

GPS Resource Mapping For GIS

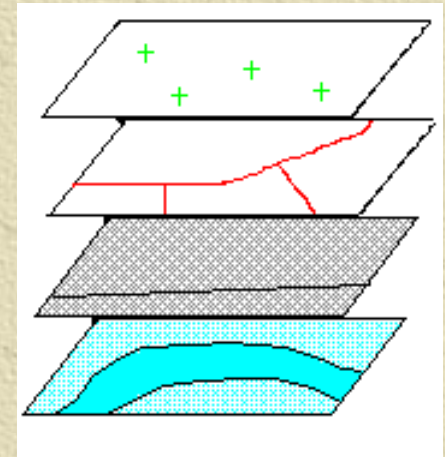
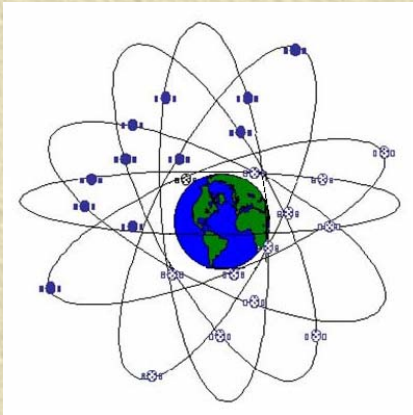
Session III-5

PSLS Surveyors
Conference

2006



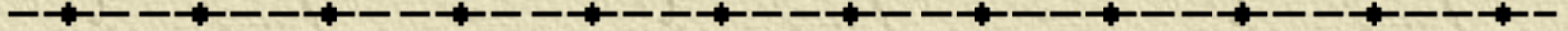
David Nichter



Outline

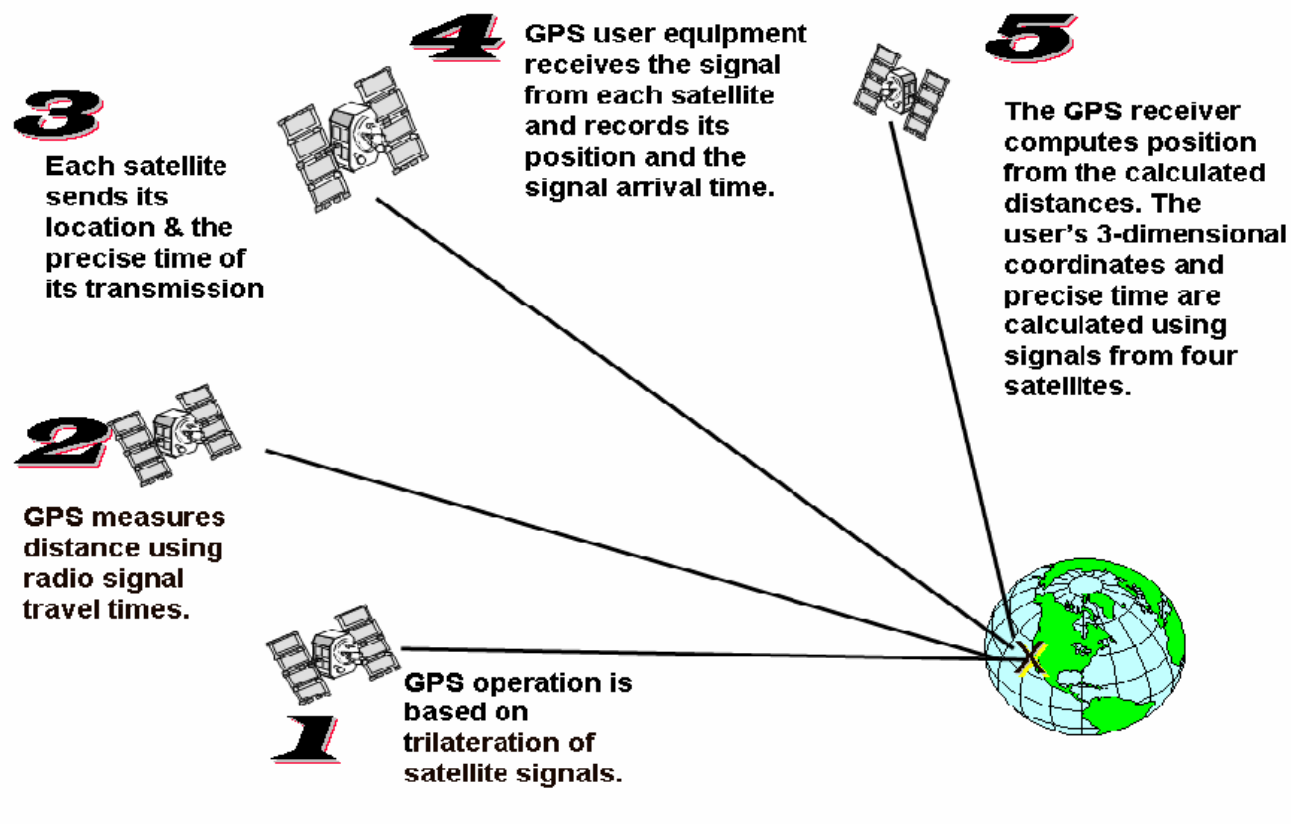
1. Project Plan
2. Resource Inventory
(paper maps, database)
3. Scope
4. Data Dictionary
5. GPS Mission Planning
(daily)
6. Field work (collect it!)
7. Data Download
8. QA/QC for
Completeness
9. Differential Correction
10. QA/QC Spatial Error
11. Export to GIS
12. Metadata
13. Use the data.
14. Review data / process

Definitions



not Survey Grade, not Recreational

Definitions



Definitions

GPS - Global Positioning System

Code GPS or Mapping Grade or Sub-meter
not Survey Grade, not Recreational

GIS - Geographic Information System

Spatial Data Management or Intelligent Maps
not CADD, not AM/FM

Definitions



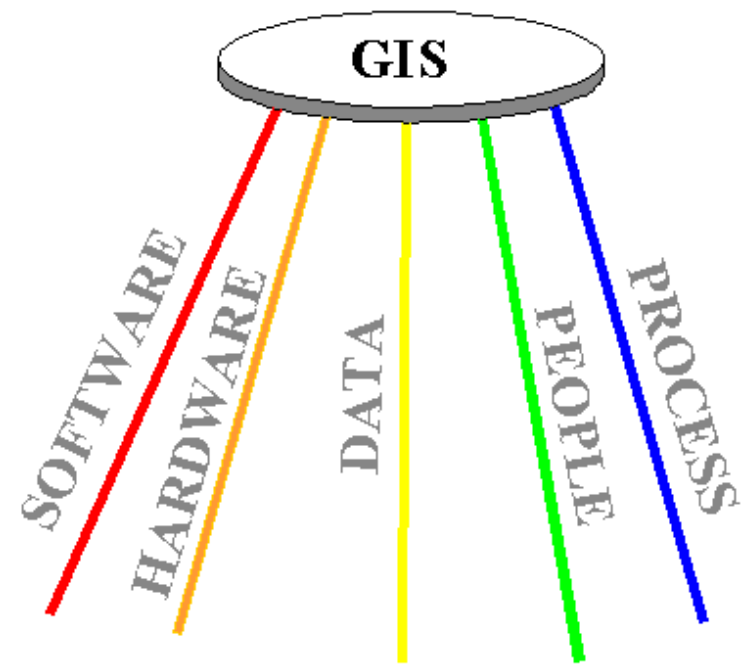
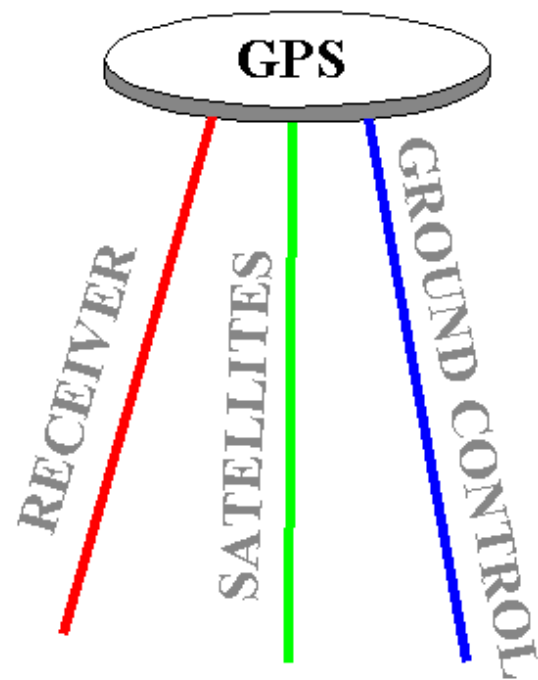
Definitions

GIS –A computer system capable of capturing, storing, analyzing, and displaying geographically referenced information; that is, data identified according to location.

(USGS definition)



Definitions



Definitions (Continued)

Raster

vs.

Vector

1	1	1	1	1	1	1	3	3	3
1	1	1	1	1	1	1	3	3	3
1	1	1	1	1	1	3	3	3	3
1	1	1	2	2	2	2	3	3	3
1	1	1	2	2	2	2	3	3	3
1	1	1	2	2	2	2	3	3	3
1	1	1	1	2	2	2	3	3	3
1	1	1	1	1	1	3	3	3	3
1	1	1	1	1	1	1	3	3	3
1	1	1	1	1	1	1	1	3	3

Cells

Point,
Line,
Polygon

Definitions (Continued)

Raster

vs.

