
Appendix H: Tracking Tool Recommendations

Purpose of this Document

Tracking progress toward the Minnesota Nutrient Reduction Strategy (NRS) goals and milestones requires a wide array of program output and water quality outcome data and information from federal, state, and local partners and stakeholders. While a variety of tracking tools exist within many federal, state, and local agencies, a coordinated system for tracking nutrient reductions associated with implementation activities to support the NRS is not available.

The development of the program and water quality measures highlighted the challenges associated with compiling the data necessary to quantify implementation activities and nutrient loads by major basin. The data compiled for the suite of programmatic and water quality measures vary in collection methodology and frequency, documented in the measure metadata worksheets provided in Appendix F of the NRS. Data from several nutrient reduction programs are tracked through grant or program-specific systems such as BWSR's eLink. Over time, an inter-agency, integrated tracking tool will provide a more systematic approach for compiling the data from the various programs to support regular assessments of the NRS's progress and reporting to key stakeholders within and outside of Minnesota.

This document provides an overview of the preliminary requirements for a NRS tracking tool, as well as information on existing data management systems related to program measures, and an overview of IT efforts taking place in Minnesota that could affect the development of a NRS tracking tool. It concludes with recommendations on the type of tracking tool Minnesota should be considered to support progress tracking and reporting for the NRS goals and milestones, with both short- and long-term proposed tasks and estimated costs for tool development.

Preliminary NRS Tracking Tool Requirements

In information management system development, the term *requirement* is used to describe a feature, behavior, or performance goal expected from an information management system. In this context, requirements are the features and performance goals needed from a tracking tool to support the NRS. There are three types of requirements involved in the system development process: 1) business requirements, 2) user requirements, and 3) non-functional requirements. A description of each type of requirement is provided below. The sections below discuss preliminary system requirements. These requirements are by no means comprehensive; they represent requirements gleaned from the information provided by MPCA staff through the NRS development process. A more rigorous requirements analysis would be required prior to system development, but the information here could serve as a starting point.

Business Requirements

Business requirements provide the high-level vision for the NRS tracking tool. They explain the compelling reasons for the NRS tracking tool, including the expected benefits. At the highest level, these requirements define what would be expected for the tracking tool to be successful. The business requirements will enable MPCA and other agencies involved in NRS implementation to measure the success of the tracking tool by tracing the requirements through the tracking tool design into tool use so that every element of the tool can be evaluated against these overarching requirements. Table 1 presents the high-level business requirements identified through discussions with MPCA staff and a working knowledge of the NRS's tracking needs.

Table 1. Preliminary High-level Business Requirements and Priority for the NRS Tracking Tool

BR ID	High-level business requirements	Priority
BR1	Track BMP implementation related to the NRS, including the key BMPs identified under selected program measures implemented by state agencies and federal agencies	High
BR2	Improve process and information management efficiency among many state and federal agencies, as well as local-level partners	High
BR3	Extract BMP information (type, location, date of implementation, treatment area, size of BMP) from existing data management tools and systems associated with key programs reflected in program measures	High
BR4	Calculate or estimate the phosphorus and nitrogen load reductions associated with BMPs	High
BR5	Track nutrient reductions associated with BMP implementation over time against Phase I Milestones	High
BR6	Track implementation of BMPs by major basin and HUC8	High
BR7	Track BMP implementation implementation-related activities related to other state agency programs including Farm Bill programs	High
BR8	Track BMPs implemented voluntarily by landowners that are not affiliated with specific governmental programs	High
BR9	An effective tool for making adaptive management decisions that will ensure that nutrient reduction activities will coincide with monitored water quality information	High
BR10	Provide data to support communicating with member states along the Mississippi River Basin and the Gulf of Mexico Task Force about Minnesota's contribution of nutrients	High
BR11	Support timely communication with the public and nutrient sources when goals and reductions are or aren't achieved	High
BR12	Provide web-accessible implementation progress information for all stakeholders	High
BR13	Integrate with ongoing MPCA IT initiatives and other statewide IT data considerations	High
BR14	Track BMP costs where cost information is available	High

User Requirements

The user requirements describe the processes and tasks that system users need to perform their job. For the NRS tracking tool, user requirements include tracking specific BMPs in the program measures, using pre-determined effectiveness values for nitrogen and phosphorus for each type of BMP, extracting data from existing agency systems, and providing information in useable formats such as Excel spreadsheets, GIS mapping, and charts. Table 2 provides a preliminary list of the user requirements that a NRS tracking tool for Minnesota should address and links these user requirements to the high-level business requirements described in the previous section.

