

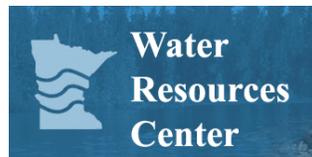
Developing an Effectiveness Tracking and Reporting Framework for Implementing the Clean Water Legacy Act

Final Report Addendum



Photo by Stephanie Grayzeck

**Prepared by:
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Executive Summary

The Water Resources Center completed the *Developing an Effectiveness Tracking and Reporting Framework for implementing the Clean Water Legacy Act* project in October 2008. The report of the work completed by July can be found at <http://wrc.umn.edu/outreach/cwlatracking/index.html>. Between July and October, the four state agencies responsible for implementing the Clean Water Legacy Act developed measures for the components of the Clean Water Legacy Act for which they were responsible. The four state agencies are the Minnesota Department of Agriculture, the Board of Water and Soil Resources, the Minnesota Department of Natural Resources, and the Minnesota Pollution Control Agency. At the request of these state agencies, the WRC agreed to re-convene the working group (referred to as the strategy group) to review and collate the measures of the four agencies.

This report reflects the work from July through October, with key results being the finalization of the framework, draft final measures and recommendations for the future. The framework essential remains the same. The measures were analyzed and are considered to be draft final, as the four state agencies should review and adopt or alter them within the next couple of months. Once finalized, the agencies must identify the metadata for each measure including baseline information and the goal for the next year or two years. Three areas for further work are in developing measures of knowledge, attitude and practices also known as social measures; incorporating cost effectiveness concepts into the framework; and determining how to measure the effectiveness of the research.

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Introduction

The MPCA selected the Water Resources Center (WRC) at the University of Minnesota to lead and facilitate the development of such a Clean Water Legacy Act tracking and reporting framework for the four agencies responsible for implementing the Clean Water Legacy Act: Board of Water and Soil Resources, Minnesota Department of Agriculture, Minnesota Department of Natural Resources and the Minnesota Pollution Control Agency. This work was completed between November 2007 and July 2008 and is available on line at <http://wrc.umn.edu/outreach/cwlatracking/index.html>.

This addendum reports only the results of the state agency work to develop measures, the results of the October 15, 2008 meeting of the strategy group and recommendations to the state agencies. The key elements of this addendum are to report on changes to the framework, the measures that were agreed upon, and recommendations for further work on measures and the framework. This report is best understood in the context of the July 2008 report on this project

This report, meeting minutes, presentations, and other supporting materials are available electronically at <http://wrc.umn.edu/outreach/cwlatracking>.

The Clean Water Legacy Effectiveness Tracking Framework

The Clean Water Legacy (CWL) Effectiveness Tracking Framework which was developed between November 2007 and July 2008 was tested by CWL staff in the Minnesota Department of Agriculture, the Board of Water and Soil Resources, the Department of Natural Resources and the Minnesota Pollution Control Agency (the agencies) as they developed measures. The agencies agreed that the framework worked for organizing measures from all agencies and the strategy group recommends this framework be used to track the progress of CWL activities. The only alteration is that the framework has been re-ordered by geographic scale, moving from the smallest scale to the largest.

One component that does not fit into this framework is research-related activities. A separate mechanism may need to be developed for reporting on funding, measuring and reporting for clean water legacy act funded research. More discussion about research tracking is contained in the measures section below.

