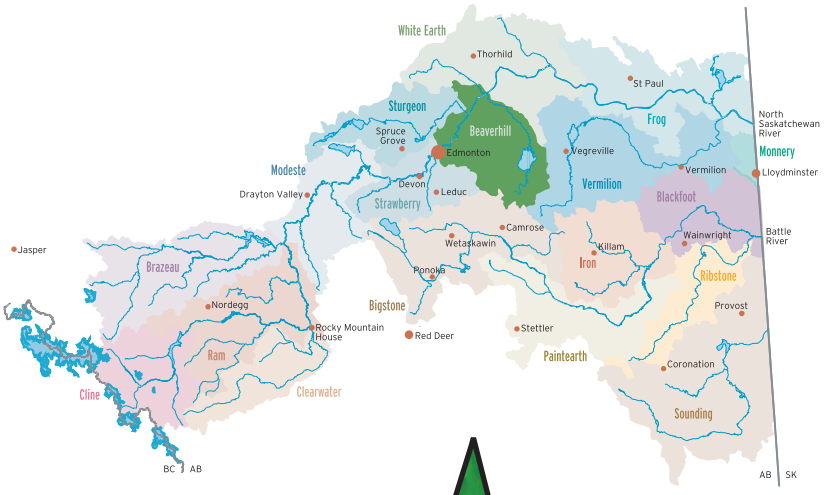
Beaverhill



Elizabeth Orr
Age 7
Elk Point




5.8 BEAVERHILL SUBWATERSHED

The Beaverhill Subwatershed lies in the Boreal Forest and Parkland natural regions and encompasses 440,544 hectares including 39,532 hectares of natural and artificial water bodies. Much of this area is an extensively treed, upland area consisting of rolling to hummocky terrain with knob and kettle topography that supports a high diversity of vegetation, waterfowl, mammals and birds. The area is rich in natural wetlands and aspen dominated Boreal mixedwood habitat.

This Subwatershed contains a combination of ecologically significant natural areas and centers of high urban activity. The Beaverhill Subwatershed includes the municipal boundaries of Camrose, Leduc, Lamont, Strathcona and Sturgeon Counties and Elk Island National Park and Miquelon Provincial Park lie completely within the Subwatershed. Municipalities in the subwatershed include all or parts of the Cities of St. Albert, Edmonton and Fort Saskatchewan. Other towns and hamlets include Antler Lake, Ardrossan, Bruderheim, Chipman, Collingwood Cove, Half Moon Lake, Josephburg, Kingman, Lamont, North Cooking Lake, Round Hill, Ryley, Sherwood Park, South Cooking Lake and Tofield.

The Beaver Hills (also known as the Cooking Lake Moraine) span into five separate Counties and includes Elk Island National Park and the Cooking Lake-Blackfoot Recreation Area. The Beaverhill Subwatershed supports a diverse range of wildlife and is a premium bird watching location. Beaverhill Lake is the focal point of the Snow Goose Festival held for the past ten years at Tofield. In 1982, Beaverhill Lake was declared a National Nature Viewpoint by the Canadian Nature Federation, and designated a Wetland of International Importance in 1987 by the RAMSAR Convention. The RAMSAR convention identifies wetlands of international importance, and provides a framework for wetland conservation.

The Cooking Lake Moraine area is one of four important areas identified by the Nature Conservancy of Canada. The mosaic of grasslands, woodlands and wetland habitats found there is important for many characteristic parkland species including the endangered Piping Plover, the threatened Trumpeter Swan, and the two species of special concern: Loggerhead Shrike and Sprague's Pipit. With the exception of wetland depressions, very little of the surrounding Central Parkland landscapes retain native vegetation. The continued disappearance of native habitats and species underlines the need to protect and steward these critical sites.

Elk Island National Park and Miquelon Lake Provincial Park both provide critical habitat for wildlife as well as recreational activities including hiking, cross-country skiing, canoeing, horseback riding, and snowmobiling.

