MINNESOTA DEPARTMENT OF NATURAL RESOURCES (MNDNR)
Ecological and Water Resources (EWR)
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Date: Monday, March 9, 2015

Addressee: Jennifer Ronnenberg,
Fillmore SWCD Water Management Coordinator
900 Washington Street NW
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Subject: Response to Request for Priority Concerns for the Root River One Watershed, One Plan (1W1P)

Dear Ms. Ronnenberg and the Root River 1W1P Policy Committee:

Thank you for the opportunity to provide comments regarding the priority concerns for the ***Root River One Watershed, One Plan***. The Minnesota Department of Natural Resources (DNR) supports the development of the Root River 1W1P for a planning area encompassing over 1.3 million acres of land across portions of six counties in southeastern Minnesota within the Root River, Upper Iowa, and Mississippi River – Reno watersheds.

Shifting traditional county water planning methodologies to a watershed scale and aggregating individual county water plans into one cohesive watershed document builds upon prior planning efforts and local knowledge, strengthens already established partnerships, and encourages management of land and water as a ***system*** to achieve ***healthy watersheds***.

The DNR believes a watershed approach will drive multi-agency coordination, and streamline science-based data delivery to better inform future implementation actions so they are prioritized and targeted to produce measurable water quality outcomes to achieve healthy ecosystems. As the Priority Concerns Watershed Implementation Plan is developed, locally adopted, and implemented, the DNR recommends actions are conveyed using a holistic approach.

The Root River 1W1P is located entirely within the Driftless Area, a region untouched by glaciers for the past 500,000 years. A significant outcome of this unique geology are the picturesque landscapes characterized by deeply dissected river valleys, rolling karst terrain, and coldwater trout streams that are highly susceptible to groundwater contamination. The bluffs and valleys of the region are home to high quality ecosystems of cliffs, forests, oak savannas, and prairies, including 40 different native plant community types mapped by the Minnesota County Biological Survey (MCBS) covering nearly 38,000 acres. As a result, the Root River 1W1P planning area is unlike any other part of the state with over 111 species of state-listed rare plants and animals that call the Mississippi River Blufflands home.

Within this ecologically sensitive landscape the issues affecting the ***watershed system*** are interconnected. The DNR uses a five component framework to describe watersheds as ***systems*** and ***biology, hydrology, geomorphology, connectivity*** and ***water quality*** all play a role in water and land use management issues. For instance, upland soil erosion causes elevated levels of total suspended solids ***(water quality)*** which is transported downstream ***(hydrology)***, stressing fish and aquatic communities ***(biology)***, which then

degrades habitat from loss of stream stability ***(geomorphology)*** and fragments habitat ***(loss of connectivity)***. ***Healthy watersheds*** with biologically diverse and connected ecosystems function to produce clean water when these five components are in sync.

Based on the notion "healthy watersheds are how we get to clean water" the DNR has developed ***DNR's Desired Watershed Conditions*** (see attached) which we use to guide our ecological approach for water quality work. We encourage a ***healthy watershed approach*** is adopted not only for plan development, but more importantly, that these principles are locally embraced and echoed through on-the-ground implementation actions and in land use decisions.

Holistic planning should identify ***system solutions*** – those that address the root cause of the problem and which result in multiple benefits, protects and restores ecosystem functions, and increases long-term ecosystem resilience in the face of more extreme weather events associated with a changing climate, land use, and other stressors.

