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Examining the Effective Use of OnePlan Nutrient Management Planning Software Implementation in Oregon and Idaho

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Abstract. *The role of agricultural waste management planning has evolved over the course of many years. What used to be recorded with a pencil and paper on a notepad in a truck is now calculated in a carefully designed software package. What is the difference and is all the extra work worth the outcome? In the Pacific Northwest, specifically Oregon and Idaho, the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) has released a software package available for nutrient management planning called the OnePlan Nutrient Management Planner (NMP). OnePlan NMP is a planning, modeling and reporting tool for Comprehensive Nutrient Management Planning (CNMP). OnePlan NMP will be compared to another CNMP development tool, Manure Management Planner (MMP), for use in Oregon and Idaho. Among other topics, one of differences that will be evaluated is the ability of OnePlan NMP and MMP to account for wet winters and dry summers specific to outdoor storage needs in the Pacific Northwest. The results of a CNMP software evaluation survey are also included.*

Keywords. CNMP, NMP, OnePlan, MMP, SNMP, AWM, nutrient management, software

Introduction

A Comprehensive Nutrient Management Plan (CNMP) is a grouping of conservation practices and management activities related to animal operations which, when combined into a system, will ensure that both agricultural production goals and natural resource concerns dealing with nutrient and organic by-products and their impacts on the environment are achieved (USDA 2006 General Manual). To be complete an Oregon CNMP must address five natural resources: soil, water, air, plants and animals (USDA 2006 Oregon General Manual). Because a CNMP includes a variety of calculations on several different topics, many computer tools have been created as an aide for CNMP writers. The computer tools include Microsoft (MS) Excel spreadsheets, MS Access databases, and custom software applications. It is common for the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) to require the development of a CNMP before providing technical assistance to an animal producer through the Environmental Quality Incentives Program (EQIP) program. Many state regulatory agencies also require the development of a CNMP or similar report before issuing operating permits.

Every state can have slight differences that make their CNMP writing process unique. Landscape and weather patterns are examples of how the considerations for a CNMP document can vary from state to state and even county to county. As a result, CNMP tools that are written in some states cannot easily be used in another state. However, if a CNMP tool is broad enough to have minimal state specific information such as soil maps or crops whose data is similar in structure and only differ in content, the CNMP tool can be used across state lines by simply substituting the appropriate state specific information. In Oregon, there are several CNMP tools available but this paper will compare two products for their applicability to Oregon and Idaho: OnePlan Nutrient Management Planner (NMP) and Manure Management Planner (MMP). Because MMP only includes a portion of the functionality of OnePlan NMP, the tools commonly used in combination with MMP will also be discussed. These tools include Animal Waste Management Software (AWM) and Spatial Nutrient Management Planner (SNMP). When discussed as a whole product this suite of software packages (MMP, AWM, SNMP) will be referred to as MMP+. All referenced software packages have been tested using a set of Oregon case studies. The results and comparison analysis will be discussed in terms that relate to the needs of Oregon and Idaho NRCS.

To begin understanding OnePlan NMP it is important to understand the history of CNMP writing in Oregon and Idaho. The tool that OnePlan NMP replaces is an MS Excel spreadsheet called Oregon Animal Waste Management (ORAWM) in Oregon and a similar spreadsheet in Idaho called Idaho Animal Waste Management (IDAWM). The spreadsheet was designed with the anticipation of being replaced with a software package inclusive of all CNMP components. In the meantime, ORAWM and IDAWM became the unwritten requirement used in developing animal waste management plans across the state of Oregon and Idaho, respectively. This tool provides a consistency among plans that is greatly needed and provides sound calculations. Although ORAWM and IDAWM include many of the engineering calculations necessary to develop a CNMP, it does not develop all of the components needed for a CNMP. Independent calculations regarding the Oregon phosphorus index, irrigation scheduling, manure application scheduling, predicted soil loss and spatial features such as acreage calculations have to be completed outside of the spreadsheet tool. In addition, land use, soil, and headquarter maps need to be drawn and a CNMP report has to be compiled. The CNMP report must include the maps, the data from all the different worksheets, and all the calculations from ORAWM or IDAWM. Because of the time involved to gather and organize all the different components, Oregon NRCS saw a need for a more inclusive CNMP tool. The tool that most closely satisfied

Oregon's needs was a tool developed for Idaho to replace IDAWM, Idaho's OnePlan Nutrient Management Planner (IDNMP).

Idaho OnePlan Nutrient Management Planner (IDNMP)

IDNMP has a history of over five years of successful partnering between Idaho's Department of Agriculture, Idaho NRCS, the University of Idaho and the Environmental Protection Agency (EPA) in assisting Idaho's Dairy Industry in meeting EPA Animal Feeding Operations (AFO)/ Confined AFO (CAFO) requirements. Idaho Administrative Procedures Act (IDAPA 2008) requires a plan prepared in conformance with the 1999 Idaho 590 Nutrient Management Standard or other equally protective standard approved by the department for managing the amount, source, placement, form, and timing of the land application of nutrients and soil amendments for plant production, and for minimizing the potential for environmental degradation, particularly impairment of water quality. Idaho NRCS considered several tools and decided to choose a tool that could handle a diverse set of animal operations and be flexible enough to serve conditions in the future with minimal updates yet stay specific to conditions and requirements in Idaho. In compliance with the state regulation, the IDNMP was developed to assist planners in preparation of NMPs. Idaho Supreme Court also exempts CNMP plans developed with IDNMP from disclosure through the Public Records Act (Idaho Supreme Court 2006).