Economic activity in the Subwatershed includes agriculture, oil and gas-related industries, urban and rural subdivision development and manufacturing including fertilizer, chemical and petrochemical plants.

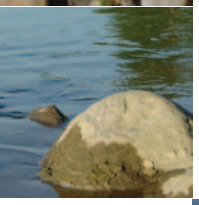
Many of the indicators described below are referenced from the "Beaverhill Hydrological Overview" map located in the adjacent map pocket, or as a separate Adobe Acrobat file on the CD-ROM.

5.8.1 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.





5.8.1.1 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. Riparian inventory data were collected for individual landowners in the Beaverhill Subwatershed at Mud Lake, Walter Lake, Astotin Lake, Bennett Lake and Campbell Slough in 2003 and at Beaverhill Lake, Hastings Lake and Amisk Creek in 2002 by Cows and Fish (Norine Ambrose *pers. comm.*). However, each report was based on one sample site only, and does not represent the entire area in the way that an overall community report would.

No other published assessment of riparian health was found for the Beaverhill Subwatershed, so we cannot make any conclusions about riparian health for this Subwatershed. For such an ecologically significant and important wildlife area, riparian health data is noticeably lacking. A thorough riparian health inventory should be undertaken for the Beaver Hills waterbodies. The City of Edmonton should also inventory the riparian areas within its jurisdiction.

5.8.1.2 Linear Development

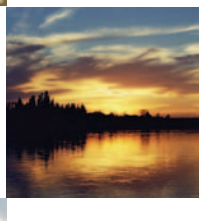
Quantifying linear development in the Subwatershed helps us understand potential changes in water quality and quantity, fish and wildlife populations, and riparian health. Just over 3% (13,846 ha) of land in the Beaverhill Subwatershed is taken up by linear developments. The majority of linear development (64%) is roads of one form or another, including paved roads (39%), and gravel and unimproved roads (26%). Other linear developments include pipeline rights of way, (18% of the area of linear developments), transmission line rights of way (8%), active or abandoned rail lines (8%) and cutlines (2%).

5.8.1.3 Land Use Inventory

An inventory of land uses 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. Water bodies, both natural and constructed, including lakes, rivers, streams, wetlands, dugouts and reservoirs cover about 9% of the Subwatershed. The vast majority of the Subwatershed is classified into various land uses related to agricultural production: grassland, 25%; cropland, 27%; and forage, 11%. About 20% of the Subwatershed is treed (87, 218 ha). The large percentage of treed land supports the high diversity of vegetation, mammals and birds found in this Subwatershed.

About 14% of the land area in the Subwatershed has been affected by various forms of development. Most of this disturbance (10% of the Subwatershed) is due to municipalities of various sizes including Sherwood Park, Fort Saskatchewan and parts of Edmonton. The remainder of the land disturbance is related to linear developments (3%), wellsites (0.6%), and industrial sites (0.1%). Only 7.3% of the Subwatershed is allocated to an FMU.

Water bodies including wetlands, rivers, lakes and dugouts cover about 42,895 hectares representing almost 10% of the area of the Subwatershed. Most of the waterbodies in this area are natural wetlands, which support a high diversity of vegetation, waterfowl, mammals and birds seen in this Subwatershed.



5.8.1.4 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 within the actual Subwatershed. Based on the available information, livestock densities in the Beaverhill Subwatershed are moderate with higher densities in areas to the east and southeast of Edmonton. Manure production in the soil polygons that cover the Beaverhill Subwatershed was estimated at between 1,194,000 and 5,422,000 tonnes. In the areas with higher agricultural intensity, there is an increased likelihood of impacts to surface water quality including increased nutrients, bacteria and pesticides. The waterbodies in these areas should be monitored regularly.

