Washington County Groundwater Plan 2003 - 2013

Prepared by:

Washington County
Department of
Public Health and Environment

With Guidance From:

Washington County
Groundwater
Advisory Committee

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2001 – 2002 WASHINGTON COUNTY GROUNDWATER PLAN KEY TO ACRONYMS

BWSR	MN Board of Water and Soil Resources
CRP	Conservation Reserve Program
DNR	Minnesota Department of Natural Resources
EOP	Emergency Operations Plan
GIS	Geographic Information Systems
GPS	Global Positioning System
GWAC	Groundwater Advisory Committee
HHW	Household Hazardous Waste
ISTS	Individual Sewage Treatement System
LGU	Local Government Unit
MC	Metropolitan Council
MDA	Minnesota Department of Agriculture
MDH	Minnesota Department of Health
MGS	Minnesota Geologic Survey
MNEXT	University of Minnesota-Extension Service
MPCA	Minnesota Pollution Control Agency
MUSA	Metropolitan Urban Service Area
NRCS	Natural Resource Conservation Service
RCRA	Resource Conservation & Recovery Act
SCWRS	St. Croix Watershed Research Station
STATE	State Government (unspecified)
TAC	Technical Advisory Committee
U of M	University of Minnesota
WC	Washington County Water Consortium
WCA	Wetland Conservation Act
WCD	Washington Conservation District
WCLM	Washington County Land Management
WCPHE	Washington County Public Health and Environment
WCTPD	Washington County Transportation and Physical Development
WD/WMO	Watershed Districts/Watershed Management Organizations
WHP	Wellhead Protection

GLOSSARY OF TERMS

This glossary provides definitions that are applicable to the region. Some definitions were modified to best fit unique local conditions.

Aquifer Rock or sediment in a formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield economical quantities of water to wells and springs.

Aquifer, confined A formation in which the groundwater is isolated from the atmosphere at the point of discharge by impermeable geologic formations. Confined groundwater is generally subject to pressure greater than atmosphere.

Aquifer, unconfined An aquifer whose upper boundary consists of relatively porous natural material which transmits water readily and does not confine water. The water level in the aquifer is the water table and is exposed to the atmosphere through openings in the overlying materials.

Aquitard (or confining layer) A geologic formation of low permeability that greatly inhibits the movement of groundwater.

Baseflow Sustained low flow of a stream which is often due to groundwater inflow to the stream channel.

Bedrock A general term for the rock, usually solid, that underlies soil or other unconsolidated material.

Bedrock Aquifer An aquifer composed of bedrock formations

Bedrock valley A valley consisting primarily of a carbonate mineral such as calcite or dolomite, the chief minterals in limestone and dolostone, respectfully.

Collector system A sewage treatment system which collects sewage from two or more residents or other establishments, consisting of collector lines, pumps, sewage tanks, and soil treatment unit.

Cone of depression (or drawdown) A depression in the groundwater table or potentiometric surface that has the shape of an inverted cone and develops around a well from which water is being withdrawn. It defines the area of influence of a well.

Contact spring A spring located at the interface of an aquitard or confining layer and aquifer.

Contamination plume The region of dispersal of groundwater contaminants in an aquifer.

Contour map A map displaying lines that connect points of equal value and separate points of higher value from points of lower value. Often used to show land or groundwater level surfaces.

Deviation from the mean The amount greater or less than the average.

Dolostone A carbonate rock (e.g. limestone) made up predominately of the mineral calcium magnesium carbonate.

Geomorphic regions Land areas divided into regions by common geologic and topographic features.

Geomorphology The study of the nature and origin of the processes that create the physical landscape and the landforms that result from these processes. The processes include the effects of tectonic forces, weathering, running water, waves, glacial ice, and wind, resulting in erosion, transportation, deposition of rocks, etc.

Glacial till Glacial deposits composed of mostly unsorted sand, silt, clay, and boulders deposited directly by the glacial ice.

Groundwater Water located in inter-connected pores found beneath the water table.

Groundwater discharge The process of groundwater leaving an aquifer.

Groundwater discharge area The point or region where groundwater leaves an aquifer. Groundwater discharge areas include the land surface, streams, lakes, wetlands, springs, and seeps. Groundwater also discharges to wells.

Groundwater recharge The process whereby surface water infiltrates into groundwater. Also used in this groundwater plan to describe the transfer of groundwater from any one aquifer into another aquifer.

Groundwater recharge area The region or area in which groundwater recharge occurs.

Hydrogeology The science of water use, quality, occurrence, movement, and transport beneath the earth's surface.

Hydrologic cycle Movement of water in and on the earth and atmosphere. Numerous processes such as precipitation, evaporation, condensation, and runoff comprise the hydrologic cycle.

Hydrostratigraphic unit A formation, part of a formation, or group of formations in which there are similar hydrologic characteristics allowing for groupings into aquifers or confining layers.

Ice contact deposits Sediment deposited beneath or adjacent to the glacier margin. Ice contact deposits are typically rich in sand and gravel.

Ice walled lake deposits and glacial lake deposits Sand and silt deposits which were formed in bottoms of lakes within or at the margin of a glacier.

Impervious surfaces Land cover that is composed of materials that inhibit the infiltration of surface water into the ground. Common impervious surfaces include: roads, driveways, parking lots, buildings and compacted soils.

Individual Sewage Treatment System (ISTS) (also known as septic system) A sewage treatment system connected to a single dwelling or establishment, consisting of sewage tanks and a soil treatment area (usually a drainfield or mound).

Infiltration The movement of water from the soil surface downward into the soil profile.

Karst A topography developed largely by groundwater erosion and characterized by numerous caves, springs, sinkholes, solution valleys, and disappearing streams. Karst features create conditions of rapid groundwater infiltration and flow.

Limestone A sedimentary rock composed mostly of the carbonate mineral calcium carbonate.

Nitrate An organic chemical compound composed of one nitrogen and three oxygen molecules (NO_3). Sources of nitrate include fertilizers, pesticides, animal and human waste. Nitrate easily dissolves in water and readily moves through soil and into regional aquifers.

Non-point source pollution Pollution originating from diffuse areas (land surface or atmosphere) having no defined source. Examples include field agricultural chemicals and urban runoff pollutants.

Outwash deposits Sediment deposited by the glacier meltwater away from the glacier margin. Outwash is usually composed of sand, sand and gravel, or fine sand and silt.

Outwash plain A region of relatively flat to undulating topography covered by glacial outwash.

Paleozoic era An era of geologic time lasting from 570 to 245 million years ago.

Perched (Lake or Wetland) A surface water body that is underlain by a fine grained geologic unit or aquitard that restricts the downward movement of surface water. Perched lakes and wetlands are less connected to groundwater systems.

Point source pollution Pollution originating from a single identifiable source. Examples include waste disposal sites, leaking storage tanks, chemical spills, ruptured pipelines, and individual sewage treatment systems.

Porosity The ratio of the volume of void spaces in a rock or sediment to the total volume of the rock or sediment.

Primary porosity Created by a high degree of porosity in geologic materials such as sand and gravel.

Quaternary period Geologic time beginning about 1.5 million years ago to present.

Regional blueprint Regional development guide prepared by the Metropolitan Council for the metropolitan area consisting of a growth strategy into the year 2040.

River terrace A mostly level to gently rolling landform that developed along the region's major river valleys by vastly larger glacial melt-water rivers. River terraces contain abundant sand and gravel deposits.

Safe well yield Amount of groundwater that can be withdrawn from an aquifer without degrading quality or reducing pumping level.

Sandstone A sedimentary rock composed of abundant rounded or angular fragments of sand set in a fine-grained cemented matrix of silt or clay.

Secondary porosity Alteration of geologic materials creating highly fractured and broken materials.

Sedimentary rock Any rock composed of sediment. The sediment may be particles of various sizes such as gravel or sand, the remains of animals or plants as in coal and some limestones, or chemicals in solution that are extracted by organic or inorganic processes. Sandstone, shale, siltstone, and limestone are common sedimentary rocks.

(201) Sewer Use Ordinance Chapter 8 of the Washington County Development Code. Provides rules on the type of waste which may be disposed in community soil treatment units and provides the legal basis for taxing and fee structures to fund waste system construction and maintenance.

Shale A fine-grained sedimentary rock, formed by the consolidation of clay, silt, or mud.

Siltstone A sedimentary rock composed primarily of silt-size materials.

Special Well Construction Areas(SWCA) An area designated by the Minnesota Department of Health where groundwater contamination is known to exist. In these areas well construction, repair, and sealing practices are more stringent than the minimum requirements specified by Minnesota Rules, Chapter 4725 (Well Code) in order to prevent human health exposure to harmful contaminants.

Stratigraphy The study of rock strata distribution, deposition, and age.

Superfund The common name for the Federal program established by the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended in 1986. The Superfund Law authorizes the U.S. Environmental Protection Agency to investigate and clean up sites nominated to the National Priorities List.

Superfund site Sites on the National Priorities List that the Environmental Protections Agency has the authority to investigate and clean up under the Superfund Law.

Surface water runoff Precipitation, snow melt, or irrigation in excess of what can infiltrate or be stored in small surface depressions.

Terrace deposits Sand and gravel deposited by vastly large post-glacial rivers that ran through the St. Croix and Mississippi River valleys. Terrace remnants within the Mississippi River valley generally are underlain by finer grained sediment than those within the St. Croix River valley.

Unsaturated zone (or zone of aeration) The part of the soil profile in which the voids are not completely filled with water. The zone between the land surface and the water table.

Water table The point beneath the unsaturated zone where aquifer materials are fully saturated and the water levels are directly responsive to changes in atmospheric pressure. The water table level may also be reflected in lakes, streams and wetlands.

Water table aquifer The uppermost unconfined aquifer in any given area. Water table aquifers are commonly found in surface or glacial sediment but can be formed in bedrock aquifers.

INTRODUCTION OVERALL GOAL AND PRIMARY ISSUES

Overall Groundwater Plan Goal: Protect the economic and environmental values groundwater provides through coordinated , intergovernmental efforts in research and assessment; policies; political influence;regulation; education; and consultation.

Introduction and Overall Goal

Groundwater is perhaps Washington County's most valuable natural resource. High quality drinking water, healthy streams, clear lakes, fish habitat, rare plants and economic vitality all depend on protecting and conserving groundwater resources. The overall goal of the Washington County Groundwater Plan is to:

> ***Protect the economic and environmental values groundwater provides through coordinated, intergovernmental efforts in research and assessment; policies; political influence; regulation; education; and consultation and technical assistance.***

The 2003 Washington County Groundwater Plan provides a County-wide framework for the protection and conservation of groundwater resources. The Groundwater Plan "ownership" and implementation falls to every community, watershed organization, and state agency with a vested interest in protecting Washington County's groundwater resources.

The groundwater Plan compliments existing water plans and establishes a structure for the writing of the next generation of water management plans in the County by establishing goals and policies to protect the groundwater. Goals, policies, and Implementation Actions will act as a model for groundwater planning and protection throughout the County.

The users of this plan are anticipated to range from city and county officials, watershed organizations, state agencies and active citizens. Washington County Government will provide overall leadership, coordination, and annual review for implementing the Groundwater Plan but it will take a concerted and coordinated effort at all levels of government to carry it out.

Primary Groundwater Issues

As the Groundwater Plan was drafted, two primary issues emerged influencing the overall direction and implementation strategies - groundwater quality and groundwater quantity.

Groundwater Quality

Maintaining clean, safe groundwater is critical to human and environmental health and to the economic and social vitality of our communities. Sources of groundwater contamination include residential, commercial, and industrial waste disposal; landfills; leaking petroleum tanks; septic systems; and fertilizer/pesticide inputs. Groundwater is of high quality throughout much of the County; however, there are locations where contaminants have been found above the established health risk limits. In these areas, there are added financial and social costs to manage the affected water supply.

The 2003 Groundwater Plan focuses on efforts to reduce or eliminate the future degradation of groundwater quality through initiatives involving community and regional planning, zoning, policies, regulations, research, education, and consultation. Communities can address water quality by amending zoning and land use to address their relationship to groundwater quality. Water resource management agencies can develop rules and provide assistance to communities and citizens using education and technical information. Collaboration between citizens, businesses, communities, local government, and state agencies is the key to protecting groundwater quality into the future.

Groundwater Quantity

Groundwater is a finite resource. The three main factors affecting groundwater abundance are:

1. the volume of replenishment to or recharge of aquifers from rainfall and snow melt;
2. the amount of groundwater pumped out of aquifers; and
3. the volume of groundwater naturally discharged to lakes, wetlands and streams.

Using a banking analogy to explain these factors, replenishment of groundwater from rainfall and snowmelt is comparable to making a deposit into a bank account. Aquifers function as the bank account. Pumping water out of aquifers is analogous to making withdrawals from the bank account. Recharge from infiltration of rainfall and snowmelt is analogous to making a deposit in the bank account. Effectively managing the groundwater account means tracking the amount deposited, monitoring the balance, and making decisions on how much can be withdrawn (pumped) without overdrawing the account.

Humans have little control over climate and weather and, therefore, cannot manage the volume of water available for replenishing aquifers. However, humans do have an effect on the land surface where groundwater recharge occurs. Development of the land generally increases the amount of impervious surfaces (pavement and buildings), reducing the natural ability of precipitation to infiltrate into aquifers and thus reducing water quality and stream base flow.

Washington County's population is projected to increase by 42% by the year 2020 to 288,670 residents. Accompanying the growth in population will be an increase in groundwater pumping to serve household, commercial and industrial needs. Historically, the region's aquifers have served populations with abundant water; however, there may be limits to the amount of water available for pumping before aquifers are depleted, lake levels are lowered and stream flows are diminished.

Managing the groundwater bank account will take a concerted effort to balance recharge (deposits) with discharge (debits). Multiple communities share the region's aquifers and it will take a collaborative, coordinated effort to develop sustainable groundwater management.

SECTION I GROUNDWATER PLAN ORGANIZATION

Minnesota Statute 103B.255 directs counties to coordinate groundwater plan implementation efforts and gives counties authority to enter into agreements with local units of government and watershed organizations establishing responsibilities during the implementation of the groundwater plan.

ORGANIZATION OBJECTIVES

The Washington County Groundwater Plan is structured to accomplish three objectives.

1. Provide structure, direction and timing to the parties charged with implementing the Groundwater Plan.
2. Concisely outline the physical nature of groundwater resources and potential impacts.
3. Adequately state the goals, rationale and Implementation Actions to address specific groundwater issues.

The Groundwater Plan is organized into two main parts: Part A and Part B. Figures and Appendices are located at the back of the Plan. Table I-1 provides an outline of the Groundwater Plan organization structure.

Table I-1: Washington County Groundwater Plan Organizational Structure

ORGANIZATIONAL STRUCTURE WASHINGTON COUNTY GROUNDWATER PLAN			
	INTRODUCTION		
	PART A	Groundwater Plan Organization	Section I
		Groundwater Plan Requirements and Preparation	Section II
		Groundwater Plan Implementation	Section III
	PART B	Groundwater Resource Overview	Chapter 1.0
		Specific Goals-Issues-Policies and Implementation Actions	Chapter 2.0 - 8.0
	FIGURES		
	APPENDICES		

Part A includes an introduction to the Groundwater Plan and addresses organization and structure (Section I), preparation (Section II), and implementation (Section III).

PART A:

ORGANIZATION- PREPARATION -IMPLEMENTATION

Sections I – III provide the administrative framework for the 2003 Groundwater Plan. These sections address the Groundwater Plan requirements, preparation, development, use and implementation as discussed below.

Section I: Groundwater Plan Organization

Section I (this section) of the Groundwater Plan lays out the organizational structure of the Groundwater Plan.

Section II: Groundwater Plan Requirements and Preparation

Section II describes the requirements and process for the preparation of the 2003 Washington County Groundwater Plan. The foundation of the 2003 Groundwater Plan is the 1992 "Draft" Washington County Groundwater Plan which was reviewed and re-drafted with the assistance of a Groundwater Advisory Committee (GWAC). The GWAC provided input to establish goals and identify issues. The GWAC then identified 32 short-term "high priority" Implementation Actions to address groundwater issues.

Section III: Groundwater Plan Implementation

Section III of the Groundwater Plan provides a framework for implementing the 32 short-term "high priority" actions identified by the GWAC, Technical Advisory Committee (TAC), and County staff. Groundwater Plan Implementation Actions are organized by leadership and team roles, and by implementation schedule.

The Washington County Department of Public Health and Environment will provide overall coordination for implementing the Groundwater Plan.

PART B:

GROUNDWATER RESOURCE OVERVIEW/GOALS/ISSUES/POLICIES/IMPLEMENTATION ACTIONS

Part B of the Plan provides a groundwater resource overview (Chapter 1.0) and a description of goals, issues, rational, policies and implementation strategies to address seven issue areas (Chapters 2.0 through 8.0) which are important for protecting and conserving groundwater resources, as described below.

Groundwater Resource Overview (Chapter 1.0)

Chapter 1.0 (Groundwater Resource Overview) provides technical information necessary for understanding and addressing groundwater issues. Topics discussed include geology, geomorphology, groundwater hydrology, groundwater sensitivity to pollution, climate, surface water interaction and groundwater related natural resources. Future groundwater related policies, regulations, research, and educational programs may utilize the technical organization and nomenclature outlined in Chapter 1.0.

Groundwater Issues (Chapters 2.0 through 8.0)

Chapters 2.0 through 8.0 provide a comprehensive overview of the issues that affect or could effect groundwater resources.

Chapter 2.0	Non-Agricultural Land Use
Chapter 3.0	Agriculture, Turf, and Animal Waste Management
Chapter 4.0	Individual Sewage Treatment Systems (ISTS)
Chapter 5.0	Wellhead Protection and Well Management
Chapter 6.0	Groundwater Supply
Chapter 7.0	Groundwater and Surface Water Interaction
Chapter 8.0	Hazardous Materials Management and Transportation

Issue Chapter Organization

Chapters 2.0 through 8.0 are each organized into three parts:

1. a "goal statement" presented at the beginning of each chapter;
2. an "issues statement" outlining the specific concerns, needs, and rationale for protecting and conserving groundwater resources and;
3. specific policy and Implementation Action statements providing direction to protect and conserve groundwater resources.

Policy and Implementation Action Statement Organization

Listed at the end of each chapter are policy and implementation statements. These statements are listed in the proposed chronological order of completion. The policy/implementation statements provide the following:

1. policy statement;
2. action to be taken;
3. action designation;
4. lead party;
5. proposed team and;
6. year the action will be initiated.

