IDModeling®
ENGINEERING INNOVATION

Approaching Sustainable GIS-Integrated Hydraulic Modeling:

Pilot Study to Full-Scale Implementation

AWWA PNWS Conference,
Friday, May 14, 2010

Agenda

- Hydraulic Model Sustainability –
  Integrating a GIS and a Hydraulic Model
- Organizing a Pilot Model Sustainability Project
- Key Sustainability Considerations
- Lessons Learned from Integration Pilot Projects

Acknowledgments

- Utilities
  - American Water
  - Anchorage Water & Wastewater Utility
  - California Water Service Company
  - Olivenhain Municipal Water District
  - Walnut Valley Water District
  - Many others
- Companies
  - Black & Veatch
  - ESRI
  - IDModeling

What is Sustainable GIS-Model Integration?

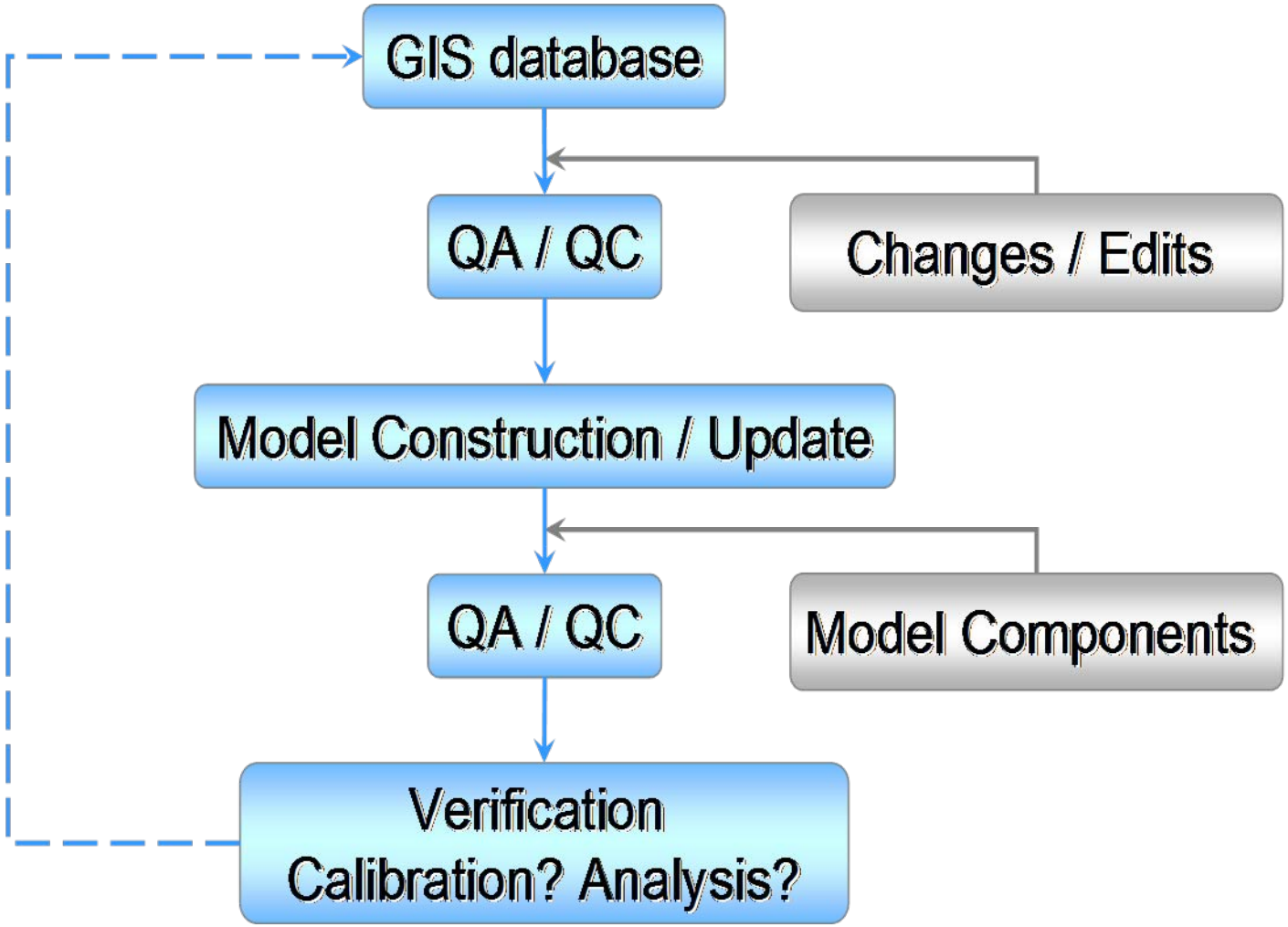
Sustainable GIS and hydraulic model integration is the process by which updates in a GIS database are rapidly and accurately reflected in a hydraulic model; and data in the model can be readily shared with the GIS database.

