

WATERSCAPE BOWEN ISLAND

Water for our island community



Geological Survey of Canada Miscellaneous Report 88, 2005

By: Bob Turner, Richard Franklin, Murray Journeay, David Hocking, Anne Franc de Ferriere, Andre Chollat, Julian Dunster, Alan Whitehead, and D. G. Blair-Whitehead.

Advisory Committee: Stacey Beamer, D. G. Blair-Whitehead, Ross Carter, Andre Chollat, Julian Dunster, Anne Franc de Ferriere, Bill Hamilton, Ian Henley, Dave Hocking, Will Husby, Murray Journeay, Denison Mears, John Reid, Mallory Smith, Ian Thomson, Bob Turner, Dick Underhill, Alan Whitehead, Dave Wrinch, Dave Yeager.



Natural Resources
Canada

Ressources naturelles
Canada

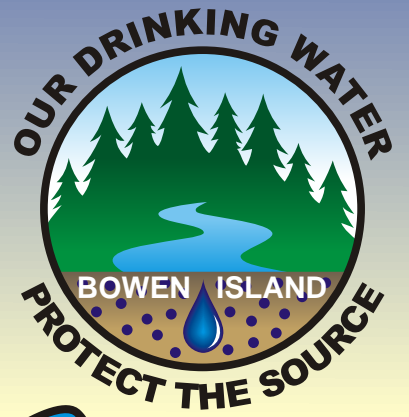


CWRA ACRH
Canadian
Water
Resources
Association
Association
Canadienne
des Ressources
Hydriques



BRITISH
COLUMBIA

Canada



Hi, I'm Raindrop. Come with me and explore the story of water on Bowen Island.

We are a small island surrounded by salty ocean water, and so there are limits to our freshwater supply. Yet all life - people, other animals and plants - rely utterly on a continued supply. So we need to answer important questions: Do we have enough water? Are we using it wisely? Are we protecting our drinking water supplies? Are we leaving enough for nature?



Watershed

by Pauline Le Bel © 2002

**Water
shed
since the beginning;
silver beads of life
falling from the sky.**

**Living water
shed
for the love of
greening things.
Living Water
cleansing
nourishing
healing.**

**Mother of all life forms
yet formless
yielding
to serpentine river bed;
blessing fingers
dipped in still ponds;
accepting
the scoop
of a child's rubber pail.**

**Powerful Water
changing everything
in your path
wearing smooth
the hardest stone
in your urgency to return
to the sea
in this neverending prayer
of renewal.**

**Island Waters
precious
vulnerable
children of the salty womb
we call you
Grafton
Honeymoon
Josephine
home of the red swimmer.**

**Restless Water
singing the shore pebbles
dancing the moon
how we long to contain you.
In our carelessness
we alter your flow
we squander
we poison
your gift.**

**Clutching our hands
we watch you slip away
drop by drop.
We forget to bow our heads.**

**Sacred Water
when will we gaze upon
the still mirror of your face
and remember
our watery beginnings
the amniotic cradle
of our Mothers?**

**When will we feel
the oceans flowing
through our veins,
taste our salty tears?
When will every water-loving
cell in our body
cry out:
what we do to you
we do to ourselves?**

**Oh, Troubled Water
one shining morning
we will gather
we will stand
ready and willing
to protect you
to honour you.**

Water in our lives: how we use it

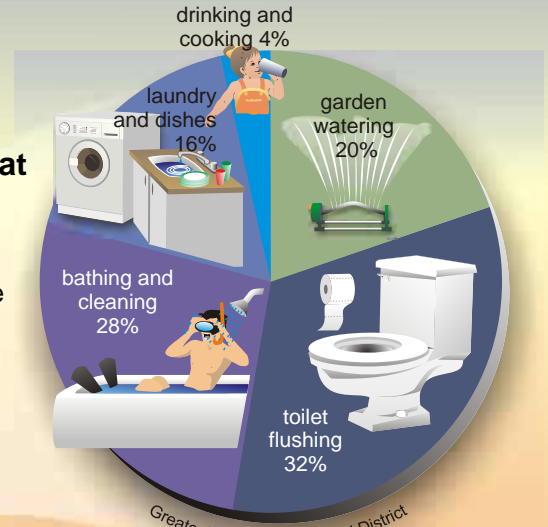
Water - essential to life

Imagine life without water. Impossible! People, animals, plants - we all need water to survive.



Where does all that water go?

We flush a third of the water we use down the toilet. In the summer, watering our gardens can cause household use to jump 30%.

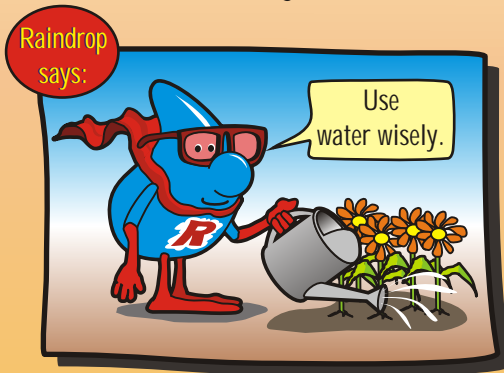
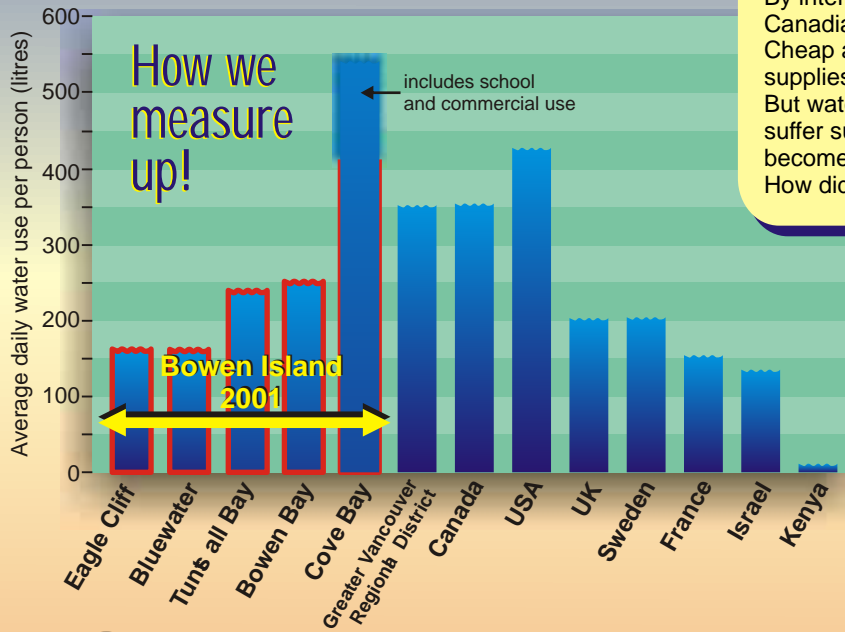


Hidden water use

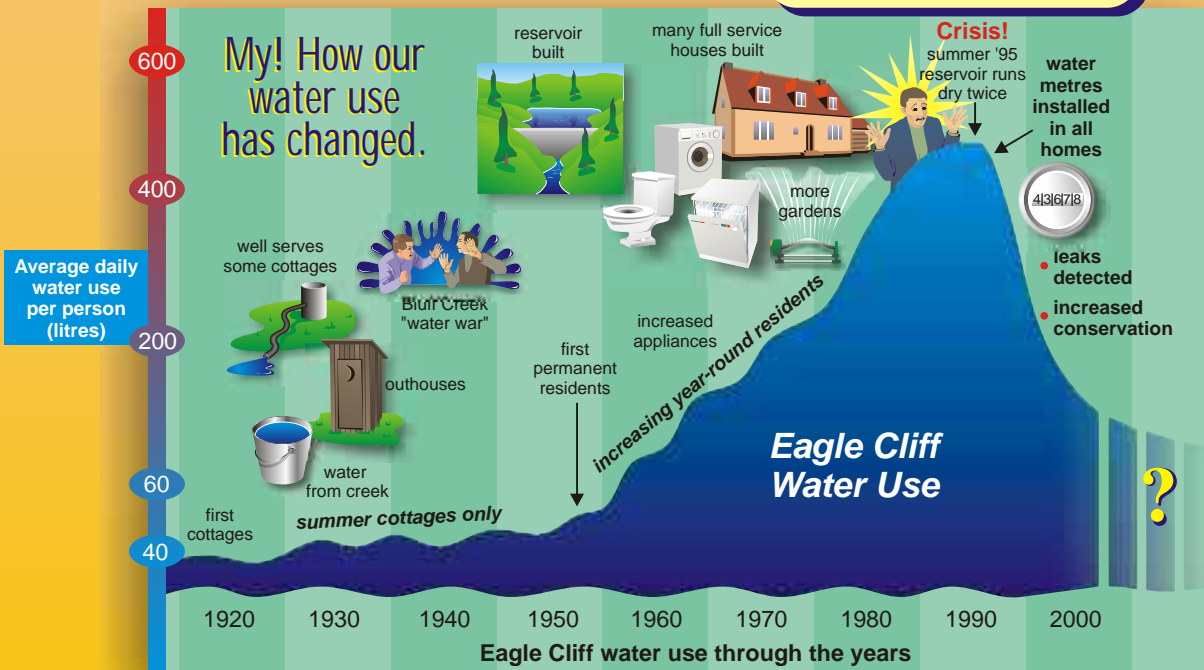
Water is used to produce the food we eat and the products we use. For example, manufacturing a car uses hundreds of thousands of litres of water.

Necessity - the mother of conservation.

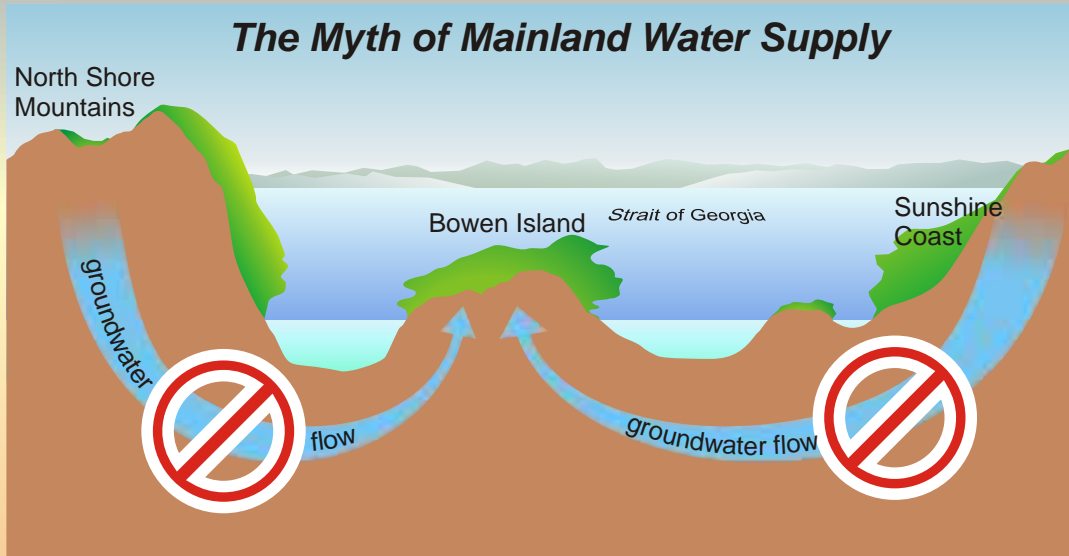
By international standards, Canadians waste a lot of water. Cheap and seemingly unlimited supplies discourage conservation. But water districts on Bowen that suffer summer water shortages have become very efficient water users. How did they do it?



User pay!
 Summer water use in Eagle Cliff dropped 70% when household meters were installed. When we have to pay for what we use, we tend to use less. Meters also identify leaks in the pipe system.

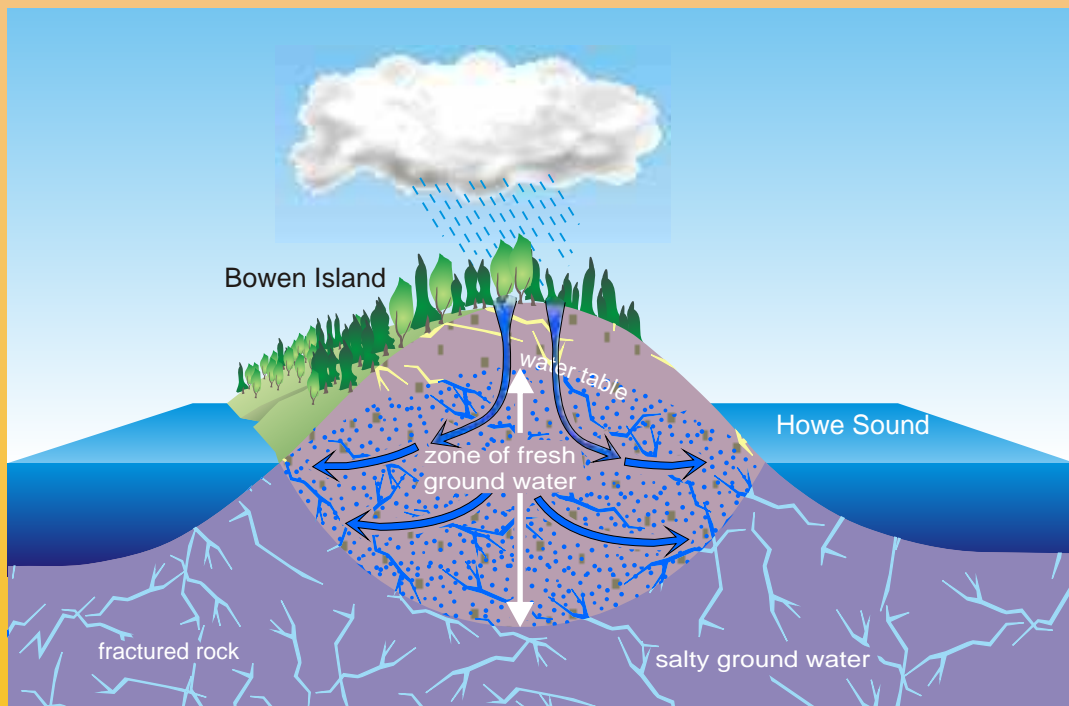


Where does our water come from?



