Adaptive Management and Tracking Progress

While the Minnesota Nutrient Reduction Strategy (NRS) is based on scientific analysis and considerable agency, academic and public input, there will continue to be a need to improve and refine the NRS based on new information and input from scientists, key stakeholders and partners. The NRS will be frequently evaluated and periodically updated using an iterative process of planning, implementing, assessing and adapting, often referred to as adaptive management (Figure 7-1). In essence, adaptive management is learning by doing and using improved data and information over time to improve decision making with the intent of achieving a goal within a specified timeframe. Adaptive management incorporates data gathering and learning from experience and improved science. The adaptive management plan described in this chapter documents the procedures for assessing progress over time and the triggers for updating the NRS to achieve the nutrient reduction goals and milestones.

The NRS sets out goals and milestones for nutrient load reductions, as well as recommended approaches for achieving the milestones. To ensure that on-the-ground implementation is on pace with the NRS milestones and goals, it is imperative to have an adaptive management plan that will guide an evaluation of the NRS’s progress over time. The basic components of the NRS’s adaptive management plan are as follows:

- Identify data and information needed to track progress toward NRS goals and milestones.
- Create a system or approach for collecting data and information needed to track progress toward NRS goals and milestones.
- Evaluate trends as well as relationships between actions and outcomes.
- Adjust the NRS as necessary.

Each of these components as it relates to the NRS is discussed in more detail below.
7.1 Information Needed to Track Progress

To understand the level of nutrient reduction progress being achieved, it is important to evaluate both changes in the adoption of best management practices (BMPs) (human actions) and water quality monitoring information (environmental outcomes). Water quality monitoring data alone will not provide sufficient information to evaluate progress and make needed adjustments to the NRS. Water monitoring does not provide reliable information on incremental nutrient reduction progress when the level of BMP adoption is not extensive enough to overshadow natural water quality variations, or when lag times are large due to phosphorus cycling in stagnant waters or when nitrate movement through the groundwater hydrologic pathway is slow compared to other pathways.

Both action and environmental outcome data will be necessary to track progress toward NRS goals and milestones. Implementation data provides early indicator information about nitrogen and phosphorus reductions that, over time, should translate to in-stream nutrient reductions. Expected water quality changes can be analyzed and modeled when the following types of information are available:

- BMP implementation through programs
- Overarching management changes through BMP adoption by all government and private action
- Land use and management changes apart from BMP adoption (i.e., cropping rotation changes, deforestation, urbanization, tiling, etc.)
- Precipitation and hydrologic information

Environmental outcomes as represented by water quality monitoring trends are an important part of tracking NRS success, since they are a direct measure of NRS goals. This is especially the case when the monitoring results are analyzed in concert with the above list of information, allowing evaluation of not only progress toward goals, but the effectiveness of actions taken to influence those outcomes. Water quality monitoring results should be evaluated at different points and scales, including:

- Watershed outlets (i.e., major 8-digit hydrologic unit code [HUC8] watershed, basin and major basin)
- Major river monitoring sites with historical monitoring
- Water supply wells (for nitrate)

When all of the information above is considered together, progress toward achieving milestones and goals can be evaluated. Each information need and corresponding evaluation approach is described below.
7.1.1 BMP Implementation Evaluation

The implementation evaluation piece of the NRS’s adaptive management process focuses on implementation of the most influential categories of BMPs and management actions described in Chapters 5 and 6. The objective of evaluating programs and BMP implementation is to determine progress toward the milestones and goals outlined in Chapter 2. The emphasis of this initial version of the NRS is on reaching goals and the Phase 1 nitrogen milestone and has an 11-year planning horizon from 2014 to 2025. Under an adaptive management approach, the implementation evaluation would allow opportunities to gauge implementation progress at several key intervals to ensure implementation is on track to achieve the goals and Phase 1 nitrogen milestone. Tracking environmental outcomes helps to inform needs to achieve environmental goals. Quantifying changes in both program implementation and water quality outcomes are complementary parts of the NRS. The approach for quantifying these changes must be meaningful, sustainable, and replicable.

The selected key programs identified in Chapter 4 implement a variety of structural and nonstructural BMPs. While programs are expected to provide accounting of the actions that they directly control, whether through permit or assistance contracts, attempting to quantify nutrient reductions for every BMP influenced by each program is not always possible with limited resources. Federal programs play an important role in promoting adoption of agricultural conservation practices using key BMPs. There is a need to develop mechanisms that allow for improved federal agency data sharing and changes to existing federal databases to support NRS tracking over time. It is expected that the public will continue to call for improved accountability in government programs.

