PRAIRIE Water News

...dedicated to protecting and improving rural water supplies

Backhoe Installed Wells

Keeping the hole full of water during the backhoe digging operation will prevent the sides from caving in.

By Richard Pasquill, Manitoba Water Services Board

At times, very shallow sand formations are the only option available for developing a source of ground water. While it is always best to install a proper well with the use of a qualified driller, local conditions may prevent the driller from installing the well. For example, if a layer of large rocks is present very close to surface, the driller may not be able to bore the hole properly. This condition existed for a farmer near Cromer, Manitoba, but a local backhoe operator was able to come to the rescue.

Wells installed with a backhoe are seldom acceptable due to caving conditions encountered during the well installation. Once the top of the water-bearing formation is encountered, the backhoe will often run into problems. As soon as the operator begins to dig into the formation, the water rushing into the freshly excavated hole causes it to collapse. These caving conditions prevent the operator from digging further than 2 – 3 feet into the formation. Once winter sets in and the water tables drop in these shallow formations, water shortages become apparent.

The backhoe operator near Cromer had watched a large diameter well driller install several wells into sand formations and was intrigued by their use of water which held the hole open during the drilling operation. When the hole is kept full of water during the drilling operation, water will move outward from the open hole and travel back into the formation. Since the water movement is outward in nature, the sand does not collapse into the hole and the driller is able to drill through many feet of water-bearing formation. Using this procedure, the driller is able to install a well that will make use of the total amount of water available in the formation even in times of drought. The backhoe operator believed that if he applied this same technique to installing a well with the use of a backhoe, he would be able to work through the boulders and sand in the area and install a well making best use of the total depth of sand present.

The operator set all the equipment up and began digging. As soon as he encountered the water table, he filled the hole full of clean water and continued to dig. By slowing down the digging rate and insuring the hole was constantly full of water, he was

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able to work through over 10 feet of sand, boulders, and water before running into clay. A slotted fiberglass crib was installed to the full depth of the formation and a well cap was placed on the bottom of the crib to prevent sand from filling in the bottom of the well. The hole around the cribbing was filled up to the top of the formation with a bed of washed and clean course sand that would hold the natural sand back while allowing the water to run into the cribbing.

Once the backfilling was completed, the dirty water was pumped out until the well produced clean water. Several loads of clean and chlorinated water were added to the well and surged to help develop a sand free well. A pump test was carried out to determine the capacity of the new well and found it produced 15 gallons per minute with little draw down. The well was finally super chlorinated and left for mechanization.

By using the same techniques as a well driller, the backhoe operator was able to install a well to the bottom of the formation that should not encounter water shortages even during periods of drought.

Approvals for this type of project vary across the Prairie Provinces and thus it is recommended that well owners and backhoe operators contact their Provincial Water Authority in regards to any permits or licenses that may be required for this type of project. It is always recommended to have clean water hauled in from an alternate source for this purpose to prevent possible contamination of the water-bearing formation.

For further information, please contact your local provincial farm water technologist or regional PFRA office.

Biofouling and Water Well Maintenance

By Twyla Legault, Water Quality Division, Prairie Farm Rehabilitation Administraiton

Water wells are a primary source of water for many rural residents of Canada. However, finding an adequate supply of good quality water can be difficult and once a well is installed well yield or water quality problems often develop. When the quality or quantity of water produced declines dramatically, rural wells are often abandoned or treatments are applied with little understanding of the cause of the problems. The cost of replacing these wells can have a significant economic impact on the owner. Correctly identifying the cause of water well deterioration offers the possibility of effective maintenance and treatment instead of well abandonment.

The Prairie Farm Rehabilitation Administration (PFRA) have directed a number of studies on the Canadian Prairies to investigate the causes of water well deterioration. These studies show that the water quality or well yield problems faced by rural well owners are often caused by the activities of groundwater microorganisms (i.e. well bioufouling).

Biofilm encrustation on pump.

The Biofouling Process

Losses in water well production and water quality have traditionally been attributed to the chemical and physical properties of the water well environment. More recently, scientists have recognized that the activities associated with microorganisms in the groundwater can also lead to losses in well production and poor water quality.

Water well deterioration caused by microbiological activity is termed biofouling. Installing and pumping a well increases the level of oxygen and nutrients in the well and surrounding aquifer. This encourages bacteria, which are naturally present in ground water, to colonize surfaces in and around the well intake. The bacterial colonies will form a gel-like slime or biofilm that captures chemicals, minerals and other deposits such as clays and silts, that move to the well during pumping.

