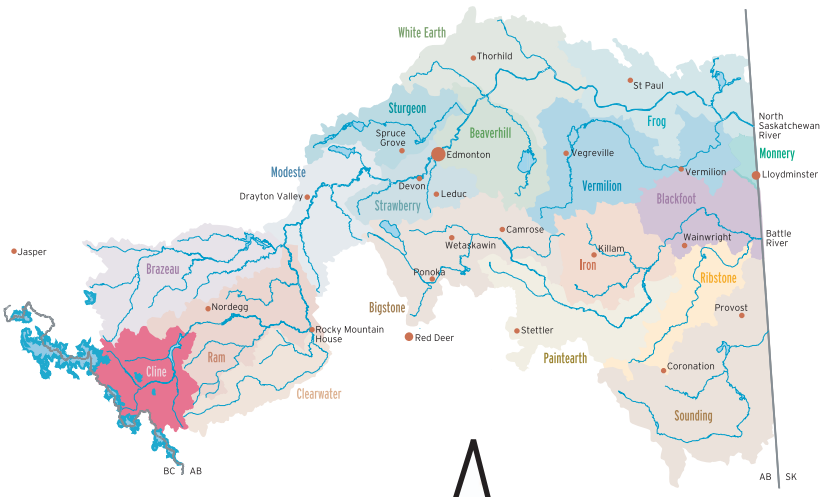
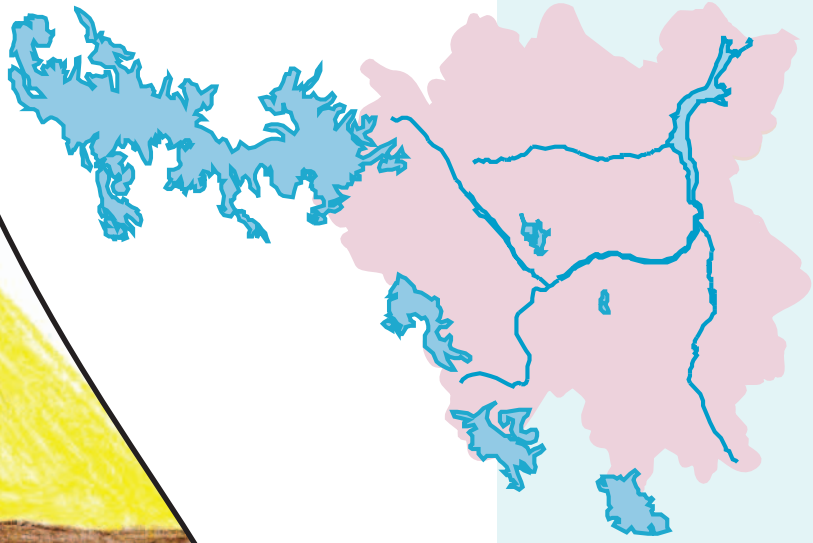
Cline





Graham Ward
Age 10
Edmonton




5.0 STATE OF THE NORTH SASKATCHEWAN SUBWATERSHEDS

5.1 CLINE SUBWATERSHED

The eastern boundary of the Cline Subwatershed is the height of land that forms the Alberta/British Columbia border. This area is in the Rocky Mountain Natural Region and the climate is dry and windy, with moderate winter temperatures and increased winter precipitation. The Cline is in the municipal boundary of Clearwater County, and there are no towns in this Subwatershed. The Cline Subwatershed encompasses 378,629 hectares including 37,286 hectares of lakes and rivers and the Saskatchewan Glacier (in the Columbia Icefield) where the North Saskatchewan River originates.

The geology of the region is that of many rock glaciers and unvegetated bedrock. In higher elevations, the vegetation is sparse consisting of lichens on rocks and shallow soils. At lower elevations, the vegetation consists of lodgepole pine and Douglas fir forests and Engelmann spruce-fir forests.

