Clearwater River

A. Water Resources

1. Major Sub Watershed Areas

The Clearwater River watershed consists of an approximately 1,362 square mile area. The watershed outlets into the Red Lake River at Sportsman's Park in Red Lake Falls, MN. The watershed is located mainly within the Glacial Lake Agassiz/Aspen Parklands and Glacial Moraine ecoregions, but is bordered by the Northern Minnesota Drift and Lake Plains ecoregion. Soil textures range from loamy-skeletal in the southeastern portion of the watershed to sandy in the west portion of the watershed. The area consists largely of agricultural and forest land, but is also made up of wetland, urban, and grassland.

2. Surface Waters

This sub-watershed is also comprised of five smaller sub-watersheds which outlet into the Clearwater River. They are the Beau Gerlot Creek, Badger Creek, Hill River, Lost River, and Poplar River sub-watersheds. The Clearwater River Sub-watershed is bordered along its north side by the Upper Red Lake River sub-watershed. All of the drainage from within the smaller sub-watersheds ends up in the Clearwater River. All of the water comes together in the Clearwater River and outlets at the confluence with the Red Lake River in Red Lake Falls.

There are many lakes in the Clearwater River Sub-watershed. There are 28 lakes larger than 100 acres, and 107 lakes smaller than 100 acres. Major lakes for recreation include Maple, Cameron, Badger, Clearwater, Pine, and Whitefish. The larger lakes typically support a fishery, with the majority of smaller lakes only supporting waterfowl hunting as a recreation. Much of the shoreline is developed on the larger lakes, and the majority of small lakeshores are undeveloped.

Wetland areas are scattered throughout the area. These wetland areas are somewhat denser in the extreme Northeastern portion of the sub-watershed. Many of the wetlands have been altered by farm drainage, and many wetlands have been drained for the purposes of agricultural production.

Drainage systems in this sub-watershed are a complex network of natural streams and legal ditch systems. Generally, the ditch systems are under the administration of the County in which they reside or the Watershed District.

Water quality monitoring has been done by the District at nineteen sites associated with streams since 1984 and more recently at four other sites on lakes within the sub-watershed. Lakes being monitored include Clearwater Lake (1993), Cameron Lake (2003), Maple Lake (2004), and Badger Lake (2004). The parameters measured included field measurements for dissolved oxygen, pH, temperature, turbidity, transparency, and conductivity. Laboratory analysis is performed on stream samples for fecal coliform, total suspended solids, total dissolved solids, chemical oxygen demand, total phosphorus, orthophosphorous, nitrates and nitrites, ammonia, total kjeldahl nitrogen, and alkalinity. Lakes monitoring data includes Secchi depth readings, as well as total phosphorous and chlorophyll-a analysis. The District periodically prepares a water quality report, and

results are available upon request in the District office. There are six impaired stream reaches as identified by the Minnesota Pollution Control Agency in this sub-watershed. They include;

Clearwater River, Ruffy Brook to Poplar River
Clearwater River, Clearwater Co. Line to Clearwater Lake
Walker Brook, from Walker Brook Lake to Clearwater River
Poplar River, from Spring Lake to Hwy 59
Lost River, from Silver Creek to Hill River
CD57, from confluence with Clearwater River to approx. 2 miles upstream

3. Groundwater

The sub-watershed is located in parts of the Lake-Washed Till Plain and Moraine physiographic area of the Red Lake Watershed. The surficial geology of the area consists of mainly glacial tills to the south, peat to the northeast, lake-washed till to the northwest and sand to the southwest. The glacial till deposits consists of sandy, clay-silt loam containing fine to medium gravel with a scattering of boulders. The peat deposits are generally only a few feet thick, caused by the poor drainage and the water table at or near the land surface. Sand deposits are described as being very-fine to fine and commonly less than 20 feet thick. The lake-washed till deposits have a similar composition as the glacial till and is overlain in many local low areas by thin deposits of clay, silt, sand, and peat. In the southern section of the sub-watershed, just north of Bagley (and other small regions to the north), deposits of sand and gravel from outwash and ice contact features are present. The deposits consist of fine sand to medium gravel, with thicknesses ranging from a few feet to almost 100 feet. Local topography is generally hilly, with improved drainage over other areas in the watershed.

