

A Sediment Transport Modeling Scoping Meeting for the Waukegan River Watershed

Lake County Administration Building, 10th Floor Assembly Room
18 N. County Street
Waukegan, IL 60085

August 28, 2008

Sponsored by: U.S. Army Corps of Engineers

Welcome, Introductions and Workshop Objectives

David Bucaro, P.E., USACE Chicago

Bucaro opened the workshop by welcoming the participants and outlining the agenda and objectives for the meeting. A total of nine people participated in the meeting in person or by phone, including representatives from U.S. Army Corps of Engineers (USACE) - Chicago District, U.S. Environmental Protection Agency (USEPA), Lake County Stormwater Management Commission (LCSMC), Lake County Planning Department, Illinois Environmental Protection Agency (IEPA), City of Waukegan, and the Waukegan Harbor Citizens Advisory Group (CAG). The PowerPoint slides presented at the meeting are available as Appendix A.

Background and Methodology

David Bucaro, P.E., USACE Chicago

Bucaro began his presentation by providing background information on the Great Lakes Tributary Modeling Program, which is authorized by Section 516(e) of the Water Resources Development Act (WRDA) of 1996. Section 516(e) directs the USACE to develop sediment transport models for Great Lakes tributaries contributing sediment to Federal navigation channels or harbors or Areas of Concern (AOCs).

These sediment transport models are intended to be used as tools by state and local entities to evaluate options for soil conservation, non-point source pollution prevention, dredging and dredged material disposal needs, Remedial Action Plans (RAPs), and Lakewide Management Plans (LaMPs). A 516(e) project for the Waukegan River could potentially be used to assess and plan actions to help restore the watershed and reduce sediment loadings to Lake Michigan. Each model developed under the program is 100% federally funded under the 516(e) program authorization and is adapted to reflect the local conditions of the watershed and the model's intended uses and user capabilities. Long-term benefits of the modeling projects include applying a watershed approach to sediment management, supporting and enhancing measures that will reduce loadings of sediments and pollutants to tributaries, reducing the costs of navigation maintenance, and reducing the need for sediment remediation. More information on the Great Lakes Tributary Modeling Program, including information about other completed and ongoing modeling projects, is available at www.glc.org/tributary.

Bucaro then outlined the multi-phased approach of each modeling project. First, the USACE undergoes a scoping phase to assemble its team of project partners, identify the needs and user expertise within the watershed community, compile existing data for the modeling effort, and select the appropriate tool(s) for the development phase. The Waukegan River watershed is fortunate to have good partnerships in place for this effort that will benefit the project. Next, the USACE begins the model development phase – which varies by watershed – but includes the integration of existing data and customization of an existing modeling tool and user interface. The USACE will either use its own technical staff for the development of the tool or will partner with other, external sources of expertise (e.g., technical contractors, local project partners, etc.) to develop the model. Finally, the USACE and its partners will develop user manuals and host at least one training workshop during the technology transfer phase of the project. This phase is critical in instructing the end users how to utilize the model, run relevant scenarios based on the needs of the watershed, and to physically hand off the model for continued use within the watershed community. As needed, the USACE will conduct follow-up within the watershed to refine the tool to meet the needs of the community of users.

Within the Waukegan River watershed, numerous previous studies and existing expertise and relationships among stakeholders will benefit the modeling effort by the USACE Chicago District. Specifically, Bucaro noted that this modeling effort would build upon work conducted for the Waukegan River Watershed Management Plan, Waukegan River National Monitoring Program, Waukegan Harbor Remedial Action Plan, several stream restoration and stabilization projects, and other data collection and analysis efforts. These activities will help to provide data for developing and calibrating the model for the Waukegan River watershed and may provide opportunities for additional data collection and other agency resources, as needed.

