

CES226152

Leveraging GIS Data for your Civil 3D and Infraworks Projects from ESRI Data Sources

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The purpose of this handout is to provide some pre-presentation background information serving as a prerequisite to the presentation as well as a good reference after the presentation.

Learning Objectives

- Learn/ Review traditional import export and data connection methods for both Civil 3D and Infraworks using tools like FDO and ArcGIS for AutoCAD
- Learn Display and Stylization methodologies in Infraworks and Civil 3D with connected ERI data sources
- Understand what the ArcGIS Data Connector is in Infraworks and using it for a new model and an existing model in the Civil BIM + GIS Design Model environment
- Understand the workflows associated with the accessibility to ArcGIS Online in Infraworks and Civil 3D and workflows associated with that connection in the Civil BIM model in Civil 3D using ArcGIS for AutoCAD

Description

Many times, project participants have large amounts of GIS data that they need to leverage in their projects or need to create deliverables in GIS format along the way in the project lifecycle. With The new ESRI Autodesk Partnership and the melding of the BIM and GIS realm gives rise to new software development to allow fluid interoperability between the two worlds.

This class is a 60 minute fast paced demonstration that uses real life project data and scenarios to allow the participant to understand the why and how to fully leverage GIS data into the Civil BIM model particularly when both Civil 3D and Infraworks are being used and the integration of spatial intelligence and 3D design model information is necessary.

This class will review and demonstrate workflows, tips tricks and traps involved with using ESRI data sources in particular some of the new breakthrough methods and tools as a result of the ESRI Autodesk partnership. The tools on the ESRI side that bring the Autodesk BIM model to ArcGIS and related products will also be discussed. The Demos take you from the most traditional import routines all the way to the current state of BIM + GIS and development being done to help bring that to reality

Speaker

CHUCK PIETRA – is the Senior Technical Applications Manager at O'Brien & Gere (OBG) Engineers in Syracuse NY, where he currently resides. At his current position at O'Brien & Gere, he manages the companies 5-member Technical Software Applications Group responsible for implementation support and training in areas such as BIM, GIS, AEC CAD, and Environmental Modeling & Data Management tools for the entire company.

Chuck has been directly and indirectly involved in the Autodesk reseller and consulting channel for over 28 years, and has held many Autodesk certifications. Chuck is an author of several books and articles related to Autodesk products. He is currently an adjunct instructor at Univ of Virginia Transportation Academy and owned his own Autodesk/ ESRI consulting firm in Central NY, Micro CAD Managers, for 17 years.

Chuck does frequent speaking engagements nationally at events such as AU (7 times). Chuck holds an MS in Physics from the State University of New York, plays drums and enjoys hobbies that include Marine Aquariums and Astronomy.

Importance of Documented SOP, Workflow, Communication, and a Lead

With the formal (on paper) coming together of BIM and GIS the need and urgency arises more than ever for project workflow, standards, SOPs, and formal related leadership from project kickoff.

The project workflows involved with AutoCAD Civil 3D represents a long legacy of design tools that output construction documentation and production sheets to match deliverables required by governments and contractors to realize a design through to its final delivery. Civil 3D through Map 3D functionality has several tools that help with data interoperability that can be used throughout the project lifecycle.

