
3. Assessment of Issues

3.1 Priority District-wide Issues

The district-wide issues described in this section provide an overview of the priority management challenges facing the District. The descriptions of issues are not listed in any particular order of importance. The descriptions are intended to be succinct yet sufficient to characterize the basic rationale for certain policies and actions as presented in Section 5.2.

The district-wide issues were identified by:

- ❖ Review of studies, reports, technical publications, and similar literature focusing on the watershed or Washington County resources;
- ❖ Contact and communication with municipal staff in the jurisdiction of the District;
- ❖ Input from the SWWD staff and the Board of Managers; and
- ❖ Technical Advisory Committee and Community Advisory Committee meetings.

3.1.1 Development of Uniform Design Standards

Development pressures within the watershed are intense. At any given time, numerous development proposals are in the process of submittal, review, or construction. These proposals are assembled by different developers, each supported by different technical firms. The water quality and quantity impacts of each proposed development must be evaluated and the effectiveness of appropriate mitigation measures demonstrated. The District seeks to assist the cities by standardizing the underlying methods, assumptions, and inputs to the assessment of impact and mitigation. Consistency is needed to avoid or reduce the likelihood of future problems.

The level of stormwater quality runoff for new development and redevelopment is based on the classification of the receiving water and allowable phosphorus loads. Examples of structural practices commonly used to treat water quality include wet detention ponds, filtration and infiltration features (swales, trenches, etc.), hydrodynamic separators, or any combination thereof. The District believes it is imperative to implement the most cost-effective, sustainable structural practices applicable. As such, technical standards for structural practices establish expectations and guidelines for design decisions and water quality performance (i.e., nutrient load reduction).

Technical standards provide a uniform benchmark based in large part on field data collected within the watershed. The standards address and establish:

- ❖ Consistent assumptions for hydrologic and water quality modeling;

- ❖ Guidelines for the design of structural mitigation practices and their subsequent performance.
- ❖ Criteria for providing credits or assigning benefits to nonstructural procedures such as soil decompaction after mass grading or disconnecting impervious drainages.

Watershed areas may be impacted by potential TMDL analyses due to existing or future identified impaired waters. Technical standards address this by incorporating monitoring data into a unified modeling approach, ensuring that TMDL assumptions are based on site-specific conditions and carried over to development reviews.

3.1.2 Flood Storage and Runoff Conveyance

The natural drainage system has been substantially altered by the construction of interconnected stormwater conveyance systems. This is evidenced in the Northern watershed of the District where the SWWD hydrologic boundary overlaps two watersheds defined by the United States Geological Survey (Map 3.1). Formerly landlocked areas are drained by lift stations (e.g., Powers Lake, Colby Lake) and exert pressure on downstream storage areas and conveyance systems.

Existing developments around lakes (and other depressional storage areas) are potentially vulnerable to flood damage. This connectivity allows previously landlocked areas to drain while also providing storm sewer systems which efficiently collect and convey runoff, thereby increasing the volume and rate of runoff. New developments create impervious surfaces and further increase the connectedness of the conveyance system, burdening existing flood storage areas. The timing of peak flows from existing and new developments exacerbates flood storage challenges. The District has been implementing projects to map critical flood storage areas and floodplains (maps included in Appendix E).

Several district-wide issues result from the existing and future urbanization and expansion of the stormwater conveyance system:

- ❖ The need to further identify and protect key flood storage areas;
- ❖ Implementing an Emergency Response Plan for flood events (both for vulnerable inland areas as well as the Mississippi River corridor);
- ❖ Identifying critical inter-community flow crossings, defined as maximum allowable peak flows at such crossings, and assessing actual flow rates; and
- ❖ A feasible, stable conveyance system as an outlet for the Northern subwatershed to the Mississippi River.

3.1.3 Lakes and Wetlands

Pollutant loads to many of the wetlands and lakes across the watershed have been altered due to land use activities. One challenge for the District is to manage the lakes and wetlands of the watershed in a manner consistent with the societal value and the classification of the resource within an urbanizing landscape. Public perception of a water body resource, be it a lake or wetland, can exert pressure on the approach to resource management. Many of the water bodies considered as lakes within the District, such as La Lake or Ria Lake, exhibit characteristics typical of wetlands such as shallow depth or a highly productive biological community. The public often desires a higher quality resource than realistically can be attained or should be expected given the physical characteristics

of a resource. Continuing data collection efforts on key lakes and wetlands will be critical to successfully managing the resources

A significant issue for the District is addressing water bodies listed as impaired on the MPCA's 303(d) list. Currently the lakes in the watershed listed as impaired include: Wilmes, Markgrafs, Colby, and Ravine. The District can initiate lake management plans to establish the allocation of nutrient loads which can lead to standards for development and redevelopment activities, and other implementation items. (This is discussed further in Sections 6.5 and 6.6.)

Other district-wide issues relating to lakes and wetlands include:

- ❖ Ensuring protection of high quality lakes and wetlands, either through structural BMP's or other techniques such as buffer strips;
- ❖ Avoiding potential water quality degradation in landlocked basins, which are especially vulnerable to low but chronic levels of pollutant loading;
- ❖ Evaluating or implementing structural features (e.g. outlets) that address undesirable species in water bodies which effect system ecology and water quality;
- ❖ Monitoring lake quality and maintaining the current water quality of lakes in undeveloped or developing areas;
- ❖ Establishing reasonable user expectations for water quality;
- ❖ Addressing water bodies listed as impaired on the 303(d) list and preventing the continuing decline and eventual improvement of degraded waters; and
- ❖ Identifying those lakes where water quality can realistically and reasonably be enhanced to the degree that would improve designated uses.

