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EQB Water Availability Project
Technical Focus Group
Survey #1 Results Compiled

Water Availability and Sustainability

<u>How do you define water availability?</u>

- I that that water availability refers to the ability to withdraw water at a given rate and of at least a given quality from a specific resource.

- Available water is ground or surface water that can be readily accessed and produced.

- Availability is the water that an aquifer can provide (specific yield).

- Water availability is the ability to extract enough water from the hydrologic cycle in amounts sufficient to serve human purposes.

- Water availability refers to the existence of water and the ability to acquire/extract that water through feasible means. We often think in terms of ground water, but water availability should be broadened to include ground water, surface water, storm water, waste water, etc.

- Water that is available as a resource = renewable water plus reserve = storage water.

- Availability is related to the volumes of water in storage and to flow into and out of aquifers.

- The amount of water available from surface or ground water sources.

- the amount of usable water remaining in a system, or the rate at which it may be removed at any one point from the system, after meeting the needs of, or without adversely affecting, the ecosystem and current human users

- Focus on groundwater - That groundwater which is accessible by drilling and is economical to pump to the surface provided the water is used in a reasonable manner, extraction does not impact (drain) existing surface water bodies, is extracted from the ground in accordance to the regulations and laws of the state, and preserves existing groundwater quality.

- Water availability is the amount of water that may be withdrawn in a given location and time for human use.

- Availability is the amount of water that is available for use. This is often calculated as the amount of water that is stored in an aquifer, however that is much more than can actually be withdrawn from an aquifer.

- This would be the amount of water that could be extracted from a water resource entity. For instance, from an aquifer it would be the amount that could be withdrawn from the porous structure, which would be an amount quite a bit less than the porosity since a substantial amount of water is help by the porous structure by capillary action and is not available to economical extraction methodologies.

- Water Availability means that the water can be removed from the ground. No matter whether it is suitable for a specific purpose or that its use would impair another's use or an threaten an ecosystem's stability.

- Water is of an acceptable quality and could be obtained in a reasonably efficient manner without interfering with the needs of the ecosystem or the needs of people currently utilizing the water.

- Water volume and flow to meet a user's need within economical and quality constraints.

How do you define water sustainability?

- I think that water sustainability refers to the capacity of a resource to provide water of a specific quality at an expected rate such that other users are not affected. Other users include aquatic life.

- Sustainable means use that maintains aquifer and surface water levels and quality indefinitely. This requires a rate of use that is balanced with atmospheric or other sources of input and must also account for the fate of ground water after its use.

- Sustainable water use is the use of water to provide for the needs of society, now and in the future, without unacceptable social, economic, or environmental consequences.(includes water quality issues)

- Water sustainability is the extraction of water from the hydrologic cycle for human purposes that is balanced in such a way to minimize ecological impacts and depletion of water resources for future generations of humans.

- Sustainability refers to a volume or flow that can be maintained indefinitely without harming the resource from which the water is coming or the ecosystems depending on the resource (e.g. wetlands, fens, fish, etc. that we often discuss). It is important to note that water sustainability does NOT depend on the water's ultimate use. Sustainability is defined by hydrogeologic conditions, climate and quality.

- Water that is only renewable that can be used for inter-generational term and must be shared by nature and humans.

- Volume of water that can be used, on a long term and sustained basis, given acceptable social, economic and environmental consequences

- The amount of water available from surface or ground water sources that can be withdrawn without causing long-term depletion of the resource.

- Managing water availability in a manner that meets current human and ecosystem needs while not compromising the ability of future users, both human and ecosystem, to meet their needs or have their needs met

- Focus on groundwater - Groundwater sustainability is use that does not result in a permanent reduction of the piezometric and water table levels, preserves existing surface water bodies, preserves existing groundwater quality, and provides water resources for future generations.

- Water sustainability is the long-term ability of the water resource (defined spatially in some way; either at the state or local scale) to meet human and ecosystem needs in the context of ongoing changes, such as climate change, urbanization, and agricultural development. Sustainability is always a 'moving target', rather than a steady state, and progress towards sustainability should be frequently re-evaluated.

- Sustainable use of ground water means use that does not compromise the availability and quality of ground water in the aquifer, and does not harm other entities that depend on the ground water, such as rivers, lakes and wetlands.

- This refers to the water that is replenished on a continuous basis to the water resource entity. So for aquifers, it is the water that is recharged and eventually 'discharges' someplace. The discharge could be at springs, at well locations, seeps into rivers/lakes, or uptake by phreatophytic vegetation.

- Use of water that does not impair the natural resource services it provides to the ecosystem. A "do no harm" kind of stance. Such a principle does not focus on human uses and it is not known if it is even possible.

- The water source can be utilized in such a manner that the water is continually replenished or that enough water remains within the source to continue meeting the needs of the ecosystem and people either indefinitely or for a prescribed period of time.

- Capacity of a water system to provide a viable water supply without causing detrimental impact on the resource.

Are availability and sustainability different?

Yes	16 responses
No	0 responses

If so, how?