Waukegan River Watershed Characteristics

Kallan Mrozek, P.E., USACE Chicago

Mrozek then presented some of the basic characteristics of the Waukegan River watershed. He noted that the watershed drains approximately 12 square miles and empties into Lake Michigan just south of Waukegan Harbor – an AOC. The watershed is heavily urbanized and industrialized with very little undisturbed land in the watershed. In addition, very little development is currently occurring. Only 13 percent of the watershed is open land or agricultural, resulting in different types of sediment delivery issues compared with typical non-urban watersheds in the region. Within the river channel, itself, 46 percent of the river contains armoring and 19 percent of the channel is enclosed. Management of stormwater in the watershed includes 48 basins (dry, wet, and wetland varieties). The Waukegan River is also listed on the Illinois 303(d) list for impaired waterways due to its impacts on aquatic life.

Digging deeper in to the hydrologic and hydraulic issues of the watershed, Mrozek noted that the watershed's high level of imperviousness causes "flashy" runoff, a key issue impacting erosion and sedimentation in the river. Due to failed hydraulic structures and channel encroachment throughout the watershed and a lack of natural floodplain areas, there is limited area for flow to expand in channels or erode the banks of the river. Thus, erosion is occurring in the channel, itself, resulting in downcutting of the river and unstable and collapsing banks. Additional flows to the river carry urban contaminants and illicit discharges, which also affect the quality of the water and sediments.

Model Capabilities and Recommendations

Kallan Mrozek, P.E., USACE Chicago

Mrozek then discussed the desired capabilities for a hydrologic model for the Waukegan River watershed and the pros and cons of several different types of models for the project. He noted that the USACE prefers to use non-proprietary models with a web-based Geographic Information System (GIS) interface. They also look for tools that have the ability to model long-term simulations to study geomorphological processes that occur over time as well as sediment transport within and delivery from the basin. However, a number of existing models do not have these types of integrated features. Mrozek indicated that the selected model would also need to be appropriate for urban settings to accommodate the conditions of the Waukegan River watershed. Thus, the model should provide the capacity to analyze pollutant loadings and water quality parameters, movement of water through sewer networks, and integrated urban best management practices (BMPs) to address the flashiness of urban flow.

See Appendix A for additional detail on desired model capabilities and a comparison chart of the different models considered for this watershed (L-THIA, HEC-HMS v3.2, SWAT2005, SWMM v5.0, GSSHA v2.0, and HSPF v11.0).

Based on a variety of parameters (i.e., non-proprietary model; the capacity for analyzing long-term simulations, runoff hydrographs, sediment delivery from basin and transport within channel, pollutant loadings and water quality, flow from sewer networks, urban environments, and integrated urban BMPs; and the model development cost and effort), Mrozek presented the USACE Chicago District recommendations to utilize the Stormwater Management Model (SWMM) v5.0 for the Waukegan River project. The current version of SWMM v5.0 was developed by USEPA and CDM, Inc. and has been widely used in urban areas and other Chicago area projects. Other considerations for the selection of SWMM v5.0 included the model's:

- Integrated capabilities for routing flow through sewer systems,
- Runoff and infiltration calculations based on the SCS Curve Number method,

- BMP removal efficiency based on particular land uses,
- Capacity to account for snow accumulation and melting, and
- Improved capabilities available through proprietary XP-SWMM software.

Overall, the USACE Chicago District recommends SWMM v5.0 as the best fit for the Waukegan River watershed project, despite its lack of a non-proprietary, web-based GIS interface. Mrozek also indicated that the USACE would consider the use of the proprietary software to enhance the capability of the model.

Mrozek then discussed the possibility of using a separate hydraulic model to complement the capability of the hydrologic model to conduct channel flow analyses, and presented the team’s recommendation for using the Hydrologic Engineering Center – River Analysis System (HEC-RAS) v4.0. He noted that HEC-RAS is the industry standard for modeling river hydraulics. HEC-RAS v4.0 offers 1-dimensional modeling with a GIS interface that can be linked with ESRI software for data input. Unfortunately, it is not designed for modeling riverbank collapses – which is an issue in the Waukegan River watershed. Other free software can be used to study this and can be integrated into the model. However, HEC-RAS can model the results of these collapses (i.e., floods of sediment) since it has the ability to model moveable bed sediment transport and water quality dynamics. HEC-RAS can also model certain water quality parameters such as temperature, dissolved nitrogen and phosphorus constituents, algae, CBOD, dissolved oxygen, and user-assigned conservative and non-conservative constituents. Mrozek then presented several examples of HEC-RAS screen captures, including cross sections showing moveable bed limits and grain size data. He also noted the ability to integrate aerial photography into SWMM and HEC-RAS.