A suite of program measures have been developed in an effort to narrow down the potential BMPs under each identified program to focus on those that are the most meaningful indicators of readily available data on statewide nutrient reduction progress. This can streamline the tracking process, but where only indicator BMPs are being tracked, a relationship to overall BMP implementation should be developed. Tracking the implementation information associated with the selected program measures provides the pulse of key implementation programs. Nutrient reduction trends for the selected program measures will show progress related to certain BMPs; yet it is important to keep in mind that there is a wide range of BMPs that are beneficial to achieving the nutrient reduction goals (as listed in Appendix B). Table 7-1 summarizes the priority programs with the associated measure and indicator BMPs. It is important to note that some measures capture more than one program. Not all programs have measures at this time due to data limitations, specific program development issues, or project resource constraints.
Each program measure has a corresponding metadata worksheet (see Appendix F). The metadata worksheets capture all the relevant information about the measure to ensure that the methodology is documented and replicable in the future. The metadata worksheets also capture data limitations and caveats associated with each measure to help the reader understand how best to interpret the measure and the type of future improvements that are necessary to make the measure more robust over time.

The format used for the metadata worksheets follows the template used in the Clean Water Legacy Fund Performance Report. This will allow for agency familiarity with the format, as well as integration of measures from that effort that capture programmatic progress related to nutrient reductions.

Table 7-1. Program measures summary

<table>
<thead>
<tr>
<th>Program</th>
<th>Measure for quantification</th>
<th>Indicator BMPs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erosion Control and Water Management Program/State Cost-Share Program (BWSR)</td>
<td>Implementation of nonpoint source BMPs tracked via eLink and estimated BMP nutrient load reductions</td>
<td>All BMPs captured in eLink</td>
</tr>
<tr>
<td>Reinvest in Minnesota (RIM) Reserve Program (BWSR)</td>
<td>Implementation of permanent easements and associated nutrient load reductions</td>
<td>Acreage and percent of permanent conservation easements on environmentally sensitive and marginal agricultural land (as defined in RIM eligibility handbook)</td>
</tr>
<tr>
<td>Nonpoint Source Management Program (Section 319) (MPCA)</td>
<td>Implementation of nonpoint source BMPs tracked via eLink and estimated nutrient load reductions</td>
<td>All BMPs captured in eLink</td>
</tr>
</tbody>
</table>
| Nitrogen Fertilizer Management Plan (NFMP) (MDA)                      | Implementation of nitrogen fertilizer management BMPs                                     | 1. Nitrogen fertilizer application rates  
2. Nitrogen fertilizer application timing  
3. Nitrification inhibitor use  
4. Use of additive and specialty formulations |
| Clean Water Land and Legacy Program (BWSR)                           | Implementation of nonpoint source BMPs tracked via eLink and estimated nutrient load reductions | All BMPs captured in eLink                                                     |
| Conservation Reserve Program (CRP) and Conservation Reserve Enhancement Program (CREP) (FSA) | Implementation of priority CRP conservation practices and estimated nutrient load reductions | 1. Filter strips (CP 21)  
2. Riparian forested buffers (CP 22) |
<p>| Conservation Security Program (CSP)/ Conservation Stewardship Program (CStP) (NRCS) | No measure at this time                                                                  |                                                                              |</p>
<table>
<thead>
<tr>
<th>Program</th>
<th>Measure for quantification</th>
<th>Indicator BMPs</th>
</tr>
</thead>
</table>
| Environmental Quality Incentives Program (EQIP) (NRCS) | Implementation of priority EQIP management practices and estimated nutrient load reductions | 1. Residue management  
2. Nutrient management  
3. Forage and biomass planting |
| Wetland Reserve Program (WRP) (NRCS) | No measure at this time | |
| Agricultural Best Management Practices (AgBMP) Loan Program (MDA) | Implementation of conservation tillage funded through AgBMP Loans | 1. Conservation tillage projects |
| Commercial Animal Waste Technicians (CAWT) Program (MDA) | No measure at this time | |
| Minnesota Agricultural Water Quality Certification Program | No measure at this time | |
| Industrial/Municipal Wastewater National Pollutant Discharge Elimination System (NPDES) Permitting (MPCA) | Municipal wastewater phosphorus trends (excerpted from the Clean Water Fund performance measures) | Phosphorus effluent statewide trends |

The selected program measures reflect government programs and do not capture all voluntary or industry-led conservation activities. Voluntary conservation activities that are not related to a specific government program can contribute a significant percentage of overall BMP adoption, especially for practices including precision farming, conservation tillage, nitrogen fertilizer BMPs, phosphorus use, and cover crops. While government funded education, demonstration and research can increase private action, BMPs adopted apart from government programs are more difficult to track and evaluate. However, certain indicators of progress can be useful for evaluating the overarching BMP adoption changes that occur through the collective private actions. Changes to the National Resource Inventory or Agricultural Census could provide statistical representation of land management and should be explored.

