Managing and Sharing 3D Models for Construction

May 7, 2014

1:00 pm – 2:30 pm EST

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U.S. Department of Transportation
Federal Highway Administration

Pre-webinar Poll 1

What data could/would/should you release pre-bid?

- Corridor models in proprietary format
- LandXML alignments, profiles, control points, surfaces, surface features, cross-sections
- 3D plan graphics
- 2D plan graphics
- Storm sewer models
- Bridge models
- Survey metadata
- Vector PDF
- Raster PDF
- Paper

Pre-webinar Poll 2

How do you deliver files to contractors?

- Secure, managed common data environment
- With other bid documents for secure, managed download
- Managed FTP site
- Unmanaged FTP site
- Physical media (USB, DVD)
- Email
- Other
- No data shared with contractors

Welcome and Introductions

Douglas Townes, P.E.
FHWA Resource Center

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U.S. Department of Transportation
Federal Highway Administration

Audience Demographics Poll

What type of organization do you represent?

- DOT Construction Division
- DOT Design Division
- DOT Survey Division
- DOT Other Division
- Local Authority
- FHWA Division Office
- FHWA Other Office
- Other Federal Agency
- Contractor
- Consultant
- Vendor
- Industry Representative

3D Engineered Models Webinar Series

Webinar 1: Overview of 3D Models for Construction
Webinar 2: Creating 3D Engineered Models
Webinar 3: Applications of 3D Models in the Contractor's Office
Webinar 4: Applications of 3D Models on the Construction Site
Webinar 5: Managing and Sharing 3D Models for Construction
Webinar 6: Overcoming Challenges to Using 3D Models for Construction
Webinar 7: Implementing 3D Engineered Models for Construction
Webinar 8: Adding Time, Cost and other Information to 3D Models

Recordings of Previous Webinars

http://www.fhwa.dot.gov/construction/3d/webinars.cfm

Social Media

Tweet along on Twitter:

#EDC2 @USDOTFHWA

Today's Speakers

Speaker	Topic
Douglas Townes (FHWA-RC)	Welcome, Introductions and Safety Message
Brian Smith, PE (Iowa DOT)	File Delivery to Support Automated Machine Guidance at Iowa DOT
Paul Wheeler, PE (Utah DOT)	Signing & Sealing Digital Documents
Bruce Flora, RLS (Flora Surveying)	Best Practices for Supporting Estimating, Construction Layout and Automation
Francesca Maier (Parsons Brinckerhoff)	Moderated Question & Answer Session
Douglas Townes (FHWA-RC)	Information on Next Webinar and Close

File Delivery to Support Automated Machine Guidance at Iowa DOT

Brian Smith, PE

Iowa Department of Transportation

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Learning Objectives

- Discuss which files in the Design Model are delivered, and why
- Describe the purpose and need for standardization and documentation of the delivered model
- Discuss effective ways for transmitting models

Topics Covered

- Data needed for construction in neutral file formats
- Data available to evaluate means & methods
- Data for validating exchanged models
- How files are delivered
- Contract Language/disclaimers for releasing files

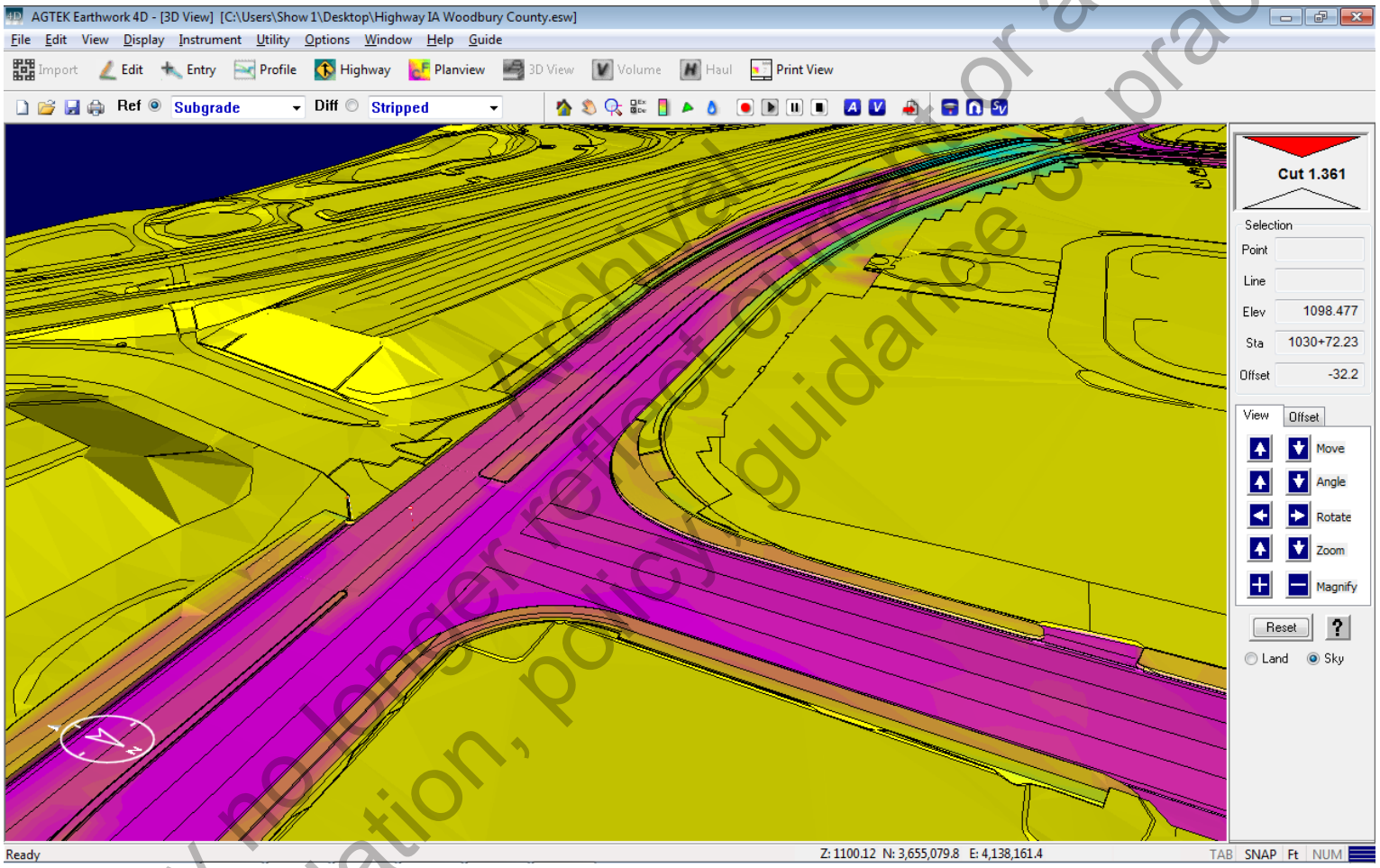
Topics Covered

- Need for Standardization
- Elements that are Standardized
  - Naming conventions
  - Data structure
  - Template Library
- Describing 3D models for designers and contractors in CADD/Design Manual