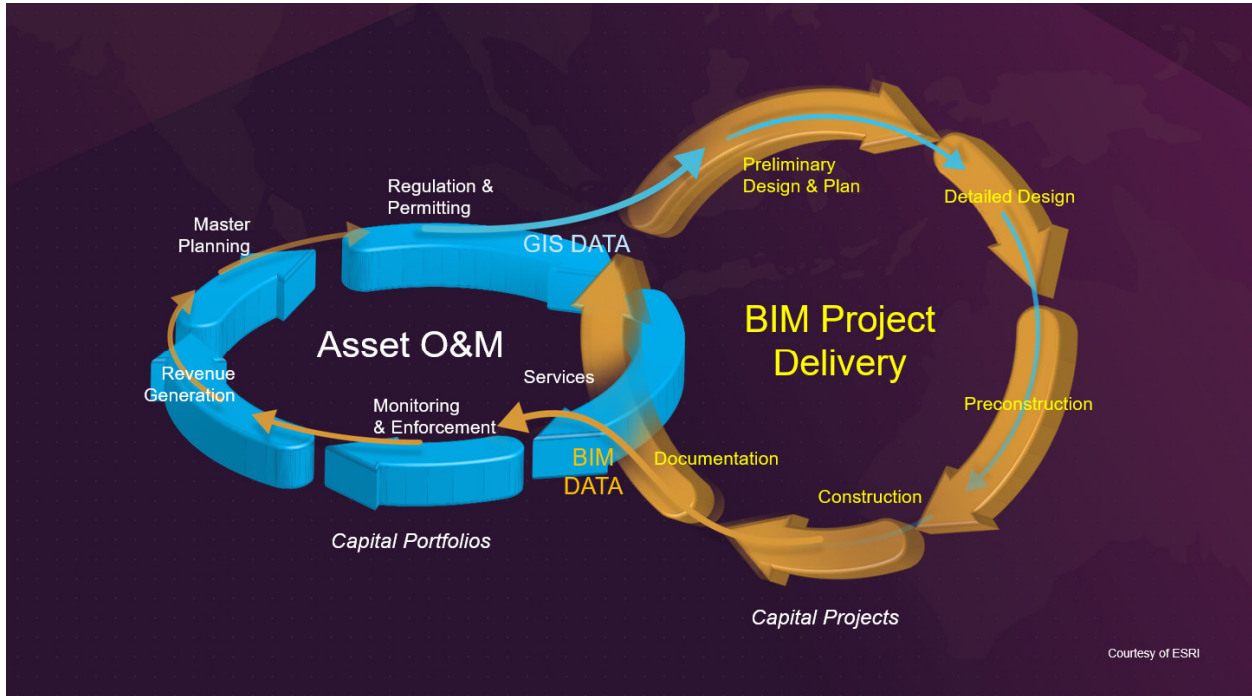
InfraWorks has introduced a wholly 3D workflow that meshes well with the requirements of preliminary design to understand site constraints; work through scenarios that weigh design options against performance and cost; and convey the resulting design to owners, stakeholders and the public. The critical role of GIS in this proposal, discovery, zero to 30 percent phase of the project cannot be over emphasized. Traditionally the data silos and the groups that create and manage them have been separated on many fronts.

With infrastructure projects of the future involved with challenges such as Smart Cities for example the GIS + BIM synergy is a critical paradigm. Separating the workflow of preliminary and detailed design is a natural break in the overall engineering design process. Conceptual and preliminary design phases often are precursors to winning the overall design work. Because it doesn't always result in work won, the less time it requires, the fewer resources are wasted if you don't win the work. As a result, GIS data coming from the Silo into products such as Autodesk InfraWorks early on and at the tail end into ArcGIS namely the Manage Phase is critical for success.

The GIS Factor

Traditionally over the past two and a half decades GIS was considered rightly so as a source of valuable data that was many times created and managed in a completely different separated silo that the Engineer Designer had access to only indirectly. Or, worse yet the GIS data is within the mix of the rest of the project data in the form of files that are not managed in any way except for consistent file names and project folders. BIM 360 and ArcGIS Server, if used properly, will relieve this pain considerably. Workflows are becoming more and more complex and old legacy data and workflow cannot be discarded since many projects have multiple lifecycles that may span over many many years.

The BIM CAD GIS Lead Manager on projects must always be aware and proactive as project data is resurrected to give birth to new projects. Workflows and tools used in the past may have to be shoehorned in to new workflows with new tools in CAD/GIS platforms to get the project off to a good start.



The Melding of BIM and GIS

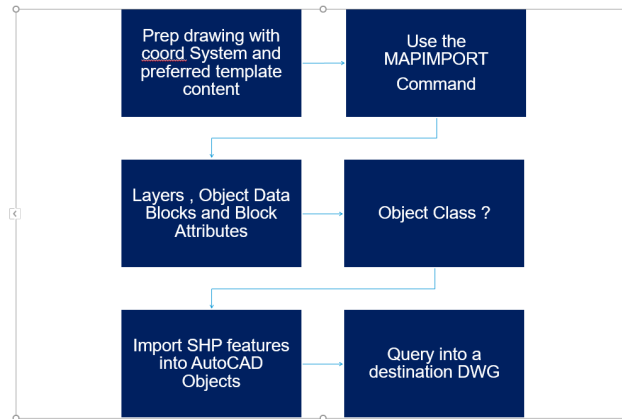
A peek into future as it is today in 2018 points to a synergy and interoperability that means that old tools methodologies as well as brand new will have to be used with a confidence that all project participants are following the same workflow. Without that consistency the wheels fall off no matter how modern sophisticated or old tried and true the tools used.

