Appendix H: Water – Improved Outcomes

As a result of the Issue Identification Panels, there were **five goals** that emerged in the area of water that had to do with improving outcomes overall.

These five goals were voted on by respondents who participated in the subject matter expert survey.

Table 1. Percent of subject matter experts who prioritized each goal in the area of Water – Improved Outcomes

		Count	Percent selected
Goal 1.	**Minnesota is prepared for water volume changes and extreme runoff events resulting from climate and land use changes.**	**60**	**37%**
Goal 2.	All Minnesota water meets quality standards and there are zero impaired waters in Minnesota.	39	24%
Goal 3.	All Minnesota waters show biologic indicators of strong aquatic health.	34	21%
Goal 4.	Storm water across Minnesota is managed through effective, innovative, and long-lasting approaches.	19	12%
	Other	5	3%
Goal 5.	Risks for water re-use in Minnesota are better understood and mitigated where needed.	4	2%
	Grand Total	**161**	**100%**

Based on feedback received from the subject matter expert survey, Goal 1 was revised to read as: *Minnesota is prepared for water volume changes, **both excesses and shortages**, and extreme runoff events resulting from climate and land use changes.*

Subject matter experts who participated in the Prioritization Panel were asked to review strategies recommended by survey respondents relating to Goal 1. All of the strategies submitted by survey respondents are included in the next section below. Panel participants were invited to revise strategy ideas or come up with their own, and as a group they prioritized five strategies that would be necessary to achieve the goal. Those five strategies, in no particular order, are:

- Research and demonstrate market-based policies that are economically viable and help pay for the land use and conservation practices needed to achieve water resources protection, especially in agricultural areas.
- Research effective water use scenarios to identify improvements needed to ensure the state's water resiliency and sustainability (including modeling water scenarios, managing water on land, optimizing use to prevent overuse of groundwater, improve water reuse, and waste water management).
- Identify and promote workable, holistic, multi-benefit, diverse, and viable (economically and socially, etc.) solutions for storing more water on the land, through both engineered and natural solutions targeted at critical areas.
- Support cities, counties, and watershed districts with developing climate resiliency and adaptation plans, and processes for funding and implementing those plans.

- Compile existing research, identify gaps, and develop research to quantify land use and land cover changes, in order to identify restoration and protection needs to achieve sustainable water systems.

The following provides the full list of strategies for the area of **Water – Improved Outcomes** that were recommended by subject matter experts who responded to the survey. They are organized by goal.

Please Note: These strategy recommendations are provided verbatim, as they were submitted through the survey. Therefore, they may contain errors or typos. They have also **not** been vetted for alignment with the ENRTF mission or charge, and may therefore not be allowable strategies for the ENRTF to pursue or include in its strategic plan.

Goal 1 – which 37% of survey respondents prioritized: Minnesota is prepared for water volume changes and extreme runoff events resulting from climate and land use changes.

- Research ideas to help manage volume changes and runoff events.
- Better quantification and mapping of current water bodies sediment loading and water capacity
- Research
- Research exploring both climactic and land use impacts. For example, increased annual precipitations coupled with expanding drain tile installations.
- Research on adaptation to potential climate change needs to be further supported, because it will be a lot of work.
- Develop comprehensive analyses to understand where runoff is likely to become more sever and develop multiple strategies to minimize this threat.
- a subset of previous response, specifically better define what the excesses will be, implications for infrastructure, forestry and ag production, and pollution. Previous question response: Education and supportive applied research on climate change limits/ temporary excesses on surface water. Key contributors and what it will take to reduce their role in surface water contamination.
- funding for continuous monitoring
- education and demonstration are critical
- Policy changes surrounding tiling
- Drastic measures may be needed to address the results of climate change. LCCMR should take a look at what circumstances would be acceptable for bending its standards when justifiable.
- Continue to fund projects which seek to understand drainage, tile and wetland basin protection.
- Clarify responsible entities for management of the volume and flow in rivers and lakes.
- Need to prepare for extreme events including drought potential--water storage solutions, recharge, erosion
- Adequate funding for development of runoff & climate data collection and assessment. These data would be used for evaluating storm events and for the revision of flood and storm frequency
- Encourage projects that focus on climate change resiliency
- Research and demonstrate market-based policies to would help pay for the currently cost prohibitive level of conservation practices (in Ag areas) required to achieve this goal.
- Provide more research, demonstrations and outreach related to preparing for climatic forecasts of increasing runoff events and storing more water on the land to reduce flashy flows. Work with stakeholders to strategize workable, affordable, diverse solutions for storing more water on the land.
- Changing the socio-economic drivers to favor minimizing runoff and maximizing water storage
- research funding to help predict expected changes with the goal of mitigating effects and strategies for land use change (i.e. agricultural impacts)