- Water availability refers to the capacity to supply water at a specific rate, without respect to affecting other uses.
- Available is short-term, sustainable is long-term.
- Sustainability may further limit a limited resource.
- Water availability does not necessarily consider impacts on ecosystems and/or future human generations.
- See the definitions. Available water does not mean it is sustainable.
- The availability definition implies that a resource may decline or be liquidated and in the past has applied only to human needs. Sustainability requires that consumption will not cause a decline or liquidation of freshwater resources. The use of this resource must be balanced between nature and humans for many generations to come.
- See the definitions above
- "Availability" does not factor in the long-term consequences of depletion. Just because water is available for withdrawal from a resource at a given rate today does not necessarily mean that rate can be sustained indefinitely into the future.
- I consider them closely related: "availability" is what must be managed to ensure "sustainability."
- Availability is a condition of the system based on physical and economic parameters and regulations whereas sustainability is a limiting factor imposed by prudent planning for the future
- Sustainability should be a broader definition that includes non-human water use and places water resources in the context of the long-term, dynamic systems in which they are embedded.
- Sustainability implies long term availability - over the decades, not just this year - and also that the quality of the ground water remains unchanged.
- Availability means you are allowed to draw down the storage of the water resource irrevocably, while sustainability means that the water resource cannot be drawn down in

this manner. For sustainability you use only the renewable portion of the resource, and not the storage. One could modify 'available' with 'sustainably', that is, 'sustainably available' water to give a phrase that means the same things as 'sustainability'.

- Water availability evaluates whether you can get the water out of the ground in useful quantities. Sustainability evaluates whether you should.

- Sustainability is the temporal version of availability.

- A function of time. Adequate water can be available to meet the users needs on a short term basis. Long term use of the resource may exhaust it.

<u>Should potential climate change impacts be considered in what we do?</u>

Yes	15 responses
No	1 response

<u>If so, how?</u>

- Maybe. It might be worthwhile to examine a few potential scenarios. But it is a pretty wide-open field with endless possibilities.

- Atmospheric delivery of precipitation is a major component of the water cycle. If that component changes, so will the other phases. At this point in time we just need to note that our management goals must adapt to climate change as it happens, or to reliable forecasts of change. I don't think climate change is something we can overcome.

- 1) When assessing whether extraction will impact ecology/posterity, best estimates of changes in the hydrologic cycle should be accounted for as best as possible. 2) The use of greenhouse gas generating technology should be accounted for and, if possible, minimized/offset in the exploration and extraction processes.

- This should be addressed by running potential scenarios for future planning. Also, as climate changes, the water use and permitting systems must be readily adaptable and responsive.

- Climate change will have a tremendous impact on the spatio-temporal variability of water resources. It will have impact on ecological services, land use, economy of the state. We should design the water resources management system in which water use and land use are directly connected. It should first start with assessment of water supply for nature and human and only then the decision must be made on of land use plan.

- Possible effects would have to be assessed with models

- Yes, but I'm not sure we know enough now to predict how climate change will effect long-term precipitation trends. Any standards, thresholds, restrictions, should be able to be modified as our knowledge and predictive abilities increase.

- Build a factor of safety into sustainability management assumptions

- Climate change could present reasons to alter water use regulations and even require a modification to our definition of sustainability. However, if climate conditions continue to place greater demand on our resources we might need to rethink our prioritization of water use and our definition of sustainability.

- Climate change will impact human and ecosystem water use, and water availability for these uses. For example, Minnesota's climate is projected to be wetter (which may decrease irrigation needs), but also warmer (which will increase evapotranspiration, and therefore crop water demand). We don't yet have a good grasp on how these dynamics will develop and interact, so research and monitoring are needed.

- The potential for more frequent and dramatic shifts in the weather and for long term trends of potentially hotter, drier weather must be considered. If consideration indicates that climate change could be an important aspect to the decision at hand, it must be documented and included as one facet of decision making.

- The numbers for estimates of sustainable water supply are determined for a given climatic regime. For instance, one could do it for the climate regime of the 20th century. Those numbers will not apply to a drastically different climate regime because another regime will lead to a different water balance in terms of precipitation, runoff, evapotranspiration, recharge, discharge.

- Monitoring should be increased in locations and in frequency. Trends should be evaluated on a five-ten year basis. Adjustments to protected levels or to permitted volumes should be made every five to ten years.

- I would say "maybe." For decision making at an individual site we don't have climate change data available that will help make a decision on a permit, for example. Climate change impacts on water availability and sustainability could be considered, though, by contingency planning in the event that a water shortage occurs. This could be similar to planning for a drought, but on a longer-term maybe even permanent basis and I believe that we professionals need to delve into this in order to provide individual project proposers with some options.

- Projected changes in water balance and ecosystem within groundwatershed.

What are three strategies for evaluating sustainability?

- First, understand the hydrologic system affecting the resource. Then, assess water flowing through the system. Finally, consider the variability of the water flowing through the system.