It is a long-term process that can evolve and adapt to address changing business needs and technology.

Benefits of Sustainability

- Improvements to the quality and ‘freshness’ of the source data
- Ease of data exchange between GIS and model
- More detailed models
- Improve model maintenance
- Build and update models faster
- Continually refine model to enable advanced analyses

Pilot GIS : Model Integration Workflow

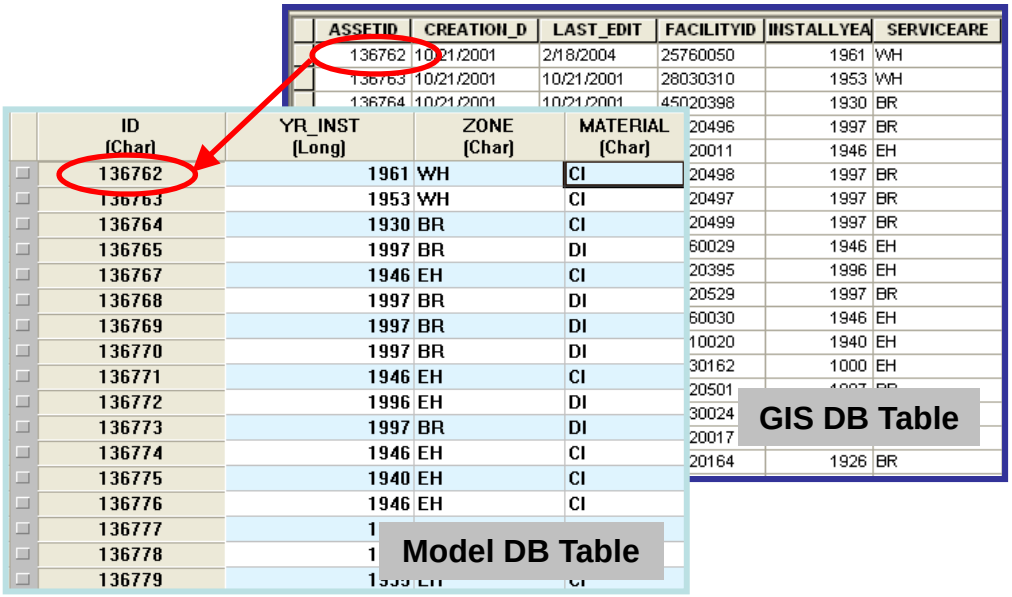


The Pilot Project – Moving Toward Sustainability

- What does a pilot sustainability project examine?
  - Quality of the source data
  - Locating all of the model input data
  - Structure and conventions of source data
  - Frequency and extent of GIS edits
  - Consistency of GIS editing procedures
  - Connections between GIS and other business systems
  - Information required for model updates
  - Modeler's familiarity with model updating tools
  - Rebuild or incremental update? Frequency?
  - Preserving model-specific information during updates (controls, demands, etc.)