Traditional Methods of leveraging GIS within CAD

Import Data

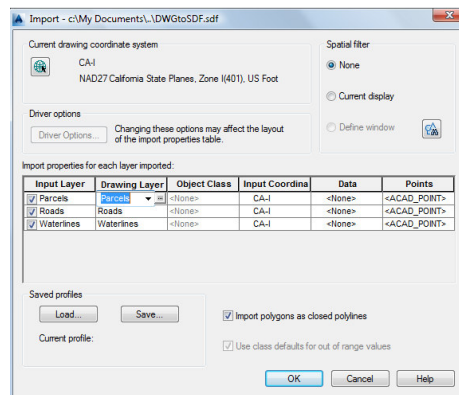
In Civil 3D data from many formats such as shp, can be imported into dwg creating AutoCAD objects(Plines, Points, MPolys, closed Plines. Importing breaks the connection to the source and adds a “snapshot” of the data to your map. Importing will map the feature attributes (in the case of shp import) to AutoCAD Object Data Tables If the data changes after that, you will not see any changes in your map unless you import the data again. There is no way to update imported data in its source. Similarly, when you export data, you export the current data only. The connection to the live data source is lost. The Object data that is created is tough to do the simplest things with (labeling for example). This is considered primitive by modern standards but when combined with CivilMap3D’s ability to query objects from source dwgs it gives a good shot in the arm to the traditional GIS Import.

Importing ESRI SHP files into C3D - Workflow



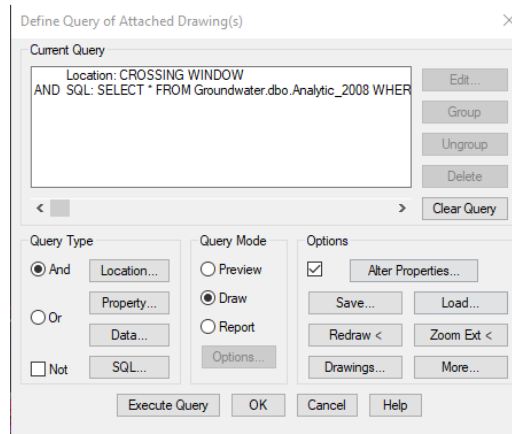
Importing GIS data into Civil 3D with Data Query to Enhance

The user can import the data from a variety of formats, leverage the attribute data, control the symbiology and spatial restrict what area to bring the data into. The CAD objects created are basic AutoCAD objects (acad points, plines, blocks) with Object data mapped representing the schema of the attribute table of the source file (e.g. shp).



When you import data, you can to a certain degree structure it in your drawing. You can assign data to layers or object classes. Add attribute data to object data tables. Assign a coordinate system. Specify that points come in as points, text, or blocks. It works and is used extensively and it sometimes can box you into a corner of confusion in your data management for the project.

Query Drawings where Data has been Imported to

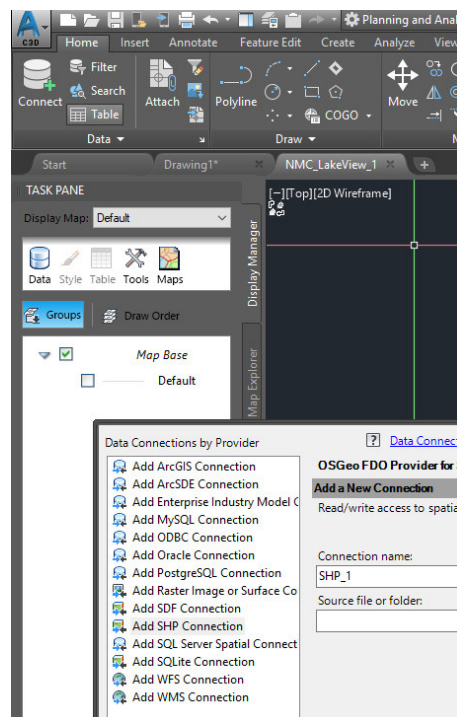


Civil Map 3D provides a very powerful tool that allows you to query AutoCAD drawing Objects from a source drawing into a destination drawing. This is a huge boost in you being able to leverage the data that was imported and doing much more with it to make it much more useful.