- Monitoring can provide empirical evidence of our success in practicing sustainable management. Water balance methodologies can provide estimates of theoretical sustainable pumping levels, but these must be allocated (somehow) to aquifers and users. Compiling usage data and relating it to water level changes is critical. Modeling will be useful when enough geologic and hydrologic information is available.

- A process that involves:
    - Identify Short- and Long-term Water Needs
    - Identify Degree to which Surface Water and Groundwater Resources are Connected
    - Assess Local and Regional Effects of Pumping on Water Availability
    - Assess the Impacts that Existing or Future Land Uses have on Quantity and Quality
    - Identify Areas Where Water Resources are Under-utilized or Under Stress
    - Identify Where Naturally Occurring or Human-caused Contamination Affects Water Use
    - Assess Long-term Impacts that Pumping may have on Water Quality
    - Identify Water- and Land-Use Management Tools for Ensuring Sustainability

- Understand and characterize the true source of water to be extracted. By this I mean when extracting ground water, need to understand which surface water bodies are connected, or acknowledge that fossil ground water is being mined. The converse is true as well - when diverting surface water, connections to ground water must be characterized. Data analysis and modeling are key elements in this strategy. 2) Characterization of ecosystems likely to be impacted by withdrawal/diversion to assess what impact will occur. Field investigation by ecologists/biologists is important for this strategy.

- Quantify what is entering the system as an upper boundary. Quantify what is leaving the system and consider much of that to be sustainably available to humans & ecosystems. Incorporate consideration of quality, because that limits how it may be used and what may be sustainably removed. A system is not sustainable if water removal from the system degrades the quality of what remains to the point that the remaining water cannot meet certain defined uses.

- A fundamental prerequisite to address freshwater sustainability is to recognize the all-encompassing context within which these issues take place. This all-encompassing context includes three pillars: natural system, economic system and social system. To manage the water resources sustainably we must first address the natural system that includes water quality, sustainable supply, withdrawal, consumption, global climate change, etc. The natural system must demonstrate balance and resilience. That balance and resilience of natural freshwater system could be sustained for a long inter-generational term if we will depend only on renewable supply.

- Understand the resource availability and define the acceptable social, economic and environmental consequences

- The following three elements are needed: 1. Evaluate current water use (requires good water use data). 2. Evaluate projected water use (#1 plus demographic data and projections). 3. Evaluate long-term capacity of sources.

- 1. developing and applying the analytical tools necessary to determine if a proposed use would affect the amounts, quality and timing needed by current users, human and ecosystem 2. developing and applying the analytical tools necessary to determine if current users would be affected by any additional uses that may be reasonably expected to occur in the foreseeable future 3. keeping a running record of the degree to which current and reasonably expected future uses are in fact consuming the water available over a long term sustainable basis 4. we need to consider new ways to interpret Minnesota's modified riparian doctrine as it concerns ground water to establish a land-based method of identifying the "reasonable" right to water based upon what the land produces in the local system

- 1. Maintain and improve active monitoring systems 2. Maintain and increase funding for managing and studying the resource 3. Increase knowledge of resource

- First, we need to define both the spatial and temporal scale at which we are evaluating sustainability. We also need to define what would be the unacceptable consequences of non-sustainable water use. For example, is it okay if one or two aquifers go dry, if there is enough overall water in the state? Is it acceptable for water to be withdrawn in a way that affects ecosystems, and if so, which effects are of concern? My understanding is that current state law indicates that *no* negative effects of water withdrawal should be apparent anywhere, which is much more stringent than an overall state budget approach. We should consider that it may be beyond Minnesota's capacity to monitor every ecosystem and human system around the state for unsustainable water use. Given that we don't know exactly how much water is available now and into the future, a modeling approach combined with ongoing monitoring of water resources and ecosystems will be essential. Modeling approaches could help us target regions of the state where more careful monitoring should be performed.

- Modeling, Monitoring, and a combination of both (the best!).

- Based on the definition for sustainability that I gave, the evaluation of sustainability requires the estimation of the renewable supply of water. I would argue that the best way to evaluate sustainability is to base it on historical data, or at least this is the best starting point. this approach involves the use of some data synthesis methodologies. A second way to conduct estimations of sustainability is to use hydrologic model(s) to compute the various relevant components of the hydrologic cycle for the area of interest. I would argue that this second way, as much as I love models, is not as sound as the data synthesis approach since models are always limited by internal unknowns and also assumptions. Of course, explicit hydrologic process models should be used with measured data when the data are available; that is, the model(s) should be calibrated. A model should not be any more complex than the data available for parameterizing the model. One advantage of models is that they can be used to look at future scenarios such as climate change scenarios. These first two methods can be used to develop sustainability maps over areas of various spatial scales and this information can be used for multi-scale planning purposes. A third approach for evaluating sustainability, in this case for ground water resource, is to use pumping tests. This third approach will provide only local information, and to do a complete evaluation it is necessary to measure in detail the effect on connected resources such as wetlands, streams, lakes, and other aquifers. While this third approach is a valuable tool for local decision-making, it should not be used without the benefit (insight) from the larger scale evaluations (data synthesis or modeling).