5.8.1.5 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. The available hydrology data show few wetlands in the Beaverhill Subwatershed. However, small sloughs and marshes are found throughout the area, and are most abundant in and south of the moraine and on the lowland in the eastern third of the area. An inventory completed by Ducks Unlimited Canada for the Subwatershed found a total of 37,508 hectares of wetlands (8.5% of the Subwatershed area). The DUC inventory included both permanent and temporary wetlands. The natural wetlands in this Subwatershed support a high diversity of vegetation, waterfowl, mammals and birds.

The City of Edmonton is working hard to conserve the remaining natural wetlands that exist within its boundaries. This is part of City policy and includes natural upland areas as well as wetlands. Where possible the City has incorporated natural wetlands into the City's drainage infrastructure to benefit from the natural stormwater management and water quality benefits that a wetland can provide. Conservation of wetlands however is a high priority whether they can be drawn into the City's drainage infrastructure or not. Constructed stormwater management facilities comprise an important part of modern drainage infrastructure for all new urban developments. It is also City policy that new stormwater management facilities are planned and implemented as constructed wetlands for the obvious water quality benefits. Dry and wet ponds are no longer encouraged as part of new development.

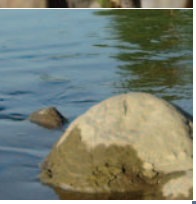
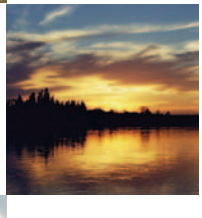
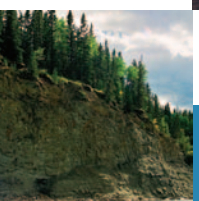
5.8.2 Water Quality and Quantity

Larger waterbodies in this Subwatershed include the North Saskatchewan River and the Beaverhill and Norris Creeks. Lakes in the area include Beaverhill, Cooking, Hastings, Joseph, Ministik, Astotin, Tawayik, Oliver, Antler, and Wanisan. ALMS Lakewatch water quality data are available for Hastings Lake for 1999. Water quality data for Beaverhill, Cooking, Halfmoon and Hastings Lakes can be found in the Atlas of Alberta Lakes (Mitchell and Prepas 1990).

Most municipalities in the Subwatershed receive their drinking water from the North Saskatchewan River through two water treatment facilities provided by EPCOR Water Services under the Capital Region Water Services Commission (Figure 16). The City of Edmonton's Gold Bar Wastewater Treatment Plant and the Capital Region's Wastewater Treatment Plant provide wastewater treatment for much of the region. The Town of Redwater takes its water from the North Saskatchewan River (via EPCOR Water Services pipeline to Thorhild), but its wastewater treatment is provided by a wastewater treatment lagoon.





