



# *2006 GIS-T Symposium Columbus Ohio*

## *ODOT District 4 GPS Culvert Inventory*

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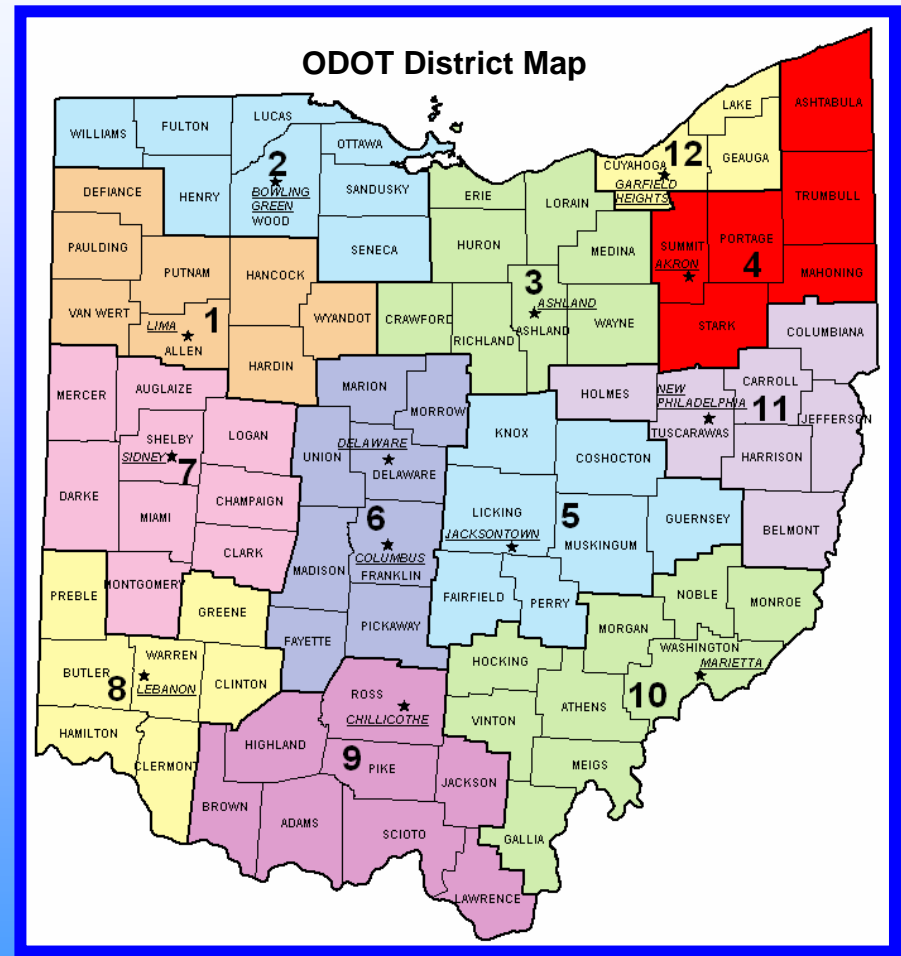
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Tim Sturges - Stark  
Dana West - Summit  
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# ODOT District 4

- ODOT District Four consists of 6 counties - Ashtabula, Mahoning, Portage, Stark, Summit and Trumbull Counties located in Northeast Ohio
- Includes the Cities of Akron, Canton, Youngstown, Warren, Ravenna and Ashtabula
- District 4 Headquarters in Akron, Ohio





## *District 4 Culvert Inventory History*

- ④ 1920 -1980s Culvert Inventory was maintained using a card catalog in the District 4 Office
  - Culverts were referenced using County-Route-Straight Line Mileage (SLM) – Ex. TRU-5-0100
  - Each County used paper forms to Inventory and Inspect their culverts
- ④ Mid-1980s the Bridge Management System (BMS) was developed
  - ODOT's first electronic bridge and culvert database
- ④ BMS Culvert workflow
  - County Highway Workers filled out Inventory and Inspection Forms and give them to the County Manager
  - County Manager would review these forms and generate work orders for deficient culverts and send copies of the inspection and inventory forms to the District Office
  - The District Bridge Department would receive these forms and update BMS



## *District 4 Culvert Inventory Discoveries at the District Office*

- Ⓢ District 4 Card Catalog was only partially updated between the 1950s – 1980s
- Ⓢ Routes constructed after the 1950's did not have culverts entered into BMS
- Ⓢ Other BMS issues
  - To successfully enter a new culvert, or recall an existing culvert from BMS, five fields had to be entered correctly
  - County, Route, Route Type, Sequence Number and SLM
  - SLM is a five character field, where a culvert at the 1.23 mile marker had to be entered as 0123; if in a station equation area, the correct entry would be 0123B or 0123A (A=Ahead, B=Back)
  - Incorrect SLM entries accepted by BMS would be 123, 00123, 1.23, 01.23, etc
  - Several duplicate culvert records resulted from incorrect entries to one or several of these fields