- Mapping, monitoring, and adaptive permit management - that means knowing the geologic framework well enough to understand the relationships between water use and water level response, expanding monitoring networks for ground water and surface water as needed to have adequate sensitivity in high use areas and using the information thus gained to set limits on use and/or impacts. . Regional studies in aquifer management areas. A refinement of the above. Undertaken with local/regional units of government that could zone for water management purposes. Calibrated models that can guide operations are a result. 3. Ecosystem studies that evaluate the natural resource benefits/services provided by the natural ground water/surface water flow systems in a quantitative way.

- 1) Define the source of interest (for example: a particular aquifer; an aquifer system; or a regional area [political? geographic? geologic?] and depth or depth increments). 2) Conduct aquifer tests (several concurrent tests may be needed depending on #1) based on expected water demand and include surface water monitoring as well as ground water monitoring. 3) Manage the water use accordingly.

- First, recognize that we must base any response on addressing both aspects of the meaning of sustainability: meeting the needs of the present while not compromising the ability of future generations to meet their own needs. Second, understand that our knowledge of hydrologic systems will evolve as more information is gathered, and more stresses put on the system. The watershed characteristics method appears to directly observe system capacities, and should provide the primary basis for estimating those long term capacities. It should be tested and adjusted by various other methods, such as MODFLOW, on a case-by-case basis. Both the short- and long-term elements of sustainability require serious efforts to identify ecosystem needs. We spend a great deal of time and money protecting water quality of surface water systems, but almost nothing to define their flow needs.

- 1. Mapping of the physical groundwatershed-areas of recharge, discharge and documenting use of both the combined surface and groundwater resource. 2. Projection of consumptive use within the resource's boundaries and its impact on water volume. 3. Determining if there are conservation and/or engineering measures that can be employed to improve sustainability based on setting and projected use.

At the June 9th meeting, the focus group was presented with a two-tier definition of sustainability:

- ***Water use that meets today's needs of people and ecosystems; that is, that does not cause conflicts between human uses and that does not harm ecosystem functions, including those provided by habitat or the native plants and animals that depend on that habitat***
- ***Water use that reserves sufficient water to meet the long term future needs of people and ecosystems". This requires us to understand how much of the renewable water resource we use today and are expected to use in the future, after that which we must leave for ecosystems.***

<u>What comments do you have on this definition?</u>

- I'd like to see some recognition of the need for a balance between atmospheric delivery of water and the use and ultimate fate of water we use. I also think we should include a goal of maintaining aquifer levels, because I can't see a positive outcome of lowering aquifer levels. Pumping can be accomplished without lowering aquifer levels if rate of recharge is increased or rate of discharge is diminished. The latter may be acceptable if other sources of water (after use) supplant natural discharge.

- This definition doesn't account for priority use when or if resources become limited. (Therefore, it is not practical and, possibly, not enforceable.)

- Sustainability does not depend on use. Thus, saying that it meets the needs of today's people is incorrect. It is independent of consumption. I would propose starting over on this definition. Both bullets incorporate water use as the foundation, which it should not. Sustainability is defined by the resource, the interaction of the resource in its hydrogeologic setting, the climate, and the needs of protected ecosystem functions. Sustainable water volumes are those water excesses that exist for whatever use society at the time defines as important. Sustainable water can be removed from the system without adversely impacting the quantity or quality of the remaining water resource. Sustainable water can be surface or ground water. We must also look to water reuse and recycling a means for meeting water consumption needs to stay within sustainable parameters.

- The first definition only talks about today's needs of people and ecosystems. That definition does not address the intergenerational term. The second definition is correct in general. However, we MUST put the need for nature first. Human must leave within the means of nature and NOT be above the nature.

- They are not operational definitions because the consequences are not defined

- The definition is good. Determining what is "sufficient water to meet the long term future needs of people and ecosystems" will be a difficult proposition

- It is solid, except that I would acknowledge the effect that water quality may play in limiting water availability.

- This is an acceptable definition, however, we might need to discuss what the definition restricts in times of dire needs (i.e., climate changes affecting food production).

- This definition is good in principle, but it is not specific enough for a state directive. As mentioned above, I believe the temporal and spatial scales at which this definition is applied should be made clear.

- The last sentence of the second part of the two-tier definition is leave room for one to violate the premise of the first sentence and the first part of the two-tier definition. From the second sentence it sounds as if human uses/needs are considered first and then the rest of the water is left for the ecosystems. But if the ecosystems are to be harmed, it is necessary to constrain the human use to limit it so that it will not harm the ecosystem function. If the human need exceeds the amount specified by this constraint, then humans will need to figure out how to re-use the water allocated within the constraint.

- We've got a long way to go before the amounts of water that can be sustainably used are quantifiable under this or any other definition I've seen.

- The first tier addresses water availability, in my opinion, in that it talks of "today." The second one incorporates time and is a better definition of sustainability.

- I think the definition is essential.

- No problem

Standards

If you were in charge, how would the state regulate water use?