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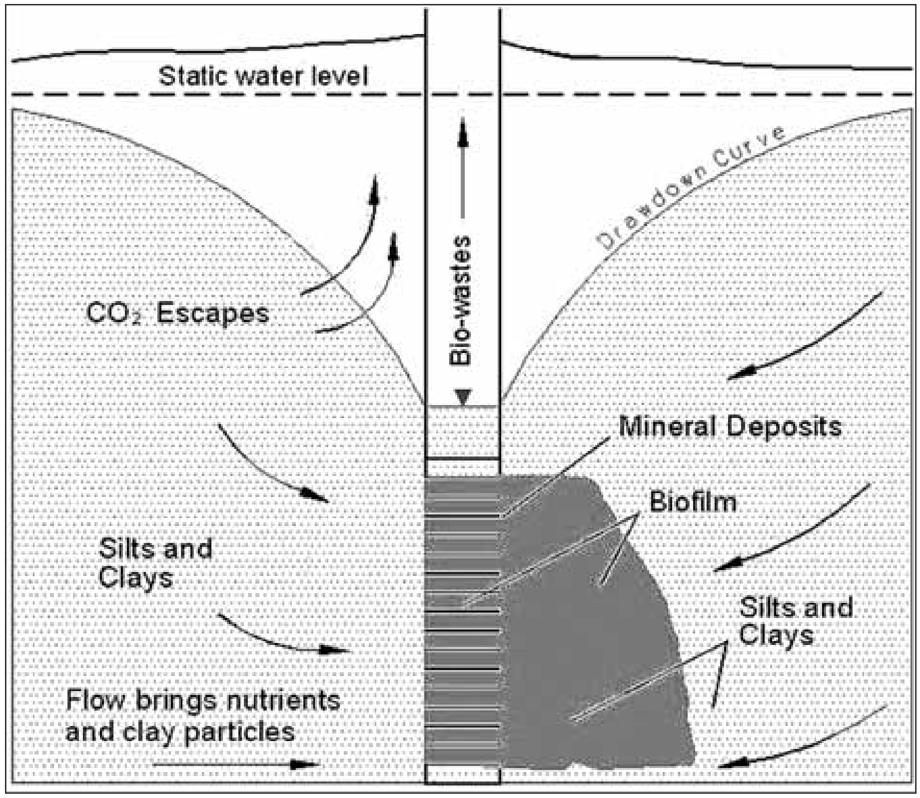
Biofouling of a water well occurs when biofilms accumulate a sufficient amount of debris to interfere with water flow and affect water quality.

If uncontrolled, well biofouling can affect well performance in various ways. Biofilms and the debris they collect can quickly coat, harden and plug the well screen, the sand pack, the surrounding aquifer material and may even plug water lines and affect the performance of household treatment systems. In addition, the bacteria living within the biofilm can increase the rate of iron oxidation increasing iron build up in the well and pipes, which may lead to occasional discoloration of the well water. Biofouling can also result in the production of odours, changes in taste, and can increase the rate of corrosion of steel and iron casings.



Biofilms are bacterial colonies that form a gel-like slime in and around the well screen.

Water Well Maintenance

To control biofouling, it is very important to regularly monitor and maintain the well and distribution line. Monitoring is also useful in identify the cause of well problems. Laboratory tests can be used to monitor changes in water quality and field tests are available to measure the level of biological activity in well water. Changes in water quality, increased levels of biological activity and reduced well yield are an indication that biofouling may be occurring. If losses in well efficiency are observed but microbiological activity is low, well biofouling is not likely the problem.

Preventative maintenance will discourage biofilm formation on the well screen, extend well life and sustain water quality. Preventative well treatments must be applied before well performance is seriously affected and may include yearly flushing, applications of a mild cleaning chemical or shock chlorination (i.e. using sodium hypochlorite).

Traditional treatments such as shock chlorination are often ineffective when applied to a well that has become significantly plugged. Chlorine is mainly intended to disinfect a well and, when used alone, it will not penetrate biofilms that have developed on the well screen. When a well is severely plugged or has not been treated for many years, a drilling contractor will be required to rehabilitate the well.