Vector

1	1	1	1	1	1	1	3	3	3
1	1	1	1	1	1	1	3	3	3
1	1	1	1	1	1	3	3	3	3
1	1	1	2	2	2	2	3	3	3
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1	1	1	1	1	1	1	3	3	3

Cells

Point,
Line,
Polygon

Definitions (Continued)

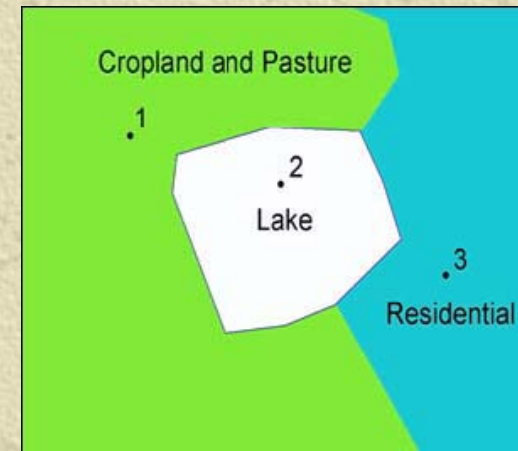
Raster

1	1	1	1	1	1	1	3	3	3
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Cells

vs.

Vector



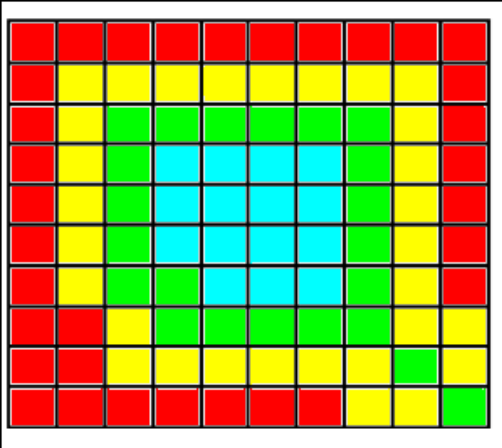
Point,
Line,
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Definitions (Continued)

Raster

vs.

Vector

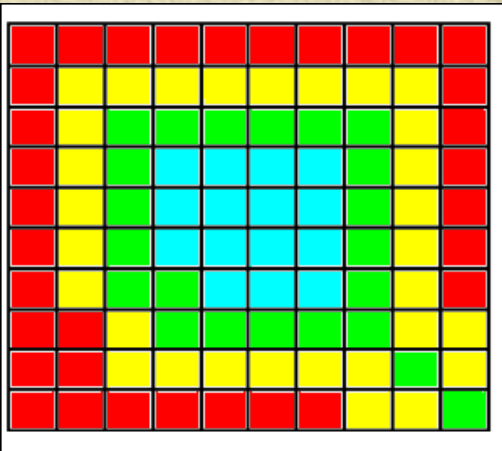


Cells

Point,
Line,
Polygon

Definitions (Continued)

Raster



Cells

vs.

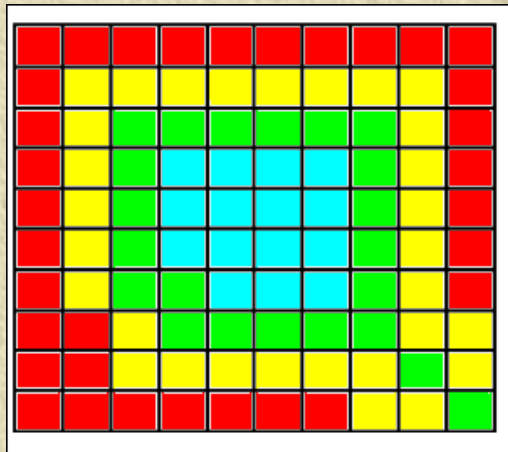
Vector



Point,
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Polygon

Definitions (Continued)

Raster



Cells

vs.

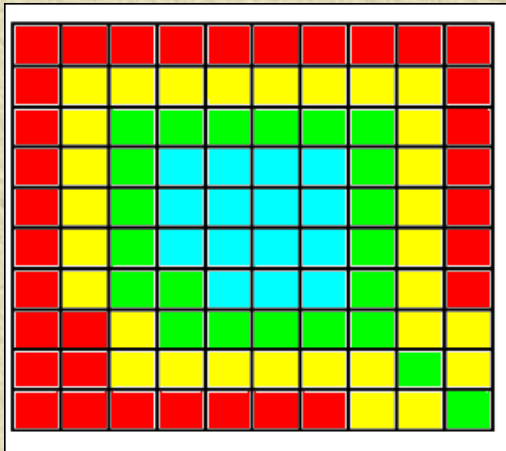
Vector



Point,
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Polygon

Definitions (Continued)

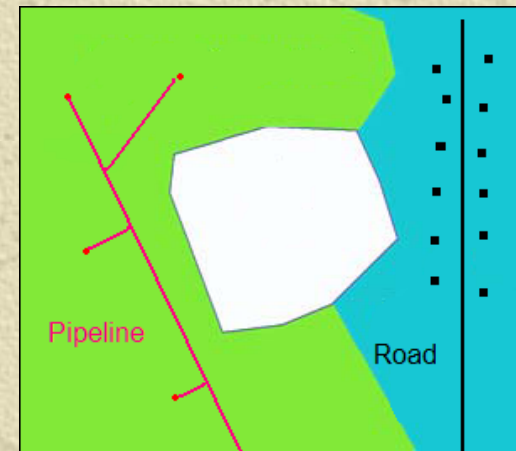
Raster



Cells

vs.

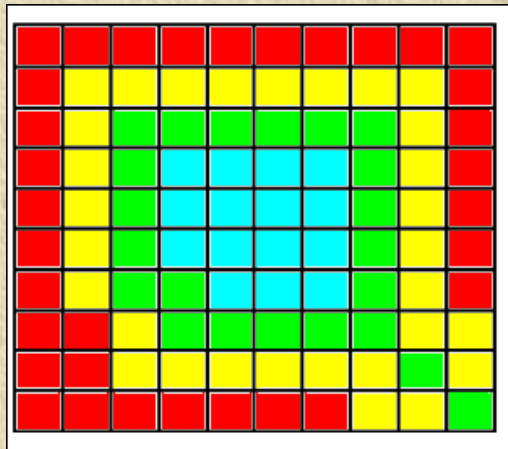
Vector



Point,
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Polygon

Definitions (Continued)

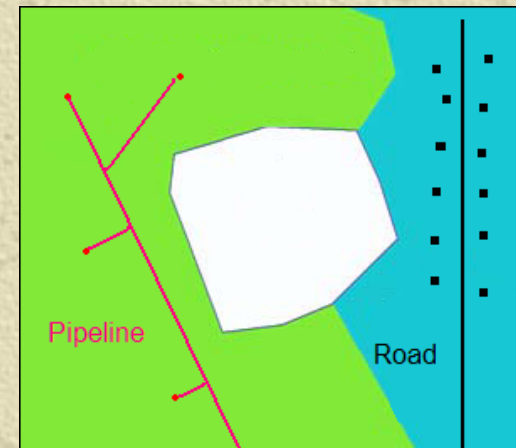
Raster



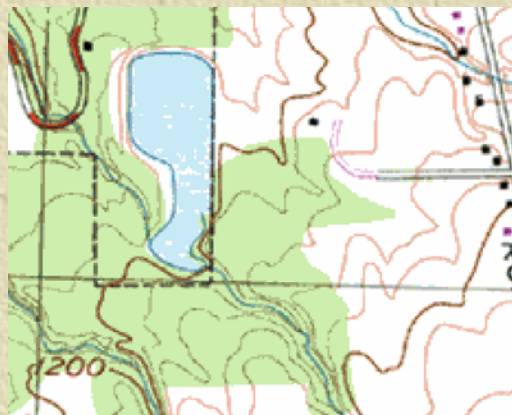
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Vector

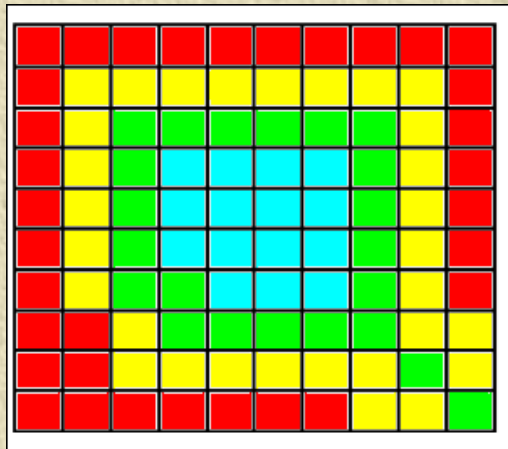


Point,
Line,
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Definitions (Continued)

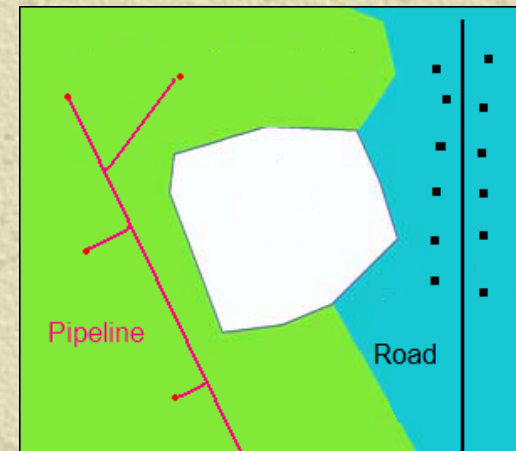
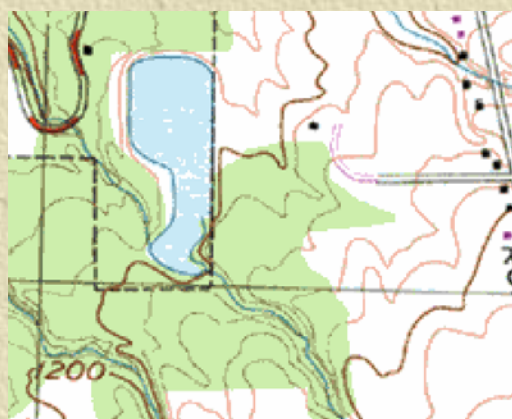
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Cells

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Point,
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Polygon

Definitions (Continued)

Facility or Business Data

Data and attributes specific to the organization

vs.

Base Data

Generic data used for analysis, location or reference

One organization's Facility data is another's Base Data...