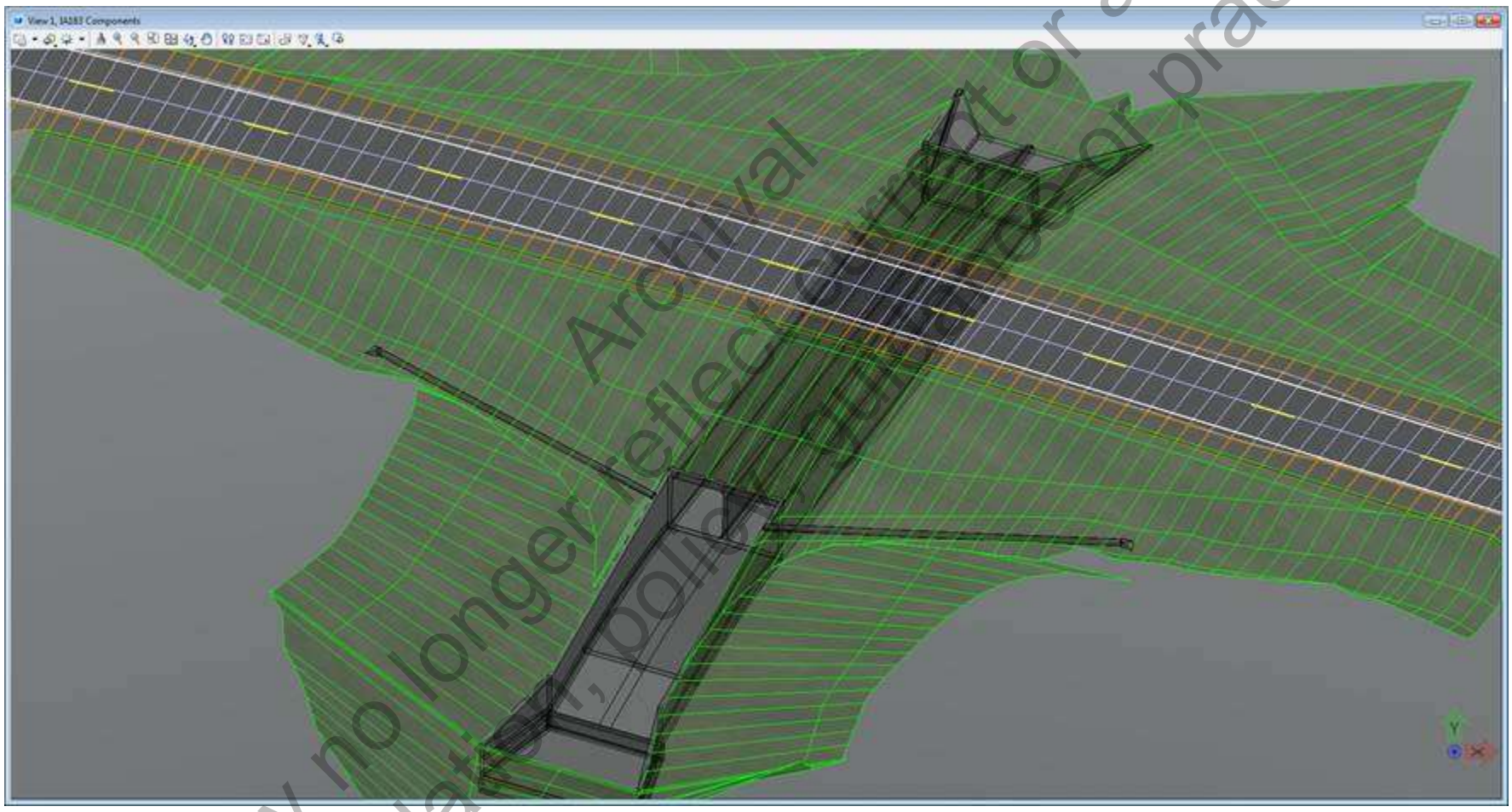
Data Needed

- Horizontal and vertical alignments
- Digital terrain model of Existing Ground
- Digital terrain model of proposed design
- 3D break line CADD file
- Project documentation file

Data Needed: Existing Surface



Data Needed: Design



Data Needed: 3D Breaklines

Poll 1: Design Model Documentation

How is your design model documented?

- Agency CADD Manual
- Office CADD Manual
- Other standard documentation
- No standard

Data Needed: Documentation

Iowa Department of Transportation
Office of Design
Project Data Summary

Iowa Department of Transportation

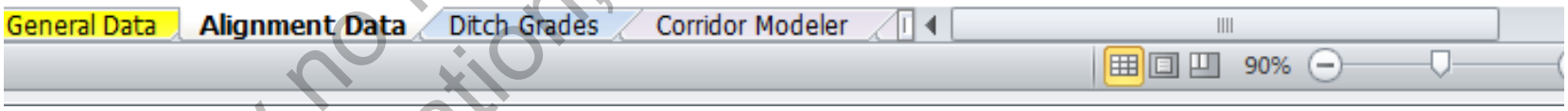
Refer to Chapter 20 of the Design Manual for information on standard naming conventions: http://www.iowadot.gov/design/dmanual/manual.html

Revised Date:

Project Information	
County:	Lucas
PIN:	09-59-014-010
Project Number:	BRF-014-2(34)--38-59
Project Location:	Bridge over English Creek 1.5 Miles North of Co. Rd. S-45
Project Description:	RCB Culvert New - Triple Box.
Design Engineer:	Flattery
Design Team:	Flattery\Luong
Design File Information	
Design File name:	59014034.dsn
Linework Model:	ML_0050_IA_14
Proposed DTM:	
Design Criteria:	
Plansheet PDFs	38-0142-034.pdf
Survey File Information	
Aerial Photography filename:	59014034.sur
Survey file name:	
TIN file name:	59014034.tin
Raster file name:	
Structure file name:	59014034.str
GEOPAK Information	
GPK File:	job014.gpk
Operator Code:	r3
Project Manager File:	
COGO Input Folder:	
COGO Output Folder:	
Location of this File:	

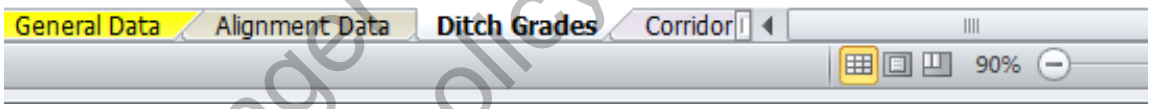
Data Needed: Documentation

Horizontal and Vertical Alignments							
Roadway	Survey Chain	Construction Chain	Point Range	Beginning Station	End Station	Existing Ground Profile	Construction Profile
Mainline							
IA 14	ML014		10 CUR1 CUR2 15	453+04.71	532+47.90	ML014_E	
Side Roads							
Ramps/ Loops							
Returns							
Miscellaneous							
English Creek Channel		CHANNEL	9010 - 9014	1+00.00	4+73.79	CHANNEL_E	CHANNEL_P



Data Needed: Documentation

Ditch Grades			
Roadway	Profile Name	Beginning Station	End Station
Mainline			
IA 14 Left	DGL500	500+00	502+10
	DGL502	502+45	505+00
	DGR500	500+00	502+00
	DGR502	502+35	505+00
Side Roads			
Ramps/ Loops			
Miscellaneous			



Data Needed: Documentation

Corridor Modeler

Project Files

	Folder / Filename	Description
Working Directory	W:\Projects\5901401009\Design	
Plan Graphics Design File	59014034CM_2DLinework.dsn	
Template Drops Visualization Fil		
Preference File	59014034.rdp	
Template Library	59014034ClosedComponent.itl	
Road Designer File	59014034.ird	
DTM - Base Existing Ground	59014034.dtm	
DTM - Proposed		

Plan Graphics Documentation

Name	Drafting Standard	Type	Purpose	Model	Created by
~~HingeLt~~	~~dsnCmLtDitches~~	~~Symbology~~	~~Left Barnroof Hinge~~	~~Project Overview~~	
~~HingeRt~~	~~dsnCmLtDitches~~	~~Symbology~~	~~Right Barnroof Hinge~~	~~Project Overview~~	
ML014_R_EX_EOP	dsn3DExistingPvmtTop	Symbology	Right Existing Edge of Pavement	Project Overview	kcb
ML014_L_EX_EOP	dsn3DExistingPvmtTop	Symbology	Left Existing Edge of Pavement	Project Overview	kcb
ML014_L_Hinge	dsn3DBackSlopeBreakLine	Symbology	Left Barnroof Hinge	Project Overview	kcb
ML014_R_Hinge	dsn3DBackSlopeBreakLine	Symbology	Right Barnroof Hinge	Project Overview	kcb
CHANNEL_L_CHNL_DB	dsn3DForeSlopeBreakLine	Symbology	ft Channel Bottom	Project Overview	kcb
CHANNEL_R_CHNL_DB	dsn3DForeSlopeBreakLine	Symbology	Right Channel Bottom	Project Overview	kcb
FILL_R_TIE	dsn3DBackSlopeBreakLine	Symbology	Right Fill Tie	Project Overview	kcb
Fill_L_TIE	dsn3DBackSlopeBreakLine	Symbology	Left Fill Tie	Project Overview	kcb
CHANNEL_ABUT_L	Level 1	Symbology	Channel Left Bridge Abutment	Project Overview	kcb
CHANNEL_ABUT_R	Level 1	Symbology	Channel Right Bridge Abutment	Project Overview	kcb

Validating Exchanged Models

- Alignments, horizontal and vertical can be loaded into the surface
- Paper plans and typicals can be used
- Cross sections may be cut and compared
- Load the 3D breaklines with the surface

Delivering Files

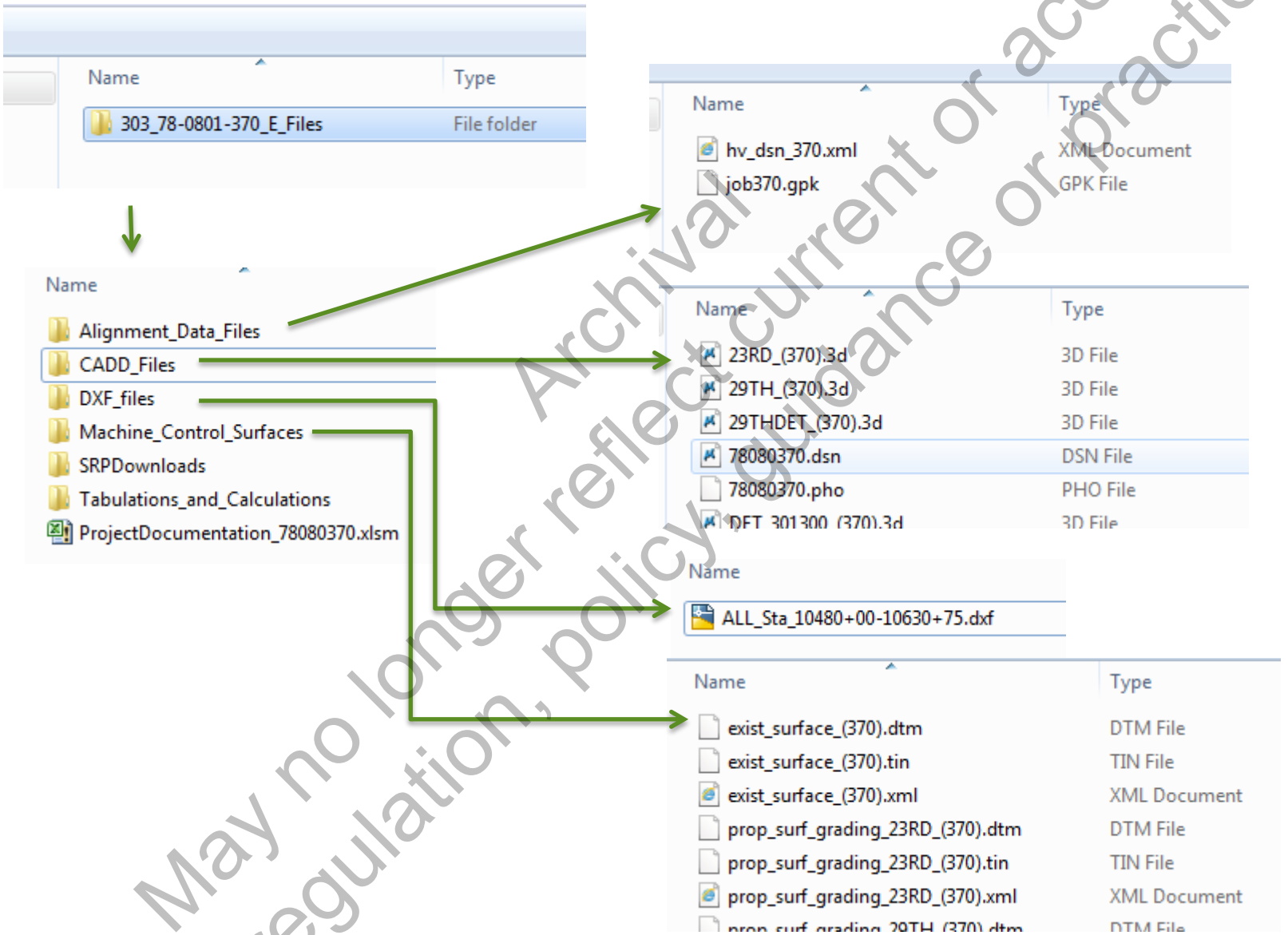
http://www.iowadot.gov/contracts/lettings.html