IDNMP is a planning, modeling, and CNMP writing tool. IDNMP was originally designed as a planning tool using NRCS standard and policy for compliance with state and federal agency requirements. It is used to assist an operator to plan for situations such as designing a new facility or expansion of facilities and waste storage systems due to an increase in animal numbers. After use as a planning tool, it evolved into a modeling tool for waste system design, a mapping tool, a distribution plan for application of bionutrients, nitrogen and phosphorus risk assessment and the generation of a report that has become the regulatory document used for permitting landuse within county ordinances. It can model situations such as roofed manure storage versus unroofed manure storage and types and slopes of feedlot surfaces, and calculate the volume of contaminated rainwater. IDNMP has the capability of addressing multiple farm/multiple field situations that allow the planner at both the facility and county level to look at application and risk assessment beyond the boundary of the facility and lands owned by the facility to as much scale as an entire watershed. Planners use IDNMP to quickly evaluate different management scenarios. Engineers use the tool to model different waste storage facility scenarios, and those interested in compliance with state and NRCS policy can review the output report for pertinent regulatory details. All of these components are packaged into the IDNMP and can be downloaded for free to anyone who has Windows XP, 300MB of disk space (for installation and storing plan data), 500MB RAM and an internet connection.

Oregon OnePlan Nutrient Management Planner (ONMP)

ONMP is patterned after Idaho's successful IDNMP. ONMP keeps all the functionality of IDNMP but state and county specifics were altered for Oregon and specific metadata unique to Oregon was added. The regulating agency, Oregon Department of Agriculture (ODA), and NRCS have worked together in creating a list of required items for a CNMP that meet both ODA requirements for a CAFO National Pollutant Discharge Elimination System (NPDES) permit and NRCS requirements. The output report is inclusive of all requirements of NRCS CNMPs as well as state regulatory requirements.

The mapping component in ONMP is web based and is the first step in the CNMP planning process. The web portion of ONMP is integrated into the ONMP software and no special

geographic information system software is required. The next steps involve characterizing the animals, bedding, and manure volumes. The manure densities are default values obtained from American Society of Agricultural and Biological Engineers (ASABE) and NRCS. Default bedding densities are also included as well as bedding types that are not necessarily common but are used in Oregon such as paper pulp. The bionutrients are then characterized into categories represented by storage type. Later in the program the user spatially designates the application of bionutrients on specific fields. Using rainfall data and the bionutrient categories, the planner can size the various storage facilities. The user has the option to designate the storage facility as planned or existing. This is especially useful when trying to determine if an existing storage facility is adequate. If it is not adequate the user can opt to move the remaining volume to a planned storage facility. The following screens require the user to input crop details including crop rotation information, irrigation details and soil lab analysis. With this information, ONMP makes an assessment of nutrient risks on the farm using the logic provided in the 2008 Oregon Nutrient Management 590 Practice Standard. The final output of ONMP is a CNMP document that meets Oregon NRCS and ODA requirements.

Manure Management Planner (MMP)

Purdue University developed a tool called Manure Management Planner (MMP) that is advertised as a tool broad enough to be used by 34 states by "automatically generating fertilizer recommendations and estimating manure N availability based on each state's Extension and/or NRCS guidelines" (Purdue 2007). The allocation process in MMP "helps to determine if the current operation has sufficient crop acreage, seasonal land availability, manure storage capacity, and application equipment to manage the manure produced in an environmentally responsible manner" (Purdue 2007). MMP is used as both a planning tool and a tool for creating manure management plans with associated documentation. MMP handles data entry through tabbed screens that resemble a spreadsheet. The following tabs are included: general, fields, assessment, soil tests, crops, storage, animals, rations, analysis, equipment and nutrient management. The nutrient management page allows the user to allocate nutrients from the different storage facilities on a monthly basis. After clicking on all the tabs and entering the required values, MMP produces a manure management report.

MMP+

In addition to installing MMP, the user has the option to install a mapping tool, Spatial Nutrient Management Planner (SNMP) developed by University of Missouri. However, before the download of SNMP will work the user will also need to obtain a copy of an expensive software package, ArcView 3.2 or 3.3, download soil data from the University of Missouri website and download Digital Orthophoto Quarter Quads (DOQQs) to obtain the aerial data. In order to estimate the production of manure, bedding, process water, and determine the size of storage/treatment facilities the Animal Waste Management (AWM) tool can be loaded on the user's computer as well. In addition to downloading and installing the AWM software, the user will need to obtain a copy of Microsoft Access version 2002 (USDA 2008 AWM). In order to understand how all the tools can be used together, help documents have been created to guide a software developer in the necessary steps to create custom reports, custom tools, and importing and exporting data exercises to help users share data between these individual software tools. The benefit to having separate tools for different components of the CNMP writing process is so planners can look at one component of the farm with a specific tool requiring data entry specific to that component only. This allows the planner to come to a decision quicker than having to assess all components of the farm before arriving at the component in question.