Sustainability Point – Using a Unique ID

- The model requires a unique ID
- Hydraulic model ID should be based on GIS asset ID to facilitate development and maintenance of an all-pipes model
- Other Key ID Requirements
  - Needs to remain unique in the GIS
  - Can't be re-indexed
  - Can't be reused



ASSETID	CREATION_D	LAST_EDIT	FACILITYID	INSTALLYEA	SERVICEARE
136762	10/21/2001	2/18/2004	25760050	1961	WH
136763	10/21/2001	10/21/2001	28030310	1953	WH
136764	10/21/2001	10/21/2001	45020398	1930	BR
			20496	1997	BR
			20011	1946	EH
			20498	1997	BR
			20497	1997	BR
			20499	1997	BR
			60029	1946	EH
			20395	1996	EH
			20529	1997	BR
			60030	1946	EH
			10020	1940	EH
			30162	1000	EH
			20501		
			30024		
			20017		
			20164	1926	BR

ID (Char)	YR_INST (Long)	ZONE (Char)	MATERIAL (Char)
136762	1961	WH	CI
136763	1953	WH	CI
136764	1930	BR	CI
136765	1997	BR	DI
136767	1946	EH	CI
136768	1997	BR	DI
136769	1997	BR	DI
136770	1997	BR	DI
136771	1946	EH	CI
136772	1996	EH	DI
136773	1997	BR	DI
136774	1946	EH	CI
136775	1940	EH	CI
136776	1946	EH	CI
136777			
136778			
136779			

Sustainability Point – Fields to import from GIS

GIS Database		Hydraulic Model		Typical attributes to Maintain in GIS and Model
Features	Feature Type	Features	Feature Type	
Tanks & Reservoirs	Point	Tanks & Reservoirs	Point	ASSET_ID, INSTALL_DATE, RETIRE DATE, ZONE, BOTTOM_ELEV, OF_ELEV, DIA, VOLUME, EDIT_DATE, IN_GIS, IN_MODEL
Fittings, Hydrants, Non-operational Valves	Point	Junctions	Point	ASSET ID, INSTALL_DATE, RETIRE DATE, ZONE, ELEV, FITTING TYPE (SUBTYPE), EDIT_DATE, IN_GIS, IN_MODEL, OPERATIONAL
Operational Valves / Boundary Valves	Point	Valves	Point/Line	ASSET ID, INSTALL DATE, RETIRE DATE, FROM ZONE, TO ZONE ELEVATION, DIAMETER, VALVE_TYPE (SUBTYPE), BODY_TYPE, EDIT_DATE, IN_GIS, IN_MODEL, OPERATIONAL (Y/N)
Pumps	Point	Pumps	Point/Line	ASSET ID, INSTALL_DATE, RETIRE DATE, ZONE, ELEV, DIA, EDIT_DATE, IN_GIS, IN_MODEL
Pipes	Line	Pipe	Line	ASSET ID, INSTALL_DATE, RETIRE DATE, ZONE, DIA, MAT, RELINE DATE, RELINE TYPE, F_NODE, T_NODE, LENGTH, ROUGHNESS, EDIT_DATE, IN_GIS