Connecting to GIS Data through Feature Data Objects

Attaching GIS Data in AutoCAD Civil 3D

Map 3D enables users to not only import from a wide array of data formats but allows connection to data in their original sources and save changes in the native format or convert the data to DWG format, breaking any connection to the original source. With the connection Map Features are created in your drawing. The ability to Style far exceeds what you can do with mere AutoCAD Layer color line type etc. You can check out edit and check in updating the source file.



Assuming the coordinate system is set (as it should be for import) The tool for connecting to files and services is *Connect* located on the Home tab of the ribbon menu on the Planning and Analysis workspace. Alternatively, the icon tool *Data* may be accessed from the top of the TASK PANE.

Data Connect

Following are some of the methods you can use to insert GIS data in to your CAD file.

Add File based or personal Geodatabase connection

Using the FDO Connect to ArcGIS you can connect to an ArcGIS file or personal Geodatabase. It is important that in the 2018 and 2019 release of AutoCAD Map Civil 3D you have an active license of ArcGIS Desktop or ArcMap on the same computer.

Add ArcSDE Connection

If you use SQL Server or Oracle you can use either Windows or ArcSDE authentication.

- Select the feature classes to include in your map.
- Style, theme, and edit the features.
- Bring in a static copy of ArcSDE data as drawing objects.

Add Raster Image or Surface Connection

Connecting to raster data as opposed to inserting the image has advantages:

- Faster Performance
- When panning and zooming only the image in current view regens
- Raster formats supported: .DEM, .JPG, .JPG2, .ECW, .SID, .TIF, .PNG
- Raster enablers are not needed to connect to ECW or SID files

Add SDF Connection (Spatial Data File)

A *Spatial Data File* (SDF) is a native Autodesk file-based geospatial format that is optimized for storing large, classified data sets. The SDF format is like the SHP format in that it contains both spatial data and attribute data. However, it accomplishes this in a single file rather than a set of files.

The SDF file has certain advantages to the SHP in the following ways:

- It stores and manages an order of magnitude more data than DWG
- It is very fast, allowing Autodesk applications, such as AutoCAD Map 3D and Map Server, to read and display tens of thousands of features per second.
- It provides the power of a database without the overhead and cost of a full relational database management system (RDBMS) such as SQL Server or Oracle.
- An SDF file can store a single feature class, or it can store multiple feature classes.
- It is easy to manage, providing access to the database schema.

Add SHP Connection (Shape Files)

A *Shape File* (SHP) is a digital vector storage format for storing geometric location and associated attribute information. The SHP format was introduced with ArcView GIS version 2 in the beginning of the 1990s. It is now possible to read and write SHP using a variety of free and non-free programs. With MAP 3D you can either insert a SHP into your drawing or create a database connection.

Select the feature classes to include in your map.

- Style, theme, and edit the features.
- Lock the file when you connect to it.

An individual SHP is actually a collection of files as described above that must be moved or distributed as a group otherwise the SHP can be rendered unusable.

- .SHP – Shape format (file that stores the feature geometry)
- .SHX – Shape Index format (file that stores the index of the feature geometry)
- .DBF – dBASE file that stores the attribute information of features
- .PRJ – File that stores the coordinate system
- .SBN and .SBX - files that store the spatial index of the features (optional)
- .FBN and .FBX - files that store the spatial index of the features for SHP that are read-only (optional)
- .AIN and .AIH - files that store the attribute index of the active fields in a table or a theme's attribute table (optional) ***Add WFS Data (Web Feature Service - web-based vector features service)*** Select the feature classes to include in your map.

MAP3D TASK PANE

The TASK PANE in the Planning and Analysis workspace serves a similar purpose to the TOOLSPACE in the AutoCAD Civil 3D workspace. From here the user has the ability to modify or Style the various components and control the order of display, moving certain features in front or behind other features.

The TASK PANE has a group of icons at the top used to edit and modify the GIS data in addition to four tabs.

