



CAD/GIS Interoperability

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Since the release of the 2014 CADD software packages, options now exist to export data from CADD to GIS (with intelligence, not just lines, points and polygons), use GIS data in CADD and a whole host of other applications.

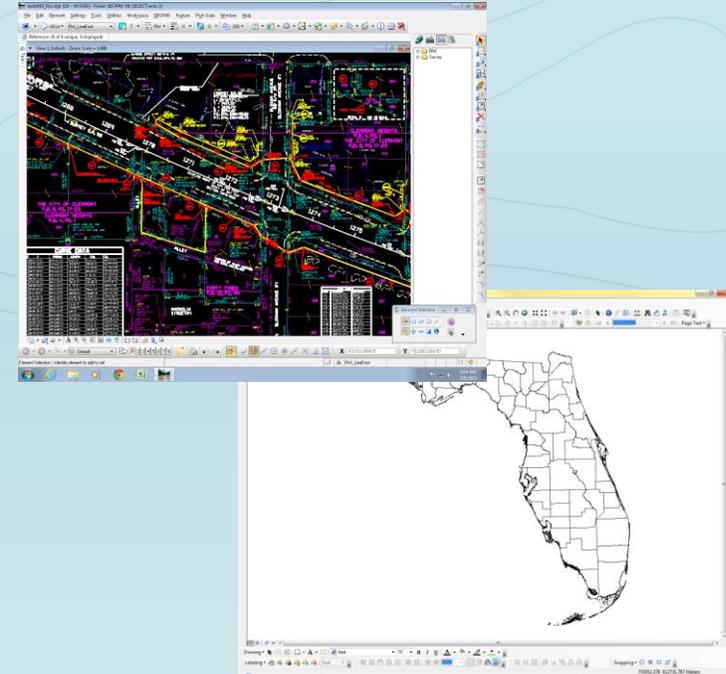
OVERVIEW

Overview

- Background
- Research
- Interoperability
- Beta Testing
- Summary

Background

- The Florida Department of Transportation (FDOT) requires standardized electronic delivery of Design Plans through CADD.
- With the advancement of the GIS Enterprise View (GEV) utilizing the FDOT Enterprise GIS Framework and the technology upgrades to CADD platforms supporting the interoperability between these environments, a path for sharing data has evolved so that users in both environments can benefit.



Background

- In 2011 started looking for a way to put everything Right of Way (ROW) related into our new enterprise GIS framework looking backward to historic records
- We had some success in manipulating the CADD line work for ROW acquisitions into a GIS environment, but the work was tedious and time consuming
- Utilities (a highly desired data set) would be even more tedious

Background

- Brought in Texas A&M Transportation Institute (TTI)
- They interviewed 3 Districts to find FDOTs
 - Business processes
 - Systems
 - Information concerning management of ROW & Utility data

Background

- We wanted them to develop a strategic implementation plan to manage ROW parcels and utility data
 - They developed steps for integrating this existing data into FDOTs enterprise GIS framework
- Including a process, workflow and a tool to hopefully “automate” bringing this historical data (CADD line work) into a GIS environment and to give it intelligence
 - They recommended that we take a database approach to manage our data and use existing survey and GEOPAK data
- This research project is now complete

GIS to CADD

- We anticipate that we will one day want the ability to reference all or some amount of historical layers such as
 - Survey Control,
 - Parcels,
 - Aerials,
 - ROW,
 - Roadway,
 - Easements,
 - Utilities, and Permit Agreements

GIS to CADD

- Technology is moving in the direction of being able to deal with these types of items in a “feature” based environment
- This information could be of great value in areas of informed decision making or those that may create high amounts of public record requests
- Both Bentley and AutoCAD platforms now have the functionality to directly support referencing of GIS data into the CADD environment and visa versa

CADD to GIS “Interoperability”

So.....

How can we integrate CADD Survey/Engineering data that's symbolized specifically to create a set of design plans for construction so that elements of that design can be visualized/attributed and thereby successfully used in a Geographic Information System?

CADD to GIS Interoperability Requirements

- Before we can begin to answer that question we must first have an understanding of what it is that GIS requires in order to visualize and geospatially query information
 - GIS uses relational tables of records that are geospatially aware
 - Along with linked attribute data

● In short---

Attributes Data Intelligence

- So that means that we must somehow create outputs in the CADD environment to meet these requirements

CADD to GIS Interoperability Requirements

- By incorporating GIS workspaces into our current workflow
- Harnessing the tools available in our latest licensed CADD products (MicroStation Power GeoPak/Map & AutoCAD Geospatial) giving us the ability to generate GIS compliant data
 - That is data that is both
 - Geospatially aware, and
 - Has attributes

CADD to GIS Interoperability Goals

- Use existing licensed products (both CADD and GIS)
- Reach out and determine all potential stakeholders to data
 - There may be some who traditionally were not interested or didn't have a need to mine CADD data from design plans as they were not CADD users and the data had no intelligence

CADD to GIS Interoperability Goals

- User assessment to identify initial need and priority of GIS features
 - Start small
 - Right of Ways
 - Parcels (both right of way and excess)
 - Alignments
- Determine workflows, and
- Build tools and workspaces in FDOT CADD platforms for creating these GIS features

CADD to GIS Interoperability Tools

- Using these tools and FDOT workspaces CADD designers can create
 - GIS compliant features (intelligent features), or
 - Promote existing CADD elements to GIS features with associated attribute data

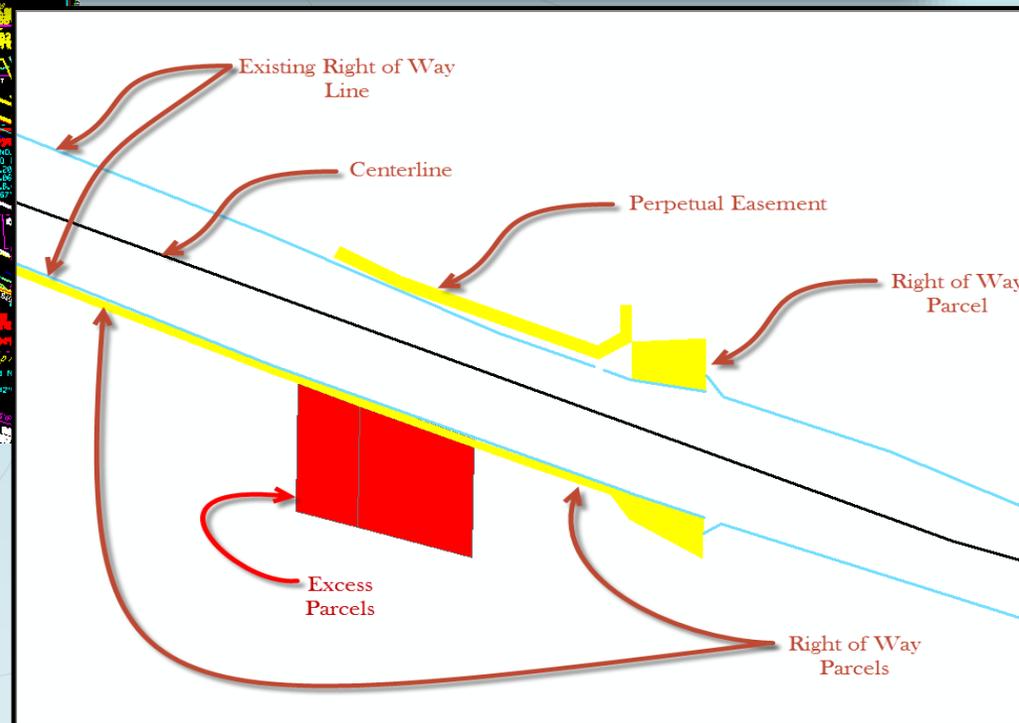
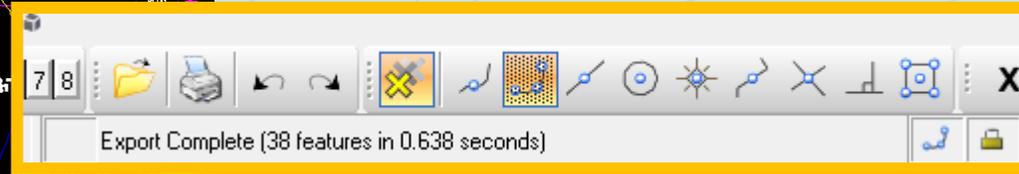
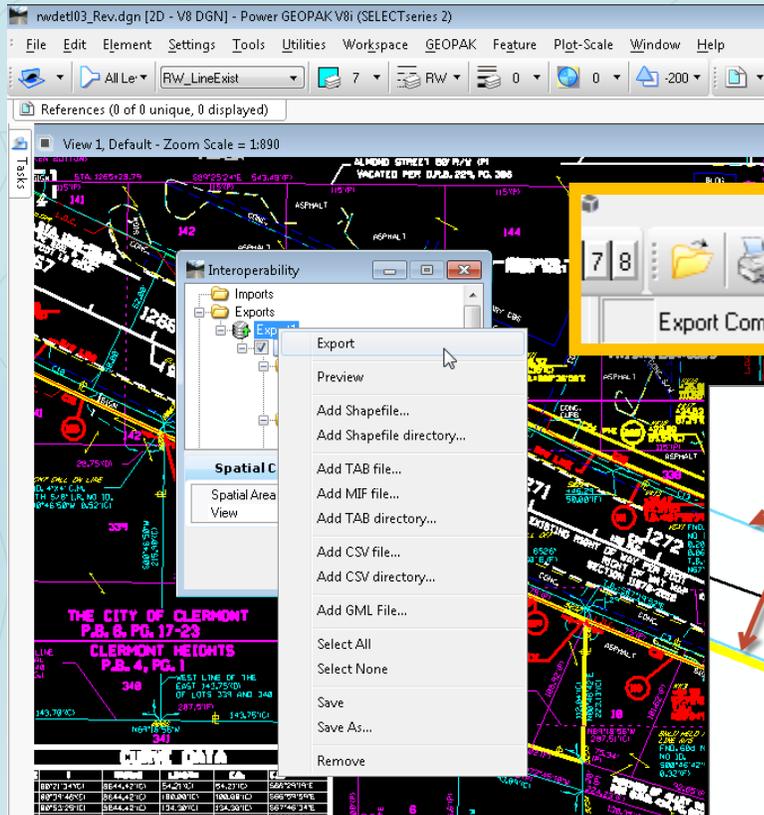