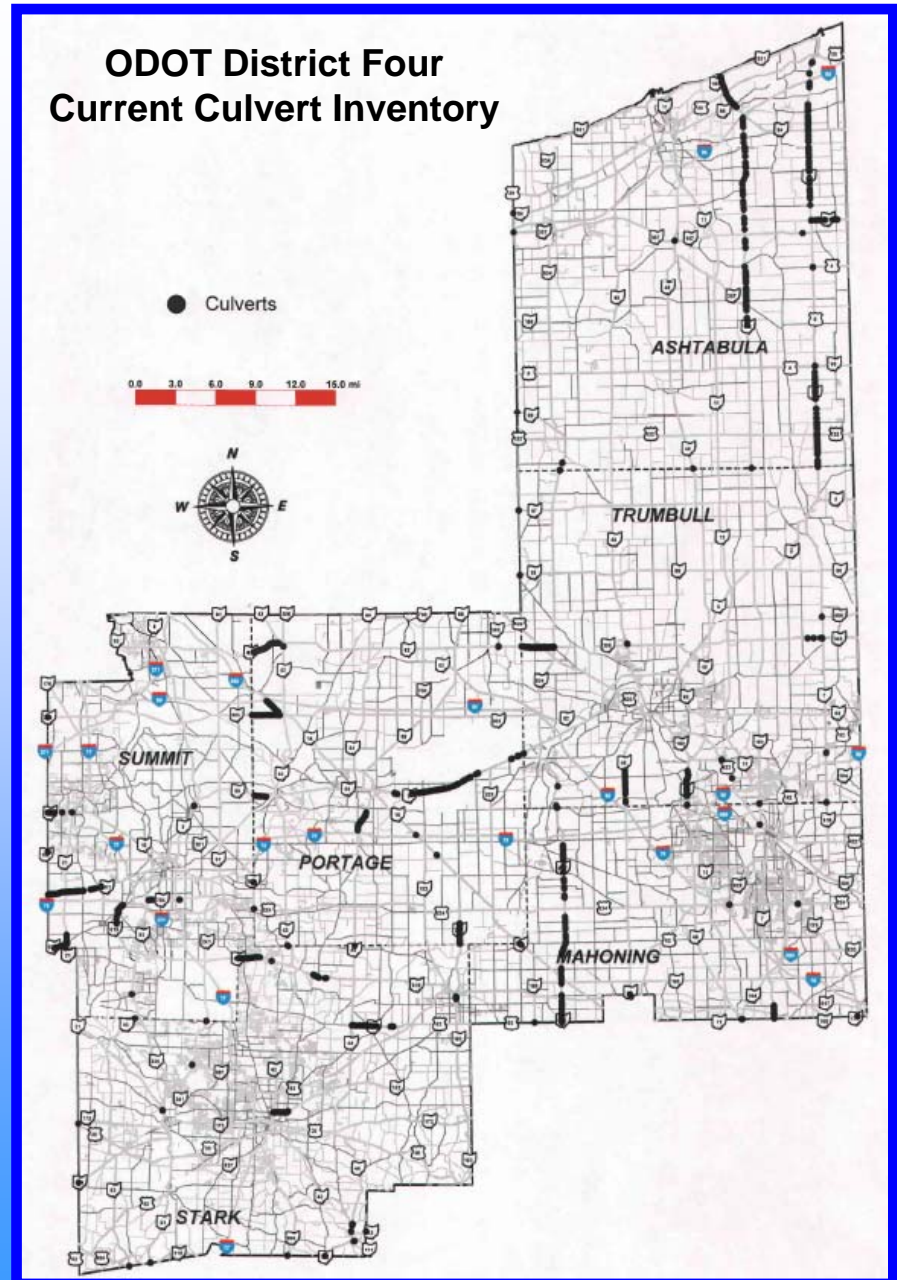
## *District 4 Culvert Inventory Discoveries in the County/Field*

- ④ Culvert SLMs are very difficult to get accurately and consistently in the field
  - Early and existing vehicle Distance Measuring Instruments (DMIs) have large errors if not calibrated regularly
  - Route Realignment/Changes – SLMs for these culverts did not get updated
  - Station Equations – highway workers did not know locations and/or the amount of corrections to apply to their SLMs
  - Mile Marker Signs “wandered” throughout the decades
  - Culverts are just hard to find; buried, under water, under thick vegetation
- ④ Culverts are often located very close together
  - Can have several culverts within a 0.01 mile (52.8 ft’) of each other – all getting the same SLM
  - A slight DMI error would lead a person to an adjacent culvert or no culvert at all
- ④ Many of the Paper Inspection and Inventory Forms were never sent to the District Office or entered into BMS