In order to maintain a ***healthy watershed system*** attention to all of the priority issues listed below (arranged alphabetically) should be addressed:

- Altered hydrology
- Contaminants of emerging concern
- Drainage systems management
- Drinking water & groundwater protection (including recharge areas, sinkholes and karst features)
- Drought mitigation
- Emerging issues (e.g. land cover, climate change, etc.)
- Feedlots and manure management
- Flood damage reduction
- Groundwater contamination
- Groundwater quantity (sustainable water supply management)
- Habitat for wildlife and fisheries
- Habitat loss and habitat degradation
- Human sewage treatment
- Invasive species management
- Maintenance of core services; understanding of local capacity
- Nutrient, manure, and human waste management
- Pesticide and fertilizer use
- Shoreland and riparian management
- Soil erosion, sedimentation, runoff and stormwater management
- Soil health
- Recreation
- Wastewater management
- Water quality
- Wetland resources and natural corridors

<u>DNR Priority Issues</u> – However, the DNR realizes water and land use management issues are complex and in order to systematically begin addressing them we have narrowed our focus to these specific priority issues:

1. **Water Quality and Quantity:** Increased demands on water resources create increased concerns and conflicts. Water supply sustainability, water supply interference, water quality issues related to water use, and ground and surface water interaction complexities are all related to impacts from development and growth. Although, Minnesota appears to have more than adequate supply of water the surface and ground water relationship is not fully understood, which implies our ideologies of groundwater management may require widespread change. In general, surface water and groundwater quality is threatened by contamination from pesticide and fertilizer use, nutrients (nitrogen and phosphorus), human and animal sewage (fecal coliform bacteria), and soil erosion (total suspended solids). Due to the intimate interaction of surface and groundwater within the watershed groundwater protection for quality and quantity is a priority concern. This includes recharge areas, sinkholes and karst features which act as direct conduits transporting contaminated surface water.

   Recommended Strategies:
   - Enforce existing rules and ordinances
   - Support securing funding for research projects designed to better understand groundwater / surface water interactions at calcareous fens, springs and designated trout streams
   - Continue springshed mapping efforts to better understand the complex surface/groundwater interactions
   - Encourage developing a monitoring program to measure discharge and water chemistry seasonally at select representative springs
   - Protect non-trout stream springs
   - Provide buffers surrounding all known or mapped sinkholes or karst features; coordinate identification of priority sites with local Soil and Water Conservation offices
   - Continue to support the Minnesota Department of Health Wellhead Protection and Source Water Protection Programs so that public water supply conflicts can be identified and groundwater use is managed sustainably
   - Ensure all large capacity wells are permitted and meet permit requirements in accordance with the Minnesota Well Code
   - Develop protection plans of surface water intakes
   - Properly seal abandoned wells

2. **Altered Hydrology:** Anthropogenic disruption has changed the magnitude and timing of natural streamflows due to conversion of perennial vegetation to cropland, increased tile drainage and straightened channels. These changes have altered the functionality of streams, floodplains and wetlands, resulting in increased flow velocities causing scour, bank and channel destabilization, soil erosion, increased peak flows, flooding and flood risk and decreased infiltration.

   Recommended Strategies:
   - Retain more water in the upland portions of the watershed through wetland restoration
   - Expand use of Reinvest in Minnesota (RIM) easements for riparian and floodplain protection and restoration to promote flood damage reduction

- Stabilize streambanks with native buffers

3. **Soil Erosion, Sedimentation, and Runoff Management:** Maintaining healthy soils help regulate water, sustain plant and animal life, cycles nutrients and filters pollutants to protect surface and ground water. Increasing soil organic matter content and water holding capacity in the upper portions of the landscape leads to water storage and a reduction in peak flows.

   Recommended Strategies:
   - Encourage the use of cover crops, crop rotation and no-till farming practices to increase organic matter content, water holding capacity and storage across the watershed
   - Address ephemeral gully, sheet and rill erosion at the source before contaminated runoff is transported into sinkholes, springs and groundwater
   - Restore hydrology to reestablish stream stability

   Related Issue:
   - **Shoreland and Riparian Management:** Protection of natural vegetation in shoreland areas, especially along streambanks and adjacent floodplains is critical to reducing soil erosion, protecting water quality and enhancing wildlife habitat. Shoreland buffers provide numerous ecological benefits by slowing water velocities to trap sediment, filters nutrients (nitrogen and phosphorus) before it enters the stream via uptake from deep rooted native vegetation, holds soil in place to protect shorelines from bank and slope failures, enhances instream stability and flood attenuation while connecting corridors.

