Groundwater Wells

Construction, Maintenance and Troubleshooting

Presentation Material Courtesy of:

Alberta Food & Agriculture

Alberta Environment - Working Well Program

Prairie Farm Rehabilitation Administration

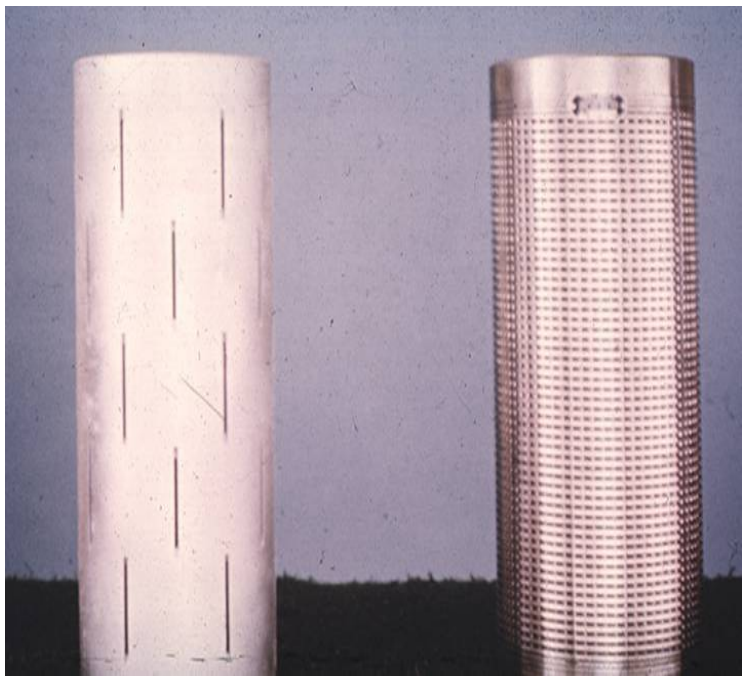
Alberta Water Well Drilling Association

Outline

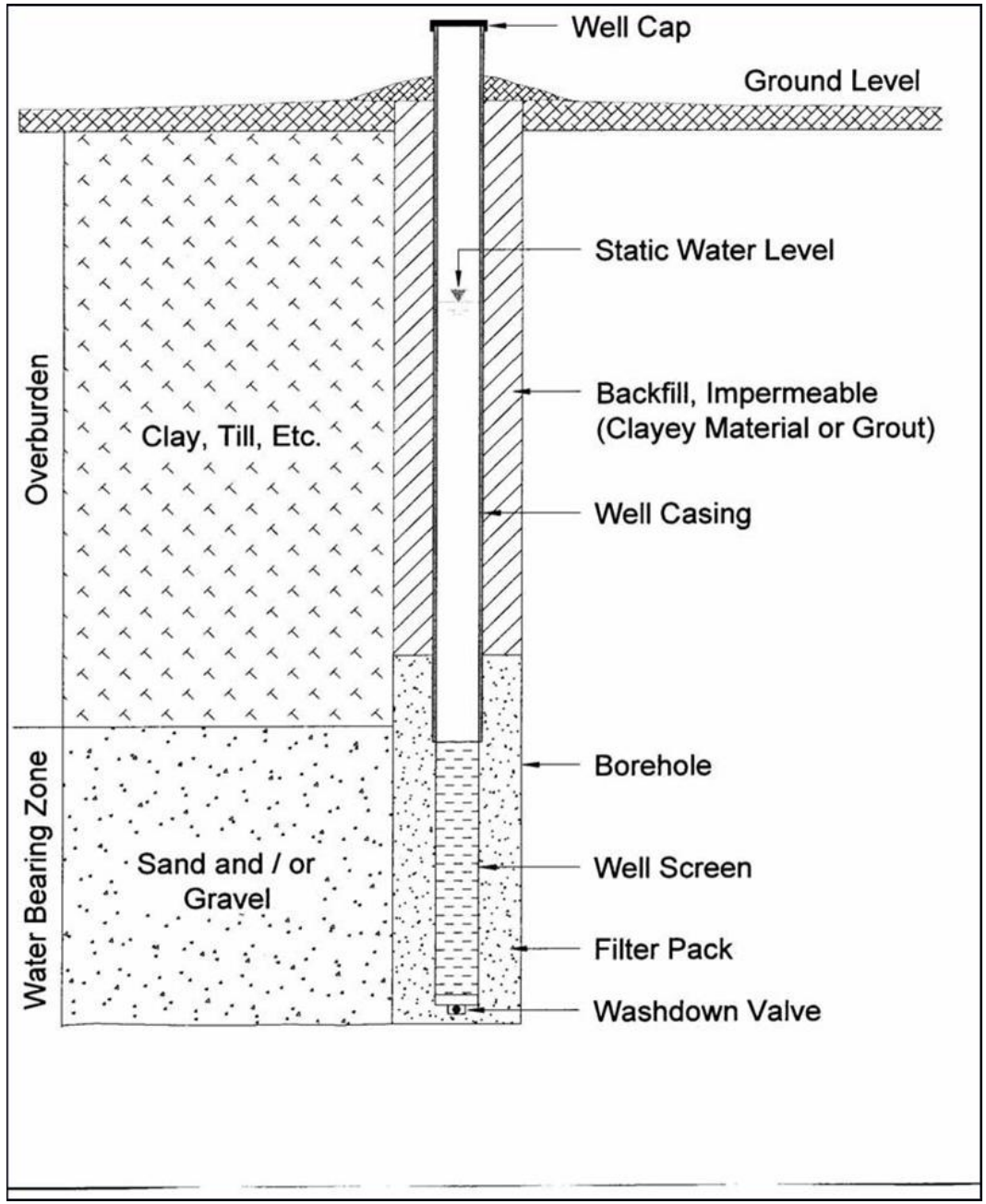
- Well Components
- Understanding the Cause of Well problems
- Preventing/Resolving Well problems
- Diagnosing Well Problems

Well Components/Well Construction

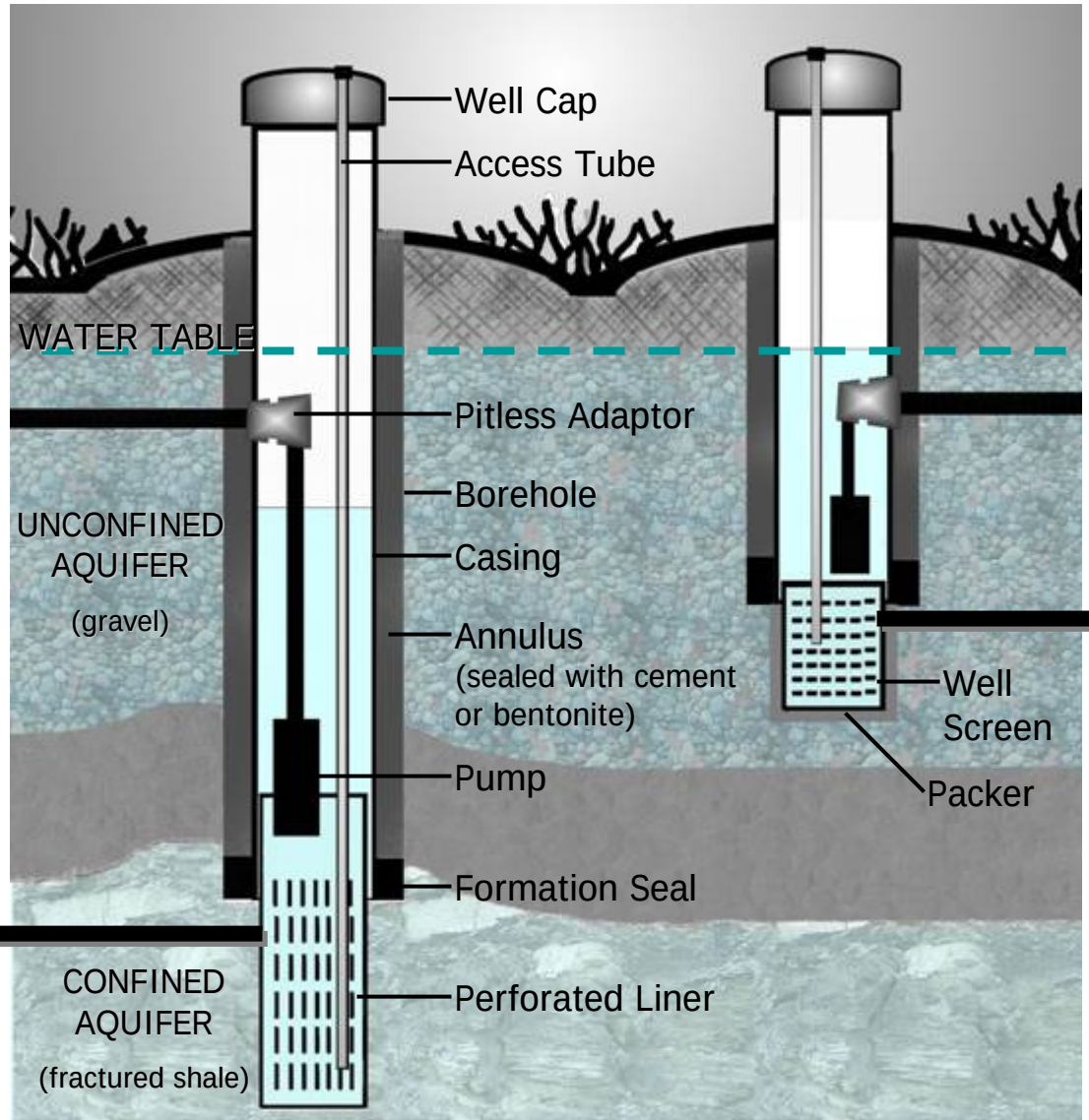
Typical Drilled Well Construction with Screen