Table 2. Preliminary User Requirements and Related Business Requirements for the NRS Tracking Tool

UR ID	User Requirements	Related BR ID
UR1	The system should track the specific BMPs in the program measure metadata worksheets used to quantify implementation in the NRS	BR1, BR3
UR2	The system should use pre-determined effectiveness values for phosphorus and nitrogen removal assigned to each BMP	BR4, BR5
UR3	The system should extract data from eLink, the RIM database, NRCS database for EQIP, FSA database for CRP, AgBMP database, WQ Delta database.	BR2, BR3
UR4	The system should develop reports in tabular format using Excel spreadsheets.	BR2, BR9, BR10
UR5	The system should allow for GIS mapping of BMP locations at the HUC8 scale.	BR2, BR6, BR9, BR10
UR6	The system should generate online graphs and charts to illustrate trends over time.	BR2, BR9, BR10
UR7	The system should track nitrogen and phosphorus reductions from sector-specific BMPs against Phase I Milestone for each major basin as documented in the NRS.	BR1-11
UR8	The system should capture instream monitoring and modeling information generated by MPCA's watershed approach to show trends in instream nutrient loads at key locations.	BR5, BR9-11
UR9	The system should allow other implementation partners to manually enter voluntary BMP implementation data related to non-governmental activities through a web-based interface.	BR7, BR8, BR12
UR10	The system should track BMP and in-stream trend information at the HUC8 level	BR6
UR11	The system should allow for additional integration with future state program databases.	BR13
UR12	The system should allow for manual input of additional program information that is not stored via database.	BR8
UR13	The system should export BMP costs where cost information is available in existing systems and allow for manual input of cost information where it is not tracked in existing systems.	BR14

There are other user requirements for the NRS tracking tool that will need to be defined by potential tool users. These requirements can be defined through a requirements scoping session by answering a series of questions, including:

- How many different report structures will there be?
- What functions will be offered to the public versus backend users?
- How many users will there be?
- How many user roles and will there be and what will they be able to do?
- What are the technology and hosting requirements of the system (e.g., which agency will host the NRS tracking tool)?
- How many records will it need to manage?
- What advanced features, such as complex logic, computations and integrations with 3rd-party tools, are required to make the system successful?
- What is the final number of other systems that it must interact with, what is the complexity of each interaction, what is the maturity and stability of each peer system?
- What is the degree of GIS functionality required and what is the level of GIS data integration?

- How flexible must the system be accommodate changes in business processes? Will those changes be configured and entered by administrative users, or will they implemented by changes to programming code?

Nonfunctional Requirements

Limitations that affect one or more user or functional requirements are referred to as nonfunctional requirements. For example, “Maintain a schedule” is a functional requirement. The corresponding nonfunctional requirement might state “Do not let the schedule consume more than 10MB of disk space.” Table 3 presents common types of nonfunctional requirements. Table 4 contains a preliminary list of nonfunctional requirements related to the NRS tracking tool.