There is a significant amount of recreational activity in the Subwatershed, particularly in the Abraham Lake area. Recreational activities include fishing, hiking, canoeing, skiing, rock climbing, and rafting.

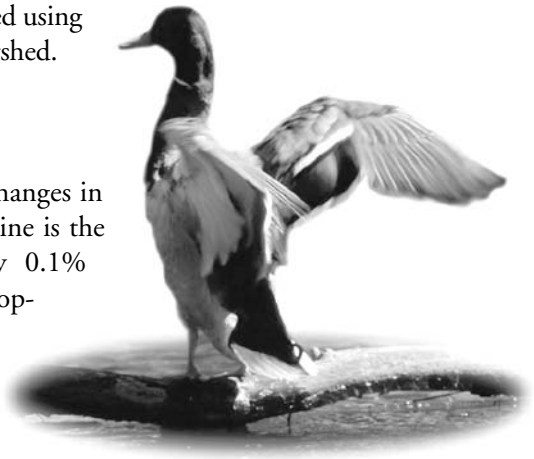
Many of the indicators described below are referenced from the "Cline Hydrological Overview" map located in the adjacent map pocket, or as a separate Adobe Acrobat file on the CD-ROM.

5.1.1 Land Use

Changes in land use patterns reflect major trends in development. Land use changes and subsequent changes in land use practices may impact both the quantity and quality of water in the Subwatershed and in the North Saskatchewan Watershed. Five metrics are used to indicate changes in land use and land use practices: riparian health, linear development, land use, livestock density, and wetland inventory.

5.1.1.1 Riparian Health

The health of the riparian area around water bodies and along rivers and streams is an indicator of the overall health of a watershed and the impact of changes in land use and management practices. No published assessment of riparian health was found for any of the waterbodies in the Cline Subwatershed, so no conclusions can be drawn about riparian health for this Subwatershed using this indicator. This data gap could be addressed in future research in the Cline Subwatershed.

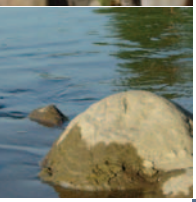


5.1.1.2 Linear Development

Quantifying linear development in the Subwatershed helps us understand potential changes in water quality and quantity, fish and wildlife populations, and riparian health. The Cline is the least disturbed Subwatershed in the North Saskatchewan Watershed, with only 0.1% (365 ha) of the land area taken up by linear developments. The majority of these developments (63%) are roads of one form or another, mostly paved undivided roads and gravel roads. The remainder of the linear disturbance (37%) is cutlines and trails.





5.1.1.3 Land Use Inventory

An inventory of land use quantifies natural landscape types and land uses and may be used to explore changes in water quality and quantity, fish and wildlife populations, and riparian health. Forty-nine percent of the Subwatershed lies within Banff and Jasper National Parks and 22% in the Siffleur and White Goat wilderness areas. Provincial Forest Management Units comprise the remaining 29% of the Subwatershed. Most of the Subwatershed lies within protected areas. Within the above areas, icefields, lakes, wetlands and rivers cover 9.8% (37,286 ha) of the Subwatershed.

5.1.1.4 Livestock Density

Areas of higher livestock density may be expected to have greater impacts on downstream aquatic systems. Manure production was used as a surrogate for livestock density. Manure production information was available only on the basis of soil polygons. These polygons do not correspond to the Subwatershed boundaries and provide only a rough estimate of manure production in the actual watershed. Based on the available information, livestock densities in the Cline Subwatershed are low. Manure production in the soil polygons that cover the Cline Subwatershed was estimated between 0 and 256,000 tonnes.

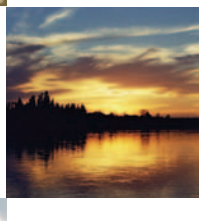
5.1.1.5 Wetland Inventory

Wetlands serve many functions in the natural landscape. The loss of wetlands to development can have impacts on water quantity and quality to downstream habitats. Alberta Sustainable Resource Development base features hydrology data shows 122 hectares of wetlands in the Cline Subwatershed. Due to the low development in this Subwatershed, we can assume that most wetlands in this area are in a natural state, and highly functional.

