Implementation of Utah's Nutrient Criteria for Headwater Streams

Introduction

Nutrients provide critical support for both stream and lake food webs. However, excess accumulation of nutrients, particularly nitrogen (N) and phosphorous (P), causes numerous water quality problems and have been demonstrated to degrade aquatic life, drinking water, and recreation uses. To protect against nutrient-related impairments, Utah's Division of Water Quality (DWQ) recently promulgated numeric nutrient criteria (NNC). These criteria (UAC R317-2, Tables 2.14.7 and 2.14.8) are applicable to headwater streams (Figure 1), which are defined as those streams assigned antidegradation categories one or two protections (UAC R317-2). Now that these important protections have been established, it is important to consider how these rules will be incorporated into existing water quality management efforts.

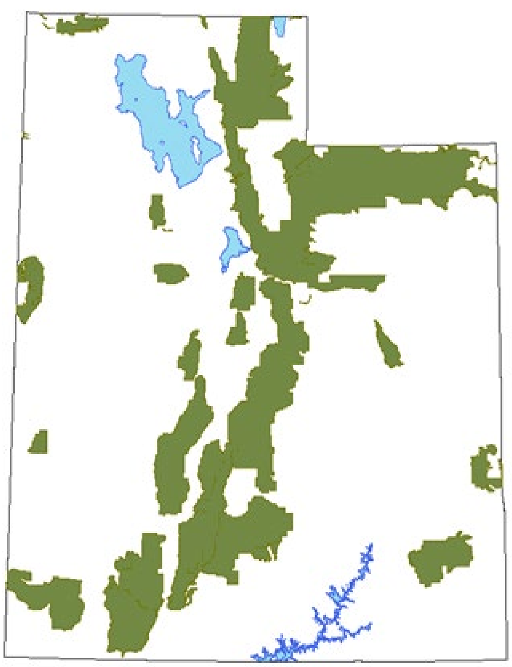

Figure 1. Map of headwater streams. watersheds.

The headwater NNC are similar to other water quality standards with respect to DWQ programs related to Clean Water Act (CWA) section 303(d). Streams will be monitored following Utah's Strategic Monitoring Plan and assessed against the criteria using [DWQ's 303(d) Assessment Methodology](). Headwater streams where water quality violates the criteria will be listed as impaired in Utah's biennial Integrated Report. Sites that are not meeting the headwater NNC will be placed in assessment category 5 until restoration activities result in the stream meeting the criteria.

With respect to assessment, the NNC combine both nutrient and ecological responses because streams differ with respect to their relative sensitivity to nutrient enrichment. For example, physical attributes such as a high channel gradient or an extensive canopy cover are protective from the adverse effects of nutrient enrichment. As such, criteria that specify nitrogen or phosphorus concentrations protective of all headwater streams without information on ecological responses to nutrients would result in erroneous impairment determinations. Combining nutrients with responses circumvents this problem, but it also complicates assessment determinations. Interpretation of these data requires both water chemistry and biological assessment data and DWQ must consider how data collection should be incorporated into existing water quality monitoring efforts.

Another key distinction is how DWQ proposes to respond to NNC impairments. Typically, restoration activities are governed by a Total Maximum Daily Load (TMDL) report that allocates specific load reductions to different sources. However, loads from diffuse non-point sources, such as headwater nutrients, are difficult to accurately measure. As a result, this implementation plan proposes an alternative restoration planning process that can avoid a formal TMDL if successfully implemented. This alternative process is intended to improve the efficiency of recreation activities and better encourage open collaboration among stakeholders.

DWQ also envisions that Alternative Restoration Plans (ARPs) will be implemented within an adaptive management framework. Most non-point sources can be addressed in several ways, and the incremental implementation of Best Management Practices (BMPs) allows us to test alternatives. Alternative BMPs can be ranked by stakeholders based on locally appropriate considerations and concerns. For example, in some cases meeting the ecological responses NNC objectives could be met by combining nutrient reduction efforts with improvements to stream habitat, which would also improve the fishery and improve the overall condition of aquatic life uses. As opposed to TMDLs that measure success by reductions of a single pollutant, ARPs have the flexibility to demonstrate progress toward water quality objectives using several measures of steam condition. This will provide more comprehensive evaluation of BMP effectiveness, while also incorporating related management objectives of restoration project partners.

DWQ has elected to use empirical data to inform the development of the unique aspects of NNC water quality programs. An assessment framework is established that translates the numeric indicators specified in the NNC into an assessment process this is consistent with how other parameters are evaluated in the Integrated Report. This framework is then tested with existing water quality data. The results of this test are then used to inform the development an alternative TMDL framework or site-specific modifications to the NNC.

Utah's Headwater NNC

Utah's Numeric Nutrient Criteria (NNC) require consideration of both ambient nutrient concentrations and ecological response data for headwater streams, which are defined as streams where antidegradation category 1 or 2 protections have been established (R317-2-3). Generally, this includes streams above United States Forest Service (USFS) boundaries—about 50% of all perennial streams statewide.

Support of Aquatic Life Uses

The NNC applicable to aquatic life include two thresholds for total nitrogen (TN) and total phosphorus (TP), based on the arithmetic average of a minimum of four samples obtained during the growing season (R317-2, Table 2.14.8). Growing season is defined by the NNC as the period of algal growth through senescence. For assessment purposes, UDWQ assumes that the growing season includes the months of June through September, although this may be lengthened where additional information demonstrates that a longer period of growth is warranted.

The arithmetic average of TN or TP, derived from four or more growing season samples, is used to place headwater streams into one of three enrichment tiers (Table 1). Lower criteria thresholds of 0.4 mg/L TN and 0.035 mg/L TP differentiate between low and moderate enrichment streams. Higher thresholds of 0.80 mg/L TN and 0.080 mg/L TP differentiate between moderate and high enrichment streams. The higher of TN or TP enrichment tiers is used to determine whether or not nutrient enrichment has degraded aquatic life uses at a site.

Any site where the growing season average of both TP and TN falls below the lower NNC thresholds (lowest enrichment tier) is considered to be supporting aquatic life uses—with respect to nutrient enrichment.