It is anticipated that through NRS assessments, additional measures will be developed in the future to track implementation success related to other programs and implementation-related activities. For example, measures should be evaluated to determine the applicability of existing techniques to track vegetative cover changes. With advancements in satellite imagery and other remote sensing techniques, it is now possible to discern changes in vegetative cover. This NRS recommends using such technology, along with on-the-ground inventory information, to evaluate changes in vegetative cover practices such as establishment of cover crops, perennials, hay, riparian buffers and potentially crop residue.
Crop residue cover and other ground-cover BMPs should also be determined with transect surveys, similar to transect surveys conducted during previous years so that changes can be evaluated from historical levels of crop residue cover.

Because nutrient efficiency is such a critical NRS element, metrics need to track improvements in overall nutrient efficiencies. These efficiencies should be also be used to estimate nutrient changes in the receiving waters. Nitrogen fertilizer sales and crop yield information are tracked and have been used to show that, during the past couple of decades, agricultural producers have made progress in growing more corn for each pound of nitrogen fertilizer. Fertilizer sales and crop yield information, when combined with trends in planting densities, manure nutrient availability, grain protein content, and other information, could provide an indication of trends related to nutrient efficiencies and changes in the amount of soil nutrients that are potentially available for losses to the environment.

BMP implementation that takes place on a watershed scale, but is occurring outside of government assistance, is likely the largest gap relative to measuring success of the NRS. Comprehensively determining outcomes will require measuring of conservation practices and farming activities that are not funded and tracked through government programs. Potential BMP implementation not accounted for due to private implementation efforts could include conservation tillage, nitrogen fertilizer BMPs, phosphorus use, cover crops and non-commodity crops.

Other metrics of nutrient efficiency, based on data from combined public and private efforts, should also be considered and developed. Sources of data for additional metrics of nutrient efficiency could include farmer and crop advisor surveys (i.e. NASS and FANMAP surveys), soil phosphorus test results, sales and use of farm implements and equipment needed for BMPs and higher precision nutrient management, and a geographically based statistical survey similar to a natural resources inventory.

Other future measures could address the following:

- Improvements in working with national and regional statistical surveys as well as with local partners to track voluntary, non-government funded BMP implementation
- CSP/CStP program measure
- Municipal wastewater nitrogen effluent trends
- Tile drainage water management practices
- Other program BMPs (e.g., constructed wetlands, cover crops)
### 7.1.2 Estimating Effects of BMPs on Nutrient Reduction

Estimates of expected nutrient reductions in waters from BMP adoption can be developed based on the level of BMP adoption change using various models and tools. However, evaluation of NRS progress should also consider the effects of non-BMP land use and management changes, as well as climate influences, so that both the estimated effects of the BMPs and other factors influencing water nutrient levels can be understood.

One of the models that can be used to evaluate the effects of changing precipitation and land use is the Hydrologic Simulation Program FORTRAN (HSPF) model. In an effort to aid the completion of watershed restoration and protection strategies (WRAPS), the Minnesota Pollution Control Agency (MPCA) is in the process of constructing HSPF watershed models for many of the HUC8 major watersheds. The HSPF model is a comprehensive model for simulating watershed hydrology and water quality for both conventional pollutants such as nutrients and sediment and toxic organic pollutants. HSPF allows the integrated simulation of land and soil runoff processes with in-stream hydraulic and sediment-chemical interactions. In the Minnesota River Basin, HSPF models for ten major watersheds have been aggregated to represent the larger basin. The results of HUC8 watershed modeling will further inform NRS implementation in the future.