OnePlan and MMP+ Comparison

Storage Capacity

An example of the difference in the software packages is with the assessment of storage capacity. In MMP the storage screen simply asks for capacity of the storage facility and manure on hand at start of plan (Figure 1). With this information and the calculations done by MMP regarding the liquids and solids produced from the animals, an assessment is made over time to determine if the storage facility is at, under, or below capacity (Figure 2). Unlike ONMP, MMP handles these calculations by month. However, MMP does not accurately account for monthly storage volumes in locations where rainfall varies greatly throughout the year as in western Oregon and other areas in the Pacific Northwest nor for operations whose process water volumes vary throughout the year. Oregon rainfall varies from less than 10 inches to over 90 inches of rainfall a year on its coast. Change in liquid volume is an extremely important factor to consider when evaluating capacity of the liquid storage facility in parts of Oregon. MMP does not use a water budget to account for variations in process water production, rainfall runoff, or changes in manure production. MMP uses an average monthly wastewater production value which is appropriate for facilities that are contained mostly indoors where weather conditions have minimal impact on waste storage facilities. This assumption does not work well for Oregon dairies or Idaho feedlots where weather is an important factor to consider for outdoor waste storage facilities especially during the wet winters versus the dry summers. A major consideration to dairy farmers in western Oregon and many producers around the Pacific Northwest is to ensure that the storage facility has enough capacity to store all the manure and rainfall produced during one particular season, the wet winter. Manure cannot be spread during the wet winter because of saturated soil and/or frozen ground in Oregon and Idaho.

AWM is an additional software package that can be used in series with SNMP and MMP. AWM a is planning/design tool for animal feeding operations that can be used to estimate the production of manure, bedding, process water and determine the size of storage/treatment facilities (USDA 2008 AWM). As part of MMP+, AWM can calculate the MMP values: spreadable or pumpable capacity of the storage facility (Figure 1) and measured manure production versus the estimated manure production (Figure 3). The AWM Help Document (USDA 2008 AWM) provides a detailed description on how to use the information from AWM and input that appropriately into MMP. These instructions are found under the MMP tab within the AWM help document. In summary, AWM produces a report of the data that goes into MMP. Following the instructions, the user can open MMP and under the specified tabs, enter the appropriate information off the AWM report. After completing these steps, MMP can “more accurately be able to balance manure production & storage to manure removed for land application” (USDA 2008 AWM). Another tool that can be used in series with AWM is AFOPro™ which will not be discussed in this paper.

In ONMP the stored liquids and solids are evaluated based on a variety of parameters as shown in Figure 4. ONMP calculates the manure group numbers in the red rectangle (Figure 4) based on the entries in the upper portion of the screen. The manure group values can be overridden by the user with proper justification. After the facility has been spatially defined, the user is prompted to select a weather station that most closely represents rainfall at the facility. With that information, as shown in the rectangle in Figure 5, ONMP accounts for the liquid volume of precipitation in uncovered waste storage facilities. ONMP also considers runoff when assessing storage needs as shown by the circled example in Figure 5. ONMP allows the user to add as many rows as necessary to capture the different areas contributing to runoff. As with MMP, ONMP does not account for monthly changes in process water volumes. Although AWM does

have a monthly water budget as shown in Figure 6, there is no means to account for these monthly values in MMP.

The major difference with OnePlan NMP calculations and MMP calculations is how the software determines the volume of manure and water that enters the storage facility. MMP takes the production volume of manure and divides by 12 to determine the monthly inputs to the storage facility. Although OnePlan NMP does the same average calculation for manure, OnePlan NMP does account for the rainfall in the wet season versus dry season that is common in the Pacific Northwest. This is done with the value entered by the user for the days of storage. In general, the wet season begins on October first so OnePlan NMP begins counting the number of days needed for storage starting with the first of October when the storage period is 180 days. If the storage period is less than 180 days, or six months, ONMP searches the rainfall data and determines the months with the greater values for rainfall minus evaporation. The smallest allowable storage period is four months so the ONMP finds either the greatest 4 months of calculated rainfall or 5 months depending if the storage period days rounds up to 4 months (124 days) or 5 months (150 days), respectively. Another way ONMP accounts for the wet season versus dry season is that all of the runoff entered into the program is taken into consideration only during the storage period. The precipitation that occurs during this storage period is also considered for sizing an unroofed storage facility. At the end of the storage period, OnePlan NMP assumes that all runoff is negligible. This is because the dry season evaporation is commonly greater than rainfall amounts.