My water comes from Mt. Baker!

Though some islanders guess that their springs or wells flow from Mt. Baker or the North Shore, there is no scientific evidence for such claims. All indications point to island rainfall as the source of Bowen's fresh water supply.



Island groundwater systems

Ocean islands such as Bowen Island are surrounded by salt water. This is also true underground. A limited zone of fresh groundwater underlies the island. This freshwater zone is fed by rainfall to the island, and is surrounded by salty groundwater that underlies the ocean.

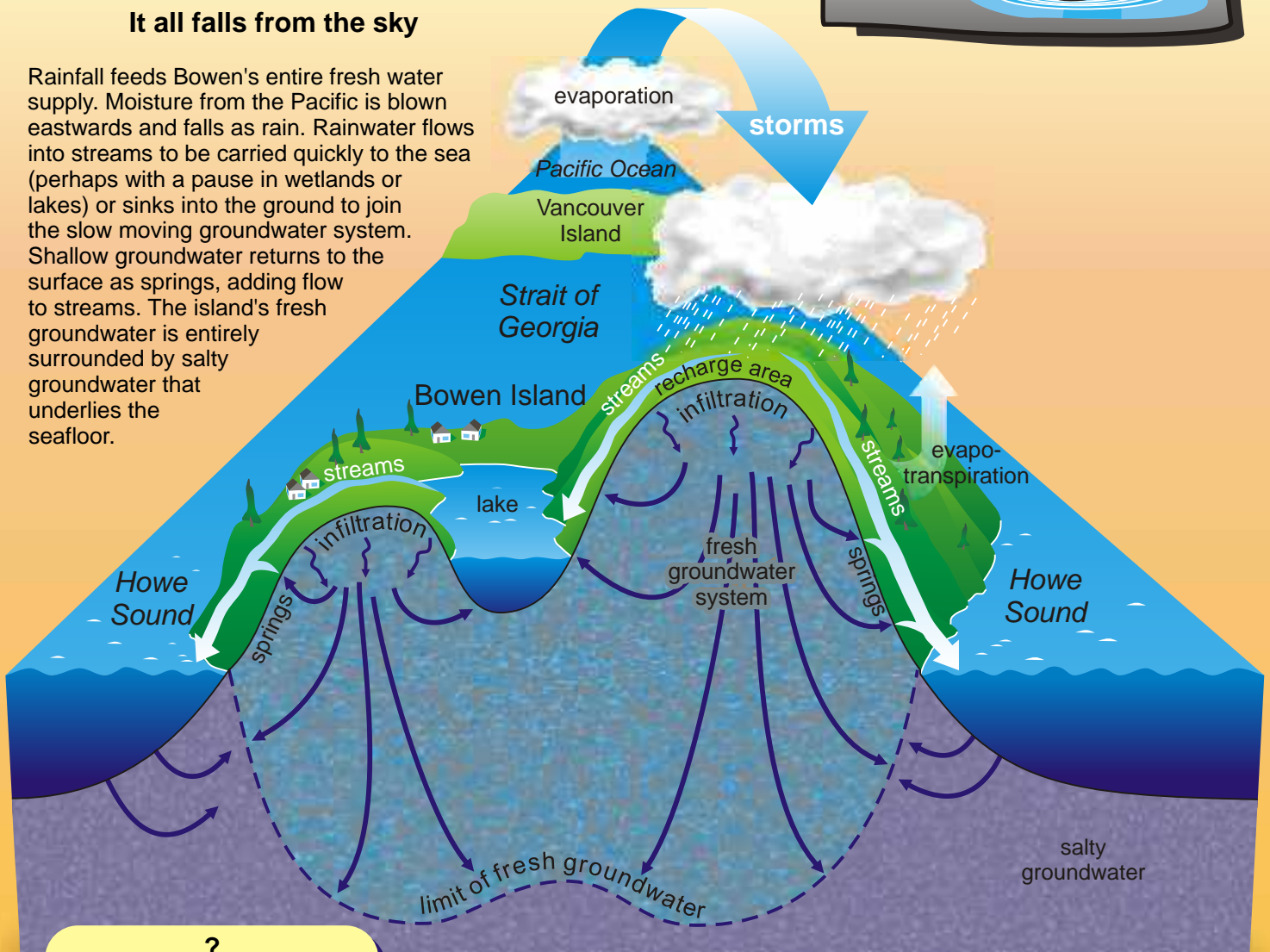
Raindrop says:

All our water comes from rain that falls on the island.



It all falls from the sky

Rainfall feeds Bowen's entire fresh water supply. Moisture from the Pacific is blown eastwards and falls as rain. Rainwater flows into streams to be carried quickly to the sea (perhaps with a pause in wetlands or lakes) or sinks into the ground to join the slow moving groundwater system. Shallow groundwater returns to the surface as springs, adding flow to streams. The island's fresh groundwater is entirely surrounded by salty groundwater that underlies the seafloor.



?

Mystery stream supply

Some streams on Bowen flow year round, even through the summer dry season. When it hasn't rained for weeks, where can the water be coming from?

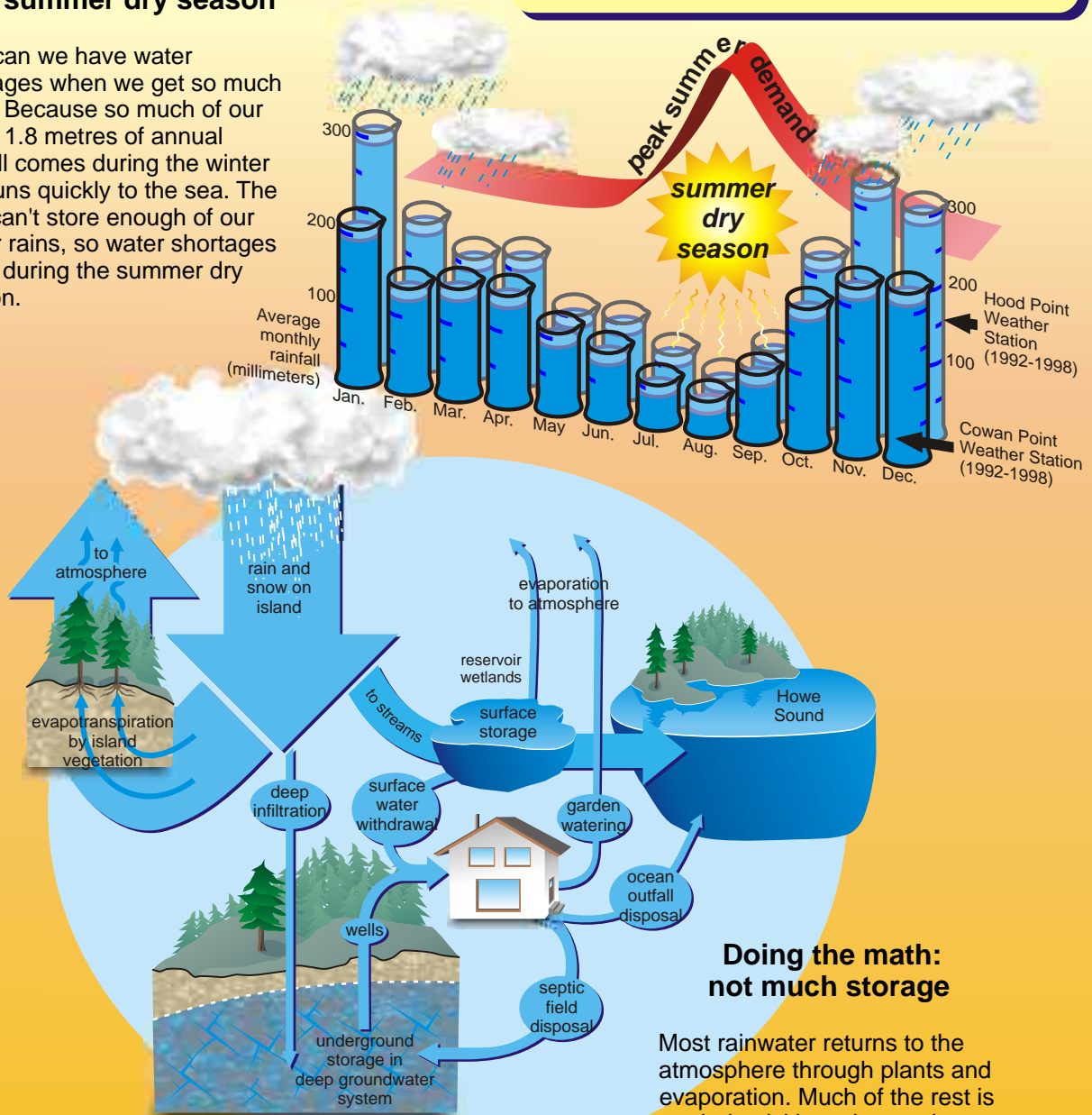
Water shortages? But this is a rainforest!

Are more droughts coming ?

Scientists predict that in the future southwestern British Columbia will receive more winter rainfall, but longer and hotter summer dry seasons. How will this effect the supply of water on Bowen Island?

The problem: our summer dry season

How can we have water shortages when we get so much rain?. Because so much of our 1.5 to 1.8 metres of annual rainfall comes during the winter and runs quickly to the sea. The land can't store enough of our winter rains, so water shortages occur during the summer dry season.



Doing the math: not much storage

Most rainwater returns to the atmosphere through plants and evaporation. Much of the rest is carried quickly to the sea by streams. Some stream water is stored for days to months in wetlands, ponds, lakes, and reservoirs. A small amount infiltrates the ground, evades capture by plant roots, and can be stored for months to centuries in the slow-moving groundwater system.

Limited re-supply!

Based on research in the San Juan Islands, it is estimated that only a small percent of our annual rainfall, likely less than 15 cm of rainwater, becomes part of deep groundwater storage.

Water in our lives: how we get it.

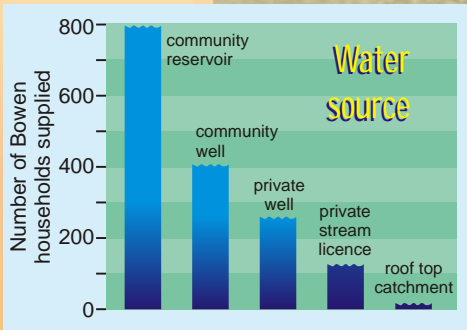
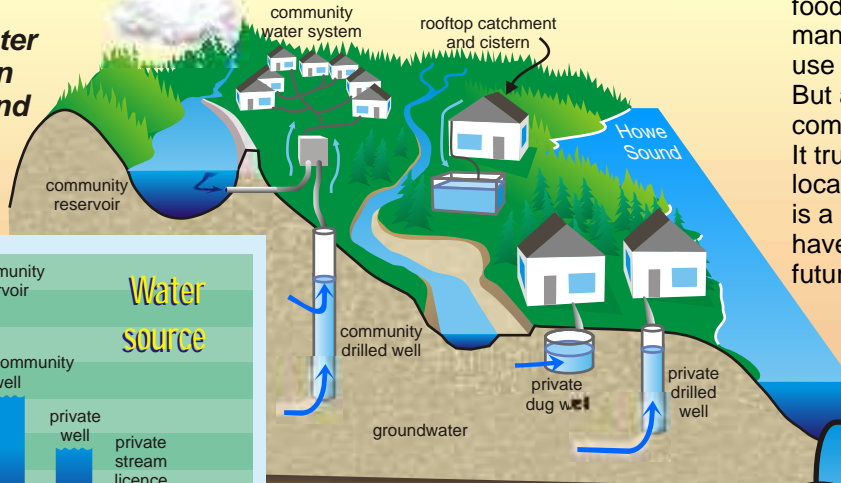


B. Turner

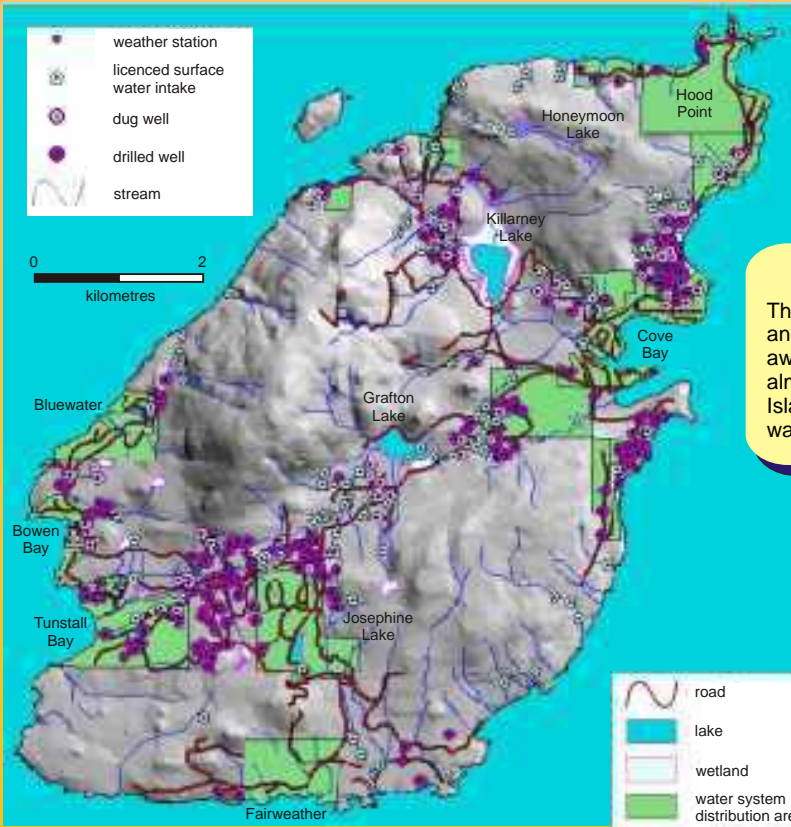
Water, the local resource

Think about it. Most of the food, energy, and manufactured goods we use come from far away. But almost all of our water comes from Bowen Island. It truly is our most valuable local resource. Because it is a local resource, we have stewardship over its future. It is for us to decide.

