

# **Watershed Based Plan Review**

## **Final Report**

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U.S. Environmental Protection Agency  
Office of Wetlands, Oceans, & Watersheds  
Assessment & Watershed Protection Division  
Nonpoint Source Control Branch

## Introduction & Purpose

In 2006, the Non Point Source Control Branch (NPSCB) of the EPA Office of Wetlands, Oceans, and Watersheds completed a review of the “best” watershed plans from each state. The purpose of the review was to evaluate how well stakeholders were meeting the challenge of developing high-quality watershed-based plans in accordance with the 9 essential components outlined in the October 2003 “Nonpoint Source Program & Grants Guidelines for States and Territories”. The 2006 review found that while some states were able to develop high quality watershed-based plans, many plans were still not sufficiently well designed or did not contain sufficient information to support a fully successful implementation effort that would lead to the attainment of water quality standards in the waterbodies identified.

Recommendations from the 2006 review included:

- Greater oversight by EPA Regions to assure watershed-based plans are adequate
- Developing a guidance document providing “best” examples for each of the 9 components
- Providing better training and guidance that demonstrates the level of detail needed to assure water quality standards are achieved in a watershed
- Distributing the “best” plans to the Regions as examples of the level of detail required for a good watershed-based plan.

Since the 2006 review, EPA Headquarters has taken action to provide guidance for developing effective watershed based plans, including publishing the Watershed Planning Handbook; releasing the best plans from the last review; posting additional exemplary plans on the EPA nonpoint source website; and convening workshops addressing watershed-based plan issues such as modeling.

In 2008, EPA Headquarters decided to conduct a second review of state watershed-based plans to determine the level of progress that states and their stakeholders have made in addressing the nine essential components of watershed-based plans. In September of 2008, the NPSCB again asked each of the regional offices to coordinate with their states and territories to identify and submit the “best” watershed-based plan from each state. A total of 49 plans were reviewed during the period 2008 – 2010.

Purposes of this review included:

- Improving our understanding of States’ ongoing efforts to develop watershed based plans and identifying needs for improvement.
- Identifying effective and innovative approaches to watershed planning and management that can be shared with states, tribes, and local partners.
- Help guide future activities to promote improved watershed planning and management.

## Evaluation Method

EPA developed scoring criteria based on the nine components of a watershed based plan, as identified in the October 2003 Federal Register notice. There are several critical elements identified for each criterion. In order for a plan to meet a criterion, it should contain each of its corresponding elements. Upon the review of each plan, each criterion was given a score of 0-3, 3 being the highest score. Scoring is further explained in **Table 1**

**Table 1: Criterion Scoring**

3	Excellent – Criterion was met at a level that goes above and beyond the minimum and/or included especially effective approaches to addressing the criterion.
2	Good - Criterion met an adequate level of detail; i.e. information provided was adequate to support successful implementation.
1	Fair – Information provided addressed some aspects of the criterion, but failed to fully address it.
0	Poor - Criterion was not adequately addressed

The overall score for each plan was based on a maximum score of 100. Each criterion was assigned a percent weight, and the weight of each criterion was based upon its relative level of importance in assuring that implementation of the plan would attain water quality standards. In particular, 54% of the final score is focused on the first three criteria.

A criterion’s score of 0-3 was converted to a percentage, which was multiplied by the weight to determine how many of the possible percentage points were earned for each criterion. For example, a plan that achieves a 2 for all criteria would have a total score of 67% and would be considered by the scoring system to be adequate to support successful implementation. The overall score was not used to assign a particular “rating” to each watershed plan, or declare that a plan “passed” or “failed”. Rather, it was used to rank all of the watershed plans; i.e. the higher the score, the higher the rank. This information has been used to identify the merits of those plans that appear to be of high quality – providing excellent models that states, local governments, watershed groups can review and learn from and to assess the overall quality of all of the plans.

The criteria that were used to evaluate the plans are listed in **Table 2**.

**Table 2. Numerical Criteria**

<b>A. CAUSES/SOURCES OF POLLUTION ARE IDENTIFIED</b>		
<b>Goals for restoration &amp; protection are clearly defined, quantified &amp; thoroughly explained</b>		8.0%
	Impaired, partially impaired, and/or threatened water bodies on the 303(d) list are identified	
	Goals are clearly defined, and quantified (if applicable)	
<b>Causes/sources of pollution that need to be controlled to meet goals are identified as it applies to areas for restoration and protection</b>		14.0%
	Sources of pollution, both point and non point, are mapped/causes identified	
	Loads from identified sources are quantified	
	Watershed sufficiently subdivided by landuse type, cover or other characteristics to enhance the assessment of sources and strategic placement of BMP's	
	Data sources, estimates and assumptions are cited & documented	
	Data Gaps Identified if they exist, but data gaps not significant enough to delay implementation	
<b>B. EXPECTED LOAD REDUCTIONS FOR SOLUTIONS IDENTIFIED</b>		18.0%
	Expected load reductions are linked to a pollution cause/source identified in (A)	
	Expected load reductions are analyzed to ensure water quality criteria, and/or other goals will be achieved	
	Basis of load reduction effectiveness estimates is thoroughly explained	
	Significant estimates, assumptions, and other data used in the analysis are cited & verifiable	
<b>C. NONPOINT SOURCE MANAGEMENT MEASURES IDENTIFIED</b>		14.0%
	Management measures needed to address causes/sources of pollution identified in (A) are listed, described, and mapped (if known)	
	Explanation for the selection of measures is included to ensure they are applicable to the pollutant causes/sources and are feasible and acceptable	
	Management measures are prioritized based on critical pollutant causes/sources, type, and location as well as compatibility with landowner operations	
	Significant estimates, assumptions, and other data used in the analysis are cited & verifiable	
<b>D. ESTIMATE OF TECHNICAL &amp; FINANCIAL ASSISTANCE</b>		
<b>Estimate of Technical Assistance needed</b>		4.0%
	Significant existing sources of technical assistance that may be needed to implement the plan are accounted for.	
	Additional technical assistance needs are identified, and referenced back to the solutions	

<b>Estimate of Financial Assistance Needed</b>		4.0%
	General cost estimate is included by task (project work plans should have more detailed cost information)	
	Multiple funding sources are listed, as well as an estimated contribution from each source	
<b>E. EDUCATION/OUTREACH</b>		8.0%
	Reaches out to the appropriate sectors of the population in the watershed	
	Both educates public and encourages participation	
	Encourages the implementation of BMP's necessary to fulfill the plan requirements	
<b>F. IMPLEMENTATION SCHEDULE</b>		6.0%
	Timeline presents projected dates for the development and implementation of the actions needed to meet the goals of the plan and includes information on how implementation will be tracked	
	Implementation of point source and regulatory activities are coordinated with nonpoint source actions and other watershed implementation activities	
<b>G. MILESTONES IDENTIFIED</b>		6.0%
	Milestones are measureable and attainable	
	Includes expected completion dates to ensure the continuous implementation of plan	
<b>H. SHORT TERM CRITERIA TO ENSURE PROGRESS IS BEING MADE TOWARDS ATTAINING WATER QUALITY STANDARDS</b>		9.0%
	Interim numerical criteria present	
	Expected dates of achievement identified.	
	Includes a review process to determine if the reductions are being met	
	Includes criteria to determine whether the watershed based plan needs to be revised based upon failure to make adequate progress in accordance with the implementation schedule	
<b>I. MONITORING COMPONENT</b>		9.0%
	Includes description of how monitoring will be used to evaluate the effectiveness of the implementation efforts	
	There is a routine recording element in which progress and methodology are evaluated.	
	Monitoring is tied to a quality assurance plan	
	Parties responsible for monitoring are identified	

Additional details were recorded for each plan to assess any trends across plans. These included:

- Organization(s) authoring the document
- Predominant pollutants addressed in plans
- Watershed size, to determine if there was any correlation between the quality of the plan and the size of the watershed.

