

Drive around, take pictures, and  
automatically make maps for GIS

Craig Greenwald

GeoMobile Innovations

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# Who we are...



**Our mission is to work with you as a partner and empower you to improve return on investment by implementing quality Mobile GIS and field data collection solutions.**

**Contact us by phone at:  
541-754-3488 (Direct to Rich)**



- Craig Greenwald
- GMI Technical Director
- Worked 7 years for ESRI; ArcPad team
- Mobile GIS Software Developer
- ArcPad trainer/consultant specialist
- [craig@geomobileinnovations.com](mailto:craig@geomobileinnovations.com)



- Rich Ash
- GMI Business Development Director
- Over 20 years experience field data collection/mapping technology
- Provides on-site training/consulting for GPS and mapping hardware/software
- Contact for quotes, questions about technology
- [rich@geomobileinnovations.com](mailto:rich@geomobileinnovations.com)

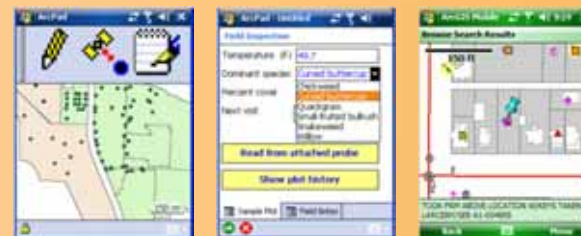
# Who we represent...

- ESRI Authorized Business Partner
  - Corporate Consultant, Software Reseller, Developer
- Laser Technology Inc. Authorized Business Partner/Dealer
- Trimble Mobile Computing Solutions Authorized Reseller
- Landmark Systems Forestry Solutions Business Partner
- Garmin Recreational GPS Authorized Dealer
- Trimble GPS for GIS & Survey (Pacific Survey Supply Rep.)
- Juniper Systems Handheld Computers
- Handheld USA Tablets and handhelds
- Bradshaw Consulting Exclusive Western State HyperPic.Mobile Reseller



# What we offer...

- ArcPad and Custom Mobile GIS/GPS Software
- Software development and consulting
  - ArcPad, ArcObjects, ArcGIS Mobile
- Hands-on software training workshops
  - ArcPad
    - ArcPad 10 Bootcamp
    - ArcPad Studio Enterprise Tricks and Tips
  - TerraSync, Solo and other Mobile GIS
  - ArcGIS Desktop
- Field Data Collectors with and without GPS
- Laser Range Finder Solutions (LaserGIS, etc..)
- GIS Photo Solutions



# Audience Poll

- Use a GPS device with a camera?
- Use ArcGIS?
- Use Google Earth?

# Agenda

- Geotagged photos overview
- Hardware options
- Review of approaches
- Case History: Garmin Oregon 550 -> ArcMap
- GeoMobile's Photo Inventory Tool



# Why capture photos in the field?

- The ultimate attribute!



Needs Replacement?

Condition

	▼
Excellent	
Fair	
Good	
Poor	

# Why capture photos in the field?

- The GIS feature itself!





# How photos are stored

- JPEG

- Lossy compression (2.6:1 to 15:1 typical)
- Direct relationship between file size and # photos you can store & time to transfer (100-1500 / GB)

- EXIF

- Extension to JPEG to store metadata
- Supports GPS and range measurement data
- IPTC supports metadata, but no coords/GPS

# EXIF Data Example

**Opanda PowerExif -- R0010023.JPG**

File: R0010023.JPG

Path: C:\Users\Public\Documents\ArcPad\Samples\Redlands\

Filename: R0010023.JPG  
 Dimensions: 374 x 500, 72dpi  
 File Size: 59722 byte  
 Create Time: 2013-02-01 12:03:20  
 Write Time: 2005-07-04 16:21:34

Copyright:  
 (C) by Caplio Pro G3 User

Entry	Meaning	Tag	Exif Name	Type
<b>Image</b>				
Make	RICOH	010F	Make	ASCII
Model	Caplio Pro G3			
Software	Adobe Photoshop Alb			
Date Time	2005-07-04 14:21:33			
Copyright	(C) by Caplio Pro G3			
<b>Camera</b>				
Exposure Time	1/217"			
F Number	F8.7			
Exposure Prog...	Normal program			
ISO Speed Rati...	125			
Exif Version	Version 2.2			
Date Time Orig...	2005-07-04 11:59:34			
Date Time Digit...	2005-07-04 11:59:34			
Aperture Value	6.3 AV			
Brightness Value	8.9 BV			
Exposure Bias ...	±0EV			

**Opanda PowerExif -- R0010023.JPG**

Entry	Meaning	Tag	Exif Name	Type	Co
- GPS Latitude Ref	North latitude	0001	GPSLatitudeRef	ASCII	
- GPS Latitude	34°2'15.4"	0002	GPSLatitude	RATIONAL	
- GPS Longitude...	West longitude	0003	GPSLongitudeR...	ASCII	
- GPS Longitude	117°11'41.34"	0004	GPSLongitude	RATIONAL	
- GPS Altitude Ref	Sea level	0005	GPSAltitudeRef	BYTE	
- GPS Altitude	400m	0006	GPSAltitude	RATIONAL	
- GPS Time Sta...	18:58:57 UTC	0007	GPSTimeStamp	RATIONAL	
- GPS Satellites	25,01,14,11,22,19,15,....	0008	GPSStatus	ASCII	
- GPS Status	Measurement in progress	0009	GPSStatus	ASCII	
- GPS Measure ...	3-dimensional measurem...	000A	GPSMeasureMo...	ASCII	
- GPS DOP	2.2	000B	GPSDOP	RATIONAL	
- GPS Speed Ref	Knots	000C	GPSSpeedRef	ASCII	
- GPS Speed	0	000D	GPSSpeed	RATIONAL	
- GPS Track Ref	True direction	000E	GPSTrackRef	ASCII	
- GPS Track	112	000F	GPSTrack	RATIONAL	
- GPS Img Direct...	True direction	0010	GPSImgDirectio...	ASCII	
- GPS Img Direct...	112	0011	GPSImgDirection	RATIONAL	
- GPS Map Datum	WGS-84	0012	GPSMapDatum	ASCII	

Path: C:\Users\Public\Documents\ArcPad\Samples\Redlands\  
 Filename: R0010023.JPG  
 Dimensions: 374 x 500, 72dpi  
 File Size: 59722 byte  
 Create Time: 2013-02-01 12:03:20  
 Write Time: 2005-07-04 16:21:34

Copyright:  
 (C) by Caplio Pro G3 User

Photographer Editor **GPS** Show All

ByteOrder: Motorola

# Agenda

- Geotagged photos overview
- **Hardware options**
- Review of approaches
- Case History: Garmin Oregon 550 -> ArcMap
- GeoMobile's Photo Inventory Tool

# GPS & Digital Camera Options

- “Standard” camera
  - Inexpensive, high resolution, lots of options
  - SD card makes for easy in-field transfer to device
  - Eye-Fi SD card add-on (4 GB + WiFi) / Trimble TrimPix Pro
- “Recreational” GPS
  - Inexpensive, lots of options
  - Accuracy limited to >10 feet
  - Tracklog capture or NMEA out