3.1.4 Groundwater

Municipalities within the SWWD rely on groundwater to provide their potable water and to satisfy all the water demand from commercial and industrial facilities, as well as irrigation. As the watershed becomes more urbanized and populated, the District has made it common practice to mitigate for the groundwater withdrawals and lost natural groundwater recharge rates by routing water that falls on impervious areas to open areas or infiltration basins. However, the District is also aware that the need to replenish the aquifers must be balanced with the need to prevent potentially degraded water from impacting groundwater quality. Overall, a key issue is that in many areas of the watershed, precipitation which infiltrates remains in the shallow soil profile and does not recharge the groundwater. Yet in other areas, sinkholes and other karst-type features allows a large percentage of infiltrated precipitation to recharge the deep groundwater.

Infiltration areas need to be selected not only based on high permeability, but also based on an area's susceptibility to groundwater impacts. Fault zones appear to act as a conduit for rapid migration of nitrate-containing groundwater. Groundwater in the uppermost bedrock appears to be highly susceptible to nitrate impacts where it underlies agricultural land. The changes in land use from agricultural to single-family residential may result in a reduction in nitrate concentrations, as nitrate from fertilizer use is reduced within the District. Locations for municipal water supply wells must be selected wisely in order to lessen the chance of pulling higher nitrate concentration groundwater into the capture zone of a well.

An increase in the application of salt as a deicing agent on new impervious roadways potentially increases concentrations of chloride and cyanide in groundwater with urbanization. Drinking water supplies can be potentially affected by these parameters, and surface waters receiving chloride-laden groundwater flows can develop salinity conditions impacting aquatic life. The District collects data on these constituents—and similar parameters of concern—within the watershed.

Since some groundwater can eventually discharge to the surface, some lakes, wetlands and streams are influenced by contributions from groundwater. Integrating surface water and groundwater management is an important issue for those surface water bodies influenced by groundwater. Assessments have been initiated by Washington County to identify key surface water resources dependent on groundwater, such as Ravine Lake. Other potential groundwater dependent resources may exist in the SWWD for which protective standards may be required.

The following summarizes the district-wide groundwater issues in the watershed:

- ❖ Managing deep groundwater recharge and key infiltration areas by preserving optimal infiltration areas with sufficient infiltration rates and low potential for groundwater impacts;
- ❖ Assessing the temporal (seasonal) significance of infiltration and groundwater recharge, especially during spring;
- ❖ Developing methods to promote and achieve sustainable groundwater withdrawals through responsible and managed pumping of groundwater for water supply to avoid mining (including water use for lawn irrigation);
- ❖ Potential for groundwater impacts due to elevated concentrations of pollutants such as nitrogen-nitrate, chloride, and cyanide stemming from watershed activities;
- ❖ Potential for geologic hazards such as sinkholes or other karst-type features; and
- ❖ Assessing groundwater and surface water interactions to identify and manage surface waters which have high contribution from groundwater.

3.1.5 Natural Resources, Recreation and Open Space

Many of the remaining natural areas including wetlands, woodlands, and prairies across the watershed have been inventoried and evaluated for their significance. A major challenge to the District is to plan for the protection and in some cases the restoration of the natural resources that are present. The urbanization of the watershed fragments the landscape and reduces the native diversity of the landscape. This occurs as roads, buildings and other structures break the environment into small pieces that no longer act as a fully functioning ecosystem.

As urbanization continues in the watershed, it is important to implement a management framework which integrates and connects the natural habitats where possible and beneficial. A major component of the District's natural resources management plan is to create a natural corridor that connects the northern parts of the District with the Mississippi River. The corridor alignment generally follows a natural drainageway that runs north-south through the center of the District. The connectivity (i.e., proximity and lack of barriers such as roads) and regional significance of the natural habitat areas in relation to the greenway corridor should be considered when planning the continued development of the District. Much of this greenway corridor is already established by local communities and plans and serves to function as park and recreation space.

Other district-wide issues relating to natural resources, recreation and open space include:

- ❖ Ensuring protection of high quality wetlands, woodlands, and prairies, either through purchase of the land by the District directly, by working with landowners to establish easements, or by placing land in a trust;
- ❖ Protection of rare and native plant and animal species
- ❖ Control of invasive non-native species
- ❖ Avoiding encroachment of development on high quality natural areas;
- ❖ Maintaining the quality of natural areas in undeveloped or developing areas;
- ❖ Identifying gaps and appropriate areas where open space can realistically be incorporated into the greenway corridor through the District; and
- ❖ Identifying areas that have potential for protection, restoration, or that could be incorporated into state wildlife areas.

3.1.6 Erosion and Sediment Control

Construction and development activities within the SWWD are occurring very rapidly. The development projects are large and spread throughout much of the District. Land use conversion will continue for many years because of the amount of undeveloped land in the watershed. Preventing erosion from construction sites and controlling sediment transported from the sites is an issue for the District.

The spatial scale, distribution, and frequency of construction activities make inspection and enforcement of erosion and sediment control an issue. Consistent and uniform standards across the District during construction site inspections are lacking. Developers and contractors need a clear and consistent message to ensure successful implementation of erosion and sediment control measures. A collaborative management framework which identifies roles, costs and implementation actions for construction site inspection for the District is needed. The District desires local delegation of the erosion control program under the current NPDES Phase II General Permit for construction site activity.