Figure 7-2 provides a summary of the current status of HSPF modeling in the state (current through August 2014). HSPF and other models such as Soil Water Assessment Tool and SPARROW combined with other modeling approaches, such as the University of Minnesota’s NBMP spreadsheet, should be used to estimate the NRS’s progress made by BMPs, along with confounding effects of changing crop rotations, hydrologic modifications, and precipitation.
Figure 7-2. Status of HSPF modeling (August 2014).
7.1.3 Water Quality Monitoring Evaluation

Water quality evaluations will largely rely on the Watershed Pollutant Load Monitoring Network (WPLMN). This network will be supplemented with special watershed monitoring projects for environmental changes below the HUC8, monitoring of sentinel watersheds, ground water nitrate monitoring, National Water Quality Initiative projects, Targeted Watershed Demonstration Program Projects, BMP effectiveness as provided in research and Discovery Farm monitoring, along with other special projects and water quality modeling. There are many other local, regional, statewide, and national monitoring programs that will inform water quality evaluations including those being conducted by the new Mississippi River Monitoring Collaborative, which is made up of federal and state agencies along the Mississippi River between the Gulf of Mexico and Minnesota. Efforts will be made to coordinate Minnesota monitoring with national monitoring initiatives.

Due to lag effects in transport of nutrients through groundwater, lakes and reservoirs, the full effects of BMPs often do not show up at river monitoring stations for years or even as long as decades. Therefore, the monitoring results will be evaluated along with estimated lag times. Some monitored watersheds will show quicker response times to BMP implementation, such as heavily tiled watersheds and watersheds where phosphorus is less likely to be cycled and held in reservoirs or stagnant waters.

Water quality and flow analysis will include trends in total load and flow weighted mean concentrations (FWMC) (see Chapter 3). Both measures are important to understand changes in load over time and tracking progress toward milestones and goals. Progress toward achieving eutrophication standards in lakes and flowing waters also provides a measure for how well the

How soon will the effects of BMPs show up in the water?

It is difficult to predict when in-stream conditions will respond to implementation activities. As a general rule, larger watersheds are slower to respond because of the pollutant transport mechanisms involved. Watersheds exceeding 5,000 acres generally require monitoring programs of 10 years or more to measure the effects of management measures, although the exact timeframe depends on a range of factors, including the type of problem being addressed, the monitoring design employed, the weather during the monitoring period, and the type and extent of treatment implemented. HUC 8 major watersheds are much larger than 5,000 acres.

In rivers fed largely by groundwater, as opposed to surface runoff or tile drainage, there can be a lag time of decades or more before the effects of nitrate reduction BMPs can be observed in the river. Groundwater often moves very slowly toward streams, whereas tile drainage and surface runoff pathways to rivers are much faster.

For phosphorus, a key factor is the amount of reservoirs and pools of more stagnant water that exist. In these pools, phosphorus can settle and then be released over time back into the water.
Chapter 7. Adaptive Management and Tracking Progress

Minnesota Nutrient Reduction Strategy

NRS addresses in-state load reduction goals. Important measures of NRS progress include:

- Trend in actual load
- Trend in FWMC
- Extent of stream and lake eutrophication impairments
- Statistical comparisons of baseline loads and concentrations at low, medium and high flow periods with comparable flow periods during recent years
- Extent of groundwater nitrate above drinking water standards in high-nitrate areas, including those watersheds where nitrate coming from groundwater currently impairs surface waters

When multiple water quality monitoring measures are considered, along with the BMP adoption and modeling evaluations previously described, then progress toward NRS goals and milestones can be more accurately assessed.

Watershed Pollutant Load Monitoring Network

The WPLMN is a multi-agency effort that the MPCA leads to measure and compare regional differences and long-term trends in water quality among Minnesota’s major rivers including the Red, Rainy, St. Croix, Minnesota, and Mississippi, the outlets of major HUC8 watershed tributaries draining to these rivers, and select subwatersheds. The network was established in 2007. Site-specific streamflow data from U.S. Geological Survey (USGS) and Minnesota Department of Natural Resources (DNR) flow gauging stations is combined with water quality data collected by Metropolitan Council Environmental Services, local monitoring organizations, and MPCA staff. Annual pollutant loads are computed from these data at river monitoring sites across Minnesota. The WPLMN is summarized at http://www.pca.state.mn.us/pyrieb.

The WPLMN has been collecting water quality at an increasing number of locations since 2007, reaching 79 major watershed and mainstem river monitoring sites by 2010 (Figure 7-3). The design scale is focused toward, but not limited to, monitoring HUC8 watershed outlets within the state. By the end of 2014, about 150 additional subwatershed monitoring sites will be installed to further apportion pollutant loads. Strategic major river mainstem sites are included to determine basin loads and assist with statewide mass balance calculations.
Figure 7-3. WPLMN monitoring sites.
Pollutant loads are calculated from water quality analysis and daily average discharge data collected at each site, using the Flux32 software. The software was designed to provide seasonal or annual pollutant loads and flow-weighted mean concentrations, but enhancements to the program allow the estimation of daily loads and concentrations. Loads and flow weighted mean concentrations are calculated annually for total suspended solids, phosphorus, dissolved orthophosphate, nitrate plus nitrite nitrogen and total Kjeldahl nitrogen. The nitrate plus nitrite nitrogen parameter is added to total Kjeldahl nitrogen to represent total nitrogen.