Final Proposed framework

	Measure Category			
Geographic scale	Partnerships/ Leveraging	Environmental Measures	Social Measures	Organizational Performance
Project Sub-watershed Political Boundaries AUID Other <i>(project level must be defined)</i>				
Major Watershed (8 digit HUC)				
Region/Basin				
State				

Measure categories: Along the top row of this framework are four categories for measures. These four categories and are defined as the following:

- Partnerships/Leveraging:** The Clean Water Legacy Act specifically calls for increasing agency cooperation and coordination, improving capacity of local governments, and leveraging other resources to improve water quality in Minnesota. Measures in the Partnerships/Leveraging category answer the question of *how well are agencies coordinating with other state agencies, with local units of government, with citizens, and with organizations like the University of Minnesota.*
- Environmental Measures:** *What are the physical results of the “effort”?* Measures that fall into this category tend to be the overall environmental goals or “outcomes” agencies and other organizations are trying to reach. (Example: Has water quality improved? Are these Best Management Practices (BMPs) effectively reducing X pollutant?)
- Social Measures:** Measures in the social indicators category refer to *changes in knowledge, attitudes and practices that impact water quality.* Social indicators tend to be medium term, predictive measures that can give agencies a heads up and allow for course correction if a program or target is not working.
- Organizational Performance:** Organizational performance refers to *How well is the organization (state agency, local unit of government, etc.) doing at managing a program or project?* Some of the measures reported in this category will be of high value to the agencies/organizations themselves in assessing and improving performance

Measures

Development of Measures - Process

The July 2008 report listed potential measures which were derived from interviews, the literature review and those developed during the first three strategy meetings. The agencies convened key staff working on the CWL activities to determine which measures would most effectively demonstrate the progress in meeting the CWL goals. The steering team developed instructions to the leads in state agencies, so that the process would be the same. These instructions can be found in Appendix A.

Agencies developed measures that were placed into matrices and distributed at the fourth strategy meeting on October 15, 2008. These initial matrices and measures are located at <http://wrc.umn.edu/outreach/cwlatracking> . The strategy team reviewed the matrices and provided general comments. The strategy team divided into three separate groups and each group reviewed the measures and made additions and subtractions. The final measures have been collated into one framework and are in Appendix B.

Social Measures

Social measures are those that capture knowledge, attitudes and practices. This is a fairly new area of measure development within water resources and environmental resources. Social measures have become increasingly important as the focus has shifted from point sources, which are heavily regulated to nonpoint sources of pollution with are not fully regulated. The nonpoint source work relies on changes by individuals, small businesses including agricultural producers and other entities and can not be measured at the end of a pipe. Social measures can be an indicator in changes that will result in better protection of water and other resources.

The social measures in the framework are not very well developed as this is an emerging field within the environmental sciences. The University of Minnesota Water Resources Center (WRC) is currently working with other Region 5 land grant universities on developing indicators of change in knowledge, attitude and practices. This regional project is focused on a survey that can be used by local and state leads of nonpoint source projects. The WRC is also researching other methods that will be quicker and less cumbersome for local units of government through piloting methods that have been used in other scientific fields. The MPCA has provided funding for this work.

The WRC recommends that as these measures are developed for the MPCA and EPA under the other projects, the state agencies and clean water council should incorporate these into the framework. These other projects will have some results that could be considered for inclusion in late 2009.

Measures for Research funded under Clean Water Legacy

The WRC and the Clean Water Council recognized that the framework does not include a way to measure research activities funded through Clean Water Legacy funds. Adam Birr of the Department of Agriculture reviewed and summarized a recent National Academies report resulting from a U.S. Environmental Protection Agency request for assistance on evaluating

effectiveness of Research and Development projects. The summary (see appendix D) recommends two metrics for evaluating research:

1. Investment efficiency, includes the relevance, quality and performance of a research project using qualitative measures within the overall strategy program and is best evaluated by which an expert review panel; and
2. Process efficiency, which uses quantitative measures to track dollars and hours devoted to a project. Process efficiency should always be secondary to investments efficiency

These two metrics could also be used in selecting research projects.

Cost-Benefit and Cost Effectiveness

The Clean Water Council Research and Outcomes Workgroup asked the WRC and the strategy team to incorporate cost-benefit or cost effectiveness into the framework. Dr. Bill Easter of the University of Minnesota Applied Economics Department provided information to both the WRC and the strategy group.