- I would assess the value of the resource and impose fees that are at least sufficient to pay for sustainable management of the resource. I would require monitoring of ground water in the subsoil to establish close ties between land use and recharge water quality. Monitoring aquifer levels and quality is necessary, but the future of water quality is dependent on recharge quality and should be monitored much closer to the source of contaminants rather than waiting for the aquifers themselves to show the degradation.

- Establish a standard for collecting and managing data so information can be easily shared between federal and state agencies, local government units, and the public.

- The current system should be adapted. Even though MN is not considered a prior appropriation state, the system really is at its core. That could prove to be a problem in the future. Some modifications I would propose include:
    - online entry of permit information
    - continuous, publicly-available water level measurement data (with QAPP and calibration schedule)
    - more stringent permit reporting requirements (i.e. flags users if they don't report; flags users if they report #s that appear erroneous such as 1,000,000 gallons per month every month with no variation)
    - longer running pump tests if warranted

- Water use and land use must go together. Knowing supply of freshwater systems we can design the land use that will directly depend on sustainable water supply as, for example, volume of water per sq. mi of land, not per aquifer.

- Better define the availability and the acceptable consequences

- Probably much the way it does now, except with more resources available for basic data collection on water resources to better inform decisions. If I really had license to start from scratch, and if I had dictatorial powers, I would create a water survey (like that in Illinois only better-funded) and/or expand the state geological survey. The water survey would combine the information-gathering that is currently parceled out to the DNR, MGS, MDH, MPCA, and others. The MGS, in addition to its research role, would not shy away from routine, basic data collection. There would be clear advantages to having (well-funded) information-gathering agencies separate from regulatory functions, but willing to do the information gathering work necessary to support regulatory programs.

- Would maintain the status quo though require more thorough evaluation for new uses and for larger appropriations.

- All water permitting (including for withdrawals for new urban development) should be conditional, and should be

- It should base water use allocations on the best estimates of sustainable supply, with built-in monitoring protocols to continually update the hydrologic database for improving the sustainable supply estimates. The regulation should be conducted from estimates made at various spatial scales since water that is used at one location is not necessarily water that is 'renewed' right at that location but would in general be water that flows to that location from somewhere else.

- Conjunctive use would be encouraged. Regional water systems in growing areas would be developed to allow conjunctive use and adaptive management in real time. High capacity wells would need "certificates of need" or "certificate of sustainability" before they could be drilled. All major water users would be required to prove that conservation measures are in place and being used before additional water could be granted. Systematic reductions in per capita use should be expected of public water supply systems. There would be grants for infrastructure improvements (how much unaccounted-for water???) in fully developed areas and for encouraging demand reduction in developing areas (grass on 1" of topsoil over sand ARE YOU KIDDING?). The existing permit system is one of the best in the nation, but we shouldn't hesitate to improve it (and most of the improvement would be to have the resources to make it work as well as possible). We could use more staff so that we could actively pursue unpermitted users by reviewing air photos and drilling reports and get them under permit. We could make all permits limited term permits to dispense with the idea of 'ownership of the water forever'. With more staff we could check up on missing or odd water use reports (exact same number every year?). We could instrument obwells in target aquifers with telemetered water level measuring devices so thresholds could be enforced in real time. Mapped high use areas

- It would use a two-tiered test: first, it would require justification of the need for the water use as an integral part of the determination of the common law doctrine requiring that "reasonable" use be permitted; second, it would assess what amounts of use are reasonable in the near and long term components of the sustainability definition.

- Overriding rules to govern prioritization of use and how to monitor the resource. Secondary level of regulating the resource on a district/watershed basis across all agencies--DNR, Ag, MDH, etc.

<u>What protections are needed (surface water – lake, wetland, flows; ground water etc.)?</u>

- Drawdown thresholds and allocation permits at whatever user level is necessary to maintain aquifer levels over the long term. Surface water flows and levels are dependent on maintaining ground water levels. Quality of all discharges should be monitored and managed including drainage systems.

- Better understanding of water resources, such as geologic atlases. Enforceable legal standards.

- Much of this is known & already agreed upon & in rule/statute. Some just need better enforcement. We need to protect & preserve:
    - -surface water features
    - -water quality (no degradation of WQ through use)
    - -ecosystem functions
    - the water resource itself (that means we should not allow significant draw down of the original resource)
- We also need to consider cumulative potential effects when evaluating proposed water users. Just as the PCA asked, what will the environment look like in 30 years with population & industrial & recreational growth?

- Land use planning around lake, wetlands and rivers must be changed to decrease and eventually eliminate pollution. Non- point pollution must be changed according to BMP practice. More importantly the land use and water use planning must be combined.

- In stream flows, discharges to streamflow, ground water levels

- Streams & Rivers - protected flows/ in-stream flow needs
  - Lakes - protected levels
  - Wetlands - protection from removal of wetland hydrology
  - Ground water - water level thresholds like those currently used but better supported by data.

- To include in regulations regarding water use the understanding that surface and groundwater are an interactive dynamic system and are not separate entities. Recently, the MPCA considers groundwater and surface separately.