Different water sources on Bowen Island



A map of Bowen Island showing sources of water



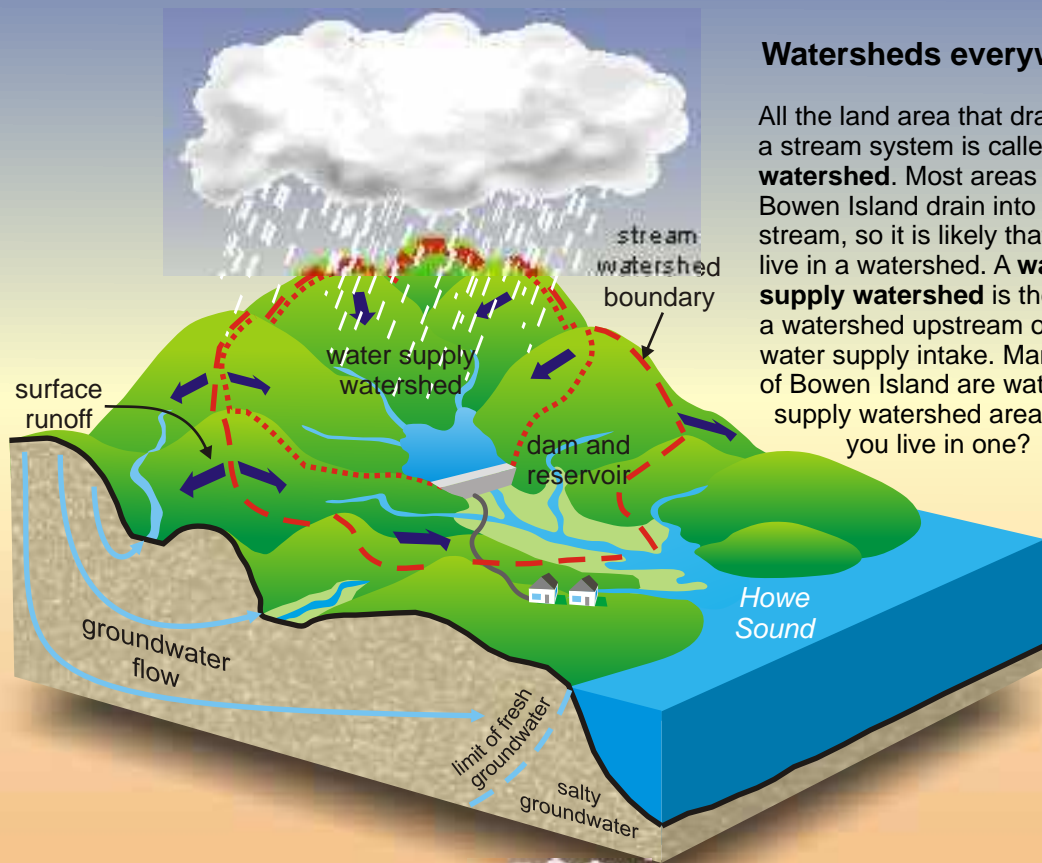
Water, the local resource

Think about it. Most of the food, energy, and manufactured goods come from far away. Only our water is home grown, almost all of it comes from Bowen Island. So we control the future of our water, it's for us to decide!

Bottled water - the foreign invasion!

Bottled water has become very popular. While it seems safe and convenient, there are disadvantages: It's expensive, it creates waste containers, and trucking water generates air pollution, causing problems like asthma and global warming.





Watersheds everywhere!

All the land area that drains into a stream system is called a **watershed**. Most areas of Bowen Island drain into some stream, so it is likely that you live in a watershed. A **water supply watershed** is the part of a watershed upstream of a water supply intake. Many parts of Bowen Island are water supply watershed areas. Do you live in one?

Living in our water supply watersheds

Vancouver protects water quality in its watersheds by restricting access. Things are different on Bowen. Some water supply watersheds lie within forested Crown Lands and are relatively pristine. But others, such as the Grafton Lake water supply, include residential and commercial areas, roads and livestock. All of these uses represent potential sources of contamination. Should we be concerned?

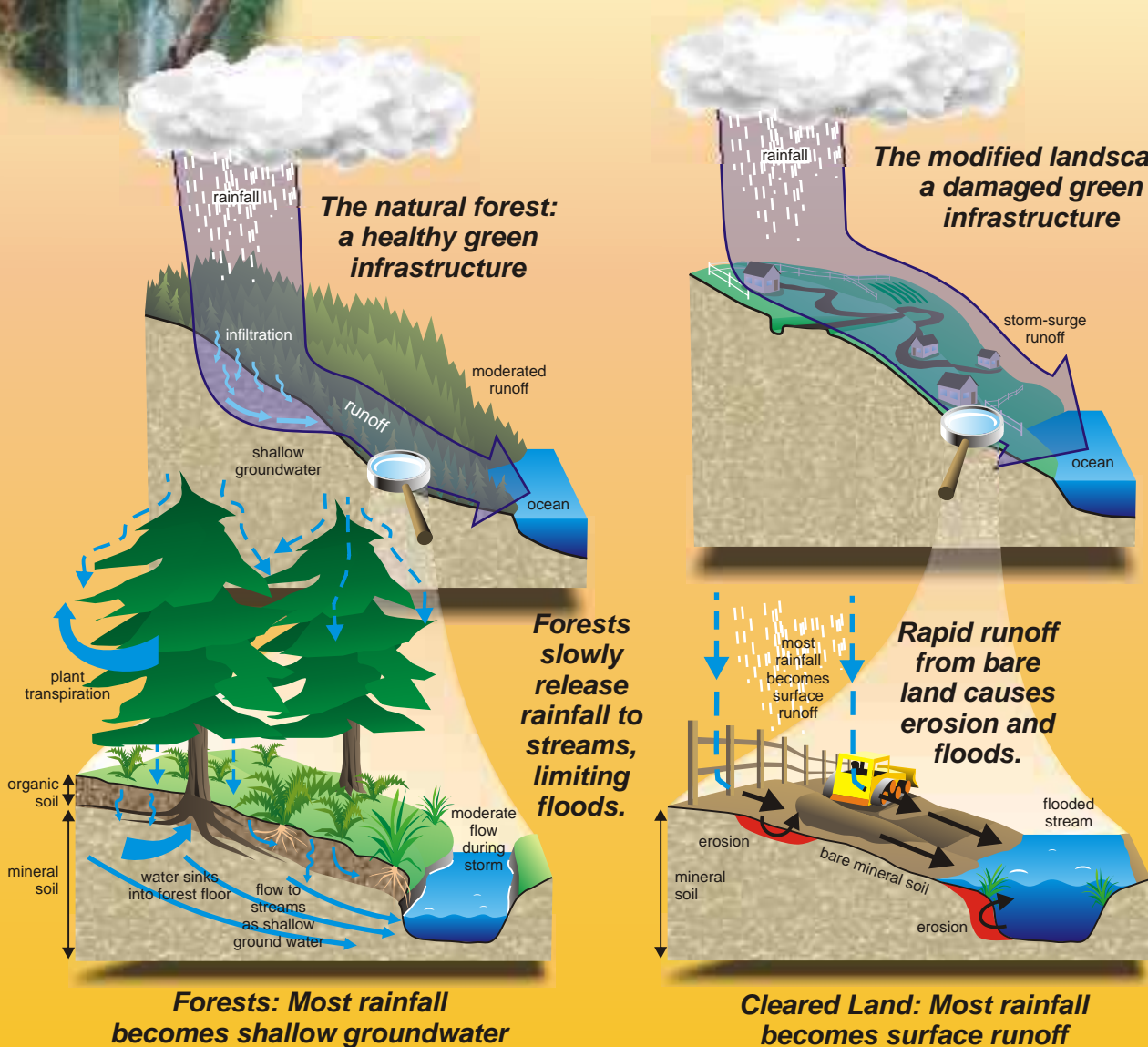


The clean water factory: forests, streams and wetlands

Hi-tech forests? How they work for us.

Our forests, streams, lakes, and wetlands provide an amazing service to us, clean water! They have evolved over millions of years of “research and development”. Forests act as a giant filter. Rain infiltrates the porous organic soils and percolates slowly to streams where it is gradually released as clear water. As a result, forest streams commonly run clear even during storms.

W. Husby



Stream “tornadoes”

In contrast to forests, rain does not easily infiltrate bare mineral soils exposed in disturbed areas. Instead, rainwater flows on the surface, eroding and carrying away fine sediment. During storms, streams flood quickly with muddy waters, eroding banks and filling channels with sediment. Such floods are like a tornado, wreaking havoc to stream life.

Skunk cabbage, a wetland indicator plant.



J. Dunster

B. Turner

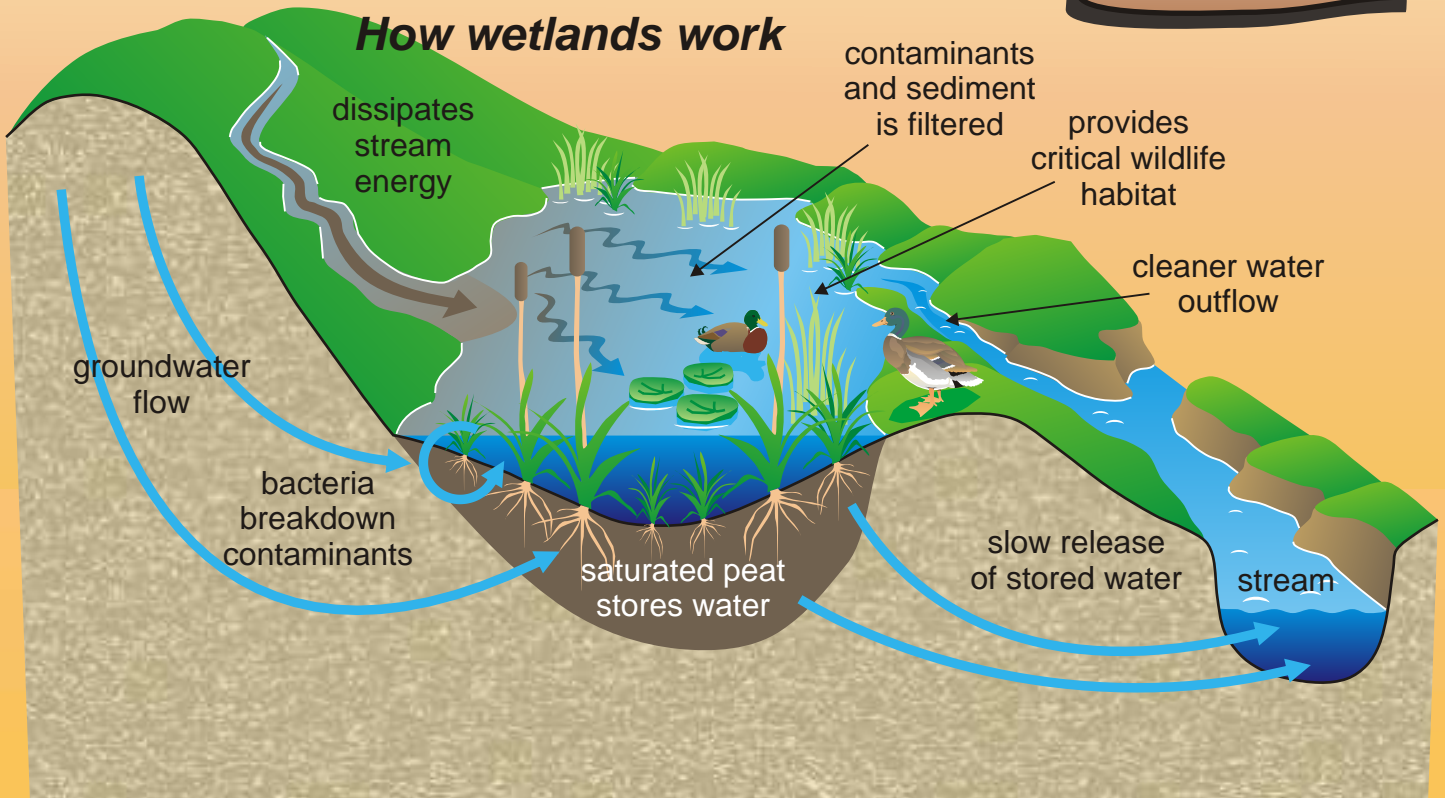
Grafton Lake hosts extensive and important wetlands

Raindrop says:

By protecting our land we protect our water.