# GPS & Digital Camera Options

- Mobile device with GPS and integrated camera
  - Camera quality and resolution often not as good\*
  - Highly customizable
- GPS-enabled camera / Camera-enabled GPS
  - Creates GPS EXIF tags automatically
- “Smart” camera (+ GPS)
  - On-board OS and software
  - Attribute tagging
  - WiFi/Bluetooth photo file transfer

# Hardware review



# Agenda

- Geotagged photos overview
- Hardware options
- **Review of approaches**
- Case History: Garmin Oregon 550 -> ArcMap
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# Review of Approaches

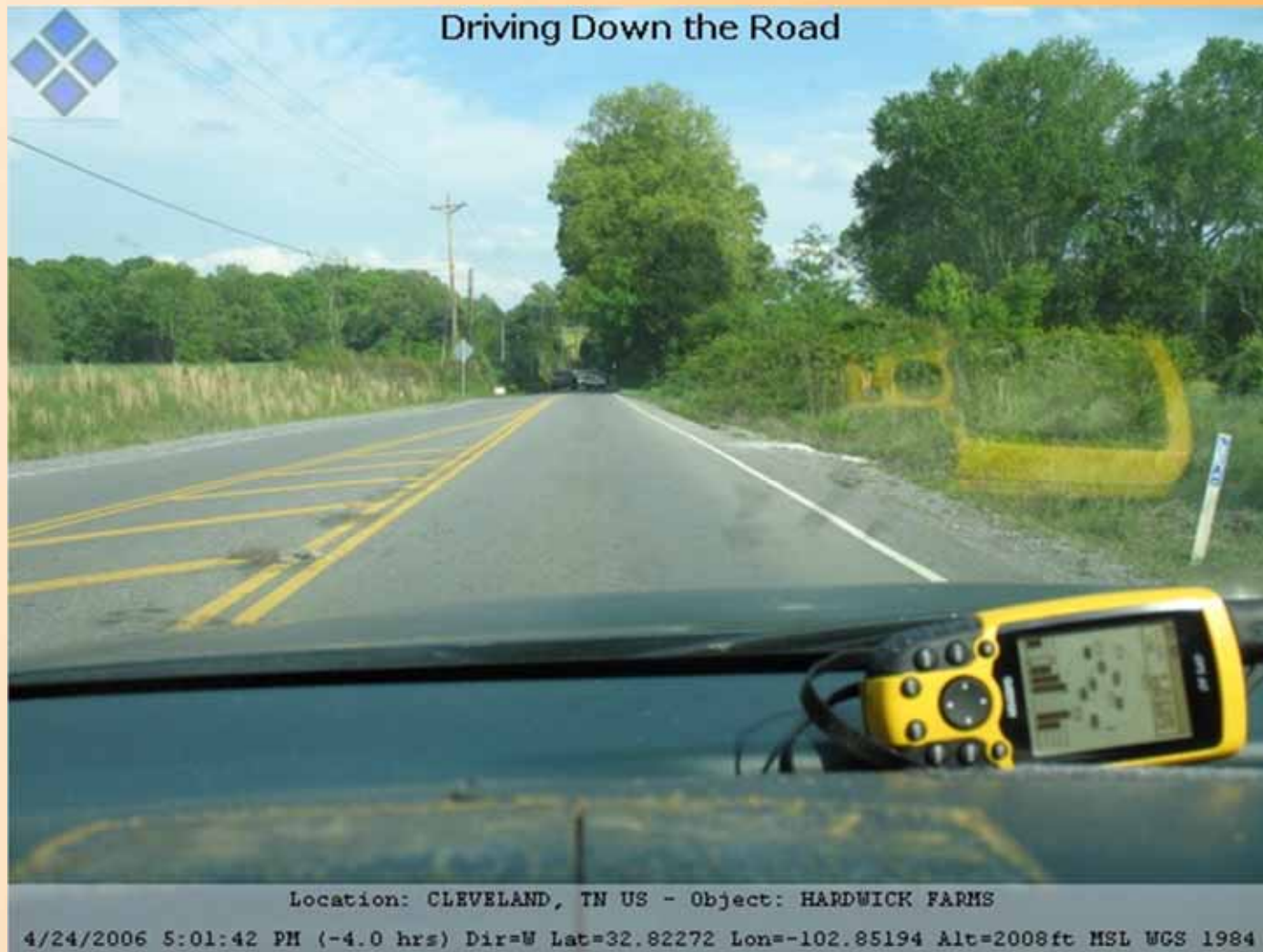
- Photos as features
  - Cornucopia of options
- Photos as GIS attributes
  - Enriches visualization & analysis
- Customized solutions
  - Get 'er done!



# Photos as self-contained features

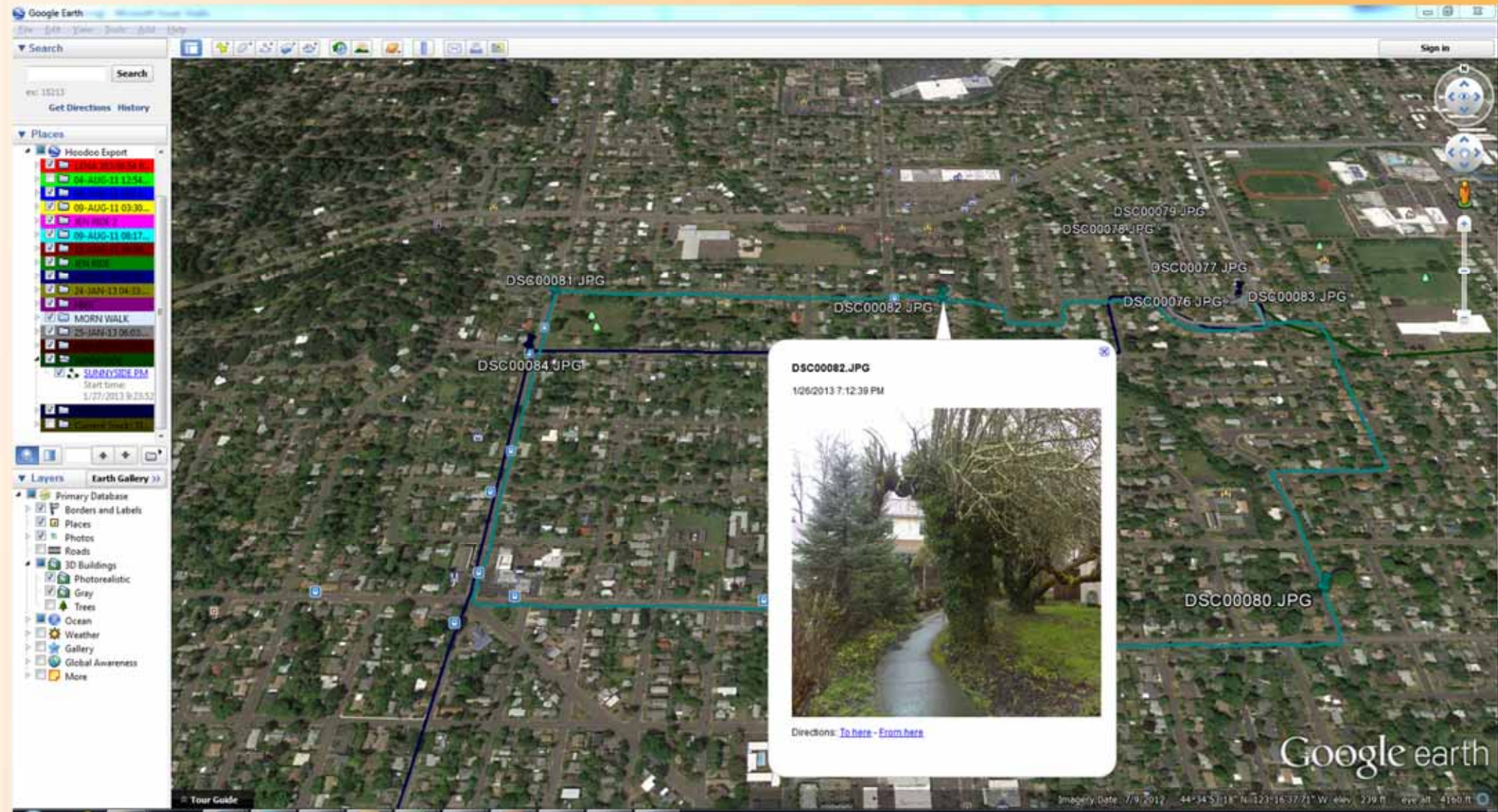
- Any camera / Any GPS
  - Tracklogs (time stamped)
- Post processing software and steps
  - GPS-Photo Link / Wind Image / RoboGEO
  - ArcPad Photo Layer tools
- Results in new features
- Lots of output options (GIS and non-GIS)
  - Shapefiles, GDB FCs, Paper/PDF maps, Google Earth, Watermarked photos, etc.