GIS Technician

Electric utility is in search of a GIS Technician to **maintain an accurate map** of our distribution system and **associated databases** in the current mapping software. The successful candidate will have knowledge of current digital mapping systems and techniques found in the Utility industry, particular **ESRI Arc GIS software**, AutoCAD 2000 **and Trimble GPS units**. An Associate degree in surveying, geology, or related field is preferred, but GIS certificates and/or the equivalent experience will be considered. Competitive salary and benefit package included. Interested candidates should send or email a resume a salary requirements, if any, by December 30, 2005 to: Director of Human Resources, Central Electric Cooperative, Inc., 716 Route 368, P O Box 329, Parker, PA 16049. Email: jmarron@central.coop An EOE

1. Project Plan

✦ What is the Strategic Purpose?

What is the objective?

✦ What is your organization responsible for?

✦ What are its functions?

✦ What does the organization produce?

2. Resource Inventory

- ✦ Review existing data resources...
Hardcopy/Digital, Tabular/Spatial
- ✦ Identify what features need to be GPSed
- ✦ Determine what attributes need to be collected for each feature

2. Needs Assessment

- ✦ Review existing processes ...
manual or automated
- ✦ Identify what processes could benefit from GPS data and GIS techniques
- ✦ Determine the priority for re-engineering the existing processes
- ✦ Create GPS process to collect data for GIS

1. Project Plan (revisited)

✦ Navigation w/ Realtime DGPS

✦ Digital Photos?

✦ Use base data?

- ✦ Orthophotos

- ✦ Raster quads

- ✦ Vector

1. Project Plan (revisited)

✱ Navigation w/ Realtime DGPS

✱ Digital Photos?

✱ Use base data?

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- ◆ Raster quads

- ◆ Vector

Coast Guard Beacons

Space Based Systems-SBAS

WAAS

**OmniStar
Landstar**

1. Project Plan (revisited)

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- ✧ Vector



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1. Project Plan (revisited)

✧ Navigation w/ Realtime DGPS

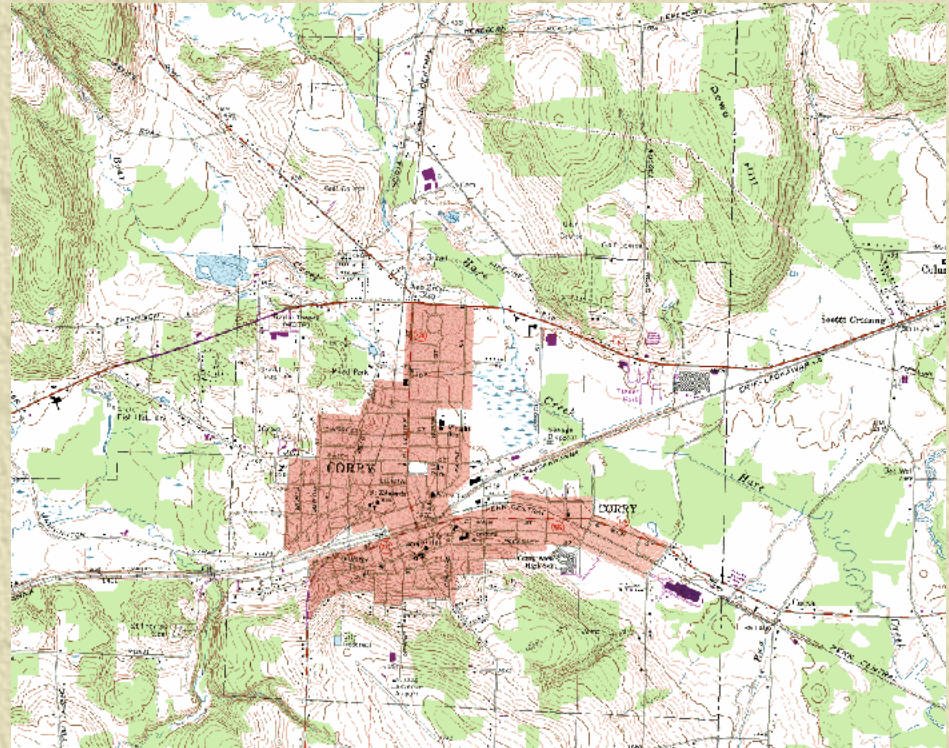
✧ Digital Photos?

✧ Use base data?

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1. Project Plan (revisited)

✧ Navigation w/ Realtime DGPS

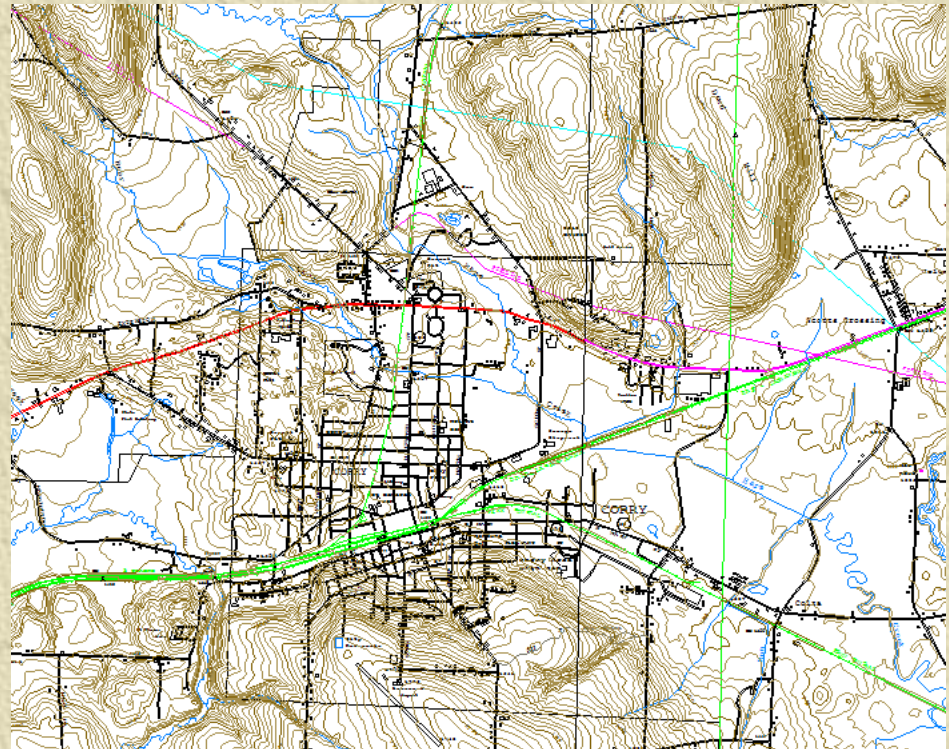
✧ Digital Photos?

✧ Use base data?

- ✧ Orthophotos

- ✧ Raster quads

- ✧ Vector



3. Scope

✦ Who

GIS / GPS Staff / Other Dept / Client

✦ What

Features GPSed, Attributes collected

Number and distribution of features

Locate new or Update existing digital data

Deliverables – data formatting, compilation

3. Scope (Continued)

✦ When

How much Time to complete project

✦ Where

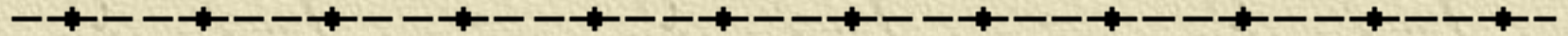
Urban, Suburban, Rural, Remote

Located together or widely separated

✦ How

Data handling process, Tools...

3. Scope (Continued)



✦ Right tools for the right job

3. Scope (Continued)

✦ Right tools for the right job



3. Scope (Continued)

✦ Right tools for the right job



3. Scope (Continued)

✦ Right tools for the right job



4. Data Dictionary

✦ Create DDF for each job type, but not too specific
include common features for flexibility

✦ Consistent look

✦ Standard attribute names

Name

Number

Type

Condition

Comments

1 Prop_Cor		OK	Cancel
Name:	Smith		
Size:	0.50		
Type:	Rebar		
Condition:			
Comment:	Base of Bank		
	New Good Poor Missing		

4. Data Dictionary (Continued)

✦ Menus

- ✦ speed up data entry
- ✦ help ensure quality
- ✦ simplify training

Reduce the number of
features with types

A screenshot of a data entry form titled "1 Sign". The form has a title bar with "1 Sign", "OK", and "Cancel" buttons. The fields are as follows:

- Type: Yield (dropdown menu)
- Support: Wood_Post (dropdown menu)
- Text: (empty text box)
- DateInst: 1/1/1970 (dropdown menu)
- Street_1: Main (text box)
- Street_2: (empty text box)
- Condition: Good (dropdown menu)
- Comment: Needs weed control (text box)
- A list of options for the Condition dropdown is shown: New, Good (highlighted), Poor, and Missing.

4. Data Dictionary (Continued)

✧ Menus...

