

List of Essential Questions

Water Resources Decision Support System: Experts Workshop, November 2001

Category 1: Basic Information on Water Withdrawal

The first category of questions covers basic information on the water withdrawal, such as the characteristics of the source and return water bodies, the proposed use of the water, and information related to the structure and operation. These questions also address alternatives to the proposed withdrawal, and the associated impacts.

1. Where is the proposed water withdrawal?

If water withdrawal is from a Great Lake, St. Lawrence River, or Connecting Channel:

- What is the specific location and depth of withdrawal?
- What are the relevant hydrology, geometry, hydrodynamics, and water quality in the vicinity of the withdrawal?

If water withdrawal is from a river:

- Where is it located on the river?
- What are the statistics on flow regime (average flow, 7Q10, 100 year flow)?
- What are the key characteristics of the river and watershed? Characterize sub-watersheds by land use types.

If water withdrawal is from an inland lake:

- What are the inflows and outflows?
- What is the lake geometry?
- What is the range of water levels?
- What is hydraulic retention time?

If water withdrawal is from a groundwater source:

- What is the elevation of the water table?
- What is the size of the aquifer?
- What is the general characterization of the aquifer?
- What is the estimated sustained yield of the aquifer?
- How does this aquifer relate to the surface waters of the Great Lakes basin?

2. What is the existing quality of the source water and sediments?

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|----------------------------|-------------------------------|
| • Temperature | • Nitrates |
| • Dissolved oxygen | • Buffering capacity |
| • BOD | • Salinity |
| • Total dissolved solids | • Sulfur |
| • Pathogens | • Water conductivity |
| • Dissolved organic carbon | • Persistent Toxic Substances |

3. Describe the current assimilative capacity of the source and return water.

4. Describe the key habitat characteristics for habitats associated with the source or receiving water (i.e., quality, access, resilience)

- Are there endangered or threatened species or fragile habitats associated with the source water? If so, list and describe.
- Does the area of influence contain a significant amount of seasonal/semipermanent wetlands, bogs or fens that are directly linked to the water table? If so, describe.

5. What components of the system are most sensitive to withdrawals? Which of these will most likely improve?

6. What are the existing uses (e.g., drinking water), of the source water body?

7. Is there a watershed management plan or objective for the area where the withdrawal is proposed to be made? For the source water? If so, is the proposal consistent with the plan?

- What are the existing water quality standards for the source water? For the return water?

8. What is the proposed use of the withdrawn water?

- What are the water use processes?

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- Will its water quality be altered by this use? If so, explain.
 - Will the use be consumptive? If yes, what fraction of withdrawn water is consumed?
 - What is the potential for future changes in the proposed use?
- 9. What is the proposed rate of withdrawal?**
- Will there be seasonal or diurnal variations in withdrawal rate? If so, describe.
 - What is the anticipated duration of this withdrawal? Will the diversion be essentially irreversible?
 - Is an increase in water withdrawal anticipated in the future?
- 10. Where is the unconsumed water proposed to be returned?**
- Will the water be impounded before being returned? If so, describe.
 - Will it be treated before it is returned? If so, describe treatment.
 - If in same water body, where is return located with respect to withdrawal?
 - If different water body, what is the location of the water return?
 - What is the quality of the receiving water for the return?
 - Are there endangered or threatened species or fragile habitats associated with the receiving water? If so, describe.
 - What are the existing uses of the receiving water for the return?
- 11. What will be the physical structure and operation of the proposed water withdrawal and return?** Describe the intake structure and operational plan in detail.
- Will there be any physical, chemical, or biological impacts due to the withdrawal operation? Describe in detail and include entrainment or impingement effects.
- 12. Are other options to this proposed withdrawal available? Can the location of the proposed withdrawal be changed to minimize the impact?** If so, describe the impacts that are associated with these alternatives.

Category 2: Water Quantity

Questions in this category relate to flows, water levels, groundwater yields, and other information about water quantity in the source and the receiving water.

- 1. For the source water, receiving water for returns, and any other impacted waterbodies (including bypassed reaches, downstream waterbodies and impacted wetlands), does the withdrawal affect:** If yes to any of the questions, describe the impacts.
- Baseflow?
 - Range and timing of water levels or water table elevation fluctuations (including seasonal ranges or fluctuations)?
 - Flows and flow variability?
 - High water mark? Stream status (permanent or intermittent)?
 - Index?
 - Recession (rate of recharge)?
- 2. How large is the proposed water withdrawal in the context of total system flows in the source water and the receiving water?**
- 3. If there are impoundments, will there be a reduction in peak flows?**
- Will there be a loss in variation of water levels? If yes, describe the impacts.
- 4. For groundwater withdrawals:**
- How important is groundwater seepage in the overall water budget and water characteristics of hydrologically-connected surface waterbodies (e.g., baseflows, water temperature)?
 - Will there be a reduction in the amount of groundwater exchange with the river? Or timing of? Explain.
 - Will there be an effect on any drinking water wells? If yes, explain.