At the other end of the enrichment gradient, any site where the average TN or TP concentration exceeds the upper NNC threshold (high enrichment tier) is categorized as threatened, unless degradation is confirmed by an ecological response, in which case it is considered impaired. —not supporting aquatic life uses. Threatened AUs are designated as category 5 due to highly enriched conditions, but the Division commits to more thoroughly evaluate threatened AUs for adverse nutrient-related responses, sources of degradation—including riparian and instream habitat, and alternative approaches that could be employed to meet water quality objectives. Flexible alternative restoration plans can then be developed to meet NNC water quality objectives. Alternatively, if no adverse responses are identified within the AU watershed or downstream, the site will be considered to be supporting aquatic life uses and reclassified accordingly in subsequent IR reports.

Moderate enrichment streams, with average nutrient concentrations between the upper and lower thresholds, require additional measures of ecological condition to determine whether or not a headwater stream is attaining the NNC water quality standards. Nutrients can degrade aquatic life uses via mechanisms related to increased growth of plants/algae (autotrophs) and/or microbes/fungi (heterotrophs). In the case of plant/algae growth, two ecological responses are not-to-be-exceeded at any headwater stream: (1) a daily gross primary production (GPP) rate higher than 6 g O_2/m^2/day or (2) a filamentous algae cover exceeding 1/3 of the stream bed. Adverse heterotrophic responses are addressed using ecosystem respiration (ER), which measures the net metabolic activities of all stream biota and is used to understand linkages among microbes/fungi, nutrients, and aquatic life uses. NNC establishes a not-to-be-exceeded rate for ER of 5 g O_2/m^2/day. Any site where TN or TP falls between the NNC thresholds is categorized as not supporting aquatic life uses if any of the three responses is also exceeded.

Support of Recreational Uses

Excessive nutrients can also degrade recreational uses. To protect these uses in headwater streams the NNC establish a not-to-be-exceeded benthic algae concentration of 125 mg/chlorophyll-*a* (chl-*a)*/m^2, or the equivalent 49 g ash free dry mass (AFDM)/m^2 (R317-2, Table 2.14.7). A site where any reach-scale biomass value exceeds either threshold will be categorized as not supporting recreational uses

Table 1. Numeric Nutrient Criteria and Associated Ecological Responses (Bioconfirmation Criteria) Proposed to Protect Aquatic Life Uses in Antidegradation Category 1 and 2 (UAC R317-2-12)[f] Headwater Perennial Streams.

Low Nutrient Enrichment at Headwater Streams: No Ecological Responses			
Summertime Average Nutrients			**Assessment Notes**
TN < 0.40[a,b]	TP < 0.035[a,b]		Fully supporting biological uses if the average of ≥ 4 summertime samples is below the specified nutrient concentration of either TN and TP unless ecological responses specified for moderate enrichment streams are exceeded. Sites with fewer samples will not be assessed for nutrients.
Moderate Nutrient Enrichment at Headwater Streams and Ecological Responses			
Summertime Average Nutrients		**Ecological Response**	**Assessment Notes**
TN 0.40–0.80[a]	TP 0.035–0.080[a]	Plant/Algal Growth[c] < 1/3 or more filamentous algae cover[d,e] OR GPP[c] of < 6 g O_2/m^2/day OR Plant and Microbial Growth ER[c] < 5 g O_2/m^2/day	Headwater streams within this range of nutrient concentrations will be considered impaired (not supporting for nutrients) if any response exceeds defined thresholds. Streams without response data will be listed as having insufficient data and prioritized for additional monitoring if either TN or TP falls within the specified range.
High Nutrient Enrichment at Headwater Streams: No Ecological Responses[e]			
Summertime Average Nutrients			**Assessment Notes**
TN > 0.80[a,b]	TP > 0.080[a,b]		Streams over these thresholds will initially be placed on Utah's Section 303(d) list as threatened. Threatened streams will be further evaluated using additional data such as nutrient responses, biological assessments, or nutrient-related water quality criteria (e.g., pH and DO) both locally and in downstream waters.

Notes: Criteria would be applicable unless more restrictive total maximum daily load (TMDL) targets have been established to ensure the attainment and maintenance of downstream waters. DO = dissolved oxygen, ER = ecosystem respiration, GPP = gross primary production, TN = total nitrogen in mg/L, and TP = total phosphorus in mg/L.
a. Seasonal average of ≥ 4 samples collected during the summertime growing season (June 1–September 30) will not be exceeded. Sites will be assessed using the higher of TN and TP threshold classifications.
b. Response data, when available, will be used to assess aquatic life use support or as evidence for additional site-specific investigations to confirm impairment or derive and promulgate a site-specific exception to these criteria.
c. Daily whole stream metabolism obtained using open-channel methods. Daily values are not to be exceeded on any collection event.
d. Filamentous algae cover means patches of filamentous algae > 1 cm in length or mats > 1 mm thick. Daily values are not to be exceeded at any time during the growing season (June 1–September 30).
e. Quantitative estimates are based on reach-scale averages with at least three measures from different habitat units (i.e., riffle, run) made with quantitative visual estimation methods.
f. Excluded waters identified in UAC R317-2-13.2 (c).

Addressing NNC Impairments: An Adaptive Management Approach

Introduction

Once nutrient enrichment problems are identified, DWQ and collaborators will assess the impairment in more detail to determine the most appropriate actions toward achieving the water quality objectives specified in the NNC (Figure 2). The first step to address headwater NNC impairments is to compile new and existing data to better understand the cause(s) and source(s) of degradation. In some cases, this may be as simple as identifying sources of nutrient enrichment, in others remediation of habitat degradation may also be required.

Development of an appropriate remediation strategy will require additional data collection to better understand the spatial extent of degraded conditions and potential sources of nutrient enrichment throughout the watershed. In some cases, these preliminary surveys may reveal causes that are complex or unknown; if this occurs, DWQ will engage in additional studies to better understand the nature and extent of all adverse effects contributing to the degradation of designated uses.