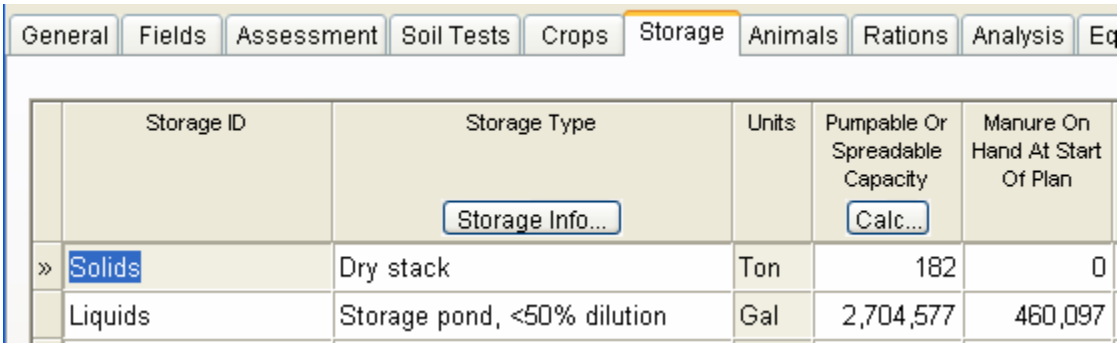

Figure 1. MMP Storage screen

Figure 2. MMP Nutrient Management screen

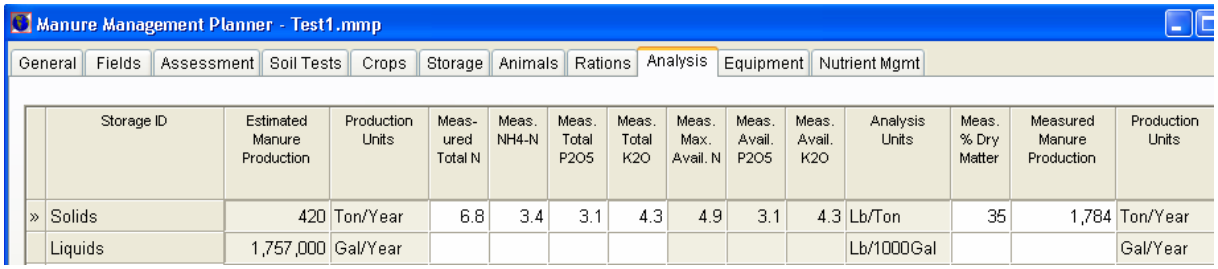

Figure 3. MMP Analysis screen

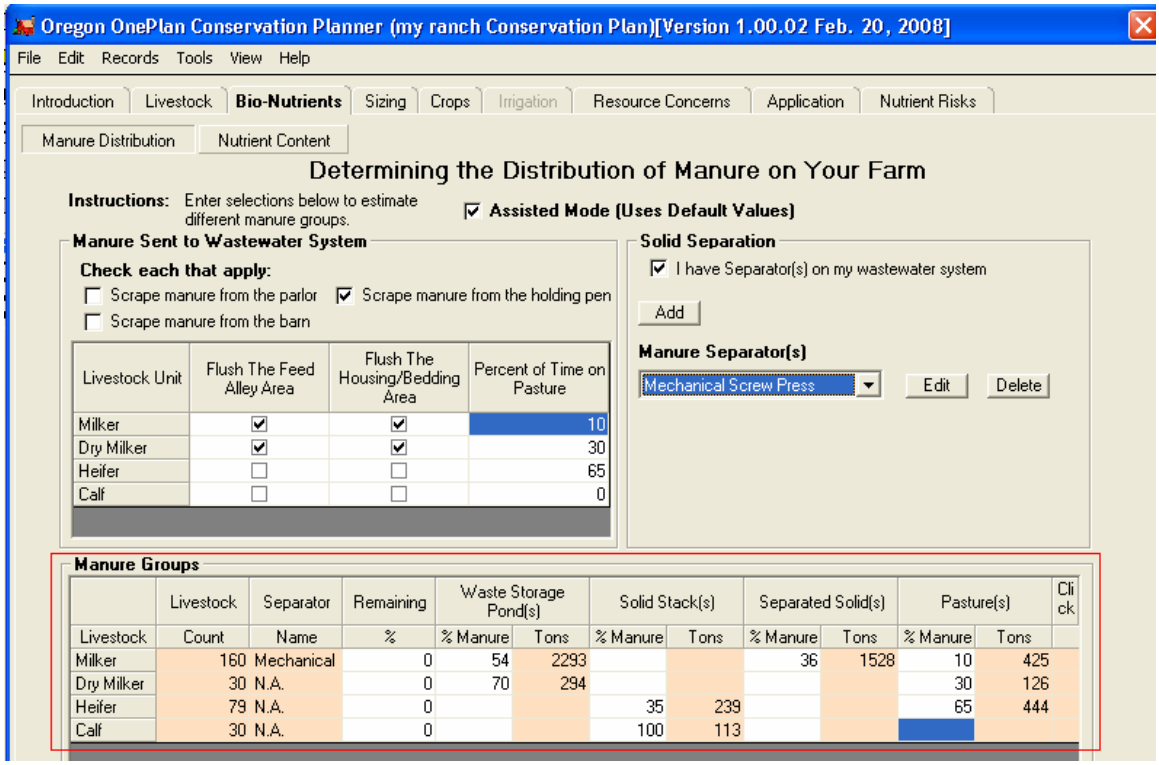

Figure 4. ONMP Liquid and Solid storage assessment screen