5.1.2 Water Quality and Quantity

Water bodies in the Subwatershed include the North Saskatchewan River, Cline River, Siffleur River, McDonald Creek, Coral Creek, and Whiterabbit Creek. Some of the larger lakes and reservoirs in this Subwatershed include Abraham, Glacier, Peyto, Mistaya, Chephren and Pinto. The five largest icefields in the Subwatershed include the Columbia, Lyell, Freshfield, Mons and Wilson. The Columbia Icefield includes the Saskatchewan Glacier. The Bighorn hydroelectric dam operated by TransAlta Utilities Corporation creates Abraham Lake, which is the longest man-made lake in Alberta, and covers 35 km^2.

Water quality on the main stem of the North Saskatchewan River is monitored regularly by Parks Canada and Environment Canada at Whirlpool Point. One of the National Parks strategic goals is to provide an overview of status and trends in water quality in the three major watersheds originating in the mountains (North Saskatchewan, Athabasca and Bow Rivers). Monthly physical, nutrients, metals and flow data were obtained from 1970 to the present. CCME Water Quality Index (WQI) data are summarized by Environment Canada for 1983-2002 (Glozier *et al.* 2004).



For the 1983-2002 period, average river water quality at Whirlpool Point was found to be fair (calculated WQI = 64). A fair value (calculated WQI between 60 and 79) means that water quality is usually protected, but occasionally threatened or impaired by conditions that depart from natural or desirable levels. The five variables in non-compliance (in order of occurrence) were: total phosphorus, dissolved oxygen, fecal coliforms, dissolved arsenic, and total nitrogen. Similar headwater sites within the park boundaries on the Bow and Athabasca rivers both ranked much higher with a good rating (calculated WQI = 93).




The reason for Whirlpool Point's lower score relative to neighbouring Bow and Athabasca Rivers results from the parameters chosen to calculate the index. The high sediment load found in the North Saskatchewan River water contains particulate phosphorus from the natural weathering of phosphorus-rich bedrock. So, if a dissolved species of phosphorus (such as soluble reactive phosphorus, a measure of phosphate) had been used to calculate the Index, the Guideline would not have been exceeded and the Index score would have been higher (Nancy Glozier *pers. comm.*) Also exceeding the guidelines was dissolved oxygen concentrations, which average 8 mg/L in the river main stem. This is lower than the 9 mg/L set out in the published guidelines, and also reduce the WQI value. Naturally occurring fecal coliforms, arsenic and nitrogen which infrequently exceed the CCME's Guideline for the Protection of Aquatic Life are the other parameters which lower the WQI.

Water quantity on the main stem of the North Saskatchewan River is monitored regularly by Environment Canada at Whirlpool Point, a HYDEX station (05DA001). Water quantity is measured at nine other HYDEX stations (05DA002-05DA010), and one site has real-time online data (05DA009). Figure 7 shows the open water season hydrograph for the Mistaya River. This hydrograph is typical for a glacial meltwater dominated stream, with peak flows during the warm summer months, and little impact from spring runoff or summer storms. Flows in the Mistaya River are very predictable.