- Model used, if applicable, to get a better idea of the models that are being most commonly used and where.

## General Results

Based on the above described scoring system, the average score for all of the plans was 56%. Figure 1 presents the average score for each of the 9 watershed based plan components required in 319 plans.

The majority of reviewed plans have done very well with respect to the following components:

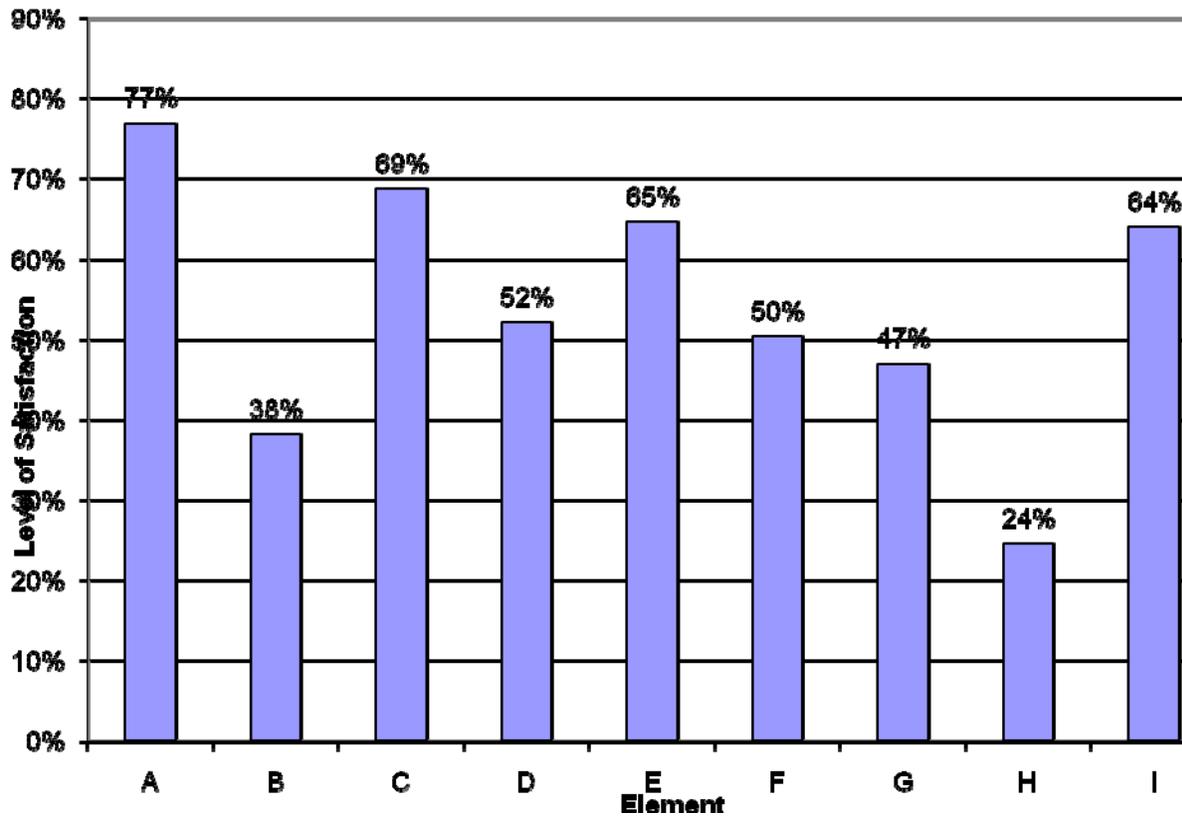
- Identifying causes and sources of pollution that need to be controlled to achieve watershed goals (Component A);
- Describing the NPS management measures that need to be implemented to achieve watershed goals (Component C);
- Developing an information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing NPS management measures (Component E); and
- Including a monitoring component to evaluate the effectiveness of the implementation efforts over time (Element I)

However, many states continue to struggle with estimating load reductions expected for the management measures selected, and setting criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards (components B and H). Components B and H were found to be problematic in the 2006 review and again were often addressed inadequately in the plans reviewed for this study. These two components go hand in hand; without adequate load reduction estimates, a state cannot develop criteria that can be used to determine whether load reductions are being achieved at an adequate rate over time.

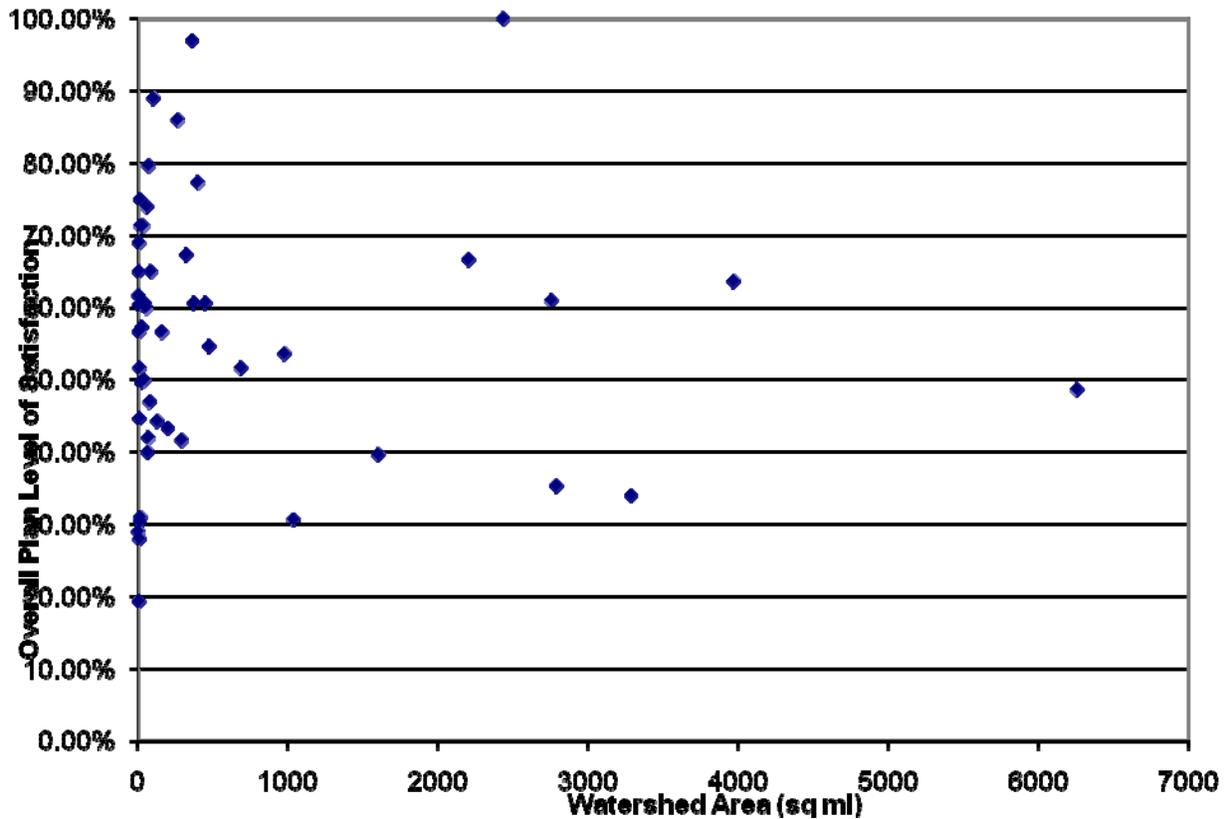
While plans in small watersheds were usually easiest to review, there appeared to be no correlation between size of watershed and overall quality of the plans (Figure 2). However, 40 of the 49 plans submitted were less than 1000 square miles and most of these were significantly smaller than that. Table 3 lists which models were used for components A-C. 13 of the plans reviewed relied solely on monitoring data, and used no formal model for estimating pollutant sources or reductions expected from management practices. Where a model was used, the model used was as varied as the plans themselves.