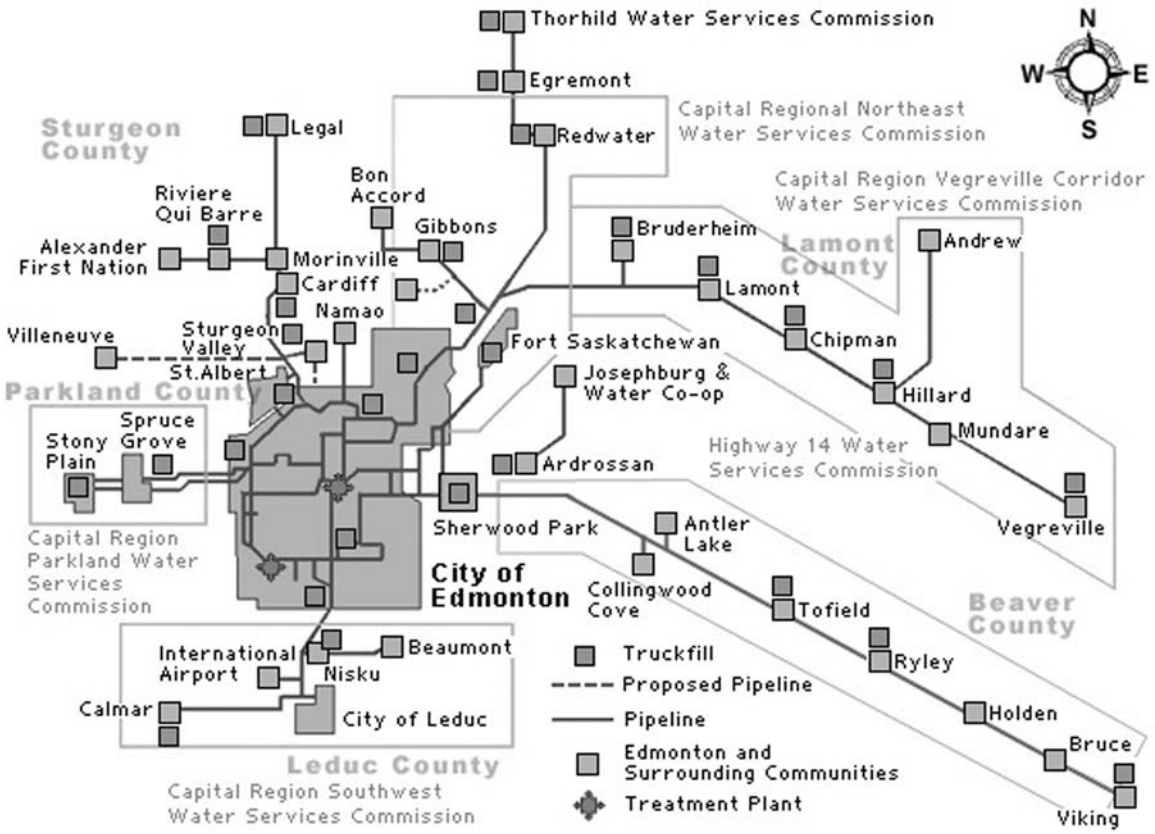


Figure 16: Capital Region Water Services Commission details. North Saskatchewan River water is withdrawn at the E.L. Smith treatment plant and treated by EPCOR Water Services. EPCOR-treated water flows to several outlying communities including Thorhild, Villeneuve, Vegreville and Viking. Figure courtesy of EPCOR Water Services.

Water quality is routinely monitored by Alberta Environment at Pakan under the LTRN program. In 2001, the ASWQI for metals, nutrients, bacteria and pesticides all rated 'good' or 'fair'. In the prior five-year period, nutrients were consistently rated 'fair', bacteria were rated 'good' or 'poor' and pesticides were rated as 'good' or 'fair' (Table 7). During the five-year index period, TP concentrations ranged from .012 to 1.15 mg/L while TN concentrations ranged from 0.06 to 4.5 mg/L. TP concentrations over 0.200 mg/L exceed the CCME Surface Water Quality Guidelines for the Protection of Aquatic Life and can lead to eutrophic conditions of enhanced aquatic vegetation growth and low dissolved oxygen levels. The index shows the impact of inputs to the river from the City of Edmonton, industrial discharges in the Edmonton region and the Edmonton regional municipalities.

Table 7: ASWQI for Pakan, Alberta in the Beaverhill Subwatershed[1].

Index Period	Metals	Nutrients	Bacteria	Pesticides
1996 - 1997	E	F	P	F
1997 - 1998	E	F	P	F
1998 - 1999	G	F	G	F
1999 - 2000	F	F	G	G
2000 - 2001	G	F	G	F

[1]Alberta Surface Water Quality Index (ASWQI) ratings: E = Excellent, G = Good, F = Fair, P = Poor

Over 1,400 samples for TP and fecal coliforms have been taken from the downstream portion of the North Saskatchewan River during the years 1997-2002 (downstream samples are those collected east of the Rossdale water treatment plant). The 415 fecal coliform samples taken downstream from the water treatment plant ranged from 0 to 29,000 counts/100 mL, and averaged 412 counts/100 mL. Most of these samples greatly exceed the CCME Surface Water Quality Guidelines for Contact Recreation. The 1119 TP samples ranged from 0 to 2.03 mg/L, and averaged 0.117 mg/L. Pesticide detections in this Subwatershed included 2,4-D, MCPA, MCPP, Picloram, Triallate and Dicamba, all of which were below the Guidelines for the Protection of Aquatic Life. Other compounds detected include Gamma-BHC, Imazamethabenz-methyl, Diuron and Diazinon, but there are no existing water quality guidelines for these chemicals.