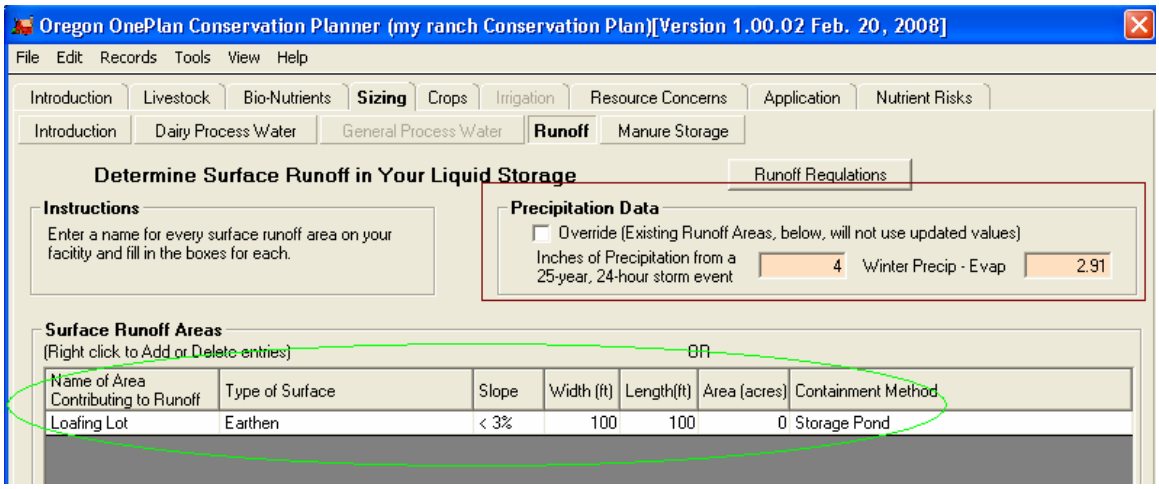

Figure 5. Precipitation and runoff assessment for liquid storage facility calculations

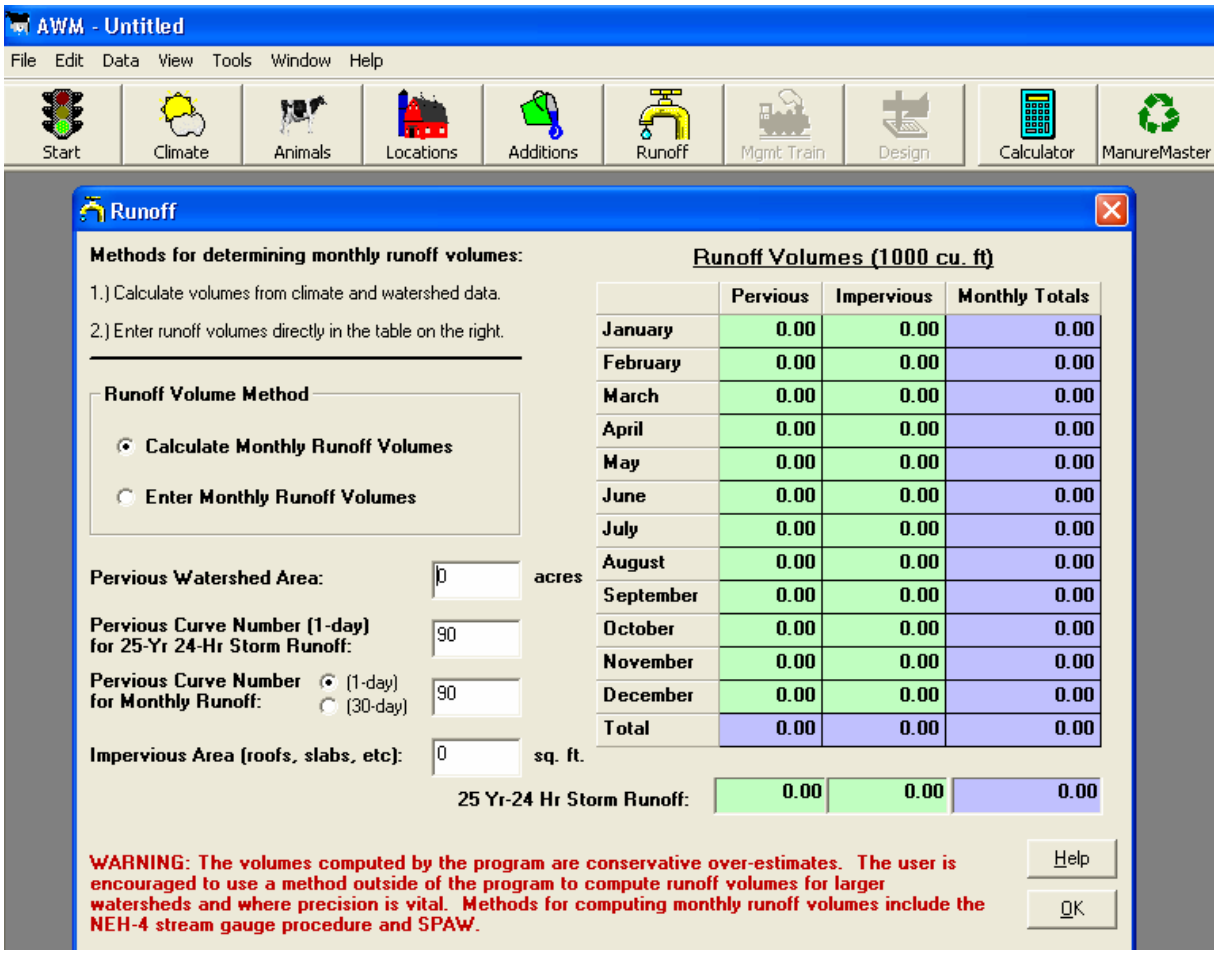

Figure 6. AWM runoff calculation screen

Phosphorous Index (p-index)