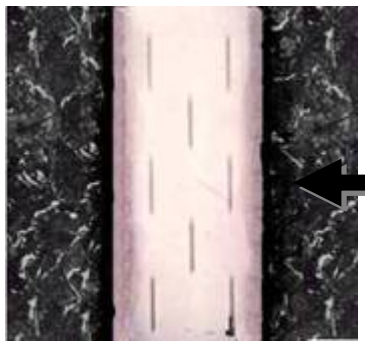


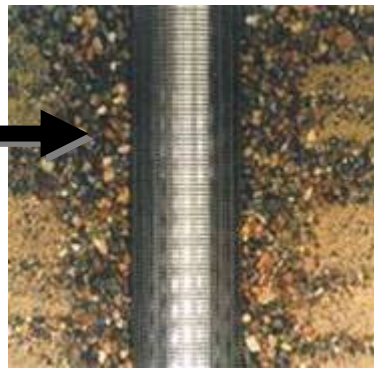
Well Screens



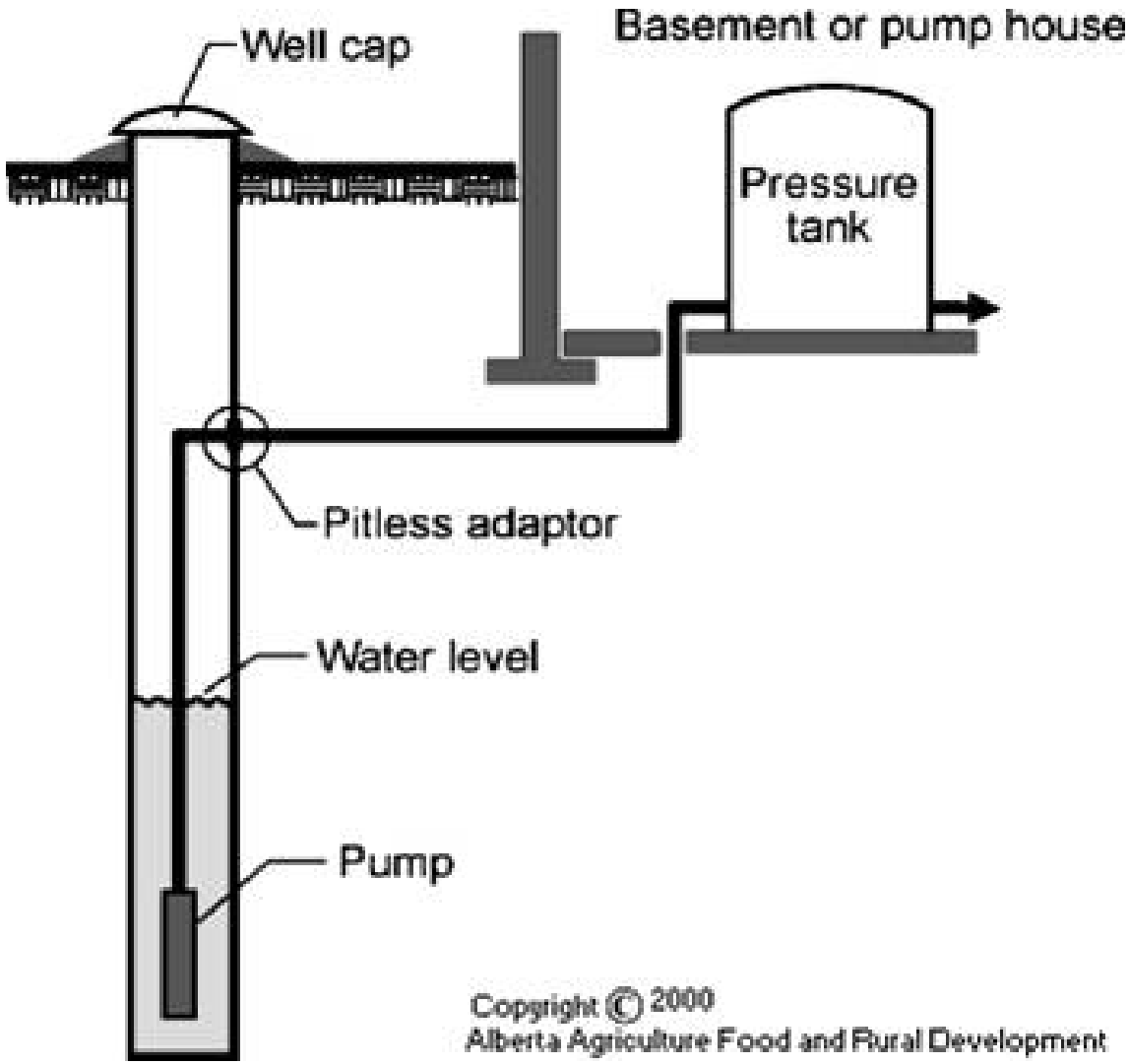
Parts of a Drilled Well





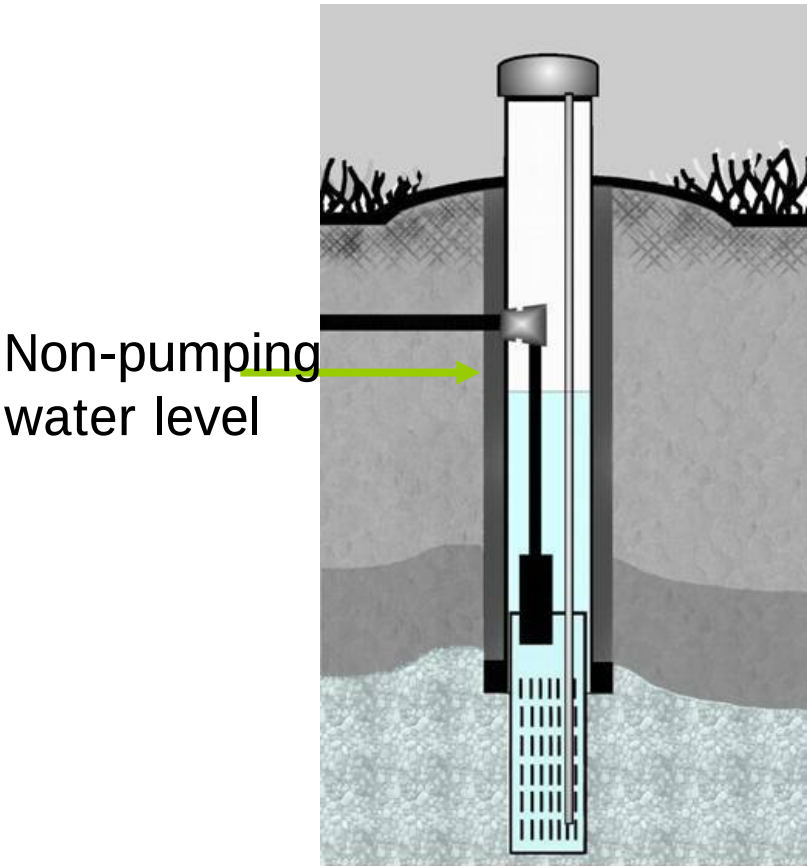


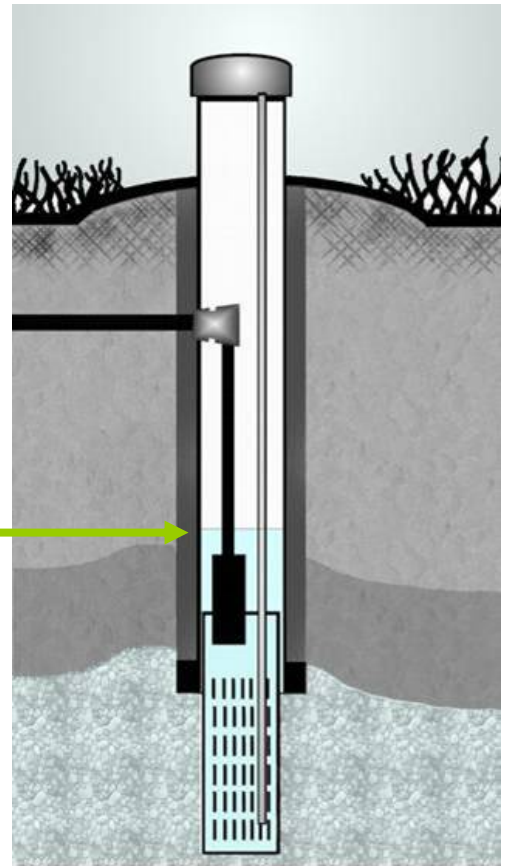
Water System



Static (Non-pumping) Water Level

Pumping Water Level

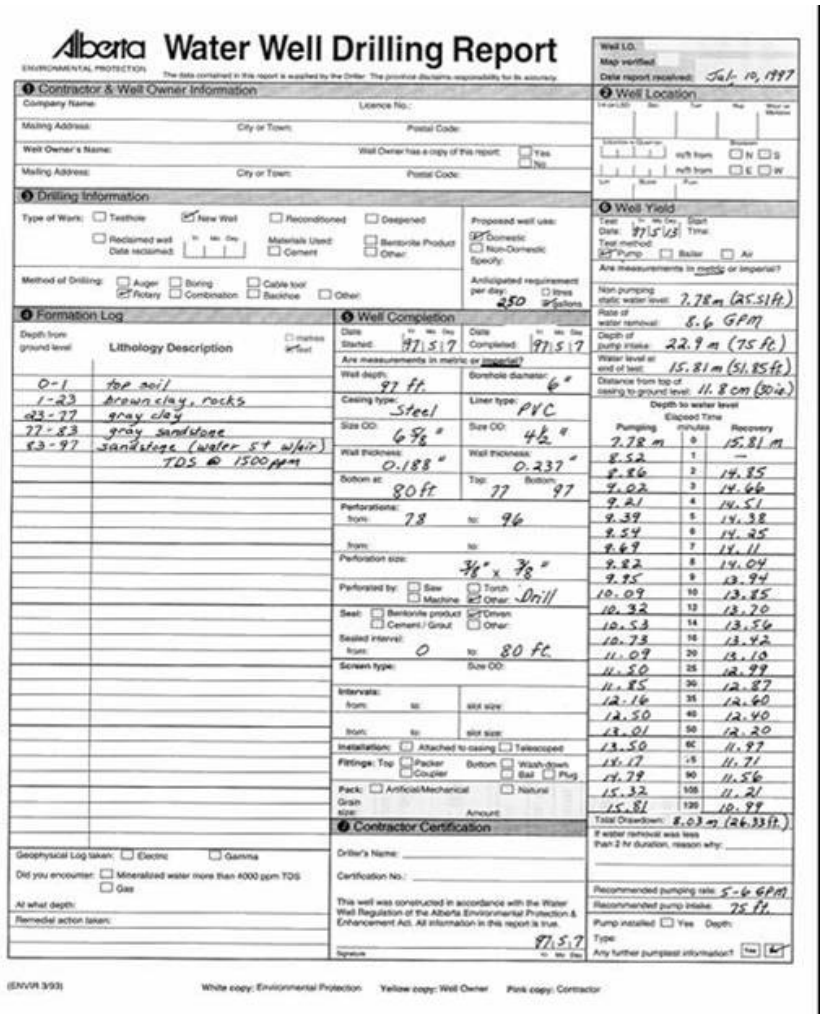




Following well construction it is important to;

-Develop the well to remove fine sediment and drilling fluids
-Correctly perform a yield test to determine the pumping rate and to determine the depth at which the pump should be placed – an ideal pump rate will keep the water level above the screened area of the well
-Obtain the drillers report

Surge Block



Alberta Water Well Drilling Report

ENVIRONMENTAL PROTECTION

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.
Map verified
Date report received: July 10, 1997

1 Contractor & Well Owner Information

Company Name: Licence No.:
Mailing Address: City or Town: Postal Code:
Well Owner's Name: Well Owner has a copy of this report: ☐ Yes ☐ No
Mailing Address: City or Town: Postal Code:

2 Drilling Information

Type of Work: ☐ Testhole ☑ New Well ☐ Reconditioned ☐ Deepened ☐ Reclaimed well Date reclaimed: Yr Mo Day
Materials Used: ☐ Cement ☐ Bentonite Product ☐ Other:
Proposed well use: ☑ Domestic ☐ Non-Domestic Specify:
Method of Drilling: ☐ Auger ☐ Boring ☐ Cable tool ☑ Rotary ☐ Combination: ☐ Backhoe ☐ Other:
Anticipated requirement per day: 250 ☐ litres ☑ gallons