Call group	Bid order range	Call group	Bid order range
Structures	001 - 080	Traffic safety	351 - 400
Alternate pavement types	081 - 100	Buildings and building sites	401 - 450
PCC pavement	101 - 150	Miscellaneous	451 - 500
HMA – pavement / resurfacing	151 - 200	Erosion control	501 - 600
Surface rehabilitation	201 - 300	Bridge painting	601 - 650
Grading	301 - 350	Small business contracts	981 - 999

Show 10 entries Search:

Bid order	Proposal ID	County	Project number	Download
212	00-0002-744	STATEWIDE	MP-000-2(744)0--76-00	DOWNLOAD .ZIP FILE
213	00-0002-745	STATEWIDE	MP-000-2(745)0--76-00	DOWNLOAD .ZIP FILE
301	20-0692-020	CLARKE	ER-069-2(20)--28-20	DOWNLOAD .ZIP FILE
302	27-C027-054	DECATUR	ER-C027(54)--58-27	DOWNLOAD .ZIP FILE
303	78-0801-370	POTTAWATTAMIE	IMN-029-3(140)54--0E-78 IM-NHS-080-1(370)4--03-78	DOWNLOAD .ZIP FILE DOWNLOAD E-FILES

Delivering Files



Contract Language

- Files for information only contractor uses at their own risk
- http://www.iowadot.gov/erl/current/GS/content/1105.htm
  - 1105.04B
  - 1105.17

Contract Language

1105.04 CONFORMITY WITH AND COORDINATION OF THE CONTRACT DOCUMENTS.

A. In case of a discrepancy between contents of the contract documents, the following items listed by descending order shall prevail:

1. Addendum
2. Proposal Form
3. Special Provision
4. Plans
5. Standard Bridge Plans, Standard Culvert Plans, and Standard Road Plans
6. Developmental Specifications
7. Supplemental Specifications
8. General Supplemental Specifications
9. Standard Specifications
10. Materials I.M.

B. Electronic support files, if available, will be provided prior to letting and are for information only. Should there be a discrepancy between an electronic support file and a contract document, the contract document shall govern.

C. Should there be a discrepancy between figures and drawings on any of the contract documents, the figures shall govern unless they are obviously incorrect.

D. The Contractor shall not take advantage of any apparent error, omission, or discrepancy in the contract documents. The Engineer will be permitted to make such correction in interpretation as may be deemed necessary for the fulfillment of the intent of the contract documents subject to compensation as provided in Articles 1109.03, 1109.04 and 1109.16. Written notice of changes in the contract documents will be given to the Contractor by the Engineer.

E. All work performed and all materials furnished shall be in reasonably close conformity with the lines, grades, cross sections, dimensions, and material requirements, including tolerances, shown in the contract documents.

F. If the Engineer finds the material or the finished product in which the material is used is not within reasonably close conformity with the contract documents but that reasonably acceptable work has been produced, the Engineer will then make a determination if the work shall be accepted and remain in place. In this event, the Engineer will document the basis of acceptance by contract modification which will provide for an appropriate adjustment in the contract price for such work or materials as is necessary to conform to the determination based on engineering judgment.

Poll 2: Design Model Standardization

How is your design model format standardized?

- Software format
- File structure
- File naming convention
- Template library and resource files
- Object naming convention
- Level structure and CADD graphics
- PDF presentation only
- No standard

Need for Standardization

- Standardization is needed to deliver a consistent repeatable product
- It also simplifies creating a process for generating the generic deliverable files
- The customer needs to receive the deliverable in a consistent format to make them efficient
- Holds designers to measurable standard

Need for Standardization

- Delivering something with documentation is way better than nothing

Need for Standardization

- Standard Template Libraries and training
- Drop spacing
- Naming Conventions
- Folder Structure
- Example files to show the level of detail
- Quality assurance of standards

Electronic File Description

http://www.iowadot.gov/design/dmanual/20B-71.pdf

Iowa Department of Transportation
Office of Design

20B-71

Electronic Files Supplied by the Office of Design

Design Manual
Chapter 20
Project Automation Information
Originally Issued: 03-23-11
Revised: 05-08-13

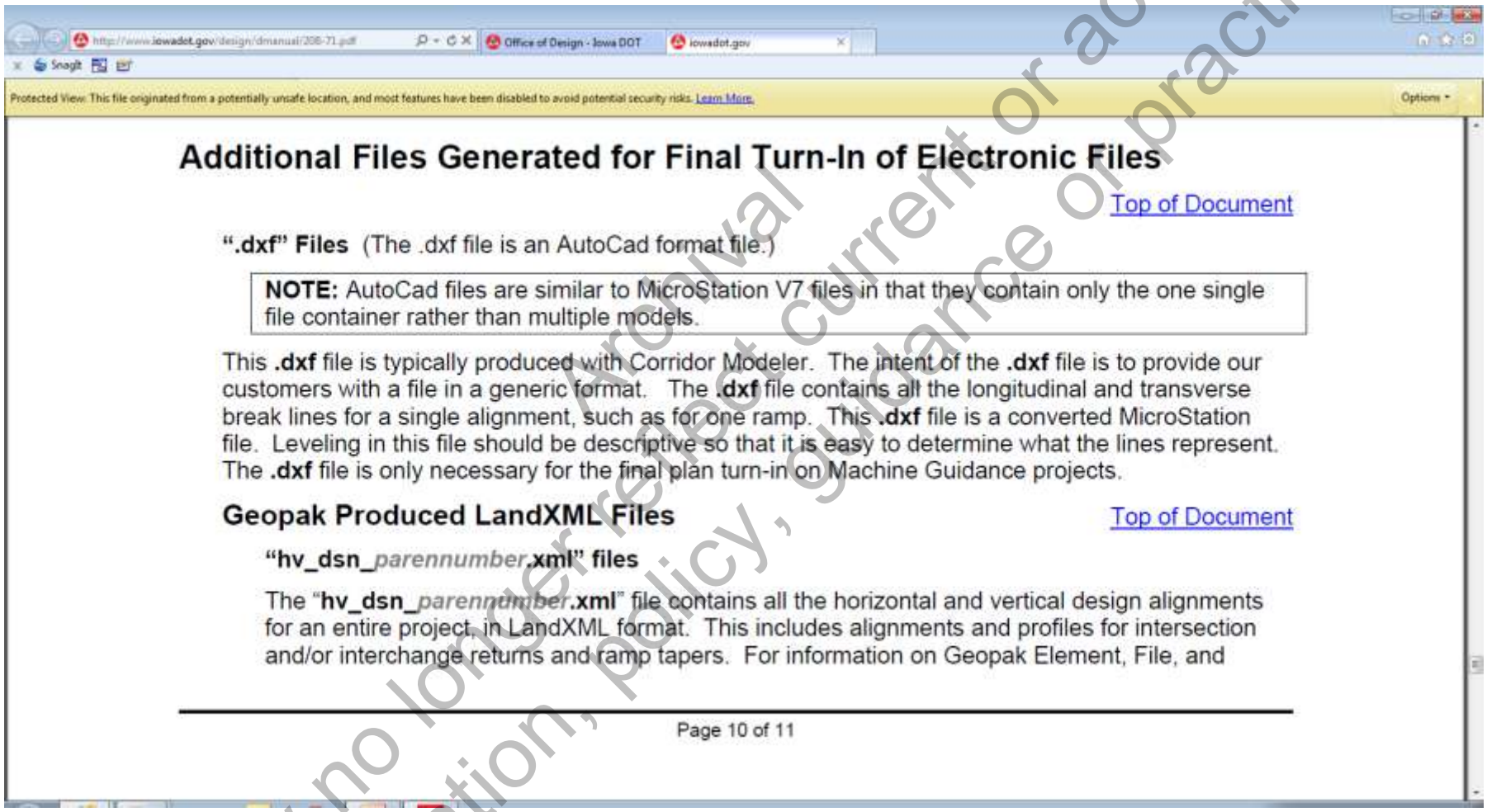
Overview

This section provides details of the origin and organization of the files generated during the design process, either from within or outside of the Office of Design. All files listed that the designer has available must be included in the submission of electronic files, unless specifically noted otherwise.