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Category 3: Sediment Dynamics and Characteristics

Questions in Category 3 relate to potential changes in sediment suspension and distribution, or sediment characteristics as a result of the water withdrawal.

- 1. Will there be a change in sediment suspension and distribution (i.e., erosion, accretion/deposition, turbidity) in the source water or the return water?**
 - What is the anticipated magnitude and extent of this impact?
 - Will this alter the shoreline geomorphic features or the location and area of shallow water zones? In what way?
 - Will this change result in the need for increased dredging? Explain.
 - If there are impoundments, will there be a reduction in total sediment delivery? Explain.
 - Will there be significant effects on dynamic beach/coastal processes? Explain.
- 2. Will the water withdrawal affect wave energy dynamics?** If yes, describe the effects.
- 3. Will there be a change in sediment characteristics in the source water or the return water?**
 - Will there be an increased sediment contamination by persistent toxic substances?
 - Will there be a change in the properties of suspended or bedded sediments?
 - Will there be an alteration of the organic carbon content of sediments?
 - Will there be an increased sediment oxygen demand?

Category 4: Water Quality

The following questions relate to the quality of the source and receiving water, including any potential impacts related to invasive species.

- 1. How will the withdrawal alter the water quality of the source water and the return water? Address changes in:**
 - Temperature
 - Dissolved oxygen
 - BOD
 - Total dissolved solids
 - Pathogens
 - Dissolved organic carbon
 - Nutrients
 - Nitrates
 - Buffering capacity
 - Salinity
 - Sulfur
 - Water conductivity
 - Persistent Toxic Substances
- 2. Are there invasive species in the source water or return water? Please list.**
 - How are invasive species in the source water affected (negative and positive impacts)?
 - What pathways, if any, will be created by the withdrawal/diversion that would allow invasive species to spread?
- 3. Will the water use (e.g., irrigation) lead to degradation of unrelated water supplies (e.g., groundwater)?** Explain.
- 4. Will there be alteration of the thermal profile in the source or receiving water?** Explain. If there are impoundments, will there be an increase in water temperature? Explain.

Category 5: Ecological Impacts

Questions in Category 5 relate to potential impacts on habitats, structure and function of the ecosystem, and any ecological benefits that may occur as a result of the proposed activity.

- 1. For the source and return systems, will the changes in water quantity, sediment dynamics, and/or water quality:**
affect aquatic or terrestrial habitats?
 - Will there be habitat loss or gain?
 - Which species habitats are impacted (fish, benthos, birds, amphibians, reptiles,

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- mammals, invertebrates)? Will any sensitive species such as piping plover be impacted?
- What are the habitat attributes that are impacted? For example, for migratory species, will access or connectivity be affected? Will resiliency of the habitat be affected?
- affect production or diversity of flora (including phytoplankton, periphyton, and macrophytes)?*
cause acute or chronic toxicity to any species?
affect population levels or growth rates of any species in impacted system?
affect hypereic zone and subsequently affect surface aquatic systems?
have an ecological impact on assemblages of endangered/threatened species?
- Describe any changes in detail. Include consideration of any seasonal pattern of withdrawals, and the related effects on impacted species (e.g., access to fish spawning areas in the spring).
- 2. For the source and return systems, will the changes in water quantity, sediment dynamics, and/or water quality:**
- affect predator-prey relationships or food web structure and/or function in the impacted system?*
- If yes, which species are impacted?
 - If yes, how will the whole community structure and function be impacted?
- cause a change in the energy flow or nutrient cycling through the ecosystem?*
cause an increased bioaccumulation of contaminants in the food web? Lead to human health impacts through increased contaminant levels in fish or other pathways?
- Describe any changes in detail.
- 3. What ecological benefits, if any, will accrue from the proposed water withdrawal or diversion?**
- 4. Will the withdrawal change the amount or the functioning of riparian land? Describe any changes.**

Category 6: Cumulative Impacts

The questions in Category 6 address the potential for cumulative impacts as a result of the proposed use and other existing and future uses of the water. Questions also address whether there are any features (such as land use) that may alter the impact of the proposed activity.

- 1. From a lake-wide, river, connecting channel, and/or systemwide basis, how will this withdrawal (and return flow if applicable) affect:**
- water levels and flows?
 - water quality and ecological health of the source water?
 - water quality and ecological health of the receiving water for the return?
- 2. Will this withdrawal (and return flow if applicable), when combined with ongoing and anticipated future withdrawals, cause a deviation from the hydrology/hydraulics of the system that is required to maintain the health and integrity of the ecosystem? In what way?**
- 3. Will changes in the hydrology/hydraulics of the Great Lakes-St. Lawrence River system that may result from global climate changes alter the impact of the water withdrawal? In what way?**
- 4. Can further impacts be anticipated in the long-term on such things as land use or population, as a result of the project?**
- 5. Are there any existing or potential features that would alter the impact of the water withdrawal (channel/lake structures, channel lake substrate, existing land use, water control structures, conservation)? If so, describe.**