Figures

All figures in the Groundwater Plan are located in the Figures section.

Appendices

Appendices A - D are located in the back of the Groundwater Plan.

SECTION II GROUNDWATER PLAN REQUIREMENTS AND PREPARATION

The GWAC provided a balanced and thoughtful foundation for building implementation strategies providing the perspectives of rural and urban communities, water management organizations, construction, well drilling, and hydrology professionals

Groundwater Planning Requirements

Minnesota Statute 103B provides counties with the authority and requirements for completing groundwater plans. All the requirements of a groundwater plan are provided to the reader in Minnesota Statute 103B.255 located in Appendix A. The statute states the groundwater plan must:

1. cover the entire area within the county;
2. describe existing and expected changes to the physical environment, land use, and development in the county;
3. summarize available information about the groundwater and related resources in the county, including existing and potential distribution, availability, quality, and use;
4. state the goals, objectives, scope, and priorities of groundwater protection in the county;
5. contain standards, criteria, and guidelines for the protection of groundwater from pollution and for various types of land uses in environmentally sensitive areas, critical areas, or previously contaminated areas;
6. describe relationships and possible conflicts between the groundwater plan and the plans of other counties, local government units, and watershed management organizations in the affected groundwater system;
7. set forth standards, guidelines, and official controls for implementation of the plan by watershed management organizations and local units of government; and
8. include procedures and timelines for amending the groundwater plan.

1992 Draft Washington County Comprehensive Groundwater Plan

In 1990, Washington County began developing a groundwater plan and in November of 1992 released a draft Comprehensive Groundwater Management Plan. The 1992 Draft Plan was not guided through the final review and approval process and, therefore, was not finalized and implemented.

2001 Groundwater Advisory Committee and Technical Advisory Committee

In January 2001 the Washington County Board of Commissioners re-activated the Washington County Groundwater Advisory Committee (GWAC) for the purpose of guiding and advising County staff in reviewing and re-drafting the 1992 draft Plan (as required by MS 103B.255).

A Groundwater Technical Advisory Committee (TAC) consisting of state, regional and federal water resource professionals regularly attended the GWAC meetings and workshops. The TAC included staff from the DNR, MPCA, MDH, MDA, Met Council, WCLM, MNEXT, WCD, U of M, SCWRS and NRCS. The TAC provided valuable insight into the multitude of scientific, regulatory and political issues facing the management of groundwater.

A list of GWAC and TAC members appears at the front of the Groundwater Plan (pgs. 4-5).

Review and Update of Policies and Content of the 1992 Draft Groundwater Plan

The GWAC began meeting in March 2001, holding monthly meetings until April 2002. Workshops were held to re-evaluate the policies and issues outlined in the 1992 draft plan. Outdated issues and policies were removed or modified and new issues and policies were identified and drafted into a new updated plan. The Plan was restructured and reformatted to reflect the changes. Updated issues and policies are presented in Chapters 2.0 through 8.0 of the Plan.

Groundwater Plan Implementation Action Development and Prioritization

The GWAC provided a balanced and thoughtful foundation for prioritizing implementation strategies. The GWAC represented the perspectives of rural and urban communities, water management organizations, construction, well drilling and hydrology professionals.

The GWAC evaluated the plan contents and developed an initial list of 90 "Implementation Action Items" prioritized into three categories based on chronological order of completion and into six categories based on the "type" or "area" of action being taken:

Implementation Action Chronological Designation

1. Short-Range Implementation Action (0-3 years)
2. Medium-Range Implementation Action (3-5 years)
3. Long-Range Implementation Action (> 5years)

Implementation Action Area

1. Policy
2. Regulation
3. Political Influence
4. Education
5. Consultation and Technical Assistance
6. Research

The list of Short Range Implementation Actions was further evaluated by the GWAC using the following criteria:

1. financial feasibility;
2. political feasibility and;
3. effectiveness in protecting groundwater resources.

This final winnowing exercise produced a list of 32 "high priority" short range Implementation Action items. The 32 high priority Implementation Actions are presented in Section III (Groundwater Plan Implementation) and in Chapters 2.0 through 8.0 of the Groundwater Plan. For a full listing of Implementation Actions, see Appendix D.

SECTION III GROUNDWATER PLAN IMPLEMENTATION

The ownership and implementation of the Groundwater Plan must be a greater Washington County community effort involving local government, watershed organizations, state agencies, and all with a vested interest in protecting groundwater resources.

Introduction

The Washington County Groundwater Plan is a comprehensive document that lays out the technical framework, issues, policies and Implementation Actions for the protection and conservation of groundwater resources. By State Statute, Washington County Government is responsible for writing, coordinating and administering the Plan; however, no one entity has the overall authority to implement all the necessary actions.

The ownership and implementation of the Groundwater Plan must be a greater Washington County community effort involving local government, watershed organizations, state agencies, and all with a vested interest in protecting groundwater resources.

Section III of the Groundwater Plan provides the organizational structure and timing for implementing the 32 high priority Implementation Actions identified during the plan's development. Each Implementation Action is assigned a Team Leader and Team Partners. Leader and Partner roles, assignments and schedules are outlined at the end of this Section (III) on Role and Assignment Sheets. Specific background information, rationale, and policies supporting these 32 Implementation Actions are provided in Chapters 1.0 through 8.0.

Groundwater Plan Implementation Expectations

The goal of preparing, adopting and implementing a Groundwater Plan is to provide proactive measures to address existing and future groundwater related problems. It is hoped that the greater Washington County community will realize the important economic and environmental benefits of enacting proactive implementation measures to protect and conserve this valuable resource now and for future generations.

The Groundwater Plan identifies Implementation Actions to correct or prevent specific problems. The severity of the problems and the scope and magnitude of the solutions will dictate the priority and public will to implement specific actions. For instance, a drought would most likely raise the awareness and magnitude of water conservation. In that situation, there will be a greater public will to implement actions to address water conservation and water supply.

It is not expected that all 32 of the high priority Implementation Action items identified in this Section will be initiated within the recommended three year period. Instead, they serve as a menu of options that can be drawn from to protect and conserve groundwater resources as the need and will arise.

Enacting specific Groundwater Plan Implementation Actions will require thoughtful coordination by Washington County staff and the assigned Team Leaders. In addition, it will take political and financial support from many agencies and the greater Washington County community.

Implementation Action Priorities

High Priority Implementation Actions

The Groundwater Advisory Committee (GWAC) and County staff identified 32 high priority Implementation Actions to be initiated within three years of the Groundwater Plan's adoption. These 32 high priority Implementation Actions are addressed in this Section in their respective Chapters. Implementation Action items were prioritized by the GWAC working with Technical Advisory Committee (TAC) and County staff (see Section II). The prioritization of Implementation Actions was based on the assessment of each Implementation Action considering the political feasibility, financial feasibility, and overall effectiveness in protecting groundwater resources.

Lower Priority Implementation Actions

Fifty-nine additional Implementation Actions were developed and considered for addressing specific groundwater issues (Appendix D). These Actions were categorized by the GWAC, TAC, and County staff into short-range (21 items), medium-range (24 items), and long-range (14 items) categories. Short-range Actions were to be initiated within three years of the Plan's adoption, medium-range Actions from three to five years, and long-range Actions in more than five years.

These 59 Implementation Actions should be considered for inclusion in future updates of the Groundwater Plan. If groundwater issues in Washington County arise that are best addressed by these lower priority Implementation Actions, any one or more may be moved to "high priority" status. WCPHE staff will work with the GWAC and involved parties to address re-prioritization of lower priority Implementation Actions. This will not involve making amendments to the Groundwater Plan.

Implementation Action Categories

Groundwater Plan Implementation Actions fall into six categories: Policy; Regulation; Political Influence; Consultation and Technical Assistance; Education; and Research as described below.

- **Policy:** Policy actions provide direction to individuals, local and regional governments, and/or state and local resource management agencies. Policies are statements outlining recommended actions to address activities that will protect or conserve groundwater resources.

- **Regulation:** Regulations are intended to provide for the protection and/or conservation of groundwater through the establishment of rules, and/or permitting authorities.

- **Political Influence:** Political influence will be used to advocate for groundwater protection policies and rules at the regional and state levels.

- **Consultation and Technical Assistance:** Consultation and Technical Assistance efforts will provide local government and resource management officials with essential data and understanding to develop policies, regulations and groundwater resource management programs.

- **Education:** Education will be used to advance understanding and awareness at the local and regional levels to protect and conserve groundwater resources.

- **Research:** Research will support policy, regulation, political influence, consultation technical assistance, and education efforts.

Groundwater Plan Implementation Funding

Minnesota Statute 103B.255 states: "A metropolitan county may levy amounts necessary to administer and implement an approved and adopted groundwater plan. A county may levy amounts necessary to pay the reasonable increased costs to soil and water conservation districts and watershed management organizations of administering and implementing priority programs identified in the County's groundwater plan."

Two levels of funding are needed to implement the Groundwater Plan. The first or base level of funding allows County staff to both provide overall Groundwater Plan coordination activities and develop an annual groundwater program workplan in coordination with the Groundwater Advisory Committee. A second level of funding is needed to complete specific Plan Implementation Actions or to initiate other related groundwater programs. Funding for these positions is derived from several sources, including state grants, the Lake Jane Landfill Fund, and the County's general fund.

Long-term funding for base level coordination and implementation of the Groundwater Plan will be derived from a variety of sources. It is anticipated that two full-time employees housed in the Department of Public Health and Environment are needed to provide overall coordination and technical services to citizens and local government. In addition, it is anticipated the Washington County Information Services will provide one quarter-time position for Geographic Information Systems (GIS) support. Other County Departments lending support at varying levels may include Administration (Planning), Transportation and Physical Development, and the County Attorney's Office. The Washington Conservation District is also an important partner in providing base technical services. The costs to provide a base level of service should continue to utilize all available grants in combination with the Lake Jane Landfill Fund and general fund dollars.

Groundwater related research projects, rule and policy development, education and technical assistance programs, and capital improvement projects will be funded based on the specific goals and benefits of the participating or benefiting parties. To the greatest extent possible, state and federal grants will be sought to fund projects. Efforts will be made to develop cooperative, joint funding of projects from local government and watershed organizations. Washington County will provide overall coordination of grant funding efforts, including cost-sharing. As part of implementation, financial assistance may also be available to individual homeowners through cost-share grants or low interest loans available from the WCD, or other organizations.

Coordination of Groundwater Plan Implementation

WCPHE staff will provide the overall coordination for implementing the Groundwater Plan. Once the Groundwater Plan is adopted, and each year thereafter, WCPHE staff will develop an annual report and a workplan detailing the next year's activities, which will include the following sections.

1. A summary of the previous year's activities and accomplishments.
2. The implementation tasks to be completed within that year.
3. A detailed schedule of activities.
4. A detailed budget.

During the annual workplan development County staff will work with the GWAC and all parties involved in implementing the specific tasks to coordinate schedules and budgets, and identify other needs or concerns.

Budget funding strategies and potential grant programs will be provided in the annual workplan. Budget development activities will be coordinated and scheduled to coincide with the budgeting activities of identified financial partners.

Once the annual review and workplan are completed, they will be distributed to all parties identified in the Groundwater Plan. County staff will work with the lead organizations to track progress of the yearly activities and budgets.

Groundwater Plan Implementation Roles – Assignments – Schedule

Implementing the Groundwater Plan will take the efforts of Washington County government, cities and townships, water management organizations, and regional, state and federal agencies.

Each of the 32 Implementation Actions has an assigned team **leader,** team **partner(s)** and a schedule. Implementation Action Team Leader roles and action summaries are presented on designated sheets (**Leader Role and Assignment Sheets**) located at the end of this Section (III). Implementation Action Team Partner roles and summaries (**Team Partner Role and Assignment Sheets**) are also provided at the end of this Section (III). Leadership and team partner roles should be considered flexible so that other parties or groups may take over leadership or partner activities if deemed desirable or necessary.

Implementation Team Leaders

Ten organizations or organization groups are identified as team leaders in implementing specific actions to protect and conserve groundwater resources. Team leaders may also be designated as team partners. Leadership assignments were based on the overall function of the identified organization with respect to the authorities and roles that the organization traditionally serves. For instance, Local Government Units (LGU) traditionally have authority over zoning and land use; therefore, Implementation Actions requiring the adoption of zoning or land use ordinances or rules were given an LGU leadership assignment. The ten organization groups identified to serve as Groundwater Plan implementation leaders are summarized on Table III-1. The table identifies the Lead Implementing Organization/Group, the number of lead actions, and the Role and Assignment Sheet designation.

Role and assignment sheets are located at the end of Section III as marked by the tabs along the right border of the Plan. These sheets identify the Lead and team organization, a description of the role the organization serves, a summary of the Implementation Action, and the year the implementation action is to be initiated. The sheets also provide a reference for all the Implementation Actions the leader is involved with as a team partner.

Table III-1: Implementation Action Leader

Lead Organization/Group	Lead Actions	Role Assignment Sheet
Washington County Public Health and Environment (WCPHE)	16	Leader A
Local Government Units (LGU)	4	Leader B
Watershed Districts Watershed Management Organizations (WD/WMO)	3	Leader C
Minnesota Department of Health (MDH)	2	Leader D
Metropolitan Council Environmental Services (MC)	1	Leader E
University of Minnesota Extension (MNEXT)	1	Leader F
Minnesota Department of Agriculture (MDA)	1	Leader G
Washington County Water Consortium (WC)	1	Leader H
Department of Natural Resources (DNR)	1	Leader I
Washington County Land Management (WCLM)	1	Leader J

Implementation Team Partners

Three organizations were identified as Groundwater Plan Implementation Partners. Implementation Partners will serve on an implementation team as directed by the Team Leader. Partners were assigned based on the traditional roles they serve in natural resources and or land use management. Table III-2 outlines the Team Partners, the number of Implementation Actions they are assigned to and the designated Team Partner Roles and Assignment Sheets located at the end of this section. Team Partner Role and Assignment Sheets provide a summary of the roles and reference to the assigned Implementation Actions (Chapters 2.0 through 8.0).

Table III-2: Implementation Action Partner Summary

Implementing Organization/ Group	Partner Actions
Minnesota Pollution Control Agency (MPCA)	9
Washington Conservation District (WCD)	12
USDA Natural Resource Conservation Service (NRCS)	1

CHAPTER 1.0 GROUNDWATER RESOURCE OVERVIEW

Groundwater resources are a major component of the regions basic infrastructure and must be understood, managed, protected, and conserved to sustain the economic vitality and environmental health of Washington County.

Introduction

Groundwater provides 100 percent of the drinking water, and virtually all the water for commercial, industrial and irrigation needs of Washington County. Groundwater is also vital for maintaining the quality and quantity of water in many lakes, wetlands and streams. Much of Washington County groundwater originates almost entirely within its own borders. The greater County-wide community must manage, protect, and conserve this resource.

To effectively protect and conserve Washington County groundwater resources, the science of groundwater and the issues generated by a growing population must be understood. Chapter 1.0 of the Groundwater Plan presents an overview of Washington County groundwater resources, providing a science-based backdrop to address groundwater concerns and to develop protective management strategies.

Geology and Landscape

Groundwater moves through several geologic formations within Washington County. Advancing and retreating marine seas left behind a sequence of limestone, sandstone and shale bedrock layers dating back to the Paleozoic Era (570 to 245 million years ago). Following these events, the bedrock was subjected to a long period of erosion. Beginning about 1.5 million years ago in the Quaternary period, a sequence of glaciers advanced and retreated across Washington County shaping the land and leaving in their wake formations of clay, silt, sand and gravel on top of bedrock formations.

Bedrock Formations

Bedrock found at the land surface or immediately beneath younger glacial deposits was formed in shallow seas during the Paleozoic Era (570 to 245 million years ago). These layers or beds of sandstone, shale, and limestone are collectively referred to as sedimentary rocks. These rocks are divided into groups or formations based on similarities in age or rock type. **Figure 1.1** illustrates the bedrock geology of Washington County showing the differing rock types and groupings. **Table 1.1** provides a description of the bedrock geologic formations or groups sorted by hydrologic significance.

Table 1-1: Washington County Bedrock Geology

Age	Bedrock Formation or Groups	Description	Thick-ness (Feet)
Middle Ordovician	Decorah Shale Platteville Limestone Group Glenwood Shale	These three formations make up the youngest or uppermost bedrock found in Washington County. They are found only in south central portions of the County.	0-35
	St. Peter Sandstone	The St. Peter Sandstone consists of poorly cemented (crumbly) medium-grained, pure quartz sandstone. The lower portions contain inter-layered beds of shale and coarse sand. The St. Peter subcrops in much of the western portion of the County, and there are scattered remnants of the unit found throughout the northern and eastern parts of the County.	0-66
Lower Ordovician	Prairie Du Chien Group	Dolostone dominates most of this unit. Minor sandstone and shale layers are found in the lower portions. The Prairie Du Chien is known to contain abundant fractures and openings and, in some areas, sinkholes and caves occur. Areas with sinkholes, large fractures and caves are called *Karst* areas. The Prairie Du Chien underlies most of Washington County. Notable absences of this unit occur in deeply incized *bedrock valleys* and in the extreme northwest and eastern parts of the County.	134-203
Upper Cambrian	Jordan Sandstone	The Jordan Sandstone consists of poorly layered, poorly cemented, medium to course sand. The Jordan is found throughout Washington County with notable exceptions in deeply incised bedrock valleys in the north and east and a region in the extreme northwest part of the County.	66-96
	St. Lawrence Formation	The St. Lawrence Formation is composed of thin layers of shale and siltstone and is found under all of Washington County except in some areas along the St. Croix River and in the far northwest.	30-58
	Franconia Formation	The Franconia Formation consists mostly of fine-grained sand in southern Washington County and ranges from medium to coarse grained in the north. The thickness of the Franconia ranges from 165 to 166 feet. These units underlie all of the County except a minor area in St. Croix Valley.	165-166
	Ironton - Galesville Sandstone	These sandstone units are composed of fine to course-grained sand. The Ironton/Galesville unit is found underlaying all of Washington County except in one deeply incised portion of the St. Croix Valley in Lakeland.	56
	Eau Claire Formation	This formation consists of shale, siltstone and very fine-grained sandstone. This unit underlies all of Washington County.	63-114
	Mt. Simon Formation	The upper third of this unit consists of very fine grained sand and siltstone beds. The lower two-thirds are composed of medium to course-grained sandstone. The Mt. Simon underlies all of Washington County.	160-255
Pre-Cambrian	Undivided	These consist of layers of shale and sandstone overlying volcanic rocks.	?