The following topics are included:

- Project Documentation—Project Data Summary

Electronic File Description



Office of Design - Iowa DOT | iowadot.gov

Protected View: This file originated from a potentially unsafe location, and most features have been disabled to avoid potential security risks. Learn More.

Additional Files Generated for Final Turn-In of Electronic Files

Top of Document

".dxf" Files (The .dxf file is an AutoCad format file.)

> **NOTE:** AutoCad files are similar to MicroStation V7 files in that they contain only the one single file container rather than multiple models.

This **.dxf** file is typically produced with Corridor Modeler. The intent of the **.dxf** file is to provide our customers with a file in a generic format. The **.dxf** file contains all the longitudinal and transverse break lines for a single alignment, such as for one ramp. This **.dxf** file is a converted MicroStation file. Leveling in this file should be descriptive so that it is easy to determine what the lines represent. The **.dxf** file is only necessary for the final plan turn-in on Machine Guidance projects.

Geopak Produced LandXML Files

Top of Document

"hv_dsn_*parennumber*.xml" files

The "**hv_dsn_*parennumber*.xml**" file contains all the horizontal and vertical design alignments for an entire project in LandXML format. This includes alignments and profiles for intersection and/or interchange returns and ramp tapers. For information on Geopak Element, File, and

Minimum File Requirement

Files Required for Final Turn-In of Electronic Files

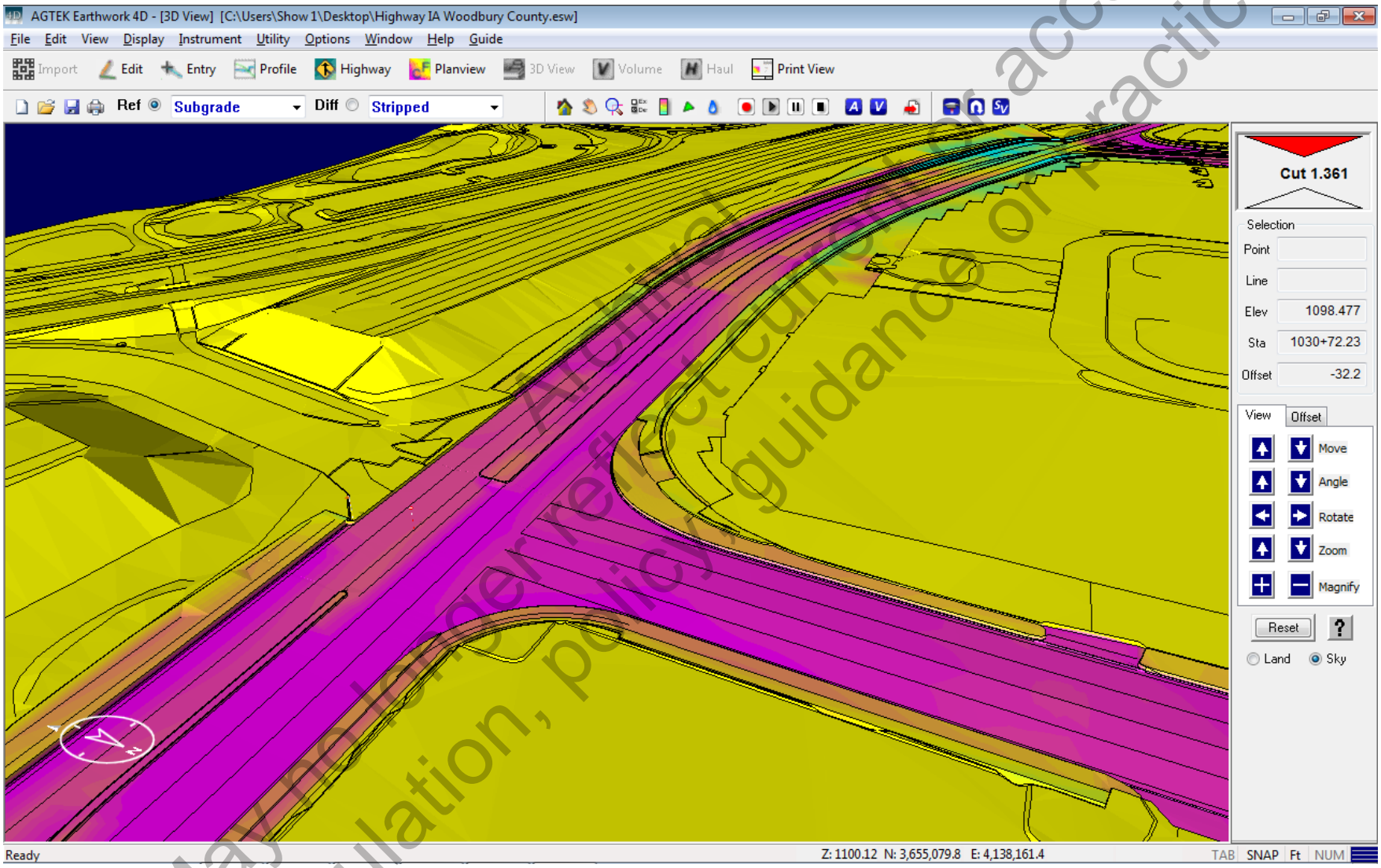
Top of Document

If the files listed below are available, they shall be submitted to the Office of Contracts for Final Turn-in.

- Project Documentation file shall always be included.
- Alignment Data Files shall be included if there is any geometry.
  - XML file for all alignments when alignments have been developed for the project
  - XML file for Survey control points
  - Native GEOPAK ".gpk" file for all alignments when alignments have been developed for the project
- CADD files
  - All MicroStation Files containing plan views and/or profiles that are available shall be included (".dsn". & ".geo")
  - All Microstation support files referenced to the "**.dsn**" file shall be included.
  - All Microstation Cross sections Files for all alignments provided shall be included.
- Machine Control Surfaces, shall be provided for all projects developed for automated machine control guidance.
  - XML files of automated machine guidance surfaces
  - Autodesk ".**dxf**" files containing three dimensional break lines
  - Native GEOPAK format Surfaces (**.tin** & **.dtm**)
- PDFs
  - VanDike reports
- Tabulations & Calculations, all tabulation files that have been created for a project shall be included (C, CS, G, J, M, and S).

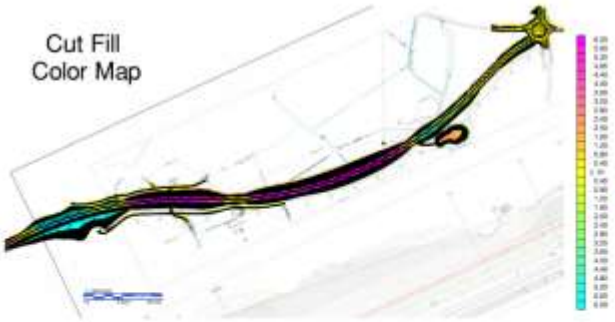
Note: Any file noted as a Microstation file that does not have the *.**dgn** file extension is a Microstation DGN file that has had its extension changed to differentiate between the office that created the file.