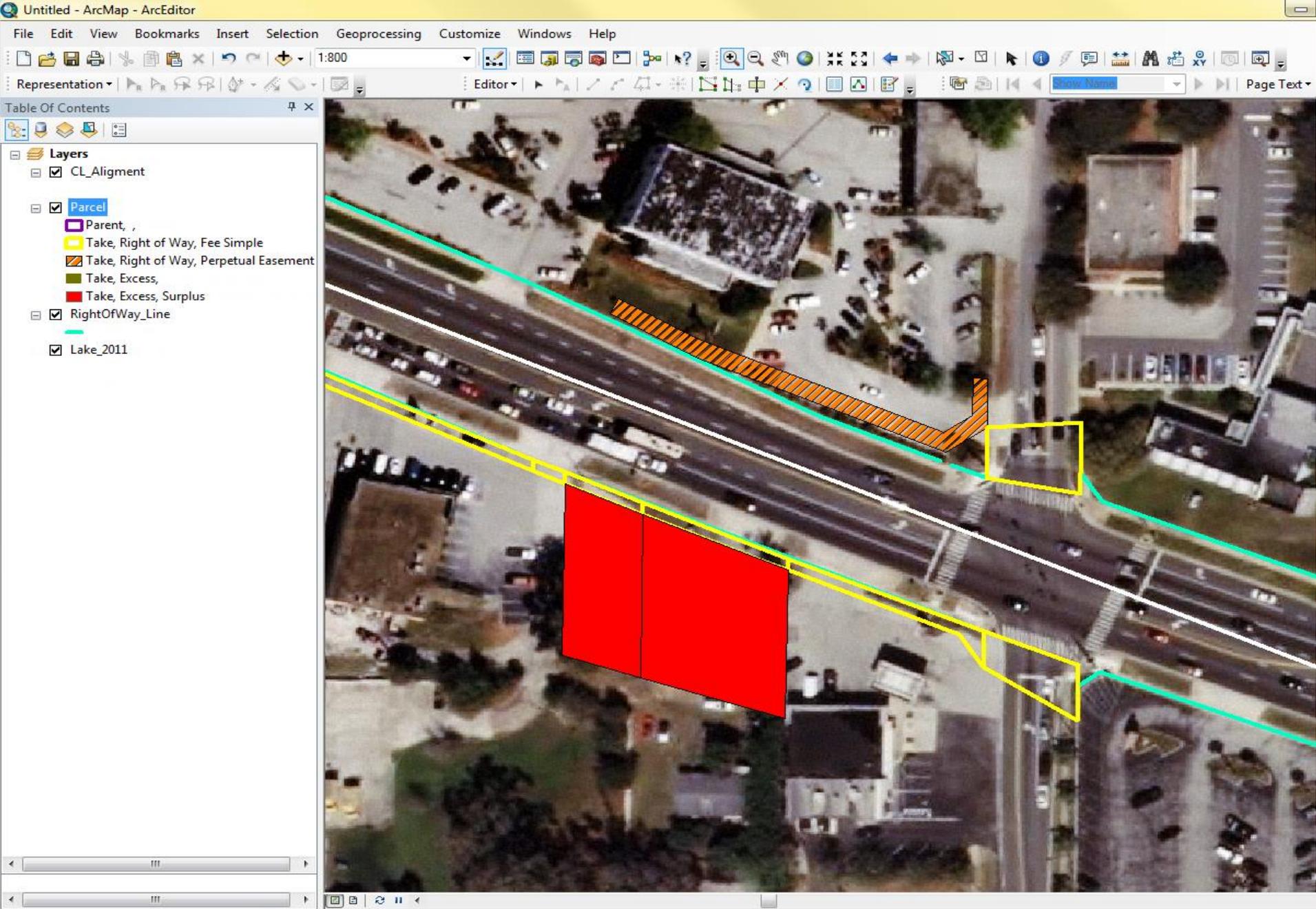
CURVE DATA

Curve No.	Station	Length	CA	CB
01	8871.34(1)	8844.42(1)	54.21(1)	54.21(1)
02	8871.34(1)	8844.42(1)	100.00(1)	55.79(1)
03	8871.34(1)	8844.42(1)	134.30(1)	57.76(1)
04	8871.34(1)	8844.42(1)	183.38(1)	57.76(1)
05	8871.34(1)	8844.42(1)	37.01(1)	57.76(1)
06	8871.34(1)	8844.42(1)	140.17(1)	57.76(1)
07	8871.34(1)	8844.42(1)	158.80(1)	57.76(1)
08	8871.34(1)	8844.42(1)	21.72(1)	57.76(1)
09	8871.34(1)	8844.42(1)	158.84(1)	57.76(1)
10	8871.34(1)	8844.42(1)	188.85(1)	57.76(1)
11	8871.34(1)	8844.42(1)	430.61(1)	57.76(1)
12	8871.34(1)	8844.42(1)	275.39(1)	57.76(1)
13	8871.34(1)	8844.42(1)	112.66(1)	57.76(1)
14	8871.34(1)	8844.42(1)	145.82(1)	57.76(1)
15	8871.34(1)	8844.42(1)	3.01(1)	57.76(1)
16	8871.34(1)	8844.42(1)	733.98(1)	57.76(1)
17	8871.34(1)	8844.42(1)	158.80(1)	57.76(1)
18	8871.34(1)	8844.42(1)	21.72(1)	57.76(1)

L1	N68°10'15"W	56.82(1)
L2	N37°49'13"W	27.88(1)
L3	S70°23'48"W	37.74(1)
L4	N26°47'03"E	4.33(1)
L5	N26°47'03"E	11.51(1)
L6	S68°36'27"E	57.24(1)
L7	S68°36'27"E	54.81(1)
L8	N57°32'02"E	24.53(1)
L9	S33°01'23"E	8.48(1)
L10	N13°52'35"E	28.14(1)

CADD Components Exported as GIS Features







Powered by OpenRoads Technology



Power GEOPAK[®] V8i

SELECTseries 4

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Bentley

- Includes new geospatial tools:

- Interoperability tools

- Map Manager

- Attaches files and features from any supported graphical source (such as vector maps and raster images) and manage feature display

- Feature Menu

- Command Manager

- Allows for the placing, editing, promotion, analyzation and browsing of feature attributes

Bentley Geospatial Administrator

The screenshot displays the Bentley Geospatial Administrator interface. The left pane shows a tree view of the project structure, with 'Parcel' selected under 'Features'. The main window is titled 'Feature Definition' and shows the following details for the 'Parcel' feature:

- Name: Parcel
- Display Name: Parcel
- Collection Name: Parcel
- Table Name: (dropdown menu)
- Category: Survey
- Description: (text area)
- Type: polygon
- Zoom Min: (text field) Max: (text field)
- Schema Version: (text field)
- Sub Features: (table with columns Name and Display Name)
- Properties Summary: (table with columns Name, Display Name, DB Property, Item Type, Type, Store Last Value, Num Chars)

The Properties Summary table contains the following data:

Name	Display Name	DB Property	Item Type	Type	Store Last Value	Num Chars
SegmItem	Segment/Item	<input type="checkbox"/>	textBox	integer	dgnFile	7
FedAidNum	Federal Aid Number	<input type="checkbox"/>	textBox	string	none	18
District	District	<input type="checkbox"/>	comboBox	string	dgnFile	10
County	County	<input type="checkbox"/>	comboBox	string	dgnFile	12
RoadDes	Road Designation	<input type="checkbox"/>	comboBox	string	dgnFile	5
RdNum	Road Number	<input type="checkbox"/>	textBox	string	dgnFile	4
RdName	Road Name	<input type="checkbox"/>	textBox	string	dgnFile	25
Type	Parcel Type	<input type="checkbox"/>	comboBox	string	dgnFile	6
TakeCateg	Take Category	<input type="checkbox"/>	comboBox	string	none	25
ROWCateg	Right of Way Category	<input type="checkbox"/>	comboBox	string	none	23
ExpDate	Temporary Expiration Date	<input type="checkbox"/>	dateTime	string	client	12
FDOTParID	FDOT Parcel ID	<input type="checkbox"/>	textBox	string	none	4
DateOfAcq	Date Of Acquisition	<input type="checkbox"/>	dateTime	string	client	12
PropAppID	Property Appraiser ID	<input type="checkbox"/>	textBox	string	none	11
OffDocType	Official Document Type	<input type="checkbox"/>	comboBox	string	none	10
BkInsNum	Book or Instrument Number	<input type="checkbox"/>	textBox	string	none	8
PageNum	Page Number	<input type="checkbox"/>	textBox	string	none	8

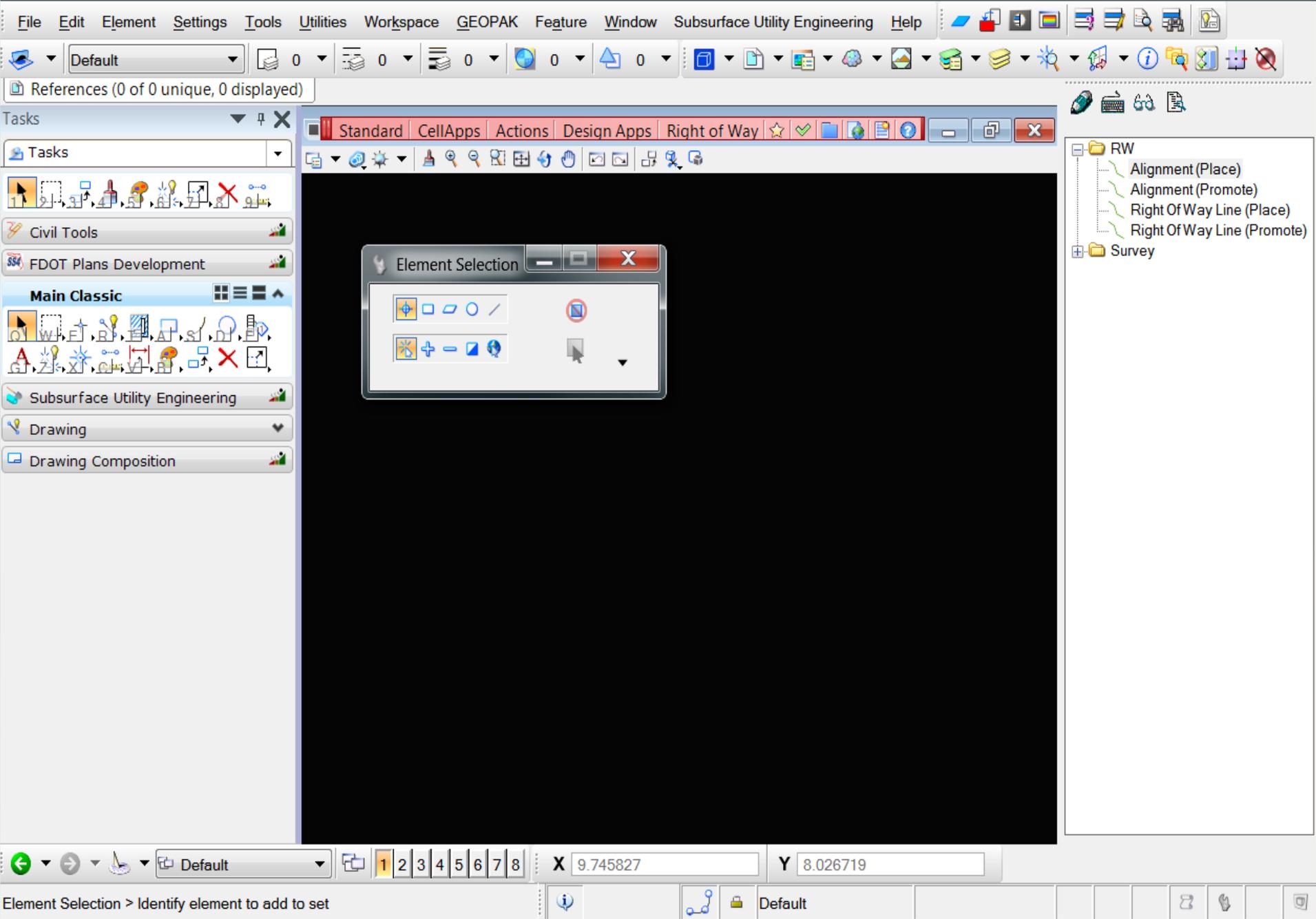
Buttons at the bottom right: Apply, Reset, Help.

Path at the bottom: C:\ProgramData\Bentley\PowerGEOPAK V8i (SELECTseries 4)\WorkSpace\Projects\Examples\Geospatial\Sc

```

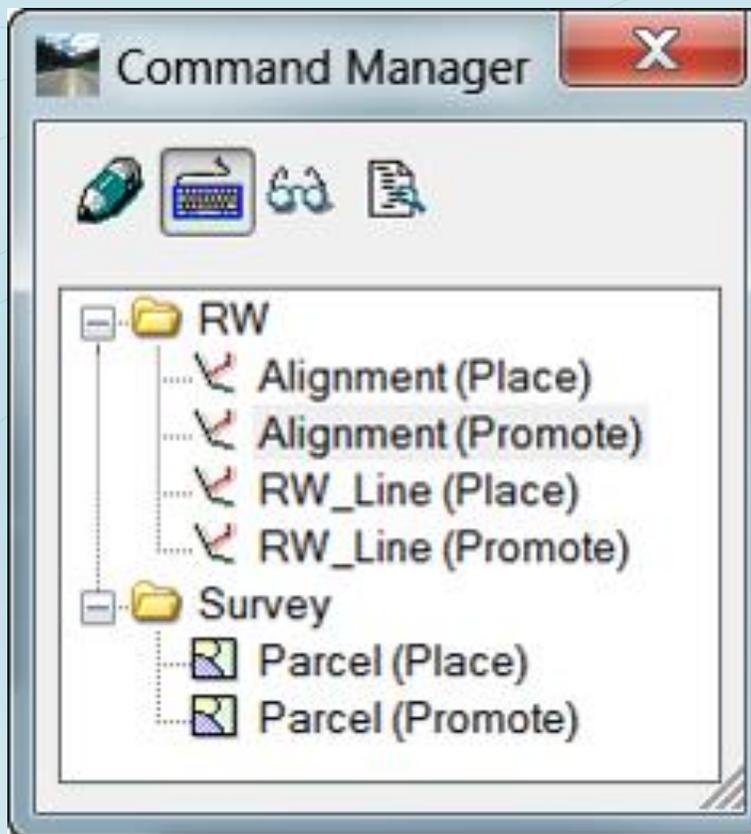
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- <GeospatialSchema projectParentDir="Geospatial" workspaceRootDir="C:\FDOTSS4\Workspace" schemaDescr="GIS schema" projectName="GIS">
  - <Workspace name="All Users">
    - <Features schemaVersion="http://www.bentley.com/schemas/GeoSpatial/XFM/GIS/1.0" genFile="features.xml">
      - <feature name="Alignment" schemaVersion="" propagateCopyFromParent="never" propagateCopyToParent="never" propagateFromRoot="never" propagateDeleteToParent="never"
        propagateFromParent="never" propagateToParent="never" category="RW" maxOccurs="1" minOccurs="0" type="linestring/curve" collectionName="Alignment" alias="">
        - <Symbology type="linear">
          <ApplyDrawingScale>true</ApplyDrawingScale>
          <OverrideScale useCriteria=""></OverrideScale>
          <Color blue="-1" green="-1" red="-1">ByLevel</Color>
          <Level useCriteria="is AlignmentBLSurvey">BaselineSurvey</Level>
          <Level useCriteria="is AlignmentCLConst">CLConst_dp</Level>
          <Style>ByLevel</Style>
          <StyleScale>1.0</StyleScale>
          <Weight>ByLevel</Weight>
          <Class>0</Class>
          <Priority>0</Priority>
          <Transparency>0</Transparency>
          <FillType>None</FillType>
          <FillMode>0</FillMode>
          <FillColor blue="-1" green="-1" red="-1">ByLevel</FillColor>
          <AreaType>0</AreaType>
        </Symbology>
        - <Properties>
          - <property name="SegmItem" type="integer" alias="Segment/Item" dbProp="" preferenceType="dgnFile">
            <initialValue valueType="value" synch="true" key="placing"/>
            <dataSpec maxExclusive="false" max="" minExclusive="false" min="" numChars="7"/>
            - <itemSpec type="textBox" labelColor="red" label="Segment/Item:">
              <textBox formatToInternal="%s" formatToDisplay="%s"/>
            </itemSpec>
            <hookOptions synchOnChangeKey="" required="true" dontclear="false" readOnly="false" uppercase="false"/>
            <toolTip>Enter Segment/Item (the first 7 digits of the FPID#)</toolTip>
          </property>
          - <property name="FedAidNum" type="string" alias="Federal Aid Number" dbProp="" preferenceType="dgnFile">
            <initialValue valueType="value" synch="true" key="placing"/>
            <dataSpec maxExclusive="false" max="" minExclusive="false" min="" numChars="18"/>
            - <itemSpec type="textBox" labelColor="black" label="Federal Aid #:">
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            </itemSpec>
            <hookOptions synchOnChangeKey="" required="false" dontclear="false" readOnly="false" uppercase="false"/>
            <toolTip>Enter Federal Aid #</toolTip>
          </property>
          - <property name="District" type="string" alias="District" dbProp="" preferenceType="dgnFile">
            <initialValue valueType="value" synch="true" key="placing"/>
            <dataSpec numChars="10"/>
            - <itemSpec type="comboBox" labelColor="red" label="District:">
              <comboBox formatToInternal="%s" formatToDisplay="%s" listWidth="6" listBoxWidth="0" numRowsToDisplay="8" widthFromList="false" editColumnName="col1" valueColumnName="col1"/>
            </itemSpec>
            <hookOptions synchOnChangeKey="" required="true" dontclear="false" readOnly="true" uppercase="false" resize="none"/>
            <toolTip>Select District</toolTip>
            - <watchersList>
              <watcher name="UpdateCountyList" type="SynchItem" alias="Alignment" valueType="blank" runWatchedWatchers="false" redraw="true" property="County" operation=""/>
            </watchersList>
            - <domainListSpec addBlankListEntry="true" numColumns="1">
              <domainRow col1="1"/>
              <domainRow col1="2"/>
              <domainRow col1="3"/>
              <domainRow col1="4"/>
              <domainRow col1="5"/>
              <domainRow col1="6"/>
              <domainRow col1="7"/>
              <domainRow col1="Turnpike"/>
            </domainListSpec>
          </property>
          - <property name="County" type="string" alias="County" dbProp="" preferenceType="dgnFile">