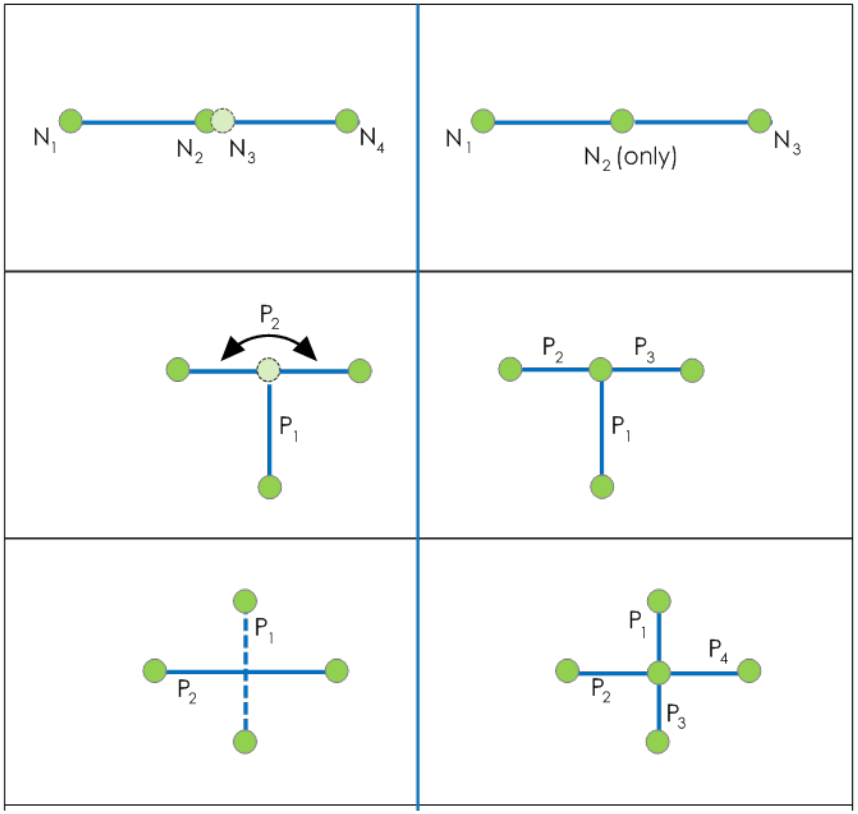
Sustainability Point – Model-Specific Fields

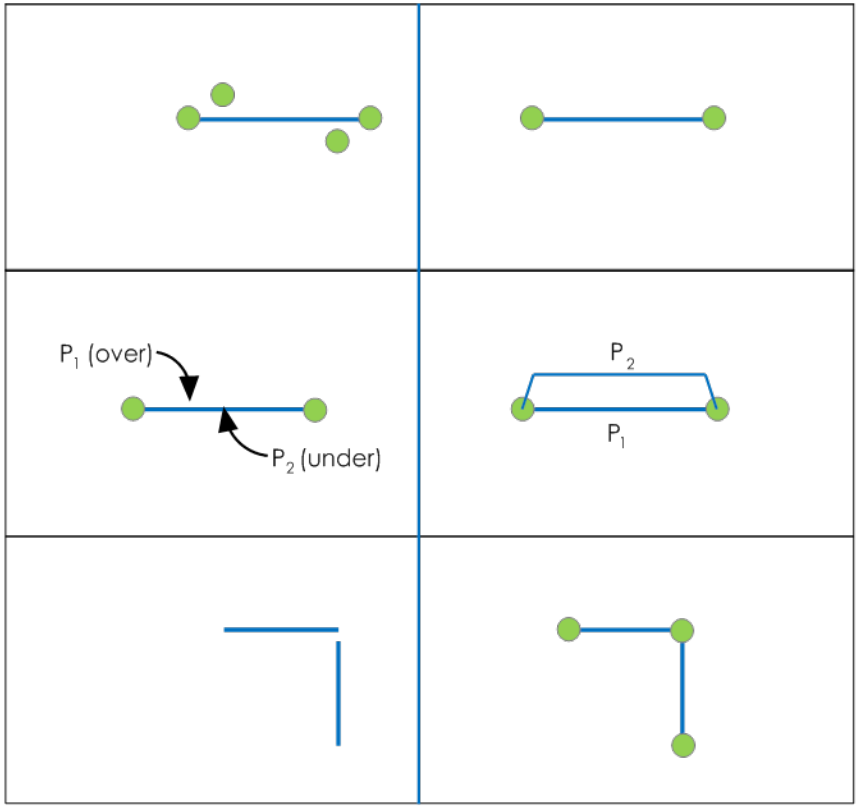
	New GIS Field?	GIS Field Name	Maps to Model Field:
Feature Class: wMainLine	YES	GISUniqueID	LABEL
	YES	IN_MODEL	IN_MODEL
	YES	MODEL_TYPE	MODEL_TYPE
	NO	ROUGHNESS	HAZEN-WILLIAMS_C
	NO	INSTALLDATE	INSTALLATION_YEAR
	NO	PRESSUREZONEVALUE	ZONE_LABEL
	NO	MATERIAL	MATERIAL
	NO	DIAMETER	DIAMETER
	NO	SHAPELENGTH	LENGTH
	NO	SUBTYPE	GIS_SUBTYPE
	NO	WATERTYPE	WATERTYPE
	NO	PIPELOCATION	NOTES
Class: ervice	YES	GISUniqueID	LABEL
	YES	IN_MODEL	IN_MODEL
	YES	MODEL_TYPE	MODEL_TYPE
	NO	INSTALLDATE	INSTALLATION_YEAR
	NO	PRESSUREZONEVALUE	ZONE_LABEL
	YES	IN_MODEL	IN_MODEL
	YES	MODEL_TYPE	MODEL_TYPE