Edit Menu Attribute

Attribute Name:

Comment:

Menu Attribute Values

Name	User Code 1	User Code 2
Bayou	1	
Canal	2	
Foreign Pipeline	3	
Interstate Highway	4	
Landing Strip	5	
Railroad	6	
Road	7	

New... Edit... Delete

Field Entry

On Creation

☒ Normal
☐ Required
☐ Not Permitted

On Update

☒ Normal
☐ Required
☐ Not Permitted

OK Cancel Help

Database Properties

General Domains

Domain Name	Description
enLCGeography	Geographical Features
fcCrossingLocation	Crossing Location
fnLineCrossing	Line Crossing
LeakCause	Cause of Leak
LeakOrigin	Origin of Leak
LeakRepairType	Type of Repair made to Leak
LeakStatus	Status of Leak
LOWType	Low

Domain Properties

Field Type	Long Integer
Domain Type	Coded Values
Split policy	Default Value
Merge policy	Default Value

Coded Values:

Code	Description
1	Bayou
2	Canal
3	Creek
4	Ditch

OK Cancel Apply

4. Data Dictionary (Continued)

✦ Sort features

alphabetical

feature type

functional groups

✦ Eliminates need for field books (almost)

4. Data Dictionary (Continued)

✦ Sort features

- alphabetical
- feature type
- functional groups

✦ Eliminates need
for
field books (almost)

- ~ AccessRd
- X BlockValve
- X Bridge
- ~ Building
- X BuildCorner
- X Creek Crossing
- X Culvert
- X Drip
- X DriveXing
- X Electric Line Xing
- X Electric Pole
- X FencePost
- ~ FiberOptic
- X FireHydrant
- ~ GasLine
- X GasLinePI
- ~ Lake Shore
- X LineMarker
- X LineXing
- X Line Tap
- X Manhole
- X Meter
- X Meter Set
- ~ Parking Lot
- X Pl
- X PropLine
- X Prop_Cor
- ~ Railroad
- X RR_Marker
- X Rectifier
- X Regulator
- X Road Gate
- X RoadXing
- ~ Sidewalk
- X Station
- ~ Tank
- X TestSta
- X Transformer
- ~ Trash Area
- X Tree
- ~ Treeline
- ~ WaterLine

4. Data Dictionary (Continued)

✦ Sort features

alphabetical

feature type

functional groups

✦ Eliminates need for field books (almost)

- X BlockValve
- X Bridge
- X BuildCorner
- X Creek Crossing
- X Drip
- X DriveXing
- X Electric Line Xing
- X Electric Pole
- X FireHydrant
- X GasLinePI
- X LineMarker
- X LineXing
- X Line Tap
- X Manhole
- X Meter
- X Meter Set
- X PI
- X Property Line
- X Property Corner
- X WaterVlv
- X Well
- X RR_Marker
- X Rectifier
- X Regulator
- X Road Gate
- X RoadXing
- X Station
- X TestSta
- X Transformer
- ~ AccessRd
- ~ Building
- ~ FiberOptic
- ~ GasLine
- ~ Lake Shore
- ~ Parking Lot
- ~ Railroad
- ~ Sidewalk
- ~ WaterLine
- ~ Treeline
- ☉ Tank
- ☉ Trash Area
- ☉ Wetlands

4. Data Dictionary (Continued)

✦ Sort features

alphabetical

feature type

functional groups

✦ Eliminates need for field books (almost)



4. Data Dictionary (Continued)

✧ Sort features

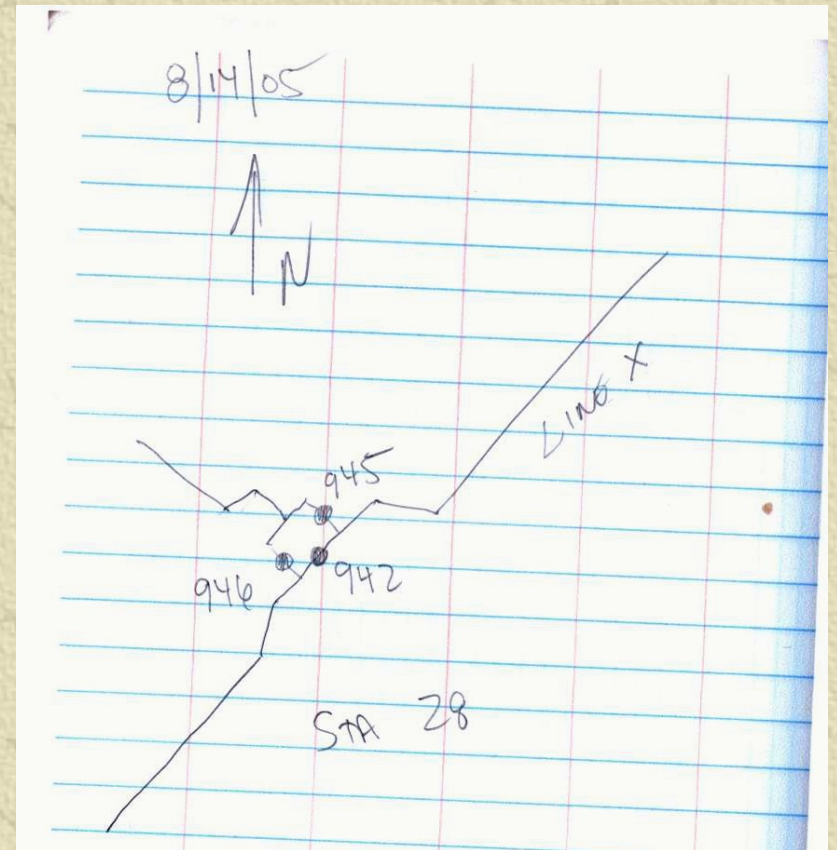
alphabetical
feature type
functional groups

✧ Eliminates need for field books (almost)

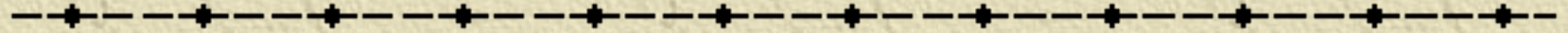
A screenshot of a software interface for data entry. The window has a title bar that says "3 Station" and two buttons, "OK" and "Cancel". Below the title bar, there are four labeled fields: "Sta Number:" with a text box containing "28"; "Type:" with a dropdown menu showing "Reg"; "Group:" with a dropdown menu showing "Transmission"; and "Comment:" with a text box containing "see sketch".

4. Data Dictionary (Continued)

- ✦ Sort features
 - alphabetical
 - feature type
 - functional groups
- ✦ Eliminates need for field books (almost)