How wetlands work

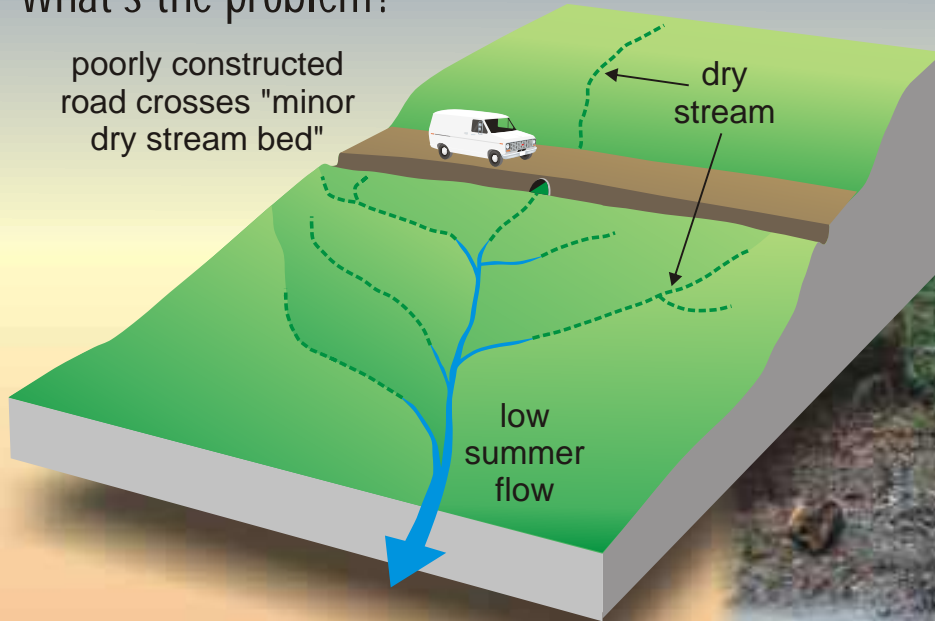


Wetlands: nature's sponge and filter

Wetlands swamps, marshes, bogs, and fens provide many services. They filter stream waters, store water, and offer critical habitat for many plants and animals. Wetlands fill with water during rains and slowly release water through droughts. Before we understood their critical role, we used to ditch and drain wetlands to create lawns, pastures, or farms.

What's the problem?

poorly constructed road crosses "minor dry stream bed"



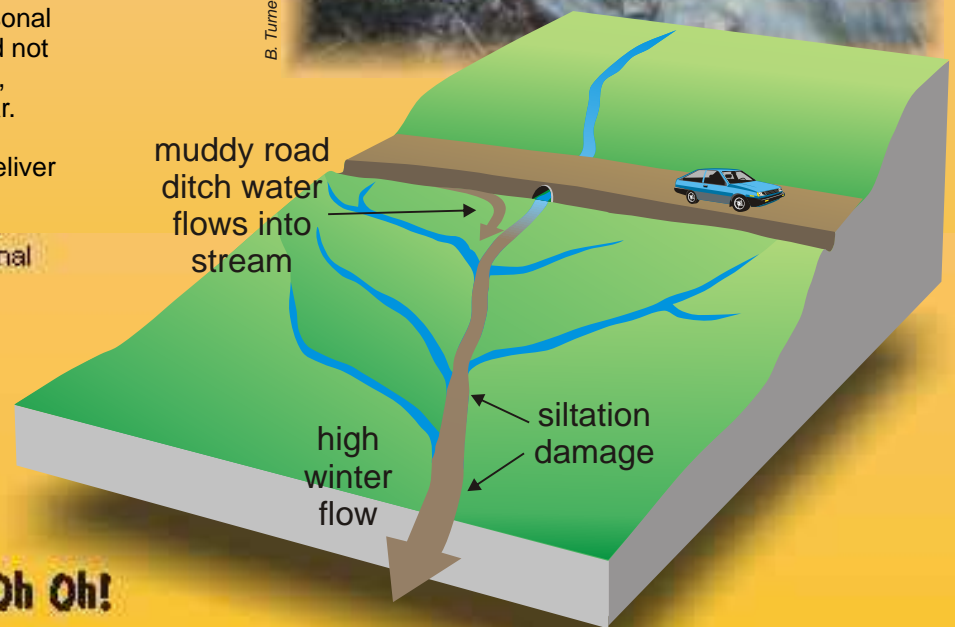
Muddy water from small tributary enters Bowen stream.



B. Turner

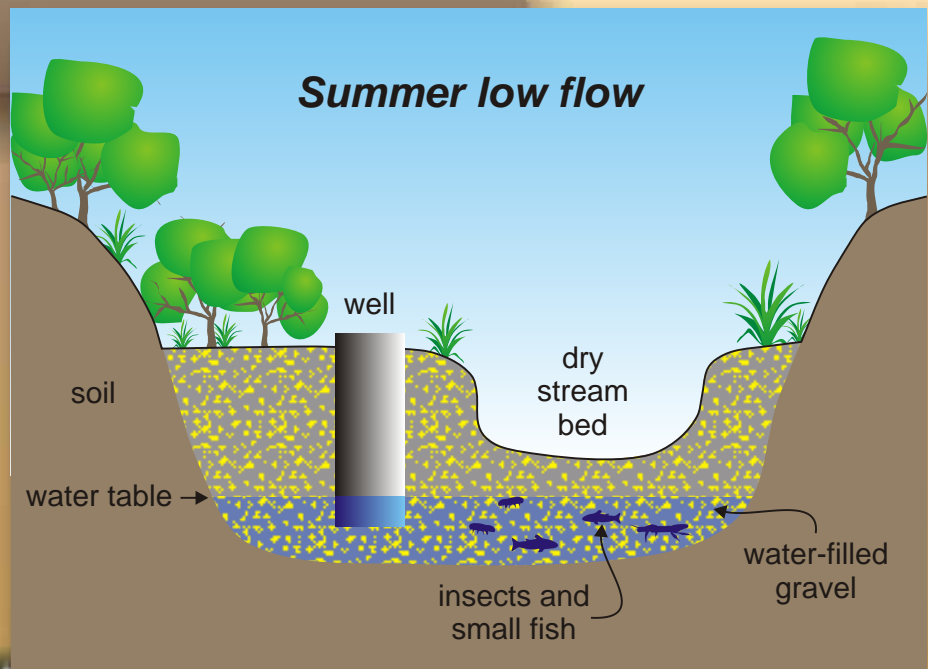
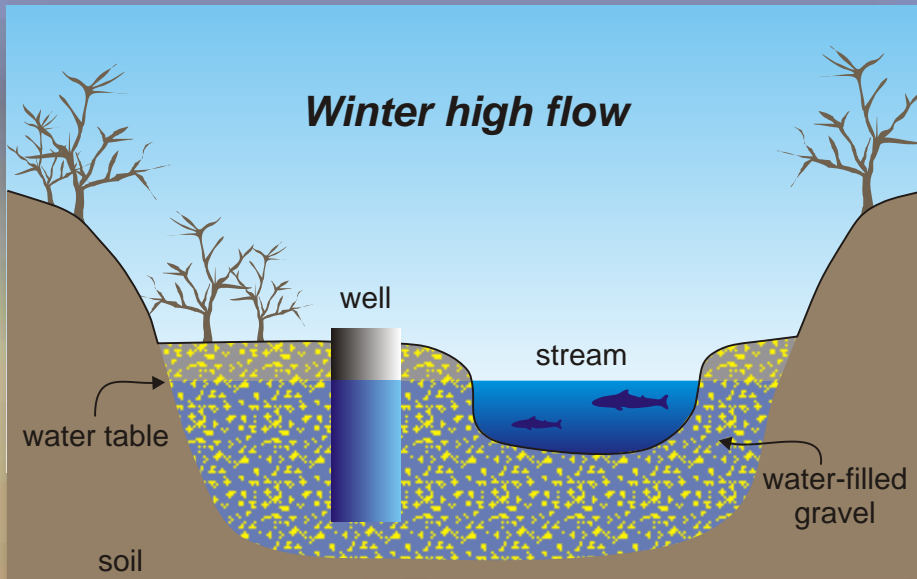
Every stream counts. Even small dry ones.

Water enters streams through many small tributary channels. During winter rains, water flows in these channels. However, this surface flow usually disappears during the summer dry season. Some might view these seasonal channels as unimportant and not worthy of protection. After all, they only flow part of the year. However, any channel, regardless how small, can deliver damaging silt to the stream system during winter storms. Therefore, even small seasonal streams need protection.



Oh Oh!

road ditch channels muddy water into stream



Underground streams? Every stream has one.

Every stream flowing over a bed of gravel has an underground stream. This underground water fills the gravels and flows slowly downstream under the stream bed. During the summer dry season, the water level can drop below the stream bed, creating the appearance that the stream has completely dried up. But water may still be flowing in the gravels. Anyone who draws water from a shallow well beside a stream knows this can be true- a well continues to produce water after the stream goes dry. This hidden underground river provides refuge for insects and even small fish through the dry periods. So a stream can still be flowing even though it looks completely dry.



This stream looks dry, but water still flows within the gravels.

Roads under construction, and newly cleared lands are major sources of turbidity on Bowen Island.



B. Turner

A little mud never hurt anyone - or did it?

Muddy water or **turbidity** is a major water contaminant on Bowen Island. Turbidity plays havoc with water treatment systems, reducing the ability of chlorine to disinfect. Muddy water also degrades stream gravels. The spaces in clean gravels are home to all kinds of life fish eggs, insects, and even small fish. Silt clogs these pores, reducing life in the stream.

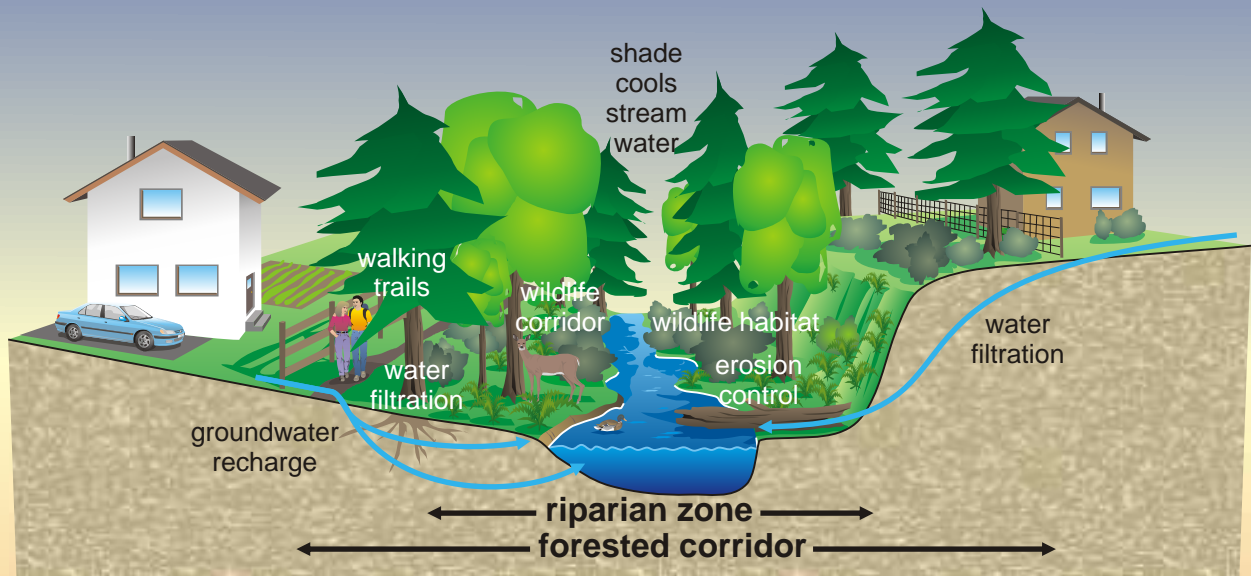
Are ditches a part of stream systems? You bet!

Construction of ditches have added many miles to our stream system. Many small streams drain into ditches, and most ditches drain back into streams. So whatever goes into ditches, ends up in our streams!



B. Turner

Ditch runoff during winter storm



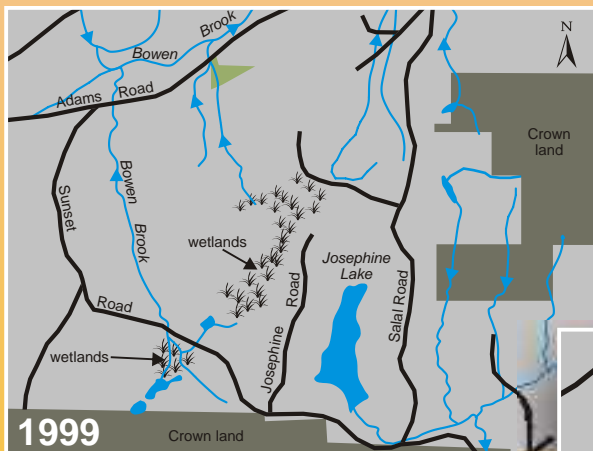
Forested corridors: vital to stream health

Maintaining forest corridors along our streams is essential to stream health. Forests filter water, and provide shade to cool waters during summer heat, logs that create pools and riffles, and wildlife travel corridors and habitat. They also provide walking trails for us!