Sustainability Point – Model Connectivity

- Hydraulic modeling requires very specific connectivity of its source data
- Geometric Networks can resolve many typical issues observed, but problems can still arise
- Inspect the GIS, identify and correct connectivity issues before the model is constructed – use native software tools to help you
- Many hydraulic modeling packages provide similar connectivity tools:
  - Orphan Pipes and Nodes
  - Nodes in Close Proximity
  - Pipe Split Candidates
  - Diameter Discrepancies
  - Parallel Pipes or Overlapping Pipes
  - Find Connected/Find Disconnected

Model Connectivity (continued)





- Nodes in Close Proximity
- Pipe Split Candidates
- Intersecting Pipes

- Disconnected Nodes
- Parallel Pipes
- Orphan Pipes

Sustainable Modeling Recommendations

- **Create an all-pipes hydraulic model**
- **Use unique IDs, and never recycle them**
- **Maintain a one-to-one relationship between hydraulic model and GIS**
- **Develop network connectivity and implement topology rules in GIS (geometric network)**
- **Track changes in the GIS – *in detail***
- **Include "IN_GIS" and "IN_MODEL" fields**
- **Maintain key model attributes (diameter, material, install date, elevation) in GIS**
- **Implement GIS-centric hydraulic modeling software**
- **Establish living documentation**

Pilot Projects – Lessons Learned

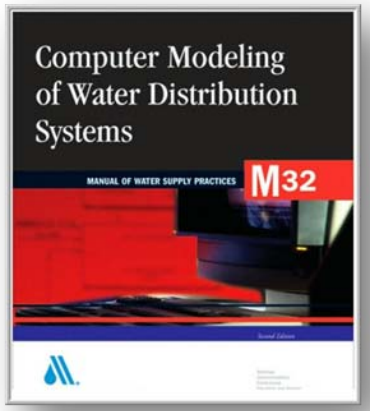
- Be prepared to *iterate*
- Integration is just as much a business process as a technical one
- Involve technical and business leadership from the start
- The importance of a unique ID and detailed change tracking cannot be overemphasized
- The findings of your pilot program may change the course of your integration project
- Your data may need additional processing – and additional software
- You may find many unanticipated benefits

Additional Resources

- ***ESRI Handbook***
  Best Practices for Sustainable GIS and Hydraulic Model Integration
  - Coming in 2010, ESRI Press
  - IDModeling, Black & Veatch, and DHI

- ***AWWA M32 Manual – New Edition***
  - Includes updates specific to GIS and Hydraulic Modeling

- ***Discussion forums***
  - www.hydraulicmodel.com



hydraulicmodel.com
...user driven resources for the hydraulic modeling community

IDModeling®
ENGINEERING INNOVATION

Approaching Sustainable GIS-Integrated Hydraulic Modeling:

Pilot Study to Full-Scale Implementation

AWWA PNWS Conference,
May 2010