

This appendix lists actions for all municipal suppliers to take to ensure supplies are used wisely. It also provides guidance for addressing water supply issues identified in the Master Water Supply Plan's community profiles (Appendix 2). The regional analysis conducted can not ensure that additional issues will not be identified through more detailed analysis and monitoring that will need to be addressed in the future.

Minimum Actions for all Water Suppliers:

Because the resources from which water supplies are withdrawn are shared throughout the region, wise use and monitoring of those resources is necessarily a shared responsibility. In addition, baseline monitoring and ongoing evaluation of the information gathered is necessary to provide early warning of unidentified or developing problems. Therefore, all appropriators will need to conduct certain activities to ensure water supplies are used sustainably.

- Measure water levels at existing production* and observation wells at least weekly from May through September and at least monthly at from October through April.**
- Communities with anticipated significant increases (greater than 5% in 10 years) in withdrawals measure water levels at least daily in municipal wells and an additional nested observation well*** in each of the aquifers hydraulically related to the aquifer being utilized.
- Implement conservation programs including those targeted at meeting or exceeding the water use benchmarks outlined in the local water supply plan template.
- Promote stormwater best management practices that improve water quality and increase infiltration rates. Areas delineated as vulnerable or highly vulnerable drinking water supply management areas through the Minnesota Department of Health (MDH) wellhead protection program require special land use considerations.

Additional Actions to Address Issues Identified on Community Profiles

Through the community water supply profiles (Appendix 2) this Master Plan identifies issues the community could face in supplying future demands. The efforts described below are intended to address these issues. When supply system expansion is proposed, requiring new or updated permits, or when water supply or wellhead protection plans are prepared or updated, water suppliers should address issues identified on their profiles in one of the following ways:

- **Acknowledgement that water supply sources with potential issues identified will not be used to meet additional future demand.** Water supply plans that propose development of a water supply source *without* any identified water availability issues or no new sources may be considered an appropriate response. The analysis conducted for the development of this plan only evaluated impacts resulting from continued use of traditional sources. Therefore, analysis of impacts resulting from use of alternative sources may be necessary prior to that use.

* Water level measurements taken from production wells should, if possible, represent static, not pumping, conditions. Where automated water level measurements are collected by a datalogger, measurement frequency should be adjusted to capture the full amplitude of water level variation during both pumping and static conditions. If a pressure transducer is used to measure water level, barometric pressure should be measured concurrently.

** All water level data should be provided to the to the DNR using the forms provided online at www.dnr.state.mn.us/waters/watermgmt_section/appropriations/permits.html

***Options for an observation well include locating an abandoned or soon-to-be abandoned well or an inactive private well. If a suitable existing well cannot be found, an observation well in the aquifer and other potentially impacted aquifers in an appropriate location may need to be constructed. Location and suitability will need to be reviewed by DNR.

- **Demonstration that use of the water supply source will not result in the issue identified in the community profile.** If accepted by the Minnesota Department of Natural Resources (DNR), past or current local studies demonstrating that use of a particular source will not result in the issue identified in a community's profile will be considered an appropriate response. The Metropolitan Council will incorporate study results, as they are available, into the regional availability analysis and include in updates to the master plan.
- **Development of a water supply source using an approved monitoring and mitigation plan as described in this appendix.** Communities that intend to use a supply source with an issue identified will be required to develop and submit a monitoring and mitigation plan incorporating the elements described in this appendix, to the DNR prior to issuance of or amendment to an appropriation permit. The development of this plan should be done in consultation with the DNR to ensure the plan is appropriately tailored to local needs and that the necessary information is collected and evaluated prior to well construction.

If a community chooses to develop a source with an identified issue, a **monitoring and mitigation plan** as described in this appendix will need to be developed. The monitoring and mitigation plan should be included as supporting documentation for water appropriation permit requests, local water supply plans, and wellhead protection plans. However, **early coordination with the DNR** on development of the monitoring and mitigation plans is critical. Some of the information and analyses described in this appendix should be reviewed with the DNR **prior to well construction**. This will help to ensure that appropriate well locations and construction are chosen to protect natural resources.