```



Command Manager Tree

Note: Commands are categorized by discipline in this example, but could be categorized/organized in other ways.



Interface

Promote to Parcel

Promote to Parcel

Single Element
 Fence
 Selection Set

Delete existing element(s) after promote

Segment/Item: Fed Aid #:
District: County:
Road: Number:
Road Name:
Parcel Type:
Take Category:
Right of Way Category: Exp Date:
FDOT Parcel ID:

Date Of Acquisition:
Property Appraiser ID:
Official Document Type:
Book or Instrument #: Pg #:
Owner:
Grantee:

Section: Township: Range:

Apparent Access:
Access Road:
Description: Comments:

Drafting Date:
Status Date: Status:

Interface

Place Parcel

Place Parcel

Segment/Item: Fed Aid #:

District: County:

Road: Number:

Road Name:

Parcel Type:

Take Category:

Right of Way Category: Exp Date:

FDOT Parcel ID:

Date Of Acquisition:

Property Appraiser ID:

Official Document Type:

Book or Instrument #: Pg #:

Owner:

Grantee:

Section: Township: Range:

Apparent Access:

Access Road:

Description: Comments:

Interface

Place and Promote Alignment

Place Alignment

Segment Modes



Allow Offset

Use Offset Distance 100

Segment/Item: Federal Aid #:

District: County:

Road: Number:

RdName:

Alignment Type:

Promote to Alignment

Single Element

Fence

Selection Set

Delete existing element(s) after promote

Segment/Item: Federal Aid #:

District: County:

Road: Number:

RdName:

Alignment Type:

Interface

Place and Promote
Right of Way Line

Place Right Of Way Line

Segment Modes



Allow Offset

Use Offset Distance 100

Segment/Item: FedAidNum:

District: County:

Road: Num:

RdName:

Right of Way Type:

Promote to Right Of Way Line

Single Element

Fence

Selection Set

Delete existing element(s) after promote

Segment/Item: FedAidNum:

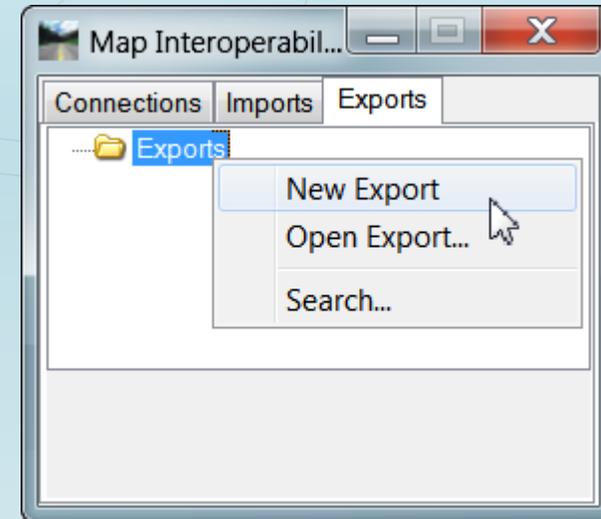
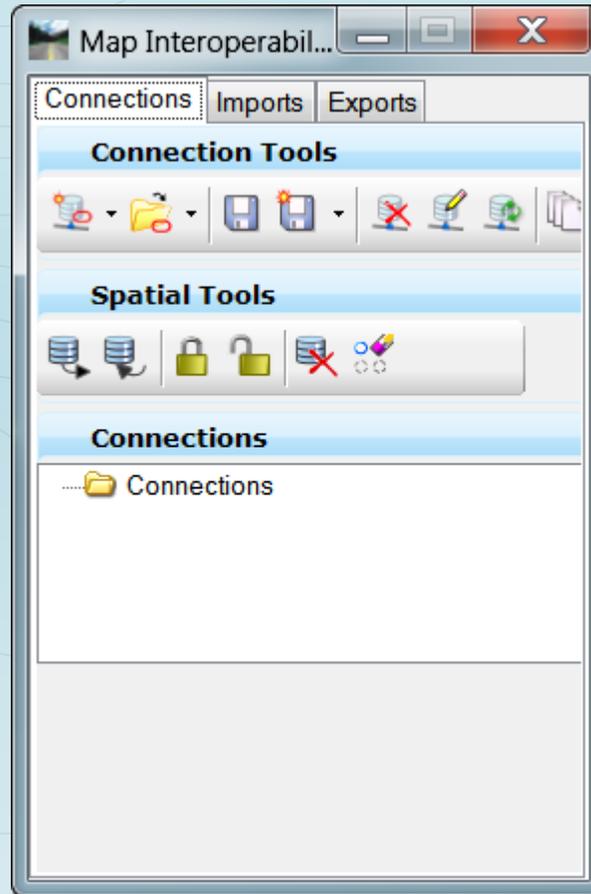
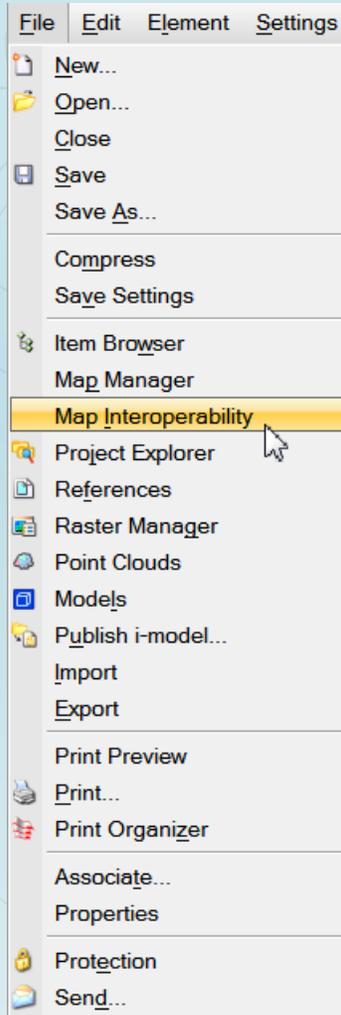
District: County:

Road: Num:

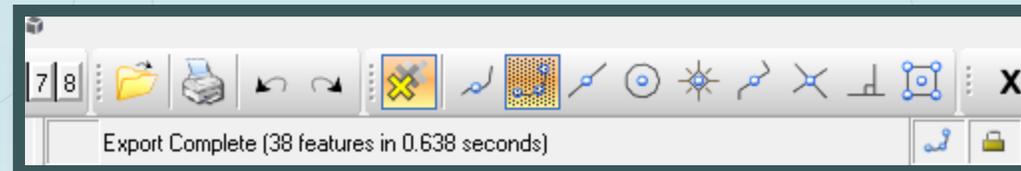
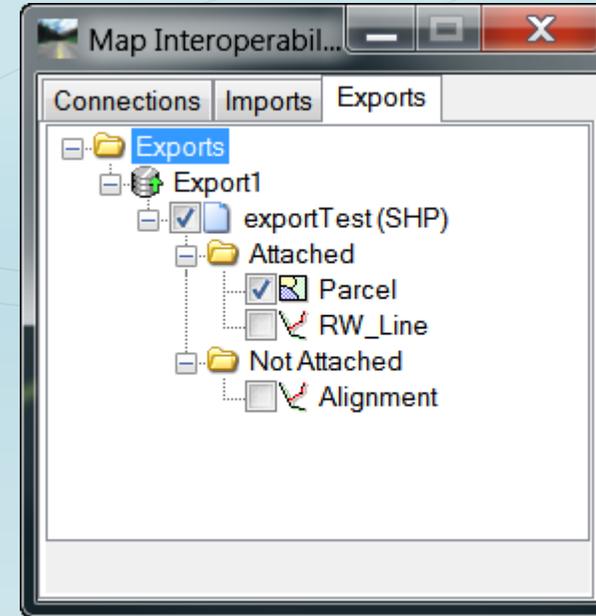
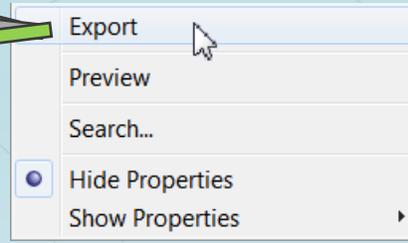
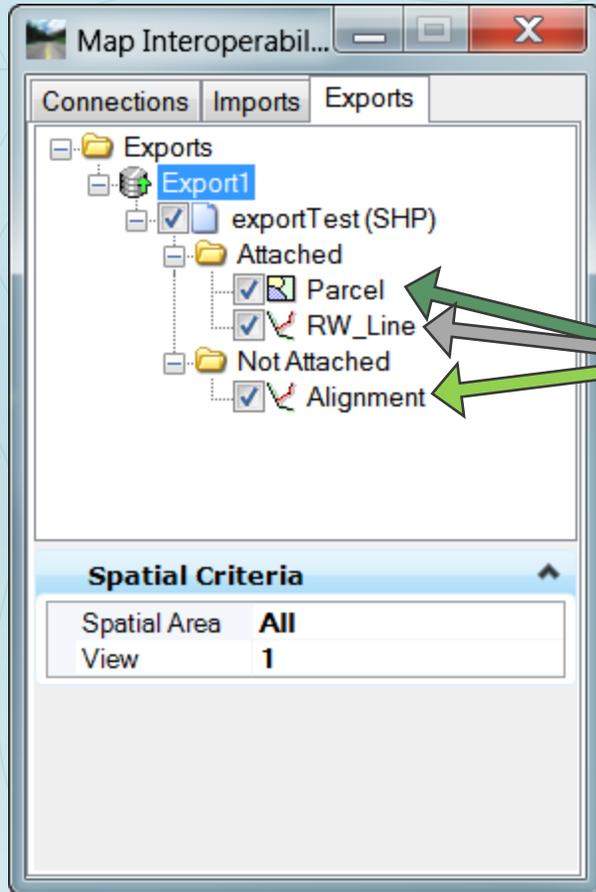
RdName:

Right of Way Type:

Export to GIS



Exporting Options

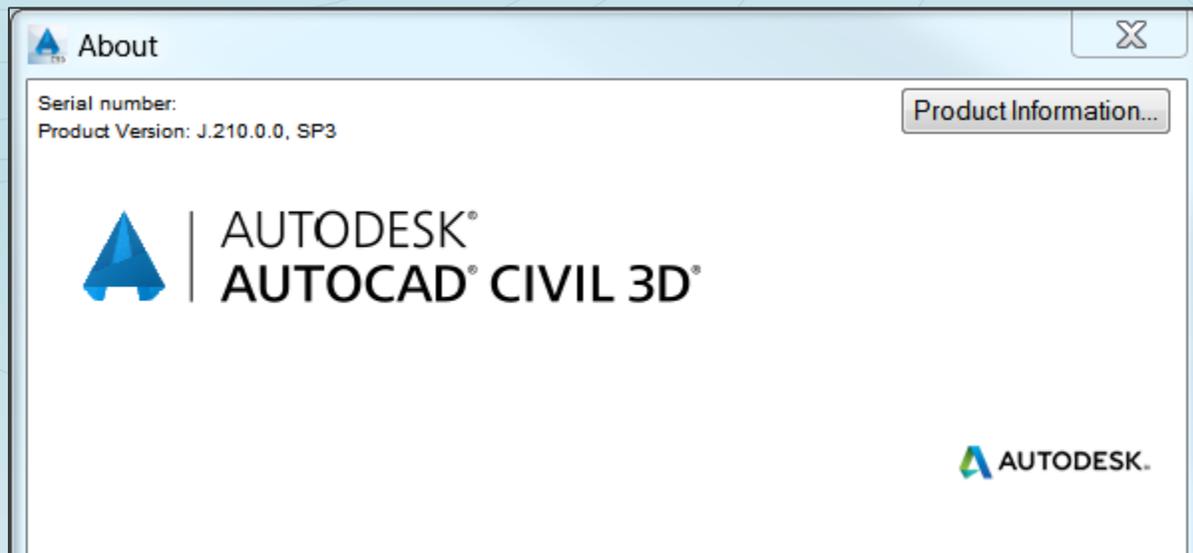


Project Template

Storage of all things GIS

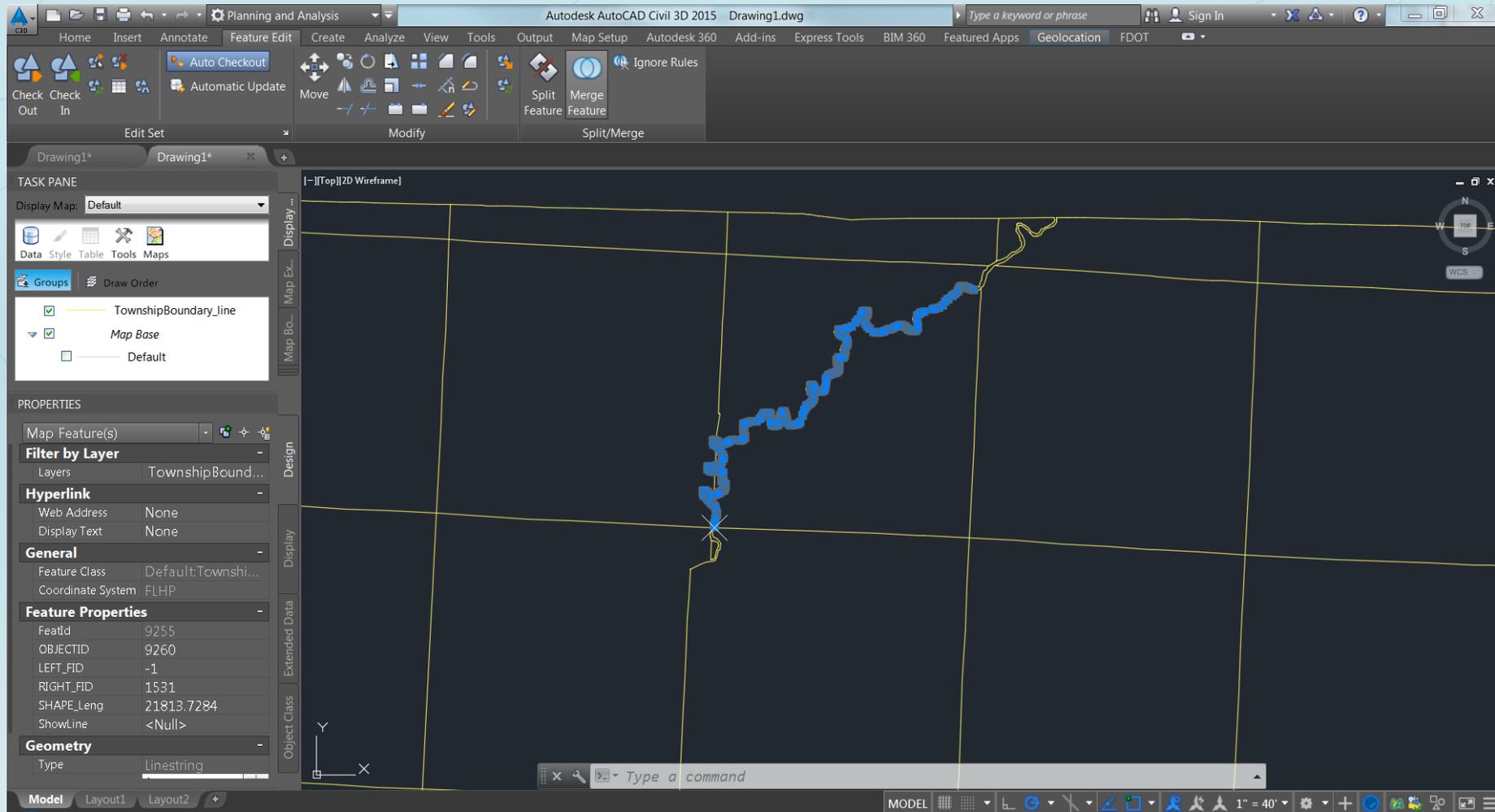
Name

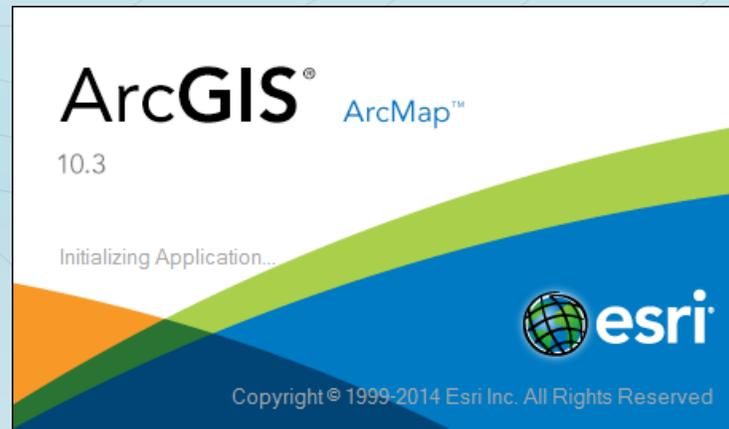
- ✓ _meta_info
- ✓ 3DDeliverables
- ✓ admin
- ✓ arch
- ✓ Brinspect
- ✓ Calculations
- ✓ cell
- ✓ Concepts
- ✓ const
- ✓ data
- ✓ drainage
- ✓ emo
- ✓ estimates
- ✓ geotech
- ✓ GIS
- ✓ ITS
- ✓ landscp
- ✓ lighting
- ✓ Maint
- ✓ Material
- ✓ out
- ✓ permits
- ✓ planning
- ✓ Preestim
- ✓ roadway
- ✓ rormap
- ✓ seed
- ✓ signals
- ✓ signing



AutoCAD

- Read, write, and convert data between widely used formats which include:
 - DWG—Output a DWG file that is readable by any AutoCAD software client, in both visual and editable modes
 - Arc/Info coverages
 - SHP and E00 from ESRI
 - MapInfo MIF/MID
 - MapInfo TAB
 - MicroStation DGN
 - Generalized Markup Language
 - Ordnance Survey MasterMap (DNF) (GML2, read-only)
 - Oracle
 - Vector Product Format (VPF, read-only)
 - ASCII
 - LandXML
 - SDF
 - Spatial Data Transfer Standard (SDTS, read-only)





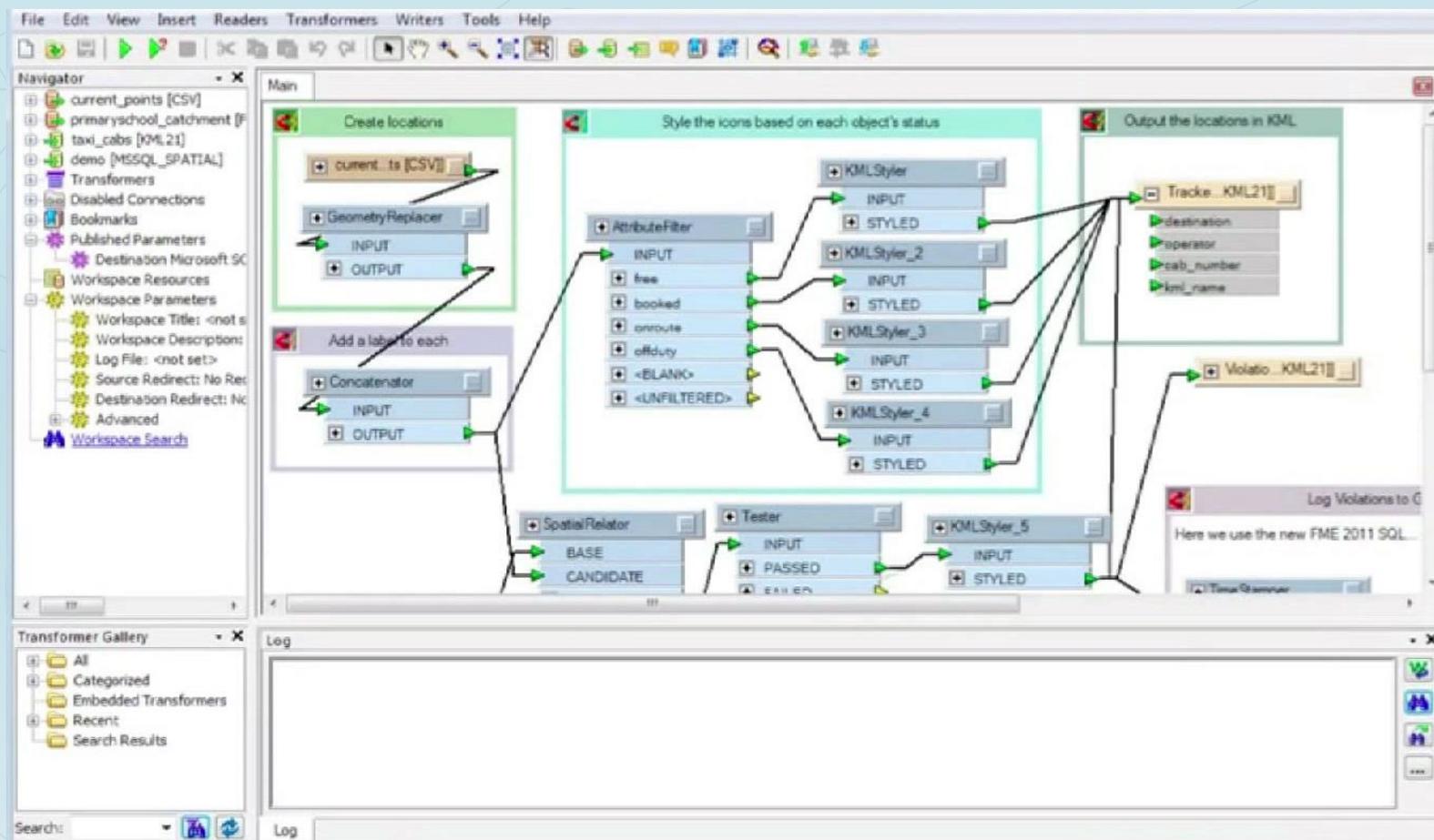
ESRI Data Interoperability Tools

Requires the Data Interoperability Extension for Basic, Standard or Advanced license levels

- **Quick Export-** Converts one or more input feature classes or feature layers into any format supported by the ArcGIS Data Interoperability extension.
- **Quick Import-** Converts data in any format supported by the ArcGIS Data Interoperability extension into feature classes.