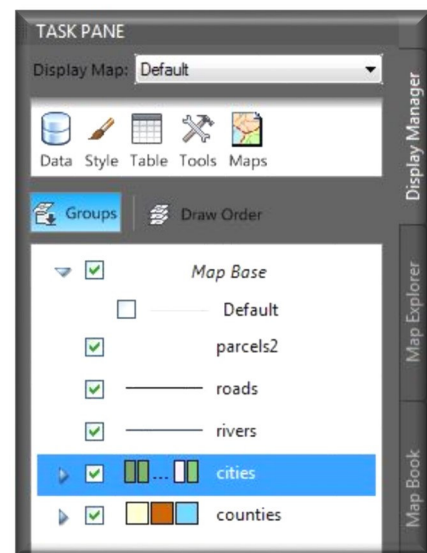
- Display Manager – Manage Features stored in data stores, attach drawing files and change the appearance of features. Each feature is a layer and drawing layers can be added as well.
- Map Explorer – View the elements of your Map Project. Such elements include files connected to as sources, queries used and saved and templates for linking drawing objects to data.
- Map Book – Divide a large map into “tiles”. Each tile is rendered on a separate page. Publish in various formats for printing and online display

- Survey – Bring in and work with Survey Point Data

Styling

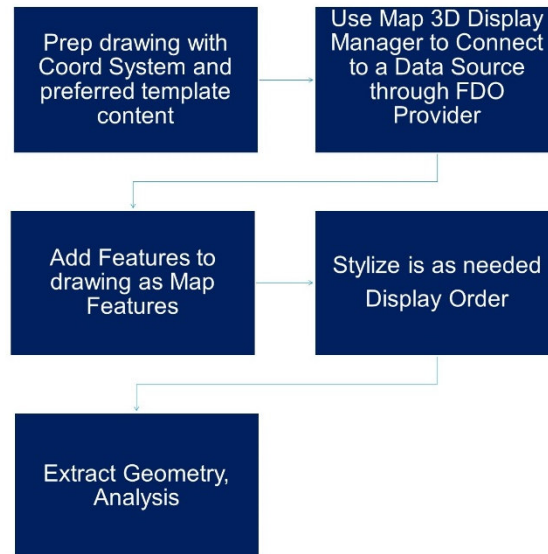
From the Display Manager Tab the user has control of the display order of the items by moving them up or down the list to move the items from front to back (top to the front and bottom to the back) of the CAD drawing.

To modify the color or line type of the attached GIS data, highlight the item to be modified in the list and select the *Style* icon near the top of the TASK PANE. The Style Editor window will open giving you access to all of the modification and label tools. From here colors, line weights and styles, transparency and labels can be set for each of the GIS data items.