Bedrock Structure

The bedrock structure refers to the angle of the layers or beds, faults, fractures and erosional features. Sedimentary rocks are typically deposited in horizontal beds or layers. Over time, these beds are subjected to small movements within the earth's crust causing downward and upward folding, fracturing, and faulting. In most cases in Washington County, the bedrock layers tilt gently to the west. Minor folding of the rock occurs in eastern portions of the County. Some faulting of the rock also occurs near the St. Croix River.

In addition to the minor movements and fracturing, bedrock is subject to weathering and erosion. Weathering is caused by the actions of freezing and thawing, and by chemical dissolution of minerals in the rock. Sinkholes and caves are known to exist in areas along the Mississippi and St. Croix River Valleys. These features were formed by the chemical erosion of limestone bedrock. Sinkholes and caves are referred to as Karst features which are visible in southern Washington County where shallow depressions on the land surface have been caused by the subsidence of underlying bedrock.

The bedrock formations in the County were eroded first by water and then by glacial ice over a several hundred million year period. **Figure 1.2** illustrates the present topography of the bedrock surface as it exists below the surface or glacial sediment. This map represents the extent to which the original bedrock formations were eroded. Prior to the advance of glaciers, the land surface was dissected by stream gullies and valleys separated by bedrock uplands and plateaus. This eroded bedrock surface was later buried by sediment derived from glaciers. The present topography of Washington County was influenced to a major extent by the pre-glacial topography. Many of the current low areas are situated over bedrock valleys. Lakes and wetlands are concentrated in these low areas. The dissected bedrock surface has an important affect on groundwater resources as is described later in this chapter.

Surface Geology

Understanding the physical characteristics, extent and relationship of the surface geology is key to developing an overall understanding of groundwater. Over the past 1.5 million years (Quaternary Period), continental scale glaciers advanced from northern regions four times into Washington County, further eroding the bedrock and depositing sediment. The last two glacial advances significantly influenced the present surface geology and landscape.

These glaciers were massive - several thousand feet thick - and moved slowly, transporting and depositing large quantities of clay, silt, sand and gravel. The glaciers deposited sediment in several different ways, which had a direct bearing on the present geology and landscape.

Sediment deposited directly by glacier ice is called glacial till. As the glaciers receded, they generated a substantial volume of melt water. Melting glaciers deposited great quantities of coarse sand and gravel beneath and close to the glacier margins. These are called ice-contact deposits. Further away from the glacier, braided melt water streams left broad deposits called glacial outwash. In some locations, melt-water formed lakes within depressions in the wasting ice mass and also in front of the glacier. Sand and silt deposits formed in the bottom of the lakes are termed ice walled lake deposits or glacial lake deposits.

The southeast corner of Washington County was not covered by either of the last two glaciers but was covered by older glaciers. Remnants of older glacial till cover some of the region. The landscape is dissected by ravines, gullies and streams. Surface sediment has filled in some of these features but, in general, bedrock is found at or near the surface. Soils in this region tend to be thin and composed of fine sand and silt.

Figure 1.3 illustrates the Surface Geology in Washington County providing the distribution of four glacial deposit types as grouped by the Minnesota Geological Survey (MGS). These deposit types - sand and gravel, fine sand, sandy silt, and glacial till – are described in **Table 1.2**.

Table 1-2: Surface Geology Washington County, MN

SURFACE GEOLOGY UNIT TYPE	SURFACE GEOLOGY UNIT DESCRIPTION
Sand and Gravel	Sand and gravel deposits are widespread and deposited in three primary ways: a) at the glacier's margin by melt water. These are termed *ice contact* deposits; b) by glacial melt waters away from but still proximal to the ice margin. These are termed *outwash* deposits; and c) by post glacial rivers that coursed through the St. Croix and Mississippi River Valleys. These are termed *terrace* deposits.
Fine Sand	Fine sand deposits are found in much of Washington County. The principal environment for the deposition of fine sands was in lakes. Fine sand is also found in post-glacial and modern river deposits.
Sandy Silt	Sandy silt deposits are found throughout the County and were deposited in both lake and river environments.
Glacial Till	*Glacial till* is deposited directly by glacial ice. Till is characteristically highly variable, containing a mix of sediment ranging from clay through sand, gravel, and boulders. Four discernable glacial till units have been mapped based on sediment type (MGS 1998). Till is found at the surface and at greater depths in the northern part of the County. Till units are thickest in the north and thin to the south.

Geomorphology

The shape of the land, or geomorphology, is the product of long-term geologic processes described above. The pre-glacial landscape was strongly modified by glaciers in most of the County. Large quantities of coarse glacial sediment were deposited haphazardly at the glacier margin, creating a landscape dominated by hills and depressions. Further from the glacier margin, broad, gently rolling plains of sand outwash were deposited. Glacial lakes left behind regions of relatively flat silty and sandy soils. The southeast corner of the County represents a contrast to the recently glaciated areas.

The County can be divided into five distinct areas, or geomorphic regions, based on common geologic and topographic features. **Figure 1.4** illustrates the locations of these regions. These regions share a commonality of factors that influence groundwater and the issues that may affect groundwater resources. The five regions are described below.

St. Croix Moraine: The St. Croix Moraine is the dominant geomorphic feature in Washington County marking the furthest most eastern advance of the last great ice sheet in the region. Glacial sediment is up to several hundred feet thick. The landscape is characterized by rolling hills, ridges and closed depressions. A complex mixture of ice-contact, outwash, ice-walled lake, and glacial till deposits cover the bedrock. Lakes and wetlands occupy many of the depressions. Streams are nearly absent. Most surface water either infiltrates into the ground or runs to closed depressions. The moraine dominates the central and northern parts of the County and extends into Woodbury.

Glacial Lake Hugo Plain: The Glacial Lake Hugo Plain lies in northwestern Washington County. The terrain is gently rolling to flat. The surface geology consists primarily of fine sand and sandy silt glacial lake deposits and outwash. Wetlands and shallow lakes are common.

Lake Elmo-Cottage Grove Outwash Plain: As the last glacial ice melted back, a large area to its south was covered with sandy outwash deposits. The outwash plain is gently rolling and punctuated by shallow depressions and lakes. Parts of the plain are hilly where the outwash deposits overlay the rolling topography of the St. Croix Moraine. The outwash plain covers parts of the south central region of the County extending from Lake Elmo to Cottage Grove. In the southern portion of the outwash plain, the bedrock surface topography is reflected on the undulating land surface.

Denmark Dissected Plain: The Denmark Dissected Plain lies in southeastern Washington County outside the region covered by the last glacial advance. This area exhibits a gentle to strongly rolling topography controlled by the topography of bedrock surface. In general, thin soils cover the bedrock. This region is distinct from the rest of the County because there is a relatively well developed surface drainage system and few lakes or wetlands are found.

St. Croix and Mississippi River Terraces: Broad flat to gently rolling areas covered by sand and gravel are found along the eastern and southern edges of Washington County. These are called terrace features which were formed from the deposition of sediment in vastly larger glacial melt-water river valleys.

GROUNDWATER HYDROLOGY

General Groundwater Principles

Groundwater hydrology or hydrogeology is the study of the interaction between earth materials and water. The occurrence of water in the earth (groundwater) and its movement is the primary focus of the field of hydrogeology. To address groundwater, it is important to step back and first look at the larger "hydrology" picture. **Figure 1.5** depicts what is termed the hydrologic cycle. The hydrologic cycle explains the three paths precipitation takes after falling onto the land surface.

1. Precipitation evaporates into the atmosphere directly or through plants.
2. Runs off directly to surface water bodies (lakes, streams, wetlands).
3. Infiltrates downward into geologic formations. Water that infiltrates into the ground moves through an unsaturated zone to the water table. At this point it becomes groundwater.

The infiltration of precipitation into groundwater is referred to as groundwater recharge.

Groundwater flows through porous geologic materials. The less porous the geologic material, the greater the difficulty for groundwater to flow through it. Aquifers are geologic formations that transmit groundwater in sufficient quantities to a well for human consumption. Permeable sand and gravel create what is called primary porosity. Highly fractured and broken materials like limestone create secondary porosity. Aquifers can exhibit primary porosity, secondary porosity, or a combination of the two. In Washington County, both porous sand and gravel glacial or surface deposit, and highly fractured, weathered, limestone and sandstone bedrock formations act as aquifers.

Geologic units that transmit little groundwater are referred to as Aquitards or confining layers. Aquitards can exhibit a range of porosity from nearly impermeable to moderately impermeable. All aquitards have some component of permeability and allow small amounts of water to pass through them. In Washington County, clay or silt-rich glacial till or lake deposits, and shale bedrock formations function as aquitards. Aquitards limit the amount of groundwater flow passing from one aquifer to another.

Aquifers can be either confined or unconfined. Confined aquifers, also called artesian aquifers, have aquitards above them. Unconfined aquifers have no aquitard above them and may also be considered a water table aquifer.

Infiltration of surface water into groundwater, or recharge, occurs in recharge areas. Recharge capability is controlled by the amount and timing of precipitation, the surface geology and geomorphology, bedrock geology, and bedrock topography. Groundwater recharges water table aquifers in widespread areas of the County where surface sediment is highly to moderately permeable. Recharge is especially focused on flat areas and areas where depressions dominate the land surface. Groundwater recharges the bedrock where bedrock aquifers are in contact with water table aquifers or where bedrock is close to the land surface.

In aquifers, groundwater is driven by gravity, migrating both vertically and horizontally, towards groundwater discharge areas. Groundwater discharge areas include streams, lakes, wetlands and wells. The major groundwater discharge zones in Washington County are the St. Croix and Mississippi Rivers.

Washington County Aquifers and Aquitards (Hydrostratigraphy)

The geologic units described on Tables 1.1 and 1.2 can be grouped and divided into either aquifers or aquitards. Hydrostratigraphy is the grouping of geologic units by the properties of groundwater flow.

Quaternary Hydrostratigraphy

The Quaternary geologic formations are varied and complex in Washington County and so is groundwater flow through them. In some cases, such as with broad outwash plains, the geology and groundwater hydrology is predictable. In many cases though, especially in deeper, older glacial sediments, geologic formations change over short distances causing groundwater flow to be less predictable. **Table 1.3** provides a description of the Quaternary aquifers and aquitards or hydrostratigraphy.

Table 1-3: Hydrostratigraphy
Glacial Sediment Units
Washington County

Hydro-stratigraphic Unit	Hydrologic Function	Hydrostratigraphic Unit Description/Importance
Sand and Gravel	Major Aquifer to Minor Aquifer	Quaternary sand and gravel deposits are important aquifers in the County. These deposits occur at the surface and at varying depths down to bedrock. Sand and gravel units at or near the land surface function as important groundwater recharge areas. Water moves rapidly and in large quantities through sand and gravel aquifers. Drinking water supply wells in sand and gravel aquifers are found in the northern part of the County and in terrace deposits along the major rivers.
Fine Sand	Minor Aquifer	Quaternary fine sand aquifers are used infrequently for water supply, but are important as groundwater recharge areas. Fine sand readily transmits groundwater but in most cases at moderate rates and quantities. Fine sand units tend to be relatively level or contain basins that enhance groundwater recharge.
Sandy Silt	Minor Aquitard	Sandy silt units function as aquitards because they transmit groundwater very slowly and in low quantity. Sandy silt units at the land surface allow less infiltration or recharge to aquifers. Sandy silt is found at the surface and at depth.
Glacial Till	Minor Aquitard to Major Aquitard	Because they vary greatly in sediment size and density, glacial till units can function as minor aquifers to aquitards in Washington County. Sandy, less compacted tills function as minor aquifers. Two tills with higher percentages of sand and gravel have been mapped in the county. Dense, clay and silt rich tills transmit water at lower rates and quantities and function as aquitards. Two till units have been mapped having greater abundance of clay and silt in the County.

Bedrock Hydrostratigraphy

Four bedrock aquifer hydrostratigraphic units are found beneath Washington County. The units vary in thickness, porosity, permeability, and water quality. The principal bedrock groundwater sources used by Washington County communities, well owners, and industry are the Prairie du Chien and Jordan aquifers. Other bedrock aquifers include the St. Peter Sandstone, the Franconia and Ironton-Galesville sandstone, and the Mt. Simon Hinckley sandstone formations. Three bedrock hydrostratigraphic units function as major aquitards. **Table 1.4** provides a description of the bedrock hydrostratigraphy of Washington County.

Table 1-4: Hydrostratigraphy
Bedrock Units
Washington County

Hydro-stratigraphic Unit	Hydrologic Function	Hydrostratigraphic Unit Description/Importance	Thickness
Decorah Patteville Glenwood	Aquitard	These units are discontinuous and where they occur in Washington County, function as a groundwater confining unit. The shales are least permeable. Parts of the Platteville limestone are permeable and may yield minor amounts of water, but it is not considered an important groundwater source in the County.	0-35
St. Peter Sandstone	Aquifer Minor	The St. Peter Sandstone is discontinuous in Washington County. The St. Peter was eroded significantly prior to deposition of glacial sediment. The unit is a minor source of water for private well use. In some areas, the lowest portion of the St. Peter contains siltstone and shale and may act as a confining layer.	0-66
Prairie Du Chien	Aquifer Major	The Prairie Du Chien Group limestone is an important aquifer in Washington County because it is relatively thick and exhibits a high level of porosity. Many private and public water supplies tap into this source. The aquifer is available nearly County-wide with exceptions in the northwest corner and far eastern side of the County.	134-203
Jordan Sandstone		The Jordan Sandstone is the most used aquifer for municipal purposes in Washington County. It is another relatively thick and porous unit that supplies abundant water to wells. It is available in nearly all areas of the County.	66-96
St. Lawrence Formation	Aquitard	The St. Lawrence Formation is a thick shale and siltstone unit that transmits little water. It is an effective aquitard separating the Prairie Du Chien-Jordan Aquifer above from the Franconia-Ironton-Galesville aquifer below.	30-58
Franconcia Ironton Galesville	Aquifer Major	These combined units are grouped into a single hydrostratigraphic unit. This aquifer is used in areas of the County where the shallower Prairie Du-Chien-Jordan aquifer is absent or may be unusable. The aquifer underlies most of the County except near Lakeland.	220
Eau Claire Formation	Aquitard	The Eau Claire Formation shale and siltstone transmit little water. This unit acts to effectively separate the Franconia-Ironton-Galesville Aquifer from the Mt. Simon Aquifer.	63-114
Mt. Simon Hinckley Formation	Aquifer Major	This is a productive aquifer located beneath the entire County. It is used only in areas located adjacent to the St. Croix River and, in one case, in Forest Lake. At present, there is a State ordinance prohibiting use of this aquifer except for municipal water supplies.	160-255

Groundwater Recharge

Groundwater recharge has a direct bearing on the future of Washington County groundwater quantity and quality. The factors that influence groundwater recharge include geology, geomorphology, land use and climate.

Groundwater Recharge to Water Table Aquifers

The quantity of groundwater recharge varies from year to year and decade to decade based on climate fluctuations. Differing geology and geomorphology influence where groundwater recharge is more or less prevalent. The quantity and quality of groundwater recharge can be altered by human activity. In urban regions, where the land cover contains a higher percentage of impervious surfaces, groundwater recharge may be reduced. Point source and non-point source pollution released in groundwater recharge areas will degrade water quality.

The five main geomorphic regions of Washington County function in varying capacities as groundwater recharge areas (Figure 1.4). The recharge characteristics of the five regions are described in **Table 1.5**.

Groundwater Recharge to Bedrock Aquifers

As discussed previously, and as presented on Table 1.4, one minor and three major bedrock aquifers lay below Washington County. Aquitards provide separation between these aquifers.

For bedrock aquifers to recharge, there must be a pathway for groundwater to move from the surface downward. Groundwater recharge to bedrock aquifers occurs where aquitards are absent. The upper bedrock aquifers (St. Peter Sandstone, Prairie du Chien group, Jordan sandstone) receive recharge waters from overlying sand and gravel, fine sand, or sandy till glacial sediment. Recharge to deeper bedrock aquifers is concentrated in bedrock valleys where aquitards have eroded away and the deeper aquifers are in contact with water bearing glacial sediment. **Figure1.2** shows the locations of bedrock valleys and **Figure 1.1** shows the uppermost bedrock surface beneath the glacial or surface sediment.

Deeper aquifers also receive recharge through leaking aquitards. Recharge through aquitards, though less significant, is an important source of groundwater in the deepest aquifers. **Table 1.6** describes the hydrogeologic factors affecting recharge of bedrock aquifers.

Table 1-5: Recharge Functions of Geomorphic Regions Washington County

Geomorphic Region	Topography/Geology	Groundwater Recharge Function
St. Croix Moraine	The heavily rolling moraine land surface is covered with permeable sand and gravel and moderate to less permeable fine sand deposits and glacial till. In urbanized areas of the moraine (Oakdale, Woodbury, Stillwater) there is a higher degree of impervious surfaces. Natural surface water drainage is limited to a few small creeks. Abundant closed depressions containing lakes and wetlands are common. Other depressions are dry.	Recharge occurs over most of the moraine. Areas with higher amounts of clay or silt till and ice walled lake sediments have lower recharge functions. Closed depressions and level sandy regions function as key recharge areas.
Glacial Lake Hugo Plain	Relatively low-lying and gently rolling to flat. Contains mostly fine sand and silty sand units. The water table is generally very close to or at the land surface. Surface water drainage systems are relatively undeveloped (except in ditched areas).	In areas where there is sufficient thickness of unsaturated materials between the land surface and the water table, a moderate to high amount of recharge will occur.
Lake Elmo-Cottage Grove Outwash Plain	Moderately flat to rolling and dominated by fine to medium sand material.Closed depressions contain lakes and wetlands, others are dry. There is generally little natural surface water drainage. In the southern part of this region, the sandy outwash unit thins and lies directly in contact with the bedrock.	Because of the gentle terrain, the abundance of permeable geologic material and the presence of numerous closed depressions, this is a key recharge area in the County.
Denmark Dissected Plain	Moderately rolling to rugged terrain with thin soils or bedrock at the surface. There is a well developed surface water drainage network of small ravines and valleys. Closed depressions (karst features) are present but not abundant and are typically dry. The fractured and karsted Prairie Du Chien aquifer is close to the surface.	Recharge is mainly into the Prairie Du Chien and Jordan Aquifers. Much of the region is subject to rapid infiltration of surface precipitation into the groundwater system.
St. Croix and Mississippi Terraces	These regions border the Mississippi and St. Croix Rivers and are generally level to moderately rolling. The surface geology consists of abundant sand and gravel.	Groundwater recharge is high on the flat sand and gravel plains.