The development of a monitoring and mitigation plan should consider regional conditions. In some cases a multi-community approach may be warranted. The DNR and Metropolitan Council will assist in development of a multi-community monitoring and mitigation plan.

Several communities are already addressing issues identified in their profiles as part of existing water appropriation permits or management activities. These efforts may meet the monitoring and mitigation plan elements listed in this appendix and may be deemed an acceptable approach by the DNR and MDH. The required elements of the monitoring and mitigation plan, outlined in this appendix, were developed by the Metropolitan Council, DNR, and Minnesota Department of Health (MDH).

Monitoring and Mitigation Plan

Water Supply Issue: Potential for well interference

Due to the pervasiveness of private wells in the metro area, all suppliers requesting water appropriations should evaluate the need to develop a strategy to address well interference. This evaluation should include:

- Inventory of all active domestic and public water supply wells near**** proposed or anticipated well locations using the County Well Index. For each well, document well depth, diameter, non-pumping and pumping water levels, well construction details including pump type and pump intake depth. In addition, use address-matching to identify additional wells at properties that are neither served by a public water supply nor a well identified in the County Well Index.
- Analysis of existing water level/water withdrawal data to identify where future drawdowns could affect domestic wells. The analysis can vary from a graphical comparison of water levels, to basic distance drawdown calculations, to groundwater flow modeling. The goal is to determine the vulnerability of wells to increased drawdowns in the source aquifer and to induced drawdowns in other impacted aquifers.

In cases where at risk wells are identified through the steps above the following information should be developed as part of the monitoring and mitigation plan:

- Aquifer test design for proposed well(s). Pump proposed well(s) at maximum capacity for 1 to 30 days and monitor water levels at appropriate locations to evaluate potential impact on other wells. This may require the construction of one or more monitoring wells**. Work with DNR to design an appropriate plan for the aquifer test.
- Additional analysis of existing water level/water withdrawal data to identify where future drawdowns could affect domestic wells. The analysis can vary from a graphical comparison of water levels, to basic distance drawdown calculations, to a groundwater flow model and should be determined in consultation with the DNR. In some cases a geologic cross-section of the area may be necessary to evaluate geologic conditions. The goal is to determine the vulnerability of wells to increased drawdowns in the source aquifer and to induced drawdowns in other impacted aquifers.
- Schedule for daily or more frequent measurement*** of water levels and/or pumping rates in existing production wells*.
- Schedule for daily or more frequent measurement*** of water levels in at least one observation well (sentinel well) in the proposed aquifer at a location deemed appropriate for highlighting an encroaching cone of depression near at-risk wells**. Monitoring may be required in other impacted aquifers where at-risk wells are completed.
- Triggers and associated actions to protect water levels in domestic wells

Sample triggers:

* Water level measurements taken from production wells should, if possible, represent static, not pumping, conditions., not pumping, water levels are recorded. Where automated water level measurements are collected by a datalogger, measurement frequency should be adjusted to capture the full amplitude of water level variation during both pumping and static conditions and monthly manual measurements should be taken to for datalogger calibration.

** If an observation well (or wells) do not currently exist, work with DNR to locate and drill a new well or convert an existing abandoned well

*** Use of an automated datalogger is recommended for all water level measurements

**** Work with DNR to establish inventory area based on local conditions; the area will typically range from 1500 feet to 1.5 miles

Monitoring and Mitigation Plan

Water Supply Issue: Potential for well interference

- Ongoing downward water level trend
- Water levels in sentinel wells fall below a predefined level
- Water demand exceeds a predefined level
- Well interference reported
- Other triggers developed in cooperation with the DNR

Sample actions (refer to Minnesota Rules 6115.0730):