It is notable that the average score of the plans that used some kind of model (61%) was substantially higher than the average score of those plans that did not use a model (44%).

**FIGURE 1**



**FIGURE 2**



**Table 3: Models used in Watershed Based Plans**

Model Name	Use
[No Model]	13
Soil & Water Assessment Tool (SWAT)	4
[Revised] Universal Soil Loss Equation ([R]USLE)	3
ArcView Generalized Loading Function (AVGWLF)	3
Loading Simulation Program in C++ (LSPC)	3
Spreadsheets Tool for Estimating Pollutant Loads (STEPL)	3
Stormwater Management Model (SWMM)	3
Automated Geospatial Watershed Tool (AGWA, uses Kinematic Runoff and Erosion Model (KINEROS2) and SWAT)	2
Hydrologic Simulation Program Fortran (HSPF)	2
Long Term Hydrologic Impact Assessment (L-THIA)	2
Pollution Reduction Impact Comparison Tool (PreDICT)	2
Annualized Agricultural Non-Point Source Pollution Model (Ann AGNPS)	1
AVNPS	1

Bacteria Indicator Tool	1
Bacteria Source Load Calculator	1
BATHTUB	1
Environmental Fluid Dynamics Code (EFDC)	1
FLUX	1
Impervious Cover Model	1
Integrated Pollutant Source Identification Pollutant Loading Model (IPSI/PLM, from TVA)	1
Method for Assessment, Nutrient-loading and Geographic Evaluation of watersheds (MANAGE)	1
BASINS Nonpoint Source Model (NPSM)	1
Nonpoint-Source Pollution and Erosion Comparison Tool (NSPECT)	1
PLAT/NLEW	1
Pollutant Load Screening Model (PLSM)	1
QUAL2E	1
R5 Pollutant Control Model	1
SELECT	1
Site Evaluation Tool (SET)	1
Stream Network Temperature model (SNTEMP)	1
Watershed Management Model	1
Watershed Treatment Model	1
Delaware Inland Bays Model (Based on CB Model)	1
Sediment Delivery Calculator	1
CE-QUAL-ICM	1

Sediment, bacteria, and nutrients were the most common pollutants addressed in the plans (Table 4).

**Table 4: Pollutants Addressed in Watershed Based Plans**

Pollutant	# Addressed
Sediment	24
Bacteria (Fecal Coliform & E.Coli)	19
Nutrients (Both Nitrogen & Phosphorus)	16
Phosphorus	8
Metals (Cadmium, Zinc, Lead, Mercury, Copper)	8
Temperature	7
DO	6
Impaired Aquatic Communities	5
Herbicides/Pesticides (including Atrazine, DDT)	4
BOD	3
pH	3
Nitrogen	2
Water Quantity	2
Aromatic Hydrocarbons	1
Oil & Grease	1

Trash	1
Salinity	1
Selenium	1
Noxious Aquatics/Exotic Species	1

While many plans were developed under the supervision of a technical committee, the “author” is the person or group that is named as the actual writer of the plan. As seen in Table 5, private consultants, hired by local watershed groups, states, and other stakeholders authored a greater number of plans than other groups, followed closely by state environmental agencies and miscellaneous entities, such as local planning commissions, large nonprofits, and other state agencies.

**Table 5: Watershed Based Plan Authors**

Author	# Addressed
Consultant	11
State Environmental Agencies	10
Etc (Incl. State NRCS, Area Planning Commissions and Environmental Councils)	7
Multiple Authors	6
Local Watershed Group	6
SWCD	4
Extension	3
Local Government (city or county)	2

## Summary of Findings for Each Component

### **Component A**

*An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in the watershed based plan (and to achieve any other watershed goals identified in the watershed-based plan). Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed.*

It is difficult to remediate an impaired waterbody without first identifying the causes and sources of impairment. Identification of pollutant sources and reductions needed to meet water quality standards (component A) are the essence of TMDL’s; in a number of cases, TMDL’s had already addressed this component to a significant extent, thereby setting a foundation for the plan. In the few plans that did not satisfy this component, load estimates from significant source categories were absent, or the sources of pollution that need to be controlled were not quantified at a level that is useful for waterbody remediation.

### **Component B**

*An estimate of the load reductions expected for the management measures selected*

Without load reduction estimates, it is not possible to determine whether or not the proposed management measures are sufficient to meet the water quality goals set in component A. As

mentioned previously, many states had difficulty addressing component B. Many plans simply did not provide any load reduction estimates. Others provided estimates, but made no attempt to show that the management measures chosen would lead to meeting the overall goals described in component A.

Quantifying expected load reductions is difficult, requiring both sufficient data and an analysis leading to a judgment as to what assumptions are appropriate to make for the situation. The processes that planners need to take into account are complex, and therefore difficult to translate to a simple numerical endpoint. While there are a myriad of tools available, from complex to simple spreadsheets, as EPA discusses in considerable detail in the [“Handbook for Developing Watershed Plans to Restore and Protect Our Water” \(2008\)](#), it requires considerable analysis supported by experience and training to determine which one will suit the needs of a specific watershed.

