DEVELOPMENT OF NUTRIENT MANAGEMENT PLANNING AND ENVIRONMENTAL RISK ASSESSMENT SOFTWARE

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The Maryland Water Quality Improvement Act of 1998 initiated the most comprehensive nutrient management planning requirements in the United States. The law requires that mandatory nutrient management plans be filed and implemented within the state of Maryland. Crop fields with high soil test phosphorus levels must have plans that evaluate a field site=s potential for phosphorus loss through the use of a Phosphorus Site Index environmental risk assessment calibrated for Maryland conditions. Phosphorus risk assessment additionally requires an assessment of soil erosion since sediment-bound phosphorus may potentially be a significant phosphorus loss pathway. Designing plans for the implementation of these nutrient management and environmental risk assessment requirements can be a very complicated process. Microsoft Windows software tools were needed that would make it possible for nutrient management consultants and farmers to meet the requirements of the Water Quality Improvement Act of 1998.

Research was proposed in 1998 and initiated in 1999 for the creation of such software tools. The Maryland Department of the Environment competitively funded a proposal for the creation of software to calculate the Maryland Phosphorus Site Index. The Maryland Department of Agriculture funded a proposal for the creation of Windows-based software for developing nutrient recommendations for crops. The combination of these two grants with support from the College of Agriculture & Natural Resources provided a sufficient level of support to successfully complete the proposed research. Concurrent development of both software products allowed for coordination of design efforts with the ultimate goal of developing and combining the nutrient management planning software, the phosphorus site index software, and the Revised Universal Soil Loss Equation software into a comprehensive nutrient management planning tool.

Guidelines established for software development included:
(1).   The software would be Windows-based so that it would easily run on Windows 95, 98, NT, or 2000 operating systems.
(2).   The software would be developed with a high level programming language (Microsoft Visual C^{++}).
(3).   The software would be user-friendly with pull down menu choices for soil properties and help screen support.
(4).   The software would produce both written reports and scenario files that could be electronically submitted for regulatory compliance or record keeping at a future date.
(5).   An object-oriented programming approach would be used where possible so that modules may be reused in future versions with minimal revision to the modules.
(6).   The program code would be Asoft-coded@ in that variable names instead of numerical values would be used with values supplied via attribute files. These attribute files could be edited by

authorized scientists and the software program easily updated.

An initial issue that needed addressing was that soil properties information, necessary when using the Phosphorus Site Index, for several Maryland counties was not readily available because of soil survey updates being conducted. Maryland NRCS also stated there were an insufficient number of soil surveys available to meet the needs of statewide implementation of the phosphorus site index. An interim software product entitled Phosphorus Index Properties for Soil (PIPS) was created and released in January 2000. Queries of the USDA-NRCS National Soils Information System (NASIS) database were conducted for each of the twenty three Maryland counties. The results of these queries were then placed in a Windows program with an easy-to-use interface.

The Maryland Phosphorus Site Index (PSI) software was released in April 2001 as a water quality planning tool to evaluate the risk potential of phosphorus losses from agricultural lands. The Windows-based software evaluates the P loading risk assessment for controlling phosphorus losses in a rapid, efficient, and easy-to-use manner. The PSI program includes all the information previously furnished in the Maryland Phosphorus Site Index Properties for Soils (PIPS) software product. The PSI program furnishes information necessary for calculating the PSI in Maryland and includes soil mapping unit information for each Maryland county, soil leaching potentials, and watershed information. Features include evaluating the impacts of buffer areas and the impacts of split applications of manure and/or fertilizer on the PSI. The program includes a farmer and consultant input screen, a field information input screen, and screens for Parts A and B of the Maryland Phosphorus Site Index. Color-coded backgrounds were used to differentiate entry box use within the program. The background color of the Total P Loss Rating box is green for low, pale yellow for medium, dark yellow for high, and pink for very high. Options include weighted multiple applications and methods for fertilizer and/or organic materials and conversion of eight laboratories soil test results to Maryland fertility index values. Although a single field is addressed in the active window, the user may address and save information for up to 999 fields in a single file. Information may be printed on any Windows accessible printer in single or multiple field formats. Manual calculation of the Maryland PSI had proven burdensome to nutrient management consultants. Although the consultant is required to enter Revised Universal Soil Loss Equation information and site specific information into the computer, the program can easily save 30 or more minutes for each field on which the PSI calculation is completed.

The Nutrient Management for Maryland (NuMan MD) software was released in December 2001. NuMan MD operates in any 32-bit Windows environment and is much more versatile and easier-to-use than the FERTREC DOS-based software which it replaces. The software facilitates the use of organic wastes and fertilizers to meet crop needs in an efficient and easy-to-use manner. The program includes a farmer and consultant input screen, a crop/field information input screen, a soil test input screen, and screens for crop nutrient inputs from organic and/or fertilizer sources. The program will produce nitrogen, phosphorus, or potassium based plans and accounts for annual legume and/or organic nitrogen carry-overs, pre-sidedress nitrogen testing, and file-based soil test inputs. Split applications of the same or different organic wastes may be applied. The software has recommendations for over 200 crop/management scenarios and mineralization coefficients for 28 types of organic wastes. Options are available to calculate crop-based phosphorus removal and/or have recommendations in different units. The software produces written reports, but also saves

information in files for electronic report submission. The user may address and save information for up to 999 fields in a single file. NuMan MD is also compatible with existing FERTREC databases in that the new program will allow the extraction and insertion of information from previous FERTREC nutrient management planning efforts.

The Maryland Nutrient Management Software Laboratory is presently developing software that will integrate the calculations for the Revised Universal Soil Loss Equation model. This Windows-based software will allow the calculation of average annual soil erosional losses on a field basis in an easy-to-use manner. The laboratory also plans to merge the Maryland Phosphorus Site Index software, the Revised Universal Soil Loss Equation software, and the Maryland Nutrient Management software into a combined product tentatively named Maryland Nutrient Management for Professionals (NuMan MD Pro). It is anticipated the NuMan MD Pro software will go into beta-testing in early 2003 with a planned release in mid-2003.

The development of these nutrient management and environmental risk assessment software packages have provided the tools necessary for the agricultural community in Maryland to meet the nutrient management planning requirements of the Maryland Water Quality Improvement Act of 1998. Nutrient management planning and environmental risk assessment software is critically important to facilitate plan development in a timely fashion for the appropriate utilization of organic wastes and fertilizers in an environmentally safe manner.