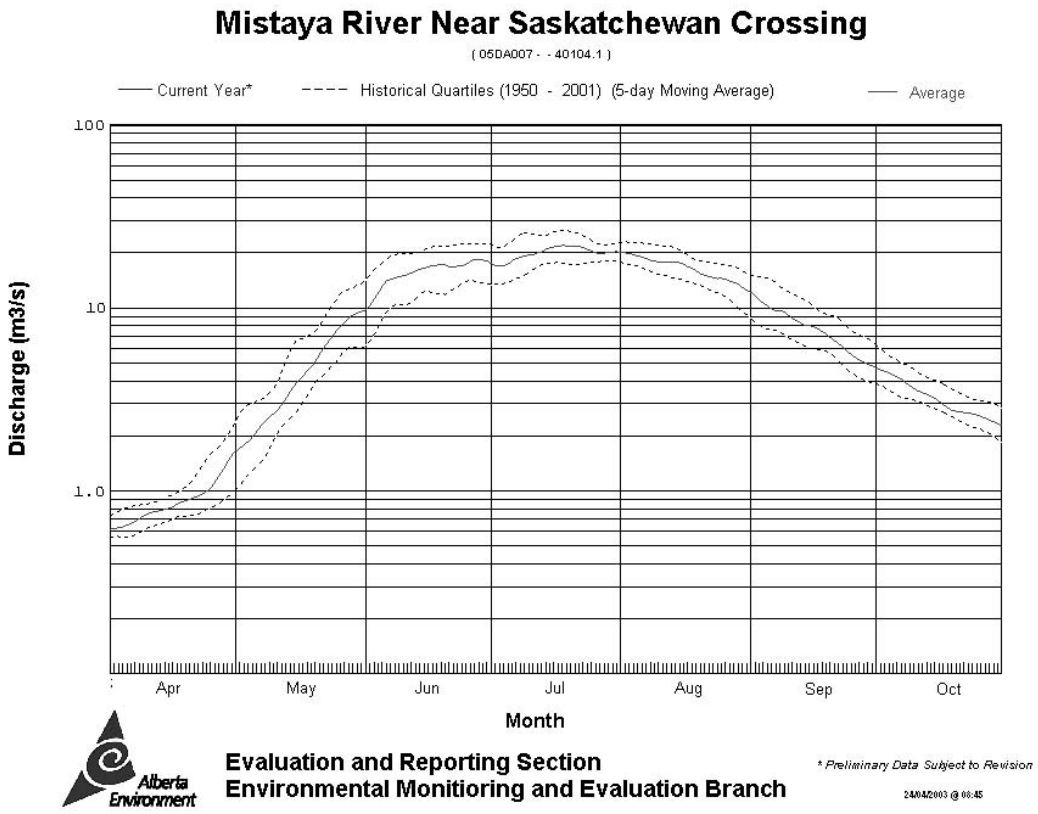
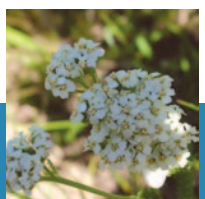


Figure 7: Mistaya River near Saskatchewan Crossing mean monthly discharge for the open water season (Station 05DA007).




5.1.3 Biological Indicators

Biological indicators include information on plant and animal species from which various aspects of ecosystem health can be determined or inferred by linking this information to information on water quality and quantity, land use and management practices.

5.1.3.1 Aquatic Macrophytes

The growth of aquatic macrophytes is directly related to the availability of the nutrient phosphorus in the water in which they are growing. Excessive growth may indicate decreased water quality, which, in turn, may be linked to various point (e.g. wastewater outfalls) or non-point (e.g. general run-off) sources related to municipal development or land use practices. No published assessment of aquatic macrophytes was found for the Subwatershed, so we cannot make any conclusions about aquatic ecosystem health for this Subwatershed using this indicator. This data gap could be addressed in future research in the Cline Subwatershed.

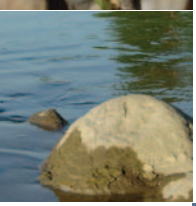
5.1.3.2 Fish Population Estimates

Inventories of selected fish populations may show changes in the presence and abundance of species that may be related to environmental factors including changes in water quality or quantity. Fish species in this Subwatershed include cutthroat trout, mountain whitefish, lake trout and bull trout. Bull trout are the most widely distributed species and are found in most major tributaries and many lakes. Mountain whitefish are resident in the North Saskatchewan River and the lower reaches of many of the tributaries (Allan 1984).