Contractor Software



Contractor Software

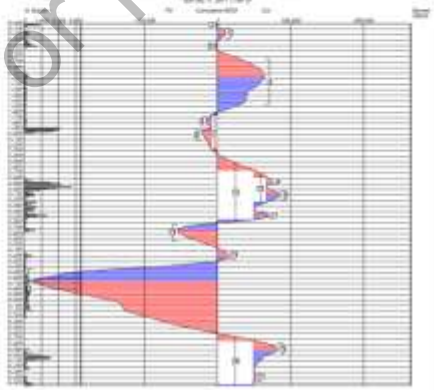
Cut Fill
Color Map



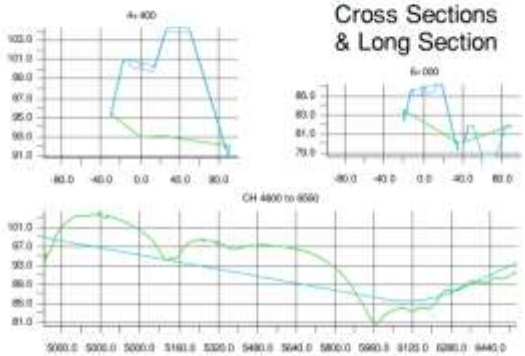
3D View North End
looking South

Volumes

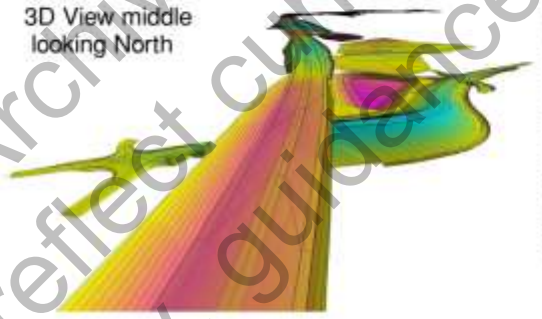
Mass Diagram



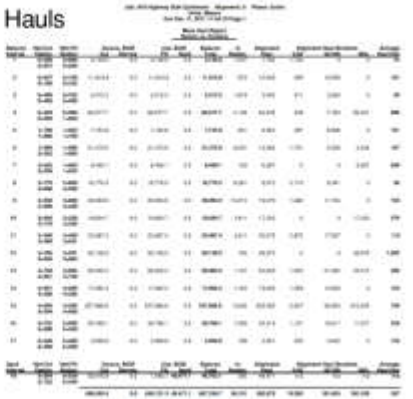
Cross Sections
& Long Section



3D View middle
looking North

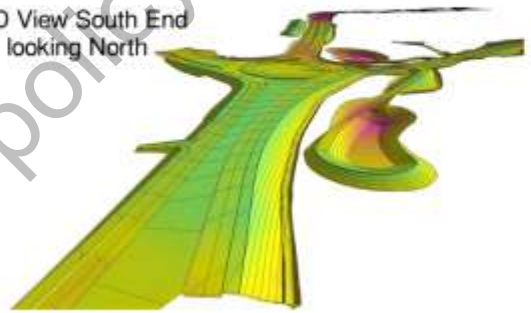


Hauls



Location

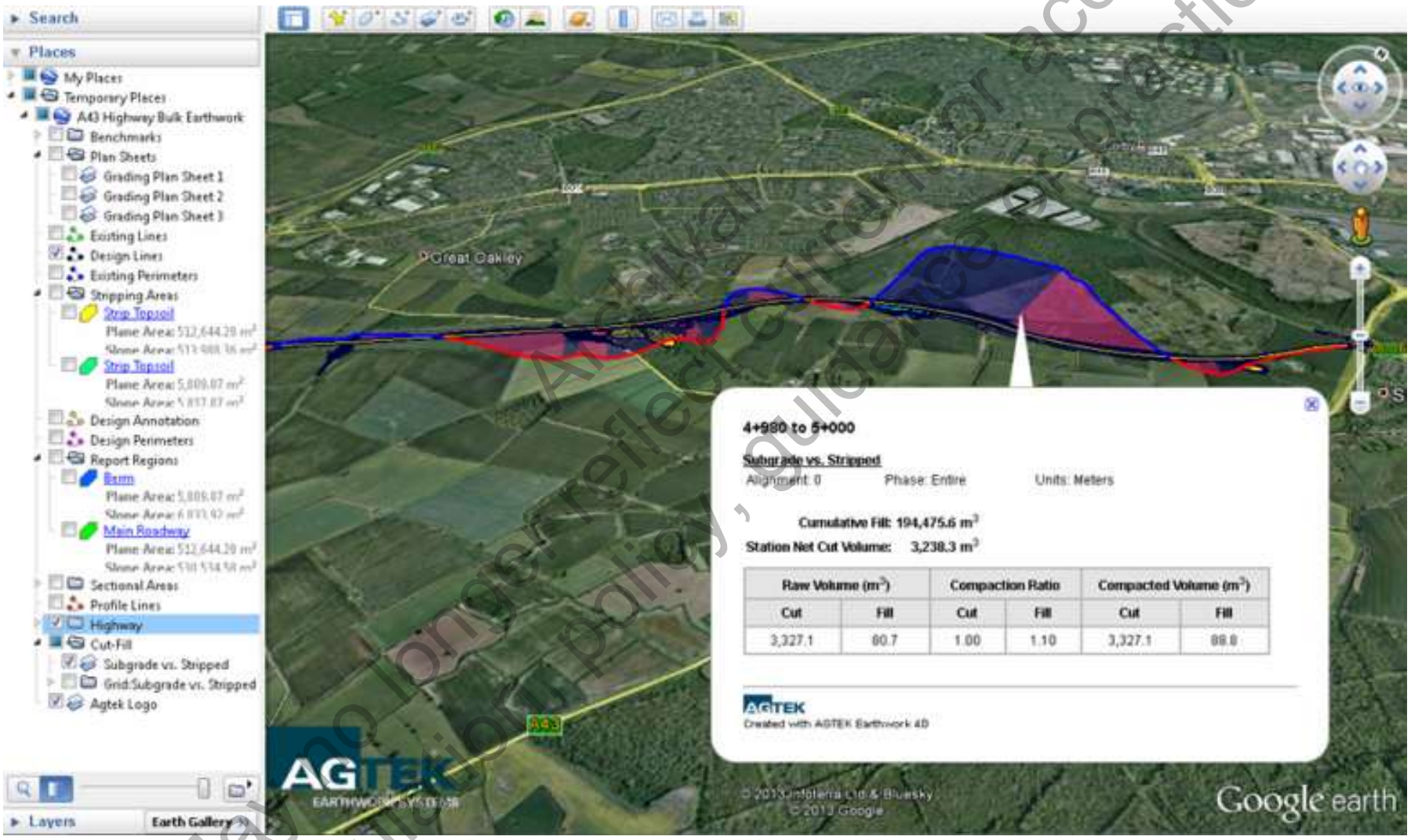
3D View South End
looking North



A43 Corby Link Road **Earthworks - Main Carriageway**

AGTEK dirt.simple.solutions.

Contractor Software: Earthwork



Contractor Software

Verify Learning Outcomes

- Discuss which files in the Design Model are delivered, and why
- Describe the purpose and need for standardization and documentation of the delivered model
- Discuss effective ways for transmitting models

Signing & Sealing Digital Documents

Paul Wheeler, Technology Advancement Specialist
Utah Department of Transportation

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Learning Objectives

- Discuss different approaches to signing & sealing digital files

Poll 3: State of the Practice of Digital Sign & Seal

Do you currently sign & seal electronic documents?

- Yes
- We'd like to
- No

Digital vs. Electronic Signatures

Electronic? Digital?

Digital vs. Electronic Signatures

Electronic Signatures

- Just an image, not verifiable
- No Integrity
- No metadata behind it.
- Easy to manipulate

Digital vs. Electronic Signatures

Digital Signatures

- The adoption of the Uniform Electronic Transactions Act (UETA) in most states and the passage of Electronic Signatures in Global and National Commerce Act (ESIGN) at the federal level in 2000 solidified the legal landscape for use of electronic records and electronic signatures in commerce.
- Intelligent electronic signature
- Provides the metadata behind the signature to enhance security and integrity

Why Digital Signatures?

- Authenticity
- Integrity of content
- Decreased printing costs
- Ease of distribution
- Save time!

Poll 4: File types for Digital Sign & Seal

What file types do you sign and/or seal digitally?

- PDF
- Office documents
- CADD files
- None

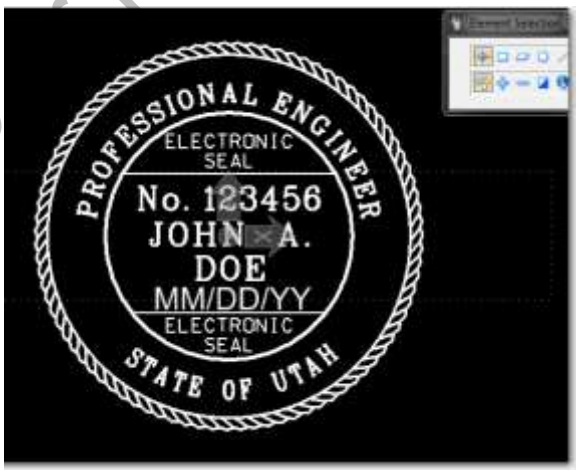
Requirements for Digital Signatures

- Each state has different requirements for licensing and electronic seal use
- Reputable Certificate Authority
- Software that is friendly to Digital Signature workflows
- Organizational understanding of the digital signature documents and workflow.

Signatures in CADD

Pros

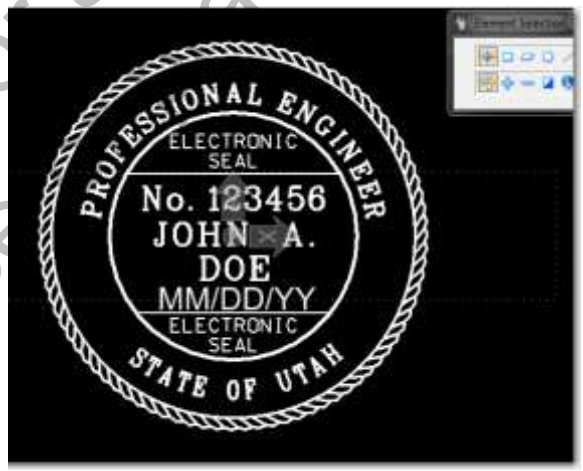
- Ability to lock (copy, print, open) the CADD Files
- Functionality of digital certificates
- Identify who certified the files
- Identify when the file was certified
- Invalidate signature if the files are changed



Signatures in CADD

Cons

- Software bugs
- Software compatibility with certificates
- Software versions need to be the same.
- Reference file problems with invalidation



Signatures in PDF

Pros

- Easy to distribute documents
- Final plan set is certified and locked
- Multiple people can easily sign
- Widely accepted format
- Portfolio Creation (Multiple PDF files combined into one container)
- Easy signing of files via free Adobe Reader
- Ability to lock document via cover sheet

Signatures in PDF

Cons

- Slow load times for validation of signatures
- Extra software needed for creation of document
- Have to add Reader functionality in order to sign in Adobe Reader.
- Portfolio size can become large for big projects.

Lessons Learned

- Ensure everyone uses the same version of the software.
- Have a system for keeping certificates up to date.
- Have an organized workflow for signing the documents.
- Make it easy to use the digital process!