ONMP has many of the Oregon specific worksheets built into the application which eliminates the duplication of data entry required with other CNMP products that rely on multiple software packages used in series. For example, in Oregon there are two p-index worksheets. One worksheet represents questions pertinent to the west side of the state and another worksheet addresses questions pertinent to the east side of the sate. The ONMP refers to the selection made by the user on the weather station screen, performs an internal determination to decide whether that weather station is located on the east side or west side of the Cascades and then the ONMP prompts the user to answer the appropriate location specific p-index questions. ONMP includes the Oregon p-index evaluation (Figure 7) rather than requiring the user to fill out the worksheets independently to then enter the value into an empty box as done with the SNMP (Figure 8) and MMP (Figure 9) tools. In MMP, the data entry fields only accept numerical values, therefore, the number calculated from the worksheet must be manually entered in the box. SNMP has a radio button selection for the rating provided by the p-index worksheet. In ONMP, the Oregon p-index worksheet in its entirety is printed as part of the report. Having all CNMP components in one software package eliminates the need for the user to find and examine worksheets independent of the software.

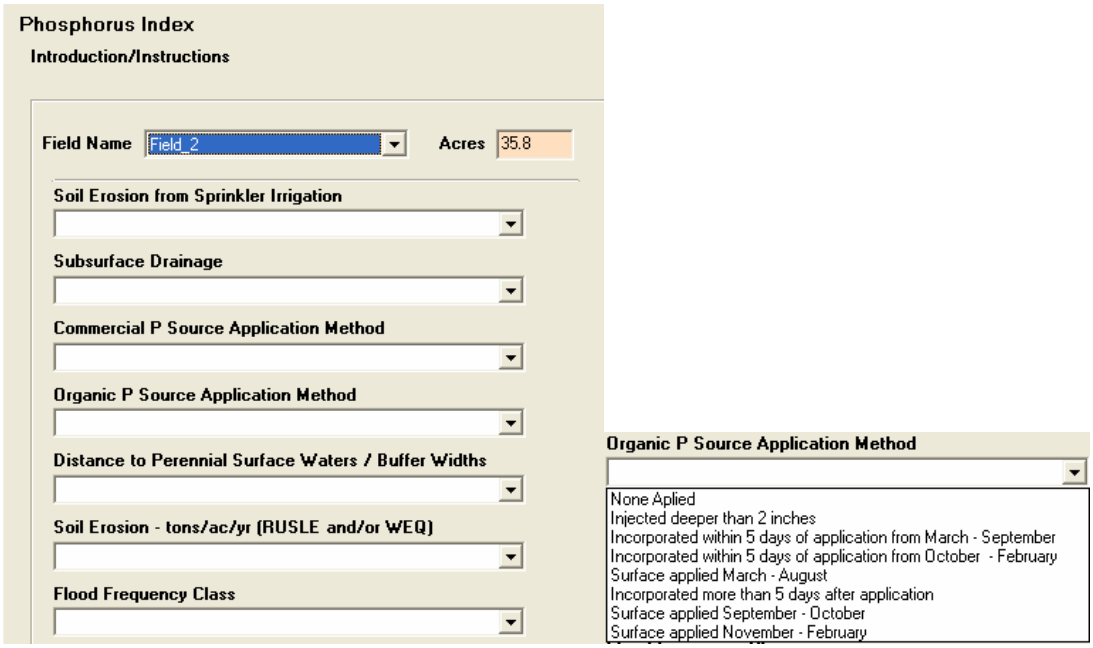

Figure 7. P-index rating entry in ONMP with example of a drop down list

Figure 8. P-index rating entry in SNMP

	Field ID	P Index Or Risk Index
»	1	16
	2	21.7
	3	22.1
	4	19.4

Figure 9. P-index rating entry in MMP

Crops

The spatial component in ONMP already contains the soil layer, CLU layer, and aerial photo without any extra download or import effort as required by SNMP. The soil information is then carried throughout the rest of ONMP and is considered in nutrient management calculations. ONMP is currently preload with 90 crops with the addition of more crops in the future. All of the information shown in Figure 10 is also preloaded with each crop. The information is derived from the appropriate Oregon or Pacific Northwest Fertilizer guides and preloaded into this table. This eliminates the need for the user to interpret the fertilizer guides. MMP comes preloaded with 48 crops in Oregon. However, it does not contain dry matter content or recognize the differences in crop nutrients between the east side and the west side of the Cascades.