Well rehabilitation involves removing the pump and then thoroughly cleaning and flushing the well using treatment chemicals and mechanical agitation. Well drillers will often use treatment products that contain a surfactant or penetrant which are more effective at removing biofouling material and acids that break down scale and iron deposits. These chemicals can be dangerous to handle and should be applied with caution. Measuring the non-pumping and pumping water levels before and after treatment well help to determine if well yield has been improved by the treatment. Although well rehabilitation may become necessary, preventative maintenance is the most cost effective way to protect water supplies and extent the life and usefulness of a water well.

For more information on water wells and biofouling, please contact the author at legaultt@agr.gc.ca or your local provincial water specialist or PFRA office.

Flood Proofing Your Well

By Richard Pasquill, Manitoba Water Services Board

The summer of 2005 proved to be an abnormality when it came to the amount of rain received on much of the prairies. Creeks and rivers in many areas were flowing to capacity or flooding in the middle of July. This is normally a time when most areas are wishing for a little moisture to keep things growing. Unlike the spring runoff period when the ground is still frozen and generally does not erode, summer flood events can cause a lot of soil to be washed along with the water as it runs off. As a result, many wells became inundated with water and became contaminated with bacteria, fertilizer, chemicals, and mud.

Many wells became contaminated not only because they were located in a low lying area but also through old trenches that suddenly settled after many years and began acting as a ditch for the runoff water, running it directly to the well. While the weather patterns that lead to all the problems are often referred to as "once in one hundred year events", it does not mean they will not happen again within the next five to ten years. It is always best to take steps to protect the water supply from events such as these as we never know when it will happen again.

There are basically three areas of concern that must be addressed when protecting the well from flooding of any nature.

- Inundation or total flooding of the well.
- Water seeping down around the crib or casing into the water formation.
- Old trenches that can settle and run water directly to the well or basement of a house.

While many wells that are flooded are located in low lying areas such as those on the edge of a river, even wells located in a normally high area can become flooded. For example, wells should never be drilled in the basement of a house as septic systems will often encounter problems and back up into the house. In addition, drillers will often leave the casing or cribbing sticking up only one foot above ground level, which makes the well susceptible to any slight amount of flooding. The casing or cribbing can easily be extended to ensure the top is above any possible flood level. Even if the well is located on a hill and in no danger of flooding, the casing should always extend at least 18 inches above the surrounding ground level.

During a well installation, a hole slightly larger than the casing or cribbing to be installed must first be drilled. Once the well is completed, the opening around the well is normally filled to ground level with a granular material Like any trench, settling of this fill material will occur over time resulting in a low area around the well that allows water to gather and seep down around the outside of the well.

Whether the well is located in a low area or in a relatively high well drained area, it should always be built up with good clay to prevent any surface water from coming within 10 feet of the well. If runoff water should surround the well, the 10 feet of clay it must pass through to access the casing will filter out most of the contaminants.

Trenches must always be maintained to ensure they have not settled down and created a ditch for

A well should always be built up with good clay to prevent any surface water from draining down the outside of the casing.

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water to run up to the well or basement. While most of the settling of a trench will occur within the first two years, a hole can suddenly appear when high soil moisture conditions occur. This will allow water to enter the trench which then acts as a conduit allowing water to run directly to the well or basement. If additional soil must be brought in to mound up an old trench, good heavy clay should be brought in, spread and packed around the well before seeding down with grass.

On the Prairies, we never know what Mother Nature will come up with or when. It is always best to be prepared. It is easier to prevent contamination of the well than to clean up the problem later.

For more specific information on protecting your water supply, please contact your local provincial water specialist or PFRA office.

Using Field Chemistry Kits For Monitoring Nutrient Concentrations in Surface Waters

By Sharon Reedyk and Amy Forsyth, Water Quality Division, Prairie Farm Rehabilitation Administration

High nutrient concentrations can lead to excessive algae and aquatic plant growth.

Why Monitor Nutrients?

Many local watershed groups often want to monitor the quality of the water in their lake or stream. In most cases, the focus of the monitoring will be on nutrients. Nitrogen and phosphorus are the nutrients that will promote excess plant and algae growth in aquatic environments.

Nutrients can be analysed using either field test kits or by sending samples to a laboratory. Laboratory tests are usually the most accurate, can detect low concentrations, and can detect all forms of nutrients; however, they can also be expensive. Depending on the purpose of monitoring, a field test kit may provide a local watershed group with the information they require.

Forms of Nutrients

Phosphorus and nitrogen are present in organic and inorganic forms. Plants can only use nutrients that are in an inorganic form. Eventually, organic forms of nutrients are converted to inorganic forms, but this can take several months.