Benefits

- Decreased printing costs for the department
- Integrity of digitally signed files
- Signing of plan sets were completed faster between departments/consultants
- Bidding for contractors became easier with Digital Print Room
- Contractors could easily distribute accurate verifiable electronic copies of the plan sets

Poll 5: Need for Digital Sign & Seal

Is digital sign and seal of CADD documents a prerequisite to releasing models For Construction?

- Yes, it's essential
- Yes, it's desirable
- No
- Not sure

Verify Learning Outcomes

- Discuss different approaches to signing & sealing digital files

Best Practices for Supporting Estimating, Construction Layout and Automation

Bruce Flora, RLS

Flora Surveying

U.S. Department of Transportation
Federal Highway Administration

Learning Objectives

- Describe best practices for delivering files for effective construction

Poll 6: Embedding Survey Metadata

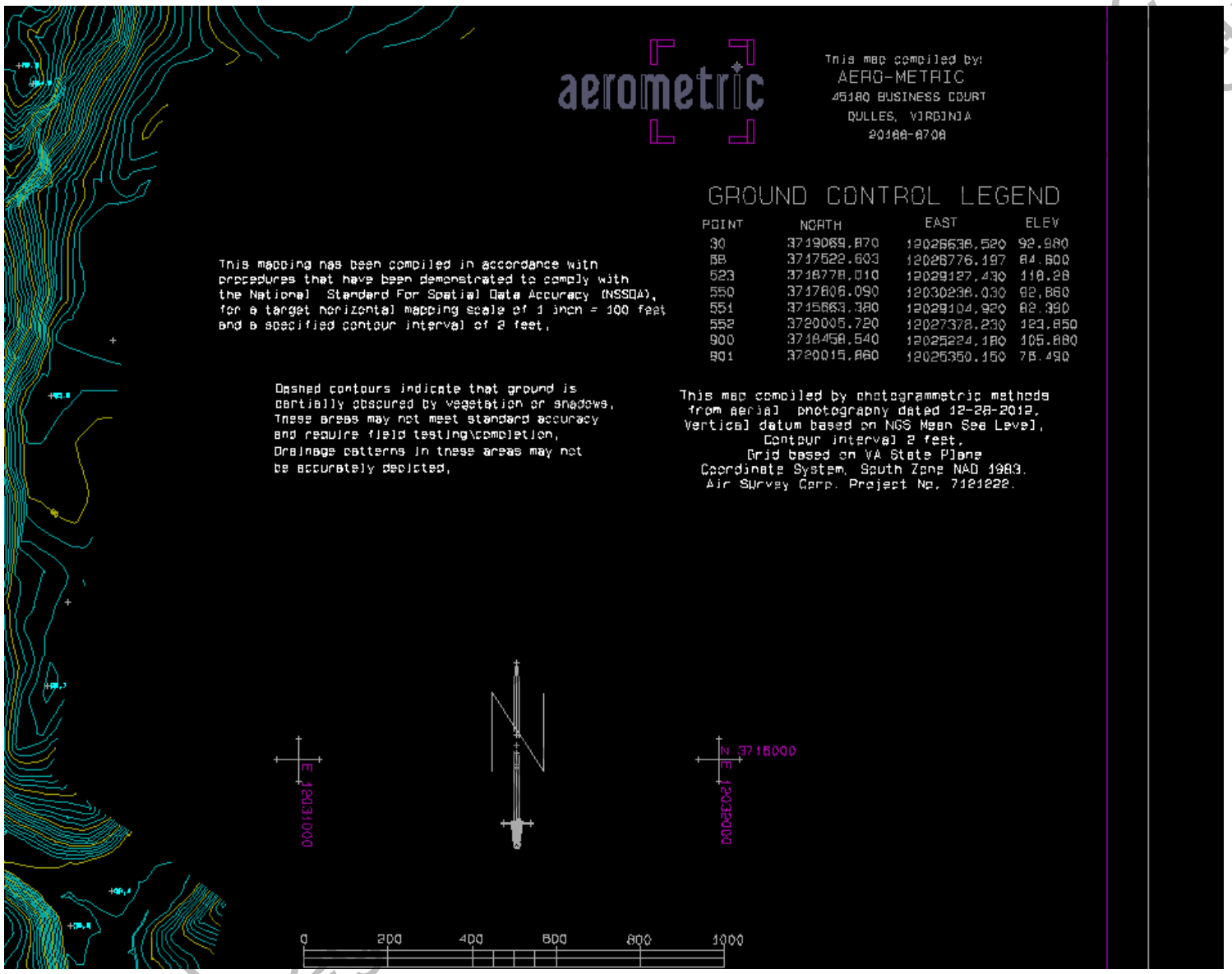
Do you embed survey metadata in your CADD files?

- Yes, it's on our seed/template
- Yes, on all files contain spatial data
- Yes, on some files
- Yes, on the survey base map only
- Not sure
- No

Estimators And Professional Surveyors Wishes

- Estimator: existing conditions at pre-bid
- Surveyor: existing conditions at construction

Original Mapping Documentation



Poll 7: Vertical Datum Description

Does your survey metadata describe the basis for the survey datum?