Amisk Creek was part of the CAESA stream network as a site in an area of high agricultural activity. Water quality data (nutrients, organic and inorganic chemistry, suspended solids, color, pH, and bacteria) is available for this creek from 1995-1996 (Anderson *et al.* 1998).

Water quantity is measured at nine HYDEX stations (05EB001-05EB002, 05EB006, 05EB015-05EB016, 05EB902, and 05EB909-05EB911). None of these sites has real-time online data. Figure 17 shows the Pointe-Aux-Pins Creek hydrograph for the open water season. This hydrograph is typical of a non-glacial, non-groundwater fed stream, with flow contributions from spring runoff and summer storms only and drying in late summer.





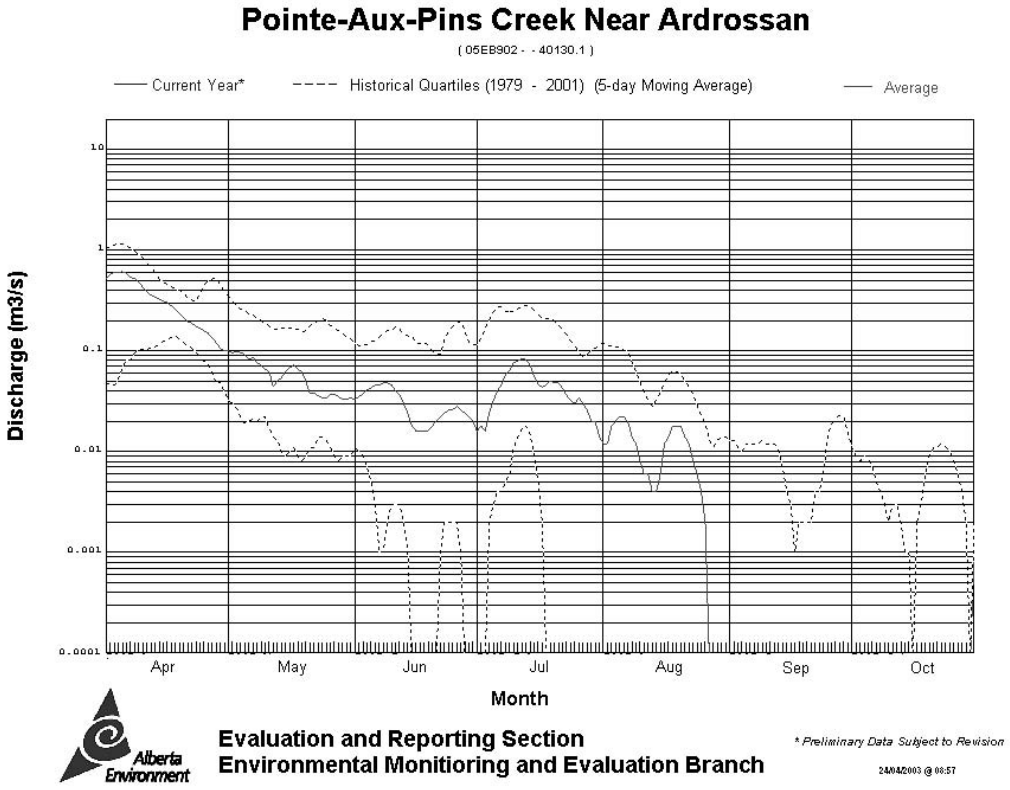


Figure 17: Pointe-Aux-Pins Creek near Ardrossan mean monthly discharge for the open water season (Station 05EB902).