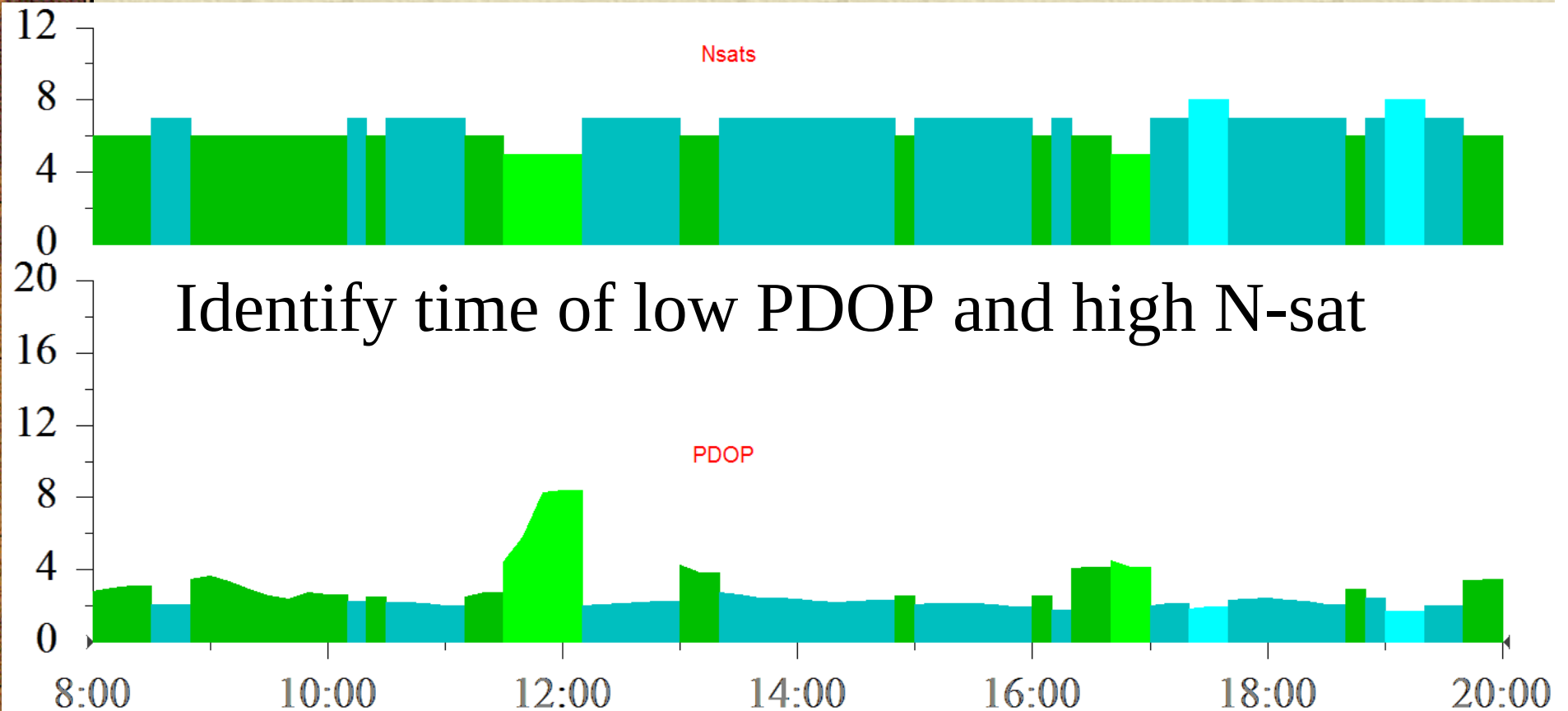


5. GPS Mission Planning (daily)



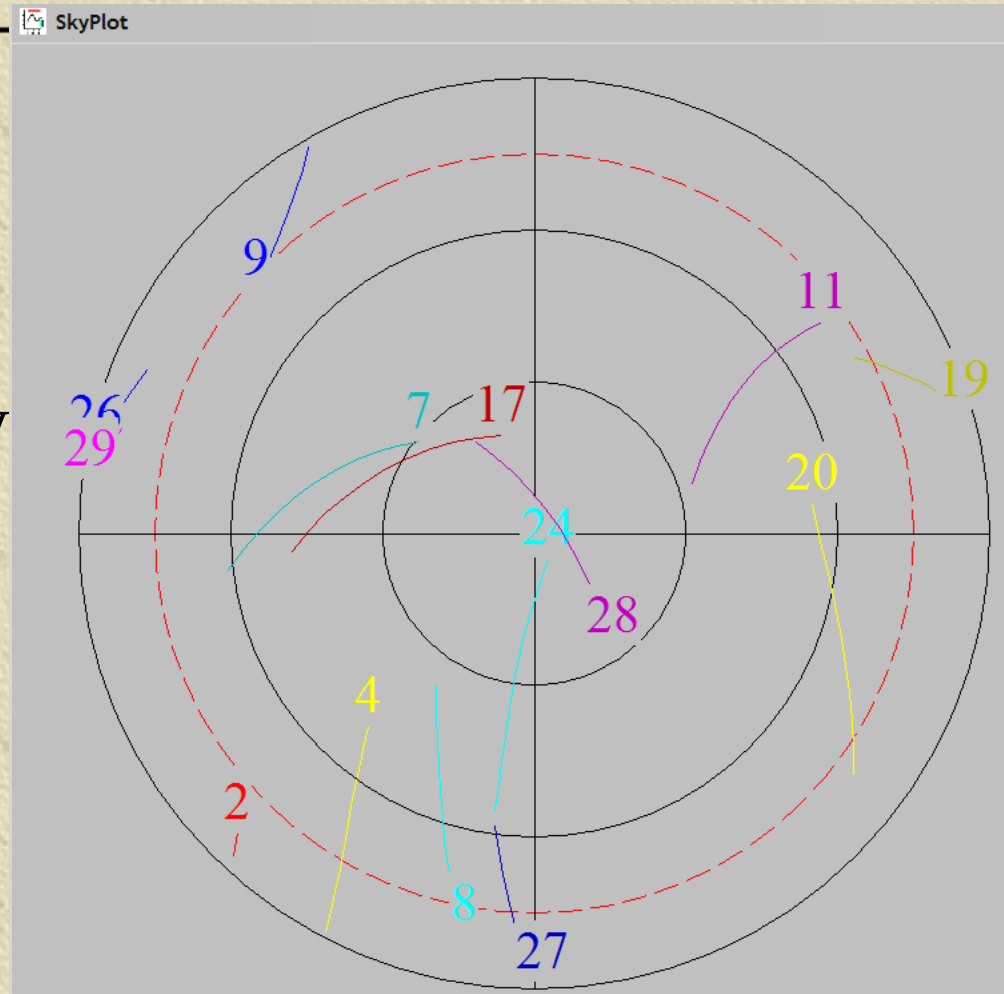
Identify time of low PDOP and high N-sat

5. GPS Mission Planning (daily)



5. GPS Mission Planning (daily)

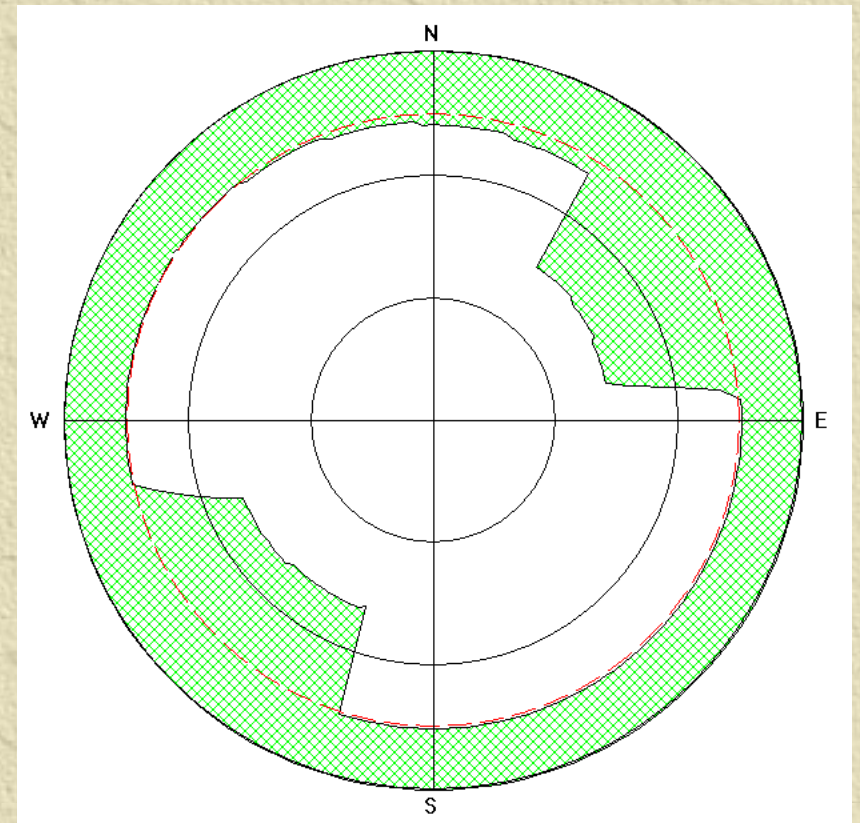
Identify



N-sat

5. Mission Planning (Continued)

- ✧ Horizon Mask
- ✧ Point Specific
- ✧ Obstruction diagram



5. Mission Planning (Continued)



Export data from GIS to use in GPS



5. Mission Planning (Continued)



Export data from GIS to use in GPS



Get Data For ArcPad

If you want to check out any of the database layers you selected on the previous panel, choose the database and the layers below.

Note: you can only include data from one database in a check out.

Database: C:\Documents and Settings\David Nichter\My Document

Layer	Feature Class
☒ FieldNote	FieldNote
☒ Leak	Leak
☒ Marker	Marker
☒ Meters	Meters
☒ StrucLoc	StrucLoc
☒ Structure	Structure
☒ Valves	Valves

☐ Only check out schema of layers (no data will be checked out)

Size of editing form that will be generated: 360x220 (for VGA)

< Back Next > Cancel

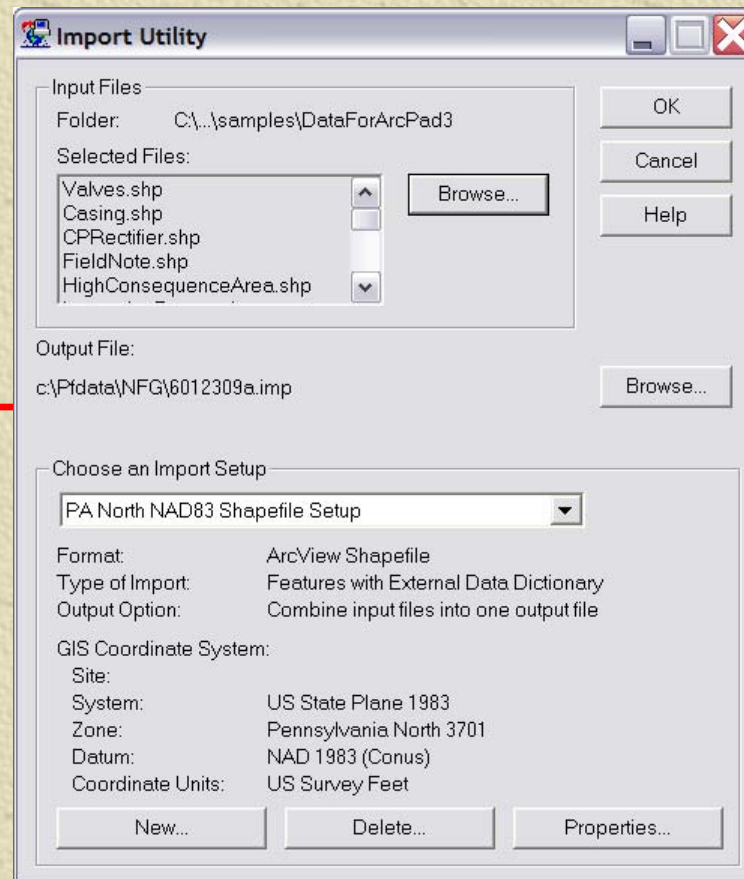
Select All Clear All



5. Mission Planning (Continued)



Export data from GIS to use in GPS



5. Mission Planning (Continued)



Export data from GIS to use in GPS



Read from Shape OK Cancel

Create data file:

Demo-Pipeline

From Shape file(s) in:

\\Documents and Settings\\David Nichter\\

Coordinate system: US State Plane 1983

Zone: Pennsylvania North 3701

Include:

Casing	☒
CPRectifier	☒
FieldNote	☒
HighConsequenceArea	☒
InspectionRange	☒



5. Mission Planning (Continued)

- ✱ Prepare hardcopy resources (lists, maps)
Configure and load data in field Computer
- ✱ Prepare equipment
functional and clean
configuration, avail. memory
batteries - receiver and field computer

6. Field work

- ✠ Go out and collect data under good conditions
 - satellite geometry
 - weather conditions
- ✠ Collect new features
 - work with staff of client or other staffers
 - work from hardcopy resources
- ✠ Navigate to and update existing features
 - Use the existing data as ‘starting point’

7. Data Download

- ✦ Return to office
- ✦ Connect up the field computer
 - ◆ Cable 
 - ◆ BlueTooth
 - ◆ Active Sync
 - ◆ Cell Phone
- ✦ Down load your field data



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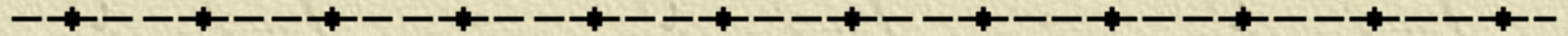
✦ Down load your field data