# Watermarked Photo





# Google Earth



# Goals for Photo Attributes in GIS

- Easily associate photos taken in the field with corresponding GIS features in the office
  - Minimize file “shuffle”
  - Minimize non-meaningful file names
- Easily display photos associated with features in desktop/server GIS
  - Review multiple photos side by side



# Challenges in GIS

- Database structure/support
  - Intrinsic 1 to Many relationship
  - Lack of standardized “linked photos” attribute type (ArcGIS 10 attachments help)
- Sharing photos between users tricky
- Workflows are limited
  - Software solutions help (e.g., HyperPic)
- Hardware connectivity can be tricky

# Photos as GIS Attributes - Types

- Hotlinking / Hyperlinking
  - Easy to configure in ArcMap
  - Field based (Hotlink) or dynamic (Hyperlink)
  - Stores name and path\* of photo files
  - Displays photos in native JPEG viewer
- Raster fields in Geodatabases
  - Embeds the file in the database as binary data
  - One per feature class
- Attachments in ArcGIS 10
  - Multiple attachments supported
  - Requires ArcGIS Standard or Advanced

# Customized Solutions

- Geotagged Photo capture for a specific goal
  - Police officer's Graffiti Buster
  - Real estate agent's Home Finder
  - Citizen Pothole Reporter
- Data structures and hardware well defined
- Streamlined workflow
- Requires a software developer

# Agenda

- Geotagged photos overview
- Hardware options
- Review of approaches
- **Case History: Garmin Oregon 550 -> ArcMap**
- GeoMobile's Photo Inventory Tool



# Case History: OSU GROW HKC

**GeoMobile Garmin GeoPhoto Field Transfer App**

Garmin Status & Summary  
Garmin connected:  GPS Tracks found: 0  
 GPS Photos found: 35


Collection Details: (You must fill these in)  
State: Oregon Community Name: Corvallis  
Date: 8/12/2011 Coordinator Name: Craig G  
Data Collector ID: CRA001

**Tracks**

Track Name	Start Time (UTC)	End Time (UTC)	# of Photos
LENA 203:58:54 PM	8/11/2011 9:23:58 PM	8/11/2011 10:34:58 PM	2
04-AUG-11 12:54:05 PM	8/2/2011 11:40:35 PM	8/4/2011 7:50:22 PM	3
09-AUG-11 03:14:19 PM	8/9/2011 9:41:35 PM	8/9/2011 10:11:24 PM	1
09-AUG-11 03:30:30 PM	8/9/2011 10:14:28 PM	8/9/2011 10:30:01 PM	4
JEN RIDE 2	8/7/2011 6:29:30 PM	8/7/2011 8:45:24 PM	3
09-AUG-11 08:17:57 PM	8/9/2011 10:30:43 PM	8/10/2011 3:15:53 AM	5

**Photos**

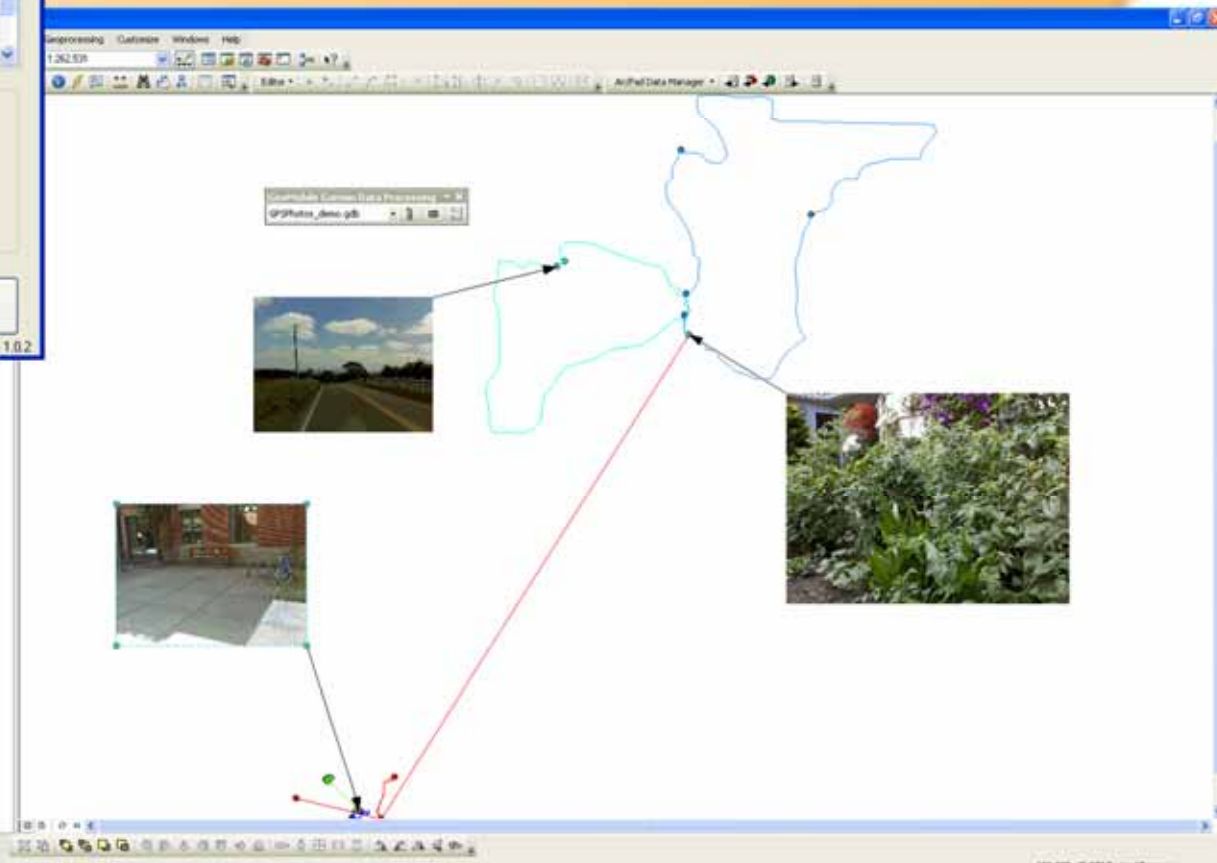
Photo Name	Date/Time Taken (UTC)	Latitude	Longitude
DSC00041.JPG	8/11/2011 10:12:10 PM	44.6667	-123.3046
DSC00040.JPG	8/11/2011 10:11:58 PM	44.6667	-123.3046