Shoreline wetland, Josephine Lake



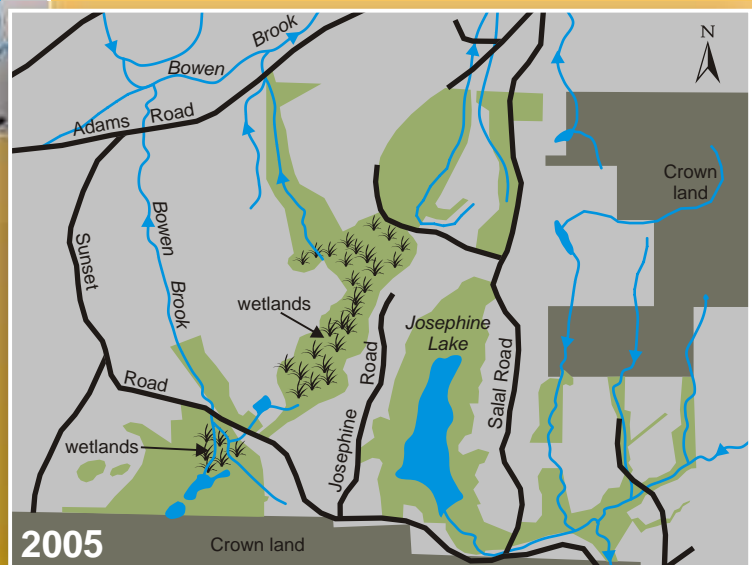
B. Turner



protected land

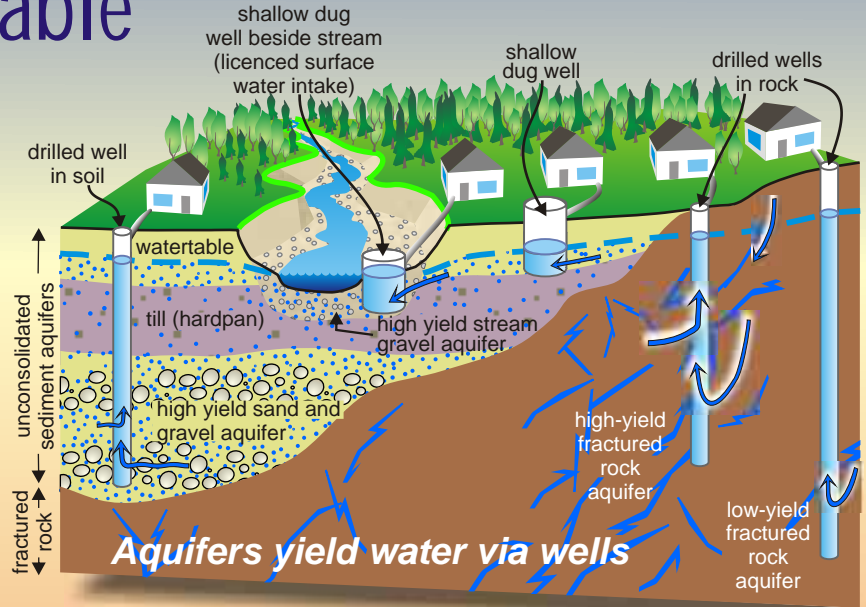
Investing in Greenways: our recent progress

Bowen's green infrastructure is in good condition. We invest in it by protecting it as parkland. Over the last several years, Bowen Island Municipality has negotiated green infrastructure protection with landowners seeking to develop their lands. A network of **greenways** has protected streams, wetlands, and lakes in the Josephine Lake area.



2005

Water stored underground: vital and vulnerable



Tapping into water stored underground

Any body of rock or sediment that yields useful amounts of water is an **aquifer**. Bowen Island has two types of aquifer: fractured rock, and sand and gravel layers. The amount of water stored in fractured rock is typically limited, and these aquifers can run low during the summer drought. Sand and gravel can store more water and these aquifers are less likely to dry up in the summer. Shallow dug wells can dry up as the water table falls during the summer.

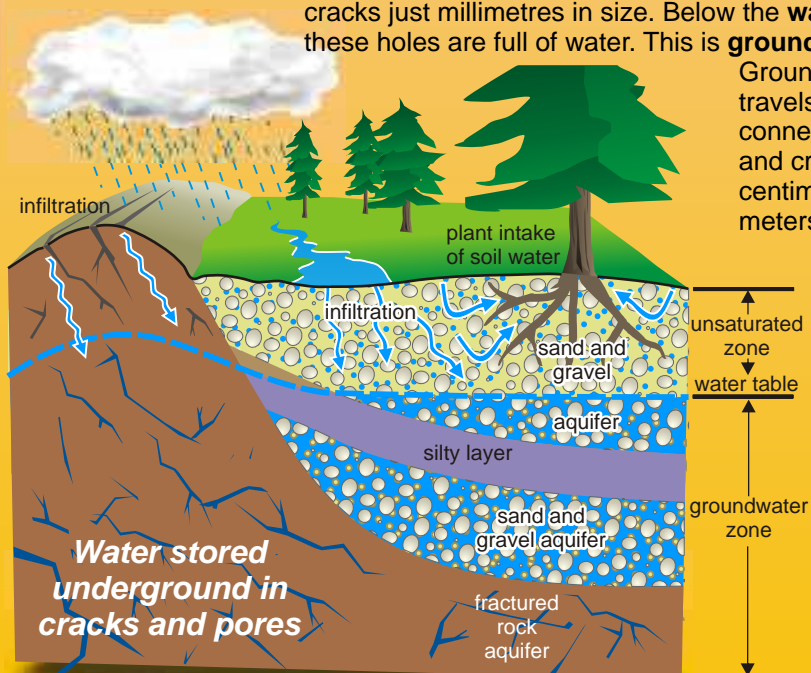
Water stored underground in cracks and pores



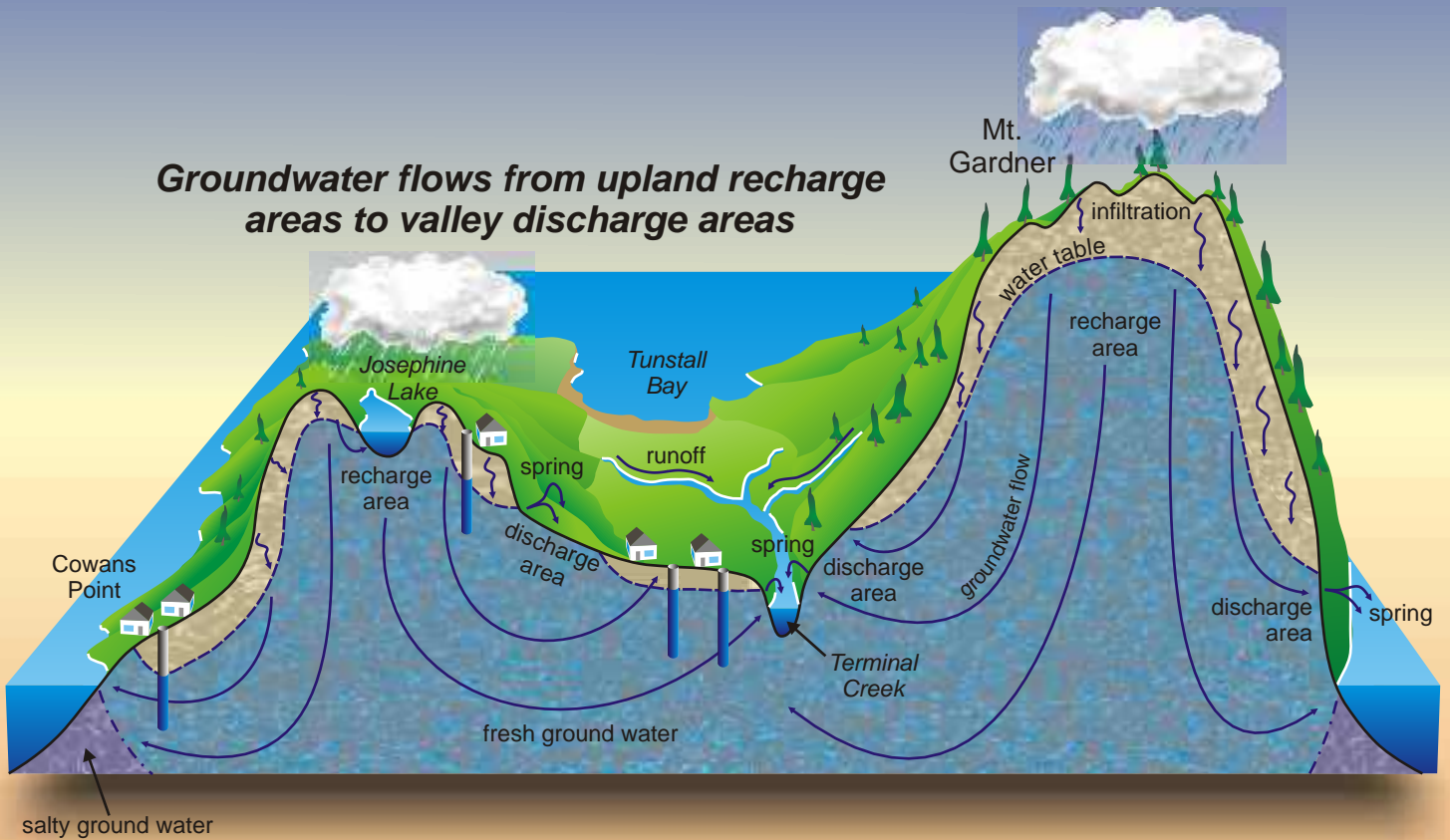
So what is groundwater?

Rainwater percolates into the earth. Soil and rock are like a giant sponge, full of holes, typically tiny pores and cracks just millimetres in size. Below the **water table**, these holes are full of water. This is **groundwater**.

Groundwater slowly travels through connected pores and cracks just centimetres to meters per year.



Groundwater flows from upland recharge areas to valley discharge areas



Ensuring our aquifers replenish

Most recharging of aquifers occurs in forested uplands and valley slopes. But land clearing, road building and ditching reduce water infiltration by creating impermeable surfaces and diverting water into ditches and streams. Infiltration ponds along ditches can increase the return of water into the groundwater system.



B. Turner

Mt. Gardner from Grafton Lake

Underground lakes and rivers?

Not on Bowen. Large underground streams and lakes only occur in limestone cave systems. Limestone is unique as it dissolves in water, allowing caves to form. Bowen's granitic and volcanic rocks do not dissolve in water and so lack cave systems.

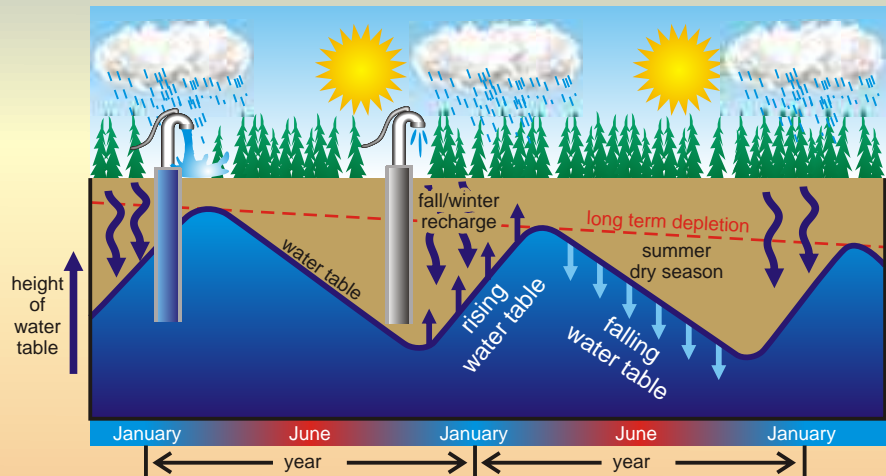
Mountains as water towers

Mount Gardner and our other forested mountains play a vital role in water capture, storage, and delivery on Bowen Island. As mountains they force moist air masses to rise, causing additional rainfall on the island. Small depressions on their forested slopes allow infiltration of rainwater, recharging the groundwater system. Because of their tremendous bulk, our mountains have a huge capacity to store groundwater. They act as giant "water towers" for the island. Groundwater moves slowly downward from these "water towers" under the pull of gravity. Some of it feeds springs that flow into streams along lower slopes and valley. Other groundwater flows directly into valley aquifers and lakes."

Protecting the balance



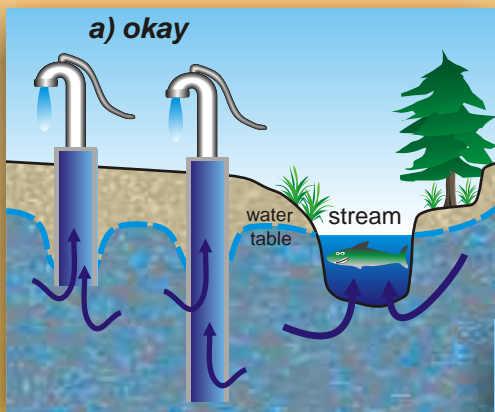
Groundwater storage is like a bank account. The balance falls when withdrawals exceed deposits. Nature makes deposits through rainfall, and withdrawals through leakage of groundwater to streams and the ocean. Our wells represent further withdrawals. If total withdrawals exceed deposits, we deplete our groundwater storage. Do we know if we are draining our account?