- Yes
- No
- Not sure

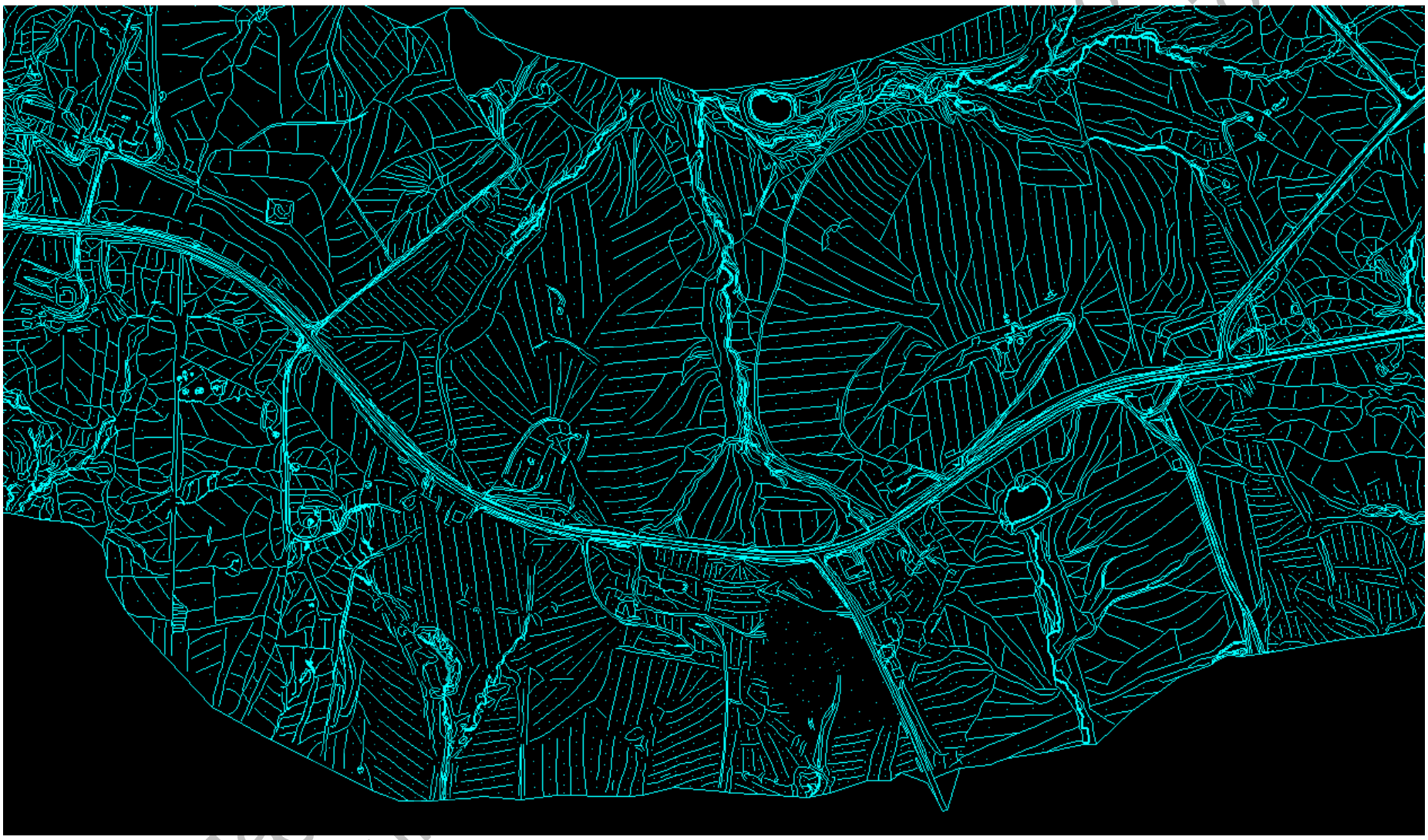
Original Mapping Ground Control

GROUND CONTROL LEGEND

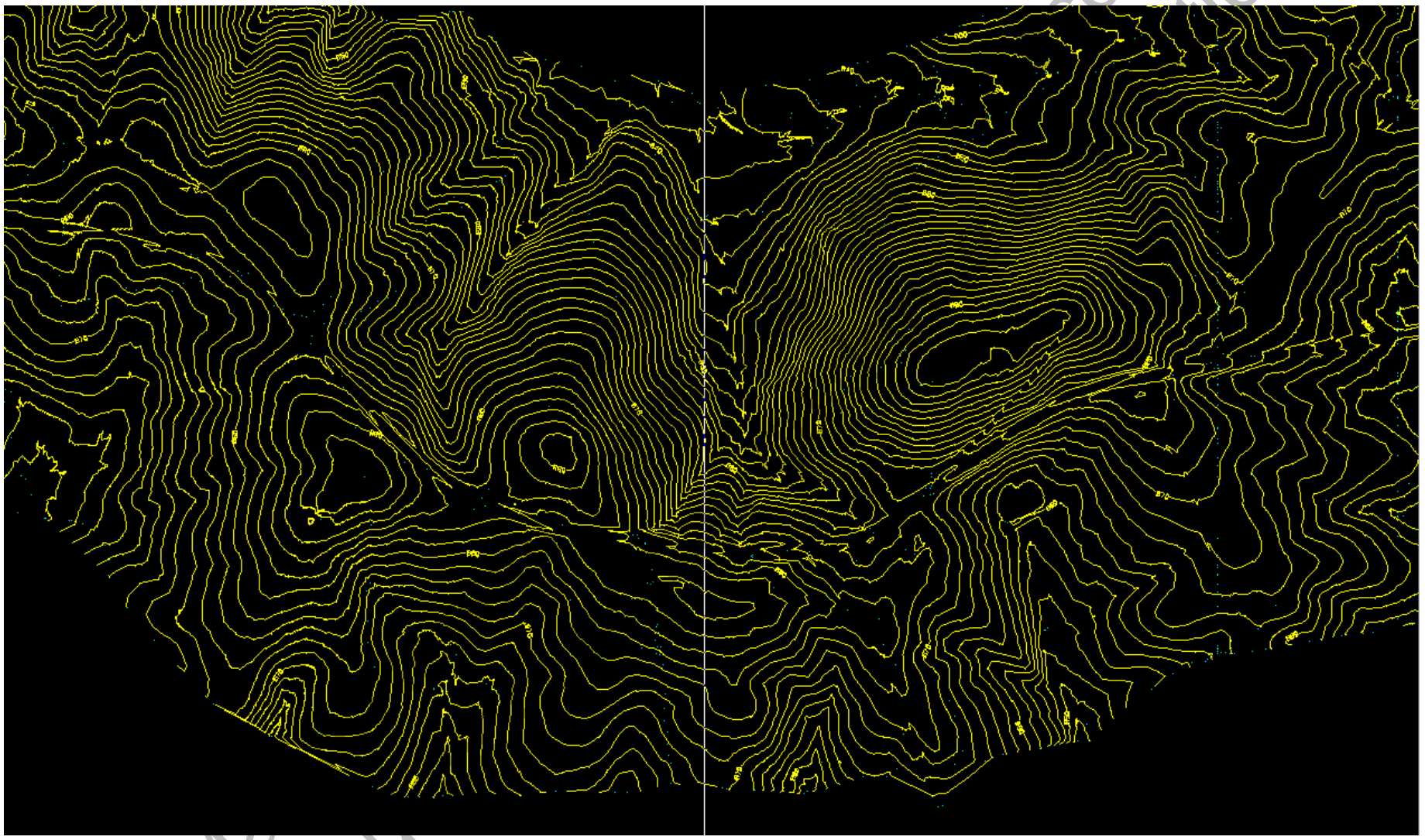
POINT	NORTH	EAST	ELEV
30	3719069.870	12026638.520	92.980
68	3717522.603	12026776.197	84.600
523	3718778.010	12029127.430	116.28
550	3717806.090	12030238.030	92.860
551	3715663.380	12029104.920	82.390
552	3720005.720	12027378.230	123.850
900	3718458.540	12025224.180	105.880
901	3720015.860	12025350.150	76.490

This map compiled by photogrammetric methods
from aerial photography dated 12-28-2012.
Vertical datum based on NGS Mean Sea Level.
Contour interval 2 feet.
Grid based on VA State Plane
Coordinate System, South Zone NAD 1983.
Air Survey Corp. Project No. 7121222.

Points and Breaklines

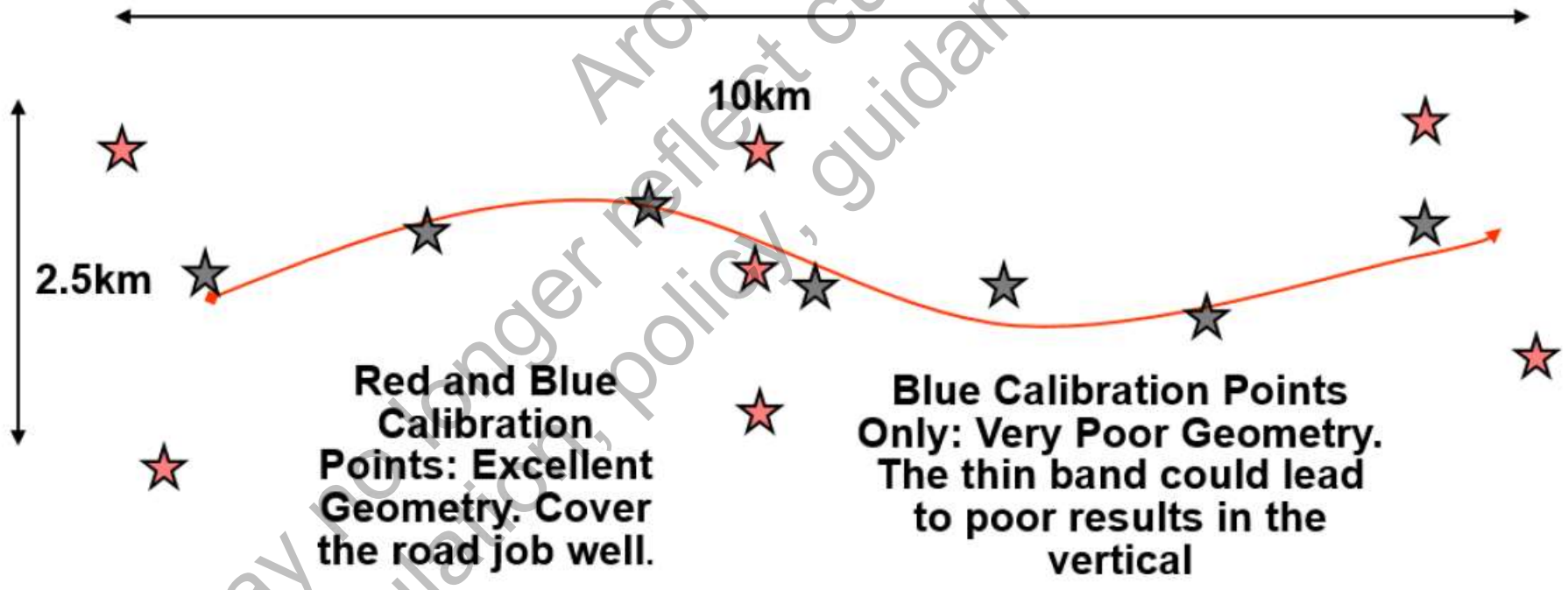


2’ Contours

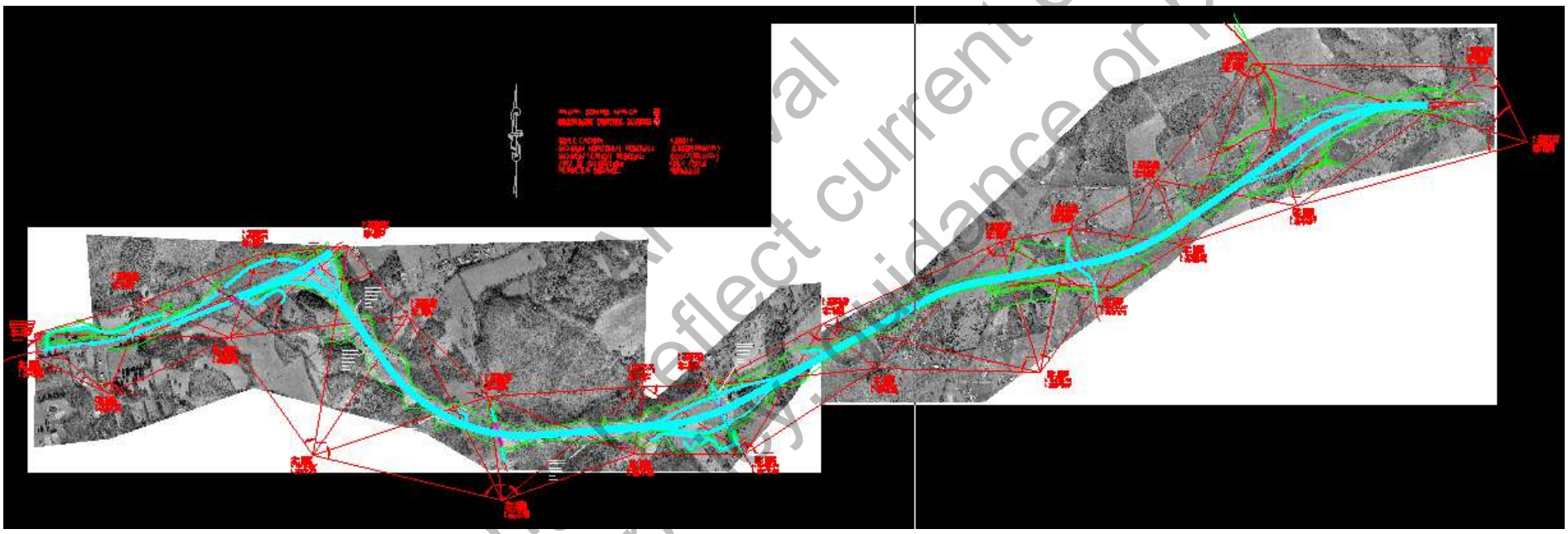


AMG Construction Control

- Road (or other elongated job)
- The points must surround the area the machines will be working in and have good geometry