A potential future erosion and sediment control issue will be the protection of natural waterways and ravines from excessive flows and erosion after watershed development. The use of rate control ponds helps to reduce peak flows but extends the hydrograph which can be detrimental to natural waterways. Also, channel forming flows (typically flows associated with a 1-year to 2-year recurrence interval) tend to occur more frequently after urbanization. It is unclear if infiltration practices will be sufficient to protect natural waterways or ravines from destabilizing. An approach to gauge the response of natural waterways and ravines to the rate of runoff is needed.

Erosion in watersheds with large infiltration basins (natural or otherwise) can be problematic by delivering sediment which reduces infiltration capacity. A tool such as the RUSLE 2 model should be promoted to quantify soil loss in watersheds with infiltration basins. This tool can also be used to quantify benefits of erosion control plans according to acceptable levels of soil loss during land development and construction. Protective standards may be required to further address these issues.

A summary of current and future issues related to erosion and sediment control includes:

- ❖ Developing a sustainable framework to ensure inspection for erosion and sediment control at all development sites across the watershed;
- ❖ Implementing consistent and uniform standards during construction site inspections;
- ❖ Promoting a tool to estimate soil loss during construction site plan review; and
- ❖ Protection of natural waterways, including ravines, from excessive flows after watershed development.

3.1.7 Education

The District has been implementing education efforts within the watershed with the goal of informing residents and cities about the direct and indirect impacts they have on the water quality of resources within the District. As a result of new stormwater regulations (i.e., NPDES Phase II), municipalities are required to implement a public education effort. Some municipalities within the watershed have been doing this on a regular basis before the NPDES Program. However, these programs have not been well-coordinated between the cities and the District.

Education activities are a district-wide issue because they affect citizens and other constituents (such as municipal staff) of the watershed. At issue is developing an education program and framework which conveys a consistent message to the different target audiences. An education plan is needed to serve as the foundation for activities. Current and future issues related to education are:

- ❖ Creating a centralized point to prepare and disseminate consistent information and coordinate implementation of programs;
- ❖ Identifying experiential (outdoor) programs that utilize watershed assets and cultivating public/private partnerships for sponsorship and related involvement;
- ❖ Leveraging existing resources to streamline costs and maximize effectiveness;
- ❖ Assisting regulated MS4 parties in meeting requirements of the NPDES Phase II permit; and
- ❖ Utilizing new technologies to reach audiences.

3.2 Priority Subwatershed Issues

The material presented in this section describes specific issues that relate to a particular subwatershed. Subwatershed issues are generally differentiated from the district-wide issues presented in Section 3.1 in that the subwatershed issues reflect potential projects whereas the district-wide issues reflect potential programs.

The subwatershed issues presented in this WMP are not intended to be thoroughly exhaustive of all areas of concern or focus for the SWWD.

The word “issues” is applied in a broad sense to include priority opportunities, solutions, or problems. The subwatershed issues presented in this WMP are not intended to be thoroughly exhaustive of all areas of concern or focus for the SWWD. District priorities may change based on outcomes of completed studies, funding availability, new

partnerships, municipal or agency leadership initiatives, or other circumstances. As such, new subwatershed issues may come to bear for the District as priorities change.

The priority subwatershed issues in this section were identified by:

- ❖ Review of studies, reports, technical publications, and similar literature focusing on the watershed or Washington County resources;
- ❖ Contact and communication with municipal staff in the jurisdiction of the District;
- ❖ Input from the SWWD staff and the Board of Managers; and
- ❖ Technical Advisory Committee and Community Advisory Committee meetings.

3.2.1 Northern Subwatershed

The Northern subwatershed is predominantly comprised by the City of Woodbury but also includes Oakdale, Lake Elmo and Afton. This subwatershed is the largest of the District's five subwatersheds and contains roughly 3-21% (about 14,600 acres) of the District's area. The Northern subwatershed is substantially urbanized although there are many areas in the south and east of the subwatershed which are still undeveloped. Some undeveloped areas currently exist in the north part of the Northern subwatershed. However, according to the 2020 MUSA information provided by the Metropolitan Council (Map 1.2), Lake Elmo is not within that future development boundary.

Due to development pressures, flooding risks, and water quality issues, there are many areas of general concern and focus within the Northern subwatershed. Examples include areas such as subwatershed lakes and associated watersheds, CD-P50, CD-P76, and CD-P82 basins, etc. The issues identified below have specific known challenges or opportunities but general areas of concern will still be addressed and added to the District's work plan when and where appropriate.

3.2.1.1 Missing Links for Greenway Corridor

A major component of the District's natural resources management plan is to purchase and set aside key natural habitat communities to create a corridor that connects the northern parts of the District with the Mississippi River. The Northern subwatershed contains two significant gaps in this corridor. One gap, considered very urgent (as described by EOR, 2000), is the section located between Lake Elmo Regional Park and Wilmes Lake. This section of the corridor would require incorporating a wildlife crossing at CSAH 10 and Interstate 94. The other significant greenway corridor gap is between Colby Lake and Bailey Lake. The specific alignment of the corridor can shift to ISD 833 property, Pioneer Drive to Mile Drive, and include the Bielenberg Sports Complex, then south to CD-P85.

3.2.1.2 Potential Flooding Risks and Flood Damage Reduction

Potential flooding risks and property damage in the Northern subwatershed is a continuing concern, especially in the Wilmes Lake drainage area. A Flood Damage Reduction report for the Wilmes Lake drainage area was completed in 2003. Efforts have begun to regulate the timing of flows reaching Wilmes Lake by adding gated structures at Armstrong Lake, Markgrafs Lake, and the Evergreen Wetland.