Glacial sediment aquifers in the region provide moderate amounts of groundwater. Suitable yields of 5 gallons per minute (gpm) or more for domestic use can be found in sand lenses within the till. These lenses are often localized and yields can vary and may accommodate municipal or industrial uses. Outwash and ice-contact sand and gravel aquifers are the best source in the watershed for a large groundwater supply. Yields can reach several hundred gpm. The areal extent of the aquifer is fairly large and water quality is adequate for municipal, industrial, domestic and irrigation use. Hardness is generally greater than 180 mg/L and iron content may be high.

Cretaceous sediments consisting of shales and limestones underlie the glacial lake deposits along the western side of the sub-watershed. Thicknesses less than 50-feet are recorded around the Red Lake Falls area. Precambrian crystalline rocks underlie the Cretaceous sediments, forming the base of the groundwater reservoir for most of the sub-watershed. The crystalline rocks do not provide an adequate supply of groundwater, due to the few and localized, interconnected fractures in the bedrock.

Information regarding the individual city wells, water quality analysis results, and the aquifers that serve as the water supply can be obtained from the individual cities and the Minnesota Geological Survey.

Lower Red Lake River

B. Water Resources

1. Major Sub Watershed Areas

The Lower Red Lake River watershed consists of an approximately 874 square mile area. The watershed outlets into the Red River of the North at East Grand Forks, and begins just downstream of the Dam in Thief River Falls. The watershed is located mainly within the Red River Valley and Glacial Lake Agassiz/Aspen Parklands ecoregions. Soil textures range from fine in the western portion of the watershed to sandy-loam in the east portion of the watershed. There are two sand ridges west of Thief River Falls along what is commonly termed the Pembina Trail. The area consists largely of agricultural land, but is also made up of forest, wetlands, urban, and grassland.

2. Surface Waters

This sub-watershed is also comprised of two minor sub-watersheds which outlet into the Red Lake River. They are the Heartsville Coulee and Burnham Creek minor sub-watersheds. The Lower Red Lake River sub-watershed is bordered along its north side by the Grand Marais sub-watershed. The drainage from within the smaller minor sub-watersheds ends up in the Red Lake River in the western half of the watershed. The Thief River and Upper Red Lake River subwatersheds are tributary to the Lower Red Lake River subwatershed in Thief River Falls. The Clearwater River subwatershed is tributary to the Lower Red Lake River in Red Lake Falls.

There are no lakes in this sub-watershed. Wetland areas are scattered throughout the area. These wetland areas are somewhat denser in the extreme southeastern portion of the sub-watershed, generally south of US HWY 2 and east of State HWY 102. Many of the wetlands in this watershed have been altered by farm drainage, and many wetlands have been drained for the purposes of agricultural production.

Drainage systems in this sub-watershed are a complex network of natural streams and legal ditch systems. Generally, the ditch systems are under the administration of the County in which they reside or the Watershed District.

Water quality monitoring has been done by the District at six sites associated with streams within the sub-watershed. Monitoring has been done since as early as 1984 for several parameters, including field measurements for dissolved oxygen, pH, temperature, turbidity, transparency, and conductivity. Laboratory analysis is performed on stream samples for fecal coliform, total suspended solids, total dissolved solids, chemical oxygen demand, total phosphorus, orthophosphorous, nitrates and nitrites, ammonia, total kjeldahl nitrogen, alkalinity, dissolved oxygen, pH, temperature, turbidity, transparency, alkalinity, and conductivity. The District periodically prepares a water quality report, and results are available upon request in the District office. There are two impaired stream reaches as identified by the Minnesota Pollution Control Agency in this sub-watershed. They include;

