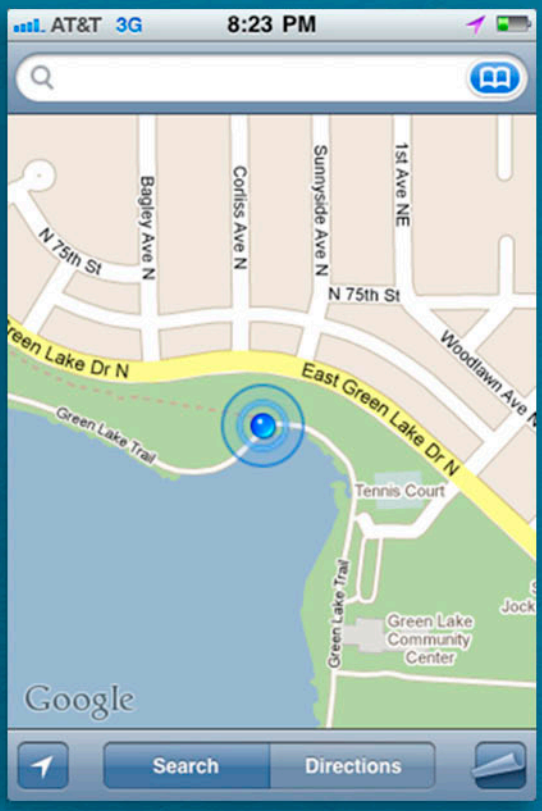
The Compass tool and its brief description are self-explanatory.

The Coordinates tool was mentioned and illustrated earlier (Slide 8).

The Open In Maps tool is illustrated on the next slide.

How did Patrick use the PDF Maps app?





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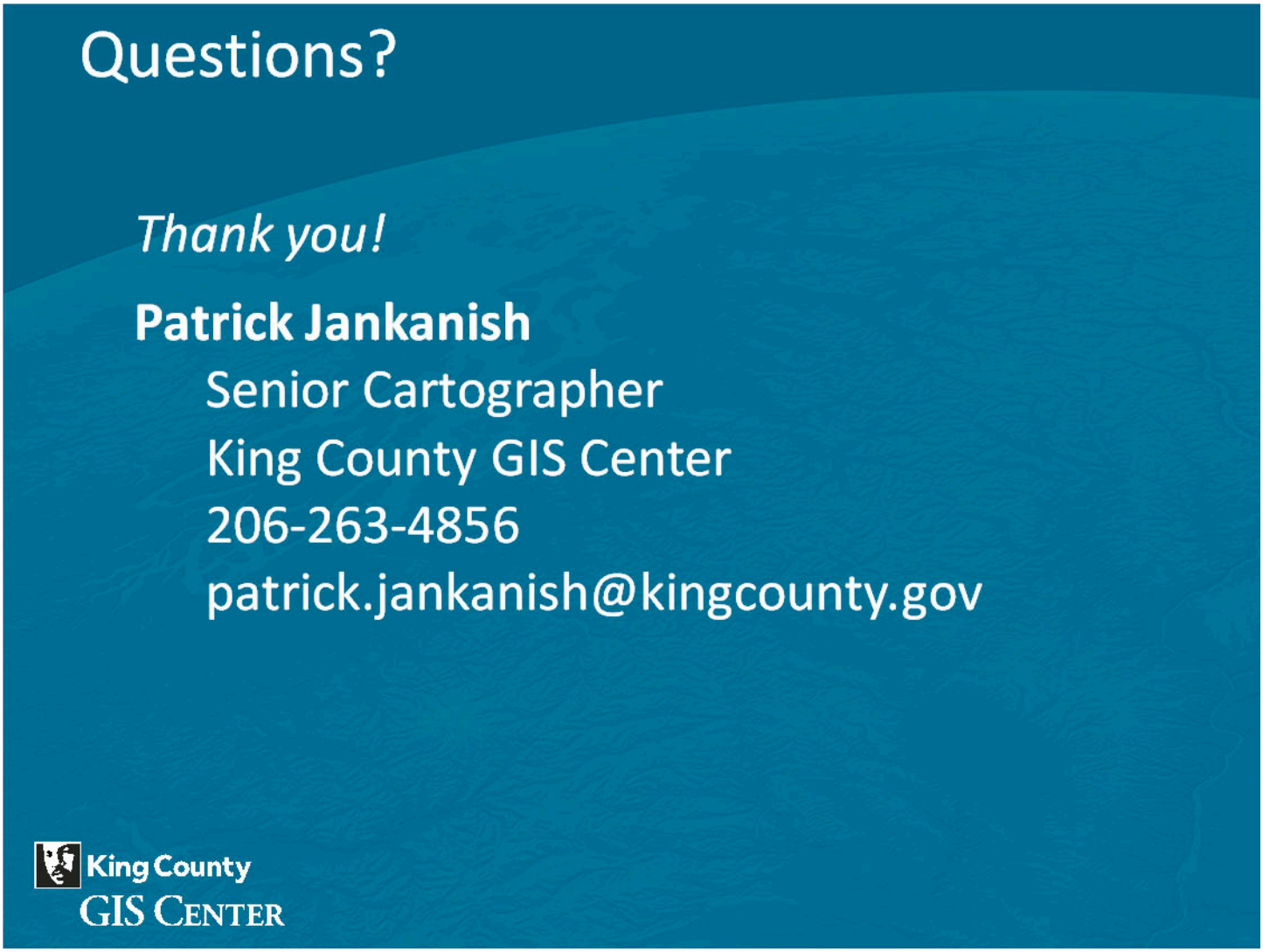
The screen on the left shows live geo-location on a map in PDF Maps. The screen on the right is the result of applying the "Open In Maps" tool. The iPhone's Google Maps app is launched automatically and its map display pans and zooms to approximately the same extent as the current map in PDF Maps.



The author welcomes comments on or questions about this presentation. He is especially interested in hearing from other users of the PDF Maps app.

Sources and References

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