Table 1B. Summary of models to be considered as mid-level nonpoint source pollution loading models (Table 2 of 2)

		Water Quality					Water Quantity: Hydrology / Hydraulics			BMPs					
	Model	Estimates sediment and nutrient loads [Water Quality]	Provides reduction estimates for BMP treatment trains	Allows for local event mean concentrations or export coefficients	Linear Conveyance Removal	Custom particle inputs	Estimates runoff volumes [Water Quantity]	Incorporates distributive curve number approach	Simulation of in-stream processes	Provides load reduction estimates associated with BMPs	Models infiltration BMPs	Allows additional BMPs to be added	Ag BMPs	BMPs of various scales (micro-scale to regional scale)	Selection Comments
	Criteria Source	(EPA)	(EPA)	(EPA)			(EPA)	(EPA)		(EPA)	(EPA)	(EPA)			
Complexity = Simple															
1	EPA SIMPLE Method / PLOAD	Yes	No	Yes – EMCs; No – export coefficients	No pollutant removal via conveyance or transport; EMCs account for removal	EMCs are user-specified for user-specified pollutants… sediment could be specified separately for particles of various sizes.	Yes	No, but runoff is distributed, not lumped	No	No, except where EMCs are adjusted downwards to account for BMP treatment	No	No, except where EMCs are adjusted downwards to account for BMP treatment	Only via determination of EMCs	No, except where EMCs are adjusted downwards to account for BMP treatment	EPA Simple Method / PLOAD - If L-THIA and STEP-L are already used in Michigan; the comparable Simple Method is NOT a good choice for the top 6 picks. It does not handle BMPs and does not appear to be used as much in Michigan (based on surveys). It is also very hard to add BMPs after-the-fact using the Simple Method.
2	High Impact Targeting (HIT) Model	Estimates erosion and sediment loads	NA	Uses RUSLE and SEDMOD to predict sediment yield	No	No	No	No	No	Limited: see Ag BMP column	No	Yes	Yes: Mulch-till, no-till, grass BMPs	No: field-scale BMPs only	Model developed for agricultural applications only.
3	**L-THIA: Long-Term Hydrologic Impact Assessment**	Yes	Aggregation of BMPs – BMPs are simulated as a change in CN	EMC data used to predict NPS pollutant masses	No	Yes: Advanced L-THIA permits user to provide their own EMC values	Yes: Average annual runoff	Yes	No	Yes: BMPs not modeled explicitly; CN modified to account for LID (bioretention; porous pavement; narrowing impervious surfaces, green roofs)	Yes	Yes	No	Micro (individual lot) scale	**Selected for further evaluation.** Spreadsheet-based (easy to use, low data needs), set-up to look at long-term impacts (average annual conditions), BMPs can be modeled. However, Ag BMPs not explicitly represented. BMP modeling very simplified (uses a surrogate change in CN).
4	PondNET	Yes	Only ponds and sedimentation-type BMPs in series	Yes – EMCs; No – export coefficients	None (only in-lake P & sediment sedimentation)	None	Yes	No	No	Yes, but limited – ponds and sedimentation-type BMPs	No	No	No	Yes	Does not allow for evaluation of a range of BMPs.
5	SPARROW: Spatially-Referenced Regression on Watershed Attributes	Calculates annual stream-load values based on monitoring data availability	No	No	No	Yes	Yes	No	No	No	No	No	No	No	SPARROW is TOO large-scale. At a recent modeling conference in Boulder, CO (Fifty Years of Watershed Modeling - Past, Present and Future, ECI Conference) it was expressed that some thought it was not such a good model since it was too over-generalized.