8. QA/QC for Completeness

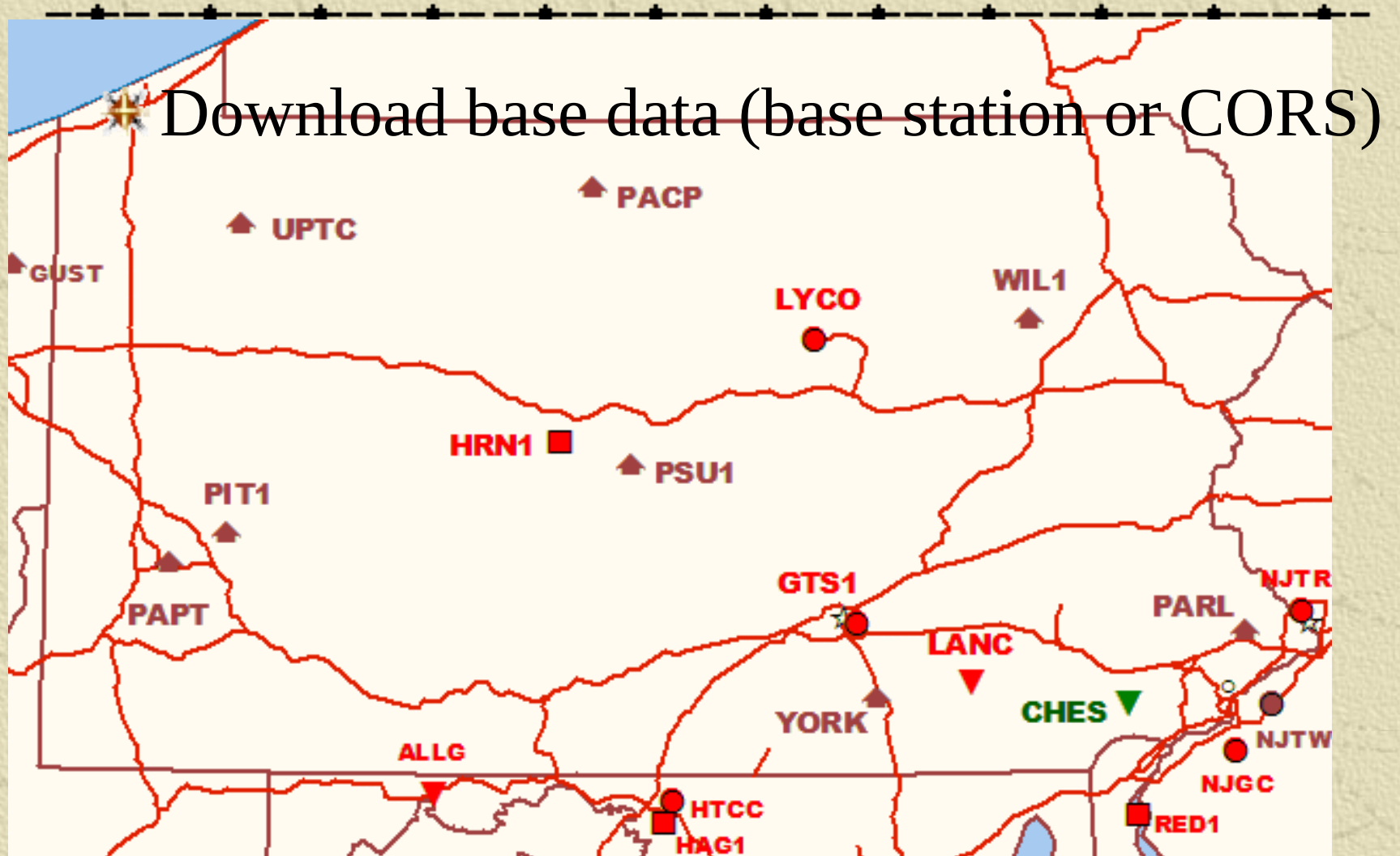
- ✦ Verify the data includes positions for all the features you intended to collect
- ✦ Check that features are generally where you expected
- ✦ Ensure you have no duplicate features
- ✦ Ensure all features are attributed properly

9. Differential Correction

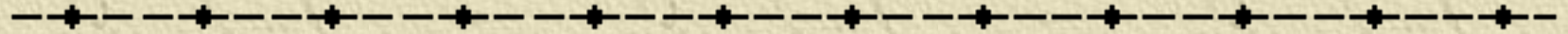


✧ Download base data (base station or CORS)

9. Differential Correction



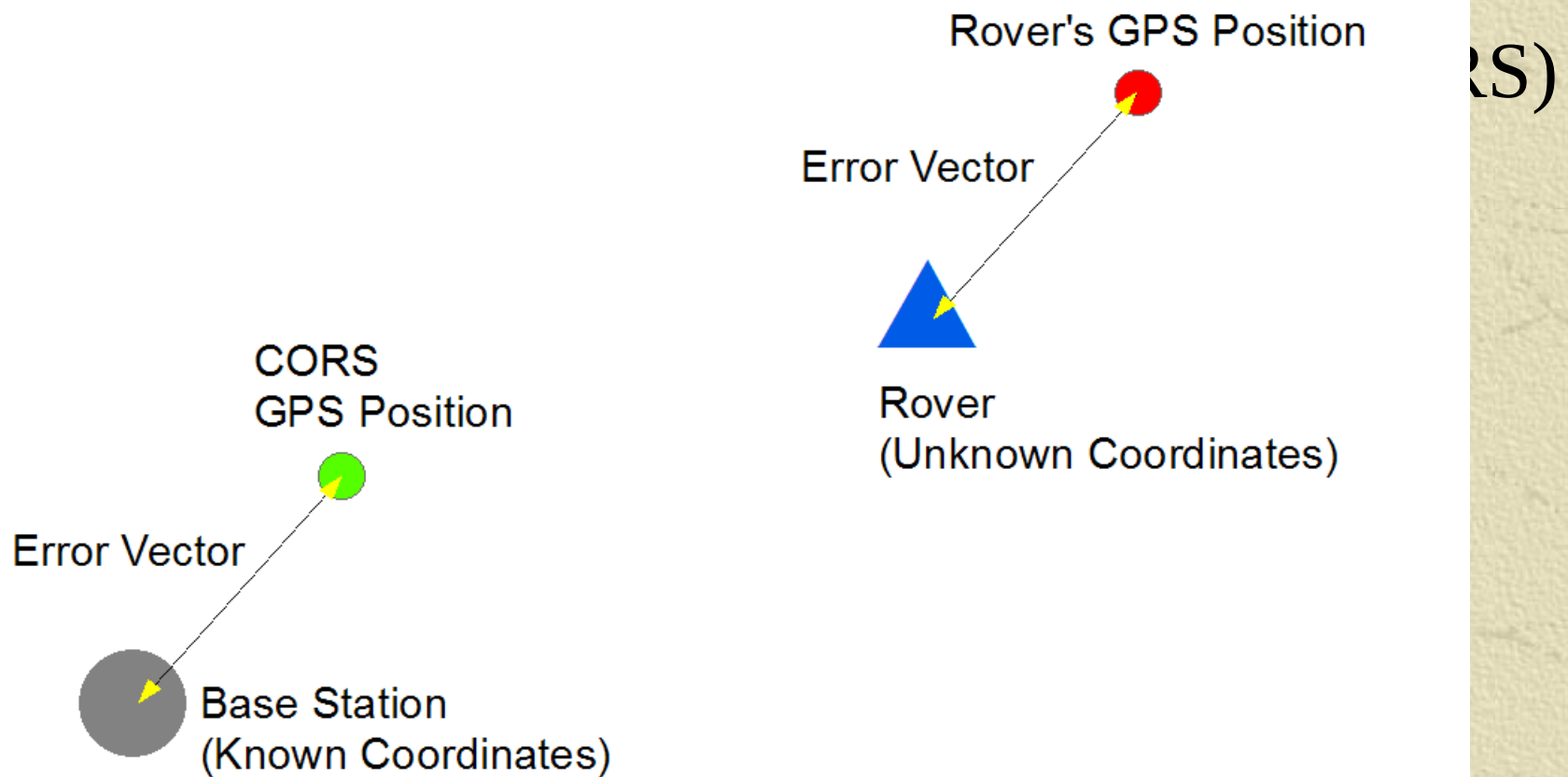
9. Differential Correction



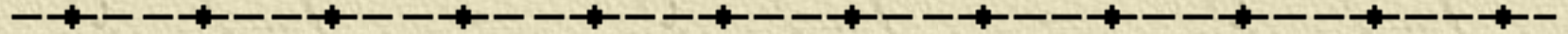
✧ Download base data (base station or CORS)

- Perform differential correction of field data

9. Differential Correction



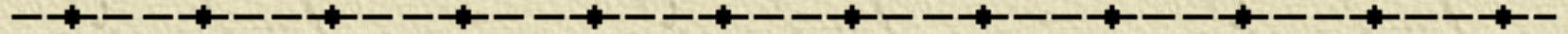
9. Differential Correction



✧ Download base data (base station or CORS)

- Perform differential correction of field data
- Did all positions get corrected?

9. Differential Correction



✦ Download base data (base station or CORS)

- Perform differential correction of field data
- Did all positions get corrected?
- Do all features have sufficient positions?