Red Lake River; Burnham Creek to Unnamed Creek (near East Grand Forks)
Red Lake River; Unnamed Creek to Red River

3. Groundwater

The sub-watershed is located in the Lake Plain physiographic area of the Red Lake Watershed. The surficial geology of the area consists of mainly clay with small regions of silt, sand, sand and gravel ridges, and lake washed till. Clay deposits dominate the Lower Red Lake River sub-watershed and is characterized as being very dense, uniform and virtually impermeable. Thicknesses can range from a few feet in the eastern part of the watershed to more than 120 feet in the western portions. Nearly level topography in this region also relates to poor drainage. Sand and gravel ridges, known as beach ridges from Glacial Lake Agassiz, occur in mainly north-south trending ridges that range in thickness from a few feet to thirty feet in some areas. Drainage is good within the ridges, but can be poor in the inter-ridge areas where deposits of peat are evident. The fine sand or silt deposits in the area are fairly uniform and underlain by till and clay deposits. Thicknesses for both deposits are generally less than 20 feet. Lake-washed till deposits are described as sandy, clay-silt loam that contains fine to medium gravel with a scattering of boulders. The deposits are generally not well drained.

Glacial sediment aquifers in the region only provide moderate amounts of groundwater. Suitable yields of 5 gallons per minute (gpm) or more for domestic use, are mainly found in sand lenses in the till or in beach ridge deposits. The extent of beach ridge deposits is limited and sand lenses are often localized. Beach ridges are typically saturated in their lower half to two-thirds. Yields of more than 20 gpm can be obtained from the larger ridges, but supplies from the smaller ridges are unreliable and can dry up in late summer to fall. Groundwater supply for industrial use and irrigation is generally poor. Quantities and quality for such uses are inadequate. Hardness of the groundwater is commonly greater than 180 mg/l.

Cretaceous sediments consisting of shales and limestones underlie the glacial lake deposits throughout most of the watershed. Thicknesses less than 50-feet are recorded west of the Red Lake Falls area. The western tip of the sub-watershed near East Grand Forks contains Paleozoic limestone and sandstone that is discontinuous and commonly less than 20-feet thick. Large yields can be obtained from this unit, but it is fairly thin and discontinuous in the watershed and contains highly saline groundwater. Precambrian crystalline rocks underlie both the Cretaceous and Paleozoic sediments, forming the base of the groundwater reservoir.

Information regarding the individual city wells, water quality analysis results, and the aquifers that serve as the water supply can be obtained from the individual cities and the Minnesota Geological Survey.

Information regarding the city wells, water quality analysis results, and the aquifer that serves as the water supply can be obtained from the individual cities and the Minnesota Geological Survey.

Grand Marais

C. Water Resources

1. Major Sub Watershed Areas

The Grand Marais watershed consists of an approximately 317 square mile area. The watershed outlets into the Red River approximately 9 miles north of East Grand Forks, and begins just west of the Goose Lake Swamp area. The watershed is located mainly within the Red River Valley ecoregion with the extreme eastern potion entering the Glacial Lake Agassiz/Aspen Parklands ecoregion. Soil textures range from Fine in the western 2/3 of the watershed to sandy-loam/fine-loam in the eastern 1/3 of the watershed. The area consists largely of agricultural land (94%), but is also made up forest, wetlands, urban, and grassland.

2. Surface Waters

The Grand Marais sub-watershed is bordered along its north side by the Middle River Snake River Watershed District, and by the Lower Red Lake River sub-watershed on the south and east sides. There are 41 minor subwatersheds within the Grand Marais and each generally represents a legal ditch system. Overland flooding is common each spring.

There are no lakes in this sub-watershed. Wetland areas are scattered throughout the area. These wetland areas are somewhat denser in the extreme eastern portion of the sub-watershed, generally east of State HWY 75. Many of the wetlands in this watershed have been altered by farm drainage, and many wetlands have been drained for the purposes of agricultural production, especially those in the western 2/3 of the subwatershed. Remaining wetlands have been estimated to be 1-20% of pre-settlement extent.

