

# The Public Works Toolkit

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[presented at the Washington URISA conference on May 6, 2009, with Dusty Gallinger, The PPI Group]

## KEY CONCEPTS

- CASE = Computer Aided Science and Engineering
- CAD = Computer Aided Dispatch, like E911
- CADD = Computer Aided Design and Drawing
- Data In...Data out
- Engineering project data should enrich the enterprise GIS
- Last mile of IT process automation
- Autocad is a database engine, plus it “draws” lines, arcs and text
- The .DWG format is a database
- Civil 3D is Autocad + Map 3D + Civil Engineering
- There are 3,141 counties and equivalents in the US
- BIM = building is a verb

My remarks today will touch on two topics:

- the legacy engineering data most Counties in Washington should have and how that data might be mined from the archive to GIS
- a day-forward process, workflow and toolkit to enable repurposing contemporary engineering data for other County uses

All of the Counties in Washington have Public Works Departments, and all of those workgroups do engineering and science to design roads and bridges, produce right of way plans, do H&H analysis, design flood mitigation structures, and so on. Those workgroups use ESRI and Autodesk software to support their lines of business, as well as mandated oversight and compliance. Most Washington State County engineering workgroups have used Autodesk civil engineering products for a couple decades and have a data archive of all of their road, bridge and surface water management projects.

The problem is, it isn't generally known that the data we produce for civil engineering construction plans aren't just plot files to drive a printer, but are actually rich datasets of survey grade vector geometry, and objects that can be densely attributed with location, materials, maintenance and other data. We don't yet have a well-understood roadmap for identifying which data subsets should be captured and

## The Public Works Toolkit

processed for inclusion into an enterprise GIS for the benefit of Facilities Management, Law and Justice, Emergency Management and Continuity, and so on.

For example, most people I've talked to in our shop to agree that our Surface Water Management Division could make good use of centimeter grade data from our engineering workflow-based project data store extracted and pushed into GIS format ("using this data would save us hundreds, if not thousands of hours of field survey time"). This could include the engineering project archive (back to 1988) and day forward SWM, road and bridge projects. In our SWM shop, ESRI and Autodesk GIS tools are available on 19 machines and many of the operators are cross-trained with both product lines. I have proposed to work with SWM to develop a project that would cover these phases and is focused on a kind of first order reuse of road project data:

- Pilot
  - Identify a couple of data types embedded in DWG format that would be useful to SWM in a GIS format (wetland delineation, catch basin and culvert locations, for example)
  - Identify the useful-to-GIS attributes that must be captured and transformed
  - Identify the method/workflow
  - Identify the projection
  - Identify a couple of likely as-built projects for data mining
  - Identify the minimum skill set needed by the project operator
  - A few run-throughs with Autodesk staff cross-trained on ESRI products should give us an idea of how much time it would cost to mine this data out of a given project
- we can then project this unit cost against the projects that are "valuable" to SWM to get a ballpark project cost, and compare that to the cost to obtain and integrate those data in the traditional way, using field crews.
- The next phase would be to go into production with existing staff, or a temp, or an intern...someone skilled with Autodesk tools and who can make judgements about the data and adherence to standards

If the pilot leads to production, some of this process could be automated, and PW could also leverage this data mining process for Asset and Maintenance Management Systems with spin-offs for Continuity and Emergency Management, an executive dashboard, facilities management, GASB compliance, NPDES, and so on, and we can offer to work with other Departments to exploit the data in ways that are useful to them. Further items to work through would be where to store and how to manage those data, what QA/QC process would be used to maintain a high confidence level in the data, how to integrate

## The Public Works Toolkit

that data into the enterprise GIS. Will Agencies choose to mine their engineering archive? The answer is “yes” if it is cost effective...however, these additional costs will be driven by:

- the lack of adherence to technical CADD standards, which can be mitigated by batch standards checking tools that are now available
- lack of CADD discipline and poor QA/QC practices
- the often poorly documented displacement of project data away from State Plane
- whether or not the data are “as-built”
- the sparseness of the data—most data in the archive will not have attributes, other than layer, color and vector geometry information
- how easily the 19<sup>th</sup> Century workflow can be brought into the 21<sup>st</sup> Century in a given shop.