3 Formation Log

Depth from (ground level) ☐ metres ☑ feet

Depth from (ground level)	Lithology Description
0-1	top soil
1-23	brown clay, rocks
23-77	gray clay
77-83	gray sandstone
83-97	sandstone (water 5' w/air) TDS @ 1500 ppm

Geophysical Log taken: ☐ Electric ☐ Gamma
Did you encounter: ☐ Mineralized water more than 4000 ppm TDS ☐ Gas
At what depth:
Remedial action taken:

4 Well Completion

Date Started: Yr 97 Mo 5 Day 7 Date Completed: Yr 97 Mo 5 Day 7
Are measurements in metric or imperial?
Well depth: 97 ft. Borehole diameter: 6"
Casing type: Steel Liner type: PVC
Size OD: 6 5/8" Size OD: 4 1/2"
Wall thickness: 0.188" Wall thickness: 0.237"
Bottom at: 80 ft Top: 77 Bottom: 97
Perforations: from: 78 to: 96
from: to:
Perforation size: 3/8" x 3/8"
Perforated by: ☐ Saw ☐ Torch ☐ Machine ☑ Other: Drill
Seal: ☐ Bentonite product ☑ Driven ☐ Cement / Grout ☐ Other:
Sealed interval: from: 0 to: 80 ft.
Screen type: Size OD:
Intervals: from: to: slot size:
from: to: slot size:
Installation: ☐ Attached to casing ☐ Telescoped
Fittings: Top ☐ Packer ☐ Coupler Bottom ☐ Wash-down ☐ Ball ☐ Plug
Pack: ☐ Artificial/Mechanical ☐ Natural
Grain size: Amount:

5 Contractor Certification

Driller's Name:
Certification No.:
This well was constructed in accordance with the Water Well Regulation of the Alberta Environmental Protection & Enhancement Act. All information in this report is true.
Signature: Yr 97 Mo 5 Day 7

6 Well Location

Lot or L.SD Sec Twp Rng West or Meridian
Subdivision or Quarter
m/ft from ☐ N ☐ S
m/ft from ☐ E ☐ W
Lot Block Plan

7 Well Yield

Test Date: Yr 97 Mo 5 Day 13 Start Time:
Test method: ☑ Pump ☐ Bailer ☐ Air
Are measurements in metric or imperial?
Non-pumping static water level: 7.78 m (25.51 ft.)
Rate of water removal: 8.6 GPM
Depth of pump intake: 22.9 m (75 ft.)
Water level at end of test: 15.81 m (51.85 ft.)
Distance from top of casing to ground level: 11.8 cm (30 in.)

Depth to water level

Pumping	Elapsed Time minutes	Recovery
7.78 m	0	15.81 m
8.52	1	—
8.86	2	14.85
9.02	3	14.66
9.21	4	14.51
9.39	5	14.38
9.54	6	14.25
9.69	7	14.11
9.82	8	14.04
9.95	9	13.94
10.09	10	13.85
10.32	12	13.70
10.53	14	13.56
10.73	16	13.42
11.09	20	13.10
11.50	25	12.99
11.85	30	12.87
12.16	35	12.60
12.50	40	12.40
13.01	50	12.20
13.50	60	11.97
13.17	75	11.71
14.79	90	11.56
15.32	105	11.21
15.81	120	10.99

Total Drawdown: 8.03 m (26.33 ft.)
If water removal was less than 2 hr duration, reason why:
Recommended pumping rate: 5-6 GPM
Recommended pump intake: 75 ft.
Pump installed: ☐ Yes Depth:
Type:
Any further pumptest information? Yes ☑

(ENV/R 3/93) White copy: Environmental Protection Yellow copy: Well Owner Pink copy: Contractor

Understanding the Cause of Well Problems

- Many possible causes
- Understanding the cause is necessary to prevent or fix the problem

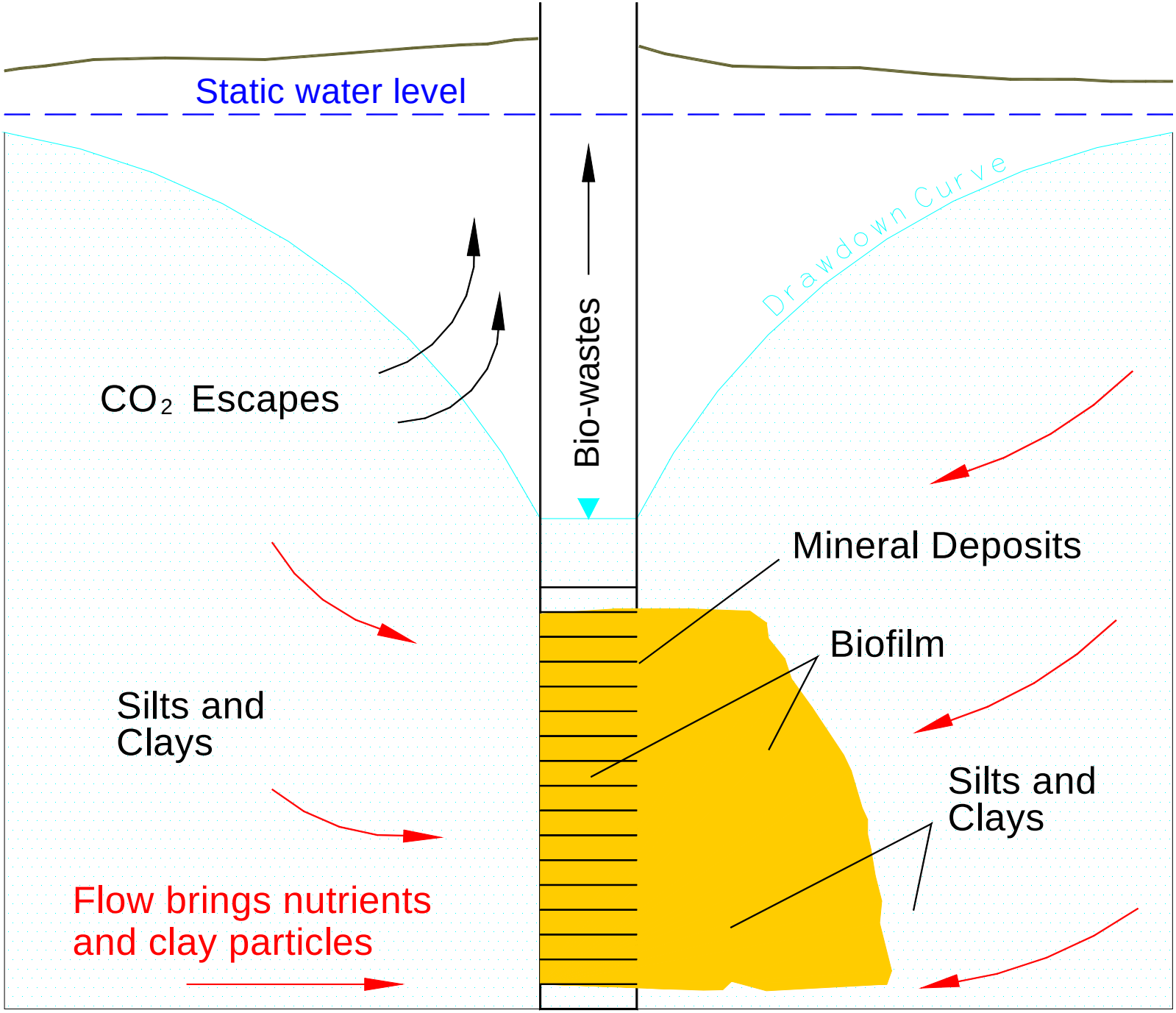
- Some causes of well problems/deterioration:
  - Bioufouling
  - Mineral Incrustation
  - Sediment plugging
  - Structural Failure (corrosion, poor construction)
  - Over-pumping
  - Aquifer Depletion
  - Well interference
  - Contamination

- Often occur in combination

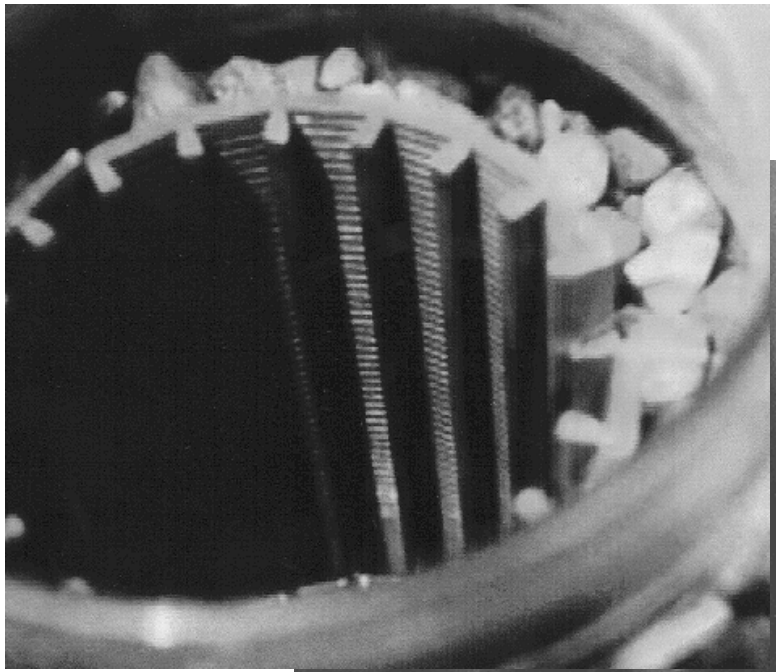
- Symptoms
  - Reduction in yield
  - Changes in water quality (i.e. changes in taste, odour, colour, chemistry, microbiology)
  - Sand or silt in water
  - Dissolved gas in water