Evaluation of the Wilmes Lake subwatershed has been conducted multiple times by the City of Woodbury and the SWWD. Following significant high water levels at Wilmes Lake (and elsewhere in the Northern subwatershed), an extensive modeling study was conducted by the District to evaluate flood mitigation options for the drainage area (Wilmes Lake Report 2006). Analysis of the watershed in 2006 focused on quantifying the effectiveness of several conceptual flood mitigation options; structural modifications considered included storage and conveyance improvements. Six options were evaluated and the results are presented in Table 3.1.

*Table 3.1 – Option comparison for HWL reductions at Wilmes Lake for the standard design storm under current land use conditions**

Option	Description	< 0.5 ft	0.5 ft to 1 ft	1.0 to 1.5	1.5 to 2.0	2 to 3	3.0 and above	Probable Cost	Cost per ft ¹
Option 1a	Storage south of I-94, all sites		X					\$5,312,250	\$7,589,000
Option 1b	Storage south of I-94, sites 1, 2, 3 and 4		X					\$4,811,250	\$8,441,000
Option 1c	Storage south of I-94, site 1 only		X					\$2,307,000	\$4,614,000
Option 2	Storage north of I-94	X						\$4,027,500	\$16,110,000
Option 3	Wilmes Lake Outlet Upgrade							\$3,715,000	\$1,494,000
Option 4	Emergency Overflow from Wilmes Lake	X						\$622,500	\$502,000 ²

1. Cost per foot of Wilmes Lake level reduction for the Standard Design Storm.

2. Cost per foot for the October storm. Option has no affect on the Standard Design Storm.

*Taken from Stormwater Modeling Report, Table 25, HDR Engineering, Inc. (July 2006).

The modeling results indicate that flood storage north of Interstate 94 will provide less than 0.5 feet of high water level stage reduction at Wilmes Lake. There are no recommended structural improvements at this time. While no incremental benefit-to-cost analysis was performed, the report concluded it is doubtful that such an analysis would yield a feasible, fiscally responsible project from the general, conceptual options studied.

Non-structural improvements were evaluated and presented in the Wilmes Lake Report. Five non-structural solutions were recommended for further consideration. The District's role, along with the associated municipalities, is to continue with the ongoing and recommended non-structural solutions. The City of Woodbury, cooperatively with the SWWD, will provide flood damage reduction efforts through implementation of non-structural solutions. Several local efforts have already begun across the City in response to the October 2005 rainfall event. Potential regional solutions, including lowering the lake level to increase live storage, and improving Wilmes Lake emergency overflow will also be

evaluated. Evaluation and implementation of regional projects will be a cooperative effort between the District and the City of Woodbury. The District and municipalities will cooperatively implement multiple flood damage reduction projects for Wilmes Lake sub-watershed, since no single project provides sufficient flood damage relief. The District will continue to periodically update the current District XP-SWMM hydraulic model as appropriate to development activities.

A priority issue for the District is to assess a flood damage reduction (FDR) project for Colby Lake. There are known high water level problems and conveyance issues from Colby to the downstream areas to the south. Also, potential high water conditions exist at Bailey Ridge Pond. The City of Woodbury plans a diversion to a gravel pit storage area to provide relief. This action may also have other corollary benefits to Marsh Creek, Savannah Oaks, and Bailey Lake. The District will assess the need for a FDR project for the Bailey Ridge Pond area.

3.2.1.3 Powers Lake Quality

Powers Lake is a significant regional resource because of its historic excellent water quality. The quality of the lake is at risk because of urbanization in the watershed which has begun expanding the drainage area to Powers Lake. Implementation of Woodbury's Phase II AUAR development will further increase the drainage area to the lake. Although the lake still fully supports designated uses, average annual phosphorus concentrations have been increasing in the lake. Reducing the level of polluted stormwater entering the lake is critical because the lake has no natural outlet; i.e., what goes in the lake, stays in the lake. A lake management plan was developed for Powers Lake which has led to a strong emphasis on infiltration as a primary stormwater mitigation tool for developments in the Powers Lake watershed. However, a geologic sinkhole has developed in the Powers Lake watershed due to a constructed infiltration system. At issue is the placement and designed size of constructed infiltration systems in this area, or other geologically vulnerable areas. A loading assessment and subsequent Retrofit Analysis was completed in 2010. The analysis identified the most cost effective projects for achieving phosphorus load reduction to Powers Lake. Implementation of those projects is classified as a high priority for SWWD.

3.2.1.4 Flood Storage Areas and Central Draw Overflow

The issue of flood storage areas is important and discussed as a District-wide issue (Section 3.1.2). However, specific assumptions were made in the Northern subwatershed in order to design an overflow from the Northern subwatershed to the Mississippi River (see Section 3.2.2.6). Existing condition advisory floodplain maps flood storage areas for this watershed for the 100-year 24-hour and 100-year 10-day precipitation events were developed in the District's 2002 Engineer's Report ("Central Draw Project And Flood Storage Area Maps"). The design of the Central Draw Overflow project assumes Woodbury will commit to the rate, volume and timing of flows (as modeled by the District) at specific locations including PL1-1, CL1E10-1, CL1E5-1, CL1N4-1, CL1N6-1, and CL1E9-1. The Central Draw Overflow schematic layout is shown in Map 3.2