- Cities, counties, watershed districts have climate resiliency and adaption plans, and a process to implement those plans.
- Demonstration with research in various scales (landscape to pipe). Water quality should be part of discussion as impacts of extreme runoff events
- Develop Best Management Practices for water volume changes/extreme runoff events that insure long-term improved water quality and quantity
- Increased rainfall is overwhelming all the systems (ag, urban, forestry) and is causing not only impacts to water quality, but is destroying infrastructure. We need to learn to deal with the new normal and not expect rainfall patterns of 50 years ago to come back.
- Develop "priority watershed" climate adaptation demonstration projects focusing on the most at risk for climate change watersheds based on U of M downscaling modeling data.
- Climate change precipitation model, followed with demonstration/education of impacts and implementation/education on BMPs with specific greenspace components. Targeting areas: agricultural land, municipalities, etc.
- Include both excesses and shortages of water.
- Funding is needed to plan risk management strategies in different regions of the state based on current trends and future forecasts.
- Interface of water quantity and quality research with weather and climate resources - currently there is limited funding for person-time to bring existing data together across the diverse landscapes of MN.
- Again, education and outreach in a fun and engaging way rather than using scare tactics, but the impacts of climate and land use change on water is not well understood.
- Use predictive climate and flooding models (100 yr, 200 yr, 300 yr flood events etc) to see where the greatest needs will be geographically and figure out how to fund restoration projects along water bodies and waterways, buy up critically threatened properties along lakes and rivers. It is nearly impossible to choose between these. #2 and #3 are the most critical, however. To have #2 happen, you would already need to have dealt with #3.
- Research focused on quantifying threshold land use and land cover changes on changes in water quantity
- large area modeling to provide guidance for future infrastructure projects
- Urban and rural BMPs
- Research into effective water use scenarios to define improvements needed to ensure State's water resiliency. This includes modeling water scenarios, managing water as it comes to the State's land in increasing intensity and volume, optimizing use to prevent over use of groundwater resources, improving water reuse and wastewater management processes.
- I'm an aquatic ecologist; I do my research on impaired waters and biotic indicators. But I did not chose either of those goals because I think the water volume changes are more threatening to the water future of many areas in Minnesota. Meeting this goal will be very difficult. We need good research on innovative options for mitigating extreme events, preparing our population for these, and getting everyone to work on this mitigation.
- Laws and rules governing various agriculture programs get aligned around keeping water on the ground, rather than sending it to creeks, rivers and lakes via tile and ditch systems. e.g., FSA / USDA rules for CRP lands allow retention of water by county ditch authorities, even though wetland standards may not be met.
- support the purchase of land that can meet demand for more parks and trails in Minnesota AND at the same time help mitigate flooding impacts to towns and cities, etc. trails & park infrastructure would be designed to withstand flooding or be easily cleaned up after an extreme runoff event
- We need to keep more water on the ground, not running off. Wetland restoration
- Go big picture--next generations are already on board, for most part, about environmental issues. Tie past and current volume changes is relevant and meaningful

- All of the above goals are important (meeting water quality standards, and strong aquatic health), but to meet all of these goals stormwater systems need to be designed to accommodate volume changes and extreme runoff events. Research is needed into 1) projected water volume changes and storm events, 2) the design of stormwater approaches in changing hydrology, and the impacts of changing hydrology on water quality standards and aquatic health
- Prediction and mapping for the future
- Highlight examples of the adverse consequences of runoff events across MN - these examples should be of regional relevance.
- data collected for the purpose of understanding the science, not for meeting regulatory requirements
- monitoring and evaluation can't be left behind
- Education about wetlands
- Consolidate knowledge of flood levels and flow patterns within one place and provide access to decision makers.
- Provide targeting funding for water storage, particularly in the high loading Minnesota River Basin. Funding should include both engineered (wetlands, storage ponds, multipurpose drainage management) and technical and financial support for management (soil health - cover crops and tillage changes).
- Research and demonstration of improved water management
- Developing water storage in agricultural areas that can have multiple benefits is going to be a challenge and more research and demonstration of new techniques will be needed to fully be prepared to address climate changes and increased rainfall.
- Currently, there are perceived barriers to working on issues of future conditions that include changing climate and weather. In order to predict future water conditions, we should openly consider climate change and how this will effect the more extreme runoff events or even the largest annual events tied to snowmelt. We also have to consider landscape changes through land cover shifts and increased drainage infrastructure.
- Most of what we can change that will have impacts on water outcomes is related to land use changes and by what we regulate and permit and how we manage the changes. Climate change research predicts that MN will receive more precip yet we are converting more land from grassed or forested cover to conventional ag or to mining which will compound the issues with increased water volume.
- High resolution monitoring of land use and landcover trends to identify regions susceptible to water volume changes
- Attention to flood prone areas...limit development
- We need innovative solutions that involve all aspects (research, policy, outreach to the public). In my opinion, this will be a huge challenge that we must tackle to have a secure water future and enough water to continue farming and have drinking water wells, while not at times being swept away by large floods.
- Increase protection and restoration of agricultural land in targeted areas to increase storage of water on lands through restoration of historical wetlands, improve wildlife habitat and reduce runoff to creeks, rivers and lakes.
- identify land along streams, creeks, and rivers (or shallow wetlands & large areas that were consistently flooded the last five years) that has formerly been enrolled in CRP and work with farmers to PURCHASE this land for flood mitigation and wildlife habitat/corridors (& public access/hunting).