However, the watershed planning process isn’t necessarily about getting exactly the right answer the first time. Rather, it is about successfully employing an adaptive management approach in which available information and analytical tools are used to support the best planning decisions that can be made. The best plans were not necessarily relying on the most sophisticated watershed models or making any claims that their load estimates are 100% correct. In fact, some plans contained explicit discussions stating factors that may lead to errors in the estimates. However, it is critical that the best effort be made to develop good estimates; set a bar to measure whether or not the proposed measures are adequate; and establish a feedback loop to determine if there are additional issues in the watershed that may have been missed when the plan was first written.

### **Component C**

*A description of the NPS management measures that will need to be implemented to achieve the load reduction estimated in component B, and an identification of the critical areas in which those measures will need to be implemented*

After the causes and sources of pollution are identified, the next step is to identify management measures that will reduce the pollutant loads from these sources to the extent necessary to meet water quality goals. Most states were able to do this without significant difficulties. However, some states failed to adequately explain why certain management measures were chosen over similar alternatives.

The discrepancy between the level of satisfaction in components B and C suggests plan writers can successfully identify best management practices to address pollutants, but many are having a difficult time quantifying the expected load reduction from these practices.

### **Component D**

*An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement the plan.*

Component D was met with a moderate degree of success. The best plans were able to list the partners that would be called upon to complete each action in the plan, and included a full cost estimate, including possible sources of funding. Other plans were commonly missing one or more of these pieces of information or included all of this information at a level of detail that was much lower than the best plans.

### **Component E**

*An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the NPS management measures that will be implemented.*

Actions to reduce nonpoint sources of pollution are usually voluntary; therefore, effective education campaigns are extremely important to watershed based plans. A good educational campaign helps to ensure that needed management measures will actually be implemented. Most of the time, some kind of education campaign was included (passing out flyers, PSA's etc) but an explanation of how these campaigns would enhance public understanding or encourage involvement was absent. In these cases, there is a serious question whether adequate community understanding of and support for the watershed plan and its implementation have been established.

### **Component F**

*A schedule for implementing the NPS management measures identified in the plan that is reasonable expeditious.*

A schedule helps ensure that the plan's developers have thought about the feasibility of their plan in relation to its objectives and available resources. It also helps to ensure the continuous implementation of the plan. In many cases, plans failed to include a schedule beyond a year of implementation, or had a much less detailed schedule compared to the best plans reviewed.

### **Component G**

*A description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented.*

Component F and G are closely related. Most states received the same scores for both components, and had the same issues with component G as they did with component F, namely, one, or in some cases, no interim milestones, and a lesser level of detail than the best plans reviewed.

### **Component H**

*A set of criteria that can be used to determine whether load reductions are being achieved over time and substantial progress is being made towards attaining water quality standards, and, if not, the criteria for determining whether the watershed based plan needs to be revised or, if a NPS TMDL has been established, whether the NPS TMDL needs to be revised.*

Components B and H go hand in hand; without adequate load reduction estimates, a state cannot develop criteria that can be used to determine whether load reductions are being achieved at an adequate rate over time. Therefore, it is unsurprising that states which are struggling with Component B are also struggling with Component H. Most of the time, Component B was not mentioned in the context of Component H, or there seemed to be confusion between what was required with respect to components G and H. Many times, the criteria that would be used to determine whether loading reductions were being achieved were actually milestones; this indicates that there was confusion surrounding the difference between the two. The criteria should be expected levels of pollutants of concern in the waterbody at different points in time, whereas milestones indicate achievement of implementation steps like the number of BMP's that will be installed in a certain year. Many plans also failed to identify how often progress would be reviewed, and who would actually be responsible for reviewing the plan to determine this information. This would likely result in a lack of implementation of this important step and perhaps lead to continued implementation along a path that needs to be modified.

### ***Component I***

*A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under component H.*

Most plans were relying on the implementation of existing state monitoring programs, which have well established procedures, so component I is relatively straightforward. In a very small number of plans, responsibility for monitoring was unclear, as well as how often monitoring would take place.

## **Best Watershed Plans**

These are the plans that received the highest scores of all rated plans. EPA recommends that state and EPA nonpoint source staff review these plans to gather some ideas regarding effective ways to address watershed based plan development. None of these plans is perfect, yet each represents a concerted effort to understand and address information and factors that affect the watershed's problems.

### ***Kansas: Lower Big Blue/Lower Little Blue River***

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<http://www.kcare.ksu.edu/DesktopModules/ViewDocument.aspx?DocumentID=4055>

The Lower Big Blue/Lower Little Blue River watershed is a transboundary watershed (Only ~ 25% of watershed is in Kansas, the rest is in Nebraska) and drains into Tuttle Creek Lake, a flood control reservoir in Kansas. The lake is impaired by phosphorus, total suspended solids, and atrazine. While the plan only addresses Kansas portion of the watershed, it is overall an excellent watershed-based plan. Every required component was fully addressed, and the information for components B-I were presented in an especially effective manner. The tables and maps made the information easy to read and digest and all of the information was tied back to meeting the goals of the plan; there was little extraneous information. It was also one of the few plans that included a brief explanation of the model used in the analysis, including why the model was selected, major assumptions, and data sources used. Specific highlights include:

- The Soil and Water Assessment Tool (SWAT) was used to determine loading rates and locations of pollutant causes and sources. Pollutant source analysis is further explored pollutant by pollutant in the critical areas identified in the modeling process.
- The plan explicitly compares load reductions expected from management measures with load reductions prescribed in the TMDL, to ensure that management measures chosen will meet the goals of the plan. Also, there is a section that clearly explains the load reduction estimate methodology.
- Using the model with some ground-truthing, the plan identifies “areas or subwatersheds with the top 20-30% of the highest loads among all areas within the watershed” as critical (targeted) areas for BMP implementation.
- The plan broke cost estimates down to BMP’s per year; provided the source of information for these costs; and also included the estimated cost of technical assistance.
- Target audiences are identified for different education/outreach activities, and the plan includes an outline for evaluating these activities.
- The implementation schedule covered the entire life of the plan, and included milestones (# of acres of BMP, miles of streambank stabilization, etc) and interim water quality milestones.
- The plan includes a strategy for reviewing the plan over time, complete with a schedule, delegation of responsible parties, and a list of indicator and parameter criteria and data sources that will be used to assess progress.

Overall, the Lower Big Blue/Lower Little Blue River plan was one of the best reviewed, and it provides an excellent example of how to develop and write a watershed based plan.