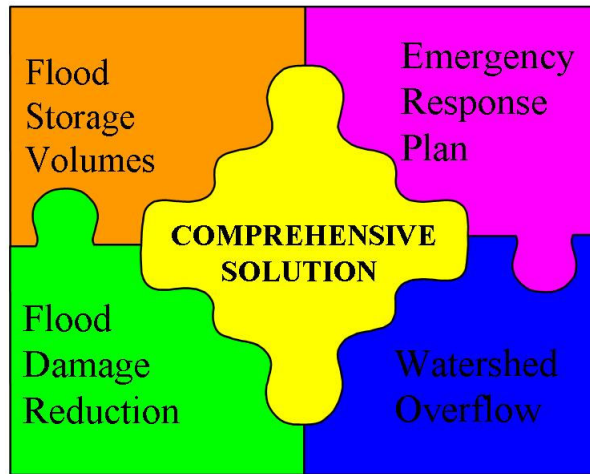
The Central Draw Overflow project is part of a comprehensive solution to addressing flooding are related issues in the Northern subwatershed. The conceptual pieces of the comprehensive solution are shown in Figure 3.1. Future changes that affect the rate, volume or timing of runoff from these basins will affect the operation and reliability of the Central Draw Overflow project. It is important to document existing conditions in order to

understand how future development will impact the built and natural environment and make necessary modifications to proposed watershed management plans for these areas.

3.2.1.5 Special Well Construction Area

Portions of Lake Elmo and Oakdale, fully including the area within the SWWD, were designated by the Minnesota Department of Health as a Special Well Construction Area (SWCA) in March 2007. This designation applies to the construction repair, modification, and sealing of wells and borings. Originally established in 1982 as the Washington County Landfill SWCA, this recently expanded SWCA addresses the finding of more extensive groundwater contamination by perfluorochemicals in Lake Elmo and Oakdale. These chemicals are very stable and can be transported widely in the environment, and in groundwater in particular. The primary purpose of the SWCA is to protect public health and groundwater quality by ensuring wells and borings are constructed to obtain groundwater from a protected aquifer(s) and to help prevent spread of contamination. Stormwater related activities in this area, such as geotechnical evaluations for a pond or infiltration feature, should reflect appropriate compliance with requirements set forth by the Department of Health given the criteria for environmental bore holes. Nonstructural methods for controlling stormwater runoff volumes should generally be given priority over structural methods.

Figure 3.1 – SWWD conceptual approach for solving flooding issues.



3.2.2 East Ravine Subwatershed

The East Ravine subwatershed is approximately 7,300 acres which is about 11% of the District's area. This subwatershed is almost entirely located in Cottage Grove. The area is predominantly undeveloped land and is expected to rapidly transition to an urban landscape.

3.2.2.1 303(d) Listing for Ravine

The intermittent stream (ravine) which flows through Cottage Grove Ravine Park and discharges into the Mississippi River is identified by the MPCA as an impaired water. This

“unnamed creek” was placed on the 303(d) list in 2002 for not meeting water quality standards based on fish diversity to support aquatic life. The listing is different than what is described in Section 3.1.3 which relates to lakes. The identified impaired status is an issue because future developments in this watershed (such as described in the Cottage Grove East Ravine AUAR) will need to comply with load allocations when a TMDL analysis is completed. The impairment designation is also an issue because of the District’s plans to utilize part of this natural drainageway to convey overflow from the Northern subwatershed.

3.2.2.2 Erosion Control for Ravine

The intermittent stream (ravine) which flows through Cottage Grove Ravine Park has exposed soils lacking vegetative cover. As a result, a delta of sediment is forming in Ravine Lake. This issue is relatively minor at present because the drainage area is undeveloped and runoff is contributed from adjacent agricultural areas. Implementation of an overflow to convey stormwater from the Northern subwatershed into the ravine will require stabilization methods and efforts. A shear stress analysis to identify erosion resistance to flows was performed, beginning efforts to define protection methods for the ravine.

3.2.2.3 Ravine Lake Water Levels

Water levels in the Regional Park water body (Ravine Lake) have risen in recent years, changing the system from a wetland-like system to more like a lake system. The rising water levels have flooded the entrance roadway to the park. The park has an outlet under T.H. 61 / T.H. 10. The County has responded to rising water levels in Ravine Lake by excavating a channel connecting Ravine Lake to the culvert under the trunk highway. This issue is currently a low priority for the District because of minimal loss to property.

3.2.2.4 Parkway Development

It is a priority for the District to coordinate with Washington County in their efforts to effectively develop a linear park system of trails and open space. A backbone of this linear park system will be located along CSAH 19. Numerous opportunities exist in the East Ravine subwatershed to integrate new trails and parkways during land development as well as when securing space for flood storage or other water-related purpose. Notably, the box culvert below Military Road linking the lobes of CD-P86 is intended for trail usage in the future.

3.2.2.5 Habitat Restoration Areas

There are large areas of remnant oak savanna and prairie planned for restoration by the City of Cottage Grove. This restoration would fill a missing link to the greenway corridor from CD-P85 to Cottage Grove Ravine Park. Successful incorporation of this area into the greenway corridor would require wildlife road crossings at Military Road and CSAH 19.

The southwest corner of Cottage Grove Ravine Park to the old river channel via Langdon Pond is a high urgency missing link in the greenway corridor. There are natural community areas within this section that have strong potential for restoration, and there are several road crossings at CSAH 19 and Highway 61 that pose a hazard for wildlife movement.