Table 1-6: Recharge Factors
Bedrock Hydrostratigraphy
Washington County

Hydro-stratigraphic Unit	Hydrologic Function	Description of Groundwater Recharge Factors
Decorah Patteville Glenwood	Aquitard	Prevents recharge to the St. Peter Sandstone and underlying bedrock aquifers. Present in much of Woodbury and Cottage Grove and in parts of Lakeland, Afton and Denmark Township. Recharge into lower aquifers may be focused along the edges of the Platteville.
St. Peter Sandstone	Minor Aquifer Minor Aquitard	Recharged in areas where it is not overlain by the Decorah/Platteville/ Glenwood confining layer, generally in the west central part of the County (Mahtomedi, Dellwood and Grant). The lower portion may act as a minor aquitard to the Prairie Du Chien-Jordan Aquifers. Numerous erosion channels and windows are cut through exposing the Prairie Du Chien-Jordan Aquifer to Quaternary sediment and recharge.
Prairie Du Chien Group	Major Aquifer	Recharge is from Quaternary aquifers. In general, regions on the St. Croix Moraine, Lake Elmo-Cottage Grove Outwash Plain and St. Croix and Mississippi Terraces not overlain by the Decorah-Platteville-Glenwood aquitard are significant recharge areas. Some recharge probably occurs from the St. Peter Sandstone. Glacial till units may function as local aquitards. In the Denmark Dissected Plain region, quaternary sediment is thin or absent and groundwater recharges directly to the Prairie Du Chien-Jordan system. In this area as well as areas along the major rivers, karst features may create highly permeable localized recharge conditions.
Jordan Sandstone		
St. Lawrence Formation	Major Aquitard	Restricts groundwater from moving downward into the Franconia-Ironton-Galesville Aquifer. Absent in a limited region of northern and eastern Washington County.
Franconcia Ironton Galesville	Major Aquifer	Recharge occurs in the far northwest and northeast portions of the County in isolated bedrock valleys where the St. Lawrence is eroded. Communication with the overlying Quaternary aquifers will vary based on the thickness and extent of till that lies above the aquifer. Bedrock valleys are important conduits into this aquifer. Recharge from outside the County and leakage through the St. Lawrence Formation is also a factor.
Eau Claire Formation	Major Aquitard	A major region-wide aquitard preventing downward migration of groundwater to the Mount Simon Aquifer.
Mt. Simon Sandstone	Major Aquitard	Recharged outside of the county in areas where it is not overlain by the Eau Claire formation. Recharge from leakage through the Eau Claire Formation is also a factor. The Minnesota Department of Natural Resources has currently placed a moratorium on use of the Mt. Simon Aquifer for water supply.

Groundwater Recharge Climate-Precipitation

Washington County lies in the northern mid-continental region of North America exhibiting a climate of warm humid summers and cold dry winters. The climate is influenced by three major elements: polar air masses originating in Canada, subtropical air masses originating in the Gulf of Mexico, and variable air masses from the Pacific regions. The region experiences marked short, near and long-term climatic variations in temperature and precipitation. In this region, the amount of precipitation considerably exceeds the amount of evaporation resulting in abundant surface water resources and groundwater recharge.

The average annual temperature is 45.2° F. Temperatures average 12.8°F in January (the coldest month) and 72.2°F in July (the warmest month). There is a slight variation in temperature from the southern to the northern parts of the County. The first frost usually occurs in early October and the last frost usually occurs in mid May.

Precipitation statistics from the past 50 years (near Stillwater) indicate an average annual precipitation of 31.34 inches. **Figure 1.6** illustrates a graph of precipitation data from 1900 to 2000. The graph shows the difference either greater than or less than the average annual precipitation. This is referred to as the deviation from the mean annual precipitation. The graph helps to illustrate the degree of precipitation fluctuations above and below normal from year-to-year and from decade-to-decade.

During the first decade of the Twentieth Century, precipitation was considerably above the 100 year average. The second decade shows about equal events above and below average precipitation. Beginning in the early 1920s and continuing through the 1930s, precipitation amounts were significantly below the average showing a drought of significant magnitude. Precipitation recovered during the early 1940s though there was a moderate drought recorded in the later part of the decade. During the 1950s and 1960s precipitation fluctuated above and below the average about equally. In the 1970s precipitation was moderately above average. Beginning in the early 1980s and continuing through the 1990s, precipitation levels exceeded the 100 year average, except for a moderate drought during the late 1980s. The 1980s and 1990s were, back-to-back, the wettest two decades recorded over the past century.

Precipitation amount is the principal driver for groundwater recharge volume. In turn, recharge volume impacts water levels in aquifers, the amount of water available to sustain human consumption, and the volume of water available to supply surface water bodies that depend on groundwater interaction.

Groundwater levels are closely tied to surface water levels in much of northern Washington County. Fluctuation of groundwater levels due to climatic variations has several major implications on local and regional planning efforts. Growth of housing in parts of the County with shallow water tables may be effected by short and long-term groundwater level fluctuations. Prior to new development, flooding potential should be evaluated in landlocked areas and areas with shallow groundwater.

It will be equally important to understand the affects drought conditions could have on groundwater systems. Even droughts of less magnitude, such as occurred in the late 1980s, triggered concerns about diminishing water supplies and lowered lake levels. A drought of the magnitude seen during the 1920s and 1930s could create a serious shortage of groundwater for pumping and may set up potential conflicts between the needs of different communities and the protection of natural resources.

Groundwater Flow and Discharge

Groundwater flows horizontally and vertically through aquifers from recharge areas to discharge areas. Groundwater flow can be mapped using water level elevation data collected from wells and surface water bodies. Points of equal elevation are connected by lines to draw a contour map of the groundwater level surface. Flow direction can be determined by drawing lines perpendicular to the groundwater contours. The flow direction is towards the contour of lowest elevation.

Groundwater Flow and Discharge: Water Table Aquifer

Groundwater flow through the water table aquifer is illustrated on **Figure 1.7**. Groundwater flow through the water table aquifer follows three general paths:

1. from recharge areas to local discharge areas such as minor streams, ditches, wetlands and lakes;
2. from recharge areas into the major river valley discharge areas (Mississippi and St. Croix); and
3. from recharge areas through this aquifer into bedrock aquifers.

Groundwater Flow and Discharge: Bedrock Aquifers

Figure 1.8.1 to **1.8.5** illustrates groundwater flow patterns in the bedrock aquifers. As is depicted on the figures, groundwater moves from the central upland regions of the County flowing in a radial pattern to the east, south, and west. Groundwater discharges to both the Mississippi River to the south and west and to the St. Croix River to the east. Along the west edge of the County, groundwater flows into Ramsey and Anoka Counties.

Groundwater discharges into the major rivers through sand and gravel deposits. Discharge is also concentrated in seeps, bedrock fractures, in ravines eroded back from the main river valleys and along contacts between confining layers and aquifers.

Groundwater also discharges to domestic, municipal and industrial wells. High capacity wells can have a significant impact on groundwater flow, creating zones of influence miles in diameter. When a well is pumped, it creates a drawdown in the aquifer water level. This drawdown, referred to as the cone of depression, can extend for great distances depending on the rate of pumping, capacity of the aquifer, and influence of other wells.

Groundwater Dependent Resources

As discussed previously and depicted on **Figure 1.5**, the hydrologic cycle refers to the interaction between water in the atmosphere, surface water and groundwater. Each element of the hydrologic cycle performs vital functions. Clean and plentiful groundwater is highly important to the economic vitality and environmental health of the region. The key resources dependent on groundwater are:

- consumptive water needs (household, municipal and industrial use)
- lakes
- streams
- unique and rare natural resources

Private/Municipal/Commercial/Industrial/Agricultural Water Use

All water used for human consumption in Washington County is derived from groundwater. All the major aquifers are pumped for human needs. The Prairie du Chien and Jordan aquifers are the most frequently used aquifers. Historically, water supplies have been adequate to meet the needs of the County's households, communities and industry. Water resources are finite so it is important to effectively manage water resources as populations grow and water use increases. Maintaining adequate supplies of groundwater to serve public needs and natural resources requires careful analysis and decision-making.

Throughout most of Washington County, groundwater resources are moderately to highly susceptible to pollution introduced from the surface environment. **Figures 1.9** and **1.10** illustrate the "Sensitivity of Groundwater Systems to Pollution." Factors that affect this susceptibility include surface geology, bedrock geology and land use.

Two general contaminant sources have historically impacted groundwater quality point source and non-point source. Point sources include waste disposal sites, leaking storage tanks, chemical spills, or ruptured pipelines. Non-point sources include such things as the wide spread application of agricultural chemicals, urban runoff pollutants, and individual sewage treatment systems.

Point Sources of Groundwater Pollution

Prior to 1976, when the Federal Government instituted the Resource Conservation and Recovery Act (RCRA), chemical wastes and petroleum hydrocarbons were virtually unregulated with respect to transport, storage, use and disposal. Because of this many hazardous chemicals and petroleum hydrocarbons were released onto the ground surface in landfills, temporary disposal areas, from leaking tanks and from spills. These releases sometimes resulted in groundwater contamination.

Over time, contaminants released from a point source migrate with the groundwater, dispersing both horizontally and vertically away from the source. The dispersal area, or contamination plume, migrates toward local and regional groundwater discharge areas. Municipal and private water wells in the path of groundwater contamination plumes may need treatment or to be replaced by drilling new wells to address the potential health risks associated with groundwater contaminates.

Beginning in the 1970s and 1980s, Federal, State and local regulations were implemented to address hazardous material transport, use and storage. Laws were developed to hold parties responsible for investigating and cleaning up hazardous wastes and affected groundwater. At present, there are numerous documented sites in Washington County that have resulted in groundwater contamination. **Figure 1.11** illustrates the locations of 13 state or federally designated superfund sites in Washington County where contaminants have been discovered.

An increasingly rigorous regulatory environment governs the transport, handling, and disposal of hazardous materials and has reduced the potential for new point source groundwater contamination problems. Point source pollution from accidental releases or spills of hazardous materials from manufacturing operations, storage facilities and from transportation activities such as pipelines, railroads and trucking remains a threat to the groundwater system. Point source pollution is also a risk where animal wastes are improperly handled.

Non-Point Sources of Groundwater Pollution

Land activities in the County have degraded groundwater quality through non-point source pollution. The most common non-point source contaminant is nitrate, a compound that is found in fertilizers and is also a by-product of animal and human waste. Insecticide and herbicide applications are other known non-point source pollutants that have been detected in groundwater in Washington County.

Hydrogeology and land use significantly influence the susceptibility of groundwater systems to non-point source pollution. Susceptibility to pollution from non-point sources exists mainly in a wide region of southern Washington County where major bedrock aquifers are only covered by a thin layer of glacial deposits. Intensive agriculture, nursery, and urban land use are three major sources of non-point pollutants in this region.

At present, approximately 16 percent (135/865) of drinking water wells sampled by Washington County in the Cottage Grove and Denmark Township area are impacted by nitrate levels that exceed the Health Risk Limit of 10 mg/l. A recent study completed by the Minnesota Pollution Control Agency (MPCA, 2000) reports that a significant number of the impacted wells also contained quantities of herbicide products or by-products.

Lake Resources and Groundwater

Lakes provide important public recreation for swimming, boating, and fishing. Lakes are also desirable aesthetic features to residents and visitors. Lakes provide important ecologic and hydrologic functions. Lakes function both as groundwater recharge areas and groundwater discharge areas. The role of groundwater in the overall ecologic health of lakes and aquifers is important, but often not well understood.

Groundwater recharge lakes collect and store water which, in turn, recharge regional aquifers. Many lakes in the County are positioned above bedrock valleys, providing a steady source of water for recharging deeper bedrock aquifers.

Lakes dependent on groundwater discharge from springs are common in Washington County. Groundwater input varies by lake with some lakes receiving relatively high levels of spring flow and some lakes only moderate amounts of spring input. Lakes with abundant groundwater input tend to be clear and are highly valued by residents and the visiting public.

Stream Resources and Groundwater

Washington County contains abundant springs that discharge to small and medium-sized creeks. The majority of these creeks lie along the St. Croix River Valley. Several spring creeks contain conditions suitable to support trout fisheries. Valley Creek, Brown's Creek, and Mill Stream are three notable trout streams. Groundwater also discharges to the Mississippi and St. Croix Rivers from springs, spring creeks and large seepage areas.

Groundwater Fed Wetlands and Unique / Rare Natural Communities

Groundwater discharge seeps to the land surface occur mainly along the St. Croix River Valley. These seeps provide a steady source of water creating conditions suitable to support unique plant and animal communities. Groundwater dependent natural communities are highly susceptible to small changes in spring flow. Natural community types dependent on groundwater identified in Washington County include the mixed hardwood seepage swamp, black ash seepage swamp, rick fens, seepage wet prairies, circum neutral tamarack swamps, sedge meadows, and moist cliff communities. Other rare community types dependent on groundwater seepage may be present in the County, but have not been identified.

Groundwater seepage is the key feature that sustains these natural communities. These resources are relatively rare in the region because of the unique hydrologic conditions which support them. There are several unique and rare plant and animal species dependent on groundwater seepage conditions. Plant species include: False Mermaid, American Water-pennywort, Bog Bluegrass, and Halberd-Leaved Tear Thumb. Rare animal species include the Louisiana Waterthrush.

Managing and Protecting Groundwater Dependent Resources

Both water quality and water quantity issues must be addressed to effectively manage and protect groundwater dependent resources. Human influence on groundwater systems is usually subtle with very few single incidents creating a measurable problem.

Land cover and land use changes are incremental. The proliferation of impervious surfaces on the landscape will, over time, slowly reduce groundwater recharge. It would take decades of monitoring to actually measure the effects. Non-point sources of pollution seldom leave decisive clues to assist in generating meaningful contaminant reduction strategies.

Point sources of pollution have caused serious groundwater contamination problems in the past. An aggressive regulatory environment has reduced this threat; however, continued vigilance and rapid response to address new releases should continue to be a high priority.

Population growth is steady, yet the affects of increased groundwater pumping are hard to gauge in any single year. The County's increasing population will increase the demand for groundwater. Detailed analysis are needed of the capacity of the region's aquifers to sustain both the growing population and groundwater dependent resources. Computer modeling of aquifers provides one tool for predicting future groundwater conditions. However, the modeling must be calibrated to real world conditions. Detailed monitoring of water levels in aquifers is a necessity to provide an understanding of the affects of pumping and climate fluctuations on groundwater supplies.

Groundwater resources are a major component of the regions basic infrastructure and must be understood, managed, protected and conserved to sustain the economic vitality and environmental health of Washington County.

CHAPTER 2.0 NON-AGRICULTURAL LAND USE

Goal: To protect and conserve Washington County's groundwater resources by promoting sustainable growth, integrated land use and water resource management through leadership, education, incentives, and regulatory mechanisms.

ISSUE STATEMENT

This Chapter discusses non-agricultural land uses including residential, commercial, and industrial development; and addresses the impacts these land uses may have on groundwater resources. Agricultural land use is discussed in Chapter 3.0. Land use planning, zoning and decision-making are functions of incorporated cities and Washington County.

Washington County is projected to have a population of 288,670 residents by 2020, with a growth rate of 42 percent between 2000 and 2020 (Metropolitan Council). Commercial and industrial land use will also continue to increase. As discussed in Chapter 1.0, activities on the land, alteration of the land surface and increased demands on water supply from growing populations can affect groundwater quality and sustainability.

The negative effects of non-agricultural land use on water quality are tangible. Today in Washington County the County has four Special Well Construction Areas **(Figure 5.1)**, due to known contamination in the groundwater. Special well construction areas are discussed further in Chapter 5.

To assure long-term economic and environmental health, groundwater protection and conservation must be incorporated into city and County comprehensive plans, zoning ordinances and land use decisions.

The following items summarize the potential impacts non-agricultural land use may have on groundwater *quality:*

- Concentration of non-point source pollutants that may concentrate in stormwater ponds and/or seep into groundwater, such as lawn fertilizers, pesticides, road chemicals and petroleum products in urban areas.
- Proliferation of individual sewage treatment systems or community collector systems in geologically sensitive areas may impact groundwater quality.

- Increase of commercial and industrial land use increases the potential for accidental releases of hazardous materials into the groundwater environment.

The following summarizes the potential impacts non-agricultural land use may have on groundwater *quantity:*

- Impervious surfaces such as roof tops, parking lots, roadways and, in some cases, lawns can significantly increase storm water runoff volume and may significantly reduce groundwater infiltration volume.

- Growing populations create a higher demand on groundwater resources for use in domestic and industrial applications.

Much of the County's land surface is rated "high moderate" to "very high" in sensitivity of the groundwater systems to pollution from contaminants (**Figures 1.9 and 1.10**). Minnesota Statute 103H.005, subd. 13 defines a sensitive groundwater area as a "geographic area defined by natural features where there is significant risk of groundwater degradation from activities conducted at or near the land surface." These regions will require the greatest level of land use management to protect sensitive groundwater resources.

Amendments or updates to city land use plans and zoning ordinances, including issuance of conditional use permits, should include measures for protecting groundwater quality and long-term sustainability. In some instances, land use or zoning changes may trigger surface water management regulations of water management organizations. Washington County administers planning and zoning ordinances in the unincorporated portions of the County. Incorporated cities within Washington County develop and enforce their own land use ordinances. The County will work with local cities to promote adoption of land use plans and zoning ordinances that protect groundwater resources.

Metropolitan Urban Service Area (MUSA) Expansion and Regional Growth

The Metropolitan Council has prepared a regional development guide for the metropolitan area. The guide or "Regional Blueprint" consists of a regional growth strategy into the year 2040. It consists of a compilation of policy statements, goals, standards, programs, and maps prescribing orderly, economic public and private development. **Figure 2.1** illustrates the projected land use in the year 2020.