This network can be used to track changes in nutrient pollutant load, yields, and mean concentrations at a major river/basin, watershed, and subwatershed scales.

**Sentinel Watersheds**

The *Selection of Sentinel Watersheds* in Minnesota was developed by the University of Minnesota and a working group consisting of agency and stakeholder representatives in 2013 as part of a project funded by the MDA. Watersheds at the HUC10 and HUC8 scales were prioritized for long-term, intensive monitoring. Criteria in the selection process included:

- Available historical data
- Diversity of landscapes and watershed characteristics
- Entities with demonstrated local capacity present
- Existing programs could be used to coordinate new activities
- Representation of water quantity and quality issues at different scales

Nineteen HUC8 watersheds and eleven HUC10 watersheds were selected as sentinel watersheds. These watersheds may be used to monitor changes in water quality as a result of conservation practices on the ground.

**Ground Water Monitoring**

Long-term ground water monitoring for nitrate conducted by state and local agencies should continue for public wells, private wells and monitoring wells, so that trends and progress to reduce nitrate levels can be evaluated. This monitoring should be coordinated with the NFMP and Source Water Protection Program efforts.
**7.2 Tracking and Communicating Progress**

Teamwork through the NRS Interagency Coordination Team (ICT) was integral to NRS development and teamwork will continue to be integral to overall NRS implementation. Accountability has been given a high priority through the legislatively mandated Clean Water Accountability Act of 2013. Accountability to the NRS should be integrated and coordinated with those existing coordinating mechanisms where possible with a subcommittee or adjunct team maintaining the perspective of the NRS. An Accountability Team could be formed, composed of a person or small group of implementation coordinators who would oversee the implementation of the NRS with input from critical program managers, represent NRS interests at a statewide level, lead tracking and reporting efforts, and oversee adaptive management adjustments to the NRS over time.

The Clean Water Accountability Act of 2013 will guide tracking efforts which may include annual or biennial reporting on the program measures developed as indicators of implementation progress, as well as planning and assessment activities triggered at 2 years, 5 years, and 10 years for reassessment, starting with the NRS implementation kickoff date and working toward the year 2025. Reporting and NRS updates will be led by an Accountability Team, who may report findings to the Clean Water Council or Minnesota Legislature. An outline of the tracking steps is outlined below.

**First year of NRS (2015)**

- Determine and initiate appropriate accountability process
- Identify Tracking Tool Team (see Section 7.2).
- Tracking Tool Team begins implementation of activities included in Section 7.2.

**Two-year tracking and reporting (2016)**

- Agencies and stakeholders develop approaches and plans to achieve BMP adoption goals
- Update NRS to incorporate additional implementation activities such as stepped up actions and tracking tool development.
- Evaluate program output and water quality outcomes.
- Evaluate implementation progress reported through the 2013 Clean Water Accountability Act to determine relevance to NRS progress reporting and tracking.
- Review progress toward goals and milestones.
- Update research for expanding feasible implementation activities (e.g., cover crops and biomass crops).
- Review effectiveness of comprehensive NRS outreach campaign and adjust as necessary.
Five-year tracking and reporting (2019)

- Assess implementation progress through other reporting (e.g., 2013 Clean Water Accountability Act).
- Report on success of implementation activities and strategies and identify needed adjustments to achieve goals and milestones.
- Survey key target audiences to gauge changes in management associated with comprehensive NRS outreach campaign.
- Evaluate program output and water quality outcomes.
- Continue to assess voluntary and industry-led implementation activities and associated nutrient reductions.

Ten-year NRS reassessment tracking and reporting (2024)

- Evaluate goals and milestones for future phases of implementation.
- Assess changes in natural conditions (e.g., climate and landscape) and potential impact on reductions.
- Establish new higher milestones that will make use of the researched BMPs.
- Continue making nutrient reduction progress as new research begins.
- Publish updated NRS document.

7.2.1 Approach for Tracking Progress

As described in the previous section, a wide range of data and information is needed to track progress in meeting the NRS goals and milestones. Synthesizing this array of data and information will require a coordinated system for tracking nutrient reductions associated with implementation activities. The previously described program and water quality measures highlight the challenges associated with compiling the data necessary to quantify implementation activities and nutrient loads. The data compiled for the suite of programmatic and water quality measures vary in collection methodology and frequency, documented in the metadata worksheets provided in Appendix F. Data from several nutrient reduction programs are tracked through grant or program-specific systems such as the BWSR’s eLink database. Over time, an interagency, integrated tracking tool would 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.