Typically, all forms of nutrients are measured in aquatic systems, even if they are unavailable in the short term, because eventually they will be available to plants. The fractions of phosphorus that are measured usually include Total Phosphorus (TP), Total Dissolved Phosphorus (TDP) and Orthophosphate (PO_4). The fractions of nitrogen that are usually measured include Total Kjeldahl Nitrogen (TKN), Nitrate (NO_3), Nitrite (NO_2), and Ammonia (NH_3 or NH_4^+).

Some of the forms of nitrogen and phosphorus can only be analysed using laboratory tests. However, field chemistry kits are useful for measuring the inorganic nutrient component that is biologically available for plant growth. This means that with respect to phosphorus, field kits typically measure Orthophosphate but not Total Phosphorus or Total Dissolved Phosphorus. Similarly, with nitrogen, field kits typically measure Nitrate, Nitrite and Ammonia, but not Total Kjeldahl Nitrogen.

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Although field kit measurements may not provide the entire picture of nutrient concentrations in water, they can provide good information on the relative health of an aquatic system. Typically, if the inorganic forms of nutrients are low, you can expect the totals to be relatively low. Similarly, if the inorganic forms are high, most likely all fractions are high.

Concentrations of phosphate, nitrate, nitrite, and ammonia are usually less than 1 mg/L in most lakes and streams, except sometimes in the spring, or after large rain events. It is usually advisable to first test a sample using low range procedures (0-1 mg/L), because more often than not, the sample concentration will fall below 1 mg/L.

Types of Field Test Kits

There are many *types* of field kits available. There are also many manufacturers of field kits. In general there are few differences between manufacturers of similar kits, but there are large differences between *types* of kits. Three common types of field kits include: Basic Test Strip Kits, Chemical Reagent Visual Kits, and Chemical Reagent Photometer Kits.

Basic Test Strip Kits

Basic Test Strip Kits use pre-treated paper strips. When the strip is dipped into a water sample, it turns a colour and the colour is matched to a paper colour comparator to determine the concentration of the parameter. Strip Test Kits are very inexpensive but usually provide coarse information and are not very useful for low concentrations.

Chemical Reagent Visual Kits

Chemical reagent visual kits require the addition of various chemical reagents to the sample. The sample then turns a colour which is compared by eye to a colour comparator to determine the concentration of the parameter.

The colour comparators are usually either a transparent coloured wheel or a set of liquid colour standards. Some manufacturers incorporate the use of a sample blank, which allows for correction of colour comparisons when the sample is naturally highly coloured. Kits that use colour blanks are advantageous for surface water applications.

Chemical reagent visual test kits are moderately expensive (~$100) but can provide readings between 0 and 1 mg/L at steps of 0.1 mg/L. Most kits will provide enough reagents to complete 30-50 tests. The colour comparators usually have a limited shelf-life so typically entire kits need to be replaced once the reagents are used up. Colour wheels may have a longer shelf-life than liquid colour standards.

Chemical Reagent Photometer Kits

Photometer kits also require the addition of various chemical reagents to the sample. When the sample turns a colour, it is placed in a photometer and the photometer records the percentage of light transmittance through the sample at a specific wavelength. The use of a photometer removes the human subjectivity that occurs when comparing the colour of the sample to a colour standard.

These kits are the most expensive ($1000-$2000), but can provide readings at very low concentrations and at steps ranging from 0.001 to 0.01 mg/L. Once the photometer kit is purchased, only reagents need to be re-purchased (~$50-$100 for 50-200 tests).

General Considerations for all Field Test Kits:

It is very important to wash everything out before and after testing your water. You don't want results carrying over between tests. Rinsing with deionized or distilled water is usually enough.

Read carefully and follow the instruction booklets. Most are easy to follow while you're performing the test.

You need sunlight or good light to perform all visual tests in order to get accurate readings.

It is important to use the right amount of sample water. It is different for every test and will alter the results of your testing if not done accurately.

Temperature of the sample water can affect the accuracy of the tests. In most tests, best results are obtained around 20°C.

Samples that have high turbidity will cause errors in results. Turbid samples should be filtered prior to testing.

Some tests (typically nitrate) produce hazardous waste that must be disposed of properly.

Metals, oil, grease, and chlorine will give low test results for nitrate.

For more information on using field chemistry kits to monitor water quality, please contact your local provincial water specialist or PFRA office.