Biofouling

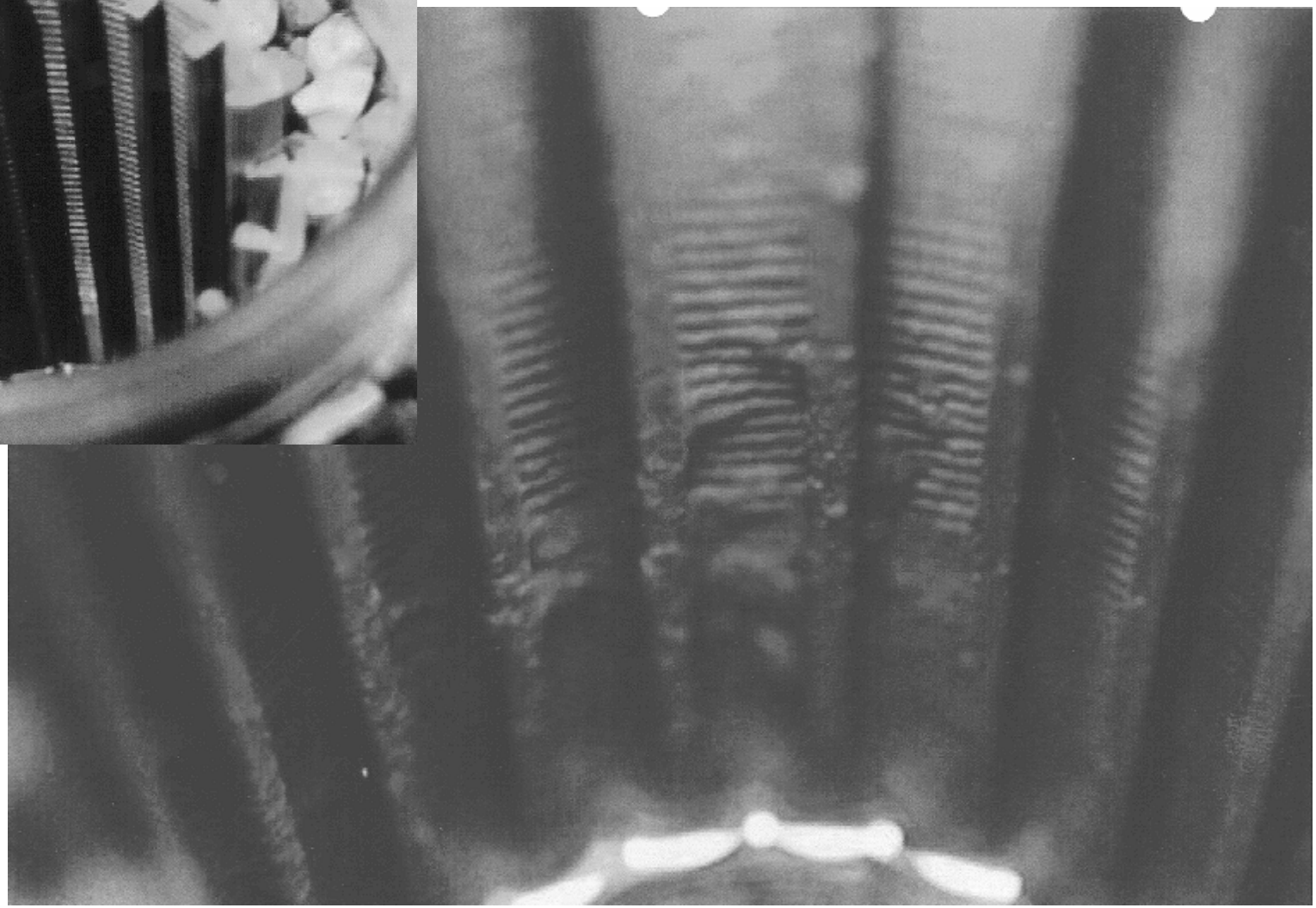
- Biofouling
  - Slime forming **bacteria** that accumulate in a well
    - Installing & pumping a well ↑ nutrients & oxygen
    - Cause ↑ bacteria
  - Plugs well
  - Decrease in water yield
  - Corrosion of metal parts
  - Impacts Water Quality


Static water level
Drawdown Curve
Bio-wastes
CO_2 Escapes
Mineral Deposits
Biofilm
Silts and Clays
Silts and Clays
Flow brings nutrients and clay particles

Clean Well Screen Vs



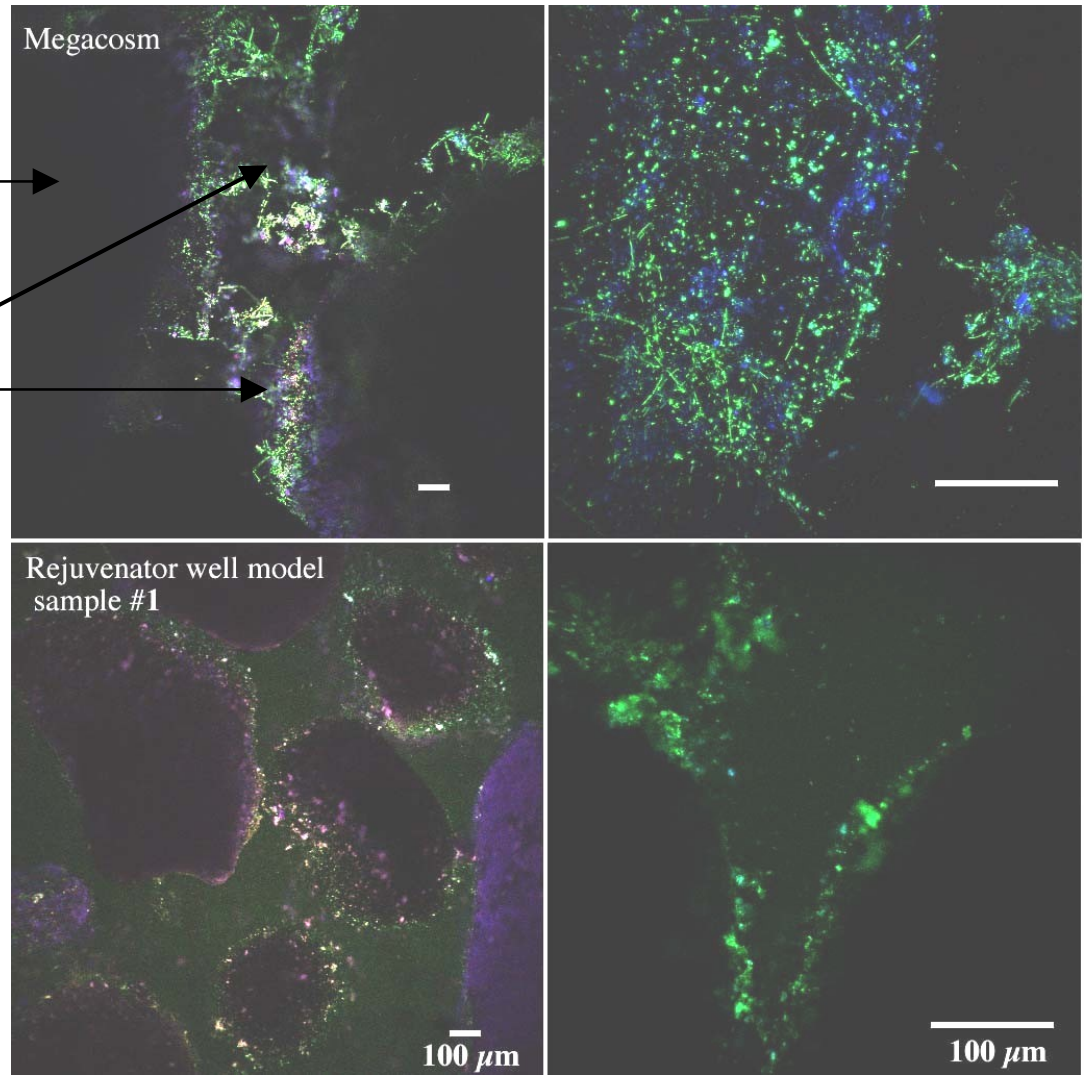
Biofouled Well Screen



Biofilm Interferes With Water Flow

Sand Grains

Biofilm



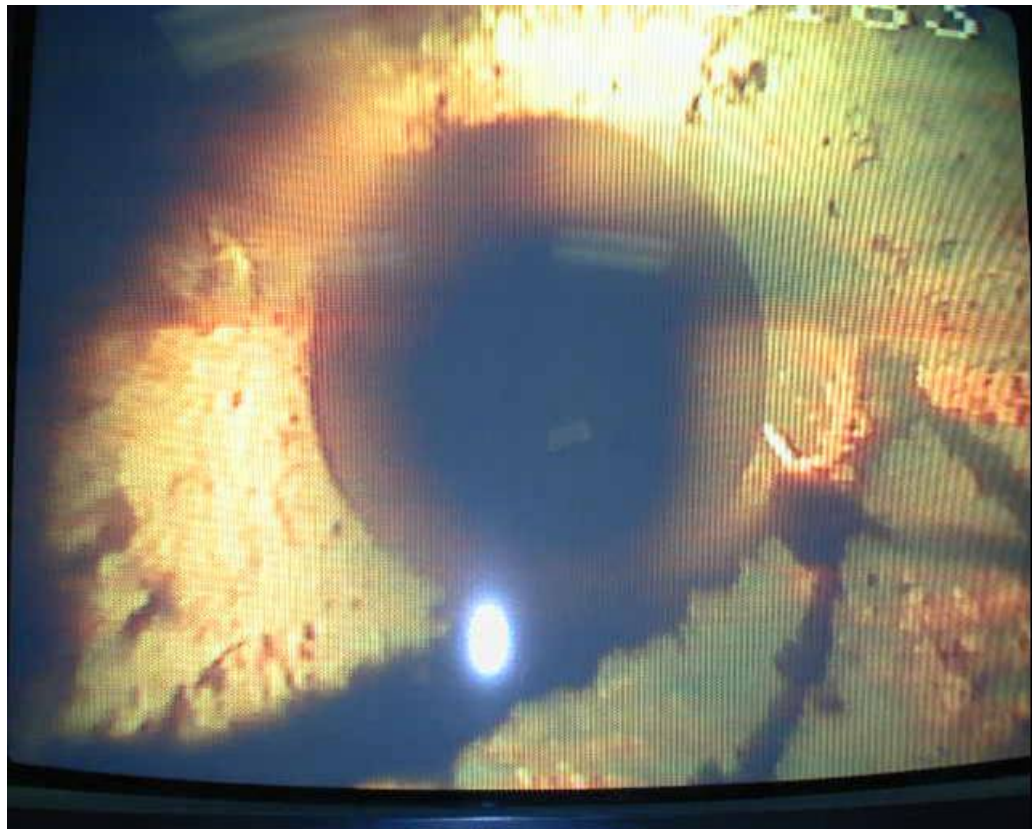
Picture Provided by Environment Canada

Biofouling

- Symptoms
  - gradual decrease in yield (lower pumping water level)
  - slime buildup on household plumbing fixtures and livestock waterers (check toilet tank)
  - changes in water quality leading to
    - staining of plumbing fixtures and laundry
    - bad taste and odour (rotten egg smell)
    - water discolouration
  - increased corrosion of stee and iron parts of the well.