3.2.2.6 Habitat Protection Areas

The District's natural resources management plan identifies creating a natural corridor that connects the northern parts of the District with the Mississippi River. There are several areas along this corridor that are currently unprotected, yet are either worthy of protection or provide excellent opportunities for reclamation/restoration. Two of these areas are within the West Draw subwatershed; i.e., Gables Lake to Cottage Grove Ravine Regional Park located in the northeast corner of Cottage Grove, and Cottage Grove Ravine Regional Park, which includes three unique natural features: a Dry Prairie, a Mixed Emergent Marsh, and a state endangered plant, kitten-tails.

3.2.2.7 Central Draw Overflow Implementation

The East Ravine subwatershed incorporates the preferred path for the Northern subwatershed overflow to provide an outlet to the Mississippi River. The proposed Central Draw Overflow Project is intended to provide principal and emergency outlet capacity for this land locked watershed under existing conditions. The Central Draw Project is comprised of two phases. The first phase of improvements provides downstream capacity up through completion of Woodbury's Phase I AUAR development area. The second phase of improvements will provide downstream capacity through storage as well as a principal and emergency outlet for full development through 2025.

The Central Draw Overflow schematic layout is shown in Map 3.1. Anticipated elements of the Overflow are:

1. Regional stormwater control at point of discharge from CD-P85
2. Regional Detention/Infiltration Basins CD-P85 and CD-P86 north and south
 - a. CD-P85/CD-P86 Connection
 - b. County Road #19 Stabilization
 - c. CD-P86 Berm
 - d. Military Road Crossing
 - e. 70th Street Stabilization
3. Overflow Conveyance System 70th Street to Cottage Grove Regional Park
4. Overland flow/conveyance north of Ravine Lake
5. Flow through lake, Ravine Lake and lake outlet control
6. Conveyance south of Ravine Lake to the Mississippi River

The first phase of the Central Draw Overflow elements include 1-2 listed above, and details are discussed in the District's 2002 Engineer's Report ("Central Draw Project And Flood Storage Area Maps"). A berm will be constructed in the saddle between CD-P86 North and South Lobes in order to maximize storage in the North Lobe prior to discharging to the south. A master grading plan is established for CD-P86 South Lobe. A stabilized channel constructed from County Road 19 to Gables Lake to handle emergency flow is NOT planned.

The second phase of the Central Draw Overflow elements includes 3-6 listed above. The second phase will provide for construction of a permanent overflow route to the Mississippi River in order to accommodate larger volume emergency overflow events. An issue to be resolved in the second phase regards a proposed piped conveyance system which would be used to discharge stormwater into the headwaters of the Cottage Grove ravine park

system. An optimal route for this conveyance system needs to be investigated in order to negotiate two resistant bedrock formations in this area. The stormwater would then be conveyed primarily in an open channel system from this point to the Mississippi. The District will coordinate the central overflow implementation efforts and update its XP-SWMM model as necessary.

The Central Draw Overflow project is included under Policy ST-4 in Chapter 5. Further, phase one and two of the Central Draw Overflow elements are referenced in the Long Range Work Plan, under Management Area 2, Action Item 2.12. Note that these elements are based on current engineering information, and as details are developed, are subject to change in order to obtain the necessary function of the Overflow.

3.2.2.8 Groundwater Influences to Ravine Lake

Ravine Lake has been shown to be strongly influenced by groundwater contribution. A walleye community appears to have successfully established in the lake due to this groundwater influx. Additionally, a degraded fen habitat exists at the northern part of the lake. Changes to the groundwater regime may have substantial impacts to Ravine Lake. This issue is a priority to the District because of the recreational, fisheries, and floral aspects of the Lake.

3.2.3 Central Ravine Subwatershed

The Central Ravine subwatershed contains about 2,735 acres which is roughly 6.4% of the District's area. This subwatershed is completely within the city of Cottage Grove and is essentially fully developed as single family residential neighborhoods. Generally, the stormwater conveyance system is well-maintained and functioning.

3.2.3.1 Subwatershed Boundary Flows

The Central Ravine subwatershed discharges into the West Draw subwatershed. This is a topic of interest to the District for managing stormwater discharge rate and volume into the downstream West Draw subwatershed. The City of Cottage Grove is continuing to work with land owners to agree on the rate and quality of water discharged through the privately owned land (roughly 1,400 acres) to the Mississippi. At a minimum, the District intends to disseminate outcomes of modeling assessments where needed to manage subwatershed boundary flows. In the future, it may be prudent to monitor flows from the Central Ravine into the West Draw subwatershed.

3.2.4 West Draw Subwatershed

The West Draw subwatershed is roughly 13% (about 9,125 acres) of the District's area. This subwatershed is continuing to experience urbanization and land use conversion. The West Draw contains a variety of land uses which poses a challenge to water quality and quantity management.

3.2.4.1 Inter-community Flows

The West Draw subwatershed is undergoing active residential development. Of particular importance is inter-community flow between Woodbury and Cottage Grove, required storage volumes to achieve the allowable flow, and downstream drainage concerns at

Hamlet Park Pond and Highway 61. (These inter-community flow locations, and other critical crossing areas, are reflected in Map 6.3 and summarized in Table 6.5.)

Modeling by the SWWD shows that the west tributary of the West Draw in Woodbury has sufficient storage volume for the 100-year event without discharging stormwater into the Cottage Grove system, assuming a drawdown between storm events. To ensure this drawdown, installation of a pump system from basin WD-WP4 to WD-WP4-2 was completed by the City of Woodbury. The agreement in the West Draw Study completed by the SWWD is that this lift station would be operated “off peak” to ensure adequate downstream capacity.