Shops which have produced construction documents with discipline and with forethought and follow-through may well have included additional attribute information on materials, elevations, maintenance, and so on...my guess is that this is rare, however.

On a day-forward basis, the PW Toolkit is a set of tools that will make it easy to:

- identify the kinds of data Snohomish County PW produces for ACP projects that are desirable to push into GIS
- pre-position the object and feature classes for the data transform to GIS format
- make the data set transforms to GIS projection and format

The PW Toolkit is preceded by **industry toolkits** written for Autodesk by Dusty Gallinger, a PPI Group staffer, which were released to Civil 3D subscribers in 2008:

- Water
- Waste Water
- Electrical Utility

Snohomish County and The PPI Group are developing a Public Works Toolkit which will have applicability for:

- State of Washington Public Works Departments
- Other County Public Works Departments
- The Washington County Road Administration Board
- DOTs
- Consultants
- Developers

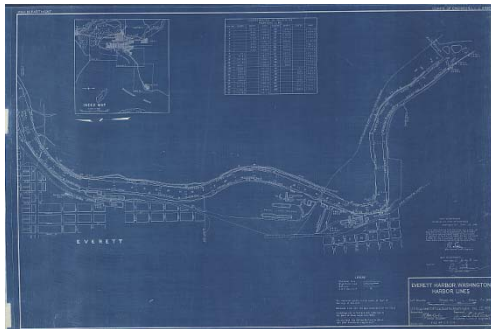
## The Public Works Toolkit

to leverage existing and as-constructed project features that are of interest to consumers of data outside the usual Survey, Design and Construction Management groups in a PW agency. The timeline is something like this:

- Assemble a team of Autodesk and ESRI specialists in SnoCo PW to develop a scope and define deliverables...the first attempt will use only about 10 data types to keep the effort manageable
- Provide Dusty the DWG and GIS data models
- Develop a prototype—first light was at the WAURISA conference on May 6— and review, and update
- Present the amended prototype as a beta to the local engineering and science community for feedback
- Incorporate the feedback into the prototype and produce a release candidate
- Test the heck out of the package and documentation
- Release to the wild

But wait, a bit of history...

[Show Construction Plan]—this is a 19<sup>th</sup> Century deliverable, updated with 20<sup>th</sup> century reproduction technology...all of us have heard of blueprints—some of us have actually produced blueprints, in the old days...did you know that the blueprint process may have been invented in [1725](#), and is essentially the [cyanotype](#) process developed by the British astronomer and photographer Sir [John Herschel](#) in 1842.



Everett Harbor 1939

These data are certified correct by the responsible engineers, surveyors and architects, by affixing wet stamps and wet signatures...all very 19<sup>th</sup> century. These data are not reusable, unless a human being extracts every data point, transforms and enriches the data, and repurposes it for a new audience. Right now, the originals of these pages are manually amended, literally with hand drafting, with as-built information to qualify them as record documents, certified, and go into a tub, probably never to see the light of day again, unless they are pulled during the discovery phase for litigation. It costs my County about \$80,000 per year to produce the paper to support the construction plan component of our Annual Construction Program. It costs my agency about \$5,000,000 a year to pay for the salaries to produce our construction plans, plus whatever \$millions we pay our engineering consultants to produce deliverables for projects for which we don't have in-house resources. We put about 20 projects per year out to ad, and we have between 100-200 projects in the project pipeline at any given time—we produce a lot of data. Those data have a significant value, and right now those data go into a tub and languish.

# The Public Works Toolkit

Isn't it about time PW agencies produced deliverables in 21<sup>st</sup> century formats, with all the data intelligence, data access and reusability we can squeeze into them—let's repurpose some of those data to help achieve business goals every Washington State PW agency must satisfy outside of their Annual Construction Programs. All of the technology is available to create and maintain data in a digital lifecycle, publish and fulfill the construction documents electronically and sign and seal the data digitally.