Goal 2 – which 24% of survey respondents prioritized: **All Minnesota water meets quality standards and there are zero impaired waters in Minnesota.**

- Improving the quality of effluent from point-sources and the quantity of discharge from non-point sources are two means to get closer to toward that is goal. To do so, continue monitoring for ambient water quality,

measuring against standards, establishing effluent limits where necessary, and incentivizing improvements through bonding recommendations for capital investment.

- Broad education efforts to advise the general public of the condition of their local ground and surface waters and the sources of pollution responsible for impairment. Make concerted efforts to educate elected officials and public servants and provide assistance with designing local and state regulations that carry enough authority to directly address the issues.
- I don't even know where to start. This is obviously the ultimate goal - but probably unrealistic.
- This is the correct goal. Again education and political will are needed.
- Protect/buy the land surrounding the water bodies (focus on headwater ecosystems) so they are natural buffers
- Standard definition. Human, agriculture and wildlife standards may be different and overlap. Work on defining how those interactions and water used will be key to implement water management practices.
- Research, education and continued citizen involvement in doing AIS testing and reporting. I think all of these are important so it is really hard to choose.
- This is a big one; I think within the purview of the ENRTF it's a combination of measurement and education.
- Lots of research
- see previous
- This seems like an ambitious goal, but I like it. The first thing I would like to see is a definition of what 'clean water' is (i.e. where do you draw the line). This may already exist, so in that case this would be an education goal (i.e. spread the word).
- Provide education and information to help people better understand their local water resources. The Watershed Health Assessment Framework created by MN DNR is an incredible tool that is available for folks to use to explore their local watershed. We need something simple, like a water quality threat sign for each water body (like the fire threat signs with Smokey Bear that the forest service uses) to show folks how their local waters are impacted daily by storms, runoff, and pollution.
- Research, infrastructure investment, policy, education--this is critical.
- Aquatic life standards are established and management actions are taken using statutes and local land use authority.
- establishing agriculture systems that don't rely on fossil fuel derived chemical fertilizers (requires changes in food system and markets)
- This one is ok if the effect of water volume/extreme runoff is included in it (i.e., #1 and #3). Goal of zero impaired waters unlikely to be met, but worthy to strive for. A important strategy for this is monitoring.
- I think we need to test all waters and keep testing to understand where we are now. This could be both education and demonstration
- Continued focus on Water Watershed One Plan efforts and funding to implement plans
- demonstrating the ability grow agricultural products without degrading surface or groundwater quality, soil health initiatives widely adopted across the state, cover crops that evapotranspirate water rather than having to drain water through a tile or ditch, more precise nutrient management requirements in the most sensitive areas
- Within each watershed in Minnesota, determine what are the major sources of impairment on each watercourse and make that information publicly available
- Support policy and fund strategies that affords the greatest protection
- Implement plans for pollutant source reduction
- research: see before, incentive approaches for reducing NPS
- Address the impacts of train tile on water quality/quantity.

- Increasing low-cost treatment solutions through research and small-scale pilot testing of emerging treatment technologies. We should fund small-scale and side-stream treatment - greater than bench-test scale - to better understand the new and emerging technologies that might use biological- and membrane-types of treatment.
- I'm not a huge fan of excessive government regulation; but we obviously need to move forward with more 50-foot buffer types of requirements. Businesses and people are just not going to make changes unless some of them are forced to - I hate to say it, but it's true.
- At some point we may need to use regulations and fines more heavily to achieve this goal. We need to increase enforcement and make an example out of those who pollute our waters; like the Wall of Shame that the Conservation Officers use to deter poachers.
- Minnesota establishes zero impaired waters as not just a goal, but with a defined date and well defined incremental requirements to achieve this goal. this c
- Identify best practices that can be done to reduce our impact on water quality.
- Lending institutions that incentivize and encourage the above strategies rather than current practice that encourages the opposite.
- Identify locations and strategies that have lowest cost and biggest reward to target with funding and implementation of protection and prevention and clean up
- Support research to identify pollutant sources and how to reduce them
- Provide recommendations for stream crossings that reflect the changing nature of stream volatility.