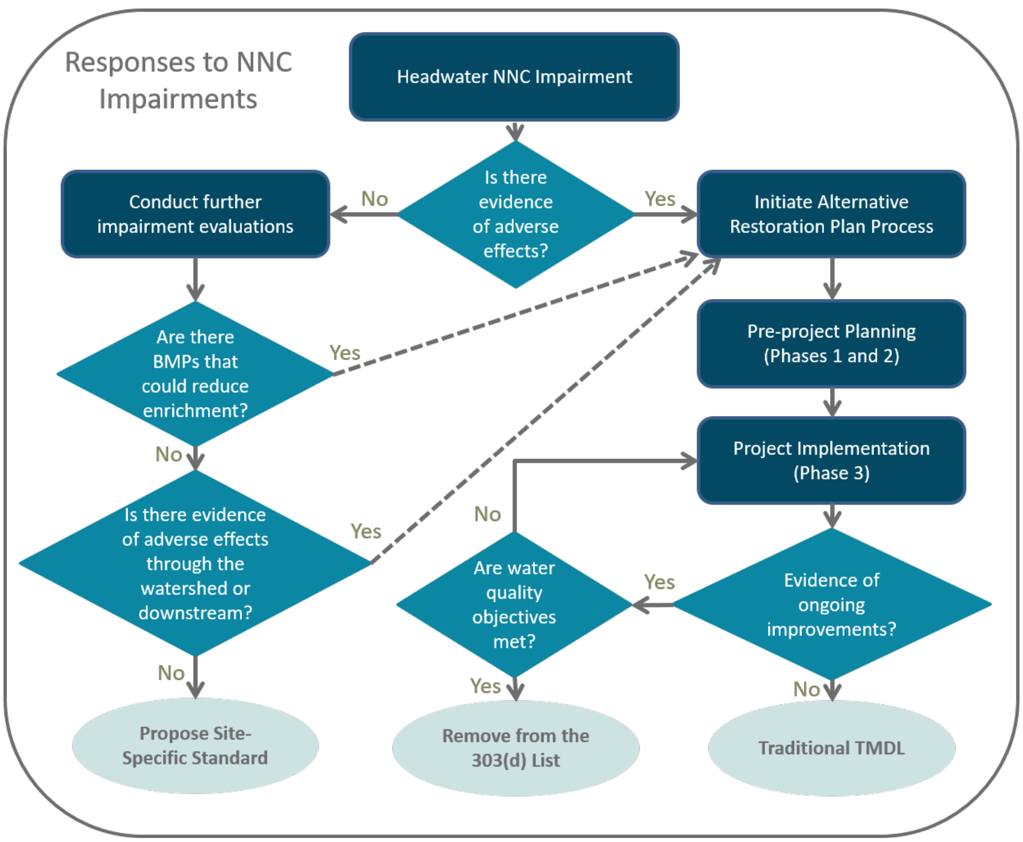

Figure 2. Alternative pathways for addressing NNC impairments.

Once the nature of the impairment has been more thoroughly evaluated, a determination will be made about the best way to restore degraded conditions. If human-caused nutrient sources are present and adverse nutrient-related effects are observed, then DWQ will move forward with the alternative restoration planning process. If DWQ determines that all nutrients sources are natural, or in circumstances where adverse effects are not observed—within the AU and downstream—the data and information necessary to propose a site-specific standard will be compiled and reviewed and submitted to the Water Quality Standard Workgroup for review. After addressing stakeholder comments, the proposed site-specific standard will proceed through the rulemaking process. If the cause is not a pollutant (e.g., it relates to habitat modification or hydrologic alteration), then the site will be reclassified to Category 4C during the next assessment cycle. Several candidate watersheds have been selected as candidates for pilot projects to allow DWQ to develop or refine appropriate methods to address NNC impairments.

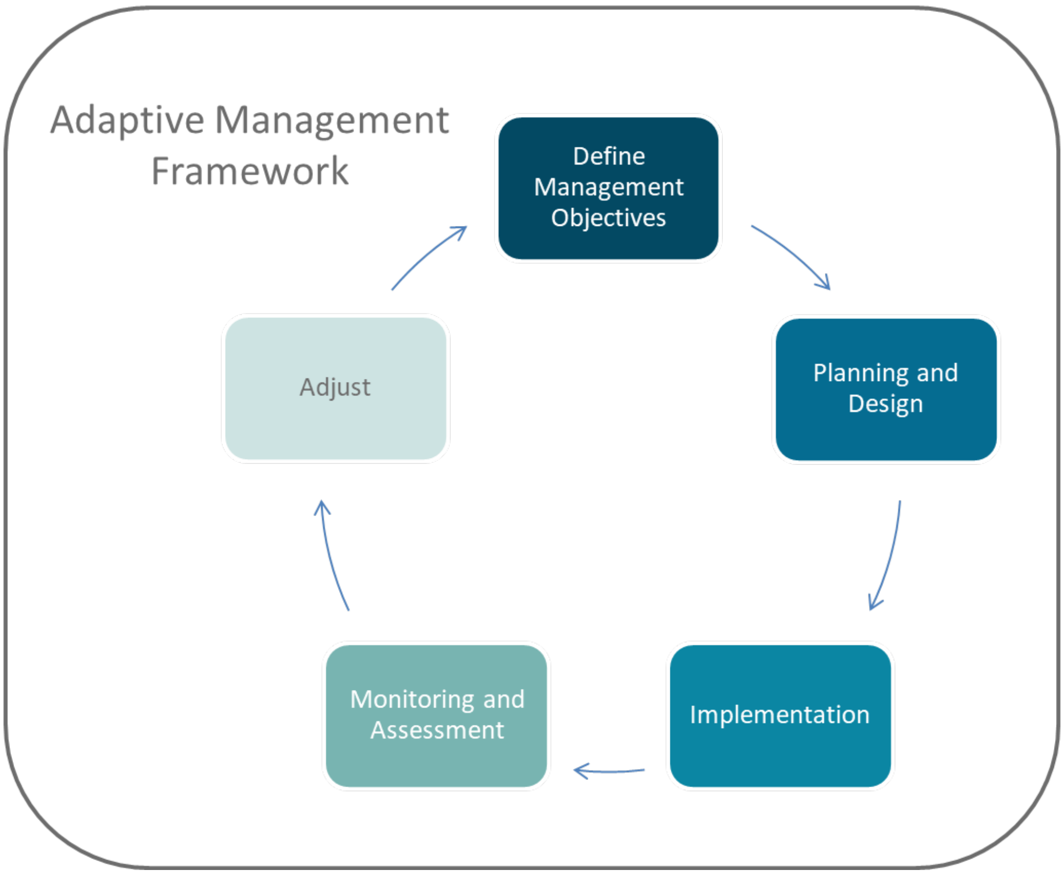

Figure 3. Important steps in the adaptive management process.