Collecting a water sample during spring runoff.

Riparian Grazing and Off-stream Watering

By Serena McIver and Kerry LaForge, Prairie Farm Rehabilitation Administration

Riparian areas –the transition between the water's edge and the upland – can help maintain water quality by reducing erosion and storing nutrients.

Riparian Areas

Riparian areas are the transition zones between the water's edge and the upland environments. They can be seen as green zones along lakes, wetlands, creeks, rivers and areas of increased moisture. Although riparian zones represent only a small percentage of the landscape, they are considered among the most productive ecosystems in the world, and are vitally important because of the abundance and diversity of plants and animals they support.

Riparian areas also help to maintain water quality and quantity by performing key ecological functions like trapping sediment, reducing erosion, storing nutrients, filtering contaminants, and recharging aquifers. Maintaining healthy riparian areas requires an understanding of how they were formed, how they function and how agricultural practices affect them.

Protecting the Resource with BMPs

One way of maintaining and possibly enhancing soil and water resources is through the use of Beneficial Management Practices. Beneficial Management Practices (BMPs) are ways of agricultural management that reduce the negative effects agriculture has on the environment. The goal of integrating BMPs into a management plan is to protect soil, water and air in an economic and environmentally friendly way. BMPs promoted to enhance riparian areas include: grazing management plans, remote (off stream) watering, concentrated stream access, and exclusion fencing.

Remote (Off-Stream) Watering As a BMP

Recent research indicates that by implementing remote (off-stream) watering systems the impacts of livestock in riparian areas can be significantly reduced. Improved water quality, ease of livestock distribution and increased livestock performance can all be provided without fencing by supplying an alternative off-stream water supply. Fencing, although very effective at controlling livestock access to streams and water sources, is costly and not always practical, depending on landscape features, and results in the loss of very valuable forage production. However, it may still be required in areas of significant degradation or sensitivity.

The effectiveness of attracting cattle away from riparian areas with off-stream watering systems is dependent on a few factors. Season and time of day are significant variables. Forage quality within riparian areas remains higher later in

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the season which leads to preferential grazing of these areas. These areas provide shade and protection from the heat, and the coolness of the water often draws animals to the water's edge. The trees and shrubs also provide grooming locations. To overcome these variables, implement a grazing management plan and provide alternative means of shade, shelter and grooming devices. Off-stream watering devices are only one BMP that should be a component of a larger grazing management plan.

Cattle can be attracted away from riparian areas with placement of salt licks or watering troughs.

Some Disturbance Can Be Beneficial In Riparian Areas

The health of a riparian area is defined by its ability to perform key ecological functions. The health and function of riparian areas is dependent upon the interactions of diverse groups of deep rooted, soil binding species. Periodic disturbances are necessary to maintain that ecological function, for example, cottonwood species require periodic flooding to establish new seed beds.

Disturbances in riparian areas can be both natural and human induced. Grazing, for example, has helped to shape and develop riparian ecosystems over thousands of years in North America, through the co-evolution of native plants and grazing regimes. Historically, grazing was applied through native herbivores, such as deer, elk, pronghorn and especially bison. With the overlap of bison and cattle diets, cattle mimic the management functions that bison once performed. Other factors such as drought floods, fire, insects, topography and climate all helped to shape riparian ecosystems.

The key to maintaining healthy riparian areas is to balance and monitor the level of disturbance. At low levels of disturbance, diversity is reduced by competitive exclusion, possibly resulting in the dominance of a particular species, desirable or undesirable. Similarly, high levels of disturbance do not allow for natural succession, thus reducing diversity and the health and function of riparian areas. Therefore, for optimal functionality of riparian areas, intermediate levels of disturbance are required. Natural fluctuations in water levels and water movements may not be enough to maximise diversity and riparian function. In these cases, proper grazing management can be used to improve riparian function and biodiversity.

A Landscape Approach To Management

Proper management of riparian areas is clearly needed to make them as healthy and productive as possible. To maximise the effectiveness of off-stream watering, the four basic principles of range management must be adhered to:

(1) Balance forage supply and demand
(2) Allow adequate rest for recovery
(3) Defer grazing during sensitive periods, and
(4) Distribute grazing pressure evenly.

Riparian systems are dynamic and unique, requiring customized management, although some areas may not be suitable for grazing due to their soil structure and susceptibility to degradation. Following a well thought out grazing management plan that includes rotation, rest and alternate water sources will aid in the conservation of riparian habitats. Managing the total landscape should be the common goal of all land managers.