### ***Oklahoma: Lake Eucha/Spavinaw***

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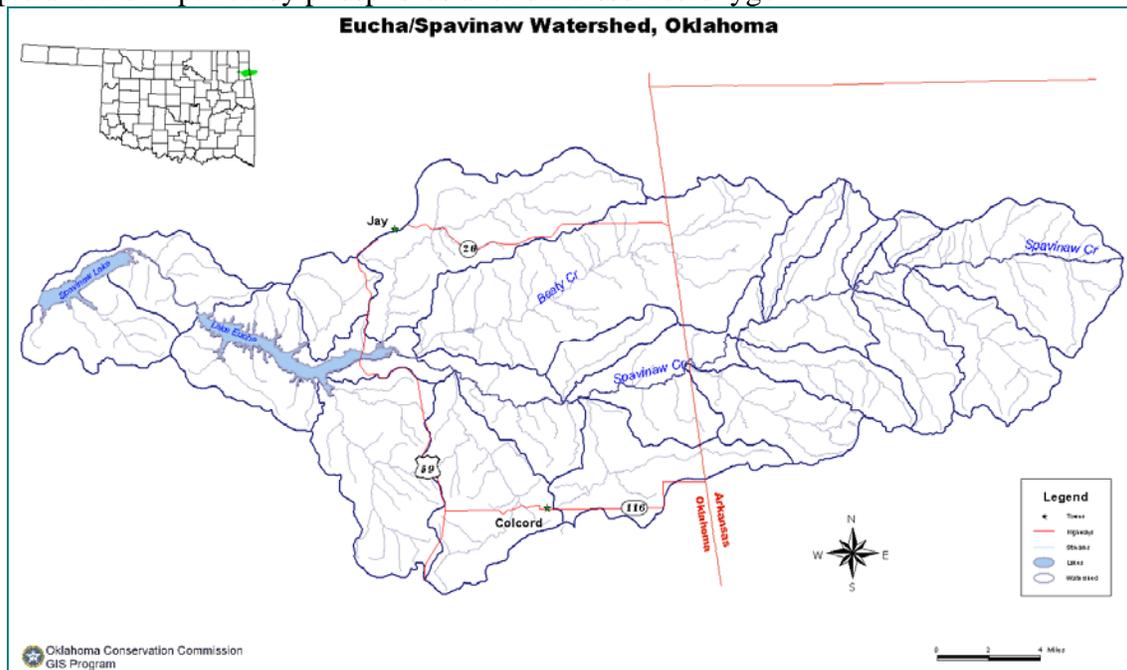
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<http://www.environment.ok.gov/documents/CWA/GrantWorkplans/Eucha-Spavinaw%20Watershed%20Riparian%20Protection%20Initiative/EuchaSpavWBPRRev2-07.pdf>

The Lake Eucha/Spavinaw watershed is a transboundary watershed (60% in OK, the rest in AR, see figure) and has been the subject of conflict, including litigation, regarding its many point and nonpoint sources of pollution. The lakes supply drinking water to approximately 1 million people and are impaired by phosphorus and low dissolved oxygen.



The watershed based plan addresses each of the 9 components and includes adequate specifics for each. In particular:

- The plan contains clear quantitative goals complete with an explanation for choosing those goals and how the goals correspond to the load reduction goals and interim water quality criteria.
- All of the information in the plan was tied back to the goals of the plan, so there was very little extraneous information which made the plan very easy to read and comprehend.
- SWAT was used to determine sources of phosphorus, including point sources of phosphorus, and was calibrated with soil test phosphorus results. The model was also used to identify critical areas in the watershed to target implementation.

- Information used for the SWAT analysis was clearly documented, and information not crucial to the WBP was included in a separate report of the modeling efforts. Results were summarized in an easy to understand table in the report, with references to a separate report if more detail is needed.
- Assumptions of the analysis are clearly stated and explained.
- Barriers to attainment of goals are discussed (for example, soils supersaturated with phosphorus may take decades to deplete) but these barriers are not presented as an excuse for inability to attain standards, rather as something to be aware of throughout the implementation of the plan.
- Reasoning for the selection of BMP's is included with the corresponding estimated load reduction. In addition, several simulations were performed to see which practices might have the greatest impact on water quality.
- The cost estimate included BMP's, education, and monitoring, and included the responsible parties for each task. The delegation of work is particularly well explained in the educational activities, which lists each group involved and clearly states what the group will be doing.
- The implementation schedule includes load reduction goals associated with planned activities and a schedule for evaluating the actions to determine if any adjustments need to be made.
- One possible improvement for the plan would be to include more interim water quality criteria.
- The monitoring plan lists what parameters will be measured and who will be responsible for which monitoring activities, as well as a map where monitoring will take place.

Overall, the Lake Spavinaw/Eucha plan was one of the best reviewed, and should be shared as another example of an excellent watershed based plan.

### **Virginia: Hawksbill & Mill Creek**

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<http://www.deq.state.va.us/export/sites/default/tmdl/implans/hksmillip.pdf> (Does not include the technical report)

Hawksbill & Mill Creek are tributaries of the South Fork of the Shenandoah River, located in the northern part of Virginia. Both waterbodies are impaired due to violations of the State's water quality criteria for fecal coliform and E. Coli. In Virginia, TMDL Implementation plans are required to be written for each TMDL and this plan was written under that requirement, taking into account watershed plan requirements from other programs, such as 319. The watershed plan for remediating Hawksbill & Mill Creek satisfies all 9 components of a watershed based plan. Highlights of the plan include:

- Several stakeholders in the watershed were involved in developing this plan. In addition to general public meetings, 3 specialized working groups (agricultural, residential, and government) were assembled to seek public input from specific stakeholders and a steering committee collected information from the different groups and guided the overall development of the plan. Throughout the rest of the plan it was clear that these groups were all very involved in the process.
- The assumptions of pollutant source analysis are clearly stated and discussed.
- Selection of management measures needed to control sources of pollution was well explained, and the public was included in selection of management measures to ensure implementation.
- The quantity of management measures needed to meet water quality goals was estimated using modeling, spatial analysis, and input from the public, and possible locations for these measures were identified in the plan.
- Education strategies that proved successful in other watersheds, which were identified by the working groups involved in plan development, were used in the implementation plan.
- This is one of the few plans that included a cost efficiency analysis of the BMP's selected; which consisted of a breakdown of pollutant removed per \$1000 spent, as well as an explanation of the non-monetary benefits of the selected BMP's. This information, along with information gathered from a land use analysis, was used to prioritize implementation.
- All information, from pollutant reduction of BMP's to costs of implementation, was clearly referenced.
- A suggestion for improvement to this plan is to explain how this plan will be reviewed over time, specifically, who will be responsible for reviewing the plan to determine whether or not changes need to be made?

Hawksbill & Mill Creek plan is another excellent example of a watershed based plan.

### ***Maryland: Lower Monocacy River***

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The Lower Monocacy River plan is a supplement to the original Watershed Plan completed in May 2004. The Lower Monocacy River and its subwatersheds are listed as impaired for: fecal coliform (2002), nutrients (1996), sediment (1996), and impacts to biological communities (2002, 2004, and 2006). However, there is only 1 TMDL that has been approved and adopted in the watershed (Phosphorus & Sediments in Lake Liganore, an impoundment within the watershed). One TMDL has been submitted but has not been approved, and the rest were scheduled for development in 2008 and 2009. In the absence of completed TMDL's, the plan developers used stream corridor assessments and the Impervious Cover Model to identify causes and sources of pollution and estimate loads. This illustrates that an excellent plan can still be written with simpler models. Additional highlights of the plan include:

- The plan was successfully able to integrate information from several sources (such as TMDL's and Tributary strategies from the 2000 Chesapeake Bay agreement). The plan contained a lot of information, but it was easy to read because everything was summarized well and contained clear references to other documents.
- The chosen management measures were adequately described, and included assumptions about their operation and effectiveness.
- This was another one of the few plans that included a benefit cost ratio of pollutant removal to aid in prioritizing implementation actions.
- A responsible party is identified for each implementation action, and all actions are clearly tied back to the goals of the plan.
- Education and outreach efforts are linked to implementation actions and goals, and each activity has measureable outcomes.
- The watershed has an extensive and well organized network of watershed groups. Plan includes a list of all groups with contact information and a summary of the type of assistance each group can provide.
- Implementation schedule reports the status of implementation, as well as the schedule for future implementation.
- The County has an electronic implementation database to track the progress of the plan. The database also calculates expected pollutant removal for each BMP entered.