Drainage systems in this sub-watershed are a complex network of legal ditch systems located at 1-2 mile intervals that drain east to west into natural streams. Generally, the ditch systems are under the administration of Polk County or the Watershed District. One notable storage project within this watershed is the Parnell impoundment which is capable of storing 3,600 acre feet of water.

Water quality monitoring has been done by the District at one site associated with streams within the sub-watershed. This is located on the Grand Marais Creek at State HWY 220. Monitoring has been done since as early as 1985 for several parameters, including field measurements for dissolved oxygen, pH, temperature, turbidity, transparency, and conductivity. Laboratory analysis is performed on stream samples for fecal coliform, total suspended solids, total dissolved solids, chemical oxygen demand, total phosphorus, orthophosphorous, nitrates and nitrites, ammonia, total kjeldahl nitrogen, alkalinity, dissolved oxygen, pH, temperature, turbidity, transparency, alkalinity, and conductivity.

Noted problems along the Grand Marais Creek are high turbidity and TSS levels. The District periodically prepares a water quality report, and results are available upon request in the District office. There are no impaired stream reaches as identified by the Minnesota Pollution Control Agency in this sub-watershed.

3. Groundwater

The subwatershed is located in the Lake Plain physiographic area of the Red Lake River Watershed District. The surficial geology of the area consists of mainly clay with small regions of silt, sand, sand and gravel ridges, and lake washed till. Clay deposits dominate the Grand Marais Creek subwatershed and are characterized as being very dense, uniform and virtually impermeable. Thicknesses can range from a few feet in the eastern part of the watershed to more than 120 feet in the western portions. Nearly level topography in this region also relates to poor drainage. Sand and gravel ridges, known as beach ridges from Glacial Lake Agassiz, are located along the eastern portion of the subwatershed. They occur in mainly north-south trending ridges that range in thickness from a few feet to thirty feet in some areas. Drainage is good within the ridges, but can be poor in the inter-ridge areas where deposits of peat are evident. The fine sand or silt deposits in the area are fairly uniform and underlain by till and clay deposits. Thicknesses for both deposits are generally less than 20 feet. Lake-washed till deposits are described as sandy, clay-silt loam that contains fine to medium gravel with a scattering of boulders. The deposits are generally not well drained.

Glacial sediment aquifers in the region only provide moderate amounts of groundwater. Suitable yields of 5 gallons per minute (gpm) or more for domestic use, are mainly found in sand lenses in the till or in beach ridge deposits. The extent of beach ridge deposits is limited and sand lenses are often localized. Beach ridges are typically saturated in their lower half to two-thirds. Yields of more than 20 gpm can be obtained from the larger ridges, but supplies from the smaller ridges are unreliable and can dry up in late summer to fall. Groundwater supply for industrial use and irrigation is generally poor. Quantities and quality for such uses are inadequate. Hardness of the groundwater is commonly greater than 180 mg/l.

Cretaceous sediments consisting of shales and limestones underlie the glacial lake deposits throughout most of the watershed. Thicknesses less than 50-feet have been documented in the watershed. The western edge of the subwatershed near East Grand Forks contains Paleozoic limestone and sandstone that is discontinuous and commonly less than 20-feet thick. Large yields can be obtained from this unit, but it is fairly thin and discontinuous in the watershed and contains highly saline groundwater. Precambrian crystalline rocks underlie both the Cretaceous and Paleozoic sediments, forming the base of the groundwater reservoir.

Information regarding the individual city wells, water quality analysis results, and the aquifers that serve as the water supply can be obtained from the individual cities and the Minnesota Geological Survey.

Upper Red Lake River

D. Water Resources

1. Major Sub Watershed Areas

The Upper Red Lake River watershed consists of an approximately 457 square mile area. The watershed outlets into the Lower Red Lake River at Thief River Falls, and begins at the Lower Red Lake outlet control structure. The watershed is located entirely within the Glacial Lake Agassiz/Aspen Parklands and the Northern Minnesota Peatlands ecoregions. Soil textures range from Fine Loam in the western portion to Coarse Loam/Sapric in the eastern portion of the watershed. The area consists a mix of agricultural land, forest, wetlands, urban, and grassland.