Table 3. Type of Nonfunctional Requirements

Type	Description
Availability	The amount or percentage of time that the system is available for use by the users. Availability may be negatively affected by a variety of events including user error, hardware failure, external system events, unavailability of support personnel, and such.
Compatibility	The ability of the system under discussion to appropriately interact with others systems in its context
Completeness	For the domain of the system, the allowable maximum number or percentage of errors of omission
Correctness	The allowable maximum number or percentage of errors of commission
Cost of Ownership/ROI	The total costs (direct and indirect) of owning the system
Environmental	The environmental conditions in which the system must function
Extensibility	The use of the system in the same context with additional functionality
Installation Complexity	The combination of direct or indirect costs of installing the system
Parallel Processing	The ability of the system to fulfill requirements simultaneously using duplicated rather than shared resources
Performance	A measure of user expectations of system response times
Portability	The ability of the system to fulfill its requirements in more than one operating environment
Regulatory	The specific regulation(s) with which the system must be compliant
Reusability	The use of the system in a different context with the same functionality
Scalability	The ability of the system to fulfill its requirements for increasing numbers of users, transactions, and such.
Security	The requirements of the system with respect to access control and/or other context-specific security rules and/or regulations
Time to Market	The statement of the time at which the system must become available to and operable by its intended users
Training Complexity	The combination of direct or indirect costs for training the system’s users
Usability	The measurement of how often, how efficiently, and/or correctly people use the system
Portability	The ability of the system to fulfill its requirements in more than one operating environment

Table 4. Preliminary List of Nonfunctional Requirements for the NRS Tracking Tool and Associated Category

NFR ID	Nonfunctional Requirement	Category
NFR1	The system should be consistent with the NRS goals, milestones and Minnesota’s water quality standards	Compatibility
NFR2	The system should link to existing state agency and federal partners’ tracking tools (i.e., databases, spreadsheets)	Compatibility
NFR3	The system should have the capacity to include additional information beyond the program measures over time	Extensibility
NFR4	Make it available to the public over time	Scalability
NFR5	Allow third-party volunteer information with screening	Security

Constraints

Constraints limit the system development process. They affect user and functional requirements at the management level. Table 5 contains a preliminary list of constraints based on knowledge of the NRS. More constraints would be identified in a comprehensive system requirements analysis.

Table 5. Preliminary List of Constraints for the NRS Tracking Tool

CON ID	Constraint	Priority
CON1	The system should be compatible with the new MPCA enterprise data model.	High
CON2	The system should be maintained and operated by MPCA, with accessibility by other state agencies.	High
CON4	Involve point person from each program captured through the existing program measures.	High

Ongoing Data Management Initiatives Affecting the NRS Tracking Tool Conceptualization

The timing of the NRS and the associated data tracking needs coincides with several other tracking and reporting efforts taking place within the state. This allows for the NRS’s tracking needs to be incorporated into other ongoing system development and refinement projects. Examples of ongoing system development opportunities that could integrate NRS tracking needs include the following:

MPCA’s Transformation Project. MPCA is currently changing their information systems to a tempo-based enterprise system. As a result of this change, all program data will be managed in a similar manner, allowing program data within the agency to be better integrated.

MPCA’s Watershed Data Integration Project (WDIPs). A multi-year data integration project intended to improve MPCA’s staff handling and sharing of data and information generated through the watershed management process. (<http://www.pca.state.mn.us/index.php/view-document.html?gid=15386>) Through the WDIP, MPCA staff are working with TMDL and WRAP program staff to develop a data capture tool to present implementation tables on MPCA’s website by 2016, as required under the 2013 Clean Water Legacy Accountability Act.

Portal. Minnesota agencies are also engaging in a Portal project that would allow better inter-agency data sharing. This project is currently in the discovery stage. It would offer the opportunity to integrate MPCA’s data systems with those at other key agencies, including BWSR, MDA, and MDNR.

FSA CRP System. FSA mentioned that their existing data management system is currently changing. Further information about the old system and the new system would be needed for integration into a NRS tracking tool.

There is also a need for improved data sharing among Minnesota agencies and key federal agencies working within the state, specifically FSA and NRCS. In addition there is a need for a tracking tool that would allow private-landowners or other government entities such as counties and SWCDs to provide information on voluntary conservation practices that are not related to state or federal programs and funding.

In addition to the programs and BMPs currently identified in the NRS, the NRS tracking tool will also need to capture non-governmental program information about voluntary BMP implementation from other entities, possibly soil and water conservation districts and extension programs. At this point in time, it is unclear how this voluntary BMP information is tracked at the local level and the type of systems that might be in place to manage this type of information. Tracking tool development will need to include a task to investigate data sources for voluntary BMP implementation and determine feasible mechanisms to either capture information from existing data systems with this information or allow for manual data entry from these entities via a Web-based interface.