- I trust the judgment of those more familiar with state water law, but please see comments below.

- We need to have improved monitoring systems for quantifying water balances and the quality of the water resource. To go with the monitoring systems we need algorithms that process data coming from various sources to assist managers to modify water allocations when conditions change.

- Knowledge of ecosystem requirements needs to be refined. Stable water levels in surface water bodies are not a natural phenomenon. Lake levels fluctuate, stream flows vary, and

- We need a better approach to protecting surface water resources, ala Michigan's proposed framework, but with a clear seasonal element.

- Protection should focus on sustainability defined on the physical constraints of the system. It must evaluate surface and groundwater as a continuum.

What changes would you propose to state's legal framework to allow the state to adequately protect water resources?

- We need to understand the legal framework better. What is enforceable? A conference on legal issues is warranted.

- Again, much of it is in place. We just need funding for enforcement and more work activities. We already are called upon to preserve the resource (quantity & quality) and evaluate future uses.

- The need to take sustainable development seriously, for the sake of our children and grandchildren, calls attention to three perspectives in terms of knowledge-based policy development:
  - Pollution must be stopped to secure usable raw water sources and protect biodiversity of aquatic ecosystems, in the long term moving toward a water pollution veto.

    - Awareness of depletive water use involved in plant production is essential, therefore water resources planning and management approaches need to incorporate green water resources (soil moisture) and green water use (evaporation).
    - Groundwater has to be incorporated into water resources planning and management because of its link to river flow.

- Improve operational definitions of sustainability

- Yikes! What we have now is a framework constructed not unlike a bunch of double-wide job-site trailers strapped together. When a new job came along, a new trailer was added on like a cheap patio enclosure. The result is an architectural monster. Any one of us could have good ideas about how to start from scratch an build a better, architecturally sound building. Reorganization ideas bubble up on a regular cycle. But they are difficult to put in place because people are occupying those trailers, and reluctant to leave them. Any changes to the framework must realistically be put in place without damaging the system as it currently functions.

- See above statement.

- This is not my particular area of expertise; I would trust the judgment of those more familiar with state water policy. However, a general comment I would make is that more rules/regulations are not helpful without an integrated, systemic approach, which is exactly what EQB is trying to coordinate. Whatever approach is taken should be based on principles of adaptive management, with ongoing monitoring efforts and management targets changing based on altered climatic/demographic conditions.

- It seems we already have the ethic of not using more than the renewable supply built into state law. Maybe this needs to be clarified further. The science of ecosystem needs for water needs to be improved, and those needs should be quantified and built into the management process. However, this does not need to be described in detail in the law, but the law does need to emphasis the protection of those ecosystem needs. Perhaps we need to begin to put an economic value on water and to begin to charge for use of public waters. The economics can, along with other regulations be an effective means for limiting wasteful use.

- Leaky aquifers are not considered in our law. We currently interpret the statutes and rules to provide protection to indirectly impacted resources, but as someone in one of the meetings said: "wait 'til they get their lawyers on your case". It would be better if our laws were not so simplistic. Plus, as is abundantly clear, our 'safe yield' is not at all safe!

- Change reference from "safe yield" to "sustainable yield" with "sustainable" defined in the two-tiered fashion. Explicitly recognize in law how "reasonable" use is dependent on: a) the need test, b) the short term sustainability test, and the long-term sustainability test. Also introduce the concept of priority sustainability management areas, building off of the aquifer management zone authority, except that these areas would address surface and ground water as one system, and be triggered by any land and water uses or expected future uses, and quality concerns, that indicate a system approaching a sustainability crisis or threat (something less than "crisis," say heading toward a crisis more long term). I also would explicitly require local, regional and state governments (all agencies) to build these concerns into their planning and development considerations, even to the point where a state agency (broader than DNR) could be required to approve decisions that would precipitate additional deterioration of a system's sustainability status. This also would require establishment of a routine, interdisciplinary monitoring and assessment program, and routing reporting of sustainability indicators based upon it. These would drive or trigger the whole process, or at least that component of the process beyond that driven by reaction to individual permit requests. We must get beyond reactionary approaches to managing water. I also would introduce the concept of permit trading as a legitimate part of the modified riparian water law in Minnesota, with conditions and subject to the same tests outlined here.

- Add credit system for conservation and restoration of water resources. Allow/mandate the engineered recharge of groundwater.

Ground Water Questions

What publicly available data do you use?

- County Well Index and geologic mapping.

- County Well Index, geologic and hydrologic atlases, SWUDS, soil data, recharge maps, DNR observation well network, precipitation data

- Permit data, county atlases, MDH municipal water supply data

- Water levels, maps, monitoring wells, chemical data, water use

- Most available data

- Water well records, layers on GIS servers, water level data, climatology data. Soils data, geologic and hydrogeologic maps.