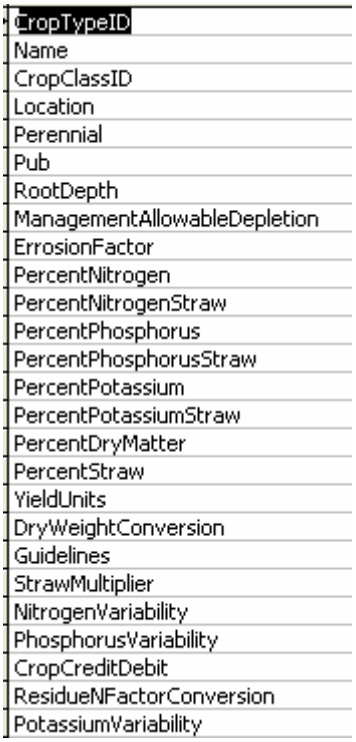

Figure 10. ONMP crop metadata

Nutrient Analysis

MMP makes fertilizer recommendations by "estimating manure N availability based on each state's Extension and/or NRCS guidelines" (Purdue 2007). Row 2 and row 3 in the example scenario (Figure 11) represent grass pasture with an estimated yield of 4 and 6 tons/acre, respectively. MMP populated the default N recommendation column with the same number, 100 for both rows. If different yields are produced for the same crop, it is likely a different management technique is being used. The 90 crop choices in ONMP provide choices based on crop management, therefore, changing the default N recommendation based on field management. MMP also references the Oregon fertilizer guide as shown at the bottom of the screen shot in Figure 11. The fertilizer guide reference points to both a guide on the east side of the Cascades and the west side of the Cascades. The problem with having a default fertilizer recommendation that combines data from both sides of the state is that each side of the state is unique and the default nutrient recommendations should be specific to the region. To have a recommendation for one side of the state that combines fertilizer recommendations from both sides of the state is not an accurate fertilizer recommendation. Additionally, in this example (Figure 11) OSU Fertilizer Guide 21, *Irrigated Clover-Grass Pastures*, is an outdated publication and not available electronically as indicated by the hyperlink.

ONMP users have the option to select crops with east side or west side designations and in some cases, further designations specific to counties, soils, or yields/cuttings. This reduces and/or eliminates the potential of providing an incorrect default nutrient recommendation and reference. ONMP has separate listings for east side and west side crops, and even further separates out crops where the fertilizer guides calls for different recommendations based on location (like the alfalfa fertilizer guides), soils (as in the spring grain fertilizer guides), and precipitation zones (east side wheat fertilizer guides). There are listings for forage, seed, and grain production for all crops for which there is are fertilizer guides that use soil test

recommendations, and there are no conflicting crop listing to confuse the user. Additionally, ONMP uses updated nutrient removal in the harvested portion numbers from a recently released Oregon State University (OSU) Extension service (OSU 2008) publication as well as the USDA NRCS Animal Waste Management Field Handbook (AWMFH). The OSU publication is specific to the west side forages, and includes yield and production parameters which are also built into the individual crop record.

In ONMP, the allocation of nutrients to the fields is a programmed calculation that considers phosphorus and nitrogen values first to determine if the field receives an allocation based on nitrogen or phosphorus uptake. Liquid is applied first starting with the first field in the list following up with pastured manure and then solid manure. Nutrients from liquids are applied first because it is less desirable to export liquids than solids. Whatever cannot be applied to the fields ends up in the export category. Although OnePlan NMP has this logic built into the program the user can choose to override these calculated values. For example, the nutrients from pastured animals may be evenly split between two different fields because of the grazing rotation. OnePlan NMP will assign all the nutrients that the first field can handle and then apply the remaining nutrients to the next field in the pastured list. This allocation does not accurately account for the described scenario. In this scenario, the user will need to manually override the nutrient values for the pastured fields. In Oregon and Idaho the calculations behind the allocation logic follow the current Nutrient Management 590 standard respective to that state.

ONMP does not have a monthly allocation budget for applied nutrients like MMP. ONMP simply allocates the nutrients in one lump sum so the timing of nutrient application during the dry season is done outside of ONMP. MMP has a month by month nutrient allocation page as shown in Figure 2 that considers available nutrients in the storage facilities as well as the nutrients required by the crop. If the user tries to allocate nutrients that are not available, the program sends a message to the user with that information. Other information observed in MMP+ that is not accounted for in ONMP includes anaerobic digesters (AWM), anaerobic lagoons (AWM), pond liner design (AWM), feed rations (MMP), and monthly analysis of storage volumes (MMP). Items included in ONMP that are not in MMP+ include a mortality management section, a nutrient leaching risk analysis, and NRCS conservation practices for planning purposes.