Water table ups and downs through the seasons

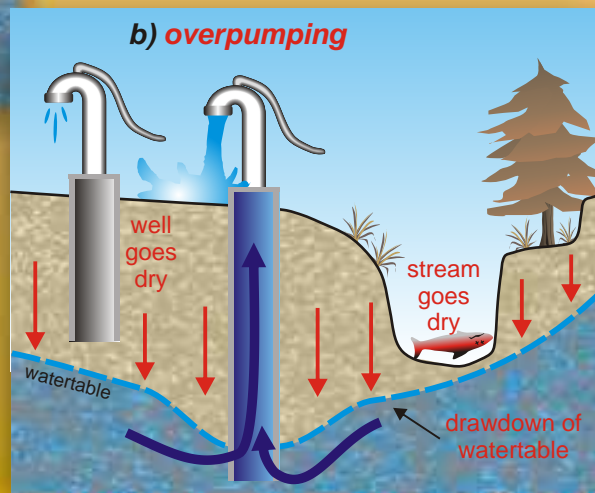
The amount of water stored underground changes through the seasons. As winter and spring rains infiltrate the ground, stored groundwater increases and the water table rises. When the rains stop, the water table falls as groundwater leaks into streams and the ocean. Well pumping also removes water and lowers the water table. Excessive pumping of groundwater can result in long term depletion of groundwater storage.

Excessive pumping can reduce flow in streams



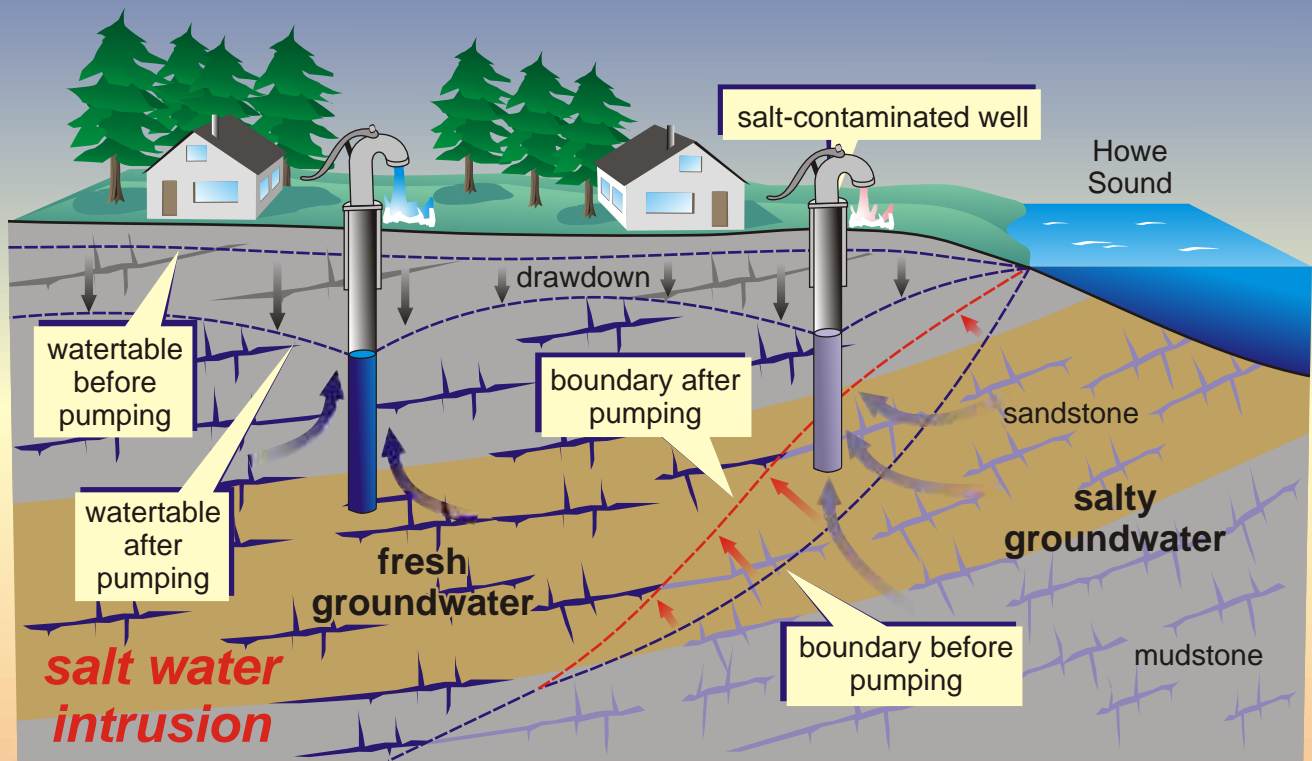
Oops! I dried up the stream

Groundwater springs feed streams year round. They are the only source of stream water during the dry season. A pumped well draws down the nearby water table. Excessive pumping for an extended period of time can lower the water table over a broad area. This can divert groundwater from streams and even cause streams to dry up. Nothing damages a stream like taking away its water!



Are we depleting our groundwater?

To determine whether we are overpumping our island aquifers, we need a series of groundwater observation wells on Bowen. These are unused wells where water table levels can be regularly checked to determine long-term trends. Some groundwater monitoring has started on Bowen but more observation wells are needed.

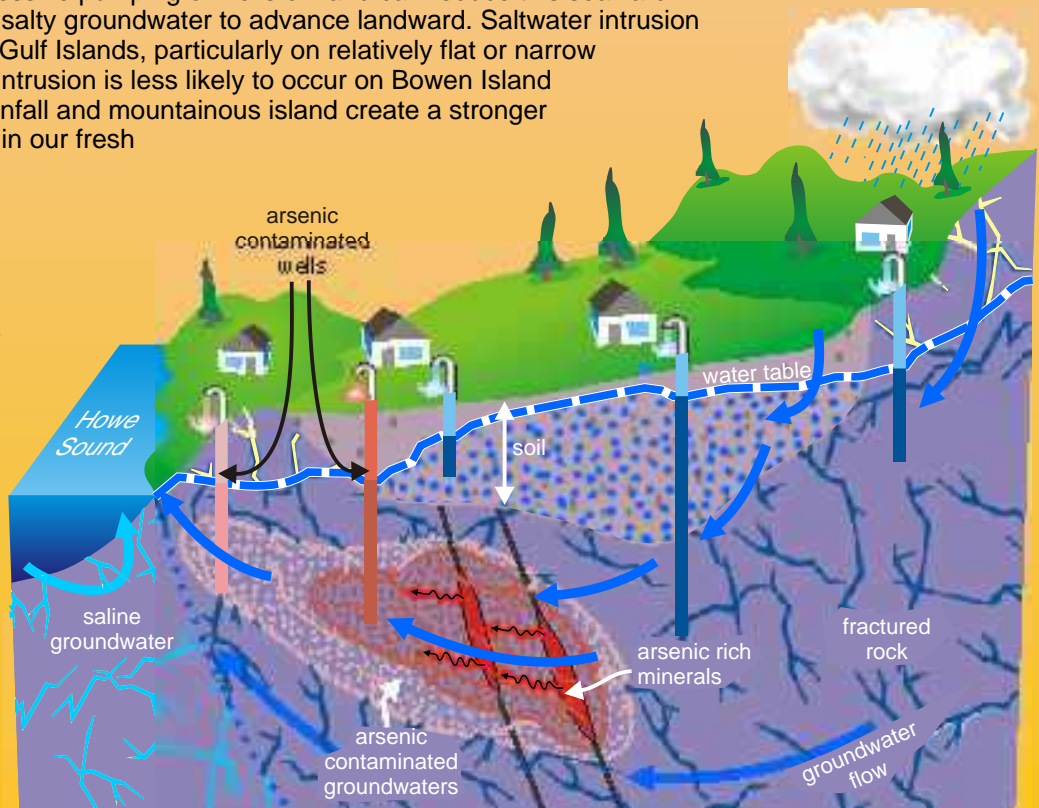



Coastal invasion: Salt water intrusion


Salt water intrusion occurs when the boundary between salty groundwater below the ocean and fresh groundwater below the land shifts landward, resulting in coastal water wells becoming salty. This boundary is dynamic and held in position by the pressure of higher elevation fresh groundwater pushing seaward. Excessive pumping of wells on land can reduce this seaward pressure, allowing the salty groundwater to advance landward. Saltwater intrusion is an issue on several Gulf Islands, particularly on relatively flat or narrow peninsulas. Saltwater intrusion is less likely to occur on Bowen Island because our higher rainfall and mountainous island create a stronger seaward pressure within our fresh groundwater system.

"Natural groundwater contamination: arsenic

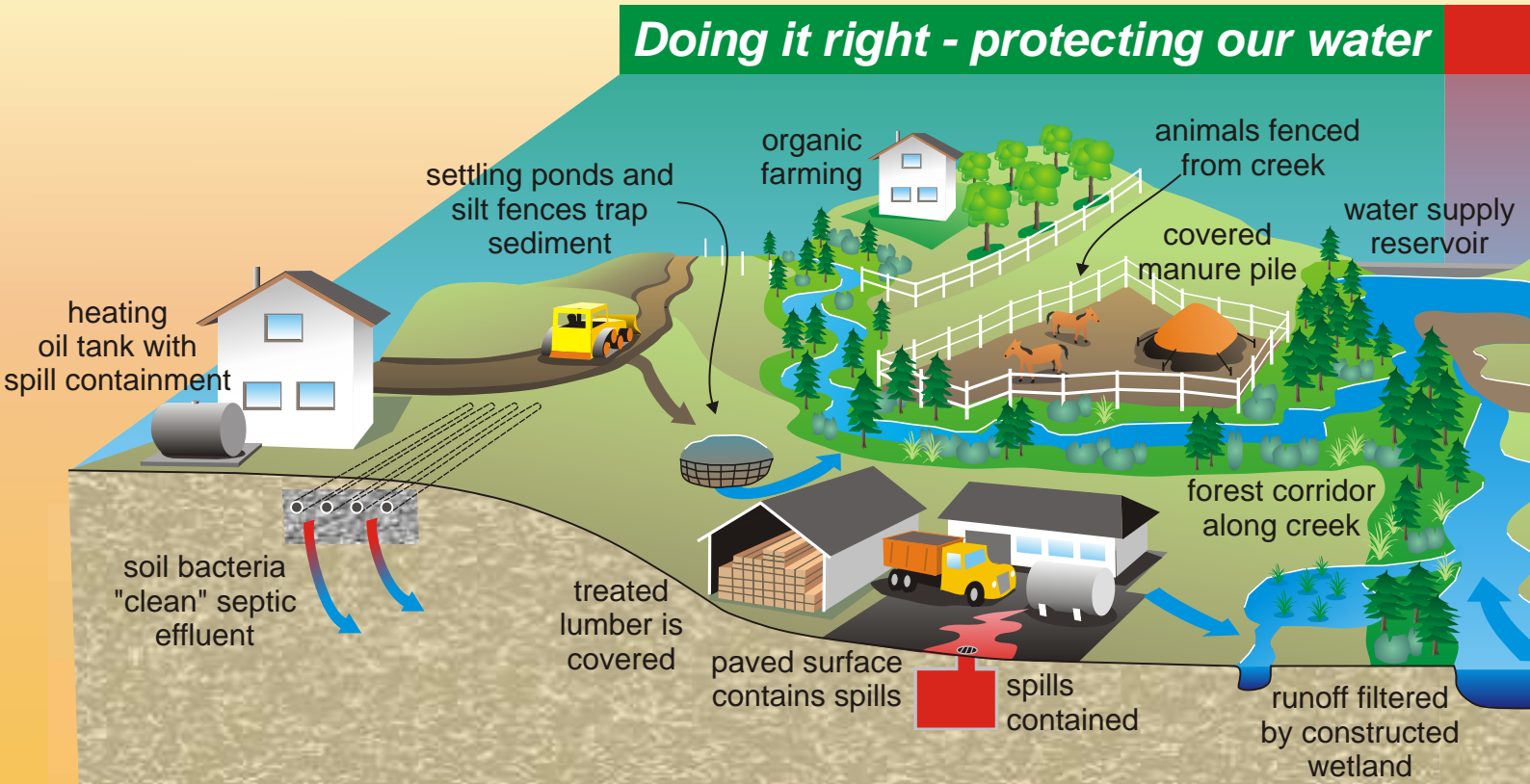
Arsenic occurs naturally as minerals in the rock of Bowen Island, as it does elsewhere. The distribution of arsenic minerals is highly variable. Where it is abundant, it contaminates nearby groundwater. Drinking water with elevated levels of arsenic is a health hazard. Many wells on Bowen Island contain some arsenic; a few wells exceed allowable arsenic levels and are not permitted as a source of potable water.



 high concentration of arsenic in groundwater

 moderate concentration of arsenic in groundwater

Reducing risks: protecting water quality



Protecting our clean water factory

We are a small island with a growing population. We are blessed with extensive forest lands, our clean water factory. Protecting this green infrastructure is vital. In developed areas, we need to commit to "best practices" to minimize the risk of contamination.