For those impairments requiring restoration, the NNC are intended to facilitate implementation of an adaptive management restoration framework (Figure 3). There are several reasons why adaptive restoration strategies are particularly useful for resolving nutrient enrichment problems. First, streams have physical attributes that alter their relative sensitivity to enrichment. As a result, the most effective restoration approaches may involve a combination of both nutrient reductions and improvements to stream habitat (e.g., riparian restoration to increase canopy cover). Adaptive management also allows evaluation of the effectiveness and efficiency of BMPs to achieve water quality objectives. The NNC also offers flexibility in establishing water quality objectives because they incorporate direct measures of biological condition (filamentous algae cover and stream metabolic rates). These responses can easily be included among Alternative Restoration Plan (ARP) water quality objectives. The NNC responses, along with other measures of stream condition, will then be monitored throughout implementation of the Best Management Plans (BMPs) specified in the ARP. Iterative BMP implementation will then continue until the watershed meets NNC requirements. The ARP process precludes the need for a TMDL regulatory action, provided ongoing progress is documented as projects are implemented.

Collaborative Management

Most of the headwater streams are in watersheds that are managed by the USFS. Hence, NNC implementation will require ongoing collaborative management with this and other federal and state agencies. Other important stakeholders include individuals with grazing permits and individuals with an interest in a watershed undergoing ARP planning processes. DWQ already maintains Memoranda of Understanding (MOUs) with many management agencies in Utah. These MOUs outline, among other things, collaborative monitoring practices. DWQ has also made a commitment to work closely with Utah Department of Agriculture and Food (UDAF) and United States Forest Service (USFS) to quickly identify whether domestic cattle grazing is responsible for any impairments identified by the NNC, and if so, to work collaboratively with the USFS and potentially affected land-use permit holders to identify a suite of potential solutions that will be implemented as equitably as possible. The Division envisions ongoing collaboration throughout the development and implementation of all ARPs. Identifying the roles and responsibilities of all project partners is an important ARP requirement. As restoration plans are implemented there will also be a need to collaborate on monitoring aimed at demonstrating progress toward meeting water quality objectives, including those specified in the headwater NNC.

Alternative Restoration Plans

Efficiently addressing headwater nutrient impairments requires an action-oriented approach that focuses resources on the implementation of on the ground remediation efforts. In 2013, EPA completed a broad and collaborative review of the nation’s Clean Water Act 303(d) program with the objective of identifying opportunities to more efficiently and effectively meet water quality objectives (EPA 2013). Among the findings of this review was an acknowledgement that traditional TMDLs may not always be the most effective approach for meeting water quality efforts, particularly in circumstances where the flexibility required by adaptive management is desirable or where multiple resource management objectives can be combined into a comprehensive restoration effort. To address this shortcoming, the report recommended ARPs aimed at getting restoration activities implemented as quickly as possible. States were tasked with translating these concepts into their water quality programs. Since this recommendation was first made, some states have made considerable progress in establishing ARP regulatory frameworks, which DWQ has built on when considering how these approaches could be used to address headwater NNC impairments.

Regulatory Framework

The process of documenting and addressing water quality impairments is dictated by sections 303(d), 305(b) and 314 of the Clean Water Act. These laws require that states assess whether or not designated uses are being supported in lakes (314) and streams (303(d)) and report the results of these assessments to EPA every other year (305(b)). For impaired waters, states are also required to prioritize the development of TMDLs, to ensure that impairments are addressed over a reasonable period of time.

There are two areas where the existing TMDL regulatory requirements offer flexibility. The first is a regulation that permits alternatives to TMDLs if “other pollution control requirements (e.g., best management practices) required by local, State or Federal authority” are stringent enough to achieve water quality standards (see 40 CFR 130.7(b)(1)) within a reasonable period of time. Traditionally, states have used this regulation to provide EPA with restoration plans as a rationale for excluding otherwise impaired sites from their 303(d) list of impaired waters. Once approved, such sites are listed in category 4B, which excludes them from TMDL development requirements. To date, the reporting requirements necessary to make a 4B determination is often as extensive as traditional TMDLs. This is because EPA approval hinges upon whether water quality standards to be met within “a reasonable period of time”, and time-definitive restoration predictions intrinsically uncertain without extensive documentation. As a result, 4B approaches have not been widely used by states to address water quality impairments.

ARPs are another recently proposed area of flexibility that emerged from the process of prioritizing impaired waters for TMDL development. In this alternative framework, sites are placed on the 303(d) list of impaired waters, but are given a low priority for TMDL development, which provides time for the development and implementation of alternative restoration plans. Documentation of ongoing progress toward meetings the water quality objectives defined in the ARPs—and ultimately the NNC—provides EPA and other stakeholders with reasonable assurance that the impairments will be addressed in a timely manner. Because the process does not include a removal from the 303(d) list until NNC are met, or submission of a formal TMDL, there is no formal EPA approval for these ARPs; formal action is deferred unless progress toward meeting water quality objective cannot be demonstrated. This provides states with the flexibility needed to better integrate water quality planning with broader resource management objectives.

DWQ believes that this alternative process provides the most sensible path for addressing headwater NNC impairments.

Usage

ARPs are intended to be flexible and focused on efficient implementation of restoration planning efforts. Sometimes, the documentation requirements can be considerably less extensive than traditional TMDLs. This is especially true in circumstances where Clean Water Act §319 9-element restoration plans are already developed for an AU where a NNC impairment is identified.