AMG Corridor Network



Professional Model Builder Wishes For AMG

- AutoCAD Civil 3D: Bind Xrefs
- Bentley InRoads/Geopak: Merge References

CAD Files Supplied By Owner

BMLK-01	4/14/2014 3:00 PM	File folder
BMLK-02	9/4/2013 11:30 AM	File folder
BMLK-03	4/14/2014 3:00 PM	File folder
BMLK-04	4/14/2014 3:00 PM	File folder
BMLK-05	4/14/2014 3:00 PM	File folder
BMLK-06	4/14/2014 3:00 PM	File folder
BMLK-07	4/14/2014 3:00 PM	File folder
BMLK-08	9/4/2013 11:30 AM	File folder
BMLK-09	4/14/2014 3:00 PM	File folder
BMLK-10	4/14/2014 3:00 PM	File folder
BMLK-11	9/4/2013 11:30 AM	File folder
BMLK-12	4/14/2014 3:00 PM	File folder
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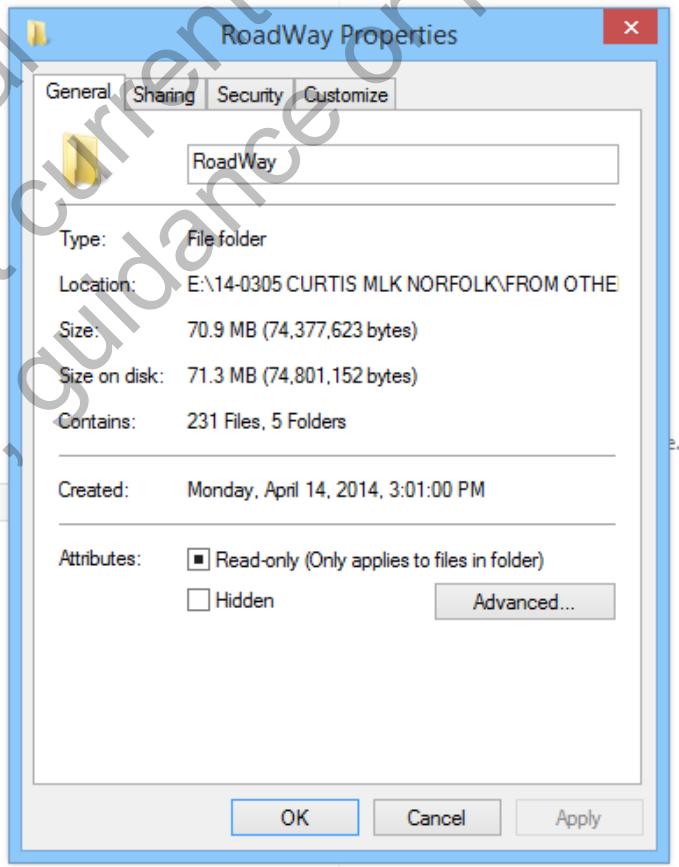
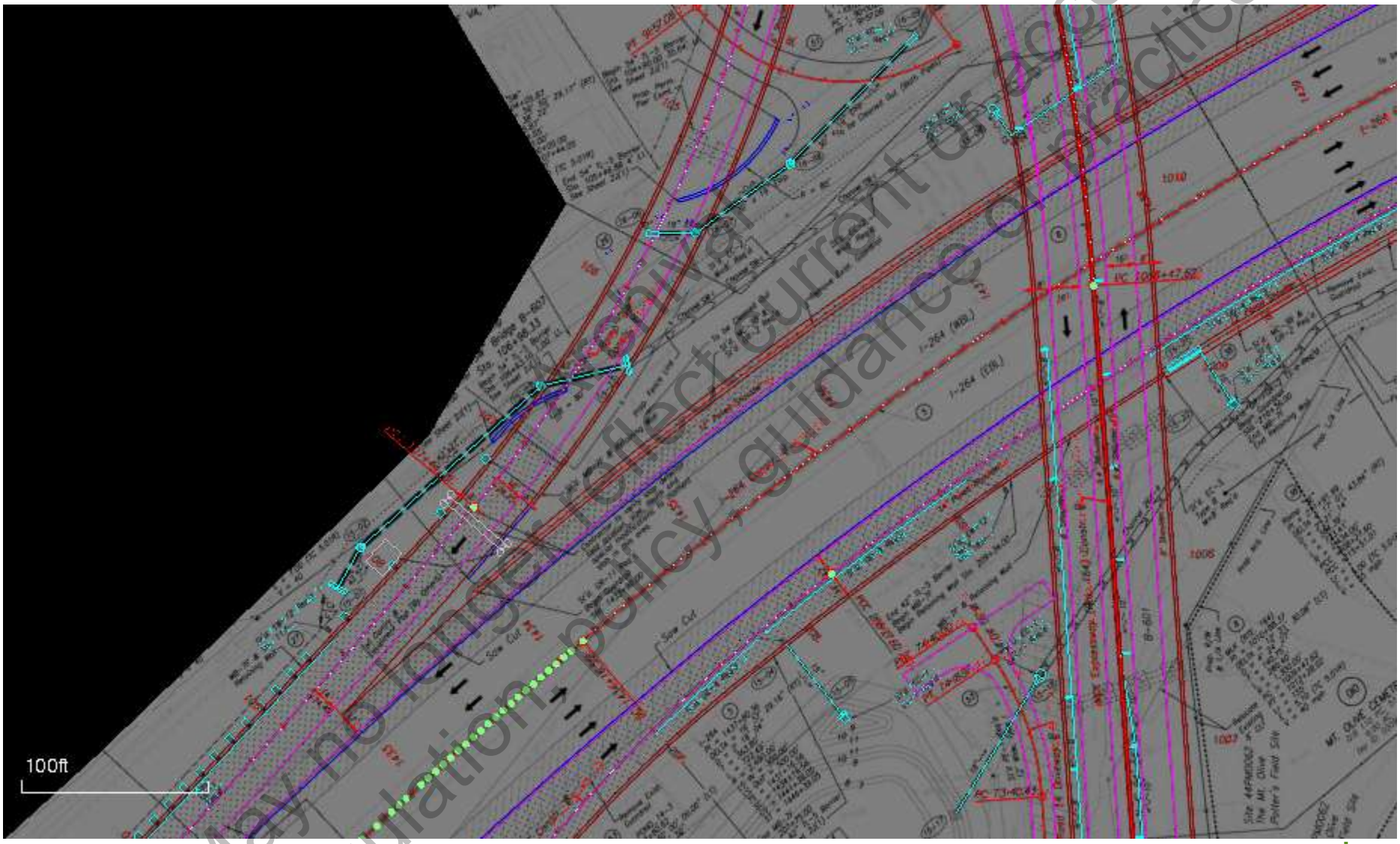
BMLK-14	4/14/2014 3:00 PM	File folder
Bridge_Ref_Files	4/14/2014 3:00 PM	File folder
Erosion and Sed	4/14/2014 3:00 PM	File folder
General	4/14/2014 3:00 PM	File folder
Grading	4/14/2014 3:00 PM	File folder
Lighting	4/14/2014 3:00 PM	File folder
RoadWay	4/14/2014 3:01 PM	File folder
site	4/14/2014 3:01 PM	File folder
SWM	4/14/2014 3:01 PM	File folder
Utilities	4/14/2014 3:01 PM	File folder
Utilities_Private	4/14/2014 3:01 PM	File folder
Walls	4/14/2014 3:01 PM	File folder



2D Linework Extracted From CAD Files/Overlayed On Plans For QA/QC

CAD File Overlay Blow Up For Detail



Verify Learning Outcomes

- Describe best practices for delivering files for effective construction

Moderated Question & Answer

Francesca Maier, P.E.
Parsons Brinckerhoff

Every Day Counts
innovation ingenuity imagination invention

U.S. Department of Transportation
Federal Highway Administration

Poll 8: Webinar 6 Topics

Which Challenges would you like to hear more about?

- Concurrence between the Plans and the Model
- Extra effort in design to create construction-ready models
- Precedence of plans and 3D model
- Creating specifications for AMG
- Reviewing 3D models prior to construction
- Procuring Survey Equipment (Rovers) for Construction Engineers & Inspectors
- Other (please add to Chat)

Question & Answer

Please add your questions to the Q&A Pod

You may add suggestions for poll pods!

Upcoming Webinars and Close

Douglas Townes, P.E.
FHWA Resource Center

U.S. Department of Transportation
Federal Highway Administration

3D Engineered Models Webinar Series

Webinar 1: Overview of 3D Models for Construction
Webinar 2: Creating 3D Engineered Models
Webinar 3: Applications of 3D Models in the Contractor's Office
Webinar 4: Applications of 3D Models on the Construction Site
Webinar 5: Managing and Sharing 3D Models for Construction
Webinar 6: Overcoming Challenges to Using 3D Models for Construction
Webinar 7: Implementing 3D Engineered Models for Construction
Webinar 8: Adding Time, Cost and other Information to 3D Models

Up Next: Webinar 6

Overcoming Challenges to Using 3D Models for Construction

September 10, 2014

1:00 pm – 2:30 pm

www.fhwa.dot.gov/3D

Douglas.townes@dot.gov