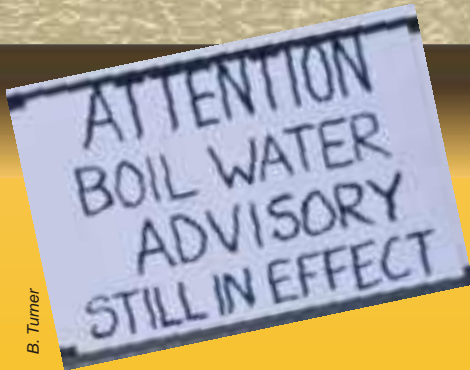
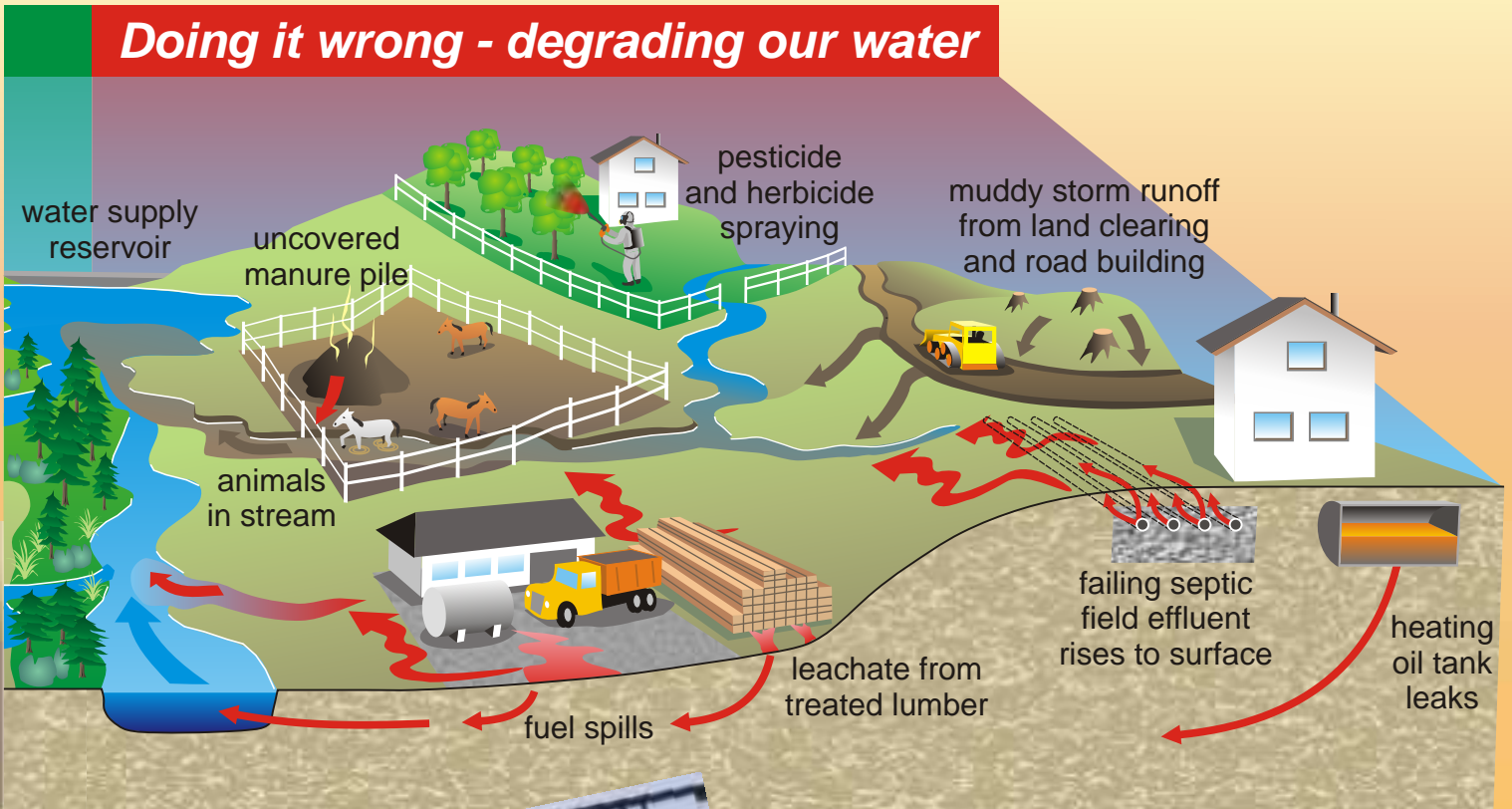


Killarney Lake valley from Rivendell

B. Turner

Reducing risks: protecting water quality

Doing it wrong - degrading our water



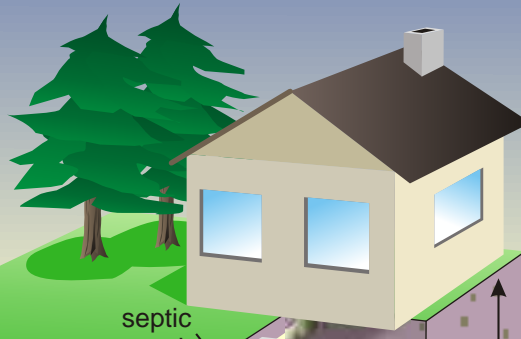
B. Turner

So what's the problem?

We can learn from past mistakes. Turbidity is a problem for many water systems - its source is road construction, land clearing, and poor storm water management. Failed septic systems and poor livestock practices can lead to bacterial contamination. Leaks from buried fuel tanks, fuel spills, and illegal burn piles have locally contaminated groundwater. We should also be concerned about risks from herbicides and pesticides.

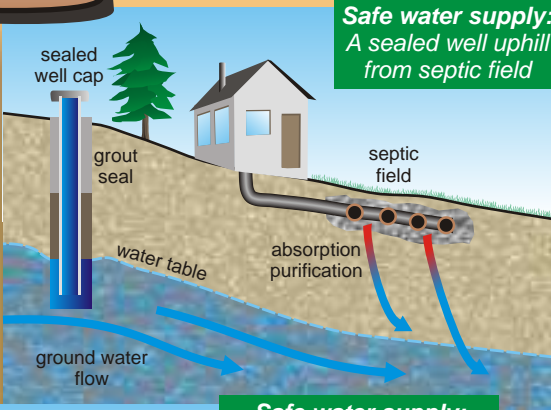
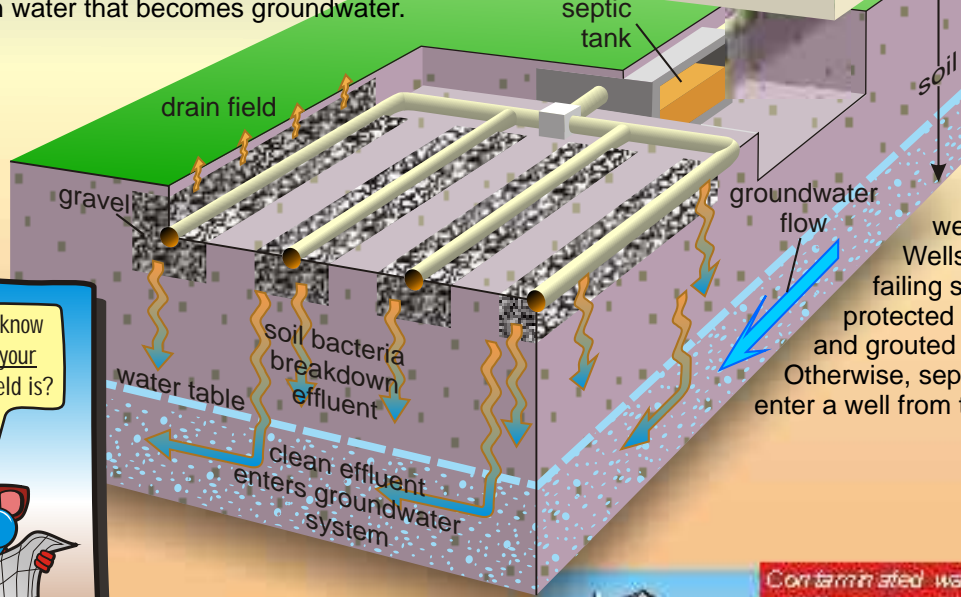
Your septic field: a friend that needs maintenance

Septic fields are safe, economical, low maintenance facilities for sewage disposal on Bowen. But they do need an annual check. Waste water flows into a tank where solids are trapped and bacteria break down wastes. Liquids flow into the drain field and percolate into the soil. Soil bacteria purify the effluent, producing clean water that becomes groundwater.

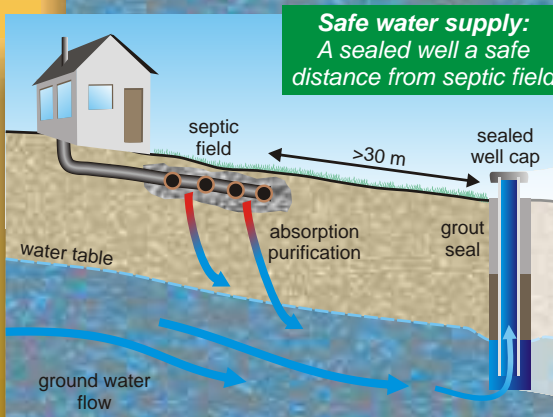
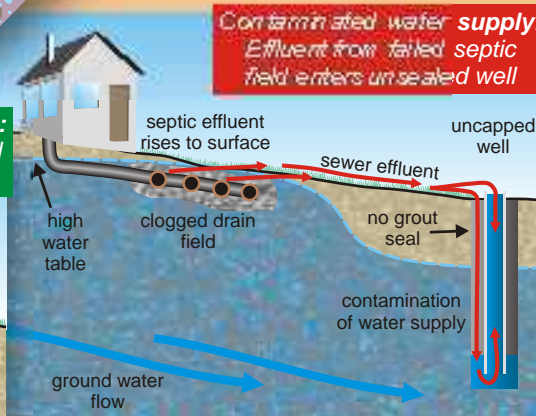


When things go wrong.

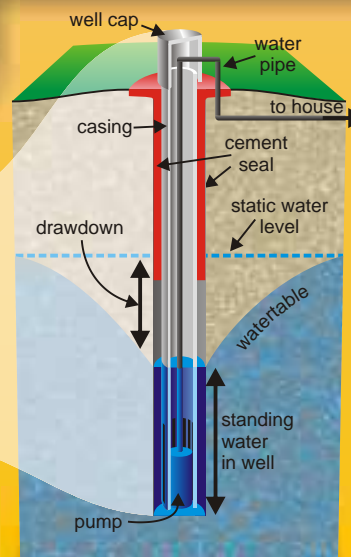
Septic fields fail when drain fields clog and septic effluent rises to the surface and flows overland, contaminating wells and streams. Wells downhill from a failing septic field are only protected if they are capped and grouted properly. Otherwise, septic effluent can enter a well from the surface.



Safe water supply:
A sealed well uphill from septic field



Safe water supply:
A sealed well a safe distance from septic field



Is your well protected?

Trouble occurs when contaminated surface water leaks down into wells. To prevent this, properly sealed wells have grout injected between the well casing (steel pipe in the upper well) and the well wall, and a cap is placed on the top of the casing. However, many wells are not properly sealed. Is yours?

Healthy forests provide the best water supply protection



B. Turner



B. Turner

The Cove Bay water supply intake is in Grafton Lake

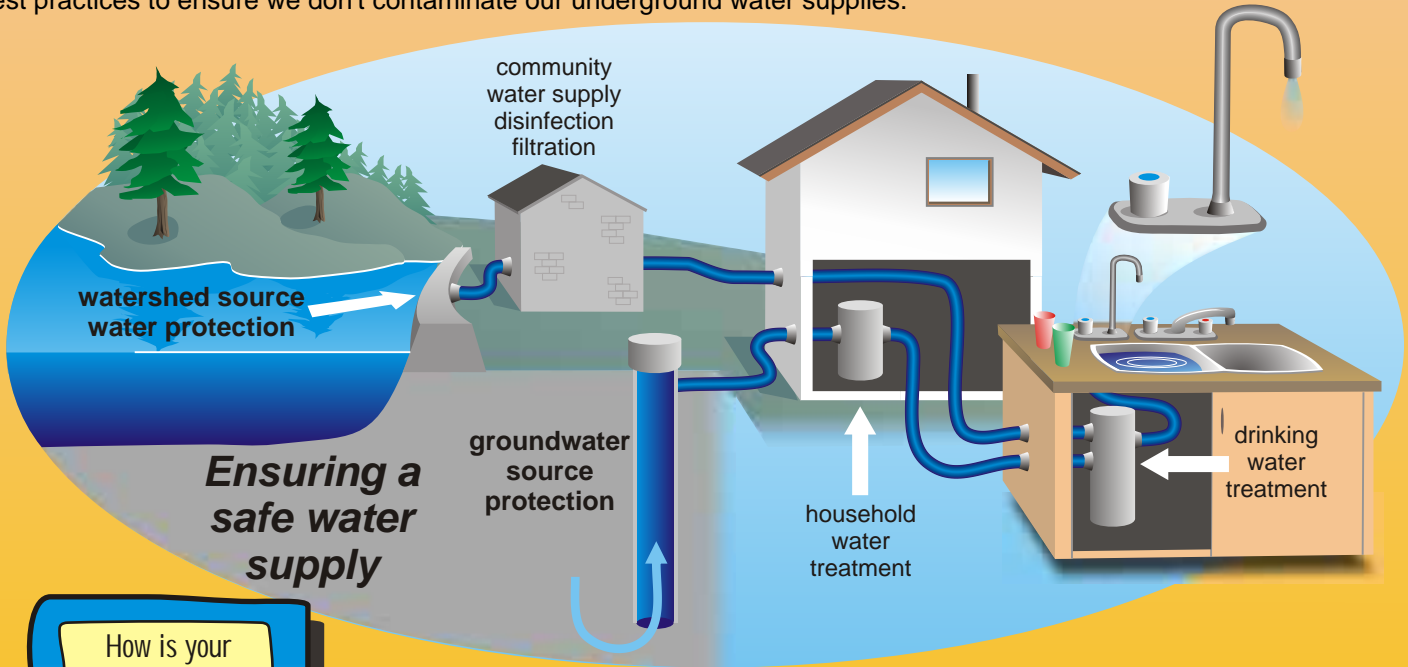


B. Turner

Many areas on Bowen Island are groundwater protection areas.