Biofouling

- What to Do?
  - regular disinfection (shock chlorination)
  - may need to have well cleaned first by a well driller



Mineral Incrustation

- Mineral Incrustation
  - Build up mineral scale in your well and water system
  - Accelerated by overpumping and bacteria
  - Plugs well, decreases water yield, impacts water quality

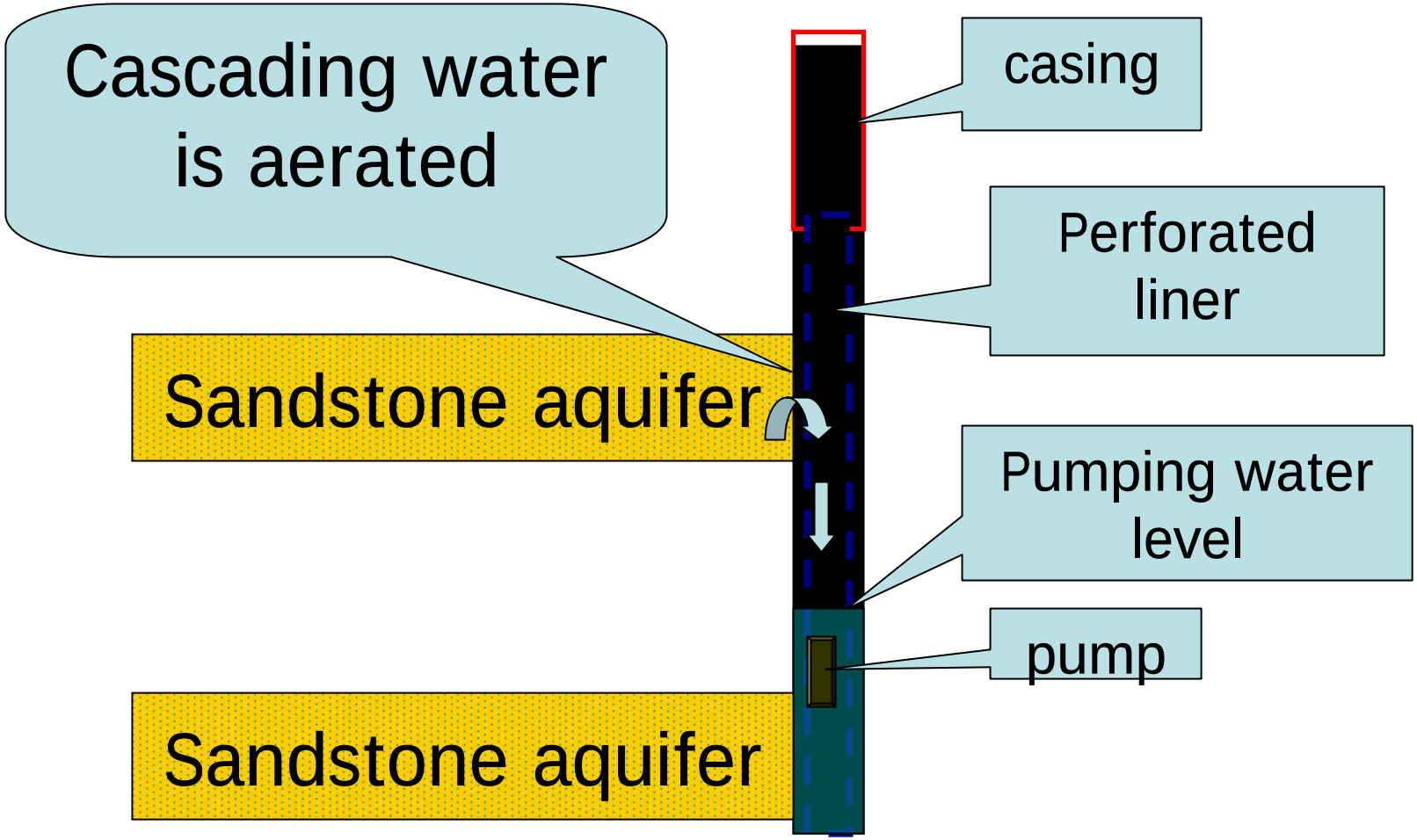
Mineral Incrustation

- Symptoms
  - Gradual decrease in yield
  - mineral scale on household plumbing fixtures and livestock waterers
  - changes in water quality

Mineral Incrustation

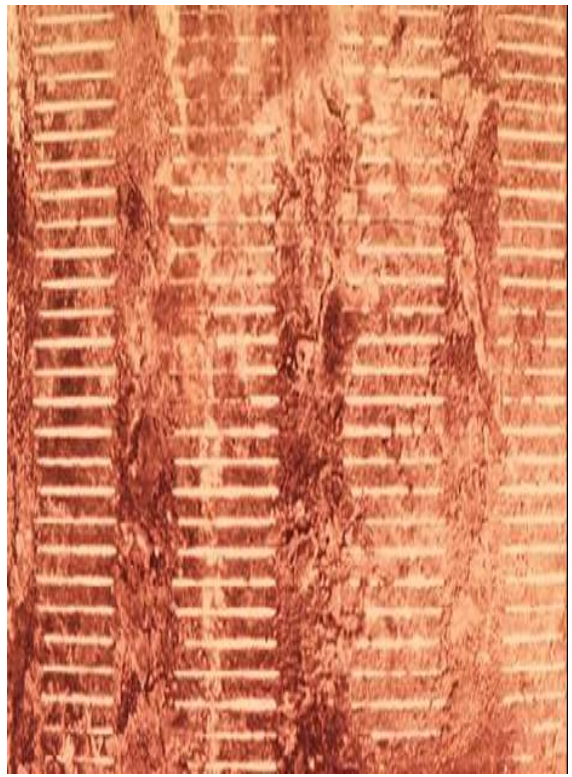
- What to Do?
  - reduce pumping rate
  - chemical analysis of water to determine risk
  - Clean the well and distribution system

Well construction affects biofouling and mineral incrustation



Sediment Plugging

- Sediment Plugging
  - Sediment plugs well screen and surrounding aquifer
  - Caused by overpumping or poor well design & construction
- Symptoms
  - Sediment in well water and Decrease in yield
- What to Do?
  - Existing wells: reduce pumping rate
  - New wells: use a qualified drilling contractor



Structural Failure

- **Corrosion**
  - Chemical substances ‘eat away’ metal casings, screens, pumps
  - Sediment enters well through holes
  - Accelerated by bacteria & cascading water
  - CO_2, O_2 & H_2S make water corrosive
- **Poor Construction**
  - Damage to pump and screen during installation
  - Poor selection and placement of gravel pack and well seal
  - Improperly sealed annulus
  - Overpumping can cause fragile wells to fail
- **Symptoms**
  - Sudden appearance of sediment in water
  - Change in water quality – high turbidity

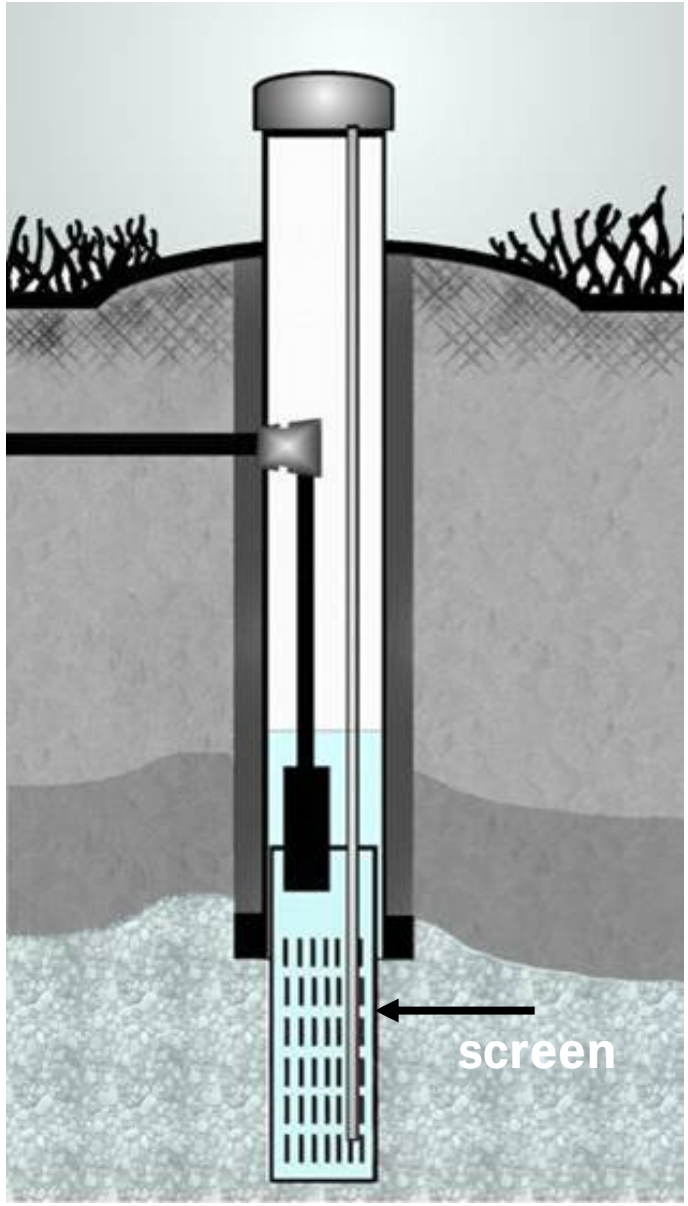
Structural Failure

- Corrosion - What to Do?
  - Regular disinfection (shock chlorination)
  - Avoid over-pumping
  - Use plastic casing liners & stainless well screens
  - Drill a new well

- Poor Construction - What to Do?
  - Prevention – ensure well is properly designed & constructed & **be prepared to pay for quality**
  - Recondition well – if not economical, plug well and re-drill new well
  - Do not over-pump well

Overpumping

- One of the most common causes of well failure
- Occurs when water is withdrawn at a faster rate then the well was designed for
- Problem increases if pump is placed below the top of the well screen and water is drawn-down below the top of the screen or slotted portion of the well



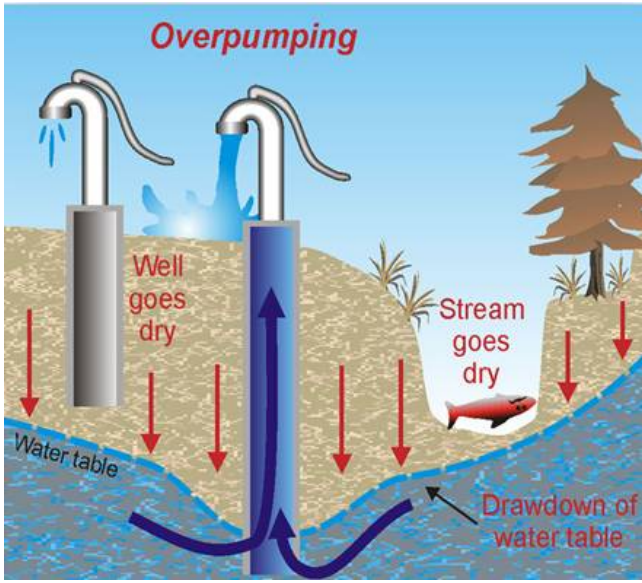
Aquifer Depletion

Indicator

- Loss in production combined with lower non-pumping water level

Cause

- Water withdrawn exceeds recharge
  - "Mining the aquifer"
  - Can be caused by overpumping