The Metropolitan Urban Service Area (MUSA) is defined as the region containing urban scale development where the Metropolitan Council operates a regional sewer system. Within the MUSA, the Metropolitan Council is responsible for planning for infrastructure such as regional highways, airports and parks. The Metropolitan Council coordinates infrastructure development and maintenance with local government. The Metropolitan Council also operates the region's wastewater treatment system and the region's transit system. **Figure 2.2** illustrates the location of the MUSA in Washington County. Those parts of Washington County that are partially or wholly within the existing MUSA are the cities of Newport, Saint Paul Park, Cottage Grove, Woodbury, Oakdale, Willernie, Mahtomedi, Birchwood, Lake Elmo, and Landfall. Expansions of the MUSA are requested by local communities and approved or denied by the Metropolitan Council.

The "Blue Print" regional growth strategy divides the metropolitan area into six land use categories including the urban core, the urban area, the urban reserve, rural growth centers, permanent agricultural areas, and permanent rural areas.

The urban core includes Minneapolis and Saint Paul, their immediate neighborhoods and the University Avenue corridor that connects them. The urban area is that part of the region actively becoming urbanized and within which local and regional services are committed during specific time periods. The urban reserve is a rural-to-urban transition area between the current MUSA line and the urban reserve boundary line. Forest Lake, Hugo, and the Stillwater/Oak Park Heights/Bayport area are examples of urban reserve areas in Washington County. The rural growth centers are incorporated areas that currently provide central sewer service and that have planned long-term expansions of their urban service area. Marine on the Saint Croix is the only rural growth center in the County.

The permanent agricultural area is outside of the urban reserve and is intended to be kept in agricultural use indefinitely (**Figure 2.2**). Parts of Afton and Denmark Township are in the permanent agricultural areas. Permanent rural areas are sparsely developed with a mix of farm and non-farm rural uses that will not require urban levels of service for the foreseeable future. New Scandia Township, May Township, West Lakeland Township, Afton, Denmark Township, and parts of Hugo, Grant, Stillwater Township, Baytown Township, Lake Elmo, Lake Saint Croix Beach, Lakeland, Saint Mary's Point and Lakeland Shores make up the permanent rural area. The permanent agricultural and rural areas are the areas that will not receive urban services before the year 2040.

Centralized sewer and water serves most of the area within the MUSA or the boundary of an urban reserve area. Centralized sewer systems should be provided in other high-density development areas to alleviate the potential for groundwater pollution that may be caused by individual sewage treatment systems. The availability of centralized sewers and the future growth of the MUSA are major factors in determining housing density in Washington County. Where the MUSA is extended, higher density development will follow. In areas where no centralized sewers are available, development densities will be lower. Decisions to extend the MUSA will need to consider groundwater resources as higher density development may have an impact on groundwater supplies.

County Comprehensive Planning Process and Zoning

In 1997, the Washington County Board of Commissioners adopted its most recent comprehensive plan. The goals and policies in the Washington County Comprehensive Plan apply to the unincorporated areas of the County. Incorporated cities prepare their own comprehensive plans as discussed later in this chapter.

The Washington County Comprehensive Plan outlines several goals to protect the natural resources of the County while managing growth and development. The elements of the County Comprehensive Plan relating most directly to groundwater protection are found in the Land Use and Natural Resources sections. The Comprehensive Plan promotes development in urban areas where urban services can be provided, and encourages clustering of housing in the rural areas.

The Groundwater Policy in the Comprehensive Plan states:

> ***"Washington County will continue to regulate the development of land so that groundwater quality and quantity is protected from degradation and depletion and maintained in a safe condition for the benefit of all citizens. Pollution prevention will be the top priority. Standards to prevent the contamination of groundwater will be established and enforced. More stringent standards should be adopted to protect areas of significant groundwater recharge."***

Commercial, Industrial and Residential Subdivisions

There are eight chapters in the Washington County Development Code that regulate land use.

1. The Zoning Ordinance establishing zoning districts and permitted uses;
2. The Subdivision Ordinance establishing procedures and standards for the subdivision of land;
3. The Shoreland Management Ordinance regulating the subdivision, use, and development of shorelands of public waters;
4. The Lower St. Croix River Bluffland and Shoreland Management Ordinance regulating land development and natural resource management to protect the scenic, natural, historic, cultural and recreational aspects of the Lower St. Croix Wild and Scenic River corridor;
5. The Flood Plain Ordinance preventing building or expanding structures in floodplains;
6. The Individual Sewage Treatment System Ordinance regulating the location, design, installation, use and maintenance of individual sewage treatment systems;
7. The 201 Sewer Use Ordinances regulating on-site systems that are constructed with state or federal grant assistance and are located within "201" study areas;
8. The Mining Ordinance regulating the orderly, economic, safe removal, processing and reclamation of sand, gravel, rock and soil activities.

The 1997 Washington County Comprehensive Plan promotes the siting of industrial and commercial uses to areas served by municipal sewer. Many commercial and industrial establishments use and generate hazardous products that have the potential to contaminate groundwater from spills or improper waste disposal. The Washington County Development Code also established land use controls in the County. The Administrative Chapter of the Development Code states one of the purposes is to "prevent environmental pollution and to protect surface and groundwater from contamination." Under the Development Code, in granting a conditional use permit, the Planning Advisory Commission "shall consider the affect of the proposed use on groundwater, surface water and air quality." Conditional use controls apply only in the unincorporated areas of the County. Washington County reviews all new conditional use permits in townships and has the ability to require specific conditions in permit applications.

The Subdivision Ordinance requires applicants to provide the following information for plat review: source of water, provisions for sewage disposal, surface water drainage plan and flood control plan. During the County plat review process, potential impacts to groundwater resources may be addressed under the authority of the County.

City Comprehensive Planning and Zoning

Incorporated cities within the boundaries of Washington County develop their own comprehensive plans and zoning ordinances based on an overall direction set by elected officials and planning commissioners. Plans and ordinances are developed working within parameters set by state statutes and on guidelines set by the Metropolitan Council. City Comprehensive Plans are reviewed by the Metropolitan Council and state agencies for adherence to their policies and plans.

Cities across Washington County are growing at varying rates. Communities served by the MUSA are developing at higher residential densities and with a greater percentage of commercial and industrial land use. Communities outside the MUSA are growing at rates and densities established by regional and local goals, policies, and comprehensive plans developed by local elected officials.

Land use planning and land use decisions have an important role in protecting groundwater resources. Groundwater protection strategies must be incorporated into city comprehensive plans to better protect groundwater resources. These strategies need to address the siting of commercial and industrial development using hazardous materials, the potential impact of impervious surfaces to groundwater recharge, and the long-term sustainability of groundwater supplies.

Land Use and Wellhead Protection

Wellhead protection is the concept of managing land use in critical zones of groundwater recharge to reduce the risk of contaminating water supplies. Chapter 5.0 discusses wellhead protection in further detail. The first section of a wellhead protection plan provides a scientific analysis to identify key groundwater recharge areas. The second section provides guidelines for land use and zoning that are protective of groundwater. County and city land use plans and zoning ordinances will need to incorporate wellhead protection.

Mining and Mine Reclamation

Aggregate mining is an important industry in Washington County. Most mining areas contain an abundance of highly permeable sand and gravel or highly permeable bedrock. Mining increases potential impacts to groundwater from spilling of chemicals and/or fuel. After mining is completed, the mining site may be more sensitive to contamination than the pre-mining condition due to the shallower depth of groundwater and, in some cases, removal of less permeable soils.

Mining may take place below the water table, requiring de-watering efforts. Operations pumping more than 10,000 gallons per day or over 1,000,000 gallons per year must obtain a Department of Natural Resources water appropriation permit. Groundwater drawdown in mining areas has the potential to impact local and regional water quantity.

The Washington County Mining Ordinance regulates the removal of sand, gravel, rock, soil, and other natural deposits in unincorporated townships. The mining ordinance also regulates the production of asphalt and concrete. Incorporated cities with mining activity administer mining ordinances and concrete and asphalt production within their boundaries.

CHAPTER 2.0 NON-AGRICULTURAL LAND USE GOAL:

Goal: To protect and conserve Washington County's groundwater resources by promoting sustainable growth, integrated land use and water resource management through leadership, education, incentives, and regulatory mechanisms.

POLICIES AND IMPLEMENTATION STRATEGIES

Policy 1:

Washington County supports basing planning, zoning and land use decisions on sound scientific data and understanding.

- ***Implementation Action 1: Research Land Use Impacts on Groundwater Quality and Quantity:***

  Assess groundwater resources and the potential impacts from different land uses on water quality and quantity. Develop guidelines on building density, percentage of impervious surfaces, stormwater management and groundwater consumption based on the hydrogeologic characteristics.

  (2.1.1-RS)

  Lead: WCHPE

  Team: MNEXT, DNR, MC, WD/WMO, LGUs, MPCA, MDH, WCD

  Year: 2003

Policy 2:

Washington County supports sharing technical information with local government for developing land use plans and zoning ordinances, and in making land use decisions protective of groundwater.

- ***Implementation Action 1: Land Use-Technical Consultation for Land Use Decisions:***

  Provide cities and townships with types of land uses that may not be suitable in un-sewered areas; specific groundwater-related standards to look for in reviewing conditional use permits; and a standard process incorporating groundwater considerations into conditional use permit decisions.

  (2.2.1-CT)

  Lead: WCPHE

  Team: LGUs, WCLM, WD/WMO, MC

  Year: 2004

Policy 3:
Washington County promotes local planning, land use and controls that protect groundwater quality and sustainability.

- ***Implementation Action 1*: *Land Use-Groundwater Supply Sustainability:***
  Recommend the Metropolitan Council consider the long term sustainability of groundwater resources with respect to both water supply and importance in sustaining natural resources as a primary consideration in granting the extension of the MUSA.
  (2.3.1-PI)
  Lead: WCPHE
  Team: WD/WMO, LGUs, DNR
  Year: 2003

- **Implementation Action 2: *Land Use-Integrating Groundwater Protection into Comprehensive Plans, Zoning Ordinances and Decisions:***
  Establish groundwater protection as a goal when making land use decisions and as part of the comprehensive planning process. Incorporate Groundwater Plan recommendations into LGU comprehensive plans. Assure coordination with other LGUs for groundwater sensitive areas, wellhead protection areas, water use contingency and allocation plans, and other groundwater issues where the plans may affect other jurisdictions.
  (2.3.2-PL)
  Lead: LGUs
  Team: WCLM, WD/WMO, WCPHE
  Year: 2005

- **Implementation Action 3: *Land Use-Enforcing and Amending Groundwater Provisions in County and Local Mining Ordinances:***
  Enforce groundwater-related provisions in County and local mining ordinances. Amend ordinances, if necessary, to include the following:
  - Require contamination to be reported, removed and treated according to existing law.
  - Require a plan for on-site servicing of equipment and waste disposal that protects groundwater from contamination.
  - Require groundwater protection plans for asphalt production facilities including such measures as impermeable liners and proper waste disposal measures.
  - Require a bond from the operator of mining operations and/or asphalt plants to assure clean-up of any pollution or pollutant sources.
  - Earmark mining license fees for regulatory activities.

  (2.3.3-RG)
  Lead: WCLM
  Team: LGUs, WCPHE, MPCA
  Year: 2004

- **Implementation Action 4:** ***Land Use-Incorporating Wellhead Protection Plans:*** Adopt wellhead protection plan; create overlay districts and standards and incorporate into zoning ordinances and other related use land regulations. **(2.3.4-RG)**
  Lead: LGU
  Team: WCPHE, WCLM, MDH
  Year: 2004

CHAPTER 3.0 AGRICULTURE, TURF, ANIMAL WASTE MANAGEMENT

Goal: To develop and implement agricultural, turf management, and animal waste management best management practices protective of groundwater resources.

Issue Statement

This chapter addresses impacts to groundwater quality from agricultural practices, turf management and animal waste disposal. Proper application of agricultural and turf management chemicals and proper handling of animal wastes are essential to protecting groundwater quality.

Agriculture and turf management are county-wide activities. Fertilizer and pesticide applications are widely used to grow crops and manage turf. Animal feedlots are common in rural areas of Washington County. Fertilizers, pesticides and animal waste by-products can degrade the quality of groundwater. Contamination risks are magnified in southern Washington County where thin permeable soils lie above shallow bedrock aquifers.

Fertilizer Issues

A common component of fertilizers, *nitrate*, is also the most common groundwater contaminant in Washington County. Nitrate easily dissolves in water and moves readily through soil and into regional aquifers.

In Washington County, the average nitrate level is 2.11 milligrams per liter (mg/l) and the median nitrate level is 2.83 mg/l based on over 12,000 well water tests conducted between the mid 1970s and 2002. Nitrate levels are highest in the southern Washington County communities of Cottage Grove, Denmark Township, and Grey Cloud Island Township. In the southern portion of the County, the bedrock is close to the surface, covered by a thin layer of glacial material offering limited protection to the nitrate-sensitive aquifers below. Historical data collected by WCPHE and recently supported by a Minnesota Pollution Control Agency(MPCA) study indicate 16 percent of the private wells tested in the Cottage Grove area exceed the State Health Risk Limit for nitrate of 10.0 mg/l.

The primary health concern associated with exposure to nitrate is methemoglobinemia, commonly known as "blue baby syndrome". This condition occurs when nitrate is absorbed into the blood stream where it reacts with hemoglobin to produce methemoglobin, thus impairing the blood's ability to carry oxygen to the tissues of the body. This rarely occurs in children older than 6 months or in adults. Epidemiological studies have indicated a possible association between nitrate exposure and an increased risk for reproductive and developmental toxicity, and for non-Hodgkin's lymphoma (NEXIR Study, MDH).

Pesticide Issues

Very few groundwater samples have been collected for pesticide analysis in Washington County. A recent MPCA study completed in the Cottage Grove area found that 68 percent of 72 samples of the groundwater contained pesticide or pesticide breakdown products. None of the samples collected by the MPCA exceeded the federal and state drinking water standards for pesticides. According to the study, there was a strong correlation between pesticides and nitrate occurrences in groundwater. The MPCA states that the correlation between pesticides and nitrate indicates that agricultural practices are the most likely source of the contaminants.

Animal Waste Issues

Animal manure, when used properly, provides essential nutrients, organic matter and moisture to crop-land. Application of manure in geologically sensitive areas, and runoff or seepage from feedlots, can increase the level of nitrogen in groundwater to levels of concern. Manure in feedlots may also contain disease-producing organisms that can cause diarrheal diseases, infectious hepatitis, parasitic infections, cholera, dysentery, salmonella and typhoid fever in humans and domestic animals. Manure management, feedlot operation practices and geologic conditions are all factors that potentially affect groundwater quality.

The Minnesota Pollution Control Agency established a feedlot regulatory program in 2000. This program is administered either by the MPCA or can be delegated to county governments. Currently the MPCA administers the state feedlot program in Washington County.

The Washington County Zoning Ordinance regulates land use in unincorporated townships. The Zoning Ordinance contains provisions for managing manure and feedlots. Provisions of the Ordinance call for "the adoption of all Minnesota Pollution Control Agency minimum requirements, the prohibition of new feedlots within 1000 feet of any lake or pond or within 300 feet of a river or stream, and require all new feedlots to have a permit from the Minnesota Pollution Control Agency." The Washington Conservation District provides technical assistance and consultation to animal feedlot operators.

Turf Management Issues

Fertilizers and pesticides are commonly applied to residential lawns, golf courses and other landscaping. There are three general categories of turf management: homeowners managing private property; commercial operators providing fertilizer and pesticide application to homeowners and commercial customers; and municipal/industrial management of golf courses, parks, schools, sod farms, and nurseries.

Turf management practices have been shown to have an impact on groundwater quality. A recent trend in stormwater management maximizes infiltration of runoff into groundwater systems. Stormwater infiltration strategies benefit surface water quality and minimize stream bank erosion; however, groundwater quality could possibly be degraded from fertilizer and pesticide contaminated stormwater.

CHAPTER 3.0 AGRICULTURE, TURF, ANIMAL WASTE MANAGEMENT GOAL:

Goal: To develop and implement agricultural, turf management, and animal waste management best management practices protective of groundwater resources.

POLICIES AND IMPLEMENTATION STRATEGIES

Policy 1:

Washington County supports using sound scientific methods to assess agriculture and turf management impacts to groundwater resources and to develop education and best management practices programs.

- ***Implementation Action: Research Groundwater Impacts from Agriculture, Turf Management and Animal Wastes.***

  Conduct ongoing groundwater resource assessments to:

  - identify groundwater resources that have been impacted by or may be highly sensitive to fertilizer, pesticide, manure and animal wastes; and
  - provide model zoning language and mitigation strategies in areas shown to have the highest impacts or susceptibility to fertilizers, pesticides or animal wastes.

  (3.1.1-RS)
  Lead: WCPHE
  Team: LGUs, WD/WMO, MDA, WCD, MPCA, MNEXT, WCLM
  Year: 2003

Policy 2:

Washington County promotes implementing educational and best management practices programs for storage, handling, and use of pesticides, fertilizers and animal wastes.

- ***Implementation Action 1: Education of Public and Local Government:***

  Expand educational programs to inform the public and LGUs of:

  - the impacts of fertilizer and pesticide use on groundwater;
  - proper use of chemical products, including the affects of different soil conditions on application rates and different irrigating regimes;
  - areas that are highly sensitive to contamination;
  - alternative management methods, and
  - advantage or disadvantage of commercial applicators.

  (3.2.1-ED)
  Lead: MNEXT
  Team: WCD, NRCS, WCPHE, MDA
  Year: 2003

Policy 3:
Washington County supports legislation and administrative rules that protect groundwater quality from degradation by agriculture, turf management or animal waste management practices.

- ***Implementation Action 1: Exert Political Influence on Agriculture related legislation or rules.***

  Provide comments on current legislative issues and administrative rules.
  (3.3.1-PI)
  Lead: MDA
  Team: LGUs, WD/WMO, WCD
  Year: 2003

CHAPTER 4.0 INDIVIDUAL SEWAGE TREATMENT SYSTEMS

Goal: To reduce groundwater contamination from individual sewage treatment systems (ISTS) by implementing regulatory, education, and technical assistance programs.

Issue Statement

Individual sewage treatment systems (ISTS), commonly called septic systems, are widely used throughout Washington County. Approximately 25 percent of all households in Washington County are served by ISTS (**Figure 4.1**). Proper treatment of wastewater reduces health risks to humans and animals and reduces the threat of contamination to surface and groundwater. A properly functioning or designed ISTS adequately treats septage waste and decreases introduction of bacteria, viruses, and other disease causing organisms into groundwater.