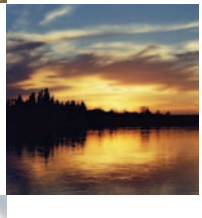
Channel morphology of the North Saskatchewan River in this Subwatershed is highly variable. In some areas, channels are narrow and confined, while in other areas they are wide and extensively braided. Low temperatures, low concentrations of dissolved nutrients, low winter flows and channel instability reduce the productivity and quality of the cold water salmonid habitat in the river main stem and tributaries (Allan 1984). Therefore, natural features of the North Saskatchewan River can negatively impact fish populations in this Subwatershed.

5.1.3.3 Vegetation Types

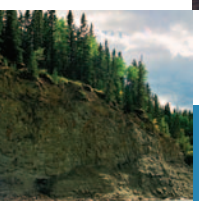
Inventories of flora populations may show changes in abundance that may be related to environmental factors including changes in land use practices. The Cline is located in the Rocky Mountain Natural Region of Alberta. This region is split into 4 subregions; the alpine subregion, the lower subalpine, the upper subalpine and the montane subregion. The alpine subregion is typically unvegetated and lacking soil. The lower subalpine is composed mainly of lodgepole pine, Engelmann spruce, and subalpine fir, while the upper subalpine has spruce and fir closed forests, and open forests featuring Engelmann spruce, subalpine fir and whitebark pine. Lodgepole forests can be found at lower elevations. The montane subregion is composed of Douglas fir, limber pine, white spruce and grasslands. At higher elevations runoff occurs more quickly than compared to lower elevations where vegetation and soil absorb runoff and slow runoff velocity.



5.1.3.4 Benthic Invertebrates



Inventories of benthic invertebrate populations may show changes in the presence and abundance of species that may be related to changes in water quality. No published assessment of benthic invertebrates was found for the lakes, wetlands, rivers or creeks in the Cline Subwatershed, so no conclusions can be drawn about ecosystem health from this indicator. This data gap could be addressed in future research of Cline Subwatershed waterbodies.






5.1.4 Cline Summary

Using the chosen indicators, the Cline Subwatershed is the healthiest in the watershed, but significant data gaps exist that would allow us to better assess ecosystem health. It is a spectacular headwater area within the North Saskatchewan Watershed with 60% of its area in National Parks or wilderness areas. Because of the protected nature and the terrain of the Subwatershed, there is little linear development (mostly roads) and little or no cut-lines or seismic activity. With its rugged landscape, low level of disturbance and pristine wilderness, there is a significant amount of recreational activity in the Subwatershed. Livestock densities in the Cline Subwatershed are minimal.

Little development means that most of the aquatic ecosystems are unimpaired and likely in a natural, optimal functioning state. Water quality on the main stem of the North Saskatchewan River monitored by Environment Canada at Whirlpool Point was found to be only "fair" for the 1983-2002 period, while similar sites in the headwaters of the Bow and Athabasca rivers both received a "good" rating. These differences can be explained by the nature of the parameters that were used to calculate the WQI. Site-specific WQI parameters for Whirlpool Point may be required to accurately reflect the true state of the water quality at this site.

Water quantity is measured at ten stations in the Subwatershed: one site has real-time online data. These stations provide information for the operation of the Bighorn hydroelectric dam.

No detailed population assessments were found for fish species in the Subwatershed, nor was a systematic examination of riparian health, aquatic plants or benthic invertebrates found for the Subwatershed. These data gaps should be addressed in future research of the Cline Subwatershed.

In summary, there is little information related to several of the indicators required to assess ecosystem health for this Subwatershed. However, of the 5 indicators assessed, three were good, one was fair, and one was poor, yielding an overall subjective rating of good. Given the high percentage of this basin that lies in national parks and wilderness areas and the rugged terrain, there is little development and significant negative impacts are not anticipated. However, the potential impacts of forest harvesting on the Subwatershed should be examined.