Cost-benefit for environmental programming is very expensive to do correctly and can not be done quickly to provide accurate information. Dr. Easter's recommendation is that Cost effectiveness would be a better alternative. Cost effectiveness can be accomplished using three different methods:

1. Constant results/effects: In this method, you predetermine the results you want, and then compare different means and associated costs for achieving the results or effects.
2. Constant cost: In this method the cost is fixed, and you compare the results or amount of impact that different outcomes or outputs would provide for the set cost.
3. Constant budget: The budget is constant and you look at the best mix of multiple options.

The WRC and the strategy group concluded that cost-effectiveness measures should not be hastily added to this framework at this time, as it falls outside the scope of this project, is very complex and requires more thought and work by experts in cost effectiveness.

Metadata

Once the measures are finalized, the agencies need to develop the metadata for every measure. The metadata categories are listed below. An addition to the metadata since July 2008 is establishing the baseline (#7)

1. **Timeframe...***How long will it take to collect and report data for this measure?* Short term refers to 1-4 years, medium term refers to 5-10 years, and long term refers to 10+ years. These timeframe specifications may be altered to fit agency reporting if necessary. Example: *number of lakes with citizen volunteers* is a short term measure, while *water quality trends* is long term measure

2. **Who collects the data?...** Many of the data collected will come from multiple sources (e.g. state agencies, local units of government, federal government). This will be particularly important when the agencies begin thinking about a data management system. Example: the MPCA collects information on the number of TMDLs completed each year, but multiple agencies collect water quality monitoring data.

3. **Is the measure an output or outcome?...** Each measure may be described as an output/activity/effort or an outcome/final goal/ effect.. An output answers “*what did we do and what products or services were produced?*” while an outcome answers “*what did we achieve?*” (Hockings et al. 2000). Example: TMDL study completion is an **output**, while actual improvement in water quality is an **outcome**. It is possible for some measures to be both an output and an outcome.

4. **Who is the audience?** Different measures may be reported to different audiences. Example audiences: the Legislature, the Clean Water Council, agency management, general public

5. **What part of the Impaired Waters process does the measure fall under?** Funding for the CWLA and water quality improvement efforts still falls into traditional impaired waters process categories.

- a. Monitoring and Assessment
 - b. TMDL/watershed Planning
 - c. Implementation: non-regulated (non point source) or regulated (point source)
- Example: *Percent adoption of key urban runoff BMPs for a given area* falls under the implementation piece of the impaired waters process.

6. **Is the measure related to Protection or Restoration activities?** The Clean Water Legacy Act calls for both protection *and* restoration activities, so if applicable, it is important to indicate which type of activity the measure falls under. Example: A pollutant load reduction for a TMDL implementation plan is a restoration measure, while miles of shoreline stabilization on an unimpaired lake is a protection measure.

7. **What is the baseline for this measure?** In order to measure success, progress must be measured against the baseline, or status at the beginning of the program. Example: X percent of TMDLs are locally led on January 1, 2009.

8. **What is the target/benchmark for the measure?...**The success of Clean Water Legacy efforts must be measured relative to targets or benchmarks. Setting these targets benchmarks will provide information for agency management, decision makers and policy makers and future decisions. Example: X percent of TMDLs will be locally led.

New Recommendations

These recommendations augment those in the July 2008 report and are from the strategy group, unless identified under the WRC recommendations.

Framework Recommendations

- Add a goal statement for each phase/table (i.e. for Monitoring and Assessment, TMDL Development, Implementation) to clarify the area and focus/context for that part of the CWL activities. For example, for monitoring and assessment, the goal might be to monitor and assess the condition of Minnesota's lakes and streams and to track trends over time.