- Implementation of a well management plan to avoid or minimize impacts including demand management, pumping schedules and rates and/or use of alternative aquifers/sources.
 - Inform potentially impacted well owners and collect baseline water level and condition information if possible
 - Inform potentially impacted well owners of well interference procedures (Minnesota Rules 6115.0730)
 - Work with domestic well owner to adjust or replace existing wells or provide municipal water to potentially affected parties
 - Other actions developed in cooperation with the DNR including an informal process for addressing well interference issues prior to the formal complaint process
- Schedule for periodic and timely analyses of water level data and other information to identify the need for action to mitigate impacts on domestic wells. In most cases, quarterly submittal of water level data and annual submittal of an analysis of the available information to the DNR is appropriate.

If well interference is documented, take actions outlined in Minnesota Rules (6115.0730).

*Water level readings taken from production wells must meet standards intended to ensure that static, not pumping, water levels are recorded. Where automated water level measurements are collected by a datalogger, measurement frequency should be adjusted to capture the full amplitude of water level variation during both pumping and static conditions and monthly manual measurements should be taken to for datalogger calibration.

** If an observation well (or wells) do not currently exist, work with DNR to locate and drill a new well or convert an existing abandoned well

*** Use of an automated datalogger is recommended for all water level measurements

**** Work with DNR to establish inventory area based on local conditions; the area will typically range from 1500 feet to 1.5 miles

Monitoring and Mitigation Plan

Water Supply Issue: Potential for significant decline in aquifer water levels

- Analysis of existing and projected water level/water withdrawal data to assess the likelihood of exceeding >50% drawdown in available head in confined aquifers and of causing continued decline in unconfined aquifers. The analysis can vary from a graphical comparison of water levels, to basic distance drawdown calculations, to a groundwater flow modeling and should be determined in consultation with the DNR
- Plan for participating in regional synoptic surveys
- Schedule for daily or more frequent measurement*** of water levels and/or pumping rates in existing production wells.*
- Schedule for daily or more frequent measurement*** of water levels in at least one observation well (sentinel well) in the pumped aquifer near the well field**.
- Schedule for periodic and timely analyses of water level data and other information to identify the need for action to mitigate impacts on aquifer water levels

Triggers and associated actions to protect aquifer water levels

Sample triggers

- Measured > 50% decline in confined aquifer available head at appropriate sentinel well(s)
- Measured or projected significant seasonal declines
- Measured continuing decline in unconfined or confined aquifer head at appropriate sentinel well(s)
- Other triggers developed in cooperation with the DNR

Sample actions:

- Implementation of a well management plan to avoid or minimize impacts including demand management, pumping schedules and rates and/or use of alternative aquifers/sources
 - Strategically locate future well(s)
 - Use alternative water supply source(s) such as different aquifers, surface water, water supplied by neighbors, or other available resources
 - Other actions developed in cooperation with the DNR
- Schedule for periodic and timely submittal of water level data and other information to the DNR. In most cases quarterly submittal of water level data and annual submittal of an analysis of the available information is appropriate.

*Water level readings taken from production wells must meet standards intended to ensure that static, not pumping, water levels are recorded. Where automated water level measurements are collected by a datalogger, measurement frequency should be adjusted to capture the full amplitude of water level variation during both pumping and static conditions and monthly manual measurements should be taken to for datalogger calibration.