A systematic approach for collecting and analyzing the output and outcome data and information would be helpful to track and communicate progress over time. The metadata worksheets in Appendix F provide an initial mechanism for capturing key output information about the suite of NRS measures.
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Updating the metadata worksheets on a regular basis (e.g., annually) will help generate trend information on the particular BMPs associated with each measure to compare against the BMP adoption needs identified in Chapter 5. This will require a comparison of the BMPs identified on the NRS Reduction Summaries for each major basin presented in Chapter 5 with the BMPs associated with the quantified program measures at the HUC8, basin, and major basin scales. The comparison of these two components of the NRS will illustrate where BMPs have been implemented at the needed levels through existing government-based programs. The approach for tracking progress needs to also account for nongovernment-affiliated BMP implementation and the water quality monitoring findings.

7.2.2 Tools for Tracking Progress

There are a variety of ongoing information technology-related activities taking place within the MPCA and other key agencies. Under the Clean Water Accountability Act of 2013, MPCA must report progress toward implementation milestones and water quality goals for TMDLs and, where available, WRAPS beginning July 1, 2016, with updates on progress made every other year. The MPCA’s Watershed Data Integration Project (WDIP) is an initiative to improve data sharing among MPCA programs at a watershed level to support the Minnesota Water Management Framework. WDIP is also working to develop a template for the TMDL and WRAPS Web-based implementation tables. MPCA also has a transformation project underway that is converting MPCA’s existing databases to an enterprise system. These are examples within one agency that will provide information for the NRS. It is likely that similar data management projects and initiatives key to tracking the NRS’s progress are also underway within other federal and state agencies. Ongoing and planned information technology-related efforts provide an opportunity to integrate the NRS’s tracking needs into the design and development of new and upgraded systems. Similar considerations may be necessary for other Minnesota agencies with key nutrient reduction programs.

There is currently no integrated tool that will allow for automated tracking of NRS output and outcome information to assess progress over time. The approach for tracking progress requires developing a tool to ensure efficient and reliable progress tracking. Developing a tool of this nature will be a multi-agency undertaking that must take into consideration the existing data management approaches and numerous programs being used within several agencies.

An evaluation of the website and tools used to track water quality implementation in the Chesapeake Bay (ChesapeakeStat) was conducted to determine if this existing tracking tool could provide a framework to incorporate an effective method for tracking nutrient reduction progress in Minnesota (Appendix G). ChesapeakeStat was viewed as a potential model for a new tool to communicate with
stakeholders and watershed managers in Minnesota as well as other states and interested parties. Analysis performed during the evaluation revealed significant gaps between data required to support a Chesapeake-style website and the current abilities of state and federal agencies to provide that data. Future planned work will increase data availability, but significant work remains to be done for watershed modeling as well as program requirements.

A NRS tracking tool would improve process and information management efficiency among the many state and federal agencies, as well as local partners, that promote BMP adoption necessary for NRS success. The recommended approach for a NRS tracking tool is one that would serve as a hub of information, extracting data from a variety of existing monitoring and program implementation databases. Using a Web-based interface, the NRS tracking tool would not only present integrated information from existing databases, but also allow for the input of voluntary BMP information by private landowners and key local or nongovernmental organizations working with private landowners (e.g., county soil and water conservation districts, university extension staff, crop advisors).

A brief overview of the recommended tasks for developing this type of NRS tracking tool is provided below. Appendix H provides more detailed information on the preliminary requirements of developing this type of tracking system and each task.

**Task 1: Identify Tracking Tool Team.** A subgroup of existing Interagency Coordination Team (ICT) members, as well as program data analysts, 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.** The NRS tracking tool team will identify program measures that require updating or refinement for tracking purposes and select 3—5 measures to use during the pilot phase of the tracking tool. The metadata worksheets presented in Appendix F should be evaluated to determine what is adequately measured and areas that are not adequately measured. This analysis could be used to develop a matrix that identifies which existing tracking efforts are adequate, what voids exist, and whether a new tracking tool needs to be developed, or if existing tracking tools can be modified.