Even in circumstances where reporting requirements are similar to TMDLs, ARPs are better suited to address NNC impairments than TMDLs. TMDLs quantify the maximum amount (load) of a pollutant (e.g., TN, TP) a waterbody can acquire and still meet water quality standards. TMDLs also quantify the pollutant reduction needed among current sources to obtain this objective. Because TMDLs focus on individual pollutants, they cannot easily account for the fact that adverse effects related to nutrient enrichment are caused by a combination of multiple pollutants (N and P) and variable physical attributes that affect the relative sensitivity of headwater streams to nutrient enrichment. Another limitation of traditional TMDLs arises from the fact that all headwater nutrient inputs in Utah are from non-point sources. Nutrients from non-point sources are diffuse and episodic in nature, making them difficult to accurately quantify, which makes it difficult to specify appropriate load reduction targets and to accurately measure progress toward meeting load reduction requirements. ARPs eliminate many of the shortcomings of traditional approaches and provide a restoration framework that is more compatible with the flexibilities intrinsic to the headwater NNC.

ARP Elements

There are no federal requirements for elements that need to be included in an ARP. However, EPA does recommend that they include eight key elements:

- Clear ***identification of the waterbodies encompassed by the restoration plan and the cause(s) of water quality impairments***. In the case restoration plans developed to address headwater NNC impairments, this would include all streams in the impaired AU, with an underlying cause of nutrient enrichment. If later investigations reveal that some of the streams in the AU are not degraded from nutrient enrichment, the scope of the restoration plan will be further refined to focus on those stream segments where nutrient enrichment or adverse responses are observed.
- Identification and relative ranking of ***potential sources of pollutants*** responsible for the impairment. For headwater NNC impairments, this would developed by conducting a survey of potential human-caused sources of nutrients in the watershed. Where possible, specific sources could also be ranked with respect to their relative contribution to observed enrichment problems.
- A ***description of planned restoration activities***. For ARPs this would include a list of the locations of planned Best Management Practices (BMPs). In many cases, a schedule or plan for phasing iterative restoration efforts will also be included.
- An ***estimate of when the water quality standard will be met.*** Because TMDL alternatives are intended to facilitate adaptive management, these projections can be revised as data and information is generated throughout the implementation of restoration objectives.
- Identification of ***partnerships and responsibilities for the implementation of the planning efforts***. At a minimum, those involved in headwater NNC alternative planning would include the land management agency [e.g., USFS, Bureau of Land Management (BLM)], UDAF, relevant use permit holders and DWQ.
- ***Identification of funding sources***. One advantage of the collaborative nature of the proposed ARP process is a potential expansion of the number of funding sources. This part of the restoration plan will identify the funding source that has been identified as the best fit for the unique circumstances of each impaired AU. Because of the collaborative nature of the restoration plans, the potential exists for additional funding sources available to project partners that would otherwise be unavailable to traditional TMDL implementation activities.
- ***A plan for ongoing monitoring and assessment of progress toward meeting water quality objectives.*** In this case, progress would include the ongoing BMP implementation activities and improvements to stream condition, including progress toward meeting water quality objectives. This will also be used to inform ongoing BMP implementation in accordance with adaptive management practices.

- ***A plan for reporting the progress of restoration activities.*** DWQ anticipates that progress of these ARPs will generally be provided in conjunction with Utah's IR or the annual non-point source report submitted to EPA. Whatever default reporting mechanism is selected, an alternative reporting mechanism could be selected for specific projects if it better aligns with the reporting requirements of funding sources.

It is worth noting that all of these elements would be needed for any restoration plan. For example, DWQ requires development of 9-element watershed management plans to be eligible for Clean Water Act §319 non-point source funding. In most cases these 9-element watershed plans will be more than sufficient to meet ARP objectives. ARP document requirements can also incorporate other restoration efforts by providing a crosswalk that shows where the plan provides the information needed for an ARP. This flexibility should facilitate collaboration with other agencies by providing a way to use planning documentation developed for other funding sources or resource planning efforts to meet ARP requirements.