V.1.0.2



- 04-AUG-11 12:54:05 PM
- 09-AUG-11 03:14:19 PM
- 09-AUG-11 03:30:30 PM
- 09-AUG-11 08:17:57 PM
- 11-AUG-11 08:19:59 AM
- JEN RIDE 2
- LENA 203:58:54 PM



# OSU Grow HKC

- Generating Rural Options for Weight-Healthy Kids and Communities
- Obesity Prevention Program for Rural Oregon
- Examine rural lifestyle such as physical activity and access to nutritious food sources
- Currently deploying 100 systems as pilot to collect data for photo and route analysis

# GeoMobile Photo/Route Mapping and ArcGIS Solution

- Garmin 550 with pre-loaded profile
- GeoMobile Garmin GeoPhoto Field Transfer App
  - Manages transfer of linked photo and route sessions
  - Auto packaging and email
- GeoMobile Garmin GeoPhoto Data Processing Tool for ArcGIS
  - Visualization tool for linked photos and routes
  - ESRI ArcGIS Extension



# GROW HKC Multi-State Project





Photo #	Picture of?	This is a photo of a place or thing that makes it... (check all that apply):				Why do you think this place or thing makes it easy or hard for you or others to be physically active or to eat healthy?
		<u>Easy</u> for you or others to be physically active	<u>Hard</u> for you or others to be physically active	<u>Easy</u> for you or others to eat healthy	<u>Hard</u> for you or others to eat healthy	
2.	<i>Trail</i>	✓ —	—	—	—	<i>I use this trail often, well maintained.</i>

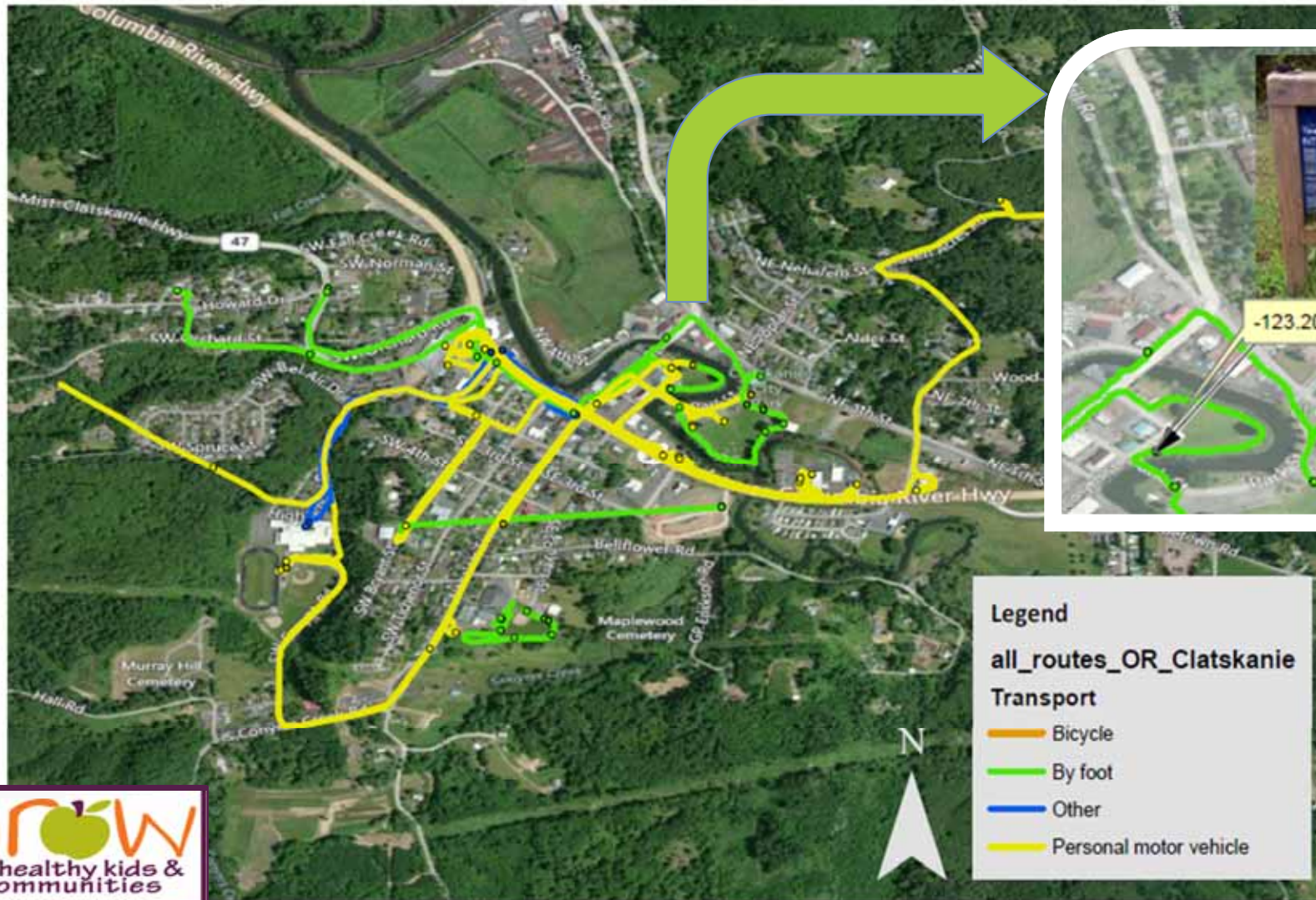


02/03/2011 14:39



# HEAL MAPPS Routes

...tell a story of how people navigate the food and physical activity features of their rural place



# DEMO OF WORKFLOW

**GeoMobile Garmin GeoPhoto Field Transfer App**

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**Garmin Status & Summary**

Garmin disconnected.

