Water Quality Matters

PROTECTING YOUR WATER

December 1997

SWQI INITIATIVE

The Surface Water Quality Initiative (SWQI) was funded by the Canada-Saskatchewan Agriculture Green Plan Agreement (CSAGPA). Its purpose was to seek affordable and dependable solutions to surface water quality problems encountered on Prairie farms. This **Water Quality Matters** publication describes the roles that watershed and water source protection and management play in providing good quality water for farm users, focusing on principles important to small on-farm reservoirs known as dugouts.

WATER MANAGEMENT PRINCIPLES

To ensure good quality water for on-farm use, it is necessary to consider water management at three levels:

- watershed management, to protect both surface and ground water sources;
- management of the water source (such as a dugout, river or ground water aquifer); and
- in-house treatment.

Management of the water source and its watershed are described briefly below as part of the total package of ensuring good quality water for on-farm users. In-house treatment methods are described in more detail in the **Water Quality Matters** publication "In-house Treatment Systems."

Watershed Management

Watershed management includes best management practices (BMPs) to protect surface water supplies (dugouts, rivers or lakes) and ground water aquifers by reducing the potential for contaminants to enter the water source. Substances which could contaminate a water source include sediment, fertilizer, pesticides, animal wastes, fuel and hazardous products. Some watershed BMPs are presented in Table 1.

Table 1: Best Management Practices in the Watershed

- constructing vegetated buffer strips (30 metre wide grassed zones between the water edge and cultivated or grazing land) and grassed runways into reservoirs or dugouts;
- reducing erosion through techniques such as crop rotations, shelterbelts, grassed runways, diversions, and sediment basins;
- erecting fences to prevent livestock access to the water source and delivering the water to the animals, through equipment such as livestock nose pumps;
- managing pasture land to prevent over-grazing;
- correctly applying nutrients or pesticides, avoiding over-application as excess chemicals may run off the land and contaminate the water source (including ground water);
- managing all farm waste including human and animal wastes, and hazardous chemicals such as pesticides, fuel, and cleaning agents to prevent accidental contamination of a water source;
- ensuring sensitive and shallow groundwater aquifers are protected from land practices such as nutrient or manure application;
- incorporating wetlands in the watershed to act as natural purifiers by reducing phosphorus movement as plants consume nutrients and trap sediment;
- practising reduced-till farming;
- ensuring manure or fertilizer applications do not coincide with runoff events like spring snowmelt;

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Management of the W ater Sour

Management of the water source includes best management practices (BMPs) to sustain the best possible water quality at the source (Table 2).

Table 2 Best Management Practices to Protect Water Sources

BMPs for Surface Water Sources	BMPs for Ground Water Sources
• proper siting and design of river or dugout intakes • selective and limited use of algicides • control of surface water inflow to the reservoir or dugout • use of biological, chemical or physical techniques such as aeration, coagulation or reservoir covering	• diverting surface water runoff away from well pits • protecting sensitive aquifers, • shock chlorination of wells when necessary.

Trees, sh ubs and grasses a e Natu e's ways to p otect watersheds

DUGOUTS AS W ATER SOURCES

Dugouts are small reservoirs designed to store two to five million litres of water. They are filled primarily from spring snowmelt, but can also receive inflow from rainfall. The surrounding watershed is usually cultivated agricultural land. Sometimes dugouts are filled by pumping from lakes, rivers, sloughs or ground water wells. Most dugouts are not designed with an inlet structure to selectively control in-flowing water.

Without vegetative cove , e osion occurs and degrades water quality in rivers, lakes and ese voirs

Although the water quality from melting snow is generally very good, dugout water quality degrades over time. This occurs because dugouts are constructed in organic soil and also receive organic matter inputs from natural and man-made sources such as plants, crops, or fertilizers. Furthermore, a lot of sediment may flow into a dugout, which may bring other nutrients including phosphorus, fertilizers and animal waste.

Because the dugout collects water and has little or no flow through it, the organic matter and nutrients which flow into the dugout build up seasonally. These nutrients can recycle within the reservoir, providing a food supply for plants and organisms. The result is a reservoir with aquatic plant growth and frequent algae blooms, including potentially toxic blue-green algae (cyanobacteria).