Data Required for Modeling Effort

Kallan Mrozek, P.E., USACE Chicago

Next, Mrozek detailed the data requirements for both models (items in bold are identified as current data deficiencies):

SWMM

- Meteorological data
- Land Use data
- Soils Data
- Topography
- **Sewer network survey data**
- Flow for major dischargers
- Runoff contaminant characteristics
- Main channel flow data
- BMP contaminant removal efficiencies

HEC-RAS

- Output from SWMM
- **Channel cross section and overbank surveys**
- **Bridge and structure surveys**
- **Bed gradation data**
- Channel stage data
- In-stream water quality monitoring data

He noted that the sewer network survey data is essential. In response, discussions among the participants suggested that the City might be able to focus its near-term work on this watershed to obtain the necessary data for this effort. John Moore also noted that Light Detection and Ranging (LIDAR) data may be available for purchase, which, when combined with channel cross sections, may provide additional data necessary for this effort. Cross sections of the north branch of the river from Washington Street up to Grand Avenue have already been surveyed as well as portions of the main channel approximately every 150-200 feet from the top of the banks (4-5 feet above water level). Bucaro indicated that the project team may need to supplement the existing data with some additional surveys and would likely need cross sections wherever there are slope changes, encroachments or bridges to show changes in the geometry of the channel. However, while the 516(e) program authority can cover the digitization of existing data it does not allow for the collection of new data. Thus, the participants were encouraged to consider alternative sources for obtaining the necessary data for the modeling project. Also, USACE will assess what can be done if only less-detailed information is available on the characteristics of the stream channel.

During the discussions, some of the participants noted their concerns about being able to acquire the necessary data but provided Bucaro and Mrozek with some potential leads. In response, the meeting participants and

project team decided to pursue the development of the SWMM portion of the tool but to hold off on the HEC-RAS portion for the near-term until additional cross section data becomes available.

Summary and Next Steps

David Bucaro, P.E. USACE Chicago

Before adjourning for the day, Bucaro provided the group with a brief summary of the next steps for the remainder of the Waukegan River project. Over the next couple of weeks, the USACE Chicago team will be working on finalizing the recommendations for the Waukegan River modeling project based on feedback received from the meeting participants and any additional comments from interested parties. This fall, the project team will develop a plan to help fill in some of the data gaps for the modeling effort by identifying alternative sources for the necessary data. Due to the program's limitations for collecting data, the USACE Chicago staff will be working with the local partners to acquire these data. The project team will also work to finalize the scoping report for the project this later this fall. Bucaro encouraged the meeting participants to contact him in the interim with any comments on the capabilities of the recommended models or to submit potential datasets for the development of the tools.

The development of the model usually takes about a year and a half and the USACE Chicago project team will be using their own district staff and personnel from other districts, as necessary, to develop the model. During this phase, the team will convene periodic meetings with the local partners and other interested parties to provide status updates on the model development and data acquisition. Upon completion of the tool (approximately Fall 2010), a hands-on training workshop will be held to teach interested users how to utilize the tools during the technology transfer phase of the project and to obtain valuable user feedback on the model and how it might be further refined.

The Great Lakes Commission was tasked with the compilation of a short summary of the meeting for distribution to the meeting participants and project partners. A webpage for the Waukegan River project will also be developed in the coming months to disseminate information and announcements specific to this project, including the finalized scoping report. Meeting participants are encouraged to view the Great Lakes Tributary Modeling Program website (www.glc.org/tributary) to learn more about the program and other completed watershed projects.

Any follow-up comments and/or additional data sources may be submitted to David Bucaro at the USACE Chicago District at David.F.Bucaro@usace.army.mil or by calling (312) 846-5583.