2. Surface Waters

This sub-watershed is also comprised of 53 smaller minor sub-watersheds which outlet into the Upper Red Lake River. The Upper Red Lake River sub-watershed is bordered along its north side by the Thief River sub-watershed. All of the drainage from within the smaller sub-watersheds ends up in the Red Lake River at various points along the river.

There are no lakes in this sub-watershed. Wetland areas are scattered throughout the area. The wetland areas are very dense in the eastern portion of the sub-watershed, generally the east Pennington/Clearwater County line. Many of the wetlands in west portion of this watershed have been altered by farm drainage, and many wetlands have been drained for the purposes of agricultural production. The majority of the eastern wetlands have been left untouched. Remaining wetlands have been estimated to be 2-43% of pre-settlement extent.

Drainage systems in this sub-watershed are a complex network of natural streams and legal ditch systems developed for agriculture. Generally, the ditch systems are under the administration of the County in which they reside or the Watershed District. One notable existing storage project within this watershed is the Good Lake project which is capable of storing 10,000 acre feet of water.

Water quality monitoring has been done by the District at two sites associated with streams within the sub-watershed. Monitoring has been done since as early as 1980 for several parameters, including field measurements for dissolved oxygen, pH, temperature, turbidity, transparency, and conductivity. Laboratory analysis is performed on stream samples for fecal coliform, total suspended solids, total dissolved solids, chemical oxygen demand, total phosphorus, orthophosphorous, nitrates and nitrites, ammonia, total kjeldahl nitrogen, alkalinity, dissolved oxygen, pH, temperature, turbidity, transparency, and conductivity. Major locations for sampling include the Red Lake Dam Outlet and the Highlanding Bridge. The District periodically prepares a water quality report, and results are available upon request in the District office. There are no impaired stream reaches as identified by the Minnesota Pollution Control Agency in this sub-watershed.

3. Groundwater

The subwatershed is located in the Lake-Washed Till Plain physiographic area of the Red Lake River Watershed District. The surficial geology of the area is dominated by the lake washed till. The till is described as a sandy, clay-silt loam containing fine to medium gravel with a scattering of boulders. The till is covered in areas to the west by very-fine to fine grained, uniform glacial lake sand generally less than 20 feet in thickness. In the eastern portion of the subwatershed, the till is overlain by a thin covering of peat (only a few feet thick) that results from the water table being close to or at land surface, paired with poor drainage in the area. Localized peat deposits are also present in many closed depressions within the till.

Glacial sediment aquifers in the region provide very moderate amounts of groundwater. Suitable yields of 5 gallons per minute (gpm) or more for domestic use can be found in sand lenses within the till. These lenses are often localized and yields can vary. The aquifer may accommodate municipal or industrial uses, possibly up to 250 gpm in some rare instances. Hardness of the groundwater is commonly greater than 180 mg/l.

Cretaceous sediments consisting of shales and limestones underlie the glacial lake deposits along the western side of the subwatershed. Thicknesses have been recorded at less than 50-feet. Precambrian crystalline rocks underlie the Cretaceous sediments, forming the base of the groundwater reservoir for most of the subwatershed. The crystalline rocks do not provide an adequate supply of groundwater due to the few, localized, interconnected fractures in the bedrock.

Information regarding the individual city wells, water quality analysis results, and the aquifers that serve as the water supply can be obtained from the individual cities and the Minnesota Geological Survey.

Red Lakes – Upper and Lower

E. Water Resources

1. Major Sub Watershed Areas

The Red Lakes watershed consists of an approximately 1,929 square mile area. The watershed outlets into the Red Lake River at the Red Lake Dam. The watershed is located entirely within the Northern Minnesota Peatlands and the Northern Minnesota Drift and Lake Plains ecoregions. Soil textures range from fine-loamy in the southern portion of the watershed to Hemic/Sapric in the northern portion of the watershed with a buffer strip of sandy soils around Lower Red Lake. The area consists largely of forest land, lakes, and wetlands, with very little agricultural or developed land.