Connecting to ESRI SHP files

Workflow

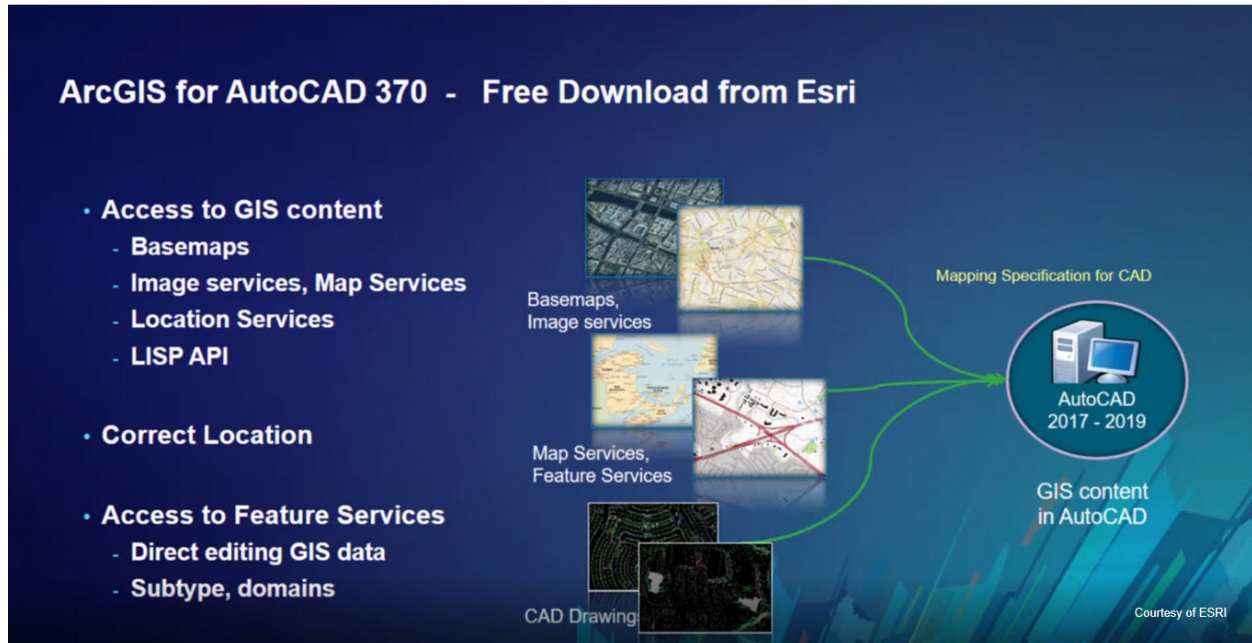


The Table below (courtesy of *A Practical Guide to AutoCAD Map 3D 2018, Catapult*) is a comparison of Shp import and Shp Connect through FDO

Shp Import vs FDO Connect to Shp

Objects	Features
Objects are opened and loaded into memory when a drawing is opened.	Features are accessed as a Data Source connection, and are cached.
Objects reside on AutoCAD layers.	Features are assigned to a feature layer, based on a feature class.
Object attribute data resides as block attributes, Object Data, or external database links.	Attribute data is integrated into the feature source.
Drawings with objects have a practical ceiling of performance when working with a large number of objects.	Feature sources have a level of performance that is several factors higher than that of objects.
Objects	Features
When working with multiple drawings, they are managed as attached source drawings.	Multiple data stores are connected to a drawing.
After you finish editing drawing objects, you save the drawing.	When editing features, you check them out of the data store, and when the editing is complete, you check the features back into the data store.

What is ArcGIS for AutoCAD 370



ArcGIS for AutoCAD is a free add on to AutoCAD, Map3D and Civil 3D that allows for access to ESRI Base Maps on line, ArcGIS Online Data sources, and much more. Objects created upon connection are basic AutoCAD Objects as is the case with MAPIMPORT with some major differences. ArcGIS for AutoCAD can also help prep an AutoCAD dwg by setting up feature classes so that when the dwg is consumed in ArcGIS Pro or Desktop the dwg is much more GIS friendly. ArcGIS for AutoCAD is a very useful tool in the grand scheme of things but like anything else needs to be formally introduced into the workflow and documented as far as SOP's related to its use or there will be more harm than good as a result.

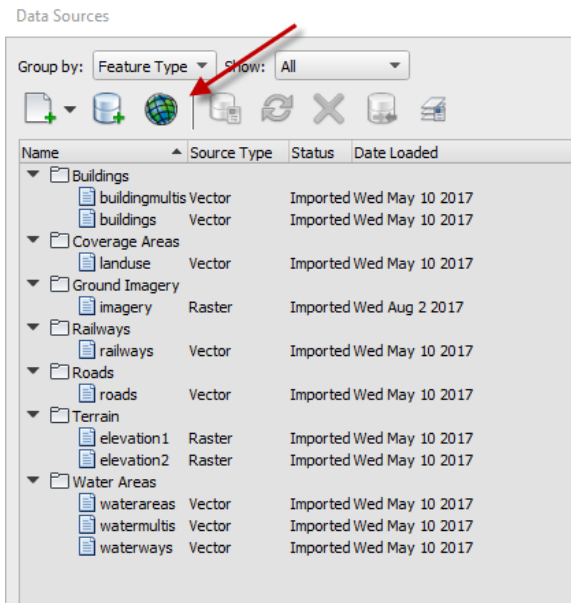
What is The ArcGIS Connector for Infraworks?