NRS Tracking Tool Development Recommendations

Based on the review and understanding of the preliminary requirements of the NRS tracking tool and the current understanding of the technical environment, it is recommended that Minnesota consider developing a tracking tool that is conceptually similar to the Chesapeake Bay Tracking and Accounting system (BayTAS) as a starting point for development of the Minnesota NRS Tracking and Accounting System (System) using .NET, ESRI Flex or JS API and SQL Server. The concept of BayTAS is a hub and spoke tool, meaning that the tracking system pulls data from a variety of existing data sources and integrates the information according to a set of specified metrics to fulfill program tracking and reporting needs. Therefore, development of the tool requires an in-depth understanding of the existing data management systems used by information that will travel from the spokes to the hub or, in this context, the NRS tracking tool.

The functionality of the NRS tracking tool will ultimately depend on the high-level business and user requirements for the tool, coupled with information about the existing data management systems. Developing this type of tool will require additional scoping to refine the business and user requirements to further define functionality. Once a final comprehensive system analysis is complete, Minnesota can begin to develop the NRS tracking tool's Web page interface and defined functionality, using 3-5 program measures as a tracking pilot for the tool. The recommended tasks for comprehensive scoping, initial development, and long-term maintenance of the NRS tracking tool are described below.

TASK 1: IDENTIFY TRACKING TOOL TEAM

The initial task for development of the NRS tracking tool is to assemble a Tracking Tool Team that can draw from the existing ICT members, as well as include program data analysts who understand the functionality of the existing data systems that will feed the NRS tracking tool. The Team will provide input on the preliminary system requirements and aid in refining those requirements.

TASK 2: REVIEW EXISTING PROGRAM MEASURES, REFINE METRICS, SELECT MEASURES FOR TRACKING PILOT

Under this task, the NRS tracking tool team will review the existing program measures in Appendix F of the NRS and identify those that require updating or refinement.

To focus efforts and demonstrate utility from development to web reporting, the number of program measures used in the initial NRS tracking tool should be limited to 3-5. This will allow for piloting the NRS tracking tool to assess the functionality before incorporating the other measures. Once the Team identifies the 3-5 pilot program measures, work can begin to refine these program measures, using the existing measure metadata worksheets.

TASK 3: ANALYZE EXISTING DATA MANAGEMENT SYSTEMS TO SUPPORT DATA EXTRACTION AND INTEGRATION

There are several data sources that are not clearly understood at this point in time or are in transition. This task focuses on collecting detailed information on the functionality of each data management system that will contribute nutrient data to the NRS tracking tool, including the type of system, planned or existing changes, users, maintenance procedures, and other factors that could influence export of data from the contributing systems into the NRS tracking tool. This task will likely require the Team to work with data management analysts and specialists from the agencies that support the program measures.

TASK 4: IDENTIFY DATA SOURCES OR APPROACHES FOR OBTAINING VOLUNTARY OR INDUSTRY-LED BMP INFORMATION

Understanding data systems used to track voluntary and industry-led BMPs that aren't affiliated with a specific governmental program is a less straightforward task, but is necessary to ensure the NRS tracking tool provides as thorough a picture of statewide BMP adoption as possible. At this point in time, voluntary BMP implementation is a significant data gap that the NRS tracking tool should attempt to fill. Under this task, the Team would work with county soil and water conservation district staff, watershed districts, crop advisors, extension staff, and other entities working with agricultural producers to improve adoption of conservation practices and BMPs on agricultural lands. This could occur through focus group sessions or a survey to better understand 1) if these voluntary BMPs are tracked, 2) the type of systems used, and 3) potential challenges to having these entities use the NRS tracking tool to voluntarily provide this information via the Web-based interface. This information will help the Team understand the requirements necessary for reaching non-governmental BMP adoption information and how to develop NRS tracking tool in a way to capture this information.