From the eastern tributary, it is recommended that the discharge from Woodbury to Cottage Grove be restricted to 25 cfs. To accomplish this, Woodbury will need to establish approximately 40acre-feet of additional storage in the east tributary near the location of where the flow crosses the city boundary. The Cities of Woodbury and Cottage Grove are moving forward with designing a stormwater system that provides flood storage within Woodbury to control peak rates and runoff volumes with interim provisions for routing unrestricted flows through Cottage Grove. The District can provide technical support and also monitor any changes to infrastructure to update any relevant hydraulic models.

3.2.4.2 Hamlet Park Pond

A major portion of the West Draw subwatershed flows through Cottage Grove and crosses Highway 61 at the intersection with 80th Street, where a 62- to 72-inch concrete pipe crosses to Hamlet Park Pond. In the 100-year storm event, the model simulating this system shows that Highway 61 is briefly overtopped for approximately 1 day. Although this is an issue, the city of Cottage Grove and other affected parties such as the Minnesota DOT are presently pursuing analysis and strategies independent from the SWWD.

3.2.4.3 Hydrologic and Hydraulic Investigation

Broadly, a priority issue of the District relating to the West Draw is to continue hydrologic and hydraulic investigations to control excessive flows and flooding. As such, it is important to identify drainage areas within this subwatershed which have a significant contribution to West Draw flows. A goal is to locate areas where flooding poses a potential hazard to homes and property.

3.2.5 East Mississippi Subwatershed

The East Mississippi subwatershed is roughly 17% (11,860) of the District’s area. Jurisdiction over this area was transferred to the District in 2003, increasing the overall District area by about 35% at the time. Accordingly, the District has certain statutory projects to implement such as extending the wetland management plan to this area. As well, there are new significant resources under the purview of the District such as La Lake which formerly was managed by the Ramsey-Washington Metro Watershed District.

3.2.5.1 Remnant Prairie Management

There is restoration potential for an area bordering the East Mississippi Watershed and the West Draw Watershed. The terrace upon which Grey Cloud Dunes SNA occurs has potential for expansion and linking to one of the best quality prairies in the Twin Cities

Area. Expansion of this area will provide wildlife habitat, and create opportunities for education and recreation.

3.2.5.2 *Flooding and Erosion*

Two major events in 2005 caused serious flooding and erosion and washouts along the ravines near the Public Works Building (PWB). At least one home is at risk due to significant erosion. The Main Ravine is located north of the PWB, and the Secondary Ravine is located south of the PWB. A watershed / hydrologic study will be needed to identify the problem and the best way to minimize the upstream contribution to the Public Works Building in Newport. The District will be involved if the issues are deemed of regional significance.

Flooding within the Mississippi River corridor is a natural occurrence. Washington County is currently performing a restudy of the County's Flood Insurance Study. Many of the municipal storm sewers in the river corridor have gate structures to prevent backflow from high water. The City of Newport has emergency levees which are in deteriorating condition according to the Department of Natural Resource. Additionally, the banks all along the Mississippi River are steep and generally prone to erosion. The District will incorporate a placeholder in the long range work plan for potential action related to river flooding and bank erosion issues, which may potentially manifest as general re-vegetation or stabilization activities to improve bank integrity and habitat.

3.2.5.3 *Groundwater Quality*

The existence of hazardous wastes in this subwatershed has the potential for contaminating both the surface water and groundwater. The businesses and facilities in this area are appropriately permitted; however, past contamination has occurred in this area. Although remediation has been achieved, the District considers this a priority issue for long-term awareness. Further, the Washington County Comprehensive Plan notes that a portion of St. Paul Park within this subwatershed was designated as a Special Well Construction Area due to contaminated groundwater (but the homes are served by a public water system).

3.2.5.4 *Newport Ravine*

A ravine located in Newport near Interstate 494 and Military Road has been receiving stormwater discharges. Erosion in this ravine has been a problem and attempts have been made to remedy the situation. Large storms in October 2005 resulted in erosion in excess 500 cubic yards of sand, flooding of residences along and at the bottom of the ravine, flooding of roadways at the bottom of the ravine, and discharge of stormwater into the sanitary sewer system. The City of Newport conducted an investigation into the 2005 event and examined possible solutions to prevent recurrence in the future. Hydrologic analysis indicated that flow velocities during major rain events are well in excess of acceptable velocities for sandy composition of the soil in and around the ravine. The City of Newport has developed a plan to address issues encountered during the 2005 event. The plan will be carried out in two phases. Phase I will include armoring the ravine channel, installation of check dams, and bluff repair and stabilization. Phase II will utilize biofiltration and pretreatment sedimentation basins at the top of the ravine to reduce peak flows. The City of Newport in cooperation with the District has completed a feasibility report for construction of the ravine stabilization project (see attached report, City of Newport, MN North Ravine Stormwater Project Plan dated April 6, 2009, BDM Consulting

Engineers and Surveyors, PLC) Phase II of the proposed project is conceptual, final design will be completed by the District. The District may become involved in the implementation of Phase I at a future date should the City of Newport request assistance.