- About every database that is available from the MPCA, DNR, MDH, MGS, MDA, and USGS. Maps (such as County Atlases)- a fundamental tool for understanding groundwater resources. County well Index (you don't know what it is like to work in areas where this information is not available). Groundwater quality data, groundwater level (water table and piezometric) data, water appropriation data, any aquifer parameters (typically in publications by USGS and MGW). We need more emphasis on mapping at appropriate scales (County Atlas Series). And did I mention that we need more funding for mapping and collection of water level data (i.e. monitoring and observation well networks). All databases need continual funding for maintenance and updating.

- DNR water permitting database; in addition, demographic and income data from State Demographer/Bureau of Economic Analysis; data on economic sectors and industrial growth; variety of other economic statistics; irrigation data from USDA national agricultural statistics service.

- Streamflow, weather, soil maps, topographic data, ground water levels, geological maps, well logs, water quality data.

- County well index, the County atlas maps (where available), air photos, observation well data, water use data, permit database information, geologic studies, USGS studies, etc.

- Water well resource base. USGS and MGS data on water and geology.

Can it be easily accessed?

- Yes.

- Within MDH, the data is quite accessible.

- Yes, generally

- NO, very difficult

- Relatively easily to those informed

- Yes, but there is always room for continued improvement and modernization.

- If you know where to look, yes. Some of the databases are better than others.

- Yes. All are available online.

- Yes, and the accessibility is continually being improved/enhanced.

- It's getting better. To be able to use the data I need a computer with ArcView 3.3 at least and access to the Quickthemes and Extensions that put these data only a click away for me. That's quite an investment!

- Yes

How do you use it?

- CWI is a large component of the information available for mapping the subsurface.

- For drinking water protection (identifying the source of the drinking water and evaluating whether it is protected from natural and anthropogenic contaminants)

- Research
- Analysis of resources
- To compare existing hydrologic situations with historical data, evaluate antecedent conditions to a particular observation date. To evaluate hydrogeologic settings of particular sites.
- Use it for every aspect of hydrogeology and evaluation of general areas and specific sites. We are fortunate to have such a wide variety of data...water quantity and quality, though we need better handle on the quantity and trends in areas of high water use.
- To generate models of water use by sector into the future under different scenarios.
- Currently using it to quantify ground water recharge
- To evaluate water use impacts = review water level changes in the context of precipitation and temperature and water use. Make determinations about future water level changes in response to newly permitted users.
- Searches on receptors

What do you see as its value?

- CWI is a reasonable model of ground water usage and supports mapping of aquifers and confining materials as well as elucidating ground water/ surface water interaction pathways.
- Meeting current and future needs of public water supply systems
- Some data, like water use, maps are very critical for research. Some data, like monitoring data are very difficult to get, but also in terms of sustainability it is just synoptic data that are not able to answer the question of freshwater sustainability.
- It is of great value
- Context. Putting observations in historical context, climatic context, geologic context, human impact context.
- Vital to doing any work related to MN groundwater resources. Critical for resource management. Cannot make decisions if you have no data to work with.
- This should help us to understand what drives water use in each application, and how that might change in the future given climate change/demographic change/urbanization/biofuel development/etc.

- The data are essential for us to grasp a better understanding of the workings of the hydrologic cycle within a given area or region.

- Couldn't do without. Need more monitored locations and more refinement in data collected.

- Ready availability. Defensibility.

<u>What additional data needs do you perceive (i.e. what additional data would you like collected or made available)?</u>

- Digital locations of wells at the time they are drilled. LiDAR statewide.

- Water quality data, base flow, aquifer parameters, contaminant plume mapping, more detailed land use information (such as pesticide use and national conservation programs)

- The county atlases need to be adapted to measure more parameters need for quantifying interactions, flow, recharge, porosity, K, etc.

- The water use data should be organized by parcel of land in addition to present system: by aquifer

- Real time ground water levels, ground water recharge, watershed streamflow for more watersheds

- Continued support for routine collection of water level data, climatologic data, and geologic data. Continued support for geologic and hydrogeologic mapping and interpretation.

- Maps. More maps, and if I haven't stressed this before, more maps. Aquifer parameters especially buried unconsolidated aquifers, county atlas maps, better delineation of buried unconsolidated aquifers. More mapping and more monitoring and observation wells, and the resources to support these programs (i.e., $$$).

- Water permitting data from earlier years would be helpful. The more years for which we have data, the more robust relations we can derive between water use and drivers of water use.

- More observation wells with higher resolution (temporally) measurements of water levels. More synthesis of the available observation well data that already exists, and synthesis of what it means. Measurements of stable isotopes at various locations to quantify ground water discharge into streams and other surface water bodies. More networks of streamflow measurements, maybe for short periods of time, to supplement the longer-term records available on 'sentinel' watersheds. Higher resolution (space and time) remotely sensed parameters (such as surface temperature) to assist with the spatial mapping of precipitation and ET. This last item needs the effort of the federal government through NASA.

- More obwells and index obwells need to be monitored with transducers and loggers to provide more detailed information. More information on water quality changes over time.

- We need a hydrologic cycle monitoring system that enables analysts to integrate and assess measurements of temperature, precipitation, land use (impervious surfaces, drainage etc.), low flow, surface water level, ground water level, and water quality monitoring network so that managers can evaluate the state of the system and its potential responses to water use, land use and water quality concerns.