** If an observation well (or wells) do not currently exist, work with DNR to locate and drill a new well or convert an existing abandoned well

*** Use of an automated datalogger is recommended for all water level measurements

**** Work with DNR to establish inventory area based on local conditions; the area will typically range from 1500 feet to 1.5 miles

Monitoring and Mitigation Plan

Water Supply Issue: Potential for impacts of groundwater pumping on surface water features

- Identification of specific surface water resources that may be affected by withdrawals from proposed wells, in consultation with the DNR
- Analysis of existing groundwater withdrawal, water level, surface water flow, climate data and projected withdrawals and wells to predict the likelihood of a connection between aquifer withdrawals and surface water features. This may include evaluation of multi-community withdrawals and monitoring information. This information should be reviewed with the DNR prior to well construction.
- Aquifer test design for proposed well(s). Pump well(s) at maximum capacity for 1 to 30 days and monitor water levels at appropriate locations to evaluate potential impact on surface water features. This may require the construction of one or more monitoring wells.
- Schedule for daily or more frequent measurement*** of water levels and/or pumping rates in existing production wells*.
- Schedule for daily or more frequent measurement*** of water levels in at least one observation well (sentinel well) in the proposed aquifer between the well field and the at-risk surface water feature(s)**. Where appropriate, observation wells should be nested to monitor multiple aquifers.
- Schedule for daily or more frequent measurement*** of water levels and/or flow into and out in the surface water feature(s) that may be affected by withdrawals.
- Schedule for periodic and timely analyses of water level data and other information to identify the need for action to mitigate impacts on surface water features
- Triggers and corresponding actions that will be taken to protect surface water features.

Sample triggers:

- Water levels at sentinel well(s) adjacent to a surface water feature fall below a predefined level
- Exceedance of predetermined resource protection thresholds (e.g. stream or spring discharge), developed in consultation with the DNR
- Measured decline in flows or water levels correlated to groundwater withdrawals
- Other triggers developed in cooperation with the DNR

Sample actions:

- Implement specific demand management activities

*Water level readings taken from production wells must meet standards intended to ensure that static, not pumping, water levels are recorded. Where automated water level measurements are collected by a datalogger, measurement frequency should be adjusted to capture the full amplitude of water level variation during both pumping and static conditions and monthly manual measurements should be taken to for datalogger calibration.

** If an observation well (or wells) do not currently exist, work with DNR to locate and drill a new well or convert an existing abandoned well

*** Use of an automated datalogger is recommended for all water level measurements

**** Work with DNR to establish inventory area based on local conditions; the area will typically range from 1500 feet to 1.5 miles

Monitoring and Mitigation Plan

Water Supply Issue: Potential for impacts of groundwater pumping on surface water features

- Reduce pumping rates
- Adjust pumping schedule at the well(s)
- Strategically locate future well(s)
- Use alternative water supply source(s) such as different aquifers, surface water, water supplied by neighbors, or other available resources
- Schedule for periodic and timely submittal of water level data and other information to the DNR. In most cases quarterly submittal of water level and other data and annual submittal of an analysis of the available information is appropriate

DRAFT

*Water level readings taken from production wells must meet standards intended to ensure that static, not pumping, water levels are recorded. Where automated water level measurements are collected by a datalogger, measurement frequency should be adjusted to capture the full amplitude of water level variation during both pumping and static conditions and monthly manual measurements should be taken to for datalogger calibration.

** If an observation well (or wells) do not currently exist, work with DNR to locate and drill a new well or convert an existing abandoned well

*** Use of an automated datalogger is recommended for all water level measurements

**** Work with DNR to establish inventory area based on local conditions; the area will typically range from 1500 feet to 1.5 miles

Monitoring and Mitigation Plan

Water Supply Issue: Potential for impacts to state protected trout habitat or calcareous fen