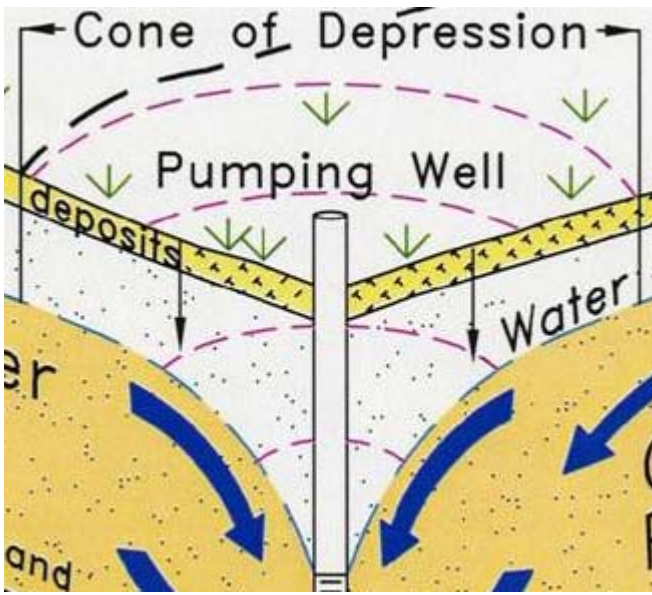
Well Interference

Indicator

- Short term fluctuation in water levels

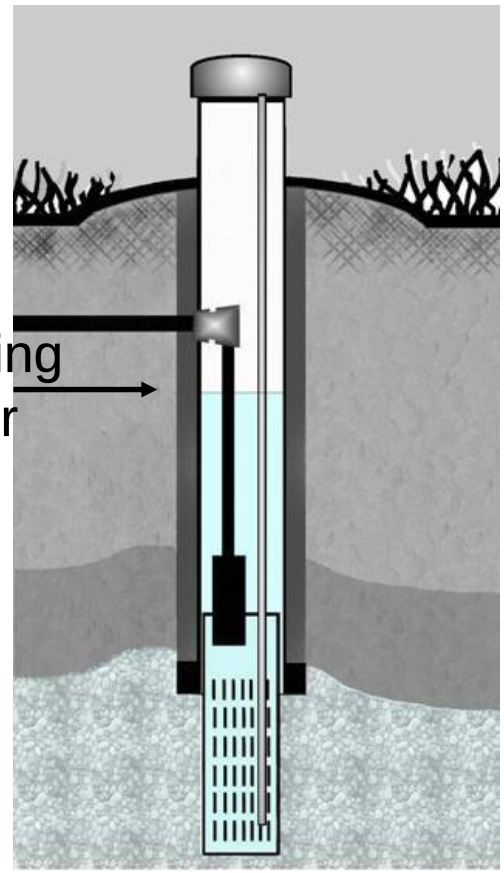
Cause

- Occurs when the cone of depression from two wells overlaps, reducing the water available to both wells



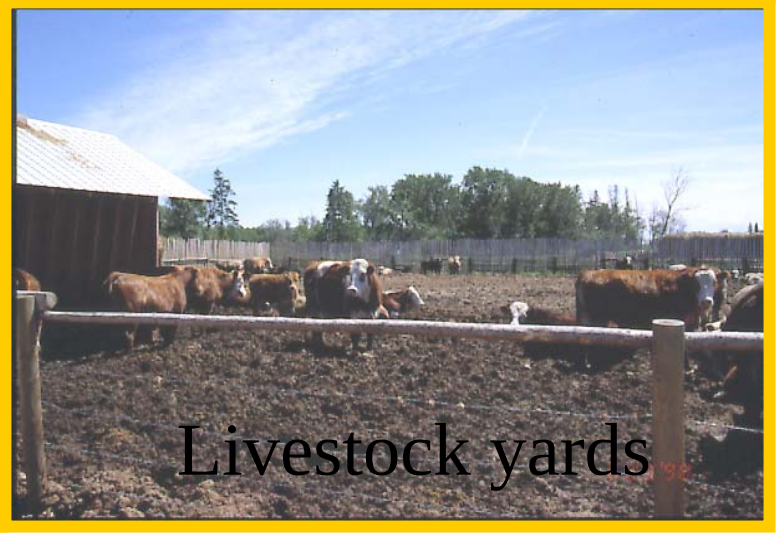
Aquifer Depletion

- Symptoms
  - Lower non-pumping (static) water level
  - Dropping water levels in nearby wells



- What to Do?
  - Regularly check static water levels
  - Reduce pumping rates & water use
  - Drill new well into deeper aquifer
  - Identify nearby wells tapped into same aquifer

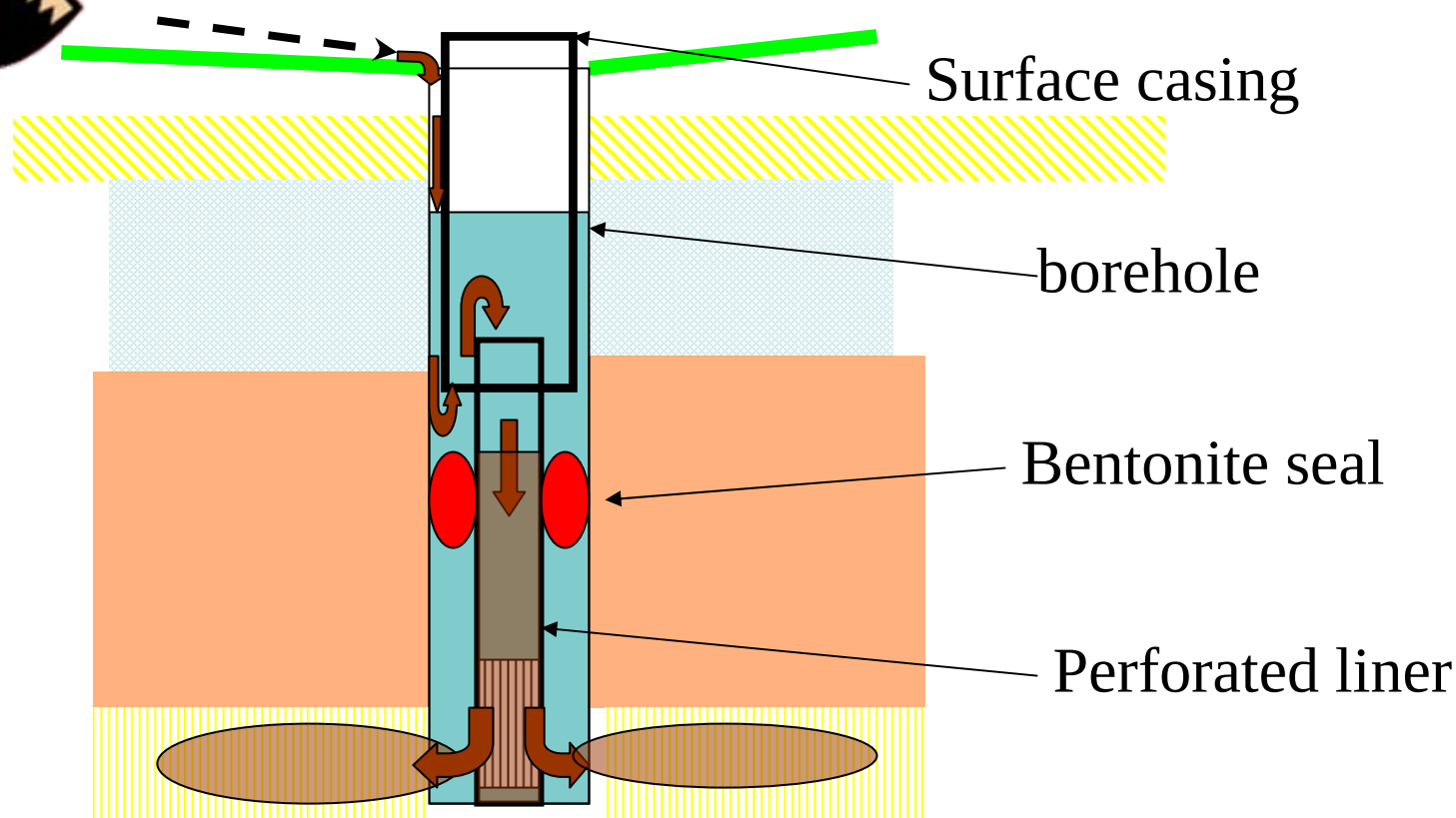
Potential Contamination Sources



Is the a well or scratching post??