   Recommended Strategies:
   - Ensure ordinances contain current shoreland and floodplain language (Minnesota Shoreland Rule 6120.2500-3900)
   - Enforce existing shoreland ordinances
   - Provide permanent buffers along all streams and rivers in agricultural areas to protect water quality, reduce erosion and enhance habitat connectivity
   - Encourage buffer areas in Public Waters Work permits
   - Plant buffers with native vegetation to encourage infiltration, minimize erosion and stabilize streambanks
   - Regularly maintain established buffers and consider rotational or flash grazing as an alternative management technique for buffer strip management
   - Support conservation grazing that helps retain perennial vegetation on the land while minimizing soil and plant disturbance
   - Pursue finding for pilot projects to accomplish innovative native plant restoration projects on trout stream easements

4. **Habitat Loss and Habitat Degradation:** Urban and rural development pressure and agricultural production reduces contiguous native habitat degrading habitat quality. Alterations from over grazing, logging or fire suppression, as well as the introduction of invasive species has resulted in reduced abundance and diversity of native species.

Recommended Strategies:

- Protect biodiversity by maintaining or improving the diversity of plant communities and provide habitat preservation for state-listed rare species, sites of biodiversity significance, and Species in Greatest Conservation Need (SGCN), especially within key habitats for the Blufflands subsection. Key habitats include oak savanna, prairie, non-forested wetlands, shoreline-dunes-cliff/talus, river-headwater to large, and river-very large (Mississippi River), which are principally located on private lands. Forested areas also provide important habitat for many SGCN. Therefore, biodiversity protection on private lands is a high priority.
- DNR recommends protection of existing Minnesota Scientific and Natural Areas (SNA) with acquisition of priority adjacent parcels, either by fee title or in some cases through prairie bank easements. The SNAs located within the Root River 1W1P area include Mound Prairie, Racine Prairie, Rushford Sand Barrens, Wykoff Balsam Fir, Pin Oak Prairie, Cherry Grove Blind Valley, Wild Indigo, and Shooting Star Prairie.
- Manage habitat for wildlife and for fisheries
- Pursue funding for habitat management, restoration, and enhancement on public lands
- Continue private land bluff prairie restorations (DNR Nongame Wildlife Program)
- Update surveys of rare plant and animal species to determine long-term trends in populations
- Monitor fish and macro invertebrates for Index of Biological Integrity (IBI) development in priority watersheds
- Support the chain of custody that enables sustainable forestry operations
- Survey for invasive species, focusing on early detection, and monitor invasives in high biodiversity areas. Provide outreach regarding identification and recommended management of invasive species

5. **Manure, and Human Waste Management:** Poor manure management techniques including spills, over-application, and application near sensitive features (land and water), application timing, and soil incorporation issues continue to persist across the watershed. In addition, inadequately treated human sewage due to failing septic systems or unpermitted systems remains a concern. Both, are sources of fecal coliform bacteria and excess nutrients in streams and groundwater and contribute to impaired waters.

   Recommended Strategies:

   - Follow the MPCAs minimum state requirements for land application of manure
   - Locally adopt and/or enforce ordinances that restrict manure application near wells, sinkholes, karst features or vulnerable drinking water supply management areas
   - Identify and repair private and public non-conforming septic systems to eliminate contamination that results from human sewage

6. **Recreation:** Outdoor recreation contributes to the overall health and well-being of the state's population and is an important driver in sustaining local economies. Outdoor recreation areas need to be protected from the detrimental effects of land conversion, development encroachment, invasive species, plant and animal diseases, floods and water pollution.

