The following table is an excerpt from the "Adaptive Management Technical Handbook". The complete guidance document is available at http://dnr.wi.gov/topic/SurfaceWater/AdaptiveManagement.html.

Estimating load reductions from nonpoint sources

The phosphorus reductions calculated above set the minimum reductions needed from adaptive management partners such as agricultural producers and MS4s for each permit term. The adaptive management plan must include modeling to ensure that the needed reductions will be achieved from the management measures selected in Step 5 of the adaptive management plan. Agricultural information is sometimes considered proprietary (not available to the public). Given this, and the constantly changing dynamic of land use practices within a watershed, it can be very difficult to gather sufficient data to model the land use for your entire action area.

To account for these restrictions, WDNR does **not** expect field-by-field modeling for the entire action area. Rather, WDNR recommends that models be run using approximate land use conditions to estimate the reductions received from various management practices. To further focus the modeling effort, modeling activities should focus on quantifying management measures within the critical area. As the adaptive management plan is implemented and more reliable land use data becomes available, models should be re-run to ensure that the needed reductions are being accomplished in the watershed.

Models can also be used to demonstrate interim compliance with adaptive management in cases where residual phosphorus loading in the receiving water prohibit measured reductions from monitoring data. In these cases, models should be selected that relate land use practices to water quality concentrations.

What models are available for use?

Facilities using nonpoint source phosphorus reductions in conjunction with the adaptive management option will be required to evaluate where phosphorus will be reduced and what type of reduction is achieved using certain best management practices (BMPs). Following the identification of critical phosphorus areas within the watershed (Step 4 of the Adaptive Management Plan), the subsequent step is to evaluate what the implementation of management practices within the targeted zones means for phosphorus load reductions. There are many models available to help determine this. The following models have been applied throughout Wisconsin to help estimate the phosphorus reduction through improved landscape practices:

- Agricultural Policy/Environmental eXtender (APEX)
- Program for Predicting Polluting Particle Passage thru Pits, Puddles, & Ponds (P-8)
- SNAP-Plus (Wisconsin Phosphorus Index)
- Spreadsheet Tool for Estimating Pollutant Load (STEPL)
- Soil and Water Assessment Tool (SWAT)
- Source Loading and Management Model for Windows (WinSLAMM)

Table 1 summarizes each of the above models, reviewing their functional scale, if model calibration is required, and the types of BMPs assessed with respect to evaluating phosphorus reductions. It should be noted that the one land type not able to be explicitly assessed using the models listed is barnyards. Barnyard models such as the USDA Barnyard Evaluation Tool (BERT) and BARNY, a Wisconsin adapted version of the ARS feedlot runoff model, are qualitative ranking tools and are less effective at quantifying load reduction. If barnyard practices are utilized as an adaptive management practice, the adaptive management applicant may want to consider offsetting more than the minimum requirement in permit terms 1 and 2 to account for the potential inaccuracy associated with barnyard models.

The landscape models discussed in this portion of the guidance vary in their complexity and have known strengths and weaknesses. The selection of a model includes factors such as the question being answered, the complexity of the landscape and the level of detail required from the model output. Simple landscape models such as STEPL require generalized data such as estimated landcover composition. A simplistic model approach typically relies on landuse-based export coefficients, yielding an event-based or average annual phosphorus load. Robust, process-based models such as APEX or SWAT require detailed data inputs; however, the benefit of such a model is that the output can be tied to in-stream water quality at a sub-annual time step. All models, regardless of their ease of use, require proper model conceptualization. In addition, all the models discussed in this step model some type of BMP. It is recommended that the simulation of BMPs include design and efficiency based on technical standards from agencies such as WDNR, NRCS, and DATCP.

While the models listed have traditionally been used to simulate phosphorus reductions from the landscape with typical BMPs, permittees are not limited to those models cited. If permittees have questions about another model's applicability, they can contact the WDNR water quality modeling group (dnrwaterqualitymodeling@wisconsin.gov) for input.

Table 1. Summary of Tools for Estimating Phosphorus Load Reductions.

Model	Functional Scale	Calibration Recommended?	Types of BMPs	
APEX	Field to Watershed	Yes	• buffer strips • channel protection • cover crops • crop change • infiltration trench	• stream restoration • terraces • tillage • wetland creation
P-8	Urban Watersheds	Yes	• buffer strips • detention ponds • flow splitters	• infiltration basins • pipes • swale
SNAP-Plus	Field to Farm	No	• contour cropping • cover crop • crop change	• fertilizer • filter strips
STEPL	Field to Watershed	No	• alum treatment • bioretention • contour cropping • diversion • dry retention • fencing • filter strips • gully stabilization	• infiltration basin • swale • strip cropping • streambank stabilization • separation basin • terraces • waste storage facility
SWAT	Watershed	Yes	• contour cropping • cover crop • crop change • fertilizer	• filter strip • infiltration basin • land use conversion • tillage
WinSLAMM	Urban Watersheds	No	• catch basin cleaning • filter • impervious disconnection • swale	• pond • street sweeping