**Task 3: Analyze Existing Data Management Systems to Support Data Extraction and Integration.** The NRS tracking tool team will collect detailed information on the functionality of each data management system that will contribute nutrient data to the System, including the type of system, planned or existing changes, users, maintenance procedures, and other factors that could influence export of data from the system into the NRS tracking tool.
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Task 4: Identify Data Sources or Approaches for Obtaining Voluntary or Industry-Led BMP Information. The NRS tracking tool team would work with local partners (e.g., county SWCD staff, watershed districts, crop advisors, extension staff, and other entities) working with agricultural producers to improve adoption of conservation practices and BMPs, inventory voluntary BMPs not associated with governmental programs, and understand existing systems used to track this information.

Task 5: Conduct Comprehensive System Requirements Analysis. The NRS tracking tool team would verify the preliminary tracking tool requirements and, as necessary, add other requirements to inform tool development.

Task 6: Develop NRS Tracking and Accounting System Web Page. The final comprehensive system requirements analysis would then allow the NRS tracking tool team to proceed with initial development and piloting of the tool using the 3–5 selected program measures.

Task 7: Long-Term Operations and Maintenance System Plan. In support of the production deployment of the tool, the NRS tracking tool team should develop an Operation and Maintenance Plan, which will address staffing, tasks, processes, and tools necessary to ensure consistent, reliable, and comprehensive production support of the NRS tracking tool.

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 incorporation of the NRS’s tracking needs 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, 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 multiyear 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](http://www.pca.state.mn.us/index.php/view-document.html?gid=15386) Through the WDIP, MPCA staff are working with total maximum daily load and WRAPS program staff to develop a data capture tool to meet a 2016 deadline of making implementation tables available on MPCA’s website.

**Portal.** Minnesota agencies are also engaging in a Portal project that would allow better interagency 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 the BWSR, MDA, Minnesota Department of Health, DNR, and the Metropolitan Council.

There is also a need for improved data collection and sharing among Minnesota agencies and key federal agencies working within the state, specifically Farm Service Agency and Natural Resource Conservation Service (NRCS). There is also a need for a tracking tool that would allow private landowners or other local 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.

7.2.3 Communicating Progress

Communicating the ongoing level of progress can be challenging, especially given that progress is not evaluated by a single indicator, but rather by a suite of indicators including BMP adoption, modeling and monitoring. The tracking tool described in the previous section, once developed, could serve as a way of communicating ongoing progress to interested parties. Until a tracking and communication tool is developed, Program Output Scorecards could be used which are similar in concept to the report cards used in the Clean Water Fund Performance Report http://www.legacy.leg.mn/sites/default/files/resources/2012%20Clean%20Water%20Fund%20Report%20Card_web%20version.pdf.

The report card can provide both a qualitative and quantitative approach to reporting on progress toward nutrient reduction goals (Table 7-2). A program measure that is showing negative implementation trends (e.g., diminished voluntary participation or significant exceedances of a mass limit) can be represented by a red symbol on the NRS report card. A yellow symbol can represent programs that have no change in implementation over time. A green symbol can represent programs that demonstrate progress toward programmatic nutrient reduction goals over time. As NRS implementation actions are further derived, specific targets can be added to the measures, and the report card can be updated to reflect quantitative targets.
Table 7-2. Report card symbols

<table>
<thead>
<tr>
<th>Status Scores</th>
<th>Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="https://via.placeholder.com/50" alt="Circle" /></td>
<td>Improving trend</td>
</tr>
<tr>
<td><img src="https://via.placeholder.com/50" alt="Triangle" /></td>
<td>No change</td>
</tr>
<tr>
<td><img src="https://via.placeholder.com/50" alt="Square" /></td>
<td>Declining trend</td>
</tr>
</tbody>
</table>

We are making good progress. If there is a target, we are meeting the target.

We anticipate difficulty; it is too early to assess; or there is too much variability to assess.

Progress is slow. If there is a target, we are not meeting the target. It is likely that the activity or target is not commensurate with the scope of the problems.

The Program Output report card (Table 7-3) is based on seven program output measures developed for high-priority programs and provides a qualitative assessment of the nutrient reduction trends over time (see Appendix F). The scores for program output measures are based on data provided by state and federal agencies and best professional judgment of agency experts. At this time, the Program Output Report card focuses on trend data, but can eventually assess progress against a specific nutrient reduction target set for a specific measure in the context of overall NRS goals and milestones. This format is similar to the Clean Water Fund Performance Report measure report card, allowing for consistency in reporting to promote cross-effort reporting when feasible. Using the program measures, it will be possible to see trends and track progress during NRS implementation. At this time, specific targets are not provided for programmatic measures. In the future targets should be added to the measures to provide a yardstick for whether the measure is making adequate progress that will have the necessary effect on nutrient load reductions.
Table 7-3. NRS report card, program output measures