GPS Tracks found: 0

GPS Photos found: 0

[Refresh Garmin Status](#)

**Collection Details (You must fill these in)**

State

Community Name

Date 4/11/2013

Coordinator Name

Data Collector ID

---

**Tracks**

Track Name	Start Time (UTC)	End Time (UTC)	# of Photos

---

**Photos**

Photo Name	Date/Time Taken (UTC)	Latitude	Longitude

**Photo Preview**

---

**Zip and Email Garmin Files**

V. 1.0.2



GeoMobile Garmin GeoPhoto Field Transfer App

**Garmin Status & Summary**

Garmin connected.      GPS Tracks found: 3

Refresh Garmin Status      GPS Photos found: 77

**Collection Details (You must fill these in)**

State: Oregon      Community Name: Corvallis

Date: 4/11/2013      Coordinator Name: CraigG

Data Collector ID: UnitA


**Tracks**

Track Name	Start Time (UTC)	End Time (UTC)	# of Photos
OFFICEWALK	4/9/2013 11:56:47 PM	4/10/2013 12:06:08 AM	6
WRIVER 04:37:01 PM	7/8/2012 7:11:15 PM	7/8/2012 11:37:23 PM	2
MORN WALK	1/26/2013 6:42:09 PM	1/26/2013 7:20:48 PM	3

**Photos**

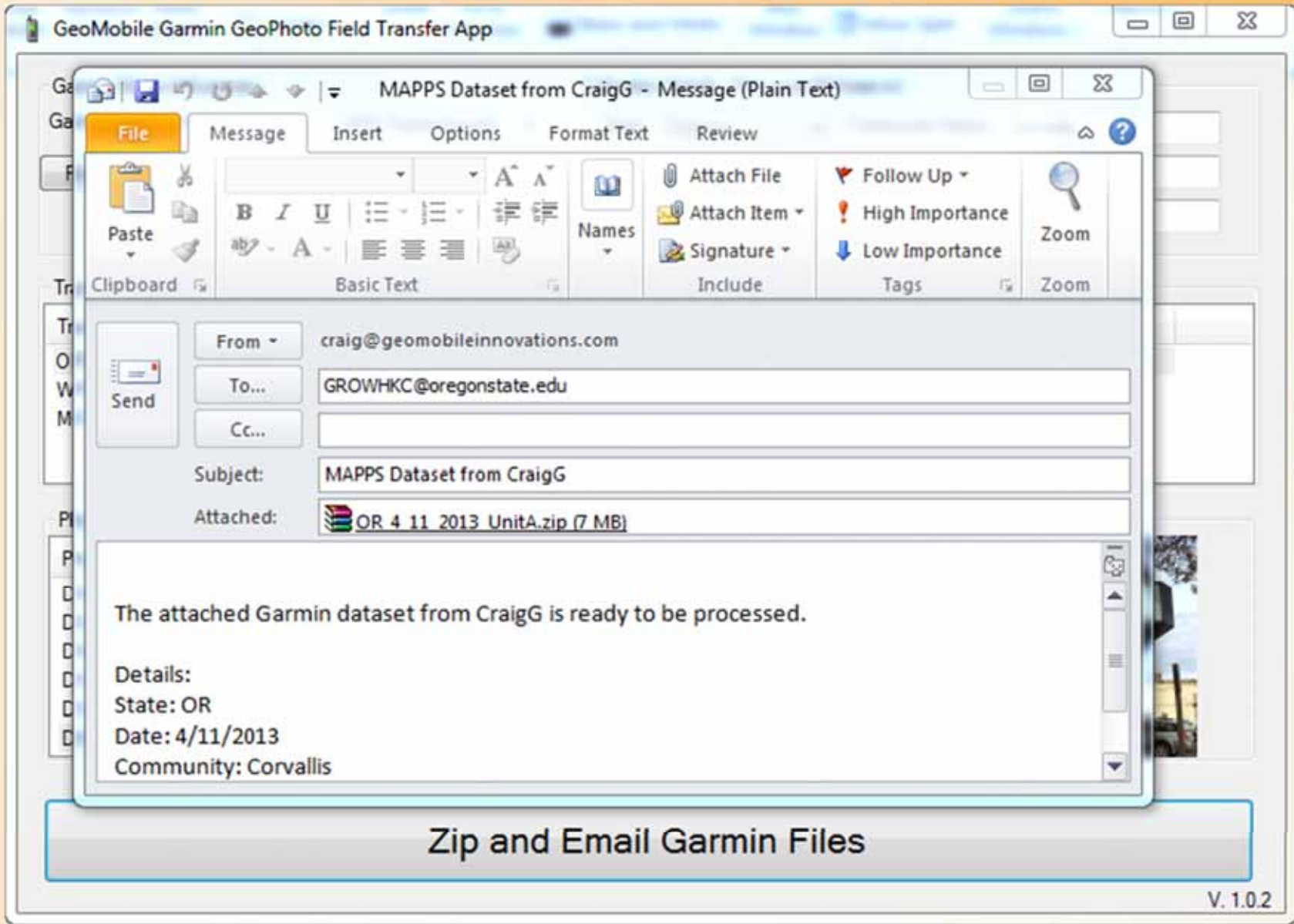
Photo Name	Date/Time Taken (UTC)	Latitude	Longitude
DSC00099.JPG	4/9/2013 11:58:01 PM	44.6905	-123.3878
DSC00100.JPG	4/9/2013 11:59:27 PM	44.6949	-123.4045
DSC00101.JPG	4/10/2013 12:00:01 AM	44.6963	-123.4096
DSC00102.JPG	4/10/2013 12:01:41 AM	44.7069	-123.4141
DSC00103.JPG	4/10/2013 12:03:24 AM	44.7041	-123.3954
DSC00104.JPG	4/10/2013 12:05:36 AM	44.6953	-123.3815