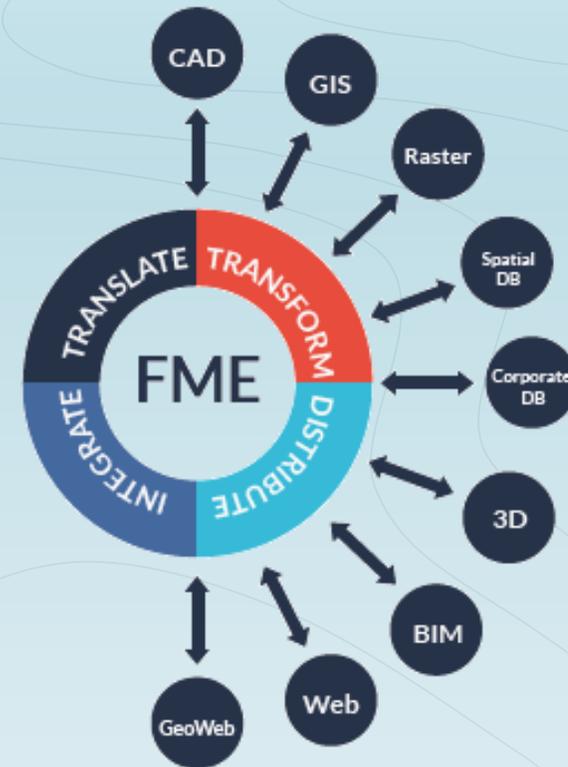
ESRI Data Interoperability Tools

- Used with Spatial ETL Tool
 - User-created geoprocessing tools that transform data between different data models and different file formats
- Using the Create Translation Workspace Wizard, which assists in building the specialized tools
 - There are also third party vendors that create this FME Workbench for use both as a plug in (still must have the ESRI Extension) to ArcMap or to run as a stand alone program, they also add further functionality



Data Types

- Over 300 spatial and non-spatial data formats including:
 - Autodesk AutoCAD Civil 3D (DWF / DWG)
 - LiDar (Point Cloud)
 - Bentley Microstation Design
 - ESRI Shape
 - Raster
 - GeoTIFF
 - MapInfo TAB
 - Oracle Spatial
 - XML/GML/KML/Web





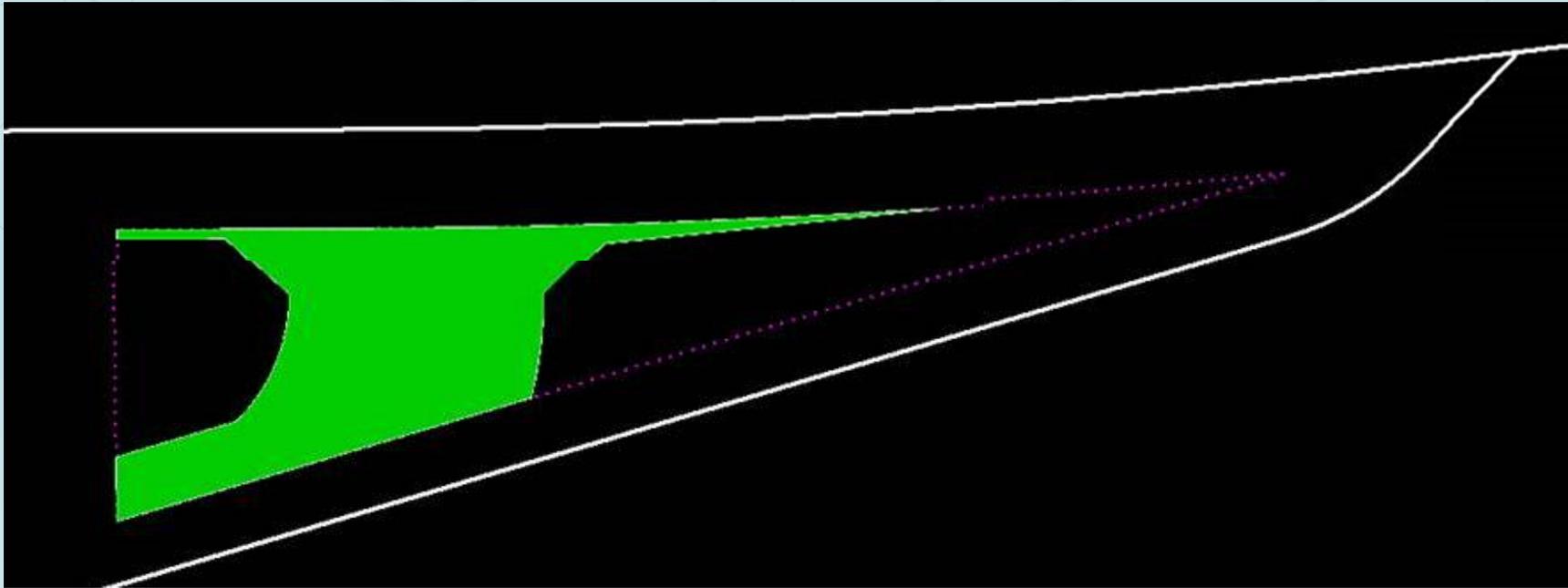
Bentley Map

BETA TESTING

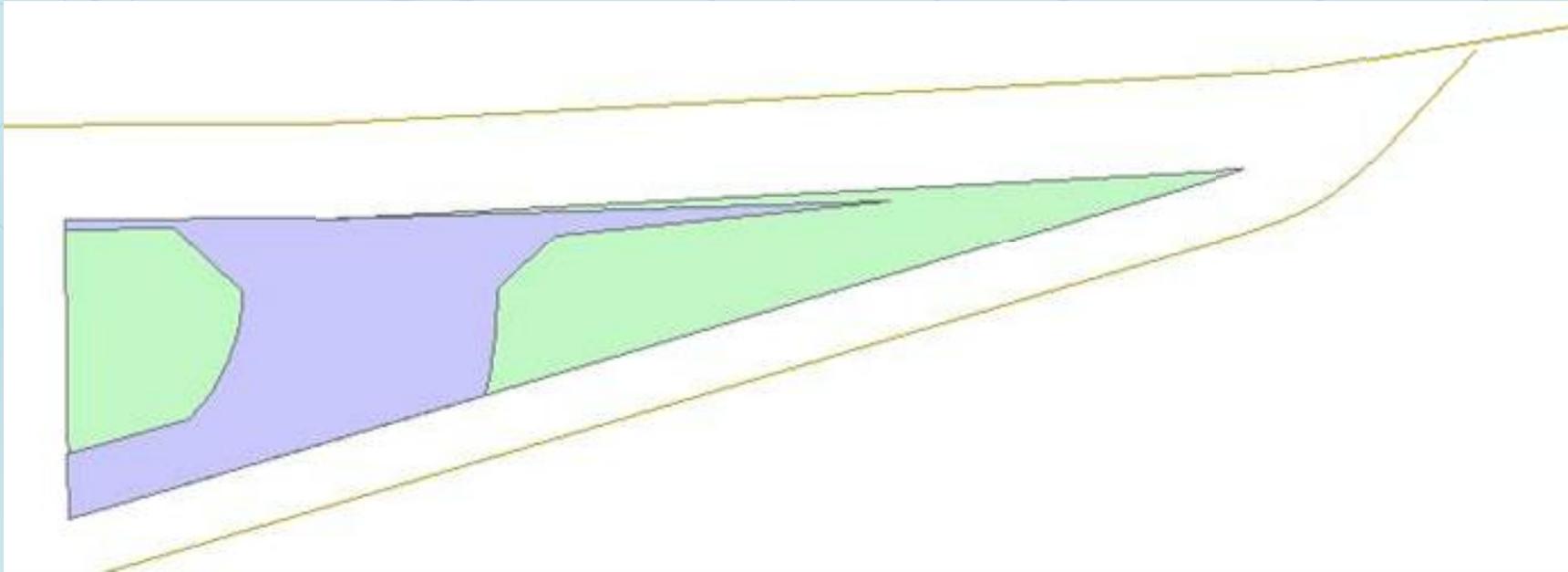
August 2015

Transportation Data Symposium

Curve Problem



Curve Problem



Curve Problem: Bentley

- Regarding the curves in GIS. This has been an issue for years and is one of the fundamental differences between CAD and GIS.
- When exporting into a shape file (SHP) curves are not supported, however with the latest version of Bentley map you can export directly to a file geodatabase where curves are supported

Curve Solution

- Modify the FDOT SS4 Workspace
 - Add a variable to the end of the GIS.txt
- Default value is 0.0 = no stroking = Curve Problem
- A value of 1 will produce stroking but not enough to produce a curve in GIS
- Lowering the variable means that the stroking would increase but also increases file size
- Currently not worried about the files size
- So variable is set to 0.1 (No more Curve Problem)

ECSDK_GEOMETRY_STROKING_TOLERANCE=0.1

Missing Data/Null Values

Table

Parcel

District	County	FPID	RD_Num	Type	Take Type	ROWType	DateOfAcqu	FDOT_Parce	FederalAid	Section	Township	Range	ApparentAc	AccessRD	AppraisedV	Geometry_A	Geometry_P
1	Hardee	123	SR 636	Parent			5/21/2014								0	46048.829516	1427.683361
1	Hardee	123	SR 636	Take	Right of Way	Fee Simple	5/21/2014	0100		3	34S	26E	Public Road	SR 64	100000	21321.771343	1227.434062

1 (0 out of 2 Selected)

Parcel New Parcel Old

Annotations above columns: String, String, String, String, String, String, String, Dateticks, String, String, String, String, String, String, String, Integer, From Micro Station