Ken Williamson-AAFRD

Example of a problem well



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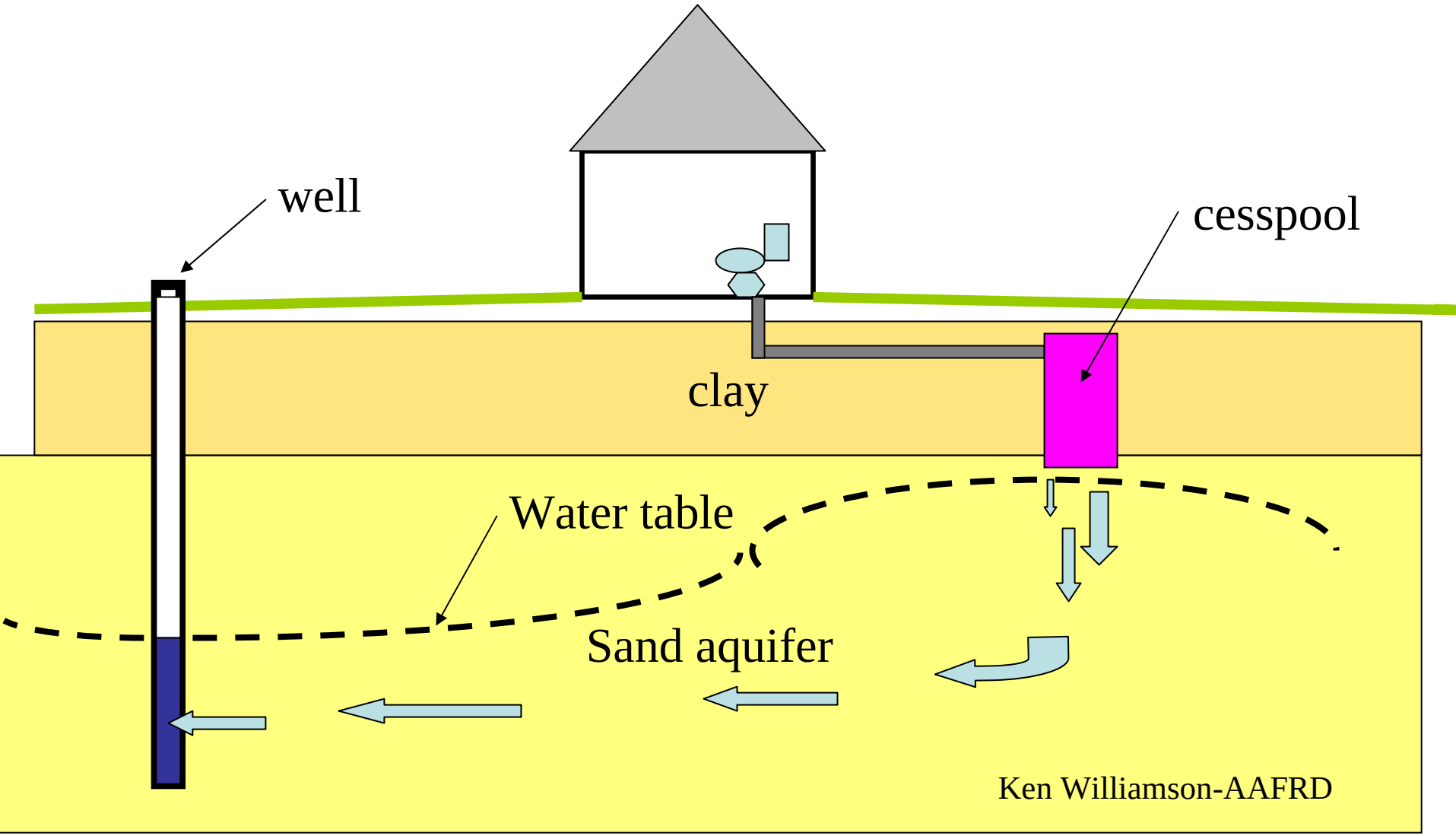
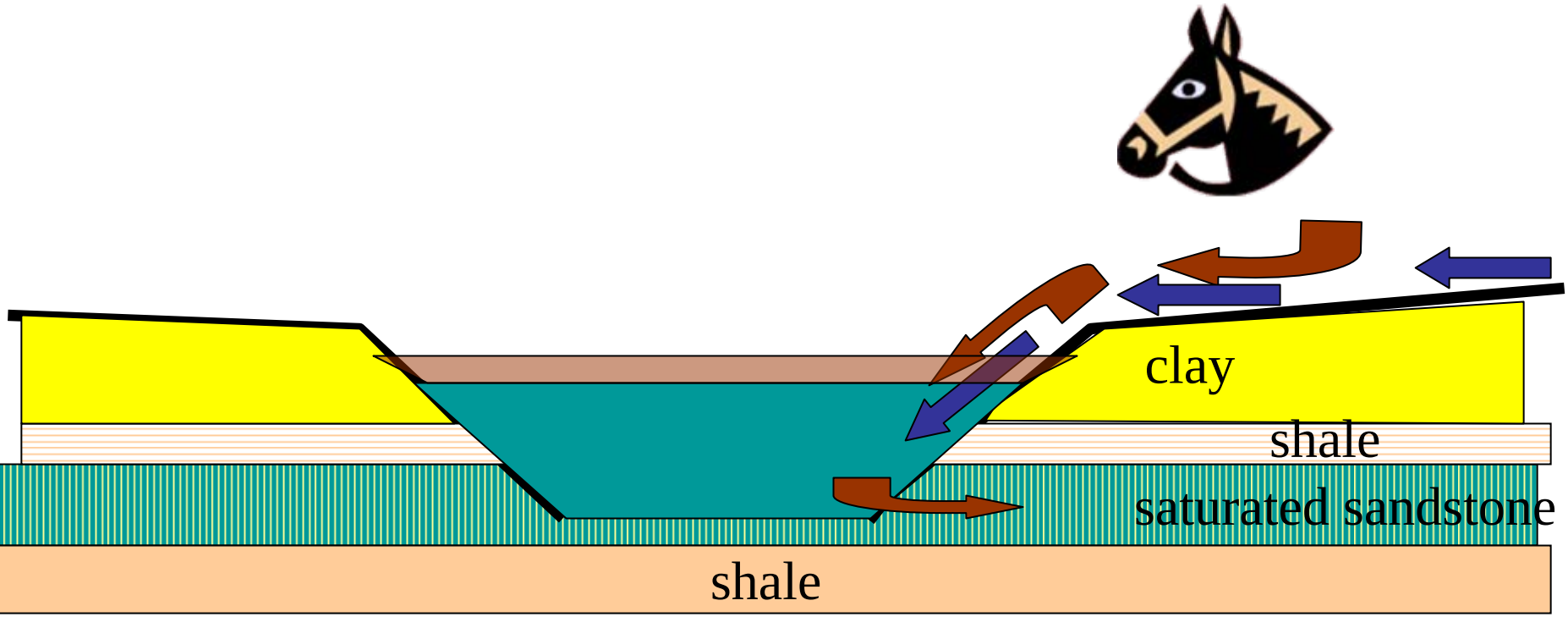
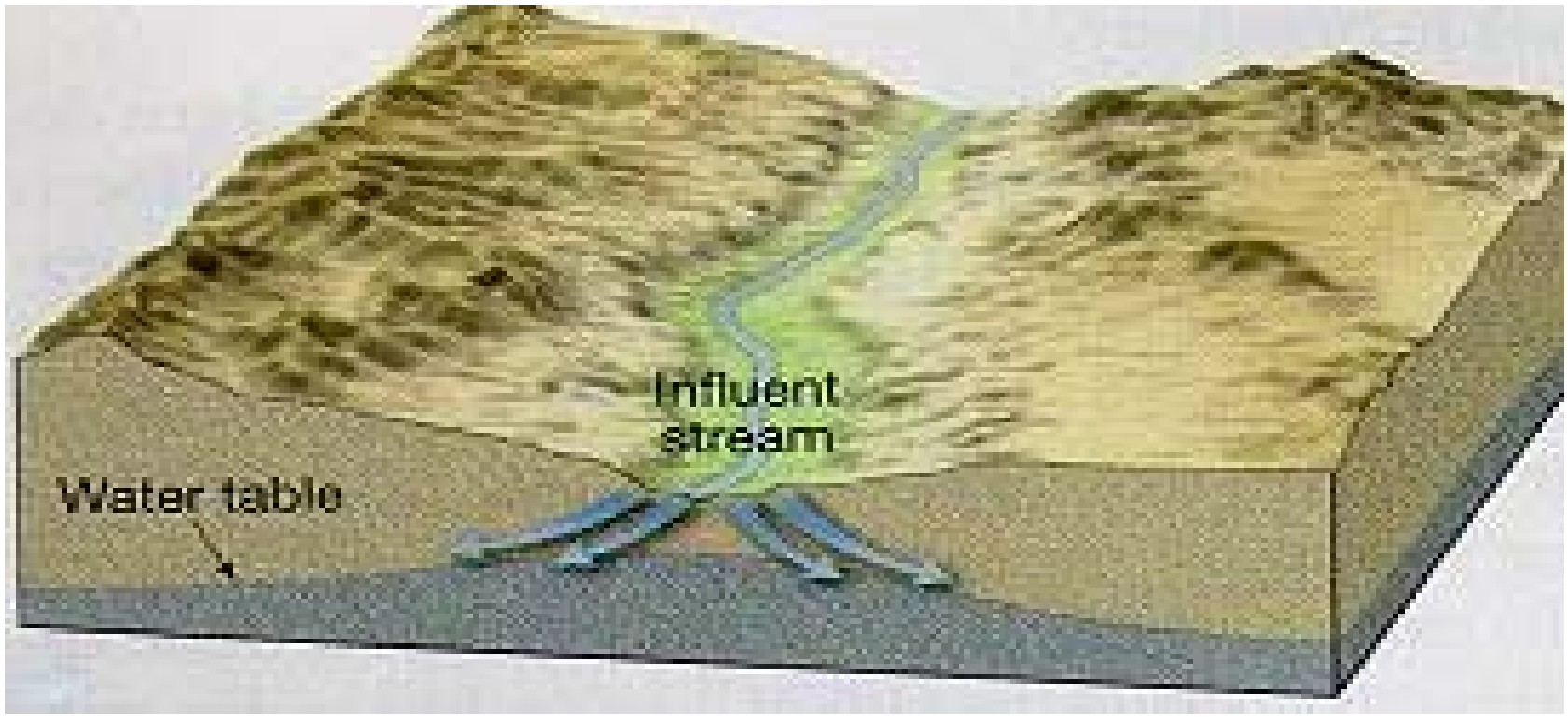
Poor Sewage System



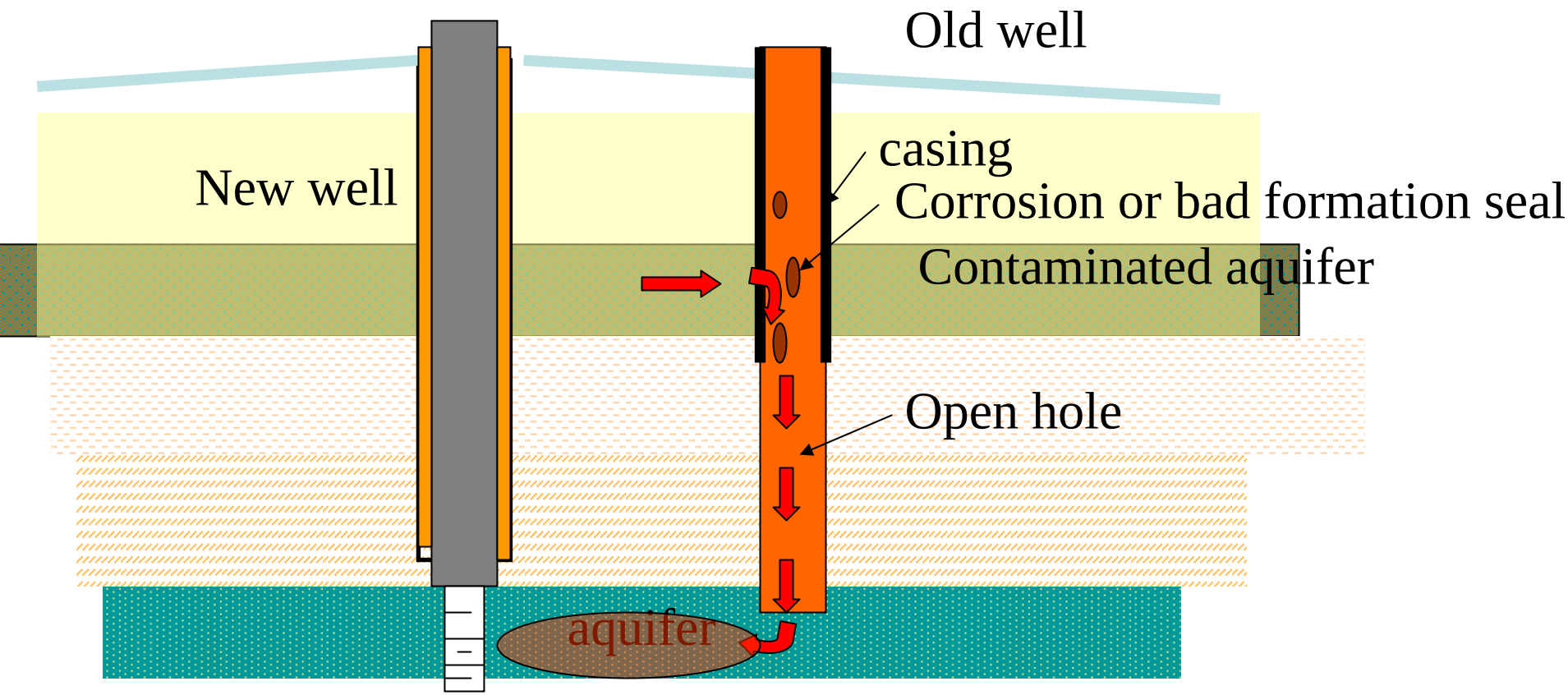
Groundwater filled dugout



An influent-losing stream supplies water to the zone of saturation and is characteristic for arid climates