**Photo Preview**



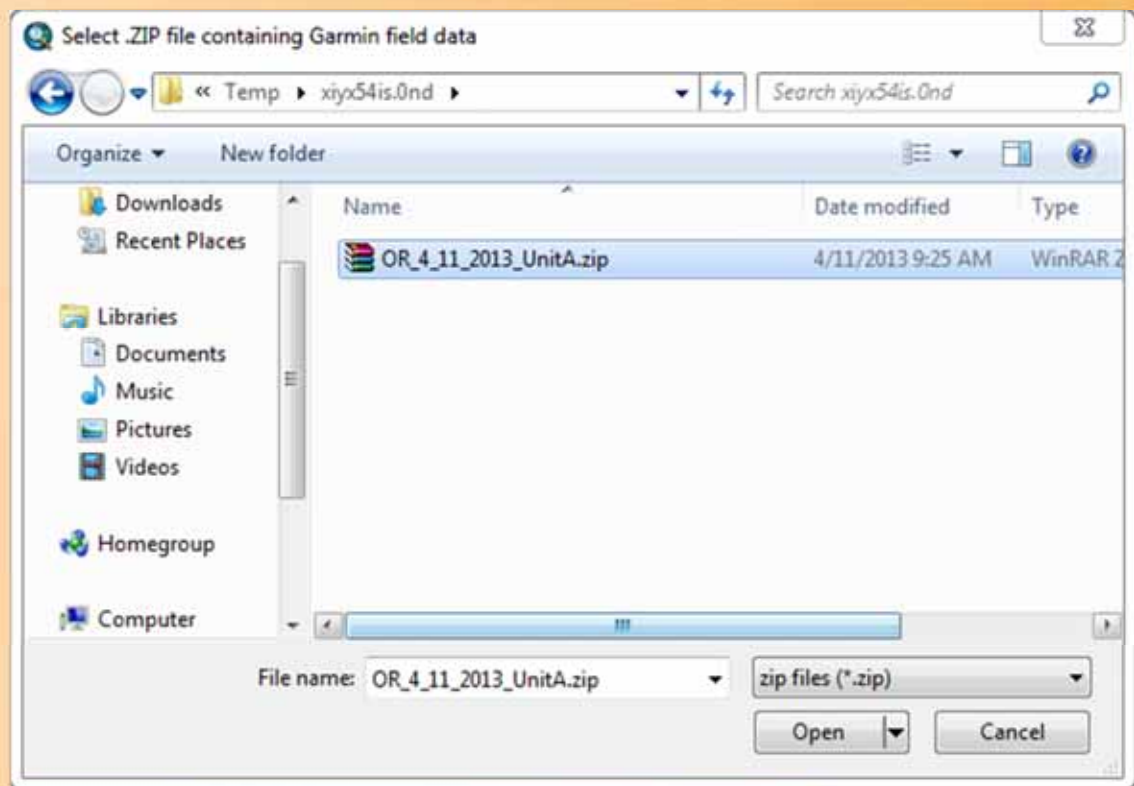
**Zip and Email Garmin Files**

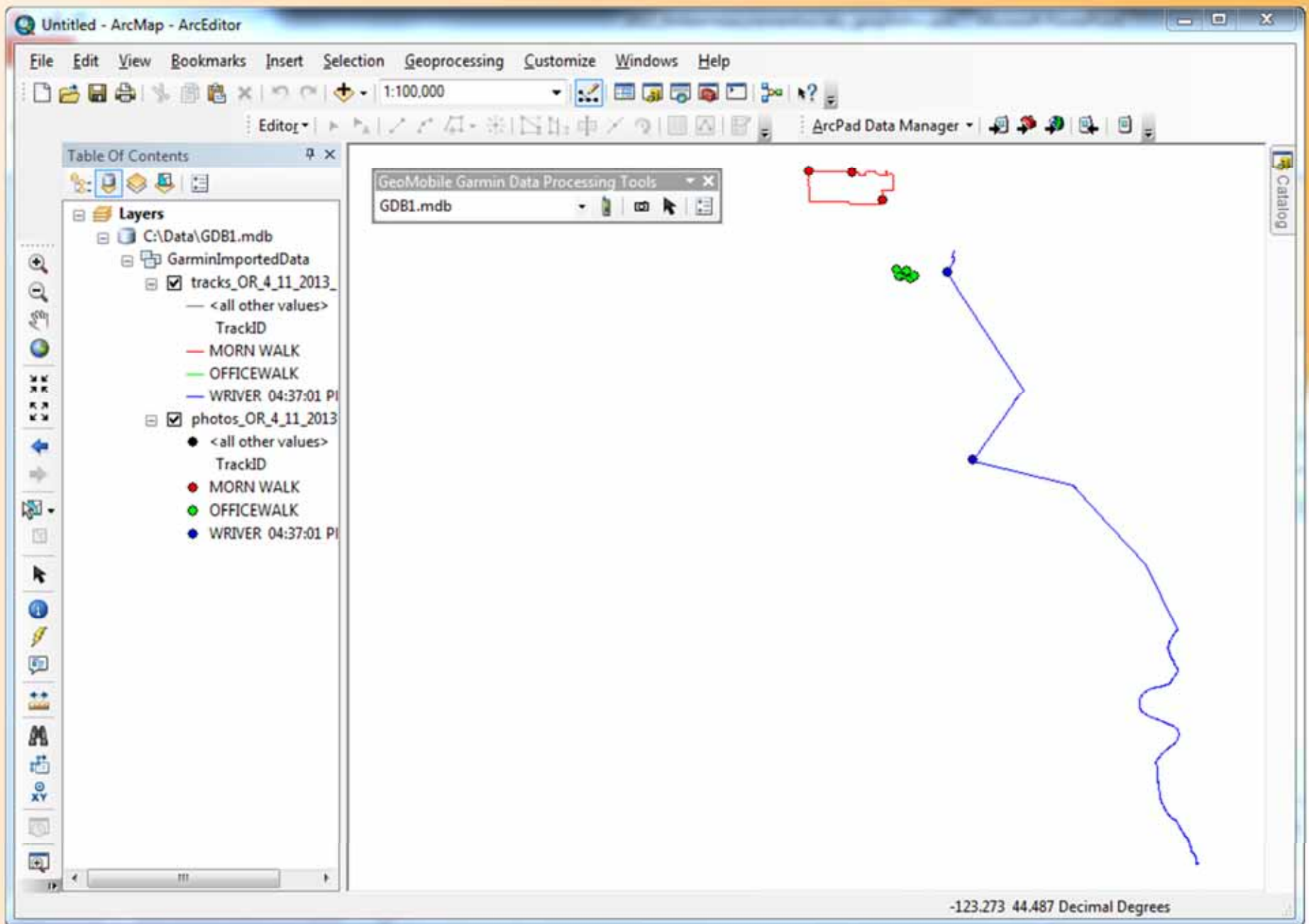
V. 1.0.2





Import zipped Garmin dataset into the selected Geodatabase







Hoodoo\_Map\_ex1.mxd - ArcMap - ArcEditor

File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help

1:10,000

Editor

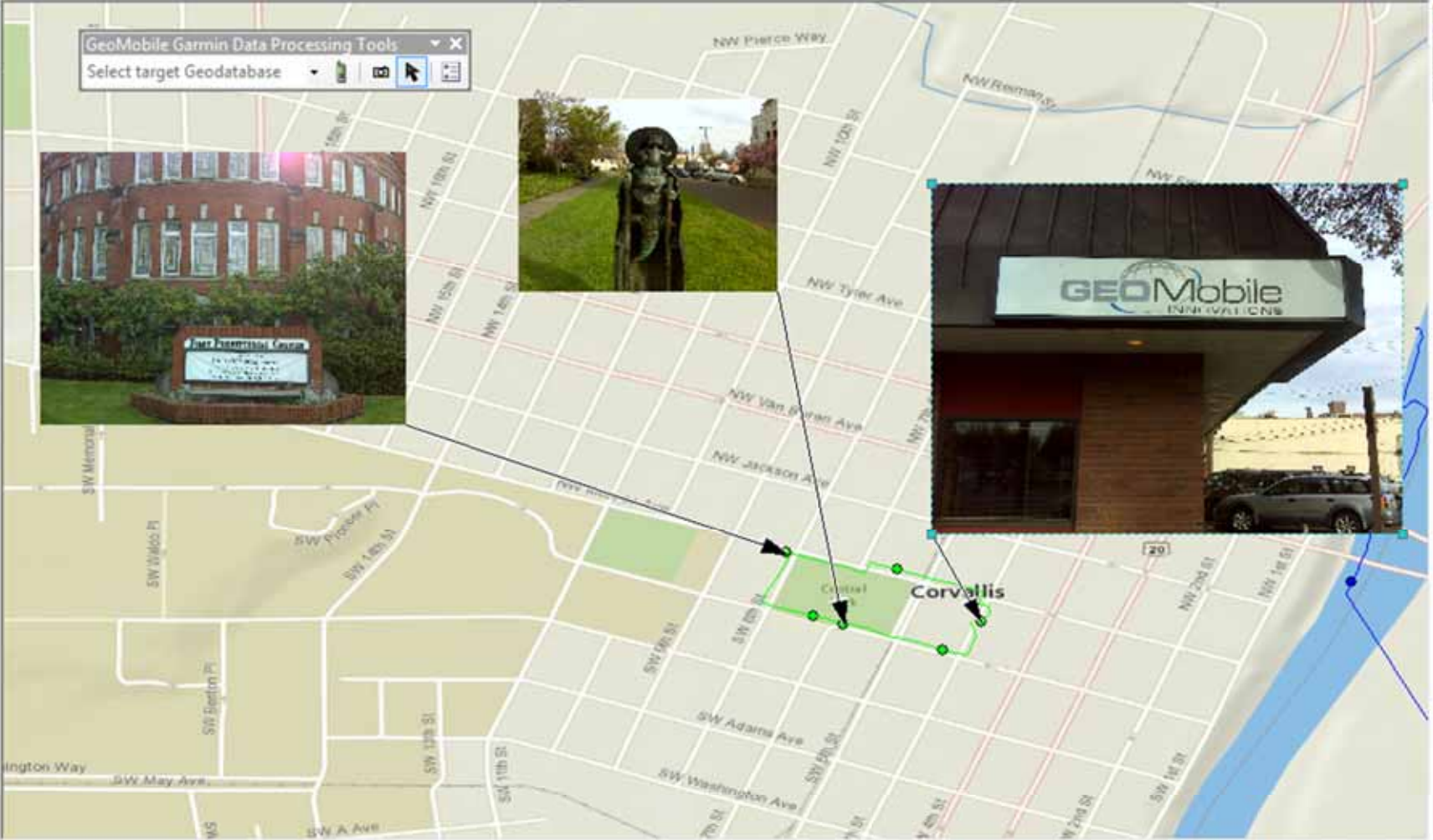
GeoMobile Garmin Data Processing Tools

Select target Geodatabase

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- C:\Data\GDB1
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    - tracks\_C
      - <all c
      - Trac
      - MOR
      - OFFH
      - WRIV
    - photos\_
      - <all c
      - Trac
      - MOR
      - OFFH
      - WRIV
  - NatGeo\_World



-123.27 44.565 Decimal Degrees

# Agenda

- Geotagged photos overview
- Hardware options
- Review of approaches
- Case History: Garmin Oregon 550 -> ArcMap
- **GeoMobile's Photo Inventory Tool**

# DEMO OF TOOL

**Hoodoo (Garmin GeoPhoto Inventory App)**

**Garmin Status & Summary**

Garmin connected.      GPS Tracks found: 4

GPS Photos found: 77