TASK 5: CONDUCT COMPREHENSIVE SYSTEM REQUIREMENTS ANALYSIS

Using the information collected under Tasks 2-4 coupled with the preliminary system requirements documented in Tables 1, 2, 4, and 5, the Team should conduct a comprehensive system requirements analysis. Under this task, the Team would verify the preliminary requirements are accurate and identify additional user requirements based on the list of questions identified under Table 2. This analysis might benefit from facilitation by a neutral third-party with IT experience to ensure the Team answers all necessary system questions and that the analysis is comprehensive.

TASK 6: DEVELOP NUTRIENT STRATEGY TRACKING AND ACCOUNTING SYSTEM WEBPAGE

The final comprehensive system requirements analysis developed under Task 5 will then allow the Team to proceed with initial development of the NRS tracking tool using the 3-5 pilot program measures identified under Task 2.

The features described below serve as a preliminary starting point, based on Minnesota's interest in the approach used for the Chesapeake Bay tracking and accounting system (BayTAS). These features are subject to evolve based on the findings under Task 5.

- 1. System Database.** Like the BayTAS, the NRS tracking tool would include an enterprise database. The NRS tracking tool database should be modeled to support short and long-term goals and allow Minnesota to add future program measures and tracking against those measures. These will also include quantitative Phase I Milestone tracking for both program outputs and environmental outcomes.
- 2. Public Module:** The NRS tracking tool Public Module would display NRS metrics (e.g., program outputs and environmental outcomes) in a way that is easily understandable and meaningful to the public using a GIS interface integrated with an existing Minnesota agency website, such as MPCA or BWSR, using either ESRI Flex or Javascript viewer (not Flex viewer which was used for BayTAS). The Public Module will provide a public facing web page that will inform the state, local, and federal stakeholders of the progress being made toward the NRS goals and milestones. The agency hosting the NRS tracking tool would have full control over the data that is shared through the Public Module so that the data available is relevant, timely, and accurate. In addition to distribution of data, the Public Module will also serve as a communication and outreach tool to communicate success, improve awareness and encourage action by specific sectors key to NRS success. For example, the Planning and Management module in BayTAS provides services to the public facing portion of the application maintained by the Bay program. The same initial design could be developed for the NRS tracking tool, which will provide key features and benefits in meeting the requirements identified for NRS tracking tool and will be a starting point for further refinement using an iterative tool development process.

- ✓ Provides a flexible GIS framework and driven webpage, dedicated to NRS tracking and accounting that contains HUC8 and major basin information on progress towards implementing goals and milestones.
- ✓ As data is populated and managed in the Planning and Management Module it could be automatically visible in the Public Module using web services.
- ✓ Includes general information related to the NRS and opportunities to be engaged and provides information relevant to those responsible for implementing various aspects of the NRS and what resource may be available to assist them (e.g., funding, technical assistance).
- ✓ Displays implementation actions spatially to allow the public to see the activities going on
- ✓ Allows user to view progress across the NRS's key metrics (e.g., program output measures and environmental outcomes by basin and HUC8) to spatially communicate progress toward meeting goals and milestones
- ✓ Can be fully integrated into an existing web presence, such as BWSR's eLink, to leverage existing stakeholder awareness and to ensure consistency and recognition for the user community

3. Planning and Management Module: The NRS tracking tool Planning and Management Module would be designed for users who are responsible for the planning, management, and oversight of the NRS implementation activities. This would include Minnesota agency staff, partner agency staff, and other people that are recording information related to specific NRS metrics (e.g., program measure outputs and environmental outcomes). The Module would provide users with tools that allow them to enter, manage, track, account, and report all of the data related to the NRS, or future NRS metrics added to the System. This include screens for data entry and editing of basic data elements, data upload tools for streamlining loading of larger more complex data sets, a map interface for spatial tagging and viewing NRS progress and actions across the key parameters/metrics, and a reporting dashboard to provide real time metric tracking and enable enhanced decision making. The Planning and Management Module would provide a single login secure access point for all of the data being collected, analyzed, and tracked as part of the NRS.