- Analysis of existing groundwater withdrawal, water level, surface water flow, climate data and projected withdrawals to predict the likelihood of a connection between aquifer withdrawals and trout habitat or calcareous fen features. This may include evaluation of multi-community withdrawals and monitoring information considering geologic/hydrologic boundaries and across jurisdictional boundaries as needed. This information should be reviewed with the DNR prior to well construction.
- Aquifer test design for proposed well(s). Pump at maximum capacity for 7 to 90 days and monitor water levels at appropriate locations to evaluate potential impact on surface water features. This may require the construction of one or more observation wells.
- Schedule for daily or more frequent measurement*** of water levels and/or pumping rates in existing production wells.*
- Schedule for daily or more frequent measurement*** of water levels in at least one observation well or well nest (sentinel well) between the well field and trout stream or calcareous fen and in at least one observation well adjacent to the trout stream or calcareous fen**. Monitoring for water chemistry may also be necessary as determined in cooperation with DNR.
- Schedule for daily or more frequent measurement*** of water levels and flows in the surface water feature(s) that may be affected by withdrawals. Monitoring for water chemistry may also be necessary as determined in cooperation with DNR.
- Schedule for periodic and timely analyses of water level data and other information to identify the need for action to mitigate impacts on trout habitat and calcareous fens
- Triggers and corresponding actions that will be taken to protect the trout stream or calcareous fen.

Sample triggers:

- Water levels fall below a predetermined level at sentinel well(s)
- Water levels fall below a predetermined level at well(s) adjacent to trout stream or calcareous fen
- Flows or water levels fall below a predetermined rate in a trout stream or calcareous fen
- Other triggers developed in cooperation with the DNR

Sample actions:

- Implement specific demand management activities
- Strategically locate future well(s)
- Adjust pumping schedules

*Water level readings taken from production wells must meet standards intended to ensure that static, not pumping, water levels are recorded. Where automated water level measurements are collected by a datalogger, measurement frequency should be adjusted to capture the full amplitude of water level variation during both pumping and static conditions and monthly manual measurements should be taken to for datalogger calibration.

** If an observation well (or wells) do not currently exist, work with DNR to locate and drill a new well or convert an existing abandoned well

*** Use of an automated datalogger is recommended for all water level measurements

**** Work with DNR to establish inventory area based on local conditions; the area will typically range from 1500 feet to 1.5 miles

Monitoring and Mitigation Plan

Water Supply Issue: Potential for impacts to state protected trout habitat or calcareous fen

- Use alternative source
- Work with neighbors to develop supplies
- Other actions developed in cooperation with the DNR
- Schedule for periodic and timely submittal of water level data and other information to the DNR. In most cases quarterly submittal of water level and other data and annual submittal of an analysis of the available information is appropriate

*Water level readings taken from production wells must meet standards intended to ensure that static, not pumping, water levels are recorded. Where automated water level measurements are collected by a datalogger, measurement frequency should be adjusted to capture the full amplitude of water level variation during both pumping and static conditions and monthly manual measurements should be taken to for datalogger calibration.

** If an observation well (or wells) do not currently exist, work with DNR to locate and drill a new well or convert an existing abandoned well

*** Use of an automated datalogger is recommended for all water level measurements

**** Work with DNR to establish inventory area based on local conditions; the area will typically range from 1500 feet to 1.5 miles

Monitoring and Mitigation Plan

Water Supply Issue: Significant uncertainty regarding aquifer extent and productivity

- Inventory of data from the nearest existing aquifer tests, including well development/capacity information
- Inventory of all active domestic and public water supply wells near**** proposed or anticipated well locations. For each well, document well depth, diameter, non-pumping and pumping water levels, quality, well construction details including pump type and pump intake depth. Use the County Well Index first to identify current wells. In addition use address-matching to identify additional wells at properties that are neither served by a public water supply nor a well identified in the County Well Index.
- North-south and east-west (or appropriate direction) geologic cross-sections across proposed well field using current Minnesota County Well Index and any other available boring information (see MNDOT etc.)
- Collect aquifer characteristic information through aquifer tests of adequate duration to assess hydrologic boundaries, groundwater -surface water interaction, and interaction among aquifers. This should be performed in cooperation with DNR, MDH and other entities.
- Schedule for daily or more frequent measurement*** of water levels and/or pumping rates in existing production wells*
- Define a strategy, to periodically analyze and report on water level, pumping, and other information

*Water level readings taken from production wells must meet standards intended to ensure that static, not pumping, water levels are recorded. Where automated water level measurements are collected by a datalogger, measurement frequency should be adjusted to capture the full amplitude of water level variation during both pumping and static conditions and monthly manual measurements should be taken to for datalogger calibration.