ArcEditor or above ArcGIS license detected.

**Collection Details (Optional)**

Data Collector Name  
CraigG

Project/Task Name  
Office Walk

Notes

**Output**

Output Folder on this PC: C:\temp

Email zipped Garmin data to

Create dataset for processing in ArcGIS (using extension)

Create ESRI Shapefile with hyperlinks

Create KMZ for Google Earth

**Map Preview**

**Tracks**

Track Name	Start Time (UTC)	End Time (UTC)	# of Photos
OFFICEWALK	4/9/2013 11:56:47 PM	4/10/2013 12:06:08 AM	6
WRIVER 04:37:01 PM	7/8/2012 7:11:15 PM	7/8/2012 11:37:23 PM	2
MORN WALK	1/26/2013 6:42:09 PM	1/26/2013 7:20:48 PM	3
Current Track: 09 APR 2013 17:06	4/10/2013 12:06:34 AM	4/10/2013 12:08:10 AM	0

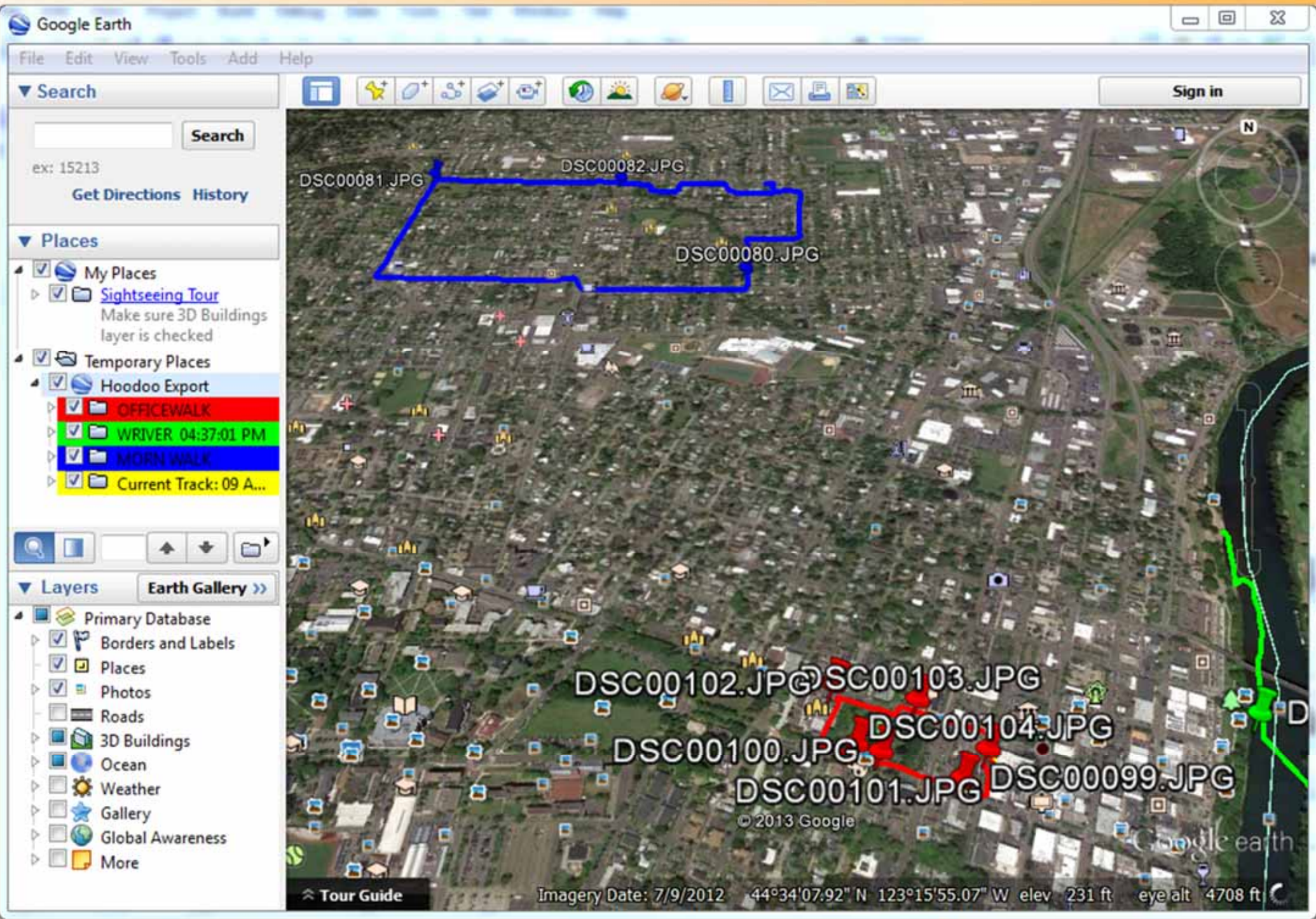
**Photos**

Photo Name	Date/Time Taken (UTC)	Latitude	Longitude
DSC00099.JPG	4/9/2013 11:58:01 PM	44.564047	-123.263781
DSC00100.JPG	4/9/2013 11:59:27 PM	44.564489	-123.265447
DSC00101.JPG	4/10/2013 12:00:01 AM	44.564625	-123.265961
DSC00102.JPG	4/10/2013 12:01:41 AM	44.565694	-123.266414
DSC00103.JPG	4/10/2013 12:03:24 AM	44.565408	-123.264539
DSC00104.JPG	4/10/2013 12:05:36 AM	44.564533	-123.263150