Goal 3 – which 21% of survey respondents prioritized: All Minnesota waters show biologic indicators of strong aquatic health.

- research
- I think you're on track with the WRAP and one water one plan initiatives
- Completion of and implementation of strategies in WRAPS.
- Devil is on the details here: 'strong aquatic health' and 'zero impaired waters' seem to be similar outcomes. I chose the former as 'strong' seems to show more resolve than meeting some minimum standard that can be changed without scientific support.
- With early rounds of watershed planning and programming, efforts including research, education, measurement should continue on impaired waters.
- Protect healthy bodies of water and aquifers.
- retain more water on the land, restore natural nutrient processing mechanisms such as wetlands and organisms that filter and process organic matter and other pollutants
- State pays for buffer zones along waterways
- Advance and enhance data collection, management, analysis and delivery sufficient to have biological indicators that represent the full range of aquatic biological systems.
- Develop practices for individual homeowners as well as municipalities to achieve biological water benefits when making needed infrastructure changes. For example, sizing culverts for optimal fish passage as well as drainage. That gets at goal number 2, but in a more holistic way.
- Provide funding for lake and river assessments of biologic indicators.
- Wild rice bed restoration
- Tighter restrictions and improved measurement of chemical release by industry, residential areas and farm chemical use. Stronger enforcement.

- Minnesota needs systematic ways for measuring biotic (and abiotic) health of our aquatic systems that will continue in perpetuity, both for baseline data and also to recognize downward trends when they begin and not when it is already too late to remedy.
- Research
- Intensive water quality monitoring
- research into what indicators are important, what alternative stable states may exist, and how to move among them if needed.
- education
- focus on voluntary, not regulatory
- Top-down enforcement strategies coupled with incentive-based and knowledge transfer strategies with landowners/local governments.
- Education, research, and monitoring are all methods by which to improve our waters.
- Partnerships and community involvement should be emphasized, creating an "ownership" to develop resolving those issues.
- Restore free flowing streams that allow for fish movements in and out of lakes and tributaries, reintroduce lost species groups that restore ecological resilience.
- Provide incentives, such as water banks, for farmers and others to keep water on the land, slow the flow, and enhance biodiversity.
- Educate about and fund projects that restore shorelines of rivers and lakes to appropriate, locally sourced native plant communities.
- Fund projects that show water quality improvement as indicated by quantity or condition of bioindicator fish and invertebrate species.

Goal 4 – which 12% of survey respondents prioritized: Storm water across Minnesota is managed through effective, innovative, and long-lasting approaches.

- Storm water causes more pollution than we think, managing stormwater will reduce run-off from many sources.
- continued monitoring and measurement of new storm water treatment technologies
- Have funds allocated to stormwater specific projects.
- focus on storm water management that conserves runoff locally while protecting local waters from pollutants commonly carried by storm water runoff
- push wetlands as methods for handling ag field runoff
- Buffers and rain gardens of native vegetation that filter contaminants
- Support development of innovative storm water runoff solutions.
- Green infrastructure investments
- Allow the use of credit trading for water quality to help MS4 communities.
- fund replacements and alternatives to field tiling.
- Smart salt, fertilizer, and pesticide application training workshops and public education campaigns
- Support projects that develop infrastructure for water reuse in MN.
- Support for forestry, forest businesses, and forest investments across rural and urban landscapes

Goal 5 – which 2% of survey respondents prioritized: Risks for water re-use in Minnesota are better understood and mitigated where needed.

- Research on new ways to address the nutrient pollution concerns
- Advanced treatment education
- gray water demonstration projects
- Education
- Research on how to implement some technologies into the field, instead of just working in the lab

Other goal ideas offered by subject matter expert survey respondents for the area Water – Improved Outcomes:

- Better, more efficient use of water... reducing groundwater use... improving quality of groundwater (protecting public health)... a more holistic approach to wastewater treatment.
- Prevention and management of aquatic invasive species are better understood.
- Agricultural communities and policies are focused on reducing their negative impacts on our states water resources.
- All water outcome goals in the sentences above are fundamentally related to climate and people, and are all inter-related. Understanding short and long-term impacts of climate and people on water is critical.
- All for the above

Other strategy ideas offered by subject matter expert survey respondents for the area Water – Improved Outcomes:

- Increased research and collaboration.
- Applied research funding that targets development of solutions for all of these goals
- Added funding for successful research projects to implement identified solutions