# *Culvert Inventory History*

- ④ In 2001, District 4 began using GIS to look at our existing BMS culvert data to track deficiencies and to incorporate them into the District's Work Plan
- ④ First GIS Culvert Map produced from BMS August 20, 2001
- ④ BMS SLM field entry error became evident
- ④ Later, input errors from the other 4 BMS culvert fields became evident





## *District 4 Culvert Inventory Attempt to Salvage the Old Inventory*

- ⓐ Summer 2002 - two district office interns were hired to screen the existing BMS culvert data
  - Received all paper inventory and inspection forms from the county managers
  - Corrected the Straight Line Mileage field entries
  - Deleted duplicate culverts, added missing culverts
  - Added culverts from routes constructed after the 1950's using the original construction plans
  - Completed this project Spring 2003



## *District 4 Culvert Inventory Attempt to Salvage the Old Inventory*

- ④ Summer 2003, began field verifying the culvert data
  - Used GeoMedia to create Countywide Culvert Maps
  - Used BMS GQL to generate the attribute data forms
  - Used a DMI to determine SLM locations in the field
- ④ Discovered that the SLMs in BMS did not match most of the physical culvert locations in the Field
- ④ Attribute data from BMS did not match many of the culverts that were located
- ④ District 4 then decided to scrap old culvert inventory and start a new districtwide culvert inventory using GPS units





## *New GPS Culvert Inventory*

- ④ District 4 borrowed 7 Trimble GeoExplorer 3 GPS units from Central Office Aerial Engineering
- ④ Central Office Structures Department finalized a new Culvert Inventory and Inspection Manual
- ④ Created a standard Data Dictionary File for each county that captured GPS Location and all Inventory and Inspection items as well as made it compatible to ODOT's GIS
- ④ Between Spring 2004 and Spring 2006 – 5,153 culverts were GPS Located, partially inspected and inventoried in District 4
  - Approximately 4,600 of the culverts were inventoried and inspected by the 6 county interns from Spring 2005 – Fall 2005
- ④ Culvert Map – created by John Puente, ODOT District 1 GIS Coordinator