**Photo Preview**

V. 1.1





DSC00081.JPG

DSC00082.JPG

DSC00080.JPG

DSC00102.JPG DSC00103.JPG

DSC00100.JPG

DSC00104.JPG

DSC00101.JPG

DSC00099.JPG

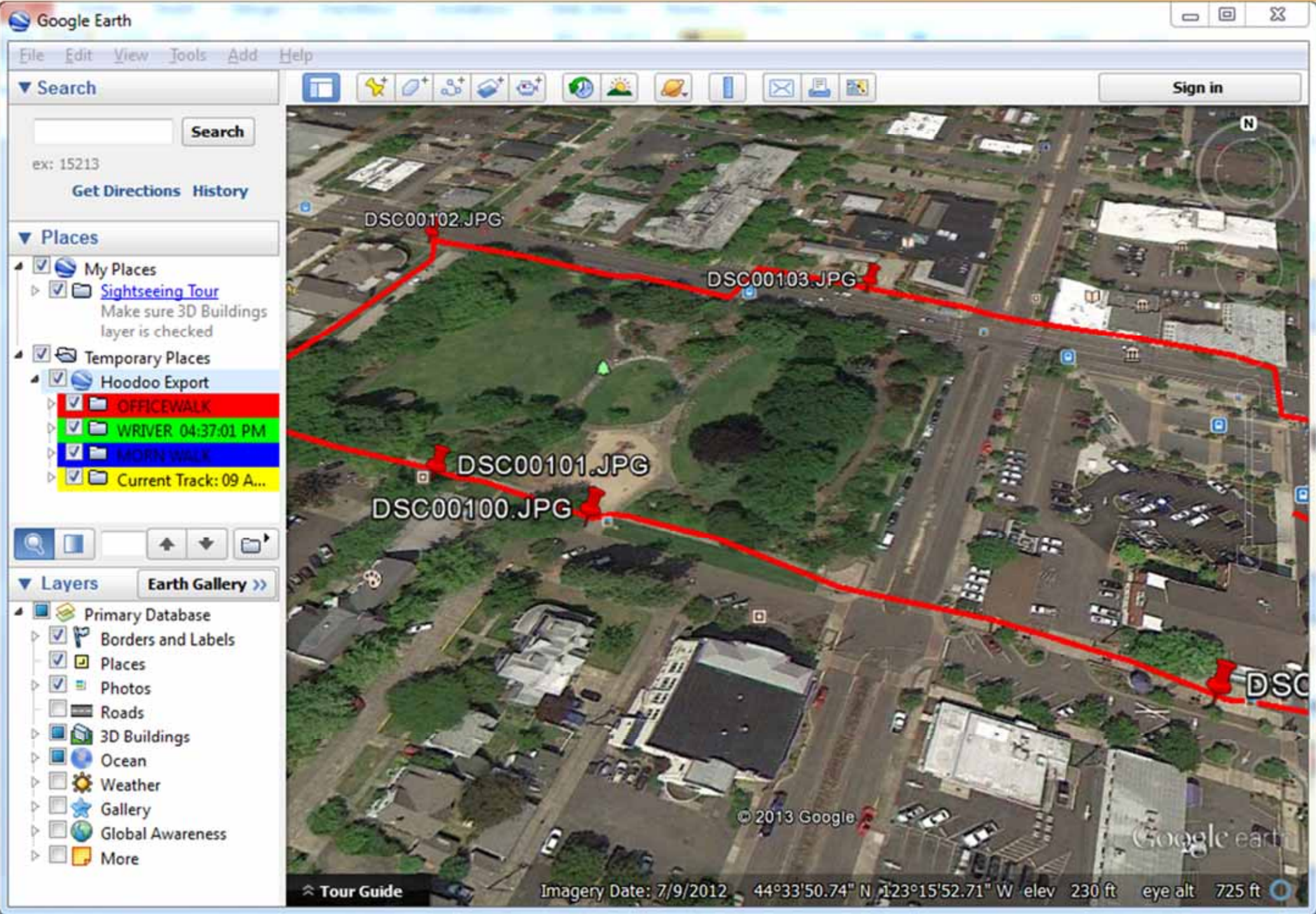
© 2013 Google

Google earth

Tour Guide

Imagery Date: 7/9/2012 44°34'07.92" N 123°15'55.07" W elev 231 ft eye alt 4708 ft





Google Earth

File Edit View Tools Add Help

Search

Search

ex: 15213

Get Directions History

Places

My Places

Sightseeing Tour

Make sure 3D Buildings layer is checked

Temporary Places

Hoodoo Export

OFFICEWALK

WRIVER 04:37:01 PM

MORN WALK

Current Track: 09 A...

Layers

Earth Gallery

Primary Database

Borders and Labels

Places

Photos

Roads

3D Buildings

Ocean

Weather

Gallery

Global Awareness

More

Tour Guide

Imagery Date: 7/9/2012 44°33'50.74" N 123°15'52.71" W elev 230 ft eye alt 725 ft

Sign in

DSC00102.JPG

DSC00103.JPG

DSC00101.JPG

DSC00100.JPG

DSC

© 2013 Google

Google earth



Google Earth

File Edit View Tools Add Help

Search

ex: 15213

Get Directions History

Places

- My Places
  - Sightseeing Tour
    - Make sure 3D Buildings layer is checked
- Temporary Places
  - Hoodoo Export
    - OFFICEWALK
    - WRIVER 04:37:01 PM
    - MOBILWALK
    - Current Track: 09 A...

Layers

Earth Gallery >>

- Primary Database
  - Borders and Labels
  - Places
  - Photos
  - Roads
  - 3D Buildings
  - Ocean
  - Weather
  - Gallery
  - Global Awareness
  - More


DSC00102.JPG

DSC00101.JPG

DSC00100.JPG

DSC00100.JPG

4/9/2013 11:59:27 PM



Directions: [To here](#) - [From here](#)

Tour Guide Imagery Date: 7/9/2012 44°33'49.38" N 123°15'50.50" W elev 231 ft eye alt 725 ft

# Possible Uses

- “Heat mapping”
  - Invasive weeds, insects, etc.
- Incident mapping
  - Endangered species encounters
  - Illegal dumping, poaching, etc.
- Scouting
  - Low cost initial review
  - Specialist review w/ possible field visit
- Walking boundaries for acreage

# Thank You!!



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