Meeting Summary Submitted By:

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Appendix A

Waukegan River 516(e) Scoping Meeting – PowerPoint Presentation

Waukegan River 516(e) Scoping Meeting

David F. Bucaro, P.E.
Planner / Hydraulic Engineer
Chicago District, Planning Branch

Kallan K. Mrozek, P.E.
Environmental / Hydraulic Engineer
Chicago District, Design Branch

August 28th, 2008
Waukegan, Illinois



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Great Lakes Tributary Modeling Program

- **Authority:** Sect 516(e) WRDA 96 (as amended)
- **Purpose:** Develop sediment delivery/transport models for GL watersheds that drain to Fed channels or AOCs
- **Goal:** Reduced tributary sediment/pollutant loads = reduced Fed costs to dredge/cleanup harbors, etc.:
 - “Grass-roots” level initiative
 - Tailored tools (based on needs & user’s expertise)
 - Universal/non-proprietary tools
- **Approach:** 3 phases (typically about 3 years)
 - Scoping: compile data, assemble team, select tool
 - Model Development: varies by WS, (OTS vs. custom)
 - Tech Transfer: training workshop, manuals, follow-up



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Completed 516(e) Tributary Models

Check out our website: <http://www.glc.org/tributary/>



Waukegan River 516(e) Building Upon Previous Work

- **A LOT** of great work has been done by many!
- This 516(e) effort will build upon that work:
 - Established close working relationships
 - Expertise & site specific experience of stakeholders
 - Input and calibration data for models
 - Additional data collection as necessary
- Information from various projects will be used:
 - Waukegan River Watershed Management Plan
 - Waukegan River National Monitoring Program
 - Waukegan Harbor Remedial Action Plan
 - Several stream restoration & stabilization projects
 - Other data collection and analysis efforts...

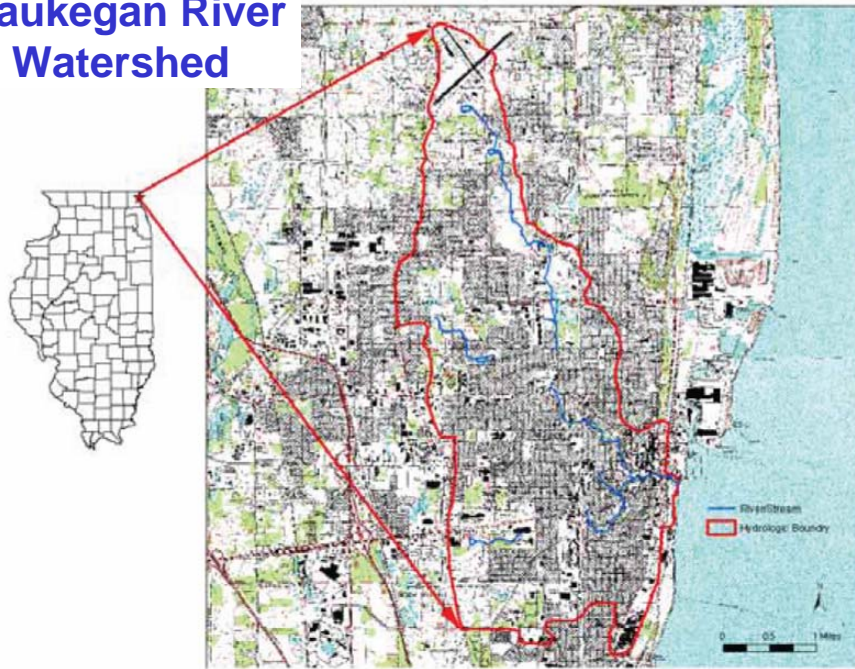


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Waukegan River Watershed



Waukegan River Watershed Characteristics

- 12 square mile drainage basin
- Mouth just south of Waukegan Harbor AOC
- Heavily urbanized (only 13% open / agriculture)
- Highly industrialized watershed
- Very little undisturbed land in the watershed
- Armoring on 46% of the channel
- 19% of river channel is enclosed
- 48 stormwater basins in the watershed
- Currently on Illinois 303(d) list for impaired waterways – partial support to aquatic life



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Waukegan River Hydrologic & Hydraulic Issues