4. Home Page and Data Viewer

- ✓ Password protected to allow only certain users to add/edit information.
- ✓ Home Page provides a snap shot of progress at the State, Basin, and HUC8 levels for nitrogen and phosphorus.
- ✓ Toggling capability provides the ability to view data across a variety of filters such as Delivered and Edge of Stream loadings as well as multiple data source dates or versions
- ✓ A series of action icons serve as communication and outreach tools, allowing users to generate standardized reports in various formats, providing ease access to supplemental resources, and highlighting current system functions and future enhancements.
- ✓ The site would provide access to online information identified or developed as part of this NRS tracking tool so that implementing parties can prioritize their activities and report on progress toward meeting goals and milestones, as well as program optimization goals, if desired.
- ✓ Data viewer would provide a GIS map interface with supporting tabular data dynamically updated based on map selection and filtering
- ✓ Provides spatial view of progress and implementation activities

5. Data Admin, Milestones and Facilities

- ✓ Data Admin screens provide straight forward data entry screens for the adding, editing, and review of relevant NRS data. Allows specified users to manage and work with their own data including adding new metrics at a later date.
- ✓ The Facility data entry module provides screens for capturing Facility location, permitting, DMR, and allocation data to allow for integrated tracking of Facilities within HUC8 watersheds.
- ✓ The Facility data entry screens are integrated with the GIS capabilities so as Facilities are added or progress data is updated they become accessible from the map interface
- ✓ Data Admin screens provide straight forward data entry screens for the adding, editing, and review of implementation Milestones for the tracking and accounting of planned activities and future progress.
- ✓ The System accommodates both quantitative and qualitative goals and milestones providing users full flexibility in capturing the planned implementation actions.
- ✓ Each goal or milestone can be linked spatially to HUC8 watersheds and basins, displayed through the map interface

- ✓ Goal and milestone tracking can be integrated with existing program databases to show a consolidated view of actual versus planned actions

6. Management Reporting

- ✓ The fully integrated and automated Management Report can be generated at any time and will reflect the most current data.
- ✓ The Management Report presents a status of the progress towards meeting the NRS goals and milestones, including WWTP nitrogen and phosphorus loads, agricultural nitrogen and phosphorus loads, aggregated loads by parameter, facility permitting action status, and overall load vs milestone target comparison.
- ✓ The Management Report can be generated in a variety of formats (PDF, Word, Excel) and can be used as both a formal communication tool as well as an internal working reporting for data analysis and decision support.

TASK 7: LONG-TERM O&M NRS TRACKING TOOL PLAN

In support of the production deployment of the NRS tracking tool, the Team should develop an Operation and Maintenance (O&M) Plan, which will address staffing, tasks, processes, and tools necessary to ensure consistent, reliable, and comprehensive production support of the NRS tracking tool. The plan should recommend O&M and hosting service level agreements to be documented in the plan to establish clear and standardized performance benchmarks to be maintained throughout the O&M period by the hosting provider.

The O&M Plan shall lay out a strategy along with the roles and responsibilities for the continued use and enhancement of the NRS tracking tool. The O&M Plan should recommend a Change Control Board that would serve as the primary decision makers regarding system priorities and enhancements and should also document the processes that will be followed for the submission of enhancement request for the Board to consider. The O&M Plan should also include technical considerations such as implementation of web services, technology enhancements, and integration with other County, State or Federal tools over time.

COST ESTIMATE

Developing the proposed NRS tracking tool is estimated between \$200-\$900K, depending on the full suite of comprehensive system requirements developed under Task 5. A variety of variables affect the potential cost of developing the recommended NRS tracking tool. Factors that impact costs include the following:

- Level of involvement and availability of client staff to assist with system design, data integration, and other tasks relating to designing and building the system
- Amount and types data analysis and migration that would be required to start using the system, as well who is responsible for the migration (contractor or client IT staff)
- Level of data cleanliness and corrections and/or transformations that must be applied before loading them, as well who is responsible for the data changes (contractor or client IT staff)
- How many stakeholders will provide input on the design and implementation of system, how involved will they be
- Amount and type of training and system documentation is required. How many people will be trained over how many sessions.
- Who will be responsible for system deployment and final system integration
- Who will be responsible for which types of testing