- The monitoring plan includes project level and watershed level monitoring. All monitoring efforts list who is responsible, and the monitoring parameters that will be measured at each monitoring location.
- The plan includes a section dedicated to discussing issues requiring further study, and strategies for resolving these issues in the future.

This plan would benefit from additional details on the implementation of agricultural BMP's, but it is mentioned that new goals are being adopted by the Tributary Strategy program and this information will be included in the next revision of the plan. Also, there is no explicit plan for reviewing and revising the watershed based plan, but considering this is a supplement of the original plan, it is clear that this work is being done.

Overall, the Lower Monocacy River plan provides an excellent example of a watershed based plan.

### ***Best Examples for Individual Plan Components***

Several plans reviewed, while not overall “the best”, did excellent jobs addressing some of the required components of a watershed based plan. Appendix B lists these examples by plan component, and hopefully can be used by plan writers in the future.

### **Plans In Need of Some Improvement**

*The purpose of this report is to provide information that can be used to help move State watershed planning and implementation programs in the right direction. Identifying and describing some of the chief deficiencies found in some plans helps to achieve this purpose. In contrast, identifying specific States' plans as having specific deficiencies would not help achieve this purpose. Therefore, the discussion in this section and the following section does not provide names of specific States but does provide descriptions of shortcomings that should be avoided by all States.*

Overall, one plan suffers from a lack of detail in certain components, but contains an excellent example of how to identify the causes and sources of pollution (component A of the 319 requirements.) The plan contains an excellent summary of existing data, and a great summary of management measures and why they are chosen. However, more information is needed to determine if the management measures chosen will achieve the pollutant reduction goals. There are no interim water quality goals, or any details on how the implementation of this plan will be assured, although the plan refers to several data sets that would be useful for further efforts.

A second plan was very easy to read because it was well laid out. For example, the 9 components of the plan are summarized in the appendix, and the plan includes a "using this document" section with summaries of each part of the plan right up front. However, there are several major flaws. While the whole plan is focused on future growth and how it will impact the stream, there doesn't seem to be any mention of revisiting the plan once it is implemented to make sure the

plan is adequately meeting the water quality goals. There is no detail on reducing the impact of agriculture on water quality, even though it is a significant portion of the watershed.

A third plan suffers most from a lack of quantitative data. The plan does not include load estimates for identified sources of pollution, or load reduction estimates for the nonpoint source management measures selected to address pollutant sources. This might be because there is no TMDL in place. The state provides the option of a locally led watershed management planning effort in place of a full TMDL. However, while specific interim numerical water quality criteria were absent, there is a clear procedure for periodically reviewing plan progress. The implementation plan was very strong, and the management measures were listed with the specific overall goals, funding mechanisms, responsible parties, and information/education activities that would be used to promote the adoption of the measure. This made it very clear how every action proposed in the plan fit together. The monitoring plan was also very clear.

## **Plans in Need of Significant Improvement**

One plan suffers from a lack of quantitative detail, especially regarding the expected pollutant-reduction benefits from management measures. There is also very little detail in terms of implementation. The evaluation of the plan that was conducted by the state DEQ, which was included with the plan, summarizes the issues best: "The TMDL provides specific numbers and pollutant reductions targets for the general basin. The (plan) provides information on general BMP's that will address pollutants in the TMDL, but they don't link specifically to load reductions or water quality numbers"

A second plan is missing several critical pieces of information required of a watershed-based plan, most notably the extent of management measures implementation needed to meet the goals of the plan, and load reduction estimates for the management measures that are identified. Without this information, there is no way to tell whether or not the proposed management measures are sufficient to meet the goals of the plan. There is also very limited implementation detail.

A third plan provided very little information, and the state supplemented this through a web- link to the statewide watershed based plan website to find any information missing from plan submitted. Few of the data gaps in the submitted plan were addressed in the documents on the website, since those documents focused on a much larger spatial scale (HUC 12 level) and none of them discussed the watershed in the submitted plan. Thus no information is provided in the plan regarding the watershed's water quality impairments, the types and quantities of sources, and all other similar relevant information. After reviewing the grant application and the other documents provided, an overall plan for addressing the water quality impairments in the watershed could not be determined. Actions are proposed in a grant application to address the water quality issues in the pond, but the expected impact is not. The amount or percentage of water quality impairment of this pond to be addressed by these projects is unstated. In addition, there is no discussion of a feedback loop and relevant monitoring related to this watershed.

## Conclusions & Recommendations

This review of watershed plans from around the country indicated that while it is possible to meet the challenge of developing high quality watershed based plans, many plans fail to rise to that level. There is not a single clear reason for this; some plan developers may lack the expertise needed to develop a high quality plan, while others may be suffering from the lack of availability to sufficient information and resources. In some cases it may simply be the lack of sufficient effort or resources devoted to the development of the plan. It is clear that more needs to be done so all plans are of a quality that will support a successful implementation effort to restore impaired waterbodies. Specific recommendations are listed below:

- EPA Regional offices should use the results of this review to discuss with States the specific components that the states are struggling with, and to also share information from States that have successfully addressed those components.
- EPA Regions should work more closely with the States to assure that the States and their watershed partners have sufficient technical capacity and are investing sufficient funds to develop robust watershed-based plans that will lay a good foundation for a successful implementation effort that will restore the waterbodies being addressed to meet water quality standards.
- States' should take greater care in their development of watershed-based plans to assure that the plans truly address all nine components of EPA's guidelines and provide as good and specific a guidepost to future actions in the watershed as reasonably possible. The Section 319 program and grants guidelines allow each State to use up to 20% of its "incremental" watershed-based plan implementation funds to develop watershed-based plans. States should dedicate sufficient funds to the development of each watershed-based plan to assure that they will successfully address all nine components of these plans in a thoughtful and useful manner that will support successful implementation.
- EPA should follow up with the developers of the best watershed plans. Interviewing writers of successful plans would provide insight from those "on the ground" as to what resources contribute most to a successful plan. This information can in turn be used by EPA to prioritize training and tool development.
- EPA should make the best watershed plans, as well as the best examples of different components of watershed based plans, available online and in tools such as EPA Plan Builder. Overall, there seems to be confusion on "how much is enough". Several plans included extraneous information that made the plan hard to review and, most likely, less useful to those using the plan. Providing more examples of what is considered adequate will clarify what an excellent WBP should look like. EPA should also take actions to promote the resources available for WBP's.
- States should focus on developing plans at a scale that allows for the development of the right level of detail. This means, for example, that even if a State develops an integrated

watershed plan at an 8-digit HUC level, it may, and likely will, need to develop a more detailed watershed-based plan at a smaller scale (e.g., HUC-12).