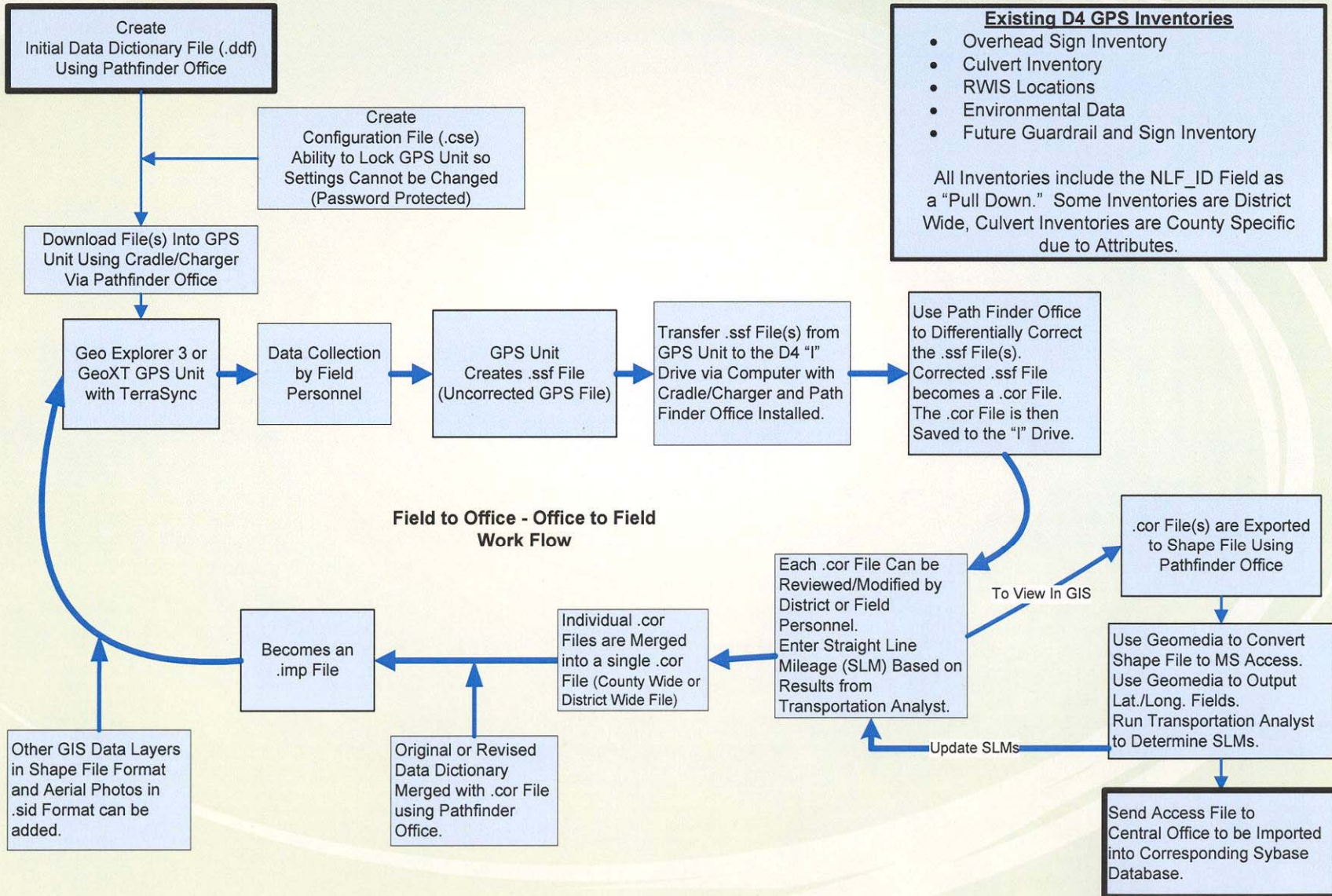
## *New GPS Culvert Inventory*

- ⓐ All interstate and 4-lane divided highway mainline culverts outside major construction projects were located, inventoried and inspected
- ⓐ All 2-lane U.S. and State Route mainline culverts outside of Cites were located, inventoried and inspected
- ⓐ Straight Line Mileage was assigned automatically using GeoMedia with Transportation Analyst from our GIS roadway inventory file – not from the field as was done with the previous culvert inventory

# ODOT District 4 GPS Work Flow

Using TerraSync and Pathfinder Office

4/14/2005





## *GPS Culvert Inventory Advantages in the Field*

- ⓐ Culvert Locations and Inventory/Inspection Items are now tied to a specific GPS Latitude and Longitude
  - Culvert Locations and corresponding attribute data are directly integrated – no more hunting for or guessing at culvert locations
  - Current Culvert Location accuracies range between 1 – 3 feet (vs. nearest 52.8 feet+ with old inventory)
  - SLM is assigned by ODOT's GIS Roadway Inventory file and not from the field, which eliminated the incorrect SLM errors that plagued the old culvert inventory
- ⓐ All data is collected, stored and recalled electronically
  - Paper forms have been eliminated – no need to have someone manually type data into BMS



## *GPS Culvert Inventory Advantages in the Field*

- ④ Culvert data is stored in one single countywide culvert file that is downloaded to and uploaded from the GeoXT GPS units
  - Highway Workers can now quickly navigate back to any specific culvert within their county
  - View previous culvert attribute data when entering new inspection/inventory items
  - Know when they have found a new or non-previously inspected/inventoried culvert
  - Use the GeoXT's query function to locate a specific group of culverts



## *GPS Culvert Inventory Advantages for the District/Central Office*

- ④ Two-way GPS data flow – Field to Office and Office to Field
- ④ GIS Culvert maps with current data can be produced “on the fly” in the District or County Office
  - District 4 now knows the number and location of most of its deficient culverts throughout the District
- ④ Non-GIS District personnel can view the culvert attribute data stored in an Excel Spreadsheet on District 4’s “I” drive



## *GPS Culvert Inventory Advantages for the District/Central Office*

- ④ GeoMedia is being used to match deficient culverts to the current 2006 – 2015 District 4 Work Plan
  - Deficient Culverts within existing project limits are gradually being added to project scopes and total project costs are being revised
  - Stand-alone Culvert Replacement projects are now being scheduled
  - Number Change Orders and Emergency Projects have been reduced in the district
- ④ Eventually all data will be integrated into Central Office's new Culvert Management Program



## *GPS Culvert Inventory Disadvantages*

### **@** Technology Learning Curve

- Field Personnel were resistant to change – had better success using interns for culvert inventory
- Fear of being tracked by District and C.O.

### **@** Cost of GPS Equipment

- GeoXT GPS unit with equipment and Pathfinder Office software costs approximately \$7,500 per unit
- Limited number of GPS units available at all times for multiple inventories

### **@** Finding personnel at the County Level willing to take over and maintain this and other GPS inventories when the current county interns graduate





Questions ???