<table>
<thead>
<tr>
<th>Measures</th>
<th>Status</th>
<th>BMP Adoption Trend</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation of priority EQIP management practices and estimated nutrient load reductions</td>
<td>Residue management</td>
<td>↓</td>
<td>Acreage enrolled under EQIP for these three priority practices has steadily declined since 2007–2010.</td>
</tr>
<tr>
<td>Nutrient management</td>
<td></td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Forage and biomass planting</td>
<td></td>
<td>↓</td>
<td></td>
</tr>
<tr>
<td>Implementation of permanent conservation easements under RIM and estimated nutrient load reductions</td>
<td></td>
<td></td>
<td>Acreage under permanent conservation easements has increased since 2000, with an upward trend since 2008.</td>
</tr>
<tr>
<td>Implementation of nonpoint source BMPs tracked via eLink and estimated nutrient load reductions</td>
<td></td>
<td></td>
<td>Although funding has increased and there is a continued increase in practices being implemented, the total requests for projects were approximately three times greater than available funds.</td>
</tr>
<tr>
<td>Implementation of priority CRP conservation practices</td>
<td>Filter strips</td>
<td>↓</td>
<td>The general trend since 2002 has been decline, but there are signs of increasing acreage under these practices. Although there isn’t a target, it appears that progress is slow.</td>
</tr>
<tr>
<td>Riparian buffers</td>
<td></td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Implementation of conservation tillage funded through AgBMP Loans</td>
<td></td>
<td>↓</td>
<td>The annual acreage associated with conservation tillage projects reported by borrowers under MDA’s AgBMP Loan Program declining from 2006–2012. Less annual marginal gains under the program.</td>
</tr>
</tbody>
</table>
### Program Output Measures

<table>
<thead>
<tr>
<th>Measures</th>
<th>Status</th>
<th>BMP Adoption Trend</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implementation of nitrogen fertilizer BMPs</td>
<td>Application rate on corn following corn (surveyed fields)</td>
<td>Green</td>
<td>Data from the 2010 Survey of Nitrogen Fertilizer Use on Corn in Minnesota only includes data point for three of four BMPs, so no trend data are available. Survey results, however, show that application rate on corn following corn are within the acceptable rates, although rates on the more common rotation of corn following legumes can in many cases be reduced. Nitrogen fertilizer timing is occurring in spring or as a sidedress, and inhibitor use increasing over time. The use of additives and specialty fertilizers is less than 9% on surveyed fields.</td>
</tr>
<tr>
<td></td>
<td>Application rate on corn following legumes</td>
<td>Yellow</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Application timing of nitrogen (surveyed fields)</td>
<td>Green</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nitrogen inhibitor use</td>
<td>Green</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Use of additives and specialty fertilizers (surveyed fields)</td>
<td>Green</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Changes over time in municipal wastewater phosphorus discharges</td>
<td>Green</td>
<td>Long-term ramp-up in requirements coupled with new Clean Water Fund investments are helping wastewater sources continue to reduce phosphorus discharges.</td>
</tr>
</tbody>
</table>

The Program Output Report card indicates some progress in program implementation. A majority of the measures indicate an improving trend. However, several of the measures indicate that sufficient progress is not being made or achievement of targets or goals is uncertain. The only measure that does not require additional attention is related to programs for reducing phosphorus in municipal wastewater on an overall, statewide basis, although there is still progress that can be made. The current report card demonstrates that all measures require attention during implementation. Overall, the current report card provides a starting point for implementation and can be used to track progress across multiple program measures over time.
The program progress included in the above tables does not provide the complete picture of progress, and additional tables, documents, and communication tools will need to be provided. It is also important to show progress status with non-governmental program BMP implementation and with water quality monitoring results.

### 7.3 Adjust Nutrient Reduction Strategy

The ultimate step of the adaptive management process is adjusting the NRS implementation activities based on the data collection and trend evaluation process to ensure progress toward the NRS goals and milestones. Adjustments to the NRS could include recommendations for adjusting implementation guided by the trends seen in the suite of programmatic measures. A formal update of the NRS will be completed in 2016. A second update would be expected prior to 2025 to incorporate updated milestones and recent progress.

In addition, adjustments to the NRS could include recommendations guided by research, additional planning details, BMP adoption progress, programmatic measures, in addition to new water quality modeling/monitoring information. It will be necessary to document the rationale for any adjustments to the NRS on the basis of progress evaluation, coordination with program management and water quality data compiled to support the NRS. Where adjustments are necessary, updated versions of the NRS will document the changes.