Recommended Strategies:

- Promote the diverse opportunities for outdoor recreation, including angling, fishing, hunting, hiking, bicycling, etc. that exists in the watershed
- Recognize the importance of outdoor recreation to sustaining local economies
- Develop and maintain a sustainable and resilient outdoor recreation infrastructure
- Obtain data that may have been collected regarding outdoor recreation in southeast Minnesota to help inform future recreation and conservation needs
- Promote increased outdoor recreation participation through targeted programing and outreach

Plan Content - The DNR offers the following comments, information, and recommendations for consideration in developing the Root River 1W1P, following the concepts of a Priority Concerns Watershed Implementation Plan:

- Organize the plan in a way that identifies specific priority concerns and implementation actions at a 10-digit HUC watershed scale, so water quality monitoring data, trends, pollutant load allocations and water quality goals can be seamlessly integrated with the Minnesota Pollution Control Agency (MPCA) Watershed Restoration and Protection Strategy (WRAPS).
- The plan should identify load reduction estimates for various strategies or actions (e.g. 50-foot buffer strips, sedimentation basins, cover crops) that will be selected as an implementation action to address the root cause for a particular priority issue within a minor watershed. Address priority issues at the 12-digit HUC subwatershed scale or smaller and ensure the load reduction estimates have enough specificity so the anticipated percent reduction can be utilized in a grant application to show measureable outcomes.
- Standardize the process, or identify acceptable tools, calculators or estimation techniques that are acceptable for quantifying measurable outcomes.
- Provide details regarding the process for initiating and completing amendments during the life of the plan. Amendments may include integrating new information as it becomes available from collected data or research studies, or to allow flexibility for opportunistic projects or partnerships to be considered.
- We encourage discussion between state agencies to consider integrating the United States Environmental Protection Agency's (EPA) Nine Key Elements of Watershed Plans as described in the *U.S. EPA's Handbook for Developing Watershed Plans to Restore and Protect Our Waters* into the Root River 1W1P document to ensure watershed stakeholders are eligible to apply for 319 funding for watershed improvement projects. A copy of the EPA handbook can be accessed here: http://water.epa.gov/polwaste/nps/upload/2008_04_18_NPS_watershed_handbook_handbook-2.pdf.
- Protection is of critical importance especially for high-quality unimpaired waters at greatest risk of becoming impaired and those impaired waters that are closest to meeting state water quality standards. The MPCA's *Root River Watershed Stressor Identification Report,* dated January 2015 is the most recent example of using science-based monitoring and assessment data to determine and report the condition of streams and rivers overall community health. Final recommendations in the report indicate exceptional and vulnerable watersheds should be protected. Thus, based on current science, DNR agrees with MPCA's recommendations that exceptional and vulnerable watersheds should be protected:

- **Exceptional**
  - Forestville Creek and Tributary
  - Beaver Cree (2 of 3 stations)
  - Thompson Creek
  - South Branch Root River (select locations)
  - South Fork Root River (select locations)
  - Badger Creek
  - Rush Creek Tributary
  - Lower Trout Run Creek
  - Daley Creek
  - Big Springs Creek
  - Shattuck Creek (Nepstad Creek)
  - Diamond Creek
  - Coolridge Creek
  - Deer Creek
- **Vulnerable**
  - Mill Creek
  - Money Creek
  - Duschee Creek
  - Willow Creek (fish)
  - Crystal Creek
  - Wisel Creek (inverts)
  - Upper North Branch (fish)

Supplemental Information - DNR staff has identified the following supplemental information which may be of value during the Root River 1W1P planning process:

- The DNR Division of Fisheries has several *Fisheries Stream Management Plans* for designated trout streams for most of the 12-digit or smaller HUC watersheds within the Root River Watershed and the Mississippi River – Reno Watershed. A master list of available management plans and .pdf documents will be made available on the Root River Watershed and 1W1P Area SharePoint site, or can be provided upon request.
- *Strategic Plan for Coldwater Resources Management in Southeast Minnesota (2004-2015)* which sets the direction for the long-term management of coldwater resources and trout fisheries in southeast Minnesota will be update this year. A copy of the current plan can be accessed here: http://dnr.state.mn.us/input/mgmtplans/troutstream/index.html.
- The *Fisheries Long-Range Plan for Trout Stream Resource Management in Southeast Minnesota 2010-2015 and Progress Report* is a means to effectively and efficiently allocate staff resources and funds to implement the goals documented in the *Strategic Plan for Coldwater Resources Management in Southeast Minnesota*. A copy of the long-range plan can be accessed here: http://www.dnr.state.mn.us/areas/fisheries/lanesboro/trout_semn_mgtplan.html.
- The *Minnesota Department of Natural Resources 2015-2025 Strategic Conservation Agenda* was recently completed to set strategic direction for natural resources and measure conservation results. A copy of the full report can be accessed here: http://www.dnr.state.mn.us/conservationagenda/index.html.
- *Minnesota's State Wildlife Action Plan: Tomorrow's Habitat for the Wild and Rare* which identifies key habitats and priority conservation actions for sustaining Species of Greatest Conservation Need (SGCN) populations for future generations is currently being updated. We anticipate the updated action plan will be completed by September 2015. A copy of the most current action plan can be accessed here: http://www.dnr.state.mn.us/cwcs/index.html.
- Regarding the topic of grazing in riparian areas, two research studies conducted in southeastern Minnesota suggest that soil, vegetation, and rotational grazing at varying degrees of intensity can

produce desirable ecological and economical effects to influence stream channel stability and aquatic life. Citations to both articles are provided below:

- Magner, et al. "Grazed Riparian Management and Stream Channel Response in Southeastern Minnesota (USA) Streams." Environmental Management Vol. 42 (2008): 377-390.
- L.A. Sovell, et al. "Impacts of Rotational Grazing and Riparian Buffers on Physicochemical and Biological Characteristic of Southeastern Minnesota, USA, Streams." Environmental Management Vol. 26, No. 6 (2000): 629-641.

DNR Watershed Priorities - DNR Staff (Region 3 & 4) are currently in the process of meeting with each Division (Ecological and Water Resources, Fish & Wildlife, Forestry, Parks & Trails and Enforcement) to develop ***DNR Watershed Priorities*** for each 10-digit HUC watershed within the Root River 1W1P planning area. Our goal is to identify DNR's Divisional priorities in order to encourage collaborative work efforts. We anticipate the DNR Watershed Priorities will be integrated into the MPCA WRAPS for the Root River Watershed. We hope to have this information completed by April or May and are optimistic the result will add value to both the WRAPS and the Priority Concerns Watershed Implementation Plan.

The DNR acknowledges all of the hard work and collaborative partnerships that have already been established within the watershed and offer our continued support. Thank you for the opportunity to provide comments and we look forward to working with you during the Root River 1W1P planning process.

Please contact me at (507) 206-2851, or nicole.lehman@state.mn.us if you have any questions or are looking for additional information.

Sincerely,

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Enclosures: DNR's Desired Watershed Conditions

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MNDNR'S DESIRED WATERSHED CONDITIONS

Vision

Healthy watersheds with biologically diverse and connected ecosystems function to produce clean water. Healthy watersheds also produce other ecosystem services and products that contribute to the state's economic and social vitality (e.g., habitat, fish, wildlife, timber, recreation). DNR uses a **five component framework** to describe watersheds as systems. This framework is based on the interplay of biology, hydrology, geomorphology, connectivity, and water quality. **Systems solutions** – those that address the root cause of the problem and which result in multiple benefits – protect and restore ecosystem functions and increase long term ecosystem resilience in the face of more extreme weather events associated with a changing climate, land use, and other stressors.

Clean Water Goal

Zero impaired waters. Healthy watersheds that provide enough clean surface water and groundwater to meet long- term human and ecosystem needs.

Desired Watershed Conditions

To reach the clean water goal, DNR's water quality work will focus on the following aspects of healthy watersheds:

A) **Upland areas** are strategically protected, restored, or enhanced so that hydrologic processes (storage, infiltration) deliver clean surface water and sustainable groundwater supplies.

B) **Floodplains and riparian areas** are connected (to their respective waterbodies, each other, and upland vegetation), composed of appropriate vegetation, and function to filter pollutants and prevent erosion.