3.2.5.5 Clear Channel Pond

Clear Channel Pond is situated in Cottage Grove. If the pond experiences flood conditions the overflow spills into St. Paul Park thereby presenting an inter-community flow issue. In order to protect the adjacent railroad tracks, modeling by Cottage Grove suggests the need to maintain the existing overland flow route from Cottage Grove into St. Paul Park during major events. Many parties are involved in the dialogue to find a solution. One proposed solution is to construct a lift station for Clear Channel Pond that would discharge to Hamlet Park Pond which is already experiencing water level issues (see section 3.2.4.3). A second, and preferred, solution is to expand stormwater storage in the area that would serve to relieve Clear Channel Pond, help protect infrastructure, and reduce flooding from inter-community flows. At this time, efforts will focus on the second solution, which is more cost-effective. To move forward with the Clear Channel Pond relief project in three phases. First, SWWD, Washington County and Cottage Grove will purchase the former Wheels of Travel property adjacent to Clear Channel Pond. Second, a study will be conducted to examine options to increase storage and design a storage facility. Finally, the stormwater storage facility will be constructed.

3.2.5.6 Grey Cloud Island Slough

Following replacement of an old bridge with an earthen dam and culverts, gradual sedimentation blocked the Grey Cloud Island Slough from Mississippi River flow. Subsequent stagnation has resulted in a significant increase in total phosphorus resulting in subsequent decline in water quality and fish populations and an increase in invasive species and algal blooms. Without action to address stagnation in the slough, water quality will continue to decline. Grey Cloud Island, working with UMN engineering students and a mentoring PE, has completed two reports. The first, "Grey Cloud Island Water Quality Project", identified water quality problems and attributed them to decreased flow in the slough. For the project, the authors built a water quality model that they used to calculate the optimum flow rate that would reduce total phosphorus in the slough yet limit risk of bank erosion. The authors then used the calculated optimum flow rate (70 cfs) to size a replacement culvert in the earthen dam. The second report, "Grey Cloud Island Slough Crossing Project", expanding on the first report, proposed a plan for dam and culvert replacement. The report includes design plans and cost estimates for replacing the dam and culverts designed for the 100 and 500 year flood events. Currently, SWWD and the Township plan to move forward with replacement above the 100 year level. Work is expected to begin in summer of 2010. Completion of the project will restore flow from the Mississippi River through the Slough and improve water quality.

3.2.6 Trout Brook Subwatershed

The Trout Brook subwatershed was transferred to SWWD in 2010 and makes up roughly 8% (5530 acres) of the District. Trout Brook was previously identified as one of the highest priority surface water resources in the former Lower St. Croix Watershed Management Organization. The stream itself is groundwater supported and provides habitat and water temperatures suitable for trout, although it is not currently known to do so.

3.2.6.1 Management Plan Implementation

The Trout Brook was a priority subwatershed for the former Lower St. Croix Watershed Management Organization and remains so for the SWWD. Increased development within the Trout Brook subwatershed has the potential to increase flow, water temperature, and nutrient concentrations within the stream. Efforts are necessary to protect the stream for existing aquatic communities and potential future trout populations. The former Lower St. Croix Watershed Management Organization initiated development of the Trout Brook Management Plan to study and address concerns in the Trout Brook subwatershed. SWWD will continue to manage the Trout Brook subwatershed as called for in the "Management & Improvement Recommendations" section of the completed plan.

3.2.7 O'Connors Creek Subwatershed

The O'Connors Creek subwatershed was transferred to SWWD in 2010 and makes up roughly 9% (6020 acres) of the District. The subwatershed is landlocked, draining via O'Connors Creek to O'Connors Lake. As a landlocked basin, it is sensitive to increased stormwater volumes that may result from development.

3.2.7.1 Management Plan Implementation

O'Connors Creek is a spring fed perennial stream that drains to the landlocked O'Connors Lake. The former Lower St. Croix Watershed Management Organization initiated the O'Connors Stream and Lake Management Plan to develop a strategy to protect and restore this unique water resource. The plan was completed following an extensive public participation process. SWWD will continue to manage the O'Connors Creek subwatershed consistent with the completed plan.

3.2.8 St. Croix Subwatershed

The St. Croix subwatershed was transferred to SWWD in 2010 and makes up roughly 10% (7130 acres) of the District. This basin drains directly to Lake St. Croix of the Lower St. Croix River which is designated as an Outstanding Resource Value Water (ORWW) and currently listed as impaired for excess nutrients.

3.2.8.1 Bluffline/streambank Erosion

Several erosion areas have been identified along the St. Croix River and it is likely that other eroded or erosion prone areas exist. These areas contribute to ongoing degradation of the St. Croix River and should be addressed as part of implementing load reductions expected to be required as part of the St. Croix River TMDL.

3.2.8.2 St. Croix River Water Quality

The St. Croix River is an important resource both locally and regionally. Currently listed as impaired, a TMDL study is underway to address excess nutrient loading. The District will cooperate with the ongoing study and work with municipalities and Washington County to implement water quality improvement projects in an effort to achieve load reductions identified in the TMDL study.

3.2.9 Lower Mississippi Subwatershed

The Lower Mississippi subwatershed was transferred to SWWD in 2009 and makes up roughly 8% (5700 acres) of the District. This basin drains to the Mississippi River via several ravines and intermittent streams. The subwatershed also includes Conley Lake which is located within the Mississippi River floodplain.

3.2.9.1 Bluffline/streambank Erosion

Several erosion areas have been identified along the Mississippi River and it is likely that other eroded or erosion prone areas exist. These areas contribute to ongoing degradation of the Mississippi River, which is currently impaired for turbidity, as well as endangering property at the top of the bluffs.

3.2.9.2 Mississippi River Turbidity

A turbidity TMDL is underway for a stretch of the Mississippi River that includes SWWD's Lower Mississippi subwatershed. SWWD will cooperate with local municipalities and state agencies to implement projects to make the necessary reductions.