For more information on water quality and range management, contact your local Provincial Agricultural office or AAFC-PFRA office.

Water in the Well: The fresh-water-injection debate

By Mike Leschart

Reprinted from the May/June 2003 issue of Alberta Views with permission from Mike Leschart and Alberta Views

Real or imagined, the link exists—firmly entrenched in the minds of many Alberta farmers, ranchers and town councillors. Few will claim that the oil and gas industry is directly responsible for the recent years of drought. But many believe that industry's use of water is linked to low lake levels, decreasing river and stream flows, poorly performing water wells, and water supply shortages in rural communities.

"We used to be in a fairly good moisture belt area, but things have dramatically changed," says Don Bester, who owns a 150-head cattle ranch near Caroline, roughly 180 kilometres west of Red Deer. "We started experiencing drier conditions, less moisture, less snowpack—river levels, dugout levels, everything, just going down." In response, Bester helped to form a local activist group, the Butte Action Committee (BAC). Since its inception in 1999, the BAC has been a visible, unofficial leader of a movement to convince the province to stop the oil industry's use of fresh water in injection processes.

Bester acknowledges it is impossible to prove that oilfield water injection is exacerbating Alberta's drought conditions. But, he argues, during a time when all Albertans are being asked to conserve water, the oil and gas industry is injecting fresh water into the ground with impunity—water that is forever removed from the evaporation and rain cycle. "You don't have to be a rocket scientist to see that if you keep removing water from the natural cycle, then there's going to be nothing left," he says. "There's only so much moisture that we're getting during these dry years—why contribute to it any further?"

Photo Credit: Peter Llewellyn

To illustrate its point, the BAC makes the standard claim that the oil and gas industry injects more than 45 billion gallons of fresh water into the ground every year—an amount roughly equal to the volume of Pine Lake, southeast of Red Deer. And unlike the water used for irrigation, livestock or other agricultural purposes, injected fresh water is gone from the cycle—it will not evaporate and hence will not return as rainfall.

More than half of all oil produced in Alberta is extracted using water, either in injection or through the steaming processes of oil sands projects. Water injection occurs throughout the province at enhanced oil recovery projects that pump water or steam deep into reservoirs to coax out more oil. These projects recycle much of the water, but much is also left deep in the ground and thus removed from the water cycle.

According to Alberta Environment, the government allocates about 176 million cubic metres, or 47 billion gallons, of water for oilfield injection and other oil recovery methods each