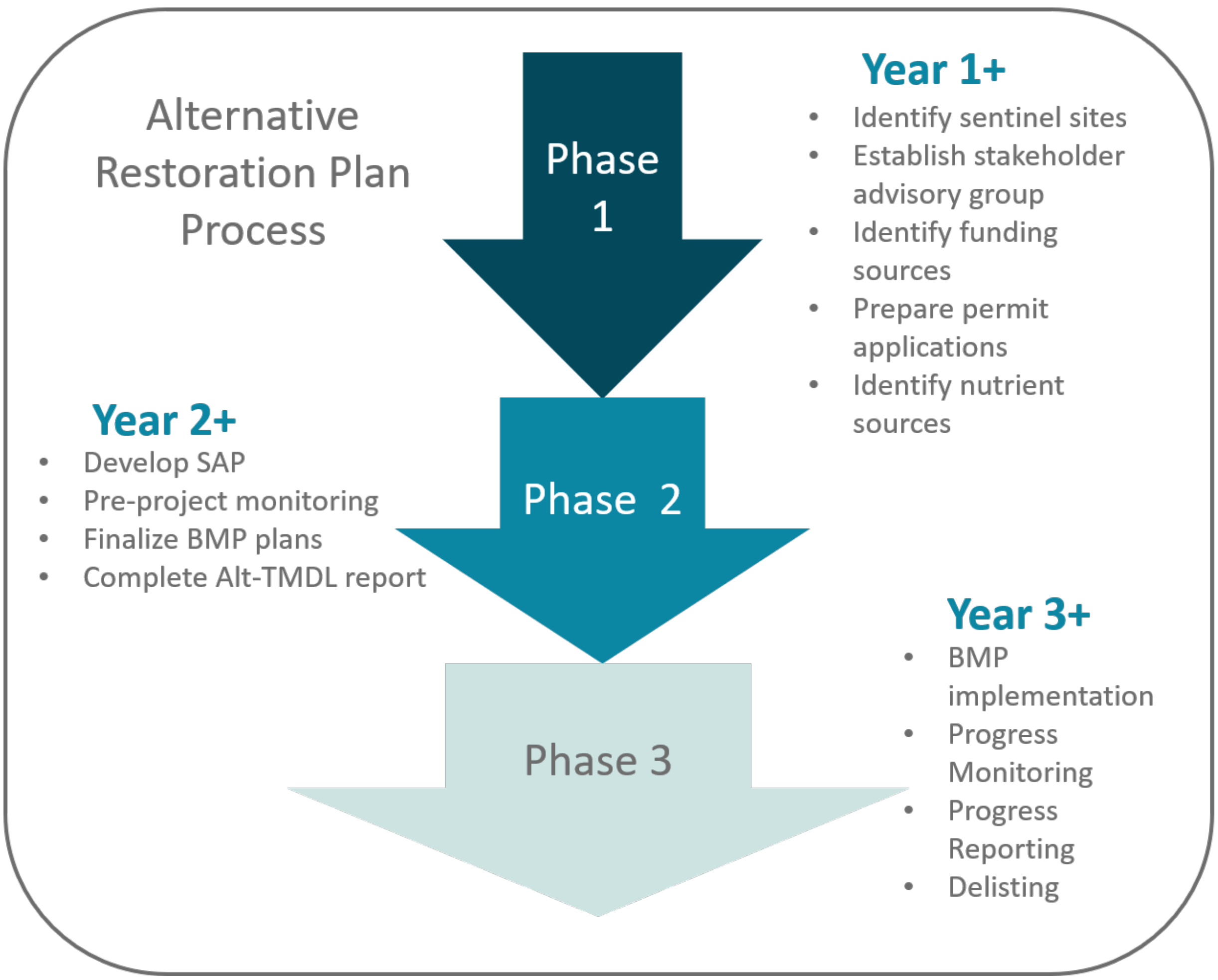

Figure 4. Three phases of ARP planning and implementation.

Development and Implementation of Restoration Plans

Once a decision has been made to proceed with an ARP, DWQ envisions a planning process where these restoration plans are ready for on the ground implementation in as few as three years (Figure 4).

The **first phase** of ARP development will focus on obtaining the requisite information to develop effective restoration plans. The specific tasks needed to meet this objective will likely differ depending on the nature of the impairment and anticipated complexities of potential restoration BMPs. However, most restoration plans will require the following tasks to be completed as early in the process as possible:

- ***Identify appropriate sentinel sites.*** Sites will need to be selected that are most likely to be sensitive to the effects of nutrient enrichment—and subsequent restoration efforts. In some cases, it may also be desirable to select sites upstream of particular restoration activities and physically similar reference sites because this will help better document ongoing improvements to the chemical, physical and biological integrity of the stream. Site selection will likely be accomplished using a combination of GIS and field site-reconnaissance.
- ***Create stakeholder advisory group.*** For collaborative management to be effective, it is important to directly involve stakeholders as early in the process as possible. At a minimum, the following people and organizations will likely need to be involved in each restoration plan: DWQ, USFS (or whatever agency is responsible for resource management in the impaired watershed), Utah Department of Agriculture and Food (UDAF), and any land use permit holders. Other stakeholders may also be advantageous depending on local circumstances.
- ***Identify and rank nutrient sources.*** It is important to identify potential nutrient sources within the watershed. If multiple sources are present, it may also be useful to estimate the extent to which each source is likely contributing to enrichment problems. Much of this work can be conducted by consulting with local resource managers, but in most cases follow-up field reconnaissance will also be needed.
- ***Identify funding sources.*** If the restoration is going to require on the ground restoration activities it will be important to identify funding sources as early in the process as possible. Application requirements for potential funding sources will also need to be identified to ensure that the requisite information is obtained prior to application deadlines.
- ***Prepare permit applications***. Depending on the nature of potential restoration activities, state or federal permits may need to be obtained. If it is anticipated that permits will be required, it will be important to ensure that the permit applications are submitted as early in the process as possible.

The **second phase** of the ARP development will focus on project planning and the completion of the 8-element ARP documentation. At the end of this phase, all of the information necessary to proceed with the planned restoration activities will be finalized. ARP documentation can be submitted to EPA and once accepted the watershed (assessment unit) will be classified as 5-alt in the next Integrated Report.

Some of the important tasks to accomplish in this phase of the planning effort include:

- ***Develop project Sample Analysis Plan (SAP).*** These plans define data that will be collected, and how it will be evaluated to demonstrate ongoing improvements in water quality. They should be developed as early in planning effort as possible to better inform any pre-project data collection activities.
- ***Conduct pre-project monitoring.*** It is exceedingly difficult to demonstrate the effectiveness of restoration projects without pre-project data collection. At a minimum, pre-project monitoring should include collection of all NNC elements at sentinel sites proximate to any planned BMPs. In some cases, it may also be desirable to collect nutrients and responses from upstream sites or comparable reference sites to help account for natural temporal variation in trends when evaluating ongoing improvements in stream condition.
- ***Finalize recommendations for new and revised BMPs.*** The most important part of this process is identifying those BMPs that show the most promise for rectifying nutrient enrichment problems, while also minimizing economic harms to stakeholders. At this point in the process it should be possible to identify the most effective BMPs and an appropriate way to phase their implementation until water quality objectives are met.
- ***Secure project funding.*** It may not be possible to obtain funding for all of the potential restoration projects, but it will be important to have secured enough money to move forward with the most important planned remediation efforts.
- ***Complete ARP documentation.*** The final ARP should be complete at the conclusion of this phase in the planning process. After addressing input from stakeholders, the plan will be submitted to EPA for acceptance into their records. More importantly, the planning documents can be used to guide ongoing restoration activities.

The **third phase** of the process involves implementation of the recommended BMPs, monitoring to ensure that the projects are achieving desired outcomes, and regular reporting on project progress. All of these tasks will be conducted on an ongoing basis until the NNC standards are met.