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6	**Spreadsheet Tool for Estimating Pollutant Load (STEP-L)**	Nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5)	Yes - BMP calculator calculates combined BMP efficiencies for a watershed	Annual nutrient loading calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices.	No	Yes	Yes	Hydrology - CN approach; nutrient concentration in runoff/shallow groundwater	No	Yes – based on user input of BMP efficiencies; (determined using BMP efficiency calculator) – changes in land use. Need to have good sense of true efficiencies in each situation. Rainfall data must be accurate or loads can vary considerably	Yes – Infiltration swale, trench, basin	Yes	Yes	Individual lot-scale BMPs (e.g. urban BMPs) can be specified, but effects appear to be evaluated at the watershed scale	**Selected for further evaluation.** Useful model because it is spreadsheet-based, easy to use, average annual conditions are modeled and urban BMPs *and* Ag BMPs can be modeled. BMP modeling is simplified – based on BMP efficiencies rather than actual simulation of processes. That said, even HSPF works this way for structural BMPs such as detention ponds and infiltration basins.
7	StormWISE: Storm Water Investment Strategy Evaluator	No. Data on nonpoint pollutant loads generated elsewhere.	No	NA – pollutant loading generated in separate modeling effort.	NA – pollutant loading generated in separate modeling effort.	NA – pollutant loading generated in separate modeling effort.	NA – pollutant loading (and hydrology) generated in separate modeling effort.	NA – pollutant loading generated in separate modeling effort.	NA – pollutant loading generated in separate modeling effort.	For TN, TP and TSS only. Provides guidance on which drainage areas and land-use categories should be given priority for locating BMP implementation projects.	Not explicitly. BMP performance-cost trade-off function plots amt of pollutant loading reduction achieved in a subwatershed vs cost of BMPs	Not explicitly	No	No	StormWISE is just for urban applications.
8	Watershed Treatment Model (WTM): 2010 Version	Evaluates N, P, TSS and bacteria	No: Individual BMPs and total of all BMPs	Primary sources uses runoff coefficients for each land cover category (turf, forest and rural)	No	Yes	Yes	No	No	Yes: Erosion and sediment control, stormwater treatment, riparian buffers	Not explicitly: model BMP to capture water quality event or first inch of runoff	Yes	No	No: Strength is smaller scale model	Does not appear to be a good model for larger scale application.

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Complexity = Medium															
9	AGNPS	Yes	No	No	Includes CONCEPTS stream corridor model	No	Yes	Runoff calculated using the curve number method	Includes CONCEPTS stream corridor model	Only land-management based BMPs	No	No	The model can be used to study the effects of alternative cropping and tillage systems including the effects of fertilizer, pesticide, irrigation application rate as well as point source yields and feedlot management	No	Model developed for agricultural applications only.
10	BasinSim 1.0	Yes – reported annually	No	Yes – same as GWLF	Yes	Yes – option to manipulate monthly nutrient data	Yes	Yes	No	No – only landuse changes	No	No	Yes	No	This would be evaluated under the Generalized Watershed Loading Functions (GWLF) models
11	Flux32	Yes – based on interpolation of water quality data	No	No	None	None	Yes – based on direct-entry of continuous flow data	No	None	None	No	No	None	None	FLUX32 and LOADEST appear to be NOT useful. They are a tool for model calibration (getting water quality data set-up properly for calibrating to pollutant loads), but they are certainly NOT watershed models.

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12	**Generalized Watershed Loading Functions (GWLF)**	Yes	Yes (MapShed)	Surface nutrient losses are determined by applying dissolved N and P coefficients to surface runoff and a sediment coefficient to the yield portion for each agricultural source area. Urban nutrient inputs are all assumed to be solid-phase, and the model uses an exponential accumulation and washoff function for these loadings.	Yes	Yes	Yes	Yes	No	MapShed has the ability to consider the potential effects of best management practices (BMPs) and other mitigation activities on pollutant loads Any reductions made are based on the extent to which different measures are applied and the reduction coefficients associated with those measures	MapShed: Infiltration facilities are trenches, basins and/or porous areas designed to allow specific volumes of runoff water to drain to underlying groundwater rather than directly to streams via overland flow	Yes	Pollution Reduction Impact Comparison Tool (*PRedICT*) software application was developed for use in evaluating the implementation of both rural and urban pollution reduction strategies at the watershed level	Yes	**Selected for further evaluation.** These models address snowmelt, perform continuous simulation, include urban BMPs and Ag BMPs, and are EPA endorsed. GWLF serves as the base software for a number of other models (e.g. BasinSIM, StormWISE, and GWLF MapShed) all of which will be evaluated for the next phase of the project.
13	LOADEST	Yes – based on interpolation of water quality data	No	No	None	None	Yes – based on direct-entry of continuous flow data	No	No	No	No	No	No	No	FLUX32 and LOADEST appear to be NOT useful. They are a tool for model calibration (getting water quality data set-up properly for calibrating to pollutant loads), but they are certainly NOT watershed models.
14	LSPC* Loading Simulation Program in C++	Yes	No	No	Simplified stream transport model	Yes	Yes	Does not use curve number, but runoff generation is distributed (not lumped)	Yes - in-stream water quality	No	No	No	No	No	Does not model BMP load reductions. Appears to be too large-scale and complicated: similar routines as HSPF.