5.8.3 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.

5.8.3.1 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 (wastewater outfalls) or non-point (general run-off) sources related to municipal development or land use practices.

No published assessment of aquatic macrophytes was found for the lakes, wetlands, rivers or creeks in the Beaverhill Subwatershed, so we cannot make any inferences about ecosystem health for this Subwatershed using this indicator. This data gap could be addressed in future research.




5.8.3.2 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 many of the lakes and creeks in the Subwatershed are limited by the shallow water depths in these systems. Shallow lakes can have low or no oxygen concentrations during winter ice cover, which can suffocate and "winter-kill" fish.

No systematic estimate of fish populations in the Beaverhill Subwatershed has been done. However, walleye, perch, and northern pike are found in some of the lakes. Lake trout and whitefish have little endurance in the warm, shallow prairie lakes, and the rivers are too turbid to support fish. The North Saskatchewan River supports northern pike, perch, walleye, and goldeye.

5.8.3.3 Vegetation Types

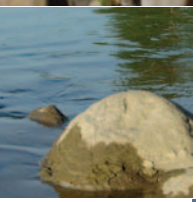
Inventories of flora populations may show changes in abundance that may be related to environmental factors including changes in land use practices. The Beaverhill Subwatershed is located in the Boreal Forest and Parkland Regions of Alberta. The Boreal Forest Region includes many areas of bogs, fens, swamps and marshes, as well as the Dry Mixedwood Subregion. The Dry Mixedwood Subregion includes species such as aspen, balsam poplar, white spruce, balsam fir and jack pine, and has many peatlands. The dominant forest cover types are trembling aspen, balsam poplar, white birch, and white spruce, with white spruce dominating in older stands. The Parkland Natural Region is the transition region between grasslands and coniferous forests. It includes one subregion, the Central Parkland, which is composed mainly of grassland with aspen, aspen parkland and closed aspen forest.

5.8.3.4 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. Between 1973 and 1977, Alberta Environment surveyed benthic invertebrates in the North Saskatchewan River. Data were summarized in a report published in 1978 (Reynoldson and Exner 1978). The study included sampling sites upstream of the major discharges from Edmonton (Big Island and Groat Bridge) as well as sites downstream of these discharges (Beverly Bridge, Fort Saskatchewan, Vinca Bridge, Duvernay and Elk Point). The authors concluded that there was little change in the species diversity or total numbers of macrobenthic fauna from year to year or season to season at the upstream sampling sites. These sites also showed less variability in both diversity and standing crop compared to the downstream sites. At the downstream Beverly Bridge site there was a major increase in numbers but a decline in species diversity. The Beverly Bridge site also had a much less stable community showing severe fluctuations in both numbers and diversity in contrast to the upstream sites. The nature of the change in the biological community suggested that the major impacts are due to organic rather than inorganic or toxic effluents.

The main invertebrate groups in five years of sampling the river upstream of Edmonton were Chironomidae, which made up 38.4% of the samples, Ephemeroptera (Mayflies), 31.7% and Plecoptera (Stoneflies), 20.0%. The remainder of the sample was Trichoptera (Caddisflies), 4.9% and Oligochaeta (Earthworms), 0.5%. At sites downstream of Edmonton, Oligochaeta made up 43.3% of the samples, Chironomidae, 40.8%, Ephemeroptera, 6.3%, Plecoptera, 4.8% and Trichoptera, 0.4%.


There have been major changes in the Edmonton area in the almost 26 years since these studies were done. In particular, stormwater management and wastewater treatment have been significantly improved. *Edmonton's Environment: A Snapshot 2002* (City of Edmonton, 2003) states that between 1996 and 2001, the City's impact on the North Saskatchewan River has steadily decreased from a ASWQI value of 26 in 1996 to 4 in 2001. This was due mainly to upgrades at the wastewater treatment plant including biological nutrient removal, enhanced primary treatment and ultra-violet disinfection prior to discharge of return flows to the NSR.