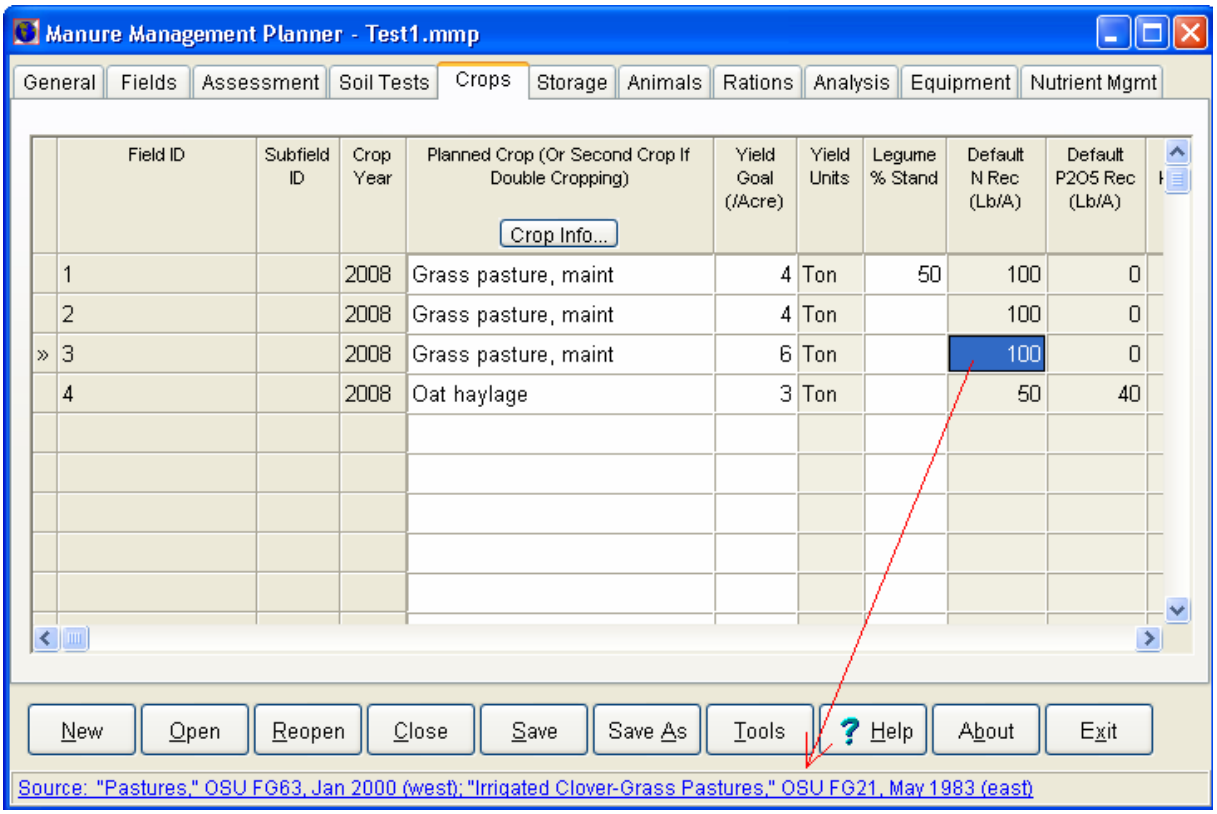

Figure 10. MMP Crops Tab

Survey

A small survey was conducted by the Idaho Association of Soil Conservation Districts to gather input from CNMP writers who are either familiar with OnePlan NMP or have used OnePlan NMP. Only seven people were included in the survey due to the unique skill set and experience required to answer the questions. The survey included US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) staff, Technical Service Providers (TSPs), and Idaho state regulatory staff. In general, the results indicated that users who use OnePlan NMP feel that this tool is adequate for developing a CNMP. Generally, users who used a custom spreadsheet or MMP felt the tool was not adequate. On this account, one person commented that "most numbers are figured on a calculator and the tool just figures the total amount of manure per acre and the nutrient balance". The users who were satisfied with MMP or their custom spreadsheet had invested many hours on their own perfecting a custom system to move data between the software packages and perfecting a custom system to generate reports that combined data from all the packages. Another response indicated that many software packages had to be used because not one package was adequate for producing a complete CNMP.

A question from the survey asked "What purpose do you primarily use CNMP software (rank the following in order): a) For the mapping functionality, b) For sizing storage facilities, c) For calculating nutrient losses due to storage, d) For calculating a nutrient balance, e) For estimating crop fertilizer (manure and/or commercial) needs. The most frequently chosen answer for a rank of 1 was d) For calculating a nutrient balance, and the second most chosen answer for 1 was b) For sizing storage facilities. Six out of the 7 people surveyed commented

that they did not know any landowners that used a CNMP software tool. However it was noted that there is a plan to provide landowners training on OnePlan NMP. Most people in the survey felt that the CNMP tools in general were too cumbersome and complicated for the average landowner. Everyone taking the survey felt that it was important for a CNMP software to produce a standard written report. Users commented that the report should be organized by the six categories required by NRCS CNMPs with a summary specifically aimed at the landowner. Both MMP and OnePlan NMP produce reports.

Conclusion

After completing a side by side comparison with ONMP and MMP/ MMP+, it was determined that although MMP+ satisfies many of the calculations required in Oregon, ONMP is inclusive of Oregon requirements and weather specifics that affect many of the calculations. This is due in part to the assessment of the dry season versus the wet season and inclusion of state specific p-index worksheet, livestock risk assessment worksheet, and risks associated with nitrogen, phosphorus and potassium as described in USDA (2008) NRCS Oregon's 590 standard. This is also due the common sense approach used in ONMP for data entry that make the software tool acceptable to for a variety of users from NRCS staff to landowners. One tool with one download and minimal system requirements is also considered a benefit compared to multiple software tools each with their own system and software requirements. This is especially the case in Oregon and Idaho where there are numerous CNMP writers from local government agencies to independent technical service providers.

Although MMP+ tools can be customized to meet most of Oregon CNMP requirements it would require significant time, budget, and knowledge of software development to match the power of ONMP. It would also require an information technology support person to acquire and manage the various software packages. However, if a user is willing to spend the necessary time and money to create a state specific CNMP tool using MMP+ and has the appropriate education and software to do so, it could be a powerful tool. OnePlan NMP Planner already has the power and precision built-in to make CNMP writing hassle free for as many users as possible in Idaho and Oregon.

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