Measures Recommendations

- Measures should have final review by agencies and Clean Water Council to ensure they can begin collecting the data in 2009
- In reviewing the measures, issues to consider are the balance across the full framework for all aspects of the program, which measures are the most effective measures in telling the story, which measures are for other purposes and what is realistic in the first year
- As the agencies and Clean Water Council use the framework and measures, both should be improved upon as needed. The two year review recommendation from the July 2008 report seems to be an appropriate timeframe.
- Measures should reflect the Clean Water Act goals of not only chemistry, but also biological and physical progress

WRC Recommendations

- The agencies should determine if and how effectiveness of Best Management Practices and field scale should be measured and tracked.
- Add social measures as they are further developed for other projects, possibly as soon as fall 2009.
- Cost effectiveness (and not cost-benefit) should be incorporated after adequate development for this framework.
- A method for better measuring research funded through the CWL funds should be developed based on the paper found in appendix C and supporting documentation.
- Once measures are finalized, responsible agencies should ensure that metadata is developed so that responsibilities are clear.

Appendices

- A. Instructions to state agencies for developing measures
- B. Final frameworks and measures
- C. Guidelines for Evaluating Clean Water Legacy Act Research Activities

Appendix A

Instructions to state agencies for developing measures

Task:

Recommend key measures to track the effectiveness of the Clean Water Legacy Initiative that your agency/division/program is either currently reporting or could collect and report with a little additional effort and NO additional funding.

You are welcome to recommend measures that other agencies/divisions/program should report but please focus first on what you could contribute.

You may also identify gaps (additional data that could be collected by your agency/division/program), but please then indicate the anticipated cost, resources, and time required to collect this additional data.

Background:

The framework that we are asking you to help populate is a product of a series of meetings beginning in December 2007, and facilitated by the Water Resources Center at the University of Minnesota. Participants in these meetings represented: BWSR, MDA, DNR, MPCA, and additional parties, including the U.S. EPA, USDA, Natural Resources Conservation Service (NRCS), University of Minnesota faculty, and a local government representative.

The framework includes four categories of measures (partnerships/leveraging, environmental indicators, social indicators, and organizational performance) which can be presented at various spatial and temporal scales.

Please Remember:

1. Identified measures should be data that can be objectively assessed.
2. Please fill out a separate worksheet (these may just be separate pages within one Word document) for EACH MEASURE you are recommending. I have attached a template (**page 2, below**) for your use.
3. *If the measure represents new work*, please also include information on anticipated cost, resources, and collection effort/time.

***Please submit completed worksheet(s) *electronically* to Megan Pavek (megan.pavek@state.mn.us) by October 1, 2008.

In you have questions, the following individuals can help:

MPCA – Gaylen Reetz
DNR – Dave Wright
BWSR – Steve Woods
MDA – Barbara Weisman

Thank you in advance for your input. After the recommended measures have been compiled, reviewed, and major gaps identified, you will be provided a copy for review/input and to see how measure you propose are integrated into the draft framework

Appendix B
Final Framework and Measures

Monitoring and Assessment				
Core Measure Category				
Geographic scale	Partnerships/ Leveraging	Environmental Measures	Social Measures	Organizational Performance
Project **		<ul style="list-style-type: none"> • % of 11-digit HUCs (within each major watershed) requiring TMDLs (MPCA) 		<ul style="list-style-type: none"> • Average MPCA cost per site for intensive stream, load monitoring and lake monitoring. (MPCA) • Average cost per site for SWAG projects. (MPCA)
Major Watershed (8 digit HUC)	<ul style="list-style-type: none"> • Number of stream flow gages with local involvement – Watershed District, County and City. (DNR) • Number of watersheds with interagency condition monitoring involvement/ cooperation (MPCA) • Number and percent of “priority” watershed lakes with SD monitors (MPCA task suggested by DNR) • Number and percent of “priority” watershed with lake level gauges (would include DOW installed gauges) 	<ul style="list-style-type: none"> • Pollutant load results and trends by watershed (MPCA) • Flow volume/rate trends (MPCA) • Trends at intensive monitoring sites (biological, physical and chemical) (MPCA) • Trend in key water quality parameters at 8 digit HUC pour points including fish tissue mercury (MPCA task suggested by DNR) • Trend in key water quality parameters on “trend” lakes in watershed (MPCA task suggested by DNR) • Number and % of lakes/lake acres and stream miles supporting/not supporting designated uses (by use, based on random monitoring)* (MPCA) 	<ul style="list-style-type: none"> • Annual % increase in CLMP and CSMP sites* (MPCA) 	<ul style="list-style-type: none"> • Cumulative % of lakes sampled/ assessed (number and lake acres by 3 size categories: ≥ 500 acres, 100-500 acres, ≥ 10 acres)* (MPCA) • Cumulative % of stream monitoring sites sampled/assessed (based on 10-year total of 3,600)* (MPCA) • Equipment at gage(s) within a watershed are fully functioning with regular maintenance (DNR) • Gage(s) has hydrologic analyses (DNR) • Gage(s) has completed up to date record with Q/A and Q/C (DNR) • Gage records available on DNR/PCA Cooperative Stream Gaging Website.