2. Surface Waters

The Red Lakes sub-watershed is the uppermost reach of the RLWD. All of the drainage from within the smaller sub-watersheds ends up in the Red Lakes and eventually outlets into the Red Lake River at the Red Lake Dam. Dam outflows are controlled by the Army Corps of Engineers.

There are 86 named lakes in the Red Lakes sub-watershed, of which 18 are over 100 acres. Major lakes for recreation include, Upper and Lower Red, Bass, Island, Puposky, Sandy and White Fish Lakes. The larger lakes typically support a fishery, with the majority of smaller lakes only supporting waterfowl.

Wetland areas are scattered throughout the area. These wetland areas are somewhat denser in the Northern portion of the sub-watershed. The majority of the Northern and eastern wetlands have been left untouched. Remaining wetlands have been estimated to be 53-95% of pre-settlement extent. Much of the northern and eastern areas of this watershed have been devoted to wildlife management areas.

Drainage systems in this sub-watershed are a complex network of natural streams with a few legal ditch systems. Generally, the ditch systems are under the administration of the County in which they reside or the Red Lake Nation.

Although not currently monitoring any locations within this subwatershed, the RLWD has past data available at one site associated with a stream from 1989-2002. The Red Lake Department of Natural Resources now monitors all major streams that enter the lakes as well as the lakes themselves within the sub-watershed. The parameters measured included field measurements for dissolved oxygen, pH, temperature, turbidity, transparency, and conductivity. Laboratory analysis is performed on stream samples for fecal coliform, total suspended solids, total dissolved solids, chemical oxygen demand, total phosphorus, orthophosphorous, nitrates and nitrites, ammonia, total kjeldahl nitrogen, and alkalinity. Lakes monitoring data includes Secchi depth readings, as well as total phosphorous and chlorophyll-a analysis. The District has past data available, but current data can be obtained from the Red Lake DNR. There are no impaired stream reaches as identified by the Minnesota Pollution Control Agency in this sub-watershed.

3. **Groundwater**

The subwatershed is located in the Moraine physiographic area of the Red Lake River Watershed District. The surficial geology of the area consists of mainly glacial tills in the southern region of the watershed and glacial sands and peat lands surrounding the Upper and Lower Red Lakes to the north. The glacial till deposits consist of sandy, clay-silt loam containing fine to medium gravel with a scattering of boulders. The peat deposits are generally only a few feet thick, caused by the poor drainage and the water table at or near the land surface. Peat deposits also occur locally within closed depressions found in the moraine. Sand deposits are described as being very-fine to fine and commonly less than 20 feet thick. Drainage is improved over areas containing clays and silts. Deposits of both sand and peat are underlain by till in most places.

Glacial sediment aquifers in the region provide very moderate amounts of groundwater. Suitable yields of 5 gallons per minute (gpm) or more for domestic use can be found in sand lenses within the till. These lenses are often localized and yields can vary and may accommodate municipal or industrial uses. Hardness of the groundwater is commonly greater than 180 mg/l.

Precambrian crystalline rocks underlie the glacial deposits throughout the watershed, forming the base of the groundwater reservoir. The crystalline rocks do not provide an adequate supply of groundwater due to the few, localized, interconnected fractures in the bedrock.

Information regarding the individual city wells, water quality analysis results, and the aquifers that serve as the water supply can be obtained from the individual cities and the Minnesota Geological Survey.

Thief River and Tributaries

F. Water Resources

1. Major Sub Watershed Areas

The Thief Lake subwatershed consists of an approximately 1,068 square mile area. The watershed outlets into the Red Lake River in Thief River Falls. The watershed is located mostly within the Lake Agassiz ercoregion with the extreme northeastern and southeastern areas fringing on the Northern Minnesota Peatlands ecoregion. Soil textures range from fine-loamy in the west to coarse-loamy in the east, with a strip of sandy soils along the northern boundary of the watershed. The area consists a mix of agricultural lands, forest lands, and wetlands, with very little grasslands, lakes or developed urban land.