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15	**P8**	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	**Selected for further evaluation.** Relatively simple but provides continuous simulation and explicit BMP representation. Ag component appears to be lacking - would need to be addressed through user-input. Max. devices less than 100 - limitations on size/complexity of watershed.
16	PCSWMM*	Yes	Yes	No, buildup/washoff routine	No	Yes	Yes	Yes, multiple hydrology methods available	No	Yes	Yes	Yes	Yes, pending completion of current updates	Each BMP must be modeled individually. No aggregate BMPs	Not recommended due to cost concerns.
17	SLAMM** Source Loading Management Model	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	SLAMM does not model BMPs in series. The newest version of WINSLAMM allows for this but is in beta testing.
18	SWMM** Storm Water Management Model	Yes	Yes, but simplified due to static particle size distribution	Yes	No	Yes	Yes	No	No	Yes, limited by static particle distribution	Yes	Yes	No	Yes	SWMM (XP and PC) does not do a good job of pollutant fate and transport (it is more or less manually entered via build-up and wash-off coefficients).
19	XP-SWMM*	Yes	Yes, but simplified due to static particle size distribution	Yes	No	Yes	Yes	Yes, multiple hydrology methods available	No	Yes, limited by static particle distribution	Yes	Yes	No	Yes	SWMM (XP and PC) does not do a good job of pollutant fate and transport (it is more or less manually entered via build-up and wash-off coefficients).

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Complexity = Complex															
20	CONCEPTS	Yes, streambank derived sediment only	No	No	Yes	Yes	No	No	Yes	Yes, streambank derived sediment only	No	Yes, streambank only	None	Streambank stabilization only	CONCEPTS is more for streams and not really for the purposes identified here.
21	**HSPF** *Version 12* Hydrologic Simulation Program FORTRAN**	Yes	No	No	In-stream water quality is modeled.	% distribution of sediment (sand, silt, clay) is specified manually	Yes	Does not use curve number, but runoff generation is distributed (not lumped)	Yes, hydraulics are simplistic (stage-area-discharge tables), water quality is more robust	Yes – for management-based or land-cover change BMPs; No – for structural BMPs, which are implemented coarsely (% application & % removal entered by the user).	No –BMPs are implemented coarsely (% application & % removal entered by the user).	Yes – for management-based or land-cover change BMPs; Yes – for structural BMPs, which are implemented coarsely (% application & % removal entered by the user).	Yes, landscape and management	Micro-scale BMPs not modeled very robustly (overall % application and % removal). Large-scale BMPs (e.g. cropping methods or nutrient appl.) modeled well in HSPF.	**Selected for further evaluation** HSPF does everything (to a certain degree) that we are looking for and is endorsed, validated, mainstream, etc. Complexity of inputs required is a major drawback.
22	SUSTAIN	Yes	Aggregation of Distributed BMPs or BMPs can be individually defined	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	Micro-scale to regional scale	SUSTAIN does not work well enough at this stage of its development.
23	**SWAT (Soil-Water Assessment Tool)**	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Not well but options are available	Yes	Yes	Yes	**Selected for further evaluation** Does everything (to a certain degree) that we are looking for and is endorsed, validated, mainstream, etc. Would be the model of choice for agricultural areas. It is more complex but it could be simplified by assigning default values for different input files.
24	WAMView* Watershed Assessment Model with an ArcView Interface	Yes (P, N, TSS, BOD)	Can assess P load strategies including use of stormwater treatment areas	No, P and N transport submodels and impervious sediment buildup/washoff	Yes. Provides stream reach flow rates and concentrations	No	Yes	No	Full erosion/deposition and in-stream routing - is used with pond/reservoirs	Yes	Yes	Yes	Yes	Yes	Developed specifically for use in Florida. More recently modified so it can be applied to other watersheds although there is little documentation supporting its use outside of Florida and New Zealand.

* Source of info on these models: TMDL Model Evaluation and Research Needs. November 2005. EPA/600/R-05/149 – These look like they meet all requirements

** Source of info on these models: TMDL Model Evaluation and Research Needs. November 2005. EPA/600/R-05/149 – Need to confirm some of the requirements

Criteria Source (EPA) – Identified in the EPA SOW as criteria to be considered. SOW also indicated that the criteria list was not exclusive of others. Those without (EPA) are others proposed for consideration.