** If an observation well (or wells) do not currently exist, work with DNR to locate and drill a new well or convert an existing abandoned well

*** Use of an automated datalogger is recommended for all water level measurements

**** Work with DNR to establish inventory area based on local conditions; the area will typically range from 1500 feet to 1.5 miles

Issue: Known groundwater contamination **This will need input from MDH**

Threshold

Response

Contamination detected in community system or aquifer that serves a community system

- Cooperate with the MDH to conduct enhanced water quality monitoring.
- Implement treatment processes to meet Safe Drinking Water Act requirements.

MDH establishes Special Well Construction Area or adjust boundaries of existing areas (in accordance to M.R. part 4725.3650)

- MDH continues enhanced monitoring.
- Meet the requirements of the Special Well Construction Area regarding the installation of new wells and the reconstruction of existing wells.
- MDH may order the sealing or reconstruction of wells and borings, in accordance with Minnesota Statutes, Sections 1031.301 and 1031.315.
- Implement treatment processes that meet Safe Drinking Water Act requirements.
- Manage pumping, if needed, to better control the extent and magnitude of contaminant plume.

*Water level readings taken from production wells must meet standards intended to ensure that static, not pumping, water levels are recorded. Where automated water level measurements are collected by a datalogger, measurement frequency should be adjusted to capture the full amplitude of water level variation during both pumping and static conditions and monthly manual measurements should be taken to for datalogger calibration.

** If an observation well (or wells) do not currently exist, work with DNR to locate and drill a new well or convert an existing abandoned well

*** Use of an automated datalogger is recommended for all water level measurements

**** Work with DNR to establish inventory area based on local conditions; the area will typically range from 1500 feet to 1.5 miles

Water Supply Issue: Significant contamination vulnerability

Threshold	Response
<p>The MDH designates all or part of a wellhead protection area as vulnerable to potential sources of contamination.</p>	<ul style="list-style-type: none"> ▪ Develop measures to mitigate public health risks due to potential contamination sources, and include these measures in the community's wellhead protection plan as required under Minnesota Rules (4720.5250). ▪ Develop a plan in cooperation with the MDH to increase monitoring for contaminants regulated under the federal Safe Drinking Water Act. ▪ Request support, if needed, from federal, state, and local governments regarding management of potential contamination sources.
<p>The MDH designates an area as exhibiting a high potential for nitrate nitrogen contamination.</p>	<ul style="list-style-type: none"> ▪ Address point sources and non-point impacts of nitrate contamination when siting new public water supply wells. ▪ Increase the testing frequency for community water supply wells, if required by the MDH, when nitrate levels exceed a background level of 3 ppm. ▪ Address existing or new potential sources of nitrate nitrogen in new or updated wellhead protection plans as required under Minnesota Rules (4720.5250).
<p>The Minnesota Department of Health designates the aquifer as a likely source of arsenic, radium, or other naturally occurring contaminants.</p>	<ul style="list-style-type: none"> ▪ Address the likelihood that treatment for naturally occurring contaminants is needed to meet drinking water standards when planning for new water supply wells. ▪ Use an alternative source to meet future demand, if treatment is not effective in meeting federal or state drinking water limits.

*Water level readings taken from production wells must meet standards intended to ensure that static, not pumping, water levels are recorded. Where automated water level measurements are collected by a datalogger, measurement frequency should be adjusted to capture the full amplitude of water level variation during both pumping and static conditions and monthly manual measurements should be taken to for datalogger calibration.

** If an observation well (or wells) do not currently exist, work with DNR to locate and drill a new well or convert an existing abandoned well

*** Use of an automated datalogger is recommended for all water level measurements

**** Work with DNR to establish inventory area based on local conditions; the area will typically range from 1500 feet to 1.5 miles