Nitrogen-containing compounds leach from all ISTS. The levels of nitrate concentration varies based on geologic conditions, chemical conditions of the groundwater, depth to groundwater, and the density or number of ISTS in a given area. Nitrate contamination levels are considered safe in most of Washington County. Areas more vulnerable to nitrate contamination include regions with abundant sand and gravel on the land surface where groundwater is relatively shallow (50 feet or less), areas with higher densities of ISTS systems, and agricultural areas.

A February 2000 study by the MPCA evaluated contamination related to ISTS beneath an unsewered portion of southeast Washington County. The location was chosen based on the higher sensitivity of groundwater systems to contamination **(Figures 1.9 and 1.10)** and the relatively high density of older ISTS. The study results showed the average nitrate concentration from well samples was 5.92 mg/l, a relatively high average when compared to the County average of 2.11 mg/l. In addition, non-fecal coliform bacteria were detected in 15 of 52 samples. The study concluded "groundwater impacts from nitrate from ISTS can be minimized by balancing lot size and well placement and well depth" and "larger lot sizes and stringent controls on maintenance of ISTS are needed to minimize impacts from septic systems."

Not all wastes disposed of in ISTS are adequately treated by the soil treatement system. Household hazardous wastes and commercial and industrial wastes are prohibited from being disposed of in ISTS. ISTS owners must be informed of the proper use and maintenance of their systems and the potential of contaminating drinking water by disposing of hazardous or other wastes into ISTS. Chapter 8.0 further discusses hazardous and industrial waste management.

Washington County ISTS Ordinance

The County ISTS Ordinance and local ISTS Ordinances regulate the location, design, installation, use and maintenance of individual sewage treatment systems. The Washington County Department of Public Health and Environment administers the ISTS program in unincorporated areas of the County and portions of the County delegated through contracts with incorporated cities. The communities of Birchwood, Stillwater, Dellwood, and Lake Elmo have adopted and enforce their own ordinances. The ISTS Ordinances in these Cities must be as restrictive as the County ISTS Ordinance.

Washington County "201" Sewer Use Ordinance

Chapter 8.0 of the Washington County Development Code provides the "201" Sewer Use Ordinance. This Ordinance regulates the use of soil treatment units and associated collector systems which have been constructed with state and federal "201" program grant assistance monies. The "201" Ordinance provides rules on the type of waste which may be disposed in community soil treatment units and provides the legal basis for taxing and fee structures to fund waste system construction and maintenance. The community collector waste water treatment systems located in Washington County are shown on **Figure 4.2**.

CHAPTER 4.0 INDIVIDUAL SEWAGE TREATMENT SYSTEMS GOAL:

Goal: To reduce groundwater contamination from individual sewage treat ment systems (ISTS) by implementing regulatory, education, and technical assistance programs.

POLICIES AND IMPLEMENTATION STRATEGIES

Policy 1:
Washington County supports a coordinated, multifaceted approach to regulating individual sewage treatment systems, including research, education and regulation.

- ***Implementation Action 1: Integrate County Programs***
  Assure coordination and integration of ISTS program activities with Hazardous Waste and Groundwater program activities to reduce groundwater contamination related to on-site waste water treatment systems.
  (4.1.1-PL)
  Lead: WCPHE
  Team: LGU
  Year: 2003

- ***Implementation Action 2: Research Commercial-Industrial Waste Impacts***
  Research the wastes generated by commercial and industrial establishments on ISTS and evaluate the potential impact to human health and the environment. Evaluate whether ISTS are properly designed for commercial wastewater.
  (4.1.2-RS)
  Lead: WCPHE
  Team: LGU, MPCA, MDH
  Year: 2005

- ***Implementation Action 3: Develop groundwater contamination risk assessment method.***
  Develop a method to assign ISTS risk levels based on criteria such as age of system, geologic conditions, density, treatment method, and system design.
  (4.1.3-RS)
  Lead: WCPHE
  Team: MPCA, MDH, MNEXT
  Year: 2005

Policy 2:
Washington County promotes conformance with MN Statute 115.55, MN Rule 7080, and the Washington County ISTS Ordinance in the construction, operation, inspection, maintainance of ISTS.

- ***Implementation Action 1: Require ISTS Inspections, Upgrades or Replacements***
  Revise County ordinance to require property owners to have a certificate of inspection, to upgrade or replace nonconforming systems, and identify and properly close abandoned ISTS before property transfer. Require upgrade of improperly installed or nonconforming ISTS.
  (4.2.1-RG)
  Lead: WCPHE
  Team: LGU
  Year: 2005

CHAPTER 5.0 WELLHEAD-AQUIFER PROTECTION AND WELL MANAGEMENT

Goal: To ensure implementation and coordination of State programs to protect public water supplies from contamination.

ISSUES STATEMENT

Wellhead and Aquifer Protection

Wellhead protection is the concept of managing land use in critical zones of groundwater recharge to reduce the risk of contaminating water supplies. Wellhead protection is designed to prevent rather than remediate contamination of groundwater.

In response to the amended Federal Safe Drinking Water Act of 1988, the Minnesota Legislature passed the Groundwater Protection Act of 1989 directing the Minnesota Department of Health (MDH) to develop a wellhead protection program. Minnesota's Wellhead Protection Rules (4717.700 and 4720.5100 to 4720.5590) set the technical and administrative requirements of the Wellhead Protection Program.

Minnesota Wellhead Protection Rules apply only to public water supply wells. The definition of a public supply well is "a well that provides drinking water for human use to 15 or more service connections or to 25 or more persons for at least 60 days a year." This includes schools, office buildings, restaurants, public buildings, and municipal water supply systems. The location of public water supply wells in the County is shown in **Figure 5.3**.

Under the Wellhead Protection Program, all public water suppliers are required to manage an inner-wellhead management zone (a 200-foot radius surrounding a public water supply) by:

A. maintaining the isolation distances for newly installed potential sources of contamination as defined in the state Well and Boring Code (Minnesota Rule Chapter 4725);
B. conducting a vulnerability assessment of the well and the wellhead protection area;
C. conducting an inventory of potential sources of contamination within the wellhead protection area based on the vulnerability assessment;
D. developing a plan to manage and monitor existing and proposed potential sources of contamination; and
E. establishing a contingency strategy for an alternative water supply should the water supply be disrupted by contamination or mechanical failure.

In addition to the inner-wellhead management zone requirements, public water suppliers serving municipalities, subdivisions, manufactured home parks, and facilities such as nursing homes, schools, factories, and hospitals must prepare a wellhead protection plan. The major components of a plan include a map showing the boundaries of the wellhead protection area, an inventory of potential sources of contamination, and a plan to manage these sources.

In Washington County, where groundwater is the sole source of drinking water, wellhead protection is especially important. **Figure 5.2** shows the location of private and public wells located in Washington County found in the County Well Index. Many wellhead protection areas in the County cross local governmental boundaries. Strong state, county and local government coordination will be essential to carry out an effective Wellhead Protection Program.

Well Management

The Minnesota Department of Health licenses well contractors, administers the permitting process for constructing wells and sealing abandoned wells, and inspects wells in Washington County. The Minnesota Well Code became effective in 1974. In some cases, past (pre-well code era) construction may have contributed to groundwater contamination. Improperly constructed and abandoned unsealed wells can act as direct conduits for surface contaminants to enter shallow groundwater and deeper bedrock aquifers.

Local geologic conditions may require special well construction methods. For example, the State Well Code prohibits completion of new wells in fractured bedrock aquifers that are not covered by at least 50 feet of glacial deposits within a one mile radius of the well site. The Minnesota Department of Health also regulates well construction in regions of known contamination. These regions are designated Special Well Construction Areas. Special well construction practices may be imposed to prevent human exposure to harmful contaminants in these areas. These efforts are also geared to promote well construction techniques that minimize the risk of cross-contaminating aquifers during and after well construction. Four Special Well Construction exist in Washington County (**Figure 5.1**). They include the Washington County Landfill site (Lake Jane); Lakeland/Lakeland Shores site, St. Paul Park/ Park Penta site, and the Baytown/West Lakeland site.

Abandoned wells are wells that are no longer in use. State Law requires well owners to either repair abandoned wells and place them in service, or have them permanently sealed by a licensed well contractor. Abandoned wells are a threat to groundwater quality. Abandoned wells are common in both developed, older residential areas that are presently served by public water supplies and in older rural homesteads. Abandoned well identification and sealing efforts will help prevent contamination of groundwater.

CHAPTER 5.0 WELLHEAD-AQUIFER PROTECTION AND WELL MANAGEMENT GOAL:

Goal: To ensure implementation and coordination of State programs to protect public water supplies from contamination.

POLICIES AND IMPLEMENTATION STRATEGIES

Policy 1:
Washington County supports the delineation and posting of wellhead protection areas and supports inter-governmental and inter-community coordination to implement planning and zoning in wellhead protection zones.

- ***Implementation Action 1: Agency implementation and coordination of wellhead protection programs:***
  Washington County will partner with the Minnesota Department of Health and LGUs to implement Wellhead Protection Programs in Washington County. The County will assist LGUs in obtaining all available applicable groundwater information.
  (5.1.1-PL)
  Lead: MDH
  Team: MPCA, WCPHE, LGUs, WD/WMO
  Year: 2004

- ***Implementation Action 2: Community education, posting of wellhead protection areas, and inter-community coordination:***
  Assist public water suppliers in the implementation of wellhead protection programs by placarding local wellhead protection area boundaries for public education and awareness. Facilitate wellhead protection steering committees when the wellhead protection area crosses political jurisdictions upon request by the public water suppliers.
  (5.1.2-CT)
  Lead: WC
  Team: WCPHE, WD/WMO, LGUs, MDH
  Year: 2003

Policy 2:
Washington County supports the enforcement and implementation of the Well and Boring Code (MN Rules Chapter 4725) by the Minnesota Department of Health to prevent contamination of groundwater.

- ***Implementation Action 1: Abandoned well reporting requirements and comments to well code legislation***
  Recommend Well and Boring Code require reporting of all abandoned wells to the MDH. Review and provide comments to pending Well & Boring Code legislation.
  (5.2.1-PI)
  Lead: MDH
  Team: LGUs, WCPHE
  Year: 2004

- ***Implementation Action 2: Well sealing financial incentives and cost sharing***
  Provide financial incentive for identifying and sealing abandoned wells. Develop and adopt sliding-fee scale for well sealing cost-share programs.
  (5.2.2-PL)
  Lead: WCPHE
  Team: LGUs, WCLM, WD/WMO, MDH, WCD
  Year: 2003

CHAPTER 6.0 GROUNDWATER SUPPLY

Goal: To manage a sustainable water supply ensuring ample, high-quality groundwater is available for residential, commercial, and natural resource needs.

Issues Statement

Groundwater is a vital resource in Washington County, providing nearly 100 percent of the potable, commercial, industrial, and irrigation water needs. Competing with these consumptive groundwater uses are natural resources such as streams, lakes and wetlands which are dependent on a steady groundwater supply to maintain their vitality.

The County's continued population growth puts an increasing demand on water supplies. Overuse of aquifers could potentially affect the availability of groundwater for public and private water supplies and reduce levels in lakes, wetlands and streams.

Groundwater contamination from domestic, agricultural, industrial and commercial sources has impacted potable water quality. Four special well construction areas have been designated by the MDH where special well construction regulations exist . Water treatment or alternative water supplies have been provided to residents due to the presence of groundwater contamination (see Chapter 5.0 and **Figure 5.1**). Some aquifers in Southern Washington County have high levels of nitrate-nitrogen, potentially limiting their ability to supply potable water. (see Chapter 3.0).

Water availability has become a Metro Area issue. At least five factors have limited water availability in the Metro area.

1. Aquifer contamination by surface pollutants has limited full availability.
2. Localized overuse of aquifers has lowered water levels causing decreased flow in some streams, lake levels to drop, wetlands to dry up, and wells to pump short or go dry.
3. Provisions of State Law (M.S. 103G) limit the availability of the Mt. Simon/Hinckley aquifer.
4. Rapid growth in second and third tier suburbs has increased demand on groundwater; little information is available to determine the long-term sustainability of water supplies and groundwater dependent natural resources.
5. Proliferation of impervious surfaces has potentially reduced surface area for aquifer recharge.

The highest demand on aquifers often comes during drought conditions. Droughts pose a serious threat to groundwater supplies due to the compounded effects of increased water use for lawn sprinkling and crop irrigation, and decrease in replenishment or recharge of aquifers. In the Twin Cities Metropolitan Area, summer water usage is 2.4 times water usage in the winter (1998 Water Availability Assessment Report, October 1998, DNR). To develop long- term stability of aquifer levels, water use habits must change, as must the misconception that groundwater reserves are infinite.

Groundwater Conservation

Appropriations

The Department of Natural Resources regulates the appropriation of groundwater under Minnesota Rules Chapter 6115 and Minnesota Statutes Chapter 103G. A DNR permit is needed to appropriate groundwater for any domestic use serving more than 25 persons or for any use exceeding 10,000 gallons per day or 1,000,000 gallons in a year.

Minnesota law sets general priorities for water appropriations in the State as outlined from highest to lowest:

DNR Water Use Priorities:

1. Domestic water supplies and power production with contingency plans;
2. Uses of water consuming less than 10,000 gallons per day;
3. Agricultural irrigation and processing of agricultural products;
4. Power production without contingency plans;
5. Commercial and industrial uses exceeding 10,000 gallons per day;
6. Non-essential uses.

The Groundwater Protection Act of 1989 restricts the use of the Mt. Simon-Hinckley aquifer in the seven-county metro area. Use of the Mt. Simon will only be permitted if the appropriation is for potable water use and there are no feasible or practical alternatives to this source. The intent of the law is to protect this resource for high priority water use. In addition, the Groundwater Protection Act prohibits the Department of Natural Resources from issuing a water use permit to increase the volume of appropriations from any groundwater source for a once-through cooling system using in excess of 5,000,000 gallons annually. Existing systems must be terminated by the end of their design-life or no later than December 31, 2010. (M.S. 1990, Sec. 103G.271, subd. 4a)

Watershed Districts are also charged with providing for the protection of groundwater and regulating its use to preserve it for beneficial purposes, as defined in Minnesota Statute 103D.201 Subd.2 (14). Watershed Districts have the authority to regulate groundwater use

and appropriations under Minnesota Statute 103D.335 Subd. 10 if the powers are incorporated into the Watershed District's plan, as defined in Minnesota Statute 103D.341 Subd. 1.

Impacts to Surface Water Resources

Groundwater and surface water in much of Washington County is closely inter-connected. Numerous spring-fed tributaries, including Trout Brook, Valley Creek, Brown's Creek, the Mill Stream and other smaller named and unnamed creeks, are dependent on groundwater discharge to maintain flow and ecological health. Unique wetland communities that rely on groundwater discharge occur along the St. Croix and Mississippi Rivers, in northwestern Washington County, and in scattered isolated regions throughout the County. White Bear Lake, Square Lake, Lake Elmo, and dozens of other lakes are linked closely to aquifer levels. Chapter 7.0 further discusses these resources.

Pumping from aquifers that are connected to surface water resources could potentially lower levels in lakes and wetlands and reduce flow in streams. Long-range comprehensive water supply planning efforts should consider both human consumptive uses and the needs of natural resources.

Conservation and Sustainability

Washington County's population continues to grow as does the demand for safe and sustainable water supplies. Linkages between comprehensive planning and sustainable water supply planning are important for effective long-range resource management. Metropolitan communities and public water suppliers serving more than 1,000 people must develop a water emergency and conservation plan approved by the DNR. In addition, demand reduction measures must be implemented before approvals can be granted for increased water volumes or new wells (MN Statute 103G.291).

Communities throughout the metropolitan area have identified a number of tools for conserving water. These include sprinkling ordinances, summer surcharges, showerhead and toilet replacement programs, joint energy/water audits, aggressive leak detection programs, and water meter upgrades. Water use in growing communities often escalates as homeowners and businesses establish new lawns and landscaping. Education is viewed as a key element in implementing conservation programs.

Water conservation can reduce capital costs for new wells and water treatment plants. Consumers can also save money on water, wastewater management and energy. Sound water supply management will reduce water use conflicts, protect economic health and will sustain natural resources dependent on groundwater.

Conservation and water supply planning will require increased coordination among municipalities, public education and, potentially, the formation of sub-regional water supply systems where conflicting needs can be balanced.

GROUNDWATER QUALITY

Detection of Groundwater Contamination

Early detection of groundwater contamination is essential to protect the public health and the environment by limiting human exposure to harmful contaminants and preventing the spread of groundwater pollution. Groundwater may remain contaminated for decades. Groundwater clean-up is costly, complex, and not always feasible.

In the past, the Minnesota Pollution Control Agency has conducted a non-regulatory groundwater monitoring and assessment program (GWMAP) to determine the ambient groundwater conditions in selected areas. At sites of known groundwater contamination, private responsible parties conduct long-term monitoring as directed by State and/or Federal regulatory agencies. Detecting groundwater contamination and managing treatment and water supplies will take a coordinated effort between State, County and local government.

CHAPTER 6.0 GROUNDWATER SUPPLY GOAL:

Goal: To manage a sustainable water supply ensuring ample, high quality groundwater is available for residential, commercial, and natural resource needs.

Policies and Implementation Strategies

Policy 1:
Washington County will promote research and water supply planning to provide for sustainable water supplies and, to the extent possible, minimize the loss of flow to surface water features and groundwater dependent natural resources.

- ***Implementation Action 1: Water Supply Assessment-Research Water Supply Sustainability and Affects on Natural Resources***
  Evaluate current and projected water use to determine the impacts to groundwater levels, flow directions, long-term water supplies, and groundwater dependent natural resources. Groundwater dependent natural resources include, but are not limited to, fens and other wetland seepage communities, trout streams, lakes, and wetlands. These evaluations will be used for developing water management policies and rules, water supply plans, and to provide DNR with support in processing groundwater appropriation permits.
  (6.1.1-RS)
  Lead: WCPHE
  Team: LGU, WD/WMO, MC, WCD
  Year: 2003

Policy 2:
Washington County supports local and State plans, policies, and permitting programs that sustain groundwater supplies and related natural resources.