- Imperviousness cause “Flashy” runoff
- Channel encroachment
- Lack of natural floodplain areas
- Channel downcutting
- Flows carry urban stormwater contaminants
- Identified problem discharge points
- Failed hydraulic structures
- Unstable and collapsing banks
- Contaminated sediments



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Waukegan River 516(e) Desired Model Capabilities

- Non-Proprietary Model
- Non-Proprietary GIS Interface
- Web-Based Interface
- Long-Term Simulations
- Runoff Hydrographs
- Sediment Delivery from Basin
- Sediment Transport within Channel
- Pollutant Loading / Water Quality
- Designed for Sewer Networks
- Used in Urban Environments
- Integrated Urban BMPs



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	L-THIA	HEC-HMS v3.2	SWAT2005	SWMM v5.0	GSSHA v2.0	HSPF v11.0
Non-Proprietary Model	✓	✓	✓	✓	✓	✓
Non-Proprietary GIS Interface	✓	HEC-GeoHMS is a GIS-based tool used for model development.	✓	N	N	✓
Web-Based Interface	✓	N	N	N	N	N
Long-Term Simulations	Uses long-term precipitation records in developing average annual results.	✓	✓	✓	✓	✓
Runoff Hydrographs	N	✓	✓	✓	✓	✓
Sediment Delivery from Basin	Utilizes coarse computations based on unit area contaminant contributions per land use.	Not currently part of the model, however unit area contaminant contributions per land use could be applied.	✓	✓	✓	✓
Sediment Transport within Channel	N	N	Has capability, but utilizes coarse fixed-bed computations.	Has capability, but utilizes coarse fixed-bed computations.	Has capability, but movable bed computations limited to sand fraction only, silts and clays are assumed wash load.	Has capability, but utilizes coarse fixed-bed computations.
Pollutant Loading / Water Quality	Utilizes coarse computations based on unit area contaminant contributions per land use.	Not currently part of the model, however unit area contaminant contributions per land use could be applied.	✓	✓	✓	✓
Designed for Sewer Networks	N	N	N	✓	N	N
Used in Urban Environments	✓	✓	Model not typically applied to urban environments.	✓	✓	✓
Integrated Urban BMPs	Integration of urban BMPs currently under development.	N	N	Has ability to add removal efficiencies for BMPs.	N	Toolkit available that adds functionality for urban BMPs.
Model Development Cost/Effort	\$	\$\$	\$\$	\$\$	\$\$	\$\$\$
Model Documentation	http://www.ecn.purdue.edu/uncdf/ltbia/ltbia_index.htm	http://www.hec.usace.army.mil/software/hec-hms/whatsnext.html	http://www.brc.tamus.edu/swat/index.html	http://www.epa.gov/edpnrmt/models/swmm/index.htm	http://chl.ercdc.usace.army.mil/gssha	http://www.epa.gov/compuh/swater/hspf/index.htm
Overall Assessment	L-This does not have the level of model sophistication required to meet the goals of the Waukegan River study.	HEC-HMS does not currently have sediment delivery, channel sediment transport, or water quality simulation capability, but is under development.	SWAT has a GIS interface through BASINS 3.1 and have been used extensively for evaluating sediment erosion and soil conservation, but is more suited for agricultural based watersheds.	SWMM was specifically designed for modeling stormwater runoff, sewers and other drainage systems in urban watersheds. In many ways, it is the best fit for the Waukegan River study.	GSSHA has many desirable features, but some functionality required for this project, particularly sewer network routing and urban BMPs are only available in conjunction with WMS v7.0 which has limited distribution.	HSPF has many desirable features including a non-proprietary GIS interface through BASINS 4.0, yet model has large input data requirements making development and calibration more intensive.