## Appendix A: List of Watershed Based Plans Reviewed

Region 1		
State	Contact	Watershed
CT	<a href="#">Steve Winnett</a>	<a href="#">Coginchaug River</a>
MA	<a href="#">Warren Howard</a>	<a href="#">Martins Pond</a>
ME	<a href="#">Warren Howard</a>	<a href="#">Spruce Creek</a>
NH	<a href="#">Warren Howard</a>	<a href="#">Webster-Highland Lake</a>
RI	<a href="#">Margherita Pryor</a>	<a href="#">Green Hill &amp; Ninigret Ponds</a>
VT	<a href="#">Warren Howard</a>	<a href="#">Lake Carmi</a>
Region 2		
State	Contact	Watershed
NJ	<a href="#">Donna Somboonlakana</a>	<a href="#">Mulhockaway Creek</a>
NY	<a href="#">Richard Balla</a>	<a href="#">Chemung &amp; Upper Susquehanna River</a>
PR	<a href="#">Nesamarie Negron</a>	<a href="#">Rio Grande De Loiza</a>
VI	<a href="#">Donna Somboonlakana</a>	<a href="#">Coral Bay</a>
Region 3		
State	Contact	Watershed
DC		
DE	<a href="#">Fred Suffian</a>	<a href="#">Indian River, and Indian River, Rehoboth and Little Assawoman Bay</a>
MD	<a href="#">Fred Suffian</a>	<a href="#">Lower Monocacy River</a>
PA	<a href="#">Fred Suffian</a>	<a href="#">Mill Creek</a>
VA	<a href="#">Fred Suffian</a>	<a href="#">Hawksbill &amp; Mill Creek</a>
WV	<a href="#">Fred Suffian</a>	Martin Creek
Region 4		
State	Contact	Watershed
AL	<a href="#">Yolanda Brown</a>	<a href="#">Indian Creek</a>
FL	<a href="#">Yolanda Brown</a>	<a href="#">Lower St. Johns River</a>
GA	<a href="#">Yolanda Brown</a>	<a href="#">Two Mile Branch</a>
KY	<a href="#">Yolanda Brown</a>	<a href="#">Corbin City Reservoir</a>
MS	<a href="#">Yolanda Brown</a>	<a href="#">Bee Lake</a>
NC	<a href="#">Yolanda Brown</a>	<a href="#">Smith Creek</a>
SC	<a href="#">Yolanda Brown</a>	May River
TN	<a href="#">Yolanda Brown</a>	<a href="#">Oostanaula Creek</a>
Region 5		
State	Contact	Watershed
IL	Amy Walkenback (IL)	<a href="#">Bull Creek/Bull's Brook</a>
IN	Andrew Pelloso (IDEM)	<a href="#">Salt Creek</a>
MI	Robert Day (MDEQ)	<a href="#">Paw Paw River</a>
MN	<a href="#">Thomas Davenport</a>	<a href="#">Lake Independence</a>
OH	Russ Gibson (OH EPA)	<a href="#">Bokes/Mill Creek</a>
WI		

**Region 6**

<i>State</i>	<i>Contact</i>	<i>Watershed</i>
AR	<a href="#">Brad Lamb</a>	<a href="#">Bayou Bartholomew</a>
LA	<a href="#">Brad Lamb</a>	<a href="#">Bayou Plaquemine Brule</a>
NM	<a href="#">Brad Lamb</a>	<a href="#">Jemez River</a>
OK	<a href="#">Brad Lamb</a>	<a href="#">Lake Eucha/Lake Spavinaw</a>
TX	<a href="#">Brad Lamb</a>	<a href="#">Plum Creek</a>

**Region 7**

<i>State</i>	<i>Contact</i>	<i>Watershed</i>
IA	Suzanne Hall	<a href="#">Lake Hendricks</a>
KS	<a href="#">Steve Schaff</a>	<a href="#">Lower Big Blue River &amp; Lower Little Blue River</a>
MO	<a href="#">Peter Davis</a>	<a href="#">Brush Creek</a>
NE	<a href="#">Peter Davis</a>	<a href="#">Carter Lake</a>

**Region 8**

<i>State</i>	<i>Contact</i>	<i>Watershed</i>
CO	<a href="#">Marcella Hutchinson</a>	<a href="#">Coal Creek</a>
MT	<a href="#">Peter Monahan</a>	<a href="#">Ruby River</a>
ND	<a href="#">Peter Monahan</a>	<a href="#">Beaver Creek and Seven Mile Coulee</a>
SD	<a href="#">Peter Monahan</a>	<a href="#">Belle Fourche River</a>
UT	<a href="#">Peter Monahan</a>	<a href="#">San Pitch</a>
WY	<a href="#">Peter Monahan</a>	<a href="#">Flat Creek</a>

**Region 9**

<i>State</i>	<i>Contact</i>	<i>Watershed</i>
AS		
AZ	<a href="#">Jared Vollmer</a>	<a href="#">Agua Fria</a>
CA	<a href="#">Tina Yin</a>	<a href="#">Agua Hedionda</a>
Guam		
HI	<a href="#">Audrey Shileikis</a>	<a href="#">Ko'olaupoko Moku</a>
NMI		
NV	<a href="#">Stephanie L. Wilson</a>	<a href="#">Carson River</a>
TT		

**Region 10**

<i>State</i>	<i>Contact</i>	<i>Watershed</i>
AK	<a href="#">Rick Seaborne</a>	Lower Kenai River
ID	<a href="#">Rick Seaborne</a>	<a href="#">Pack River</a>
OR	<a href="#">Rick Seaborne</a>	Willamette River Basin: City of Lowell
WA	<a href="#">Rick Seaborne</a>	<a href="#">Stillaguamish River</a>

## Appendix B: Best Component Examples from Watershed Plans

Puerto Rico's plan provides an excellent example of an approach to successfully implementing **component A**. Unlike most plans, model selection criteria are identified to guide model selection. Model input assumptions are clearly explained, and assumptions are supported with appropriate references. Explanation of the calibration process clearly lays out what information was used and data gaps that limited the analysis. The modeling results are presented by subwatershed, and each section includes a pollutant source assessment, priority ranking (with explanation), a breakdown of loading by source, and an analysis of seasonal variations or other critical factors that may exacerbate pollution issues. *Link: [Rio Grande De Loiza](#), pp. IV-1 – IV-2; IV-18 – IV-28, V-2 – V-164*

The New Hampshire plan provides great examples for **components A-C**. The New Hampshire plan outlines different pollutant estimate approaches that apply to their watershed, clearly stating the limitations and assumptions of each. The pollutant source analysis begins with an in-depth study of the watershed completed several years ago using one of the more complicated approaches. Simplified approaches were then used to assess how conditions may have changed since the original study was completed.