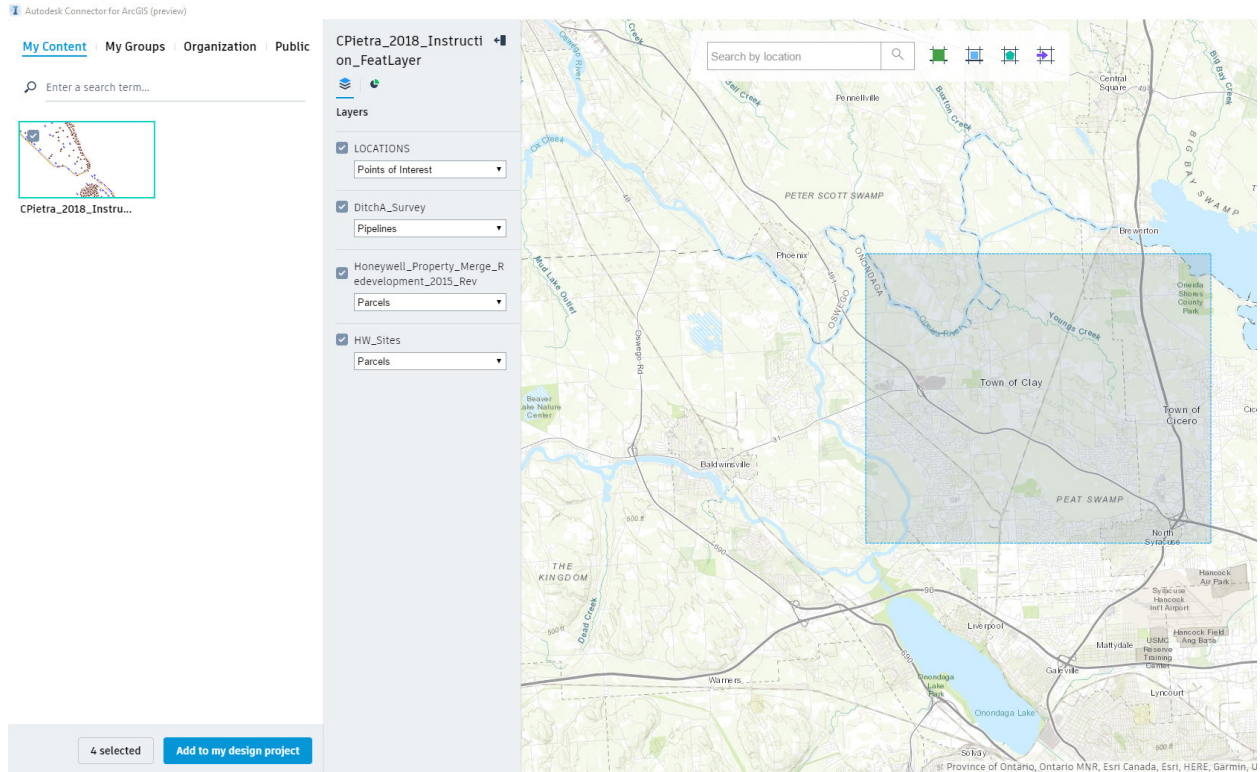
What the ArcGIS Connector Brings to the Table

There have been many features, add ons, products and related over the years to help bridge the gap, allow for fluid sharing, translate, import, connect, GIS data to CAD and back. Many are in still in use today and are mixed with new SOP's and methodologies that bring the holy grail of the BIM Design Wheel and the GIS Manage and Operate Wheel to be melded together.

The ArcGIS Connector premiering in Autodesk Infraworks is the newest tool that allows for an effortless gateway to ArcGIS On Line for the Infraworks user. Since Infraworks is used in the early on stages of the project life cycle and so is GIS this provides a way for the fast pace

Infraworks user to quickly consume managed GIS data with confidence. Connectors such as these will provide exactly what the Dr. ordered as they mature.





The ArcGIS connector in Infracore brings you out to ArcGIS On Line and connect to feature sources and import selected data that you need in you Infracore project. It's a one-way street right now but since the Infracore project can be in BIM 360 and the data you are consuming is potentially from ArcGIS Enterprise you are working with data from a cloud source that is managed, authenticated, reliable, single source, multiuser, web enabled, and readily accessible from anywhere.

Lets go in the other direction

In the AU presentation associated with this document a workflow will be demonstrated whereas the user starts with an Infracore project and much of the preliminary data was obtained from a combination of model builder and the ArcGIS Connector. A preliminary drainage system is laid out in the proposed parking lot. The Infracore model is then brought in its entirety into Civil 3D. The drainage network comes in as a viable Civil 3D Gravity Pipe Network. The Civil 3D objects are then exported to and Autodesk SDF file. SDF is akin to a geodatabase version of a dwg where Civil 3D objects are welcome. This SDF is connected through FDO and then Bulk copied to create shp files of the Civil 3D objects where the Civil 3D object properties are mapped to the shp's feature attribute table. The shp file is then used in ArcGIS Pro. All the geometry and intelligence of the original sketched out drainage network is all there in tact at the endpoint in ArcGIS Pro.