It's amazing to me after all these years that it isn't generally understood that the data we produce for civil engineering construction plans aren't just plot files to drive a printer, but are actually rich datasets of survey grade vector geometry, and objects that can be densely attributed with location, materials, maintenance and other data.

We don't yet have a well-understood roadmap for identifying which data subsets should be captured and processed for inclusion into an enterprise GIS for the benefit of:

- Facilities Management
- Law and Justice
- Emergency Management
- Continuity
- Road Maintenance
- NPDES
- GASB

But as we build out the Toolkit those needs will reveal themselves.

Again, there are already 3 industry toolkits available which take advantage of Autodesk's Map 3D product capabilities, and consist of a drawing template—a DWT file— an object definition file in XML format and documentation, which includes AVI-based tutorials and PDFs.

Map 3D understands the following data formats:

- DWG™
- Arc/Info® coverages
- SHP and E00 from ESRI
- MapInfo MIF/MID™
- MapInfo TAB
- MicroStation® DGN (V7 and V8)
- Generalized Markup Language (GML 3.1.1)
- Ordnance Survey MasterMap (DNF) (GML2, read-only)
- Vector Product Format (VPF, read-only)
- ASCII
- LandXML
- SDF

# The Public Works Toolkit

- Spatial Data Transfer Standard (SDTS, read-only)

Here are some of the features of Autodesk Map 3D exploited by the PW Toolkit:

Analysis Tools

Surfaces and 3D Visualization

Database Integration

Create and Edit Metadata

Extensibility via Open Source

There are some specific areas that have taken careful treatment during this toolkit development process:

- Data transformation
  - DWG features and objects to SHPs—a lowest common denominator
- Projection—our survey shop has consistently published base maps and project data in a project datum, which basis has changed from time to time; our current practice is to add 10,000 10,000 to our X,Y coordinates; our surveyors have developed the concept of the “combined grid factor” which is location-specific and the application of which allows project data to be shifted back to State Plane as needed with high confidence—Autodesk provides tools to aid in these projection shifts
- And then we are currently undergoing a shift from an earlier datum, 83/91 HARN to 83/2007 CORS—Metadata is critical to managing any large collection of data, and it is something we typically don’t do at this time for engineering data created with Autodesk products for project fulfillment; some types of metadata to consider:
  - theme
  - data set name
  - data quality information
  - format
  - scale/resolution
  - UPI# (we are now actually using a unique project identifier for our project data)
  - State Plane projection
  - Vertical datum
  - Current as of:

# The Public Works Toolkit

Autodesk provides metadata creation tools to help with our publishing and maintaining metadata in several industry-standard formats

Clearly, the enterprise GIS would benefit from these data and an internal workflow could pave the way for electronic submissions to our Planning and Development Services. Many agencies now accept or require electronic submissions for review and permitting, and a few require specific data in SHP or other GIS formats to enrich their enterprise GIS.

I think the biggest issues boil down to typical data management workflows and issues like:

- What data do we want to pull from a construction project
- What do we want to see in the tables
- Metadata
- QA/QC
- Who owns the data
- How best to integrate the data with PW GIS
- How best to integrate the data with SnoCo GIS

DEMO...

Dusty Gallinger is here to show us the beta version of the PW Toolkit. He is a PPI Group staffer, and he was hired by Autodesk to write and develop the first 3 Industry Toolkits based on Autodesk specifications, and which Autodesk provided to subscribers in 2008. He developed the Public Works Toolkit based on our need to provide engineering data to our business GIS, and eventually, presumably, our enterprise GIS. Dusty built this kit with Snohomish County engineering data and GIS data models. It's our intent to have a public event soon to preview the tool and get feedback from the local private sector and agency users, refine the tool and integrate it into our project close-out workflow.