Monitoring and Assessment

Core Measure Category

Geographic scale	Partnerships/ Leveraging	Environmental Measures	Social Measures	Organizational Performance
		<ul style="list-style-type: none"> # and % of lakes with increasing/decreasing water quality* (MPCA) 		
Region/Basin	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> Overall trend in fish tissue contaminant concentration in major basin rivers (DNR) 	<ul style="list-style-type: none"> 	<ul style="list-style-type: none">
State	<ul style="list-style-type: none"> Number of lake sites and stream sites sampled via Surface Water Assessment Grants (SWAG) each year (MPCA) % of SWAG grants with volunteer participation (MPCA) % of assessments that rely in part or in whole on data collected by partners (MPCA) \$\$ spent by MPCA on local/citizen monitoring efforts (CLMP, CSMP, SWAG) (MPCA) Number of stream flow monitoring sites coordinated through more than one agency (NWS, USGS COE, MDNR, MPCA, MDA) Number and percent of “priority” watershed lakes with SD monitors (MPCA) 	<ul style="list-style-type: none"> Number and % of lakes/lake acres and stream miles supporting/not supporting designated uses (by use, based on random monitoring)* (MPCA) # and % of lakes with increasing/decreasing water quality* (MPCA) % of load monitoring sites and Milestone sites with decreasing/increasing trends in pollutant load or concentration (MPCA) Total number of major watersheds with effective stream flow monitoring (DNR) Proportion of tested waters that are impaired (MPCA task suggested by DNR) Overall trend in fish tissue mercury concentrations in MN lakes (MPCA task that includes DNR data) 	<ul style="list-style-type: none"> Annual % increase in CLMP and CSMP sites* (MPCA) Cumulative total of volunteers (active and inactive) that have participated at one time or another CLMP, CSMP, SWAG) (MPCA) Number of stream flow gages with multiple use – water quality, flood warning, water supply and drought management activities. (DNR) 	<ul style="list-style-type: none"> Cumulative % of lakes sampled/assessed (number and lake acres by 3 size categories: ≥ 500 acres, 100-500 acres, ≥ 10 acres)* (MPCA) Cumulative % of stream monitoring sites sampled/assessed (based on 10-year total of 3,600)* (MPCA) Number of lake sites and number of stream sites monitored by MPCA staff each year (target is 100 lakes/year, 500 stream sites/year) (MPCA) Cumulative % of watersheds intensively monitored (MPCA) % of major watershed load monitoring sites sampled each year (MPCA) \$\$ spent by MPCA (annually, biennially) on monitoring and assessment (MPCA) Number of gages with fully active functioning equipment and maintenance. (DNR)

Monitoring and Assessment

Core Measure Category

Geographic scale	Partnerships/ Leveraging	Environmental Measures	Social Measures	Organizational Performance
	task suggested by DNR) <ul style="list-style-type: none"> • Number and percent of “priority” watershed with lake level gauges (would include DOW installed gauges) (DNR) • 			<ul style="list-style-type: none"> • Number of gages with completed records with Q/A and QC available for water quantity and quality analyses. (DNR) • Number of gages with hydrologic analyses. (DNR) • Continuous evaluation of web based flow and water quality data distribution system (DNR/PCA Cooperative Stream Gaging Website) to insure updated material and function. • Number of hits to the DNR/PCA Cooperative Stream Gaging Website. • Waterbodies assessed for fish contaminant concentration vs identified CWL annual target (DNR) • Lake IBI assessments completed vs. identified CWL annual target (DNR)