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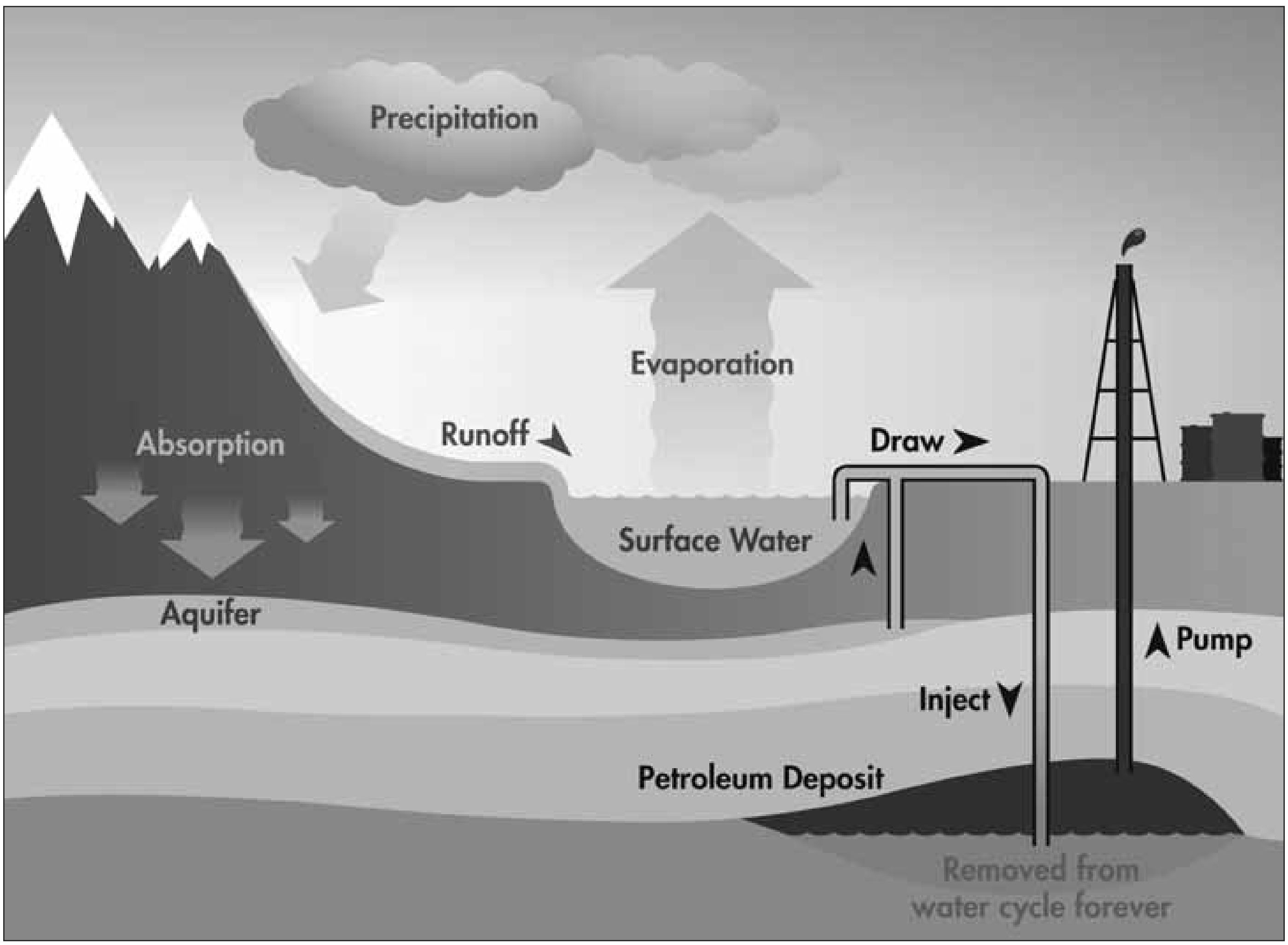
year. (Other industrial uses, including oil sands processing, are allocated 236 million cubic metres.) About four-fifths of this allocation is surface water and the rest is groundwater. Also, some companies use saline water, which the government does not regulate.

The government does not keep track of how much water is actually used. "At the moment we don't have proper reporting of the amount of water that's used," says Mary Griffiths, a scientist with the Pembina Institute in Calgary. "They've got the figures more or less, but not exactly." When Griffiths approached the government for figures on how much water, and what type, is used in injection, she was directed to the Alberta Energy and Utilities Board (EUB).

The EUB responded that the total amount of water used for oilfield injection in 2001—as reported to the board by the oil industry—was about 47 million cubic metres, of which 32 million cubic metres came from surface water or shallow wells and 15 million cubic metres from licensed source wells. Some of that water was saline—the EUB explained that their "records do not distinguish between useable and non-useable water for licensed wells."

The oil industry claims that their water use is comparatively light. "The amount of water consumed by the industry, as compared to municipal use or agricultural use or other industrial use is very small," says Pierre Alvarez, President of the Canadian Association of Petroleum Producers (CAPP), "and we have to make sure the public understands that."

Although Alberta Environment allocates roughly one quarter of the fresh groundwater in the province to the oil industry, in total the industry receives only 3 per cent of all water licensed in Alberta. Alvarez suggests that, aside from the nominal portion



The oil industry's deep injection technique disrupts the natural water cycle. Illustration Credit: Scott Dutton of water the industry uses, its allocations are validated because, in the end, the entire province benefits. "We're not the only ones using that water base. There's a lot of other sectors doing it as well, and some of them don't generate anywhere near the economic returns to the province that we do."

But despite the belief of many Albertans that the government is in the pocket of the oil industry and would never restrict their water supply, CAPP is clearly not dismissing the issue. As part of what Bester refers to as a "major campaign of propaganda," CAPP has published a brochure designed to correct what the association sees as a public misperception about their irresponsible use of water.