C) **Hydrologic processes** (e.g., storage, infiltration, and conveyance) are appropriate for a given watershed's setting (e.g., precipitation, soils, slopes, natural vegetation) so that watershed responses (e.g., peak flows, annual water yield, low flows) do not result in disproportionate floods, drought, or pollutant loading that degrades rivers, lakes, streams and wetlands.

D) **Use of groundwater is sustainable** and does not harm ecosystems, water quality, or the ability of future generations to meet their needs. *(From DNR's Groundwater Management Strategic Plan)*

Approach

DNR provides **information, analysis, recommendations, and assistance** that help federal, state and local partners address watershed restoration and protection **according to the Minnesota Water Quality Framework.**

We **integrate** with other DNR work to achieve multiple benefits for clean water and other natural resource management goals. We do this by building upon our existing data collection and analysis, regulatory programs, land management activities, and outreach to support the outcomes stated below.

The type and location of strategies needed to reach watershed restoration and protection goals will be grounded in science based on watershed assessment data and local experience. Specific approaches will be developed for watersheds with federal, state, and local partners. **We acknowledge that success depends, in part upon good local engagement.**

Watersheds: a note about scale

A **watershed*** is an area of land that drains to a common body of water. Watersheds can be defined at multiple scales, from major river basin (Minnesota has 12) to catchments as small as 2 acres (currently over 10,000 delineated in the state). The scale at which we assess and manage watersheds must match the scale of the processes controlling the phenomena of interest.

Strategies

In order to achieve the desired watershed conditions, DNR's water quality work will promote or support the following strategies through our data collection, analysis, recommendations, regulatory programs, and assistance.

A) **Upland areas** are strategically protected, restored, or enhanced so that hydrologic processes (storage, infiltration) deliver clean surface water and sustainable groundwater supplies.

1. **Lands within degraded lake and river watersheds** are **strategically protected and restored** to reduce risk of further impairment and improve water quality.

2. **Intact functioning ecosystems are protected** to ensure they don't become pollution sources, and to maintain their current capacity to store, infiltrate, and filter pollutants from surface water.
    a) Watersheds have **enough undisturbed vegetation** to prevent excessive pollutant loading that could degrade water quality.
    b) Sites of biodiversity significance, mapped native plant communities, rare species, and priorities in statewide landscape plans (e.g., prairie plan, State Wildlife Action Plan) which enhance watershed functions that deliver clean water are **protected and connected** to one another and to riparian areas.

3. **Land altering activities** (agriculture, forestry, urban development, and mining) that generate polluted runoff and other hydro-modifications **use best management practices** adequate to prevent degradation to downstream receiving waters.

B) **Floodplains and riparian areas** are connected (to their respective waterbodies, each other, and upland vegetation), composed of appropriate vegetation, and function to filter pollutants and prevent erosion.

1. Streams and rivers have **access to their floodplains.**

2. **Floodplains are connected**; roads, trails, and other development projects are designed to maintain or re-establish connectivity.

3. Existing **riparian vegetation is protected and managed** to maintain its long-term health and resilience to change. Sites of biodiversity significance, mapped native plant communities, rare species, and priorities in statewide landscape plans which enhance watershed functions that deliver clean water are **protected and connected** to one another.

4. Ditches are designed with **floodplain benches.**

5. **Degraded riparian areas** of streams, lakes, rivers, wetlands, and ditches are **actively managed** to improve species composition and vigor of plant communities.

6. For streams and rivers, **perennial vegetation in the meander belt and the wider floodplain** is protected and re-established wherever possible; development is removed from or kept out of these dynamic systems.

7. **Best management practices** for land altering activities in floodplains and riparian areas allow reasonable uses while maintaining their structure, function, and composition.

C) **Hydrologic processes** (e.g., storage, infiltration, and conveyance) are appropriate for a given watershed's setting (e.g., precipitation, soils, slopes, natural vegetation) so that watershed responses (e.g., peak flows, annual water yield, low flows) do not result in disproportionate floods, drought, or pollutant loading that degrades rivers, lakes, streams and wetlands.