In larger ecosystems such as rivers or lakes, a variety of inter-dependent processes exist which keep healthy ecosystems in balance. The chemical, physical and biological cycles in a dugout are not in balance. For example, as living organic matter such as plants and animals die in a lake, there is usually an adequate supply of oxygen to sustain the decomposition process. Dugouts do not usually have adequate oxygen levels unless they are aerated. As the organic matter decomposes, the oxygen is consumed, and the water quality further degrades as hydrogen sulphide gases are formed. These problems are worse under ice cover.

DUGOUT CHARACTERISTICS

Typical dugout characteristics are presented in Table 3.

Table 3: Typical Prairie Dugout Characteristics

Characteristic	Typical Values in Dugouts	Impact
• high levels of dissolved organic carbon (DOC)	• 13 mg/L (median value) • 6 to 40 mg/L (range)	• potential formation of trihalomethanes (THMs) • taste and odour problems • decreased water treatment system efficiency
• highly coloured water	• 20 to 90 TCU (Total Colour Units)	• aesthetic problems, staining
• elevated phosphorus levels	• >0.05 mg/L, with some levels recorded over 2.0mg/L	• abundant food supply for plants and algae
• frequent summer or even winter algae growth	• levels of chlorophyll *a* regularly exceed 0.05 mg/L indicating algae blooms	• potential release of blue-green algae toxins • taste and odour problems, coloured water
• variable turbidity levels	• 5 to 40 NTU (Nephelometric Turbidity Units) or even higher during and after peak runoff events	• taste and odour problems, coloured water • compromises disinfection
• variable levels of suspended sediment and silt		• increased turbidity, with problems of taste, odour and colour
• production of hydrogen sulphide		• odour problems

Sometimes dugouts can have inorganic problems caused by chemicals such as calcium and magnesium (hardness), sulphates, iron or manganese. Such inorganic problems often indicate that the dugout is partially supplied by ground water.

SOURCE WATER MANAGEMENT OF DUGOUTS

Dugout reservoir management techniques *MUST* include year round supplemental aeration to sustain adequate oxygen levels since a dugout can not sustain oxygen levels on its own.

BMPs can include shelter belts and aeration of dugouts, along with vegetated buffers that surround the dugout

Selective use of algicides (e.g. copper sulphate) at low doses can be beneficial to control blue-green algae but this practice is not effective in controlling green algae. Other physical, chemical and biological reservoir management techniques are sometimes attempted (e.g. chemical dyes, additions of bacteria). They often have limited benefits and can sometimes cause other problems with water quality. Any treatment measures that are adopted must be used with correct procedures and doses and will only achieve specific goals based on the product. If a product is not clearly labeled as being safe for human or animal consumption, then the use of that product may be inappropriate for dugouts used as a drinking water supply for humans or animals.

The SWQI focused on specific means to improve water quality in dugouts, including:

- coagulation (**Water Quality Matters** "Dugout Coagulation"),
- covers (**Water Quality Matters** "Dugout Covers").

These approaches were designed to improve the water quality in the dugout by reducing natural organic matter, phosphorous levels, algae growth, turbidity and colour. The purpose was to generally improve water quality at the source and to make the supply more suitable for other uses, including domestic use (with additional in-house treatment), livestock watering, or crop spraying.

CONCLUSION

For Prairie agricultural land, watershed management techniques offer the first water treatment strategy for maintaining good water quality. Management of the water source is the second barrier, aimed at maintaining and improving water quality. Although both strategies will improve the quality of the source water, neither is capable of providing safe and aesthetically-pleasing household water.

Watershed management and water source protection strategies must be combined with other processes such as in-house treatment and disinfection, to ensure that the water is safe for drinking and aesthetically-pleasing for general household use.

For further information on rural Prairie water quality and treatment technology:

- contact your local Prairie Farm Rehabilitation Administration office (PFRA is a branch of Agriculture and Agri-Food Canada);
- read the other publications in PFRA's **Water Quality Matters** series;
- get a copy of "Rural Prairie Water Quality: Searching for Solutions for On-farm Users" available from PFRA; or
- read Prairie Water News, available from PFRA, or on the Internet at www.quantumlynx.com / water

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