- Would like groundwater level data and chemistry.

<u>How would they be applied?</u>

- An accurate well location and elevation enables use of the drilling record in mapping geologic and hydrologic themes.

- For protecting drinking water supplies (see above)

- They will be compared with renewable water supply.

- To understand recharge and discharge

- To be in a better position to answer questions and solve problems as they come up, rather than to do last-minute scrambling to generate data to put out a particular fire.

- Better planning for short and long term resources management and use.

- To use in models of future water withdrawals by sector/geographic location.

- To improve our assessments of how much water we can use, how good is the quality, and what trends are there.

- During the irrigation season, for example, we could get monitoring well water levels to see what the current impact of pumping in the area has been. We could, if needed, put irrigators on the equivalent of the suburban sprinkling ban when levels are rapidly declining.

- As designed above

- Patterns of flow, receptor evaluation.

Surface Water Questions

What publicly available data do you use?

- Water quality information
- Stream flow data
- Most available data
- Flow data, lake level data.
- Not quite as much as groundwater use--discharge or flow rates, water appropriations, surface water quality, and locations of wetlands etc.
- See above. All answers similar to those for groundwater.
- I view the ground water system and the surface water system as intimately connected, so the data sources are mutual. Answers to the following questions are mostly the same as those above, with some exceptions, as given.
- Streamflow data, lake levels, wetland levels, climate data
- Rarely use it. Some river stage/elevation data.

Can it be easily accessed?

- No - we need better access to surface water quality information
- Yes, but not all the data. Random measurements are difficult to get.
- Relatively easily to those informed
- Yes, but, as above, there is always room for continued improvement and modernization.
- Yes, if you know where to look
- Same as for GW

How do you use it?

- Research
- To define recharge and discharge, low flows, base flows

- In the same way as the ground water data - to compare existing hydrologic situations with historical data, evaluate antecedent conditions to a particular observation date. To evaluate hydrogeologic settings of particular sites.

- Use it for interaction with groundwater and for evaluation of sites.

- Quantifying surface water flows; low-flows, peak flows, mean flows, sediment transport, downstream loadings, etc.

- Same as for GW

<u>What do you see as its value?</u>

- Very critical to address the renewable supply of water for inter-generational term as well as for study of global climate change

- It is of great value to this process

- Same as above. Context. Putting observations in historical context, climatic context, geologic context, human impact context.

- Same answer as above for groundwater.

- Only way to know what's up.

<u>What additional data needs do you perceive (i.e. what additional data would you like collected or made available)?</u>

- Better information on surface water supplies

- All hydro-climatic data, such as ET, surface temperature, soil moisture, precipitation in addition to surface water, vadose zone and ground-water must be collected. Satellite data are very critical.

- additional and better streamflow data

- Continued support for stream gaging and water level data collection.

- No opinion of this one.

- More stream gages. More specifics on what protected flows should be (and not just on an annual basis - for each month. More information on water quality changes over time.

- see above

How would they be applied?

- would be applied to study spatio-temporal variability of these characteristics through the system analysis to answer questions of climate change and water resources management and protection

- To understand availability and sustainability

- Same as above - the growing base of data puts us in a better position to answer questions and solve problems as they come up, rather than to do last-minute scrambling to generate data to put out a particular fire.

- As part of the understanding of the whole system - can't let use of ground water impair stream or wetland functions.

General

Do you have any questions you would like asked of the group or discussed at the next meeting?

- If/when we agree on the acceptability of any of the water budget methods of estimating sustainable water availability, how will the results of that method be transferred to management policy and methodology? For example, how will that acceptable amount of water usage be allocated to aquifers or wells?

- 1. How can we assist agencies for increasing funding for maintaining databases and collecting additional data and for additional mapping projects? 2. We should not spend money and resources attempting to determine the volume of groundwater that is available in a single aquifer or in geographic area, such as a county, especially Anoka County. These exercises result in enormous numbers that are misleading and only convince lay persons that we have all the water we and future generations will ever need. It is acceptable to determine water quantity is specific areas such as a municipal well field and the area that might be captured by municipal wells. Should groundwater management include evaluating water volumes in areas defined by political boundaries? Defined by aquifer boundaries (i.e., buried unconsolidated aquifer in Bonanza Valley area? 3. Anoka County has balked at the MGS request for funding assistance for a County Atlas, but then wants the MDNR to determine how much water is underfoot. Should a state agency respond to this type of inquiry and expend limited resources attempting to create a number, that is at best, a wild ass guess?

- I have not seen much on the topic of quantifying the water resource needs of ecosystems. Perhaps it is in the draft report. We need to have a way to quantify how much water is needed by ecosystems so that the human use can be constrained.

- How can we operationalize the legitimate theory of sustainability even when we don't have the data we may want, with both its short- and long-term elements, in a manner that integrates quality, quantity and land use considerations? How can we shift from a reactive mode of managing water appropriations to a proactive one, even when we don't have all the data and system understanding we might want?