- ***Implementation Action 1: Groundwater Appropriations-Permitting Commentary***
  Provide an opportunity to local government or special governmental units to comment on groundwater appropriation permit applications in applying MN Rules 6115.0600 to 6115.0810 and MN Statutes 103G.271 to restrict large volume pumping of aquifers in regions where overuse of groundwater will negatively impact natural resources or interfere with current well use.
  (6.2.1-PL)
  Lead: DNR
  Team: LGU, WD/WMO, WCD, WCLM,MDH, MC, WCPHE
  Year: 2003

- ***Implementation Action 2: Groundwater Appropriations-Rules Protecting Natural Resources***

  Develop and adopt rules or policies on the quantity of water used in areas where existing wells and/or groundwater dependent natural resources could be negatively impacted by overuse of groundwater. Negative impacts include reduced flow to surface water bodies, lowering of lake or wetland levels, or interference with other wells.
  (6.2.2-RG)
  Lead: WD/WMO
  Team: LGU, WCPHE, DNR
  Year: 2003

Policy 3:
Washington County will promote educational efforts focused on the conservation of water resources.

- ***Implementation Action 1: Groundwater Conservation Plans-Assessing Effectiveness-Assisting Communities***

  Develop methods to determine the effectiveness of municipal water conservation plans. Assist communities in the development of water conservation plans and ordinances.
  (6.3.1-CT)
  Lead: MC
  Team: WCPHE, DNR, WD/WMO, WCD
  Year: 2003

- ***Implementation Action 2: Groundwater Conservation-Reducing Consumption and Recycling***

  Provide information and assistance to local government, businesses and industry to reduce water use and to increase recycling of process and cooling water used in manufacturing facilities.
  (6.3.2-CT)
  Lead: MC
  Team: WCPHE, WD/WMO, LGU
  Year: 2004

- ***Implementation Action 3: Groundwater Conservation-Community Water Use Reduction Education***

  Inform and educate local government officials on community conservation techniques (such as changing water rate structures, establishing sprinkling ordinances, establishing Water Conservation Boards, conducting joint energy/ water audits, creating showerhead or toilet replacement programs, or conducting water leak detection projects).
  (6.3.3-CT)
  Lead: WCPHE
  Team: MNEXT, DNR, MC, WD/WMO, LGU
  Year: 2003

Policy 4:
Washington County supports the coordination of efforts for early detection of contaminants, assessment of groundwater contamination trends, and promotes the responsible use or conservation of groundwater being pumped for remediation or containment purposes.

- ***Implementation Action 1: Use of Non-potable Groundwater***

  Explore the potential for the use of contaminated water for non-potable needs in conjunction with groundwater clean-up.
  (6.4.1-PL)
  Lead: WCPHE
  Team: WD/WMO, MPCA, MDH
  Year: 2005

- ***Implementation Action 2: Groundwater Contamination Education***

  Educate County residents and the business community on the impacts of groundwater contamination to potable water supplies and economics.
  (6.4.2-ED)
  Lead: WCPHE
  Team: MNEXT, WCD, MPCA, MDH, WD/WMO
  Year: 2003

- ***Implementation Action 3: Groundwater Supply Assessment-Impacts of Contamination on Water Supply***

  Conduct a County-wide assessment on the impacts of groundwater contamination on water supply. Determine the locations of contaminants, the volumetric loss of potable water and the associated costs for treatment and clean-up.
  (6.4.3-RS)
  Lead: WCPHE
  Team: WCD, MPCA, MDH
  Year: 2004

CHAPTER 7.0 GROUNDWATER SURFACE WATER INTERACTION

Goal: To promote the protection of water quality and natural resources through integrated groundwater and surface water management.

ISSUES STATEMENT

Lakes, wetlands, and streams are frequently surface exposures of the water table intersecting the land surface. Lakes and wetlands can function both as groundwater recharge or groundwater discharge zones and in most cases, streams function as groundwater discharge zones. Both groundwater quantity and quality have an impact on surface water quantity and quality. The reverse is also true in that surface water quantity and quality can impact groundwater. Understanding the degree to which surface water level fluctuations affect groundwater level fluctuations and vice versa is extremely important in understanding the water balance of surface water bodies.

Surface water is managed and regulated by State agencies, watershed organizations, and local governments. Historically, surface water management organizations and agencies have not factored groundwater provisions into their plans, policies and rules. To provide effective overall management of both surface water and groundwater, it will take a coordinated effort between State and County agencies, watershed organizations and local government. Efforts should focus on researching the level of connection between surface water and groundwater, identifying groundwater recharge and discharge zones, and developing policies and rules to protect and holistically manage water resources.

Water Quantity

Short and long-term precipitation trends greatly affect groundwater levels and the levels of inter-connected lakes, wetlands and streams. **Figure 7.1** illustrates annual precipitation data from Stillwater measured from 1950 - 1999. The data reflects the difference in precipitation above or below the 50 year average (deviation from the mean) for each year. The straight line sloping upward from left to right represents the "trend" in precipitation. As the graph shows, precipitation amounts have generally increased from 1950 to the present. During the period 1975 to 1999, annual precipitation was above the 50 year average 19 of 25 years, or 76 percent of the time.

The effect of increased precipitation over multi-year periods causes a marked increase in the quantity of water in both the shallow and deeper aquifers. Increased water levels in aquifers extend to inter-connected surface water bodies causing lakes and wetlands to rise in elevation.

There has been fallout from the increased levels of precipitation experienced over the past half century. Rising water levels in many of the lakes and wetlands in Washington County have flooded property, septic systems and roads. Groundwater systems respond slowly to precipitation trends, so most flooded areas have experienced multiple years of inundation. Water management groups have struggled to understand and address flooding issues and, in many cases, the relationship of aquifer levels to surface water levels has been poorly understood.

Groundwater discharge to streams, referred to as baseflow, also fluctuates with climate and aquifer levels. Prolonged wet cycles increase the amount of baseflow in streams, while prolonged drought conditions reduce stream baseflow. Stream baseflow conditions have a strong impact on stream ecology and hydrology.

Population growth in the County will increase the level of pumping from aquifers. The safe yield of an aquifer is the amount of water that can be appropriated without overly depleting water supplies and damaging lake, stream and wetland resources. In urbanizing areas, the proliferation of impervious surfaces from buildings, roads, driveways and parking lots has the effect of increasing the volume and rate of surface water runoff, thus reducing the volume of water available for groundwater recharge.

Water Quality

Surface water contaminants can degrade groundwater quality when the surface water feature is located in a groundwater recharge zone. Sources of contaminants include pesticides and fertilizers from agriculture and turf management, nitrate and other nutrients from septic systems, and petroleum, automotive fluids, or hazardous materials from parking lots, and industrial-commercial spills.

If groundwater quality is degraded, it can also have an impact on surface water quality in groundwater discharge zones. For instance, a recent study has shown that Square Lake (a spring-fed lake) located in May Township receives 80 percent of its nutrients from groundwater discharge. Similarly, the South Branch of Valley Creek located in Afton contains relatively high levels of nitrate. A 1999 study (St. Croix Watershed Research Station, 1999) attributes the elevated nitrate levels to nitrate contaminated groundwater.

Surface Water Resources

Most surface water bodies in Washington County (lakes, wetlands and streams) interact with groundwater systems, functioning as groundwater recharge or groundwater discharge features. Not all surface water resources are strongly connected to groundwater systems. In these cases, the surface water body is separated from groundwater by a confining geologic formation composed of finer grained clay or silt material. These surface water bodies are referred to as perched lakes or perched wetlands.

Lake Resources and Groundwater

Lakes are an important element to the Washington County landscape. Lakes provide valuable public recreation and add aesthetic values to the County. Lakes also provide key ecologic and hydrologic functions. Groundwater plays a vital role in the overall function of lake hydrology and ecology. Lakes function as both groundwater recharge and discharge areas.

Groundwater Recharge Lakes

Groundwater recharge lakes are significant in maintenance of groundwater quality and quantity. Recharge lakes add stability to aquifer levels by collecting and storing large quantities of precipitation that will eventually infiltrate to groundwater systems. Watershed management goals should focus on maintaining the natural storage function in groundwater recharge lakes to promote groundwater recharge. Diverting water out of lake basins will decrease the amount of water available for recharge.

Groundwater quality can be impacted by the water quality in recharge lakes. Efforts to protect surface water quality will also ultimately protect groundwater quality.

Groundwater Discharge Lakes

The clearest and cleanest lakes in Washington County rely on high volumes of groundwater discharge or springs for their primary source of water. Northern Washington County's Square Lake receives over 70 percent of its volume from springs and is regionally renowned for its clear waters, attracting thousands of scuba divers annually. Spring-fed lakes vary in the amount of groundwater input. The lakes with the highest quantity of groundwater input exhibit the highest water quality and are regionally important natural and recreational resources.

Groundwater fed lakes can be affected by both pollution and the loss of groundwater flow. Relatively small quantities of nitrate or other nutrients in groundwater could alter the ecological balance of spring-fed lakes. It is critical to maintain spring flow to groundwater-fed lakes by ensuring groundwater infiltration and sustainable water supplies are not impacted by development and land use.

Stream Resources

Washington County contains dozens of small and medium-sized springs and spring-fed creeks that feed both the St. Croix and Mississippi Rivers. The majority of the springs and creeks lie along the St. Croix River Valley (**Figure 7.2**). As with spring-fed lakes, spring-fed creeks are ecologically fragile.

Many of the Washington County spring-fed creeks are suitable for brook trout and brown trout to thrive and reproduce. In the metropolitan area, the Minnesota Department of Natural Resources has a program titled the "Metro Trout Stream Watershed Initiative." The program has named 15 streams to their list of "Designated Trout Streams." Six of those trout streams are classified as streams of "special concern" due to their relatively large size, high quality and vulnerability to development. Of the 15 "designated trout streams," six are located in Washington County. Three of the six streams listed as "special concern" are located in Washington County (**Figure 7.2**). The three streams of special concern are Brown's Creek, Mill Stream, and Valley Creek. Numerous other small streams with naturally reproducing brook trout populations also exist in Washington County. These streams are not DNR "designated trout" waters.

Washington County streams are generally of high quality and support important natural and recreational resources. Groundwater systems are the principle source of water for streams in Washington County. A 1999 study conducted by the St. Croix Watershed Research Station found that approximately 85 percent of the total volume of discharge from Brown's Creek was derived from groundwater sources. In the same study, it was found that approximately 92 percent of the volume of stream discharge in Valley Creek was from groundwater discharge. Maintaining sufficient quantities and high quality groundwater are critical to maintain stream base flow and water temperatures. Spring flows to streams is threatened by both the depletion of groundwater recharge from the increase of impervious surfaces and the increase in pumping from aquifers that feed streams.

Groundwater and Wetlands

The National Wetlands Inventory Map (**Figure 7.3**) illustrates the location of wetlands in Washington County. A 1984 study (University of Minnesota 1984) calculated that only 42.9 percent of original wetland acreage in Washington County remained. Each remaining wetland performs one or more of the following vital hydrologic functions:

1. water storage and flood control;
2. water treatment;
3. groundwater recharge;
4. groundwater discharge; and
5. critical habitat.

It would be extremely difficult to quantify the exact benefit wetlands provide in protecting and conserving groundwater resources. Nevertheless, preserving and protecting the remaining wetlands in Washington County is critical to maintaining groundwater recharge and water quality.

The Minnesota Wetland Conservation Act (WCA) was signed into law in 1991. The purpose of the law is to prevent further loss of wetlands and to promote restoration of former wetlands. A "net gain" in wetlands is the desired result. The WCA requires persons proposing to drain or fill a wetland to first attempt to avoid the impact; second, attempt to minimize the impact; and finally, replace any impacted area with another wetland of equal function and value. The law is administered by local government units and the Washington Conservation District. Some communities within Washington County have additional rules in place that are meant to protect and preserve wetlands. Several water management organizations also have rules in place to protect wetlands. The Board of Water and Soil Resources (BWSR) oversees WCA programs.

Wetlands/ Unique / Rare Natural Communities

Groundwater discharge supports a number of different wetland types found primarily adjacent to streams and along the edges of the St. Croix and Mississippi River Valleys. Groundwater seepage provides a highly stable source of consistently cool, mineral rich water creating conditions suitable to support unique plant and animal communities. These communities are highly susceptible to disruption in groundwater discharge and from land disturbances.

According to the publication "St. Croix River Valley and Anoka Sand Plain- A Guide to Native Habitats" (University of Minnesota Press 1996), there are several unique and rare natural community types in Washington County dependent on groundwater seepage including black ash seepage swamps, hardwood seepage swamps, rich fens, circum neutral tamarack swamps, sedge meadows, wet prairies and moist cliff communities.

Groundwater seepage is the key feature that sustains these relatively rare natural resources. Several unique and rare plant and animal species are found in these groundwater seepage communities including: False Mermaid, American Water-pennywort, Bog Bluegrass, and Halberd-Leaved Tear Thumb. Rare animal species include the Red-Shouldered Hawk and the Louisiana Waterthrush. As with stream resources, threats to seepage wetlands include loss of groundwater flow from over-pumping, increasing impervious surfaces, loss of recharge from water diversion and groundwater quality degradation.

Surface Water Runoff Management

Non-point sources of pollution derived from numerous, widespread, small releases of contaminants have the potential to contaminate groundwater. Some major sources of non-point pollution include:

- Agriculture runoff (fertilizers, pesticides, sediment)
- Construction site runoff (sediment)
- Urban runoff (petroleum, household products, fertilizers, pesticides, metals)
- ISTS/Septic systems (leachate, nitrate)
- Highway de-icing activities (chemicals, salts, sand)
- Dredging and ditching (sediment)
- Air pollution from cars, power plants, industry (metals, organic contaminants)

The 1990 Federal Clean Water Act, administered by the MPCA contains two phases of implementation. Phase I addresses point sources of pollution and Phase II regulates surface water runoff quality in urban areas and at construction sites. Under the US EPA rules administered by the MPCA, cities will be required to obtain stormwater runoff permits starting in the year 2003. Non-point source pollution should be reduced after the Phase II program goes into effect.

Surface water runoff quality and quantity factors have an effect on groundwater. Watershed organizations and local government units manage and regulate runoff quality and quantity. Increased runoff volume reduces infiltration and robs aquifers of recharge waters.

To protect water resources, water management organizations and local government units should continue to focus on protecting water quality and consider the implementation of runoff volume controls to promote recharge of aquifers.

CHAPTER 7.0 GROUNDWATER SURFACE WATER INTERACTION GOAL:

Goal: To promote the protection of water quality and natural resources through integrated groundwater and surface water management.

POLICIES AND IMPLEMENTATION STRATEGIES

Policy 1:
Washington County supports research, assessment and policies that aid in the integration of surface water and groundwater management.

- ***Implementation Action 1: Research groundwater and surface water functions.***
  Conduct research to inventory and develop a priority ranking system for the groundwater recharge or discharge function of lakes, wetland and land areas. Make identification and ranking of groundwater recharge areas a priority element of WD/WMO local wetland and natural resource inventories.
  (7.1.1-RS)
  Lead: WCPHE
  Team: WCD, WD/WMO, DNR, MC
  Year: 2003

Policy 2:
Washington County supports inter-governmental coordination and cooperation in support of existing and/or in developing new groundwater, surface water and wetland rules, policies and programs.

- ***Implementation Action 1: Groundwater Recharge Area Management***
  Develop land use regulations to protect groundwater resources based on completed studies, and rankings of groundwater recharge areas.
  (7.2.1-RG)
  Lead: LGUs
  Team: WCLM, WD/WMO, MC, WCPHE, DNR
  Year: 2004

- ***Implementation Action 2: Groundwater-Surface Water Interaction Education***
  Provide education to citizens and public officials on the inter-relation of surface and groundwater quality and quantity; the value of and need to protect groundwater recharge areas and wetlands; and implementation of best management practices and low-impact development and redevelopment strategies to protect groundwater resources.
  (7.2.2-ED)
  Lead: WD/WMO
  Team: WCPHE, WCD, WCLM, LGUs, DNR, MC
  Year: 2003

Policy 3:
Washington County supports the development and adoption of best management practices and rules to control rates and volumes of runoff to reduce non-point source pollution and maintain groundwater recharge.

- ***Implementation Action 1: Develop Runoff quality and volume control rules.***
  For all new developments and re-developments, adopt rules controlling stormwater runoff volume and establish performance standards based on issues identified in water resource plans, inventories or studies, and on available scientific literature.
  (7.3.1-RG)
  Lead: WD/WMO
  Team: WCLM, LGUs
  Year: 2004

CHAPTER 8.0 HAZARDOUS MATERIALS MANAGEMENT AND TRANSPORTATION

Goal: To reduce the risk of groundwater contamination by ensuring sound management of hazardous materials and road compounds transported, stored, or used within Washington County.

Issues Statement

Improperly handled hazardous materials have contaminated some groundwater in localized areas of Washington County. Hazardous wastes include solvents, paints, chemicals, acids, oils, lead acid batteries, heavy metals, pesticides, and other toxic substances that pose a risk to people or the environment. Four hazardous waste-related special well construction areas have been identified by the Minnesota Department of Health (**Figure 5.1**). In these areas, special well construction practices are in effect to protect the public from contaminated groundwater (see Chapter 5.0). In addition, 13 State or Federally designated soil and groundwater contamination areas, termed Superfund Sites, are located in Washington County (**Figure 1.11**).

Sources of contaminants in groundwater include municipal, commercial and industrial dumps; old or unregulated landfills, including pesticide container dumpsites; leaking underground storage tanks; accidental spills from pipeline ruptures or tanker rollovers; disposal of household wastes; and salts used for de-icing roadways.

The majority of hazardous material releases that have contaminated groundwater occurred prior to the implementation of Federal and State regulations in the 1980s. Properly managed hazardous materials and wastes should not pose a threat to groundwater. The Washington County Waste Management Master Plan (Master Plan), adopted in 1999, emphasizes the reduction of toxic and hazardous waste. Recycling of waste continues to be an important element of waste management - emphasizing both commercial sector and household hazardous waste disposal programs. The Master Plan also contains provisions focused on modifying industrial processes to reduce or eliminate the use of toxic and hazardous materials.

Washington County Hazardous Waste Management

Washington County's Department of Public Health and Environment has been implementing a hazardous waste licensing and inspection program for over two decades. Currently, Washington County's hazardous waste program licenses and inspects approximately 550 hazardous waste generators, five waste transfer facilities and administers a "household hazardous waste" (HHW) program. HHW is suspected of contributing contaminants to at least two identified groundwater contamination sites.

