Development of a Flow Model to Simulate Discharge in Tims Branch, Savannah River Site

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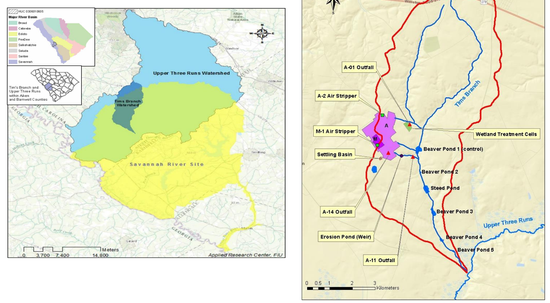
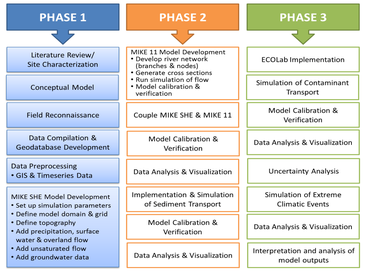
Introduction



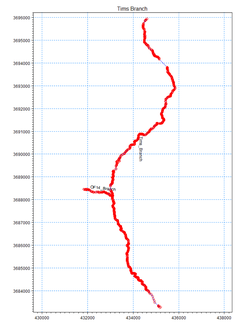
- Tims Branch Watershed (TBW) located on the Northwest side of Savannah River Site, Aiken, SC.
- Receives outflow from remediation efforts in the A/M Area.
- Tin was introduced by injection of stannous (tin) chloride into mercury contaminated groundwater.
- Tin is primarily deposited as sediment but remobilization may occur due to extreme weather events.

Project Objectives and Benefits

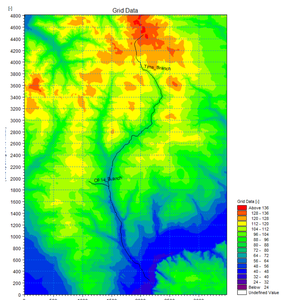


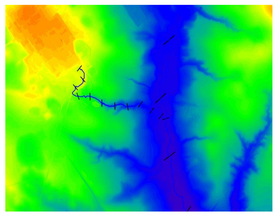
- To develop a hydrodynamic model of flow in Tims Branch using MIKE 11 software (developed by DHI).
- MIKE 11 is an implicit finite difference model that uses the one-dimensional Saint Venant equation to perform detailed modeling of surface runoff, flow, sediment transport, and water quality in rivers, channels, estuaries, and floodplains.
- MIKE 11 will be coupled with MIKE SHE and ECO Lab to develop an integrated hydrological model of Tims Branch watershed capable of simulating water flow as well as contaminant transport during extreme events such as heavy rainfall and flooding.
- Understanding the fate and transport of contaminants is of the utmost importance, especially if detrimental to human health and the environment, as in the case of tin if it becomes methylated under suitable environmental conditions.

MIKE 11 Model Setup

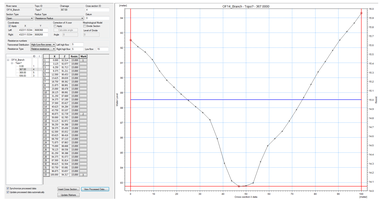


Network setup:
- Create points along river
- Connect points to create branches
- Define boundary conditions
- Identify hydraulic structures
- Export network data as shapefile



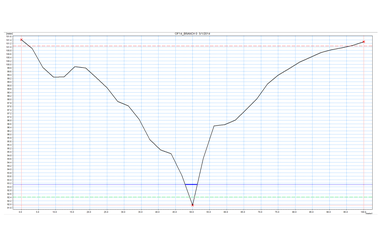


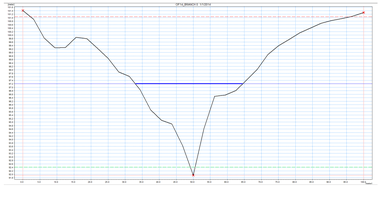
Cross-sections (using MIKE HYDRO):
- Input digital elevation model (DEM)
- Import network shapefile
- Set up MIKE HYDRO to create cross-sections automatically
- Specify water flow parameters

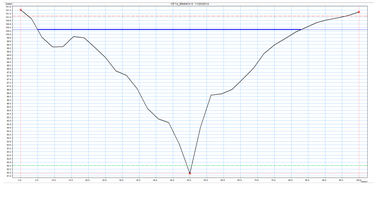


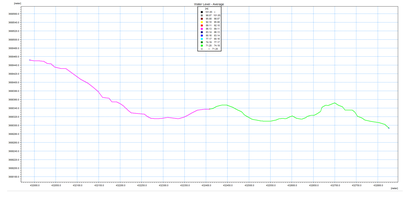
Preliminary Results

Water level animation at different times:

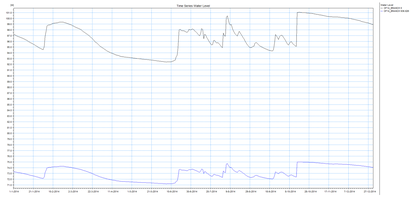




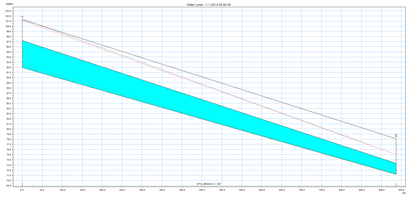




Average water level across Outfall 14 Branch



Water level timeseries at start and end points of branch



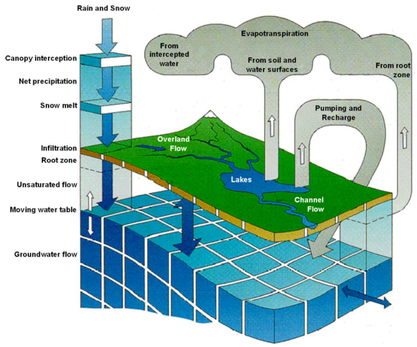
Water level profile at beginning of simulation

Volume Balance Summary

A: Initial volume in model area					**42910.16**	**m^3**
B: Final volume in model area					**87650.62**	**m^3**
Lateral sources inflow	0.00	m^3				
Lateral correction	0.00	m^3				
Open boundaries inflow	198790803833.39	m^3				
C: Total inflow					**198790803833.39**	**m^3**
Lateral sinks outflow			0.00	m^3		
Open boundaries outflow			198790780217.73	m^3		
D: Total outflow					**198790780217.73**	**m^3**
E: Continuity balance = B-A-C+D =					**21124.51**	**m^3**
Relative deficit E/max(A,B,C,D) =					**0.00**	**()**

Water volume balance summary

Discussion



- Preliminary MIKE 11 model successfully set up.
- Model is a preliminary, simplified, simulation of river flow.
- Results analysis facilitated by powerful visualization component.
- Important water flow parameters such as Manning's coefficient are crucial for accurate results.
- When coupled with MIKE SHE, model will be able to simulate complete water cycle hydrology.
- MIKE SHE is an integrated modeling system, which couples the surface water and the groundwater processes.
- MIKE SHE is able to successfully model rivers and channels (1D), overland flow (2D), unsaturated zone flow (1D), and groundwater flow (3D).

Future Work

- Include hydraulic structures (culvert and weir)
- Model calibration and validation
- Couple with MIKE SHE
- Couple model with contaminant transport model (ECO Lab)

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