* These measures are collected at the watershed level and rolled up into the state level

** *project level must be defined, potential could be subwatershed, political boundaries, AUID,etc*

TMDL Development
Core Measure Category

Geographic scale	Partnerships/ Leveraging	Environmental Measures	Social Measures	Organizational Performance
Project Scale **	<ul style="list-style-type: none"> • Number and percent of locally led TMDL studies underway or approved by EPA.* (MPCA) • Amount of money/time invested by local entities, state & federal on local TMDLS.* (MPCA) • Number of watersheds with involvement of more than one agency (USGS COE, MDNR, MPCA, MDA USFWS) • # of substantive comments received and incorporated into each TMDL 		<ul style="list-style-type: none"> • % of projects with pre & post social indicator survey (CAP study)* 	<ul style="list-style-type: none"> • Number and percent of 303(d) impaired waters listings (total and by listing year) addressed in TMDL studies that have been approved by EPA. * (MPCA) • Number and percent of 303(d) impaired waters listings (total and by listing year) with MPCA approved protection/restoration implementation plans.* (MPCA) • Dollar investment spent (federal, state & local) on TMDLS.* (MPCA) • # of research projects to determine adequacy of models used.*
Major Watershed (8 digit HUC)	<ul style="list-style-type: none"> • Number and percent of locally led TMDL studies underway or approved by EPA.* (MPCA) • Amount of money/time invested by local entities, state & federal on local TMDLS.* (MPCA) 		<ul style="list-style-type: none"> ○ See above for rolling data up to larger scale 	<ul style="list-style-type: none"> • Total number of completed models and watershed (lakeshed) delineations. (DNR) • Number of TMDL or Watershed planning efforts where DNR delivers specialized technical advice that substantially improves quality of product. • Number and percent of 8-digit HUC watersheds fully addressed by EPA approved TMDLS.* (MPCA) • Number and percent of 8-digit HUC watersheds fully addressed in TMDL studies that are

TMDL Development				
Core Measure Category				
Geographic scale	Partnerships/ Leveraging	Environmental Measures	Social Measures	Organizational Performance
				underway.* (MPCA) <ul style="list-style-type: none"> • Number and percent of 8-digit HUC watersheds fully addressed through MPCA-approved protection/restoration implementation plans.* (MPCA) See above for rolling data
State	<ul style="list-style-type: none"> • Number and percent of locally led TMDL studies underway or approved by EPA.* (MPCA) • Amount of money/time invested by local entities, state & federal on local TMDLS.* (MPCA) 	.	<ul style="list-style-type: none"> • See above for rolling date up to state-wide 	<ul style="list-style-type: none"> • Number and percent of 303(d) impaired waters listings (total and by listing year) addressed in TMDL studies that have been approved by EPA.* (MPCA) • Number and percent of 303(d) impaired waters listings (total and by listing year) addressed in TMDL studies that are underway.* (MPCA) • See above for rolling data

*These measures are collected at the project or watershed scale and rolled up to the statewide scale