10. QA-QC Spatial Error

✦ Check spatial accuracy of corrected data

RMS errors

✦ Data clean up

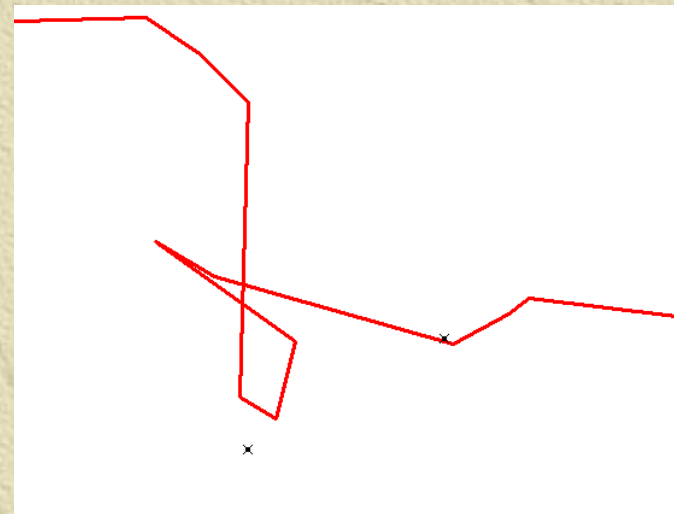
- ◆ Knots or "Bow-ties"
- ◆ Jogs
- ◆ Missed Vertices
- ◆ Gaps in satellite coverage
- ◆ Gaps in features



RMS errors



- ◆ Knots or "Bow-ties"
- ◆ Jogs
- ◆ Missed Vertices
- ◆ Gaps in satellite coverage
- ◆ Gaps in features



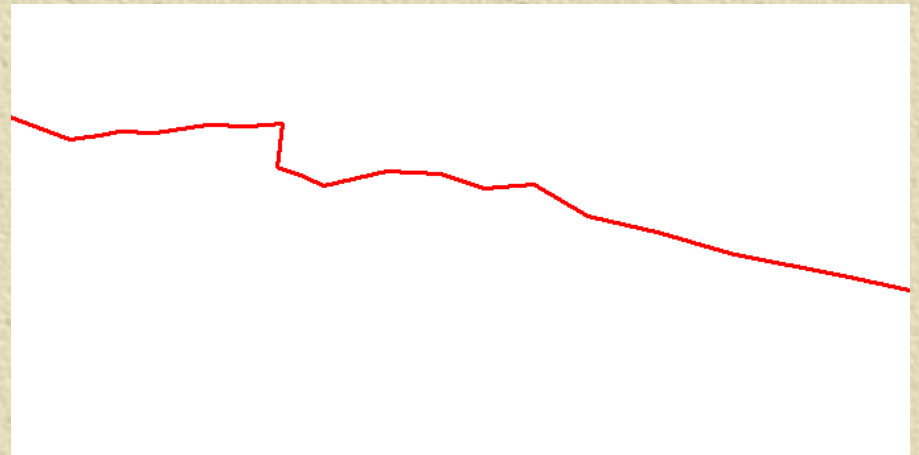
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- ◆ Knots or "Bow-ties"
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- ◆ Missed Vertices
- ◆ Gaps in satellite coverage
- ◆ Gaps in features



10. QA-QC Spatial Error

✦ Check spatial accuracy of corrected data

RMS errors

✦ Data clean up

- ◆ Knots or "Bow-ties"
- ◆ Jogs
- ◆ Missed Vertices
- ◆ Gaps in satellite coverage
- ◆ Gaps in features



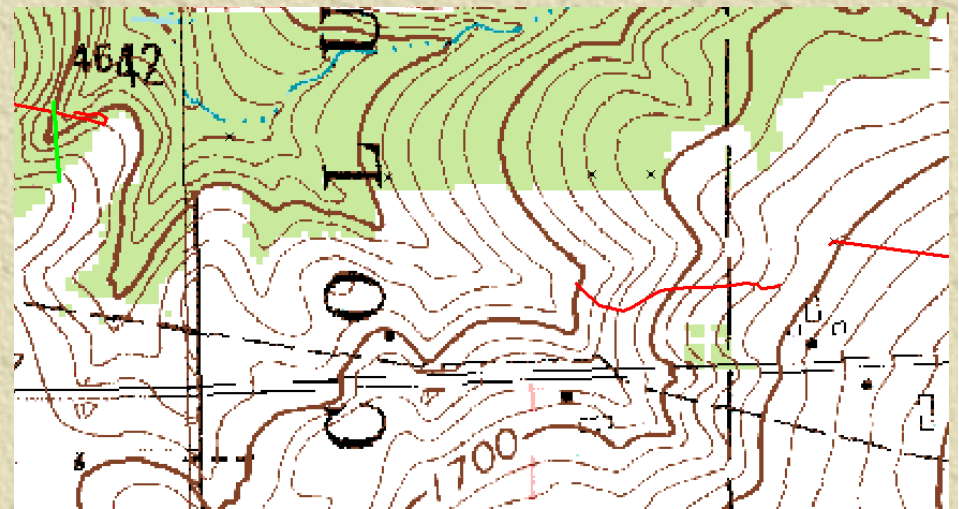
10. QA-QC Spatial Error

✦ Check spatial accuracy of corrected data

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- ◆ Knots or "Bow-ties"
- ◆ Jogs
- ◆ Missed Vertices
- ◆ Gaps in satellite coverage
- ◆ Gaps in features



10. Quality (Continued)

- ✠ Did anything get missed?
- ✠ Were features collected in-accurately?
- ✠ Identify missing feature / attribute
- ✠ Identify source of error / omission
- ✠ Communicate with data collectors

11. Export to GIS

✧ Define export specs

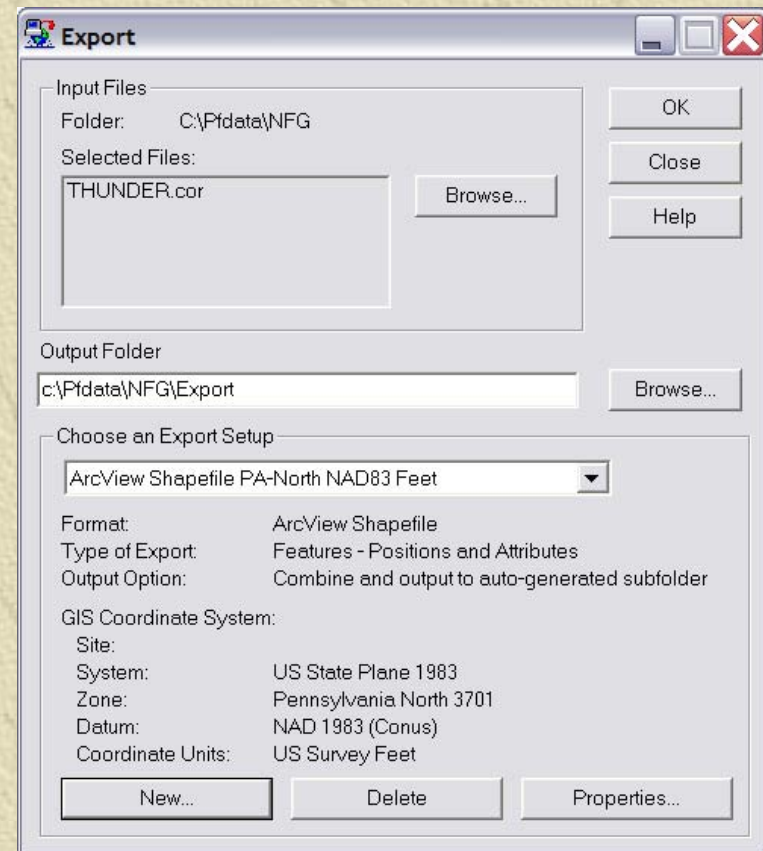
✧ Format

✧ Attributes

✧ Update Status

✧ Spatial reference

- Projection, Datum
- Coordinate System
- Units (on both tabs)



11. Export to GIS (Continued)

✧ Create Projection file (.prj)

```
PROJCS["NAD_1983_StatePlane_Pennsylvania_North_FIPS_3701_Feet",  
GEOGCS["GCS_North_American_1983",DATUM["D_North_American_1983",  
SPHEROID["GRS_1980",6378137.0,298.257222101]],PRIMEM["Greenwich",0.0],  
UNIT["Degree",0.0174532925199433]],PROJECTION["Lambert_Conformal_Conic"],  
PARAMETER["False_Easting",1968500.0],PARAMETER["False_Northing",0.0],  
PARAMETER["Central_Meridian",-77.75],PARAMETER["Standard_Parallel_1",40.88333333333333],  
PARAMETER["Standard_Parallel_2",41.95],PARAMETER["Latitude_Of_Origin",40.16666666666666],  
UNIT["Foot_US",0.3048006096012192]]
```

12. Metadata

- ✱ “Data about Data”
- ✱ Attribution Definitions
- ✱ Date and Method of collection
- ✱ Accuracy / Precision
- ✱ Proj, Coord Sys, Datum, Units.

13. Use the Data



Load or Integrate GPS data with existing data

Object Loader

For each target field, select the source field that should be loaded into it.

Target Field	Matching Source Field
CreatedBy [string]	CreatedBy [string]
CreatedDate [DATE]	CreatedDat [DATE]
EffectiveFromDate [DATE]	<None>
EffectiveToDate [DATE]	<None>
GroupEventID [string]	<None>
LastModified [DATE]	LastModifi [DATE]
ModifiedBy [string]	ModifiedBy [string]
OperationalStatus [int]	<None>
OriginEventID [string]	<None>
ProcessFlag [string]	<None>