5.8.4 Beaverhill Summary

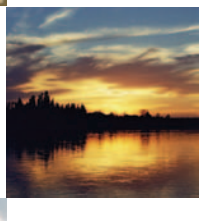
The Beaverhill Subwatershed contains a combination of ecologically significant natural areas, recreational opportunities, and centers of high urban activity. The majority of the Subwatershed is classified in land uses related to agriculture; however, about 20% is treed. Livestock densities are moderate with higher densities being indicated in areas to the east and southeast of Edmonton. Economic activity includes agriculture, oil and gas-related industries, urban development and manufacturing.

Riparian inventory data were collected for landowners at several locations in the Subwatershed; however, these data are not representative of the Subwatershed. For such an ecologically significant and important wildlife area, riparian health data is noticeably lacking. A thorough riparian health inventory should be undertaken for the Beaver Hills waterbodies. The City of Edmonton should undertake a project to have its riparian areas assessed.

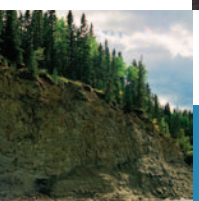
Just over 3% of the Subwatershed is taken up by linear developments including roads, pipeline rights of way, transmission line rights of way, rail lines and cutlines. In addition, about 11% of the land area has been affected by development including municipalities, well sites and industrial sites. Water bodies cover about 9% of the Subwatershed. The available hydrology data show few wetlands; however, Ducks Unlimited Canada data show wetlands on 8.5% of the Subwatershed. This variance should be resolved.

Water quality is routinely monitored by Alberta Environment at Pakan. The City of Edmonton has a pronounced negative impact on water quality for some distance downstream (as far down river as Pakan). Water quality downstream of wastewater discharges from the City of Edmonton, was much lower than water quality upstream of the City at Devon. Municipal discharges increase river nutrient and bacterial concentrations, while household, municipal and agricultural pest control efforts leach pesticides into the river. Total phosphorus concentrations exceed the Guidelines for the Protection of Aquatic Life, and for Recreational Use. In 2001, the Surface Water Quality Index for metals, nutrients, bacteria and pesticides all rated 'good' or 'fair'. This was similar to the rating in the prior five-years for nutrients and pesticides. It was an improvement in the rating for bacteria, but a slight decrease for metals. The improvements are likely due to improvements in stormwater management and wastewater treatment by the City of Edmonton. Further examination of the data are needed to determine if the changes are significant and the reasons for them. Water quantity is measured at nine stations. No site has real-time online data.

Fish species in many of the lakes and creeks in the Subwatershed are limited by the shallow waters, which can result in low oxygen concentrations and winterkill. No systematic estimate of fish populations in the Beaverhill Subwatershed has been done. Of the seven indicators assessed, none were good, four were fair, and three were poor, yielding an overall subjective rating of fair.



Surveys of benthic invertebrates in the North Saskatchewan River in this Subwatershed concluded that downstream sites showed more variability in both diversity and standing crop compared to the sites upstream of Edmonton. There is a major increase in numbers and a decline in species diver-






sity downstream of Edmonton. The benthic invertebrate community was also much less stable at the downstream sampling sites. The changes suggested impacts due to organic rather than inorganic or toxic effluents. No information was found on water plants in the Subwatershed.

In summary, water quality information and surveys of benthic invertebrates indicate some detrimental impacts of development in this Subwatershed. Land disturbance affects a relatively large percentage of the Subwatershed, which contains many ecologically significant areas and important recreational opportunities. The Beaver Hills Initiative is a sustainable community initiative that is active in this area. Further data collection and analysis are needed to understand the impacts of this development and to develop actions for management.