Implementation Core Measures

Geographic scale	Partnerships/ Leveraging	Environmental Measures	Social Measures	Organizational Performance
Project	<ul style="list-style-type: none"> Ratio of CWLA to total project \$ 	<ul style="list-style-type: none"> Acres and % meeting NRCS T limits in ag areas per NRI Acres and % meeting goals per WI Erosion Transect Acres and % meeting goals per Tillage Transect Survey Degree of implementation of targeted BMPs (as specified in implementation plans or protection plans) 	<ul style="list-style-type: none"> Acres, % of BMP adoption at local goals Develop KAP survey and identify constraints to BMP adoption 	<ul style="list-style-type: none"> # major wshd plan priority <u>bmps</u> considered in local plans Degree of implementation of targeted BMPs (as specified in implementation plans or protection plans)
Major Watershed (8 digit HUC)	<ul style="list-style-type: none"> # (and % of area represented) of lgus actively engaged in imp plan process 	<ul style="list-style-type: none"> Results and trends of DNR fish surveys PCA IBI results Wshd yield trends (ac-ft per inch of annualize precip) Aquatic Habitat; Connectivity results 	<ul style="list-style-type: none"> 	<ul style="list-style-type: none"> % of projects completed relative to implementation plan estimates
State	<ul style="list-style-type: none"> # (and % of area represented) of lgus actively engaged in imp plan process 	<ul style="list-style-type: none"> Individual pollutant trends (i.e. P, fecal, and BOD are ↓ while N is ↑) % meeting current standard 	<ul style="list-style-type: none"> Need to develop Capacity Building indicator 	<ul style="list-style-type: none"> Ratio of AGENCY admin: project awards or program dollars % of funds spent in priority areas (per local plans)

* These measures are collected at the watershed level and rolled up into the state level

** *project level must be defined, potential could be subwatershed, political boundaries, AUID, etc*

*** Not enough information currently to report statistically valid number. Some may need additional resources and time investment in order to generate

- Note: MS4 in this document means only 235 'regulated' MS4s, not all state public entities with stormwater conveyance systems

Appendix C

Guidelines for Evaluation Clean Water Legacy Act Research Activities

The U.S. Environmental Protection Agency (EPA) recently asked the National Academies to form a committee to assist with developing tools to comply with the Program Assessment Rating Tool (PART) developed by the Office of Management and Budget (OMB) in response to the Government Performance and Results Act of 1993. The committee was charged with addressing EPA and other federally funded research and development (R&D) programs. The Clean Water Legacy Act (CWLA) does not support a formal R&D program to address impaired waters; however, each of the state agencies has used CWLA funds to support research projects. The principles and recommendations resulting from the EPA study provide insight for evaluating the effectiveness of CWLA funded research projects.

The challenge with evaluating R&D program efficiency is that the course of research cannot be planned in advance, because it operates on feedback loops from observation and experimentation that result in changes in research priorities and courses of study over time. This is particularly true of basic research, whereas applied research emphasizes translating research findings to a particular group, agency, or use. For instance, CWLA projects should in part be used by TMDL project staff to refine load allocations and implementation strategies. The intended outcomes of applied research are known though the pathway to the endpoint is not clear at the outset.

The primary focus of many metrics used to evaluate programs is outcomes. Outcomes are the benefits resulting from a research program. Intermediate outcomes are short-term such as a contribution of research to a body of knowledge. Ultimate outcomes are long-term in nature such as improved water quality or de-listing of water bodies from the 303(d) list of impaired waters for CWLA funded activities. In the case of research, ultimate outcome based metrics for evaluating research are neither achievable nor valid. There is often a significant time lag between completion of the research and the ultimate outcome of research. A number of end users such as agencies and resource managers are needed to implement research findings to achieve outcomes. Finally, the knowledge and understanding gained through research activities may change the nature of the outcome.

Despite the challenges associated with evaluating research programs and projects, the use of taxpayer's money necessitates that a system be used to ensure that limited resources are being optimized to address impaired waters issues. The committee proposed principles and guidelines that should be considered when developing a framework for evaluating EPA research programs that can be applied to CWLA research activities. The first principle is that metrics for evaluating research efforts should address three elements: relevance, quality, and performance. Relevance is a measure of how well research supports the mission or purpose of the CWLA which is to protect, restore, and preserve the quality of Minnesota's surface waters by achieving and maintaining water quality standards. Quality refers to the contribution of research to our understanding and knowledge of surface water systems. Metrics for this element should evaluate the soundness, accuracy, novelty and reproducibility of the research project. Performance is described in two facets: effectiveness and efficiency. Effectiveness refers to the usability of research results by various stakeholders such as TMDL project staff and resource managers.