1. Excess **runoff volume is reduced** by increasing storage, infiltration, and evapotranspiration. Reductions are adequate to help achieve identified water quality goals.

a) **Soil health** is improved by increasing organic matter to retain more water.
b) **Wetlands** are strategically restored or improved to reduce runoff volume.
c) Water is strategically held on the landscape. **Off-channel impoundments** are strategically sited and operated to reduce total runoff volume and peak flows.
d) **Ditches** that no longer serve their original purpose are abandoned to reduce runoff.
e) **Agricultural tile drainage systems** are designed and managed to temporarily store and infiltrate water, increase evapotranspiration, decrease nitrogen loading, and decrease need for irrigation. Open surface tile intakes should be designed and/or retrofitted (e.g., French drain, raised inlet, buffer) to treat agricultural runoff, especially sediment.
f) Effective implementation of **best management practices** to manage water where it falls for **agriculture** (e.g., minimum till instead of conventional tillage, conversion of critical areas from row crops to perennial vegetation) **urban stormwater management** (e.g., Low Impact Development), **forestry** (spatial and temporal cutting patterns, harvest BMPs), and **mining** (example) are applied to reduce runoff volumes to help achieve water quality goals.

2. **Timing of runoff is managed** to balance peak flows and base flows within an acceptable range of variability for that watershed.
   a) **Agricultural tile drainage** is actively managed to alter timing (and volume) of drainage water reaching stream channels (e.g., wetland treatment systems, controlled drainage, saturated buffers, bio-reactors).
   b) Agricultural **water detention impoundments** are strategically located and sized.
   c) **Urban stormwater ponds** are appropriately located and sized when LID approaches are not feasible.

3. **Watercourses are stable;** stability means that a channel does not aggrade or degrade because it is able to transport the water and sediment from its watershed and maintain its dimension, pattern, and profile.
   a) Groundwater sources of **base flows** are protected.
   b) **Bridges and culverts** are designed to ensure bedload transport and adequate access to floodplains, and to minimize human constraints on stream systems.
   c) **Grade controls** are used appropriately.
   d) Restored and rehabilitated reaches of stream use **natural channel design principles** based on appropriate reference conditions.
   e) **Ditch systems** have stable channels (meander pattern and floodplain bench) to provide water quality benefits.
   f) **Dams and other barriers** are removed, modified, or designed to minimize human constraints on stream systems.

g) Sites of biodiversity significance, mapped native plant communities, rare species, and priorities in statewide landscape plans are **protected and connected** to one another.

4. **Lakes and wetlands** are supplied with quantities of runoff and groundwater so that amplitude and frequency of water level fluctuations support biotic integrity and shoreline stability. In – lake processes assimilate pollutants from watershed runoff without leading to impairment.
   a) **Lake outlets**, where they exist, are able to maintain lake level fluctuations consistent with sustainable hydrologic conditions in the watershed.
   b) **Water levels in degraded shallow lakes and reservoirs** are managed to improve water quality.
   c) **Biological processes** associated with in-lake nutrient cycling are managed to prevent or address impairments (e.g., common carp, curlyleaf pondweed).
   d) Sites of biodiversity significance, mapped native plant communities, rare species, and priorities in statewide landscape plans which enhance watershed functions that deliver clean water are **protected and connected** to one another.

5. **Artificial surface (ditches) and subsurface (tile) drainage systems** better designed and managed.
   a) **Systems that no longer serve their original purpose** are abandoned.
   b) **Side inlet controls** are used to reduce sediment loading from areas with channelized flow.
   c) Side slopes and bottom width are properly designed; use of **two stage ditch design** maximizes stability and other benefits (e.g., nitrogen removal) where appropriate.
   d) **Outlets** are designed and located to prevent downstream channel erosion.
   e) **Maintenance activities** on artificial channels consider opportunities to use natural channel design principles.
   f) The **adequacy of natural channels** is determined prior to allowing increased artificial drainage.