STEPL was used to estimate the loads from individual sources of pollution in the watershed. All of the sources for information used in the modeling are listed, and while the model was not fully calibrated, an attempt was made to compare how the model results differed from monitoring results. Each possible pollutant source is further explored in the following sections, including relevant studies and visual evidence of problems that could not be taken into account using STEPL. Also included are measures to control the individual sources of pollution and estimated load reductions, explicitly linking pollutant control measures to specific sources of pollution. The information about pollutant source loads and control measures are summarized in a table as an easy reference. *Link: [Coginchaug River](#), p. 7 – 47*

The Mill Creek plan from Pennsylvania does a good job of identifying NPS management measures that need to be implemented to meet the goals of the plan. Plan writers not only have an idea for which BMP's to install (**component C**), but where they should be installed and to what extent (acres treated by a cover crop, length of fencing, etc). This level of specificity suggests that plan writers are intimately involved in this watershed and provides confidence that the plan, once it is implemented, will succeed. The Mill Creek plan also provides a detailed cost estimate for each proposed BMP (**component D**). Potential funding sources are also identified for the different types of BMP's. *Link: [Mill Creek](#), p. 24 – 46*

The Coal Creek plan from Colorado addresses **component C** with a short table that summarizes the appropriate management measures and how those measures work to reduce pollution. The Coal Creek plan also uses a summary table to illustrate gaps in the monitoring data used for quantifying the causes and sources of pollution. *Link: [Coal Creek](#), pp. 8 – 9; 49*

The Washington State Stillaguamish plan follows a similar format as New Hampshire to address **component C**, providing a section to discuss each source of pollution, specific problem areas and the management measures that should be used to address each source. The watershed characterization in this plan is very thorough and allows for the ability to very specifically target sources of pollution with management measures. This is also one of the few plans that addresses temperature, and does a great job explaining suspected causes of impairment and targeting specific areas for management actions.

The plan also does an excellent job identifying sources of technical assistance, which is part of addressing **component D**. Partners are identified from the federal to the local level and specific actions are identified for each partner. These expectations are described in text, and then summarized in an “Implementation Tracking Sheet” to easily keep track of the tasks that need to be accomplished by which partner. This differs from most of the plans reviewed; most identified partners but did not specify what these partners were expected to contribute. *Link: [Stillaguamish River](#), pp. 14 – 87; D-3 – D-7*

The Agua Hedionda watershed plan from California does an excellent job describing the NPS management measures that will need to be implemented to meet the goals of the plan (**component C**). Each management measure includes a detailed explanation for why it was chosen and where exactly it would be implemented, and most measures also include a strategy for prioritizing implementation. Maps of critical implementation areas enhance the presentation of this information, and cost estimates are included. A discussion of potential funding sources is also included (**component D**). The education/information component identifies target audiences and activities to reach these audiences, and it outlines specific goals for outreach activities (**component E**). The monitoring component of this plan is very clear (**component I**). Monitoring indicators are specifically linked to plan objectives. The plan also lays out the groups responsible for the different pieces of the monitoring plan and recommends specific monitoring locations that would enhance the ability of watershed managers to determine if the implementation efforts are working over time. *Link: [Agua Hedionda](#), see Chapter 6*

The implementation piece of Wyoming’s plan for Flat Creek is very strong. The management measures are broken down by the goal the measure is meant to address along with cost estimates, possible funding sources, responsible parties and information/education activities that would be used to promote the adoption of the measure (**components D, E, F, G**). This made it very clear how every action proposed in the plan fit together. The implementation summary table also makes clear how the monitoring efforts will be used to ensure goals are being reached (**component I**). Many of the plans reviewed contained a lot of information, and it was not always clear how the information would be used to implement the watershed plan. By summarizing information in this way, it is clear how each and every piece of information in the plan fits into the overall watershed goals. The Flat Creek Plan also outlines a clear procedure periodically reviewing the plan to ensure progress is being made and that the plan is revised as new information is collected. *Link: [Flat Creek](#) p. 30 – 37*

The education/information section (**component E**) in the Lake Hendricks plan from Iowa is presented in a question and answer format that clearly illustrates the decision process the plan writers followed to choose information/education activities that would be effective. Unlike most

other plans, barriers to practice adoption are identified in advance along with strategies to overcome those barriers. Also, plan writers interviewed landowners in person to get a better idea of how to target the information/education campaign. *Link: [Lake Hendricks](#) See Information & Education Section.*

The education and outreach strategy (**component E**) in the Bee Lake watershed plan from Missouri includes indicators for success, which is not present in other plans. The plan also assigns responsibility for each education/information activity to a specific party, and provides a detailed cost estimate for each activity. The Bee Lake plan also includes a good summary of data used for quantifying causes and sources of pollution. *Link: [Bee Lake](#) pp. 11 – 13; 40 – 51*

Tennessee's watershed plan for Oostanaula has a clear implementation schedule (**component F**) and does a good job describing measurable, interim milestones in addition to the implementation schedule and setting criteria that can be used to determine whether loading reductions are being met over time (**components G, and H**). *Link: [Oostanaula Creek](#) pp. 55 – 57; 60 – 62*

The Lower St. John's River Basin watershed plan from Florida contains one of the most detailed sections on how the monitoring component would be used to evaluate effectiveness of the plan over time (**component I**). An explanation why different modeling stations and parameters were chosen is included, in addition to a map of monitoring stations (that also illustrated which subbasins the stations corresponded to). Most other plans reviewed did not go very far beyond a map of stations, if a map was included at all. The monitoring efforts are summarized in a table that listed the monitoring stations, what parameters would be monitored at each station and how often, and who would be responsible for carrying out the monitoring. The plan also explains how the monitoring database would be managed, which is another factor missing from most other plans. The plan also includes a thorough discussion of the assumptions made in the analysis of causes and sources of pollution. *Link: [Lower St. Johns River](#), pp. 8 – 12; 80 - 90*

Indiana presents its causes and sources of pollution in a table, complete with an explanation for suspecting each source. It is very clear what previous monitoring was used to verify/quantify each pollutant source. *Link: [Salt Creek](#), p. 97 – 101.*

Hawaii developed a unique way to prioritize project implementation in the Koolaupoko watershed plan that takes into account factors such as landowner support, as well as factors such as BMP efficiency. This plan also includes a really good discussion of the model used for watershed analysis that includes assumptions and limitations. *Link: [Ko'olaupoko Moku](#), p 3-7 – 3-11; Appendix B*

The Carter Lake plan from Nebraska is one of the only plans that included an economic valuation of the waterbody. *Link: [Carter Lake](#), p. 8 – 11*

The Chesapeake Bay Tributary strategy from New York has a very detailed section discussing the information needed to refine the plan in future iterations. *Link: [Chemung & Upper Susquehanna River](#), p. 76 – 83*

**Addendum:**

**Evaluation for Plum Creek (Texas)**