- ***BMP Implementation.*** The restoration plan will identify BMPs that are tailored to the specific conditions observed in the impaired AU. In some cases, this may involve better enforcement of existing BMPs, in others entirely new restoration efforts will need to be identified. Consistent with the adaptive management framework, these BMPs will be implemented iteratively, with modifications to future plans as information on the relative effectiveness of each BMP in achieving water quality objectives becomes available.
- ***Progress Monitoring.*** Monitoring will be conducted, by DWQ and cooperators, throughout implementation of restoration plan BMPs. Data collected from these efforts will be evaluated on an ongoing basis to help inform future restoration work.
- ***Progress Reporting.*** ARPs ensure accountability through ongoing reporting of restoration progress. At the initial stages of the projects, progress reports will summarize the status on ongoing restoration efforts. In later stages, progress reports will focus on iterative improvements in environmental outcomes. This process will be ongoing until the water quality objectives defined in the SAP are met. DWQ envisions that progress

reports will be incorporated into the annual §319 progress reports, which will then be included among the Integrated Report review materials.

Discussion

There are several reasons why ARPs may be ideally suited to addressing headwater NNC impairments. TMDLs are most effective where pollutants primarily originate from point sources, because loads from these sources are more easily quantified and incorporated into permits. In the case of Utah's headwater NNC, all human-caused nutrient sources are of non-point origin. It is difficult to accurately measure nutrient concentrations from non-point sources, which means that documenting progress to water quality goals is also difficult. ARPs circumvent this problem because they include a broader suite of water quality objectives.

Another advantage of ARPs is their potential to facilitate interagency collaboration in the development and implementation of watershed-scale restoration planning and implementation. Most of Utah's headwater streams are located on publically owned lands. As a consequence, collaboration among resource management agencies will be critically important in effectively addressing headwater NNC impairments. The ARP structure that DWQ proposes is focused on identifying and implementing those BMPs that can most efficiently and effectively remediate the adverse effects of nutrient enrichment. All other resource management agencies express resources management objectives in the context of BMP implementation and expressing water quality objectives similarly will help maximize resources among all participatory agencies.

Additional Implementation Considerations

Revisions to Water Quality Standards

A critical step in adaptive management is revisiting previous decisions as additional data become available. DWQ has developed the proposed NNC to be generally applicable to headwaters statewide, but there will likely be circumstances where they need to be modified. Site-specific standards are the most resource intensive response to headwater impairments because a lack of adverse effects or human-caused nutrients needs to be demonstrated for the assessment unit. Meeting the data requirements required to relax an existing criterion on a site-specific investigation generally involves several years ofintensive data collection. However, in most cases, it is relatively easy to evaluate whether or not the option is worth pursuing using follow-up survey investigations. For example, if follow-up surveys reveal human-caused nutrient sources that are easily addressed with new or expanded BMPs, it may be more efficient to address these sources via an ARP than the investigations necessary to modify the standard.

Ongoing Monitoring

NNC data have already been collected and evaluated from the majority of headwater streams where data collected prior to 2015 suggested a potential for nutrient enrichment.However, protection of Utah's headwater streams also requires an ongoing monitoring plan that identifies emerging nutrient enrichment problems across all of Utah's headwater streams. DWQ envisions NNC monitoring activities will continue to be integrated into ongoing data collection activities such as those conducted for Utah's biological assessment program or rotating basin water quality sampling efforts. Additional details will continue to be provided in DWQ's long-term Strategic Monitoring Plan and yearly monitoring plan reports.

Targeted Monitoring by DWQ

Utah currently monitors six major basins using a tiered, rotating monitoring approach that combines the strengths of both systematic and random site selection. Randomly selected sites are used for routine assessment purposes and are conducted in year one of the rotation; systematic monitoring is used to support regulatory programs and is conducted in year three of the rotation. Each of the six major basins is visited in two different years within each rotation; all six basins are visited twice within a single six-year rotation, with two basins visited per year.

DWQ will evaluate existing information to ensure that headwater streams with known or suspected nutrient enrichment are included in these monitoring activities. Data collected from these efforts include water quality samples of sufficient frequency to growing season average ambient of nutrient concentrations at each location. In addition, other water quality parameters related to adverse effects of nutrient enrichment (e.g., pH and DO) are also collected. If these data reveal potential problems with nutrient enrichment, DWQ will conduct follow-up investigations as part of its Utah's Comprehensive Assessment of Stream Ecosystems (UCASE) data collection efforts (discussed further below).

Probabilistic Monitoring: UCASE

DWQ uses a spatially balanced, stratified, random sampling design called generalized random tessellation. Each year, 25 sites are selected statewide for probabilistic UCASE data collection efforts. At each of these sites, approximately one day is spent monitoring multiple chemical, physical, and biological water quality indicators during the summertime growing season. This includes collection of water chemistry data for dissolved TP and TN and individual N analytes including: Kjeldahl N, nitrate-nitrite and ammonium. In addition, these monitoring efforts currently include collection of a reach-scale benthic algal sample for chl-a concentrations and AFDM analysis, which will allow DWQ to assess each of these sites against the headwater NNC for recreational uses. Sites where the TP or TN data exceed the lower summertime average NNC will be prioritized for subsequent intensive monitoring efforts to obtain water chemistry samples of sufficient frequency to calculate growing season ambient nutrient concentrations for N and P, along with monthly filamentous algae cover data.

Each year UCASE data collections are also conducted at targeted sites where a more comprehensive suite of condition indicators is required to inform various DWQ monitoring objectives. With respect to the headwater NNC, this would include any site where the growing season average of ambient nutrients obtained from targeted sites exceeds the lower threshold for N or P. In addition, sites that are potential candidates for site-specific NNC could also be included in targeted UCASE data collection efforts to more thoroughly evaluate whether or not adverse effects from nutrient enrichment are occurring in enriched streams. Finally, it may also be useful to conduct these evaluations at sites where alternative TMDL restoration plans include restoration of stream habitat.

Targeted Monitoring: Federal Cooperators

Approximately 80% of land in Utah is publically owned. As a result, DWQ has developed an extensive cooperative monitoring program where the agencies who manage these lands {e.g., USFS, Bureau of Land Management (BLM), National Park Service (NPS)] help collect water quality information to better inform both state and federal resource management efforts. Many of the streams evaluated through this cooperative agreement occur in areas sensitive to human activities and/or are likely affected by human-caused nutrient enrichment. DWQ will work with these cooperative agencies to ensure that the information needed to evaluate the headwater NNC are collected at cooperative monitoring streams where nutrient enrichment is a potential water quality concern.