APEX (Available at http://epicapex.brc.tamus.edu/ or http://apex.tamu.edu/) Maintained by the Texas A&M AgriLife Research & Extension Center	
Background	The Agricultural Policy/Environmental eXtender (APEX) model provides a continuous-time daily simulation to predict the impact of management practices on soil and water quality at the edge-of-field and watershed. The model can be linked with the Soil and Water Assessment Tool (SWAT) to evaluate small-scale impacts within a larger watershed.
Interface	Windows (WinAPEX)or ESRI ArcMap Add-in (ArcAPEX)
Scale	Field / Watershed
Time Step	Daily
Input	• Topography (DEM) • Soils (STATSGO / SSURGO) • Time series metrological data (User defined or from model database) • Land use • Land management (tillage, crop, fertilizer, herd size)
Output	• Daily stream flow • Daily sediment load and concentration • Daily phosphorus load and concentration
BMPs	• Structural practices: infiltration trench, terraces, wetland creation, stream restoration • Nonstructural practices: no till, cover crops, buffer strips, channel protection Complete list: http://apex.tamu.edu/media/57882/conservation-practice-modeling-guide.pdf

P-8 (Available for download at http://wwwalker.net/p8/) Maintained by Dr. William Walker	
Background	The Program for Predicting Polluting Particle Passage through Pits, Puddles, and Ponds – Urban Catchment Model predicts the generation and transport of stormwater pollutants in urban watersheds.
Scale	Watershed (Urban)
Time Step	Hourly
Input	• Time series metrological data • Land area and use (and associated curve number) • Pervious and impervious surface percentages • Existing BMPs (and parameters for pond, basin, buffer, pipe, splitter) • Depressional storage
Output	• Water and mass balances • Mean inflow and outflow concentrations • BMP removal efficiencies • Sediment accumulation rates
BMPs	• Structural practices: swales, detention ponds, flow splitters, infiltration basins, and pipes. • Nonstructural practices: buffer strips

SNAP-Plus (Available at http://www.snapplus.net/) Maintained by the University of Wisconsin - Madison Department of Soil Science	
Background	SNAP-Plus is the interface for the Wisconsin Phosphorus Index and is designed to produce a nutrient management plan. In accordance with Wisconsin's nutrient management standard code 590 the tool also simulates annual sediment and phosphorus losses from cropland.
Interface	Windows
Scale	Field / Farm
Time Step	Annual
Input	• Field Acreage • Crop per year • Tillage per year • Field characteristics (*size, slope, slope length, below field slope to water, distance to water*) • Soil test information (*pH, percent organic matter, phosphorus, potassium, and buffer pH*) • Fertilizer or manure amount, method, season, and composition (N, P, K, percent dry matter)
Output	• Phosphorus export • Soil loss
BMPs	• Nonstructural practices: contour or strip cropping, filter strips, cover crops, changes in management (crop rotation, fertilizer or manure, tillage)

STEPL (Available for download at http://it.tetratech-ffx.com/stepl/default.htm) Maintained by the US EPA	
Background	The Spreadsheet Tool for Estimating Pollutant Load (STEPL) is a regression-based model with simple algorithms that calculates sediment and nutrient loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs).
Interface	Microsoft Excel Workbook
Scale	Field to Watershed
Time Step	Annual
Input	• Drainage area and Land use • Hydrologic soil group • Metrological data (pre-loaded precipitation stations) • Animal units and manure application • Septic systems and point sources • Universal soil loss equation parameters per land use Model input generator (http://it.tetratech-ffx.com/stepl/steplweb.html)
Output	• Annual phosphorus and sediment load • BMP Efficiencies
BMPs	• Structural practices: terraces, bioretention, dry retention, streambank stabilization and fencing, infiltration basins, swales, diversion, separation basin, waste storage facility • Nonstructural practices: contour or strip cropping, buffer strips, alum treatment • Custom BMPs with known pollutant load reduction efficiency rates

SWAT (Available for download at http://swatmodel.tamu.edu/) Maintained by the Texas A&M AgriLife Research & Extension Center	
Background	The Soil and Water Assessment Tool (SWAT) model is a continuous-time, physically-based model that can predict the impact of land management practices on water, sediment, and nutrients within complex, mixed land use watersheds. The model is relatively complex; calibration to measured flow and water quality is recommended.
Interface	Fortran executable, EPA BASINS, or ESRI ArcMap Add-in (ArcSWAT)
Scale	Watershed
Time Step	Daily
Input	• Time series metrological data • Soils • Land use • Topography • Land Management • Hydrology • Point Sources
Output	• Discharge at various scales • Sediment and nutrient concentrations and loads at various scales • Crop yields • Water and mass balances
BMPs	• Nonstructural practices: contour and strip cropping, changes in management (crop rotation, cover crop, fertilizer, tillage), changes in landuse (cropped to grassland), buffer strips • Structural practices: infiltration or detention basins, wetlands

WinSLAMM (Available for download at http://www.winslamm.com) Maintained by the PV & Associates	
Background	Source Loading and Management Model for Windows (WinSLAMM) is a proprietary model used as an urban watershed decision support system. Computations are based on extensive field data collected in Wisconsin.
Scale	Watershed (Urban)
Time Step	Hourly
Input	• Drainage area • Soils • Time series metrological data • Pervious and impervious surface percentages • Land use (types of urban such as parking lots, roofs) • Existing BMPs
Output	• Phosphorus concentration and yield at outfall • BMP removal efficiencies
BMPs	• Structural practices: ponds, swales, and filters • Nonstructural practices: street sweeping, catch basin cleaning, and impervious area disconnection