Table

Parcel New

District	County	FPID	RD_Num	Type	Take Type	ROWType	DateOfAcqu	FDOT_Parce	FederalAid	Section	Township	Range	ApparentAc	AccessRD	AppraisedV	Geometry_A	Geometry_P
1	Hardee	123	SR 636	Parent			<Null>	0							0	0	0
1	Hardee	123	SR 636	Take	Right of Way	Fee Simple	<Null>	0		3	34S	26E		SR 64	0	0	0

0 (0 out of 2 Selected)

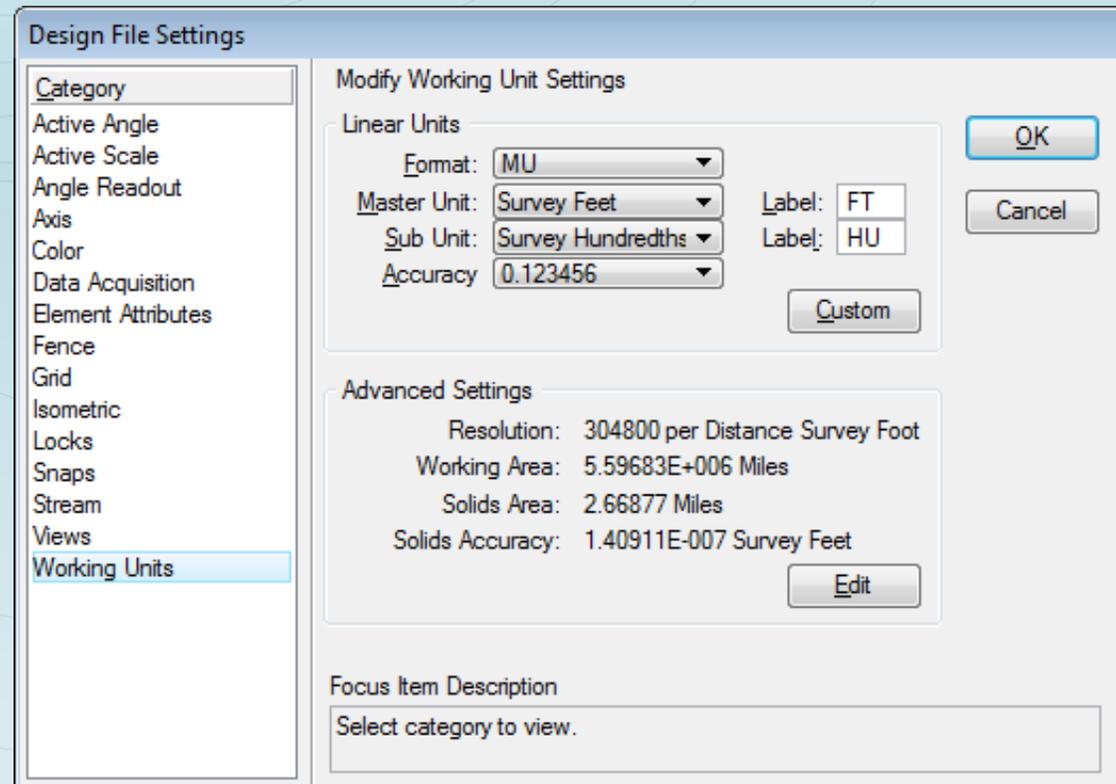
Parcel New Parcel Old

Annotations: Missing/Null Data (pointing to DateOfAcqu and FDOT_Parce), Double (pointing to FDOT_Parce)

Whenever new releases occur keep an eye out for problems!

Working Units

- ArcMap is unitless until you set a projection, all state plane projections in Florida are in survey feet. The programs know the difference and automatically do the calculations so it is important that the units are set correctly.



The screenshot shows the 'Design File Settings' dialog box with the 'Working Units' category selected. The 'Modify Working Unit Settings' section is active, displaying the following configuration:

- Linear Units:**
 - Format: MU
 - Master Unit: Survey Feet
 - Sub Unit: Survey Hundredths
 - Accuracy: 0.123456
- Advanced Settings:**
 - Resolution: 304800 per Distance Survey Foot
 - Working Area: 5.59683E+006 Miles
 - Solids Area: 2.66877 Miles
 - Solids Accuracy: 1.40911E-007 Survey Feet

Buttons for 'OK', 'Cancel', 'Custom', and 'Edit' are visible. The 'Focus Item Description' field at the bottom contains the text 'Select category to view.'

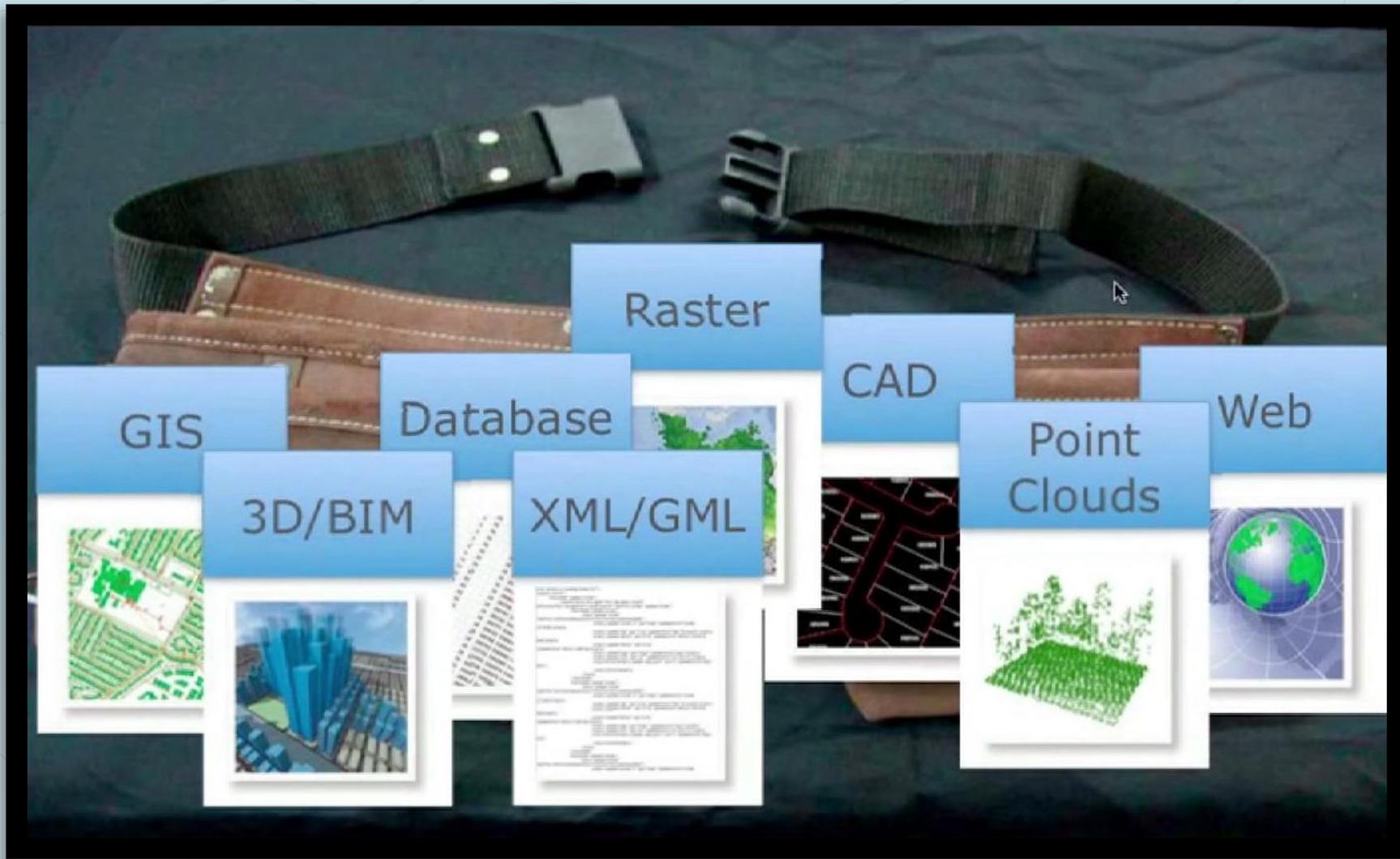
Summary

● Process/Workflow

- Developed a process/workflow allowing both CADD and GIS environments to interchange/share data

● So that the information can become:

- A one stop shop for public records requests, and
- Allow for better collaborative decision making tools with stakeholders,
 - whether through technical (data only in the form of tables or queries) or having a GIS/Thematic look (for display)



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- For more information and a detailed step-by-step How To document see:

www.dot.state.fl.us/surveyingandmapping/Inno-CADGIS.shtm

Questions:



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