The HHW program provides a separate collection system for residents to dispose of common products such as paints, solvents, pesticides, and petroleum wastes. In 1994, Washington County opened a permanent, year-round HHW collection facility in the city of Oakdale. In addition to providing the permanent HHW facility, satellite collection events are offered throughout the County several times each year. The HHW program is important in reducing potential groundwater pollution by giving alternatives to residents who might otherwise dispose of hazardous materials down drains, septic systems, and in back yards.

The Department of Public Health and Environment also provides technical assistance and education to businesses and the public to minimize or eliminate toxic materials use. This approach has led to the reduction in volume and toxicity of wastes at the generator level, decreasing the potential impacts to the environment and groundwater.

Storage Tanks

Underground storage tanks for fuels, chemicals, or fertilizers are a potential threat to water quality. The MPCA defines an underground storage tank as any tank with at least ten percent of its volume below ground. Present State regulatory programs require owners of all tanks larger than 1,100 gallons to register the tanks with the MPCA. Tanks with a capacity of less than 1,100 gallons, septic tanks, and storm water tanks are not regulated.

Tank location, construction, and age are all factors that determine relative risk to groundwater. In the past, hazardous materials stored in underground tanks have leaked into groundwater. Current regulations require leak detection equipment and regular inspection of tanks. The volume of contaminants leaking from failing tanks has been significantly reduced since the implementation of regulatory controls.

Leaks can be identified more readily in above-ground storage tanks. Most releases from above-ground storage tanks are associated with spills that occur while filling tanks or removing product. Primary and secondary containment structures provide added protection against hazardous material releases at above-ground storage tanks.

Transportation of Hazardous Materials and Hazardous Material Spills

Hazardous materials are transported throughout Washington County by truck, rail and pipelines. The movement, loading, and off-loading of hazardous materials pose potential threats of accidents, leaks, and spills. The most effective method of protecting groundwater resources from hazardous materials is by reducing spill incidents and volume.

In 1991, the Minnesota Legislature passed legislation requiring hazardous materials transporters to prepare and train to respond to petroleum and chemical spills. Pipelines, trucking, and railroad businesses that transport more than 100,000 gallons of hazardous substances per month are mandated to develop spill prevention and preparedness plans.

Hazardous Materials Pipelines

Four companies operate pipelines in Washington County: Williams Brothers Pipeline Company, Amoco, Minnesota Pipeline Company, and Northern Natural Gas Company. Products carried in local pipelines include natural gas, fuel oil, crude oil, gasoline and other petroleum products. Pipelines cross many parts of Washington County, including areas considered sensitive to groundwater contamination **(Figure 8.1)**.

The Federal Department of Transportation and the Minnesota Office of Pipeline Safety regulate pipelines. The MPCA is responsible for responding to pipeline release incidents and local first responders are responsible for public safety. Local governments do not have direct pipeline regulatory authority.

Hazardous Materials Spills - Public Safety

Spills occur from tanker truck rollovers or collisions, train derailments, pipeline ruptures, above ground tank leaks, underground tank leaks, and overflows or accidents during material off-loading or filling operations. When a spill does occur, State agencies and the party responsible for the spill are required to ensure environmental protection. Public safety is the responsibility of local first responders. Public safety takes precedence over environmental protection. All spills over five gallons must be reported to the State of Minnesota Office of Public Safety (Minnesota State Duty Officer) within 24 hours. The MPCA oversees the initial response and clean up of non-agricultural spills and the Minnesota Department of Agriculture (MDA) oversees clean-up of agricultural chemical spills.

Most spills occur during material handling operations such as fueling or the transfer of materials between tankers and fixed storage vessels. In such cases, proper primary and secondary containment structures can provide protection to groundwater resources.

Road Salt Storage and Use

Salts, such as sodium chloride and magnesium chloride, are widely used to de-ice roads, parking lots, driveways, and sidewalks. Chloride has been shown to have detrimental effects on aquatic ecology. The storage and application of de-icing salts creates the potential for surface water and groundwater pollution.

During winter, snow removal concentrates road salt and sand in ditches and in snow removal stockpiles. Spring melting results in the release of runoff contaminated with chloride and trace metals. The polluted runoff may contaminate surface water or infiltrate into the groundwater.

Unprotected road salt storage sites also pose a risk to water quality by allowing rain and melting snow to leach contaminants into groundwater. Covered and lined facilities will eliminate groundwater contamination from stockpiled road de-icing materials. Limiting de-icing compound use or using less environmentally damaging products will reduce the level of contamination spread during de-icing operations.

CHAPTER 8.0 HAZARDOUS MATERIALS MANAGEMENT AND TRANSPORTATION GOAL:

Goal: To reduce the risk of groundwater contamination by ensuring sound management of hazardous materials, and road de-icing compounds transported, stored, or used within Washington County.

POLICIES AND IMPLEMENTATION STRATEGIES

Policy 1:
Washington County supports current State and County rules and permitting programs that regulate hazardous materials storage, transportation, disposal and clean-up.

- ***Implementation Action: None required. State and County agencies should continue enforcing rules and operating programs.***

Policy 2:
Washington County supports the current emergency response structure to address hazardous materials spills and pipeline ruptures.

- ***Implementation Action: None required. State and County agencies should continue enforcing rules and operating programs.***

Policy 3:
Washington County supports working with communities to develop groundwater protection policies related to the siting and permitting of new commercial and industrial development.

- ***Implementation Action 1: Provide consultation and technical assistance to LGUs***
  Assist LGUs with groundwater monitoring plan or groundwater protection plan requirements. Provide "model" plans to LGUs. Assist LGUs in plan review and approval process. Where available, use wellhead protection plans to assist with the review process.
  (8.3.1-CT)
  Lead: WCPHE
  Team: MDH
  Year: 2004

- ***Implementation Action 2: Groundwater planning and monitoring as part of building permit or conditional use permit process.***

  Require a groundwater monitoring plan or groundwater protection plan as part of a permit application for businesses that store, use, or transport hazardous materials and for properties formerly used as a waste disposal site or waste transfer facility. Where available, use wellhead protection plans to assist with this process.
  (8.3.2-RG)
  Lead: LGUs
  Team: MDH, WCPHE, MPCA, WCLM
  Year: 2005

Policy 4:
Washington County will advocate for and supports cooperative efforts to develop alternatives to using and storing salt for de-icing operations that are protective of public safety and the environment.

- ***Implementation Action: No high priority Implementation Actions were assigned to address this policy. Non-high priority Implementation Actions are located in Appendix D.***

LIST OF FIGURES

APPENDIX A
MINNESOTA STATUTE 103B.255
GROUNDWATER PLAN
AUTHORITY AND REQUIREMENTS

103B.255 Groundwater plans.

Subdivision 1. **Authority.** A metropolitan county may prepare and adopt groundwater plans in accordance with this section.

Subd. 2. **Responsible units.** The county may prepare and adopt the plan or, upon request of a soil and water conservation district, the county may delegate to the soil and water conservation district the preparation and adoption of all or part of a plan and the performance of other county responsibilities regarding the plan under this section and section 103B.231.

Subd. 3. **Local coordination.** To assure the coordination of efforts of all units of government during the preparation and implementation of watershed and groundwater plans, the county shall conduct meetings with local units of government and watershed management organizations and may enter into agreements with local units of government and watershed management organizations establishing the responsibilities during the preparation and implementation of the water plans.

Subd. 4. **Assistance.** The county may contract with the Minnesota Geological Survey, the United States Geological Survey, a soil and water conservation district, or other public or private agencies or persons for services in performing the county's responsibilities regarding the plan under this section and section 103B.231. Counties may enter into agreements with other counties or local units of government under section 471.59 for the performance of these responsibilities. To assist in the development of the groundwater plan, the county shall seek the advice of the advisory committee, the Minnesota geological survey, the departments of health and natural resources, the pollution control agency, and other appropriate local, state, and federal agencies.

Subd. 5. **Advisory committees.** (a) The county shall name an advisory committee of 15 members. The committee must include representatives of various interests, including construction, agriculture, hydrogeology, and well drilling. At least four members of the committee must be from the public at large, with no direct pecuniary interest in any project

involving groundwater protection. At least seven members must be appointed from watershed management organizations, statutory and home rule charter cities and towns, and these local government representatives must be geographically distributed so that at least one is appointed from each county commissioner district. (b) The county shall consult the advisory committee on the development, content, and implementation of the plan, including the relationship of the groundwater plan and existing watershed and local water management plans, the effect of the groundwater plan on the other plans, and the allocation of costs and governmental authority and responsibilities during implementation.

Subd. 6. **General standards.** (a) The groundwater plan must specify the period covered by the plan and must extend at least five years, but no more than ten years, from the date the board approves the plan. The plan must contain the elements required by subdivision 7. Each element must be set out in the degree of detail and prescription necessary to accomplish the purposes of sections 103B.205 to 103B.255, considering the character of existing and anticipated physical and hydrogeologic conditions, land use, and development and the severity of existing and anticipated groundwater management problems in the county. (b) To the fullest extent possible, in a manner consistent with groundwater protection, a county shall make maximum use of existing and available data and studies in preparing the groundwater plan and incorporate into its groundwater plan relevant data from existing plans and studies and the relevant provisions of existing plans adopted by watershed management organizations having jurisdiction wholly or partly within the county.

Subd. 7. **Contents.** A groundwater plan must:

(1) cover the entire area within the county;

(2) describe existing and expected changes to the physical environment, land use, and development in the county;

(3) summarize available information about the groundwater and related resources in the county, including existing and potential distribution, availability, quality, and use;

(4) state the goals, objectives, scope, and priorities of groundwater protection in the county;

(5) contain standards, criteria, and guidelines for the protection of groundwater from pollution and for various types of land uses in environmentally sensitive areas, critical areas, or previously contaminated areas;

(6) describe relationships and possible conflicts between the groundwater plan and the plans of other counties, local government units, and watershed management organizations in the affected groundwater system;

(7) set forth standards, guidelines, and official controls for implementation of the plan by watershed management organizations and local units of government; and

(8) include procedures and timelines for amending the groundwater plan.

Subd. 8. **Review of the draft plan.** (a) Upon completion of the groundwater plan but before final adoption by the county, the county shall submit the draft plan for a 60-day review and comment period to adjoining counties, the Metropolitan Council, the State review agencies, the Board of Water and Soil Resources, each soil and water conservation district, town, statutory and home rule charter city, and Watershed Management Organization having territory within the county. The county also shall submit the plan to any other county or watershed management organization or district in the affected groundwater system that could affect or be affected by implementation of the plan. Any political subdivision or watershed management organization that expects that substantial amendment of its plans would be necessary in order to bring them into conformance with the county groundwater plan shall describe as specifically as possible, within its comments, the amendments that it expects would be necessary and the cost of amendment and implementation. Reviewing entities have 60 days to review and comment. Differences among local governmental agencies regarding the plan must be mediated. Notwithstanding sections 103D.401, 103D.405, and 473.165, the council shall review the plan in the same manner and with the same authority and effect as provided in section 473.175 for review of the comprehensive plans of local government units. The council shall comment on the apparent conformity with metropolitan system plans of any anticipated amendments to watershed plans and local comprehensive plans. The council shall advise the Board of Water and Soil Resources on whether the plan conforms with the management objectives stated in the council's water resources plan and shall recommend changes in the plan that would satisfy the council's plan. (b) The county must respond in writing to any concerns expressed by the reviewing agencies within 30 days of receipt thereof. (c) The county shall hold a public hearing on the draft plan no sooner than 30 days and no later than 45 days after the 60-day review period of the draft plan.

Subd. 9. **Review by metropolitan council and state agencies.** After completion of the review under subdivision 8, the draft plan, any amendments thereto, all written comments received on the plan, a record of the public hearing, and a summary of changes incorporated as part of the review process must be submitted to the Metropolitan Council, the State review agencies, and the Board of Water and Soil Resources for final review. The State review agencies shall review and comment on the consistency of the plan with State Laws and Rules relating to water and related land resources. The State review agencies shall forward their comments to the board within 45 days after they receive the final review draft of the plan. A State review agency may request and receive up to a 30-day extension of this review period from the board.

Subd. 10. **Approval by board.** After completion of the review under subdivision 9, the Board of Water and Soil resources shall review the plan as provided in section 103D.401. The Board shall review the plan for conformance with the requirements of sections 103B.205 to 103B.255, and chapter 103D. The Board may not prescribe a plan but may disapprove all or parts of a plan which it determines is not in conformance with the requirements of sections 103B.205 to 103B.255, and chapter 103D.

Subd. 11. **Adoption and implementation.** The county shall adopt and implement its groundwater plan within 120 days after approval of the plan by the Board of Water and Soil resources.

Subd. 12. **Amendments.** To the extent and in the manner required by the adopted plan, all amendments to the adopted plan must be submitted to the towns, cities, counties, the Metropolitan Council, the State review agencies, and the Board of Water and Soil Resources for review in accordance with the provisions of subdivisions 8 to 10.

Subd. 13. **Property tax levies.** A metropolitan county may levy amounts necessary to administer and implement an approved and adopted groundwater plan. A county may levy amounts necessary to pay the reasonable increased costs to soil and water conservation districts and watershed management organizations of administering and implementing priority programs identified in the county's groundwater plan.

HIST: 1990 c 391 art 2 s 16; 1992 c 511 art 2 s 3; 1995 c 184 s 18-23

APPENDIX B
GROUNDWATER
PLAN
AMENDMENT PROCEDURE

GROUNDWATER PLAN AMENDMENT PROCEDURE

The Groundwater Plan is intended to extend through the year 2013. The Plan is intended to be updated at least every five years.

The County shall prepare proposed amendments updating the Plan and give notice of the proposed Plan amendments before the end of any calendar year. Notice of public hearing on proposed Plan amendments and a description of the amendments shall be published by the County in at least one legal newspaper in the County. Publication shall occur at least ten days before the hearing. Notice shall also be mailed at least 30 days before the hearing to all the towns, and statutory and home rule charter cities having territory within the County, to the Metropolitan Council, Watershed Districts, Watershed Management Organizations, DNR, MPCA, MDH, and BWSR.

At the hearing the County shall solicit comments on the proposed Plan amendments. Any person may submit a request to the BWSR not later than ten days following the close of the hearing, asking that the proposed Plan amendments be reviewed in accordance with the provisions of section 103B.255, subdivisions 8, 9, and 10.

The County shall not adopt any proposed Plan amendments before the BWSR has decided whether the amendment is in accordance with provisions of section 103B.255, subdivisions 8, 9, and 10. If the BWSR has not made a decision within 45 days of the close of the hearing, unless the County agrees to a time extension, review in accordance with the provisions found in section 103B.255, subdivisions 8, 9, and 10 shall not be required.

APPENDIX C
CONFLICT ANALYSIS
AND
CONFLICT RESOLUTION

Analysis of Potential Conflicts

At this time, there are no known conflicts between the Groundwater Plan and other Washington County, local government, Watershed District, Watershed Management Organization, or neighboring county plans. Comments received from these agencies indicated the Washington County Groundwater Plan conforms and supports existing Water Management Plan. If conflicts should arise in the future, they may be addressed by the following informal or formal conflict resolution processes.

Informal Conflict Resolution

The County or other local units of government may request a meeting with the Chair of the BWSR to informally resolve disputes before initiating a contested case procedure as covered under Minnesota Statutes 103B.345. An informal hearing can be called to:

- Determine the meaning of any provision of Minnesota Statutes Chapter 103B;
- Resolve conflicts between any two ground water protection plans or a groundwater protection plan and a surface water management plan or comprehensive water plan; or
- Settle any other dispute relating to the Groundwater Plan.

The informal resolution process is as follows:

1. A meeting with the Chair of the BWSR may be requested in writing by any of the involved parties.
2. The nature of the provision of omission causing the conflict must be described, whether it is in the Groundwater Plan, or other control. All parties in the conflict must be identified.
3. The Chair shall acknowledge the request in writing, and request a meeting of all parties. If request for a meeting does not satisfy the parties, or if there is no response from one of the parties, the Chair shall make a reasonable effort to obtain the information needed for resolution in another manner.

4. The Chair shall establish the meeting time and place, and inform all parties in writing. A local unit of government may be represented by any person or persons of its choosing, subject to control of the Chair. The Chair may consider any relevant and reasonable evidence or argument by local unit of government in reaching a resolution.

5. The decision of the Chair may be announced at the meeting, or made later. In any case, the decision shall be submitted in writing to all parties, and will be effective 60 days following the decision of the Chair.

6. A petition may be filed within that time pursuant to Minnesota Statutes, Section 103B.345, subdivision 3, for a contested case hearing under that section.

Formal Conflict Resolution

A county or other local government may petition for a contested case hearing if:

- The interpretation and implementation of a groundwater protection plan is challenged by a local unit of government aggrieved by the plan;
- If two or more counties or local governmental units disagree about the apportionment of the costs of a project implemented in a groundwater protection plan; or
- If a county and other local unit of government disagree about a change in local surface or groundwater and related land resources plan or official control recommended by the County under MN Statute 103B.

The process for a formal resolution of a conflict is as follows:

1. A petition must be filed within 60 days after the date of adoption of approval or the disputed ordinance, or the date a local unit of government receives a recommendation of the County Board under MN Statute Section 103B.325.

2. The petition must be made in writing, addressed to the BWSR, and include the following: the names, phone numbers, and addresses of the parties or their representatives involved in the petition; a request for a hearing; a statement of the allegations or issues to be determined by the hearing; and proof of service of a copy of the petition on all others involved in local units of government.

3. The petition is considered filed with the BWSR when it is received by the Board. The BWSR shall acknowledge receipt of the petition in writing.

4. If the aggrieved county or other local unit of government files a petition for a hearing, a hearing must be conducted by the State Office of Administrative Hearings under the contested case procedure of Minnesota Statues Chapter 14 within 60 days of the request. The subject of the hearing may not extend to questions concerning the need of a groundwater protection plan. In the report of the administrative law judge, the fees of the Office of Administrative Hearings and transcript fees must be equally apportioned among the parties to the proceeding. Within 60 days after receiving the report of the administrative law judge, BWSR must make a final decision on the issue. All parties will be informed of the decision in writing.

5. A decision of the board may be appealed to the Court of Appeals in a manner provided by Sections 14.63 to 14.69.