Efficiency refers to the ability to achieve quality, relevance, and effectiveness while maximizing resources devoted to the project in terms of time and money.

Efficiency is often one of the primary concerns of both legislators and project administrators; however, the evaluation committee warns that efficiency should not be measured separately but rather be a relatively minor component of a comprehensive evaluation of a program or project's relevance, quality, and effectiveness. Research efficiency should be based on two metrics: *investment* and *process* efficiency.

Investment efficiency asks the question: is the agency making investments in the right projects? Investment efficiency is best evaluated by expert-review panels that use predominantly qualitative metrics tied to long-term plans. The charge of the panel is to determine that the research embodies the purpose of the CWLA (relevance), that the research is technically sound (quality), and that the research results will have a significant impact on impaired waters programs and activities given the funds available (performance). The panel can also identify emerging issues and determine their place in research priorities.

Process efficiency asks the question: are the research investments being managed well? Process efficiency can be measured quantitatively by evaluating adherence to pre-determined milestones, timelines, and budgets. Process efficiency refers to inputs, outputs, and intermediate outcomes of a research project/program. Inputs include agency resources such as funding, facilities, and human capital that support research. Outputs are products delivered by a research project such as conclusions and papers published. Intermediate outcomes provide reviewers of a research project or program with tangible metrics of evaluation. Examples of intermediate outcomes may include an improved body of knowledge available for decision-making, integrated science assessments, and newly developed tools and models.

Most metrics for evaluating research projects/programs address process efficiency rather than investment efficiency. When developing process-efficiency metrics, several questions should be answered including:

- Does it cover a representative portion of the program's operations?
- Does it cover both inputs and outputs of the program?
- Is its use likely to create undesirable incentives for researchers and research managers?
- Does collecting the information add sizable administrative costs?

The EPA and other agencies have developed a number of process efficiency metrics, but the committee believed each had inherent shortfalls in light of the preceding questions. Examples of metrics proposed include:

- Metric: Time to process, review, and award grants.
 - Critique: The metric is tied to time rather than total resources. Improving time may reduce the quality of the research conducted.
- Metric: Publications per Full Time Equivalent (FTE).
 - Critique: Does not evaluate the relevance, quality, and effectiveness of the publications.
- Metric: Percentage of budget that is overhead.
 - Critique: Doesn't account for quality of the outputs.

It is important to note that process efficiency is secondary to investment efficiency in that it adds value only after a comprehensive evaluation of relevance, quality, and effectiveness.

The evaluation committee provided a simplified example of a logic model for evaluating research project/programs that incorporates many of the concepts and terms presented earlier such as inputs, outputs, intermediate outcomes, and ultimate outcomes. This logic model has been adapted to illustrate how it might be applied to CWLA research funded activities (Fig. 1). The models can assess the degree to which research results are translated into benefits for taxpayers. They can also connect inputs to ultimate outcomes. The steps needed to translate research into the ultimate outcome of clean water are numerous and are not conducive to an annual review of a research project/program. However, the model demonstrates how intermediate outcomes can provide a measure of progress made toward achieving the ultimate outcome.

In conclusion, the use of ultimate outcomes is not appropriate for evaluating research projects due to the significant time lag. Furthermore, metrics currently used by many agencies focus on particular aspects of programs such as dollars spent rather than evaluating the research itself. In contrast the committee appointed by EPA recommended two metrics for evaluating research projects and programs: investment efficiency and process efficiency. Investment efficiency utilizes an expert review panel to evaluate the relevance, quality and performance of a research project using qualitative measures within the context of the overall strategy program. Process efficiency uses quantitative measures to track dollars and hours devoted to a project. Process efficiency should always be secondary to investment efficiency.

References

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