2. Surface Waters

This sub-watershed is also comprised of two smaller sub-watershed which outlet into the Thief River. They are the Moose River and Mud River/Agassiz sub-watersheds. The Thief Lake sub-watershed is the northernmost reach of the RLWD. All of the drainage from within the smaller sub-watersheds flows into the Thief River and eventually outlets into the Red Lake River at Thief River Falls.

There are 7 named lakes in the Thief River sub-watershed. Major lakes for recreation include Thief Lake and Mud Lake/Agassiz. All lakes within this watershed typically support only waterfowl as they are too shallow to support a recreational fishery. Shoreline is typically undeveloped on the lakes.

Wetland areas are scattered throughout the area. These wetland areas are somewhat denser in the eastern portion of the sub-watershed, especially east of the Beltrami County line. Many of the wetlands in west portion of this watershed have been altered by farm drainage, and many wetlands have been drained for the purposes of agricultural production. The majority of the eastern wetlands have been left untouched. Remaining wetlands have been estimated to be 2-43% of pre-settlement extent.

Drainage systems in this sub-watershed are a complex network of natural streams and legal ditch systems developed for agriculture. Generally, the ditch systems are under the administration of the County in which they reside or the Watershed District. Notable existing storage projects within this watershed include Thief Lake, Agassiz National Wildlife Refuge, Elm Lake, Lost River Pool, and the Moose River Impoundment which collectively can store up to 138,000 acre feet of water.

Water quality monitoring has been conducted by the District at five sites associated with streams within the sub-watershed. Monitoring has been done since as early as 1980 for several parameters, including field measurements for dissolved oxygen, pH, temperature, turbidity, transparency, and conductivity. Laboratory analysis is performed on stream samples for fecal coliform, total suspended solids, total dissolved solids, chemical oxygen

demand, total phosphorus, orthophosphorous, nitrates and nitrites, ammonia, total kjeldahl nitrogen, alkalinity, dissolved oxygen, pH, temperature, turbidity, transparency, and conductivity. Major locations for sampling include the Hillyer Bridge and two sites on the Moose and Mud Rivers.

Noted problems along the Thief River are high turbidity and TSS levels. The District periodically prepares a water quality report, and results are available upon request in the District office. There are no impaired stream reaches as identified by the Minnesota Pollution Control Agency in this sub-watershed.

3. Groundwater

The subwatershed is located in the Lake-Washed Till Plain physiographic area of the Red Lake River Watershed District. The surficial geology of the area is dominated by the lake washed till. The till is described as a sandy, clay-silt loam containing fine to medium gravel with a scattering of boulders. The till is covered in areas by a very-fine to fine grained, uniform glacial lake sand generally less than 20 feet in thickness. Throughout the subwatershed, the till is overlain by a thin covering of peat (only a few feet thick) that results from the water table being close to or at land surface, paired with poor drainage in the area. Localized peat deposits are also present in many closed depressions within the till.

Glacial sediment aquifers in the region provide very moderate amounts of groundwater. Suitable yields of 5 gallons per minute (gpm) or more for domestic use can be found in sand lenses within the till. These lenses are often localized and yields can vary. The aquifer may accommodate municipal or industrial uses, possibly up to 250 gpm in some rare instances. Hardness of the groundwater is commonly greater than 180 mg/l.

Cretaceous sediments consisting of shales and limestones underlie the glacial lake deposits along most of the western half of the subwatershed. Thicknesses have been recorded at less than 50-feet. Precambrian crystalline rocks underlie the Cretaceous sediments, forming the base of the groundwater reservoir for most of the subwatershed. The crystalline rocks do not provide an adequate supply of groundwater due to the few, localized, interconnected fractures in the bedrock.