Source water protection is cost effective

Many jurisdictions in North America have decided that source water protection is the most cost effective way to protect their water supply. On Bowen Island we need to protect lands within our water supply watersheds. Our forested mountains and uplands, much of which are Crown Lands, are essential parts of many island water supply watersheds. We also need to protect our valley aquifers which underlie much of the developed area of Bowen Island. In this regard, many of us live on our water supply. It is extremely difficult to clean a contaminated aquifer. So we all need to use best practices to ensure we don't contaminate our underground water supplies.



Water treatment

Protecting water quality in source areas is our first line of defense. Beyond that, community water systems use disinfection (chlorination, ultraviolet radiation) to kill bacteria, viruses, and *Giardia* cysts, and filtration to remove turbidity that interferes with the sterilization process. Some homeowners on wells treat water to remove dissolved minerals such as calcium (hardness), iron, manganese, or arsenic.



Living with summer drought: Ideas for conserving water

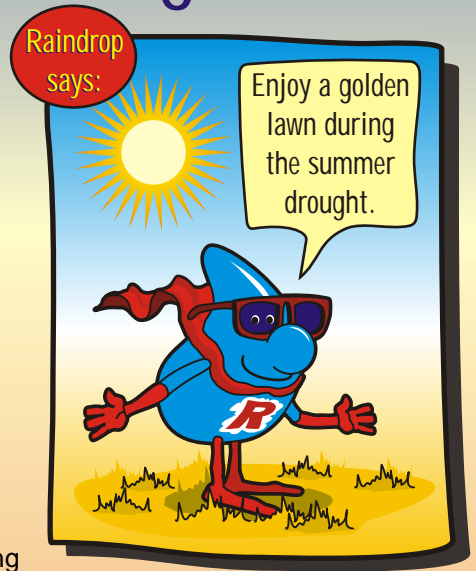


Low water at Josephine Lake, September, 2002



B. Turner

B. Turner



Thirsty lawns and gardens

Why should we conserve water?

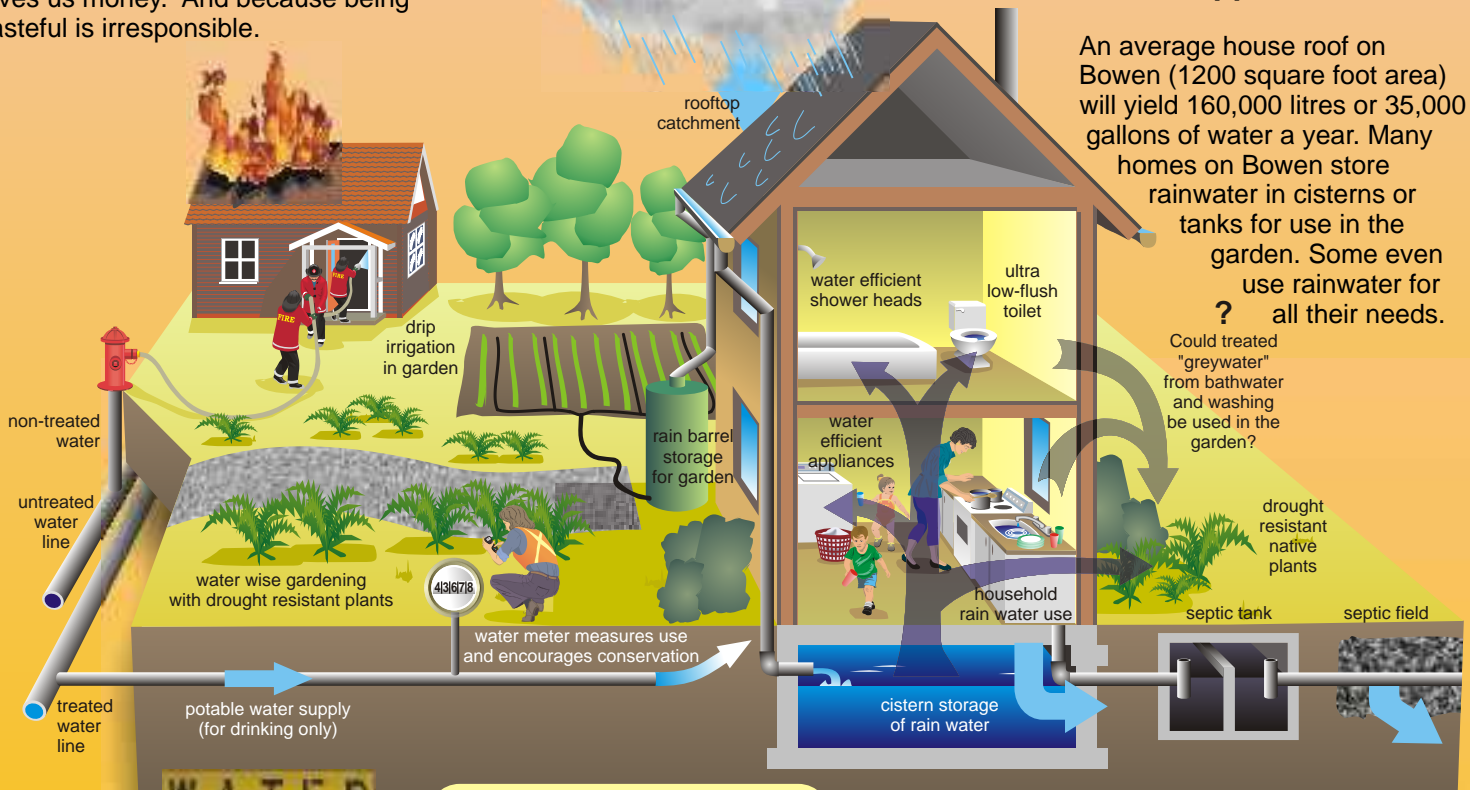
So our neighbours and ourselves don't run short. So we don't deplete our groundwater storage. So stream, lake, and wetland water levels aren't lowered unnecessarily, damaging their ecosystems. Because it saves us money. And because being wasteful is irresponsible.

Outdoor water use, primarily gardening, increases Vancouver's water use by 30% during the summer. Lawns are incredibly thirsty, using four times as much as anything else in the garden. But this need not be. There are many beautiful gardens of native, drought-tolerant plants. Sprinklers can be replaced by efficient drip systems.

Rooftop rainwater: the untapped resource

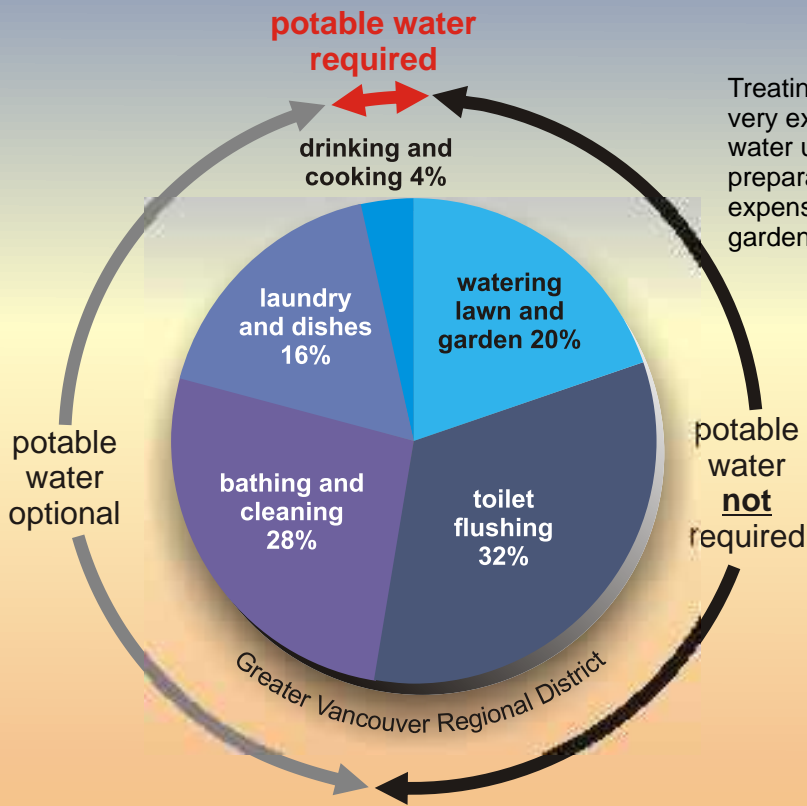
An average house roof on Bowen (1200 square foot area) will yield 160,000 litres or 35,000 gallons of water a year. Many homes on Bowen store rainwater in cisterns or tanks for use in the garden. Some even use rainwater for all their needs.

Could treated "greywater" from bathwater and washing be used in the garden?



The leak detective - the water meter

Installing a water meter is the fastest way to detect leaks. A leaking toilet can waste 90 gallons (400 litres) a day.

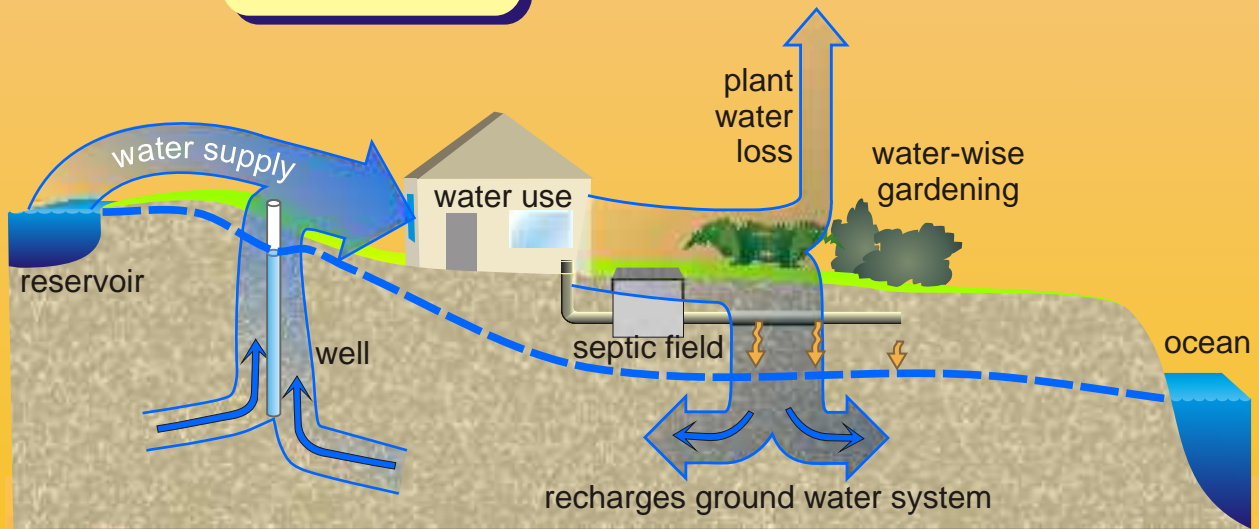


That was an expensive flush!

Treating water to meet drinking water standards can be very expensive. Yet only 10% of our average household water use requires potable water for drinking, food preparation, and kitchen washing. We use this expensive treated water to flush toilets, water our gardens, wash the car, even fight fires!



Miserly toilets
Ultra-low flush toilets decrease water use by 40%! That really saves on the water bill.



Septic fields recharge groundwater storage

Most water used by households with septic fields returns to the groundwater system. We use the water, but we return it to the earth. This is good management. In contrast, sewer systems export water to ocean, depleting groundwater storage.

**Waterscape Bowen Island
water for our island community**
Geological Survey of Canada
Miscellaneous Report 88, 2005

Production: Robert Turner and Richard Franklin
Illustration and graphic design: Richard Franklin and Robert Turner
Three-dimensional image of Bowen Island: Ryan Grant
Reviewers: Diana Allen, Ed Livingstone, Mike Wei
Advisory Committee: Stacey Beamer, DG Blair-Whitehead, Ross Carter, Andre Chollat, Julian Dunster, Anne Franc de Ferriere, Bill Hamilton, Ian Henley, Dave Hocking, Will Husby, Murray Journeay, Denison Mears, John Reid, Mallory Smith, Ian Thomson, Bob Turner, Dick Underhill, Alan Whitehead, Dave Wrinch, Dave Yeager.

Suggested citation

Turner, R.J.W., Franklin, R.G., Journeay, J. M., Hocking, D., Franc de Ferriere, A., Chollat, A., Dunster, J., Whitehead, A., Whitehead, D.G., 2003, Waterscape Bowen Island water for our island community. Geological Survey of Canada Miscellaneous Report 88, 2004.



The community advisory committee discussing a draft of the Bowen Waterscape poster



B. Turner

The Bowen Island Waterscape poster was developed by Natural Resources Canada, with the support of its partners, to test the idea of community-based water resource posters. The experience gained in the process of community engagement, and in the development of the poster's content and design, has influenced subsequent water posters in other communities, including the Gulf Islands, Sunshine Coast, and Calgary region.

Want to know more?

The *Waterscape Bowen Island poster* is on the internet at www.bowenland.info/waterscapes and www.geoscape.nrcan.gc.ca

The Waterscape Bowen Island poster is available from the Geological Survey of Canada Map and Publication Sales Office at 101-605 Robson Street, Vancouver, B.C. V6B 5J3. Phone 604-666-0271. Fax 604-6661337

Maps of Bowen wells, streams, water licences, wetlands, and much more? The Bowen Island Geolibary CD, 2002. www.bowenland.info, Bowen Island Forest & Water Management Society (604-947-0016)

Bowen Island water systems? Public works superintendent, Bowen Island Municipality 604 947-4255.

Local help? Check the Bowen Island telephone directory.

Groundwater <http://wlapwww.gov.bc.ca/wat/gws/>



B. Turner

This booklet is derived from the "Waterscape Bowen Island" water poster. Look for the poster around the island.