Reset

< Back Next > Cancel

Check In Edits From ArcPad

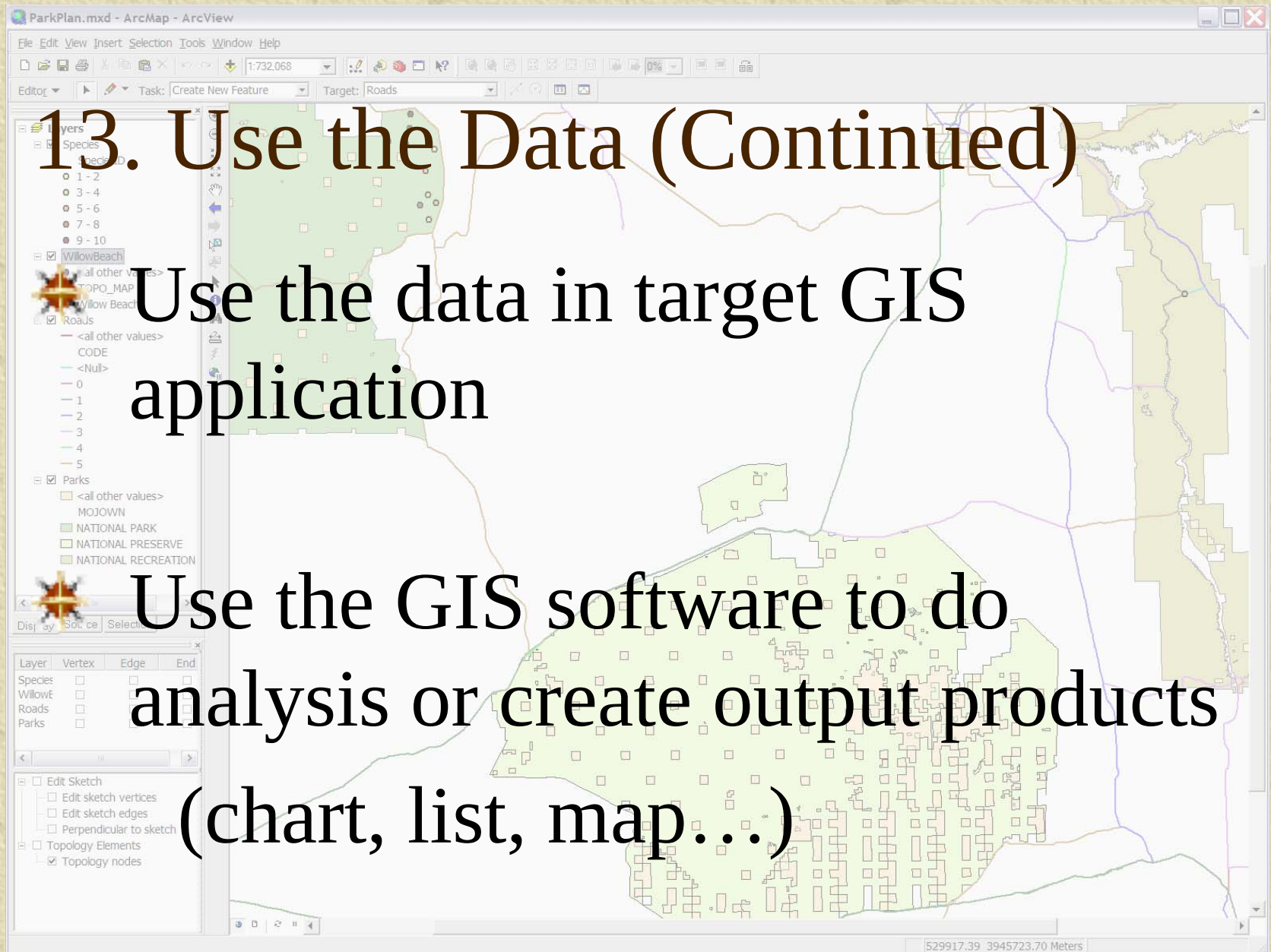
Choose the data you want to check back into the database:

Feature Class	Check Out Name	Target Database	Folder
☒ Station	DataForArcPad2	C:\Documents and S...	C:\Documents and Setti

Select All Clear All Check in Cancel

13. Use the Data (Continued)

- ✦ Use the data in target GIS application
- ✦ Use the GIS software to do analysis or create output products (chart, list, map...)



13. Use the Data (Continued)

Use the data in target GIS application

Use the GIS software to do analysis or create output products (chart, list, map...)

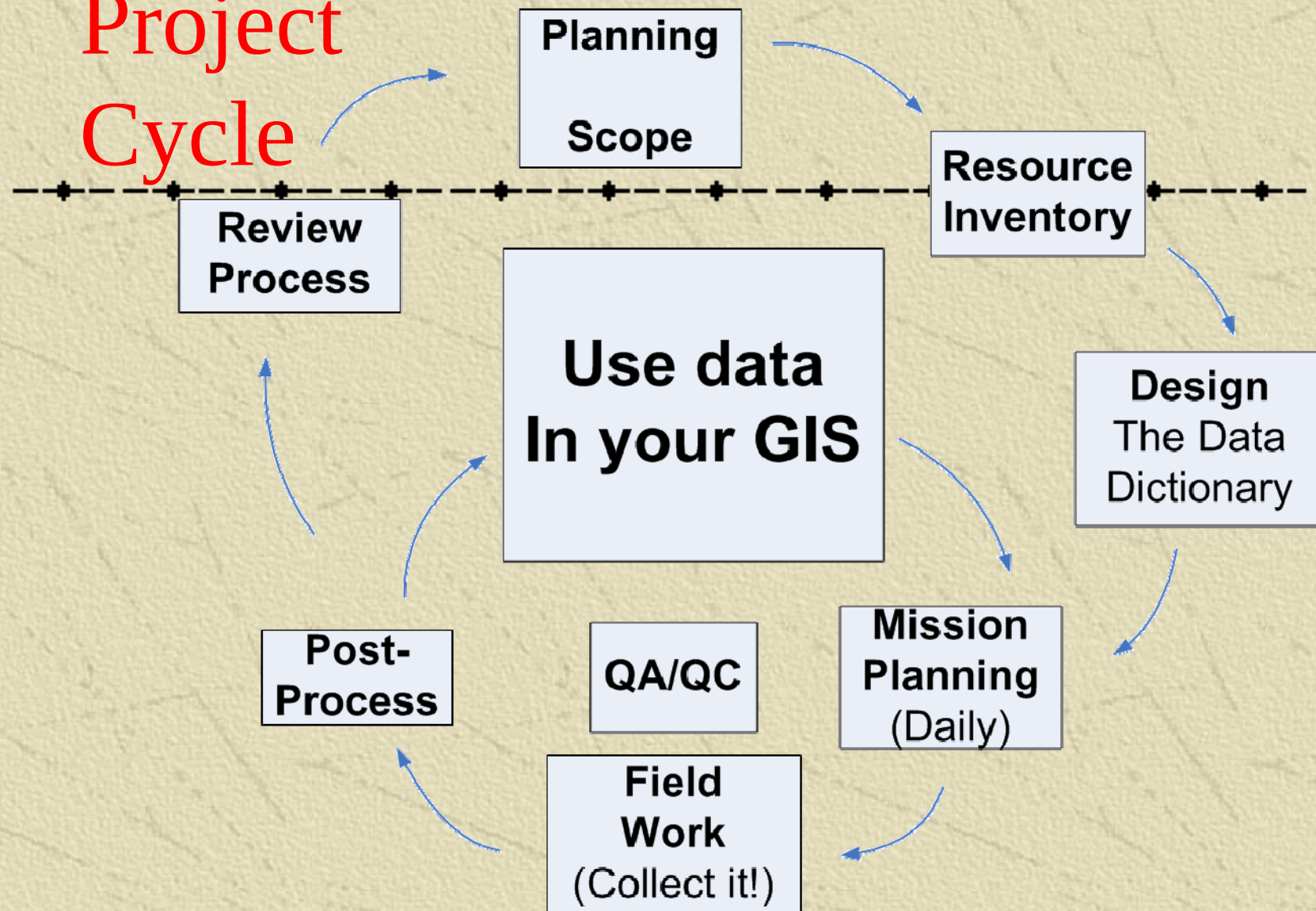
14. Review Data and Process

✦ Learn from your GPS data to make you a better field collector in the future

✦ Do you need to change
 ✦ process / methodology / training?

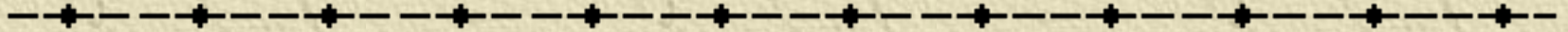
✦ This leads to a continuous cycle...

Project Cycle





Thanks for Attending



Questions / Comments ?

WWW Resources



✧ GPS

<http://trimble.com/mgis.shtml>

<http://www.leica-geosystems.com>

<http://www.sokkia.com>

<http://ThalesNavigation.com/>

<http://www.TopConGPS.com>

✧ GIS

<http://www.esri.com>

<http://www.autodesk.com/gis>

<http://www.bentley.com/>

<http://www.mapinfo.com>

<http://www.intergraph.com/>

WWW Resources (Data)

<http://www.pasda.psu.edu/>

<http://www.dcnr.state.pa.us/topogeo>

<http://www.nysgis.state.ny.us/>

<http://cugir.mannlib.cornell.edu/>

http://erie-gis.co.erie.ny.us/website/erie_help/

<http://www.erie.gov/maps/>

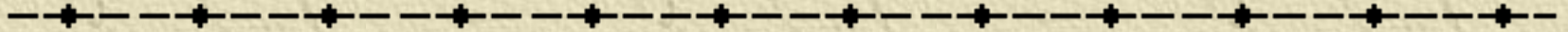
<http://www.maptech.com/>

<http://www.ngs.noaa.gov/>

<http://seamless.usgs.gov/>

<http://er.usgs.gov>

WWW Resources (Community)



<http://www.GISuser.com/>

<http://www.GeoPlace.com>

<http://www.GisCafe.com>

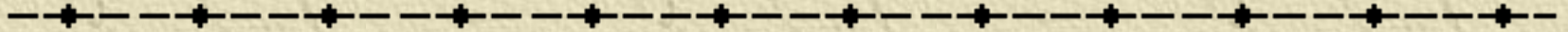
<http://www.PAmagic.org/>

<http://www.GisDevelopment.net>

<http://www.DirectionsMag.com>

<http://www.GeoCaching.com>

WWW Resources (Careers)



<http://careers.geocomm.com/>

<http://www.gisjobs.com/>

<http://www.gjc.org>

<http://www.GeoJobSource.com/>

<http://www.GisPortal.com/gis3d.thm>

<http://www.GisLounge.com>



Bio

Mr. Nichter has worked with GPS and GIS Technology for over 9 years. In that time he has worked on a variety of GIS projects for public utilities, municipalities, timber management and engineering firms. These projects include: GIS parcel mapping for Right of way, vegetation mapping along electrical transmission lines, GPS mapping of natural gas transmission lines and forestry management GIS development. His areas of responsibility have included: field data collection, data editing, feature digitizing, database and application design, GIS analysis, data QA/QC, GIS consulting and client training.

He graduated with a Bachelor's degree in Forest Biology and Resource Management from State University of New York - College of Environmental Science and Forestry in Syracuse, NY. While at ESF he studied raster and vector GIS techniques as well as field survey and GPS for data collection. He is a veteran of the US Army. Mr. Nichter has 9 years of experience with a number of firms involving GPS data collection, GIS analysis and mapping, CADD mapping and field surveying.