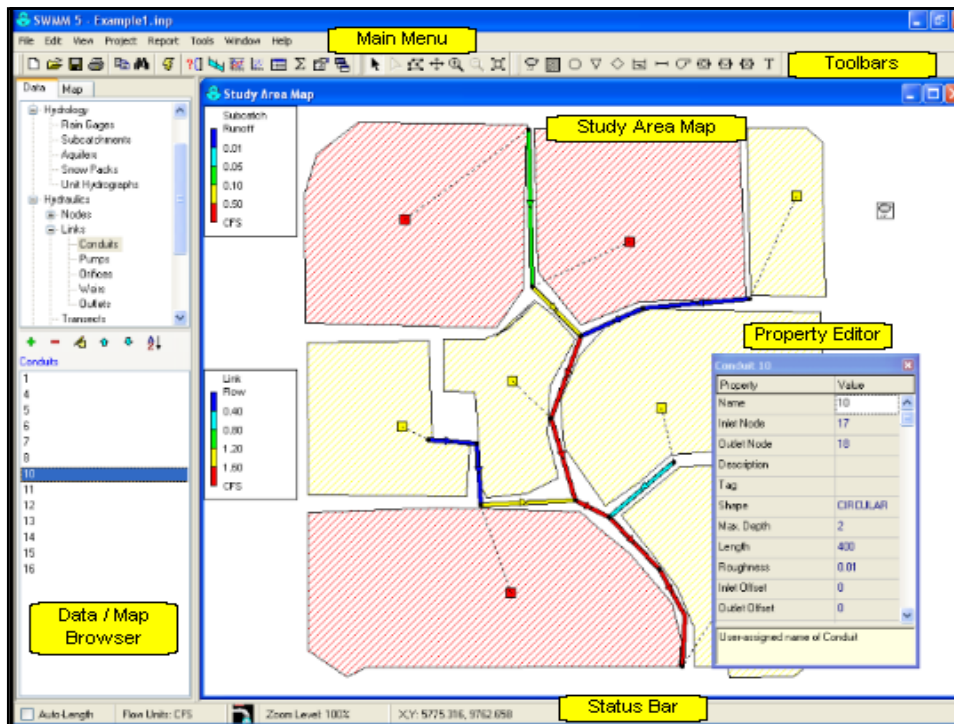
Waukegan River 516(e) Recommendations: Hydrologic Model – SWMM v5.0

- Current version developed by USEPA and CDM
- Widely used in urban areas including Chicago area
- Integrated capabilities for routing flow through sewer systems
- Runoff and infiltration can be calculated using SCS Curve Number method
- BMP removal efficiency can be tied to a particular land use
- Snow accumulation and melting
- Improved capabilities available through proprietary XP-SWMM software



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Waukegan River 516(e) Recommendations: Hydraulic Model – HEC-RAS v4.0