Individual companies, likewise, are working to change the perception that they are squandering massive amounts of fresh water from lakes and aquifers. Imperial Oil's Cold Lake oil sands project uses an injection process in which steam is sent down a well to loosen the buried bitumen. Imperial Oil spokesman Pius Rolheiser says the company uses roughly 400,000 barrels (63,500 cubic metres) of water per day to make steam, but about 90 per cent of that amount is recycled. "You inject 350,000 barrels per day—most of it comes back, along with the bitumen. So we purify and soften it and it goes back into the steam boilers," he says. "If we could use nothing but recycled water that's what we'd do, because it's more energy efficient." The remaining 10 per cent of the water comes from nearby salt water wells (which the industry commonly calls brackish water or brine). Fresh water drawn from Cold Lake and aquifers in the region is used for on-site showers, toilets and fire protection.

Imperial says its withdrawals from Cold Lake represent less than 1 per cent of the volumes that flow out of the water body. However, a number of similar steam-injection oil sands projects operate in the area and people are afraid that oil companies are draining the lake. When a lake level is declining, Rolheiser says, an oil company is an obvious, if wrongly accused, target. "People, unfortunately, tend to associate that with industrial activity," he says. "The lake levels are low, but that's a function of regional drought conditions."

Though Rolheiser sees this connection as a misperception, the Alberta Energy and Utilities Board agreed that the people had grounds for their concerns. In 1999, a group of citizens persuaded the EUB that Imperial's groundwater extraction was affecting local water wells. The EUB stated: "the Board notes that there have been impacts to domestic water wells from Imperial's groundwater extraction practices in the past. The Board agrees with intervener statements that impacts to domestic wells resulting from groundwater withdrawal by Imperial are not acceptable." The company was ordered to monitor the response of groundwater to steam injection.

To Fritz Crone, who owns a ranch near Provost and is serving his first term as Reeve of the Municipal District, the link between oilfield water injection and drought is as clear as the dry dugouts and sloughs on his property and the receding water level in nearby Muriel Lake. "We feel that it's contributing to the drought," he says bluntly. "It's depleting the aquifers, so we feel that it's having an effect on our environment."

Last fall, Crone presented his view to colleagues at the Alberta Association of Municipal Districts and Counties, which represents all 65 of Alberta's rural municipalities, and persuaded the association to pass a resolution urging the provincial government to halt the use of fresh water for oilfield injection. Crone says the group is beginning to "perk the government's ears," but little action on the issue has been taken. "[The Alberta government] derives a lot of revenue from the oilpatch, so they don't really want to rock the boat," he says.

Without a doubt, water use has boosted both oil production and the government's revenue stream. No regulatory changes discouraging the use of fresh water in injection are on the horizon, according to Sherri-Dawn Annet, a spokeswoman with Alberta Environment. She says changes designed to reduce the injection of fresh water and encourage alternatives—such as saline water, carbon dioxide or petrochemicals—are "not [happening] at this time."

Alberta Environment's water strategy draft, which it released at the end of March, may lead to a more active role for the government in this area. The draft says the government will discourage, and eventually eliminate, processes that remove fresh water from the water cycle. But for now, not only does the government not keep track of how much water is used in injection but it also doesn't consider the use to which water will be put when it grants water licences. "The government is not in a position to put value judgments on what use of water is most important—be it industry, be it irrigation, be it golf courses, be it townships etc.," Annet explains. "Currently, we do not evaluate what the water will be used for." Instead,

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the government looks at whether the water is available, in-stream flow needs are met, the ecosystem is protected when water is removed, and existing licence-holders are affected.

The lack of data on water use has been a source of frustration for Griffiths. The Pembina Institute has yet to finalize a policy on the oilfield water injection issue, but Griffiths is working on a draft document that recommends the province limit the amount of fresh water used in oil injection projects and require the use of saline water wherever possible, because "much water that is injected is lost to the hydrologic cycle." She also recommends that the government keep a better record of the amount of fresh water injected each year into oil wells.

Don Bester notes that his group has had some success. He says that the BAC convinced ConocoPhillips that it was using too much fresh water and convinced Murphy Oil to drill deeper water wells to tap into saline water.

But he says the group's work will not be truly done until no fresh water is injected into the ground to help recover oil. And like the oil and gas industry, he seeks a change in public perception to help his organization achieve its goal.

"Until every Albertan realizes that this use of fresh water has got to stop, and it's wrong, we're not going to get anywhere," he says. "We need water to live. I can live without oil."

Prairie Water News is published semi-annually. It is co-sponsored by the following:

Saskatchewan Research Council
Alberta Agriculture, Food & Rural Development
Alberta Environment
Department of Fisheries and Oceans
Province of Manitoba
Agriculture and Agri-Food Canada - Prairie Farm Rehabilitation Administration

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