Next Steps

This document provides a framework for the implementation of the headwater NNC. It describes general processes that can be followed to accommodate the unique circumstances of watersheds that are placed on category 5 in the Integrated Report because they failed to meet NNC requirements. In some instances, additional guidance, templates or other supporting materials will be necessary for project implementation. Additional guidance documentation will be developed on an ongoing basis to streamline future NNC implementation efforts.

The 2022 Integrated Report contains several NNC impairments that can be used to pilot different approaches for addressing NNC impairments, including: ARP development processes, processes for addressing threatened waters degraded habitat or hydrologic alteration (candidate 4c listing decisions) or waters with natural or uncontrollable nutrient sources.

ARP Development Pilots

Most NNC impairments will be addressed using ARPs as opposed to traditional TMDLs. In some cases, this can be easily accomplished by linking existing or newly developed 9-element watershed plans that were already developed to obtain restoration funding—particularly Clean Water Act §319 funds—to address non-point source pollution in Utah. These watershed plans are developed collaboratively, frequently involving numerous public and private stakeholders.

In circumstances where 9-element plans are already developed, the transition to an ARP is accomplished by creating a crosswalk that points out where ARP planning elements are already discussed in the 9-element plans. After these documents are accepted by EPA, DWQ will assess them as 5-alt on the next biennial Integrated Report. As plans are implemented, incremental progress needs to be documented, which means that pre- and post-project monitoring plans that include NNC responses will need to be established.

The 2022 Integrated Report found Otter Creek (AU: UT16030002-002_00) to be impaired due to high levels of filamentous algae and high rates of ecosystem respiration. A 9-element watershed plan was recently completed due to previously established impairments (DO, pH, macroinvertebrates) that are likely related, in part, to nutrient enrichment concerns. Thus, Otter Creek is an ideal watershed to pilot the processes ARP monitoring and reporting procedures.

UM Creek (AU: UT14070003-002_00) is another NNC impairment that can serve as a pilot to refine earlier ARP processes. This watershed, previously listed as impaired for E. coli (2020) has a number of partners interested in conducting restoration work to improve its potential to become a high-quality fishery in a recreationally important area of the state. Early work will involve conducting extensive watershed evaluations to identify the spatial extent of degraded conditions, nutrient sources and potential restoration projects. While this work is underway, a stakeholder group can be established. This will allow stakeholder objectives and concerns to be captured so that they can be considered throughout the watershed process. Establishing collaboration partners early in the process will help identify potential funding sources for conducting future restoration work. This will ensure that the ARP ultimately meets multiple funding and project partner objectives.

Threatened Water Pilots

The 2022 Integrated Report also identifies several watersheds (AUs) as threatened because they had nutrient concentrations that exceeded the upper NNC thresholds, but the ecological responses did not: White River-Colton (AU: UT14060007-001_00), Santa Clara-3 (AU: UT15010008-003_00) and Threemile Creek (AU: UT16030001-014_00). In all three cases, previous Integrated Reports had already noted issues with eutrophication. Threemile Creek was also listed as impaired for the nutrient parameters of pH and DO and was previous impaired for temperature impairments in 2008. The other watersheds had moderate amounts of filamentous algae, but cover never exceeded 1/3 of the stream bed as required by the NNC for moderately enriched streams.

ARPs may ultimately be developed for these threatened watersheds, but more extensive preliminary evaluations are necessary before initiating a formal watershed planning process. It is possible that deleterious ecological responses are present within these AUs, but were missed in previous monitoring efforts. As a result, watershed surveys will need to establish stream reaches that are most susceptible to enrichment so that additional monitoring can be conducted. In addition, all potential nutrient sources—both natural and human-caused—will need to be identified. Surveys may also need to evaluate whether or not nutrients are contributing to water quality problems downstream of the AU. Data and information collected through these evaluations will inform decisions about the most appropriate ways to resolve threats to aquatic life uses in these watersheds. In some cases, the results may reveal a need for a site-specific standard. In others, the information will provide the necessary information to proceed with an ARP.

Addressing Atypical Circumstances: Natural or Uncontrollable Nutrient Sources, Habitat and Hydrologic Modifications (4C) Pilots

Numeric criteria are often not applicable to all waters, particularly those with atypical watershed conditions. Sometimes degraded conditions are caused by something other than pollution, making them eligible for placement into Integrated Report category 4C. For example, the 2022 Integrated Report includes an impairment for Provo River-3 (AU: UT16020203-002_00), due to an exceedance of lower nutrient thresholds and high levels of filamentous algae accrual. Preliminary information at this site suggests that the deleterious responses may be largely or entirely caused by a significant diversion for irrigation. In such circumstances, work could be conducted to document the extent of the degradation and what, if anything, can be done to improve degraded conditions. If these investigations find that this impairment is entirely due to hydrologic modification, it could be placed into Category 4C; otherwise, ARP processes could be implemented. This site will serve as a pilot for deciding the appropriate remediation approach for impairments causes by water diversions.

The 2022 Integrated Report also identified an impairment on the South Fork of the Ogden River (AU: UT16020203-002_00), which is just downstream of Causey Reservoir. It is likely that algae accrual at this location is exacerbated by very stable growing season flows. Causey Reservoir is fully supporting its aquatic life uses and there is no evidence that this water body has eutrophication problems. Controlling nutrient sources may be difficult if the sources are coming from historic reservoir accumulations in the reservoir. Some practices such as dredging may actually cause more environmental damage than already exists downstream, making a site-specific standard the appropriate regulatory response [40 CFR 131.10(g)(3)]. It is also possible that other sources of nutrients exist, such as input from septic systems located upstream. These will also need to be evaluated before a recommendation is made about the appropriate regulatory remedy to this NNC impairment.

Conclusion

DWQ will take an adaptive, collaborative approach to implementation efforts addressing NNC impairments. Guidance on restoration planning efforts such as funding procurement, project scoping, SAP development and monitoring strategies may be needed, and DWQ is committed to working with resource management partners to develop robust processes and materials for future efforts. Furthermore, several watersheds identified in the 2022 Integrated Report will serve as useful pilots for the NNC implementation framework and will provide valuable data and information to continually improve habitat restoration throughout the state.