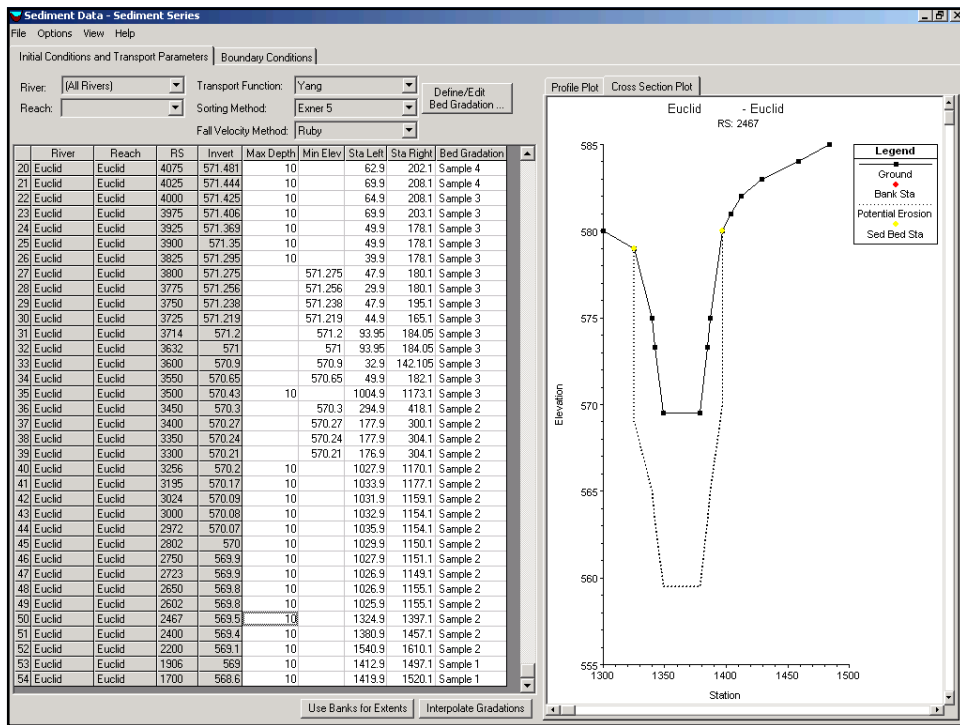
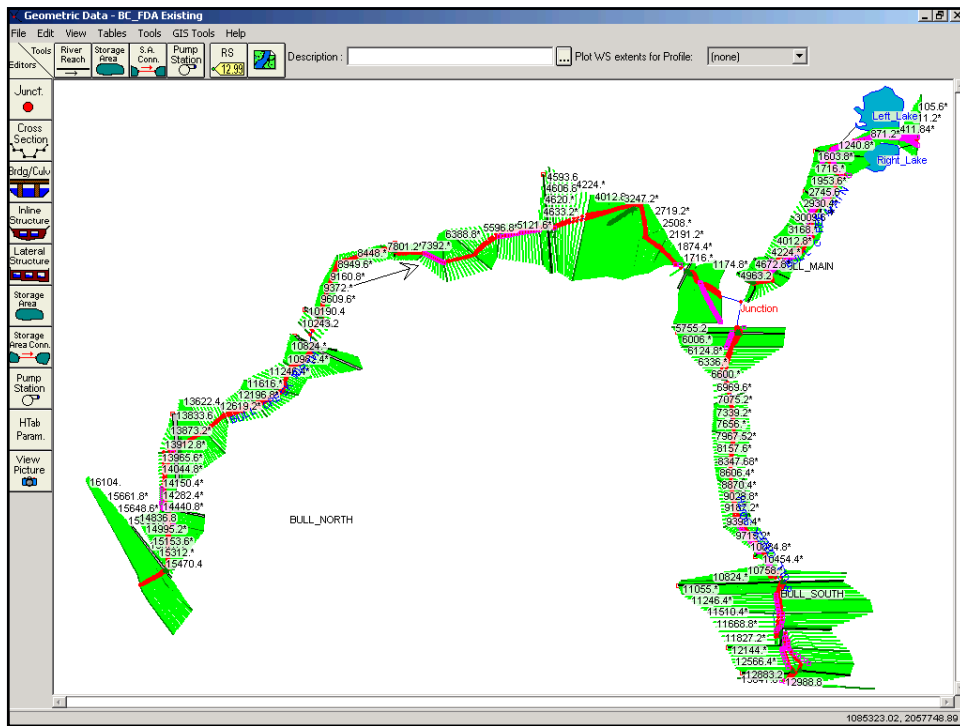
- Developed by USACE / widely used
- 1-Dimensional hydraulic model
- GIS interface can be used for data input
- Ability to model moveable bed sediment transport and water quality dynamics
- Not designed for modeling bank collapses
- Water quality parameters: temperature, dissolved nitrogen constituents, dissolved phosphorus constituents, algae, CBOD, DO, user-assigned conservative and non-conservative constituents



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Waukegan River 516(e) Data Required for Models

SWMM

- Meteorological data
- Land Use data
- Soils Data
- Topography
- Sewer network survey data
- Flow for major dischargers
- Runoff contaminant characteristics
- Main channel flow data
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HEC-RAS

- Output from SWMM
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Waukegan River 516(e) Next Steps...

- Fall '08
 - Buy-in on model recommendations
 - Establish a plan to fill data gaps by others
 - Finalize scoping report / publish on web
- Winter '08 through Summer '10
 - Develop SWMM & HEC-RAS models
 - Using in-house / acquired staff
 - Periodic meetings with stakeholders
 - Develop user manual / training documents
- Fall '10
 - Training / Tech Transfer Workshops
 - Hands on use of models
 - User feedback
- '11 & beyond
 - Possible Further Development/Refinement



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Questions?

Comments?

Discussion.



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