Old well contamination



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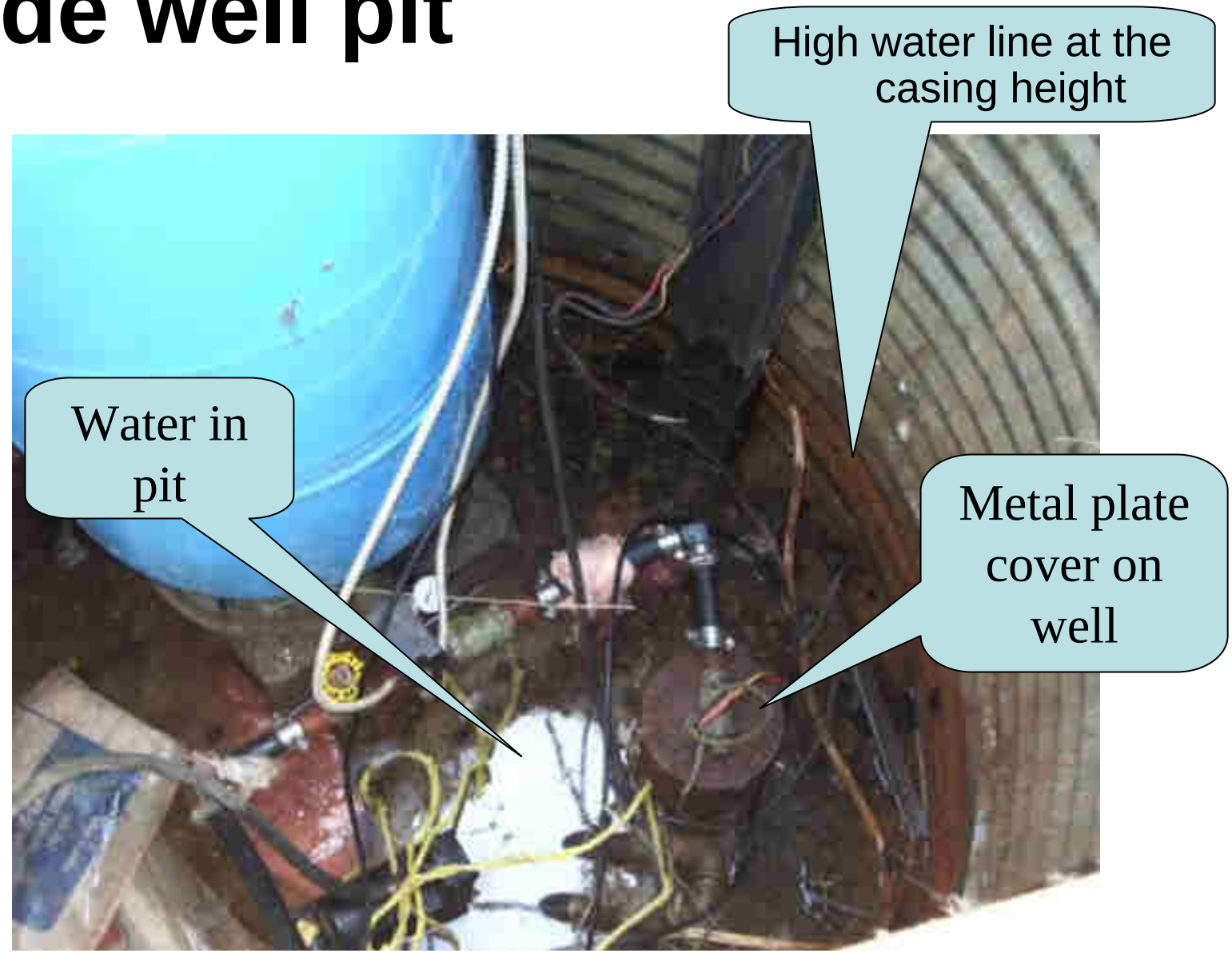
Inside well pit



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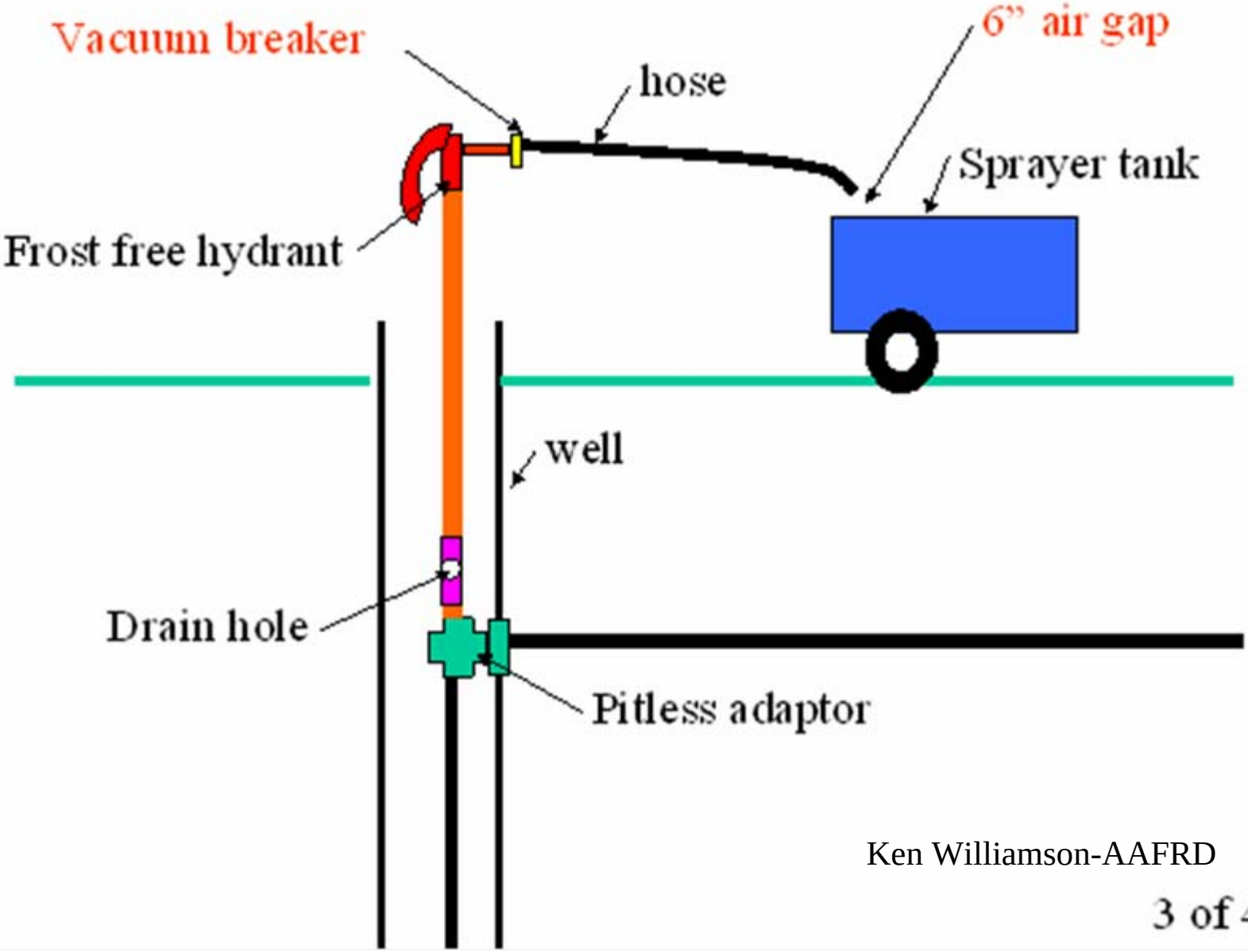
backflow



Ken Williamson-AAFRD

Preventing Well problems

Install a Good Well

- Features of a Good Well
  - Setbacks
  - Landscaping
  - Pitless adaptor (no pits!)
  - Vermin-proof well cap
  - Watertight borehole seal
  - Single aquifer source
  - Backflow prevention
  - User-friendly

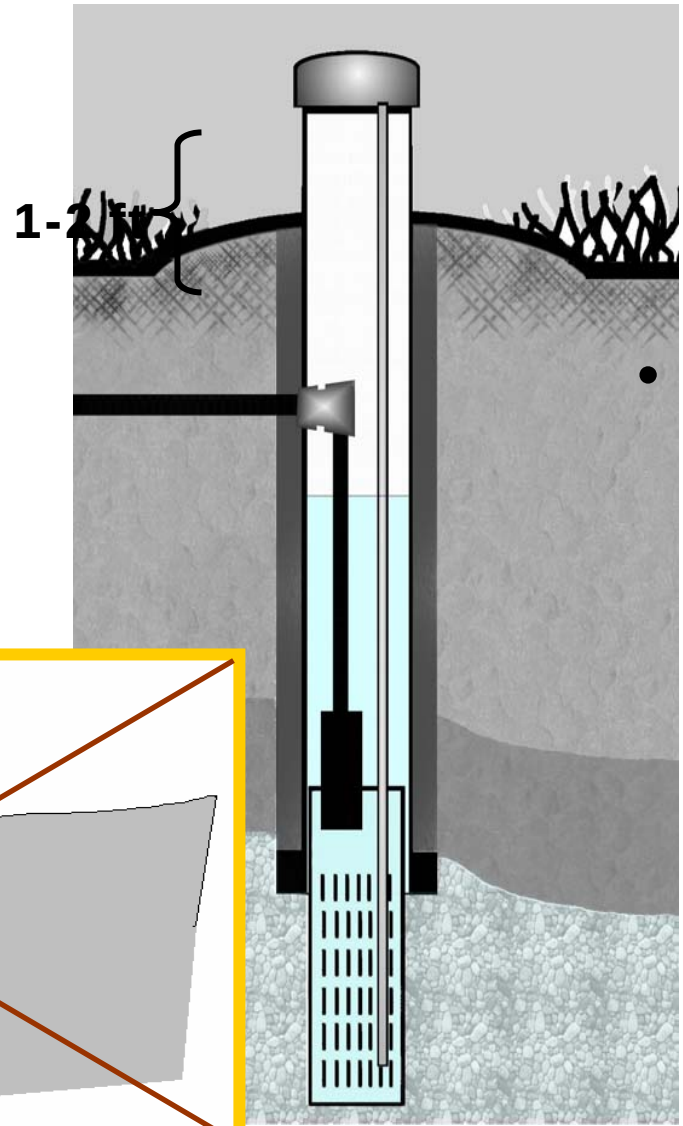
…Setbacks

watertight septic tank	10 m (33 ft.)
weeping tile effluent disposal field or evaporation mound	15 m (50 ft.)
sewage surface discharge	50 m (165 ft.)
sewage lagoon	100 m (329 ft.)
above-ground fuel tanks	50 m (165 ft.)
manure storage facility	100 m (329 ft)
manure application area	30 m (100 ft)
landfill	500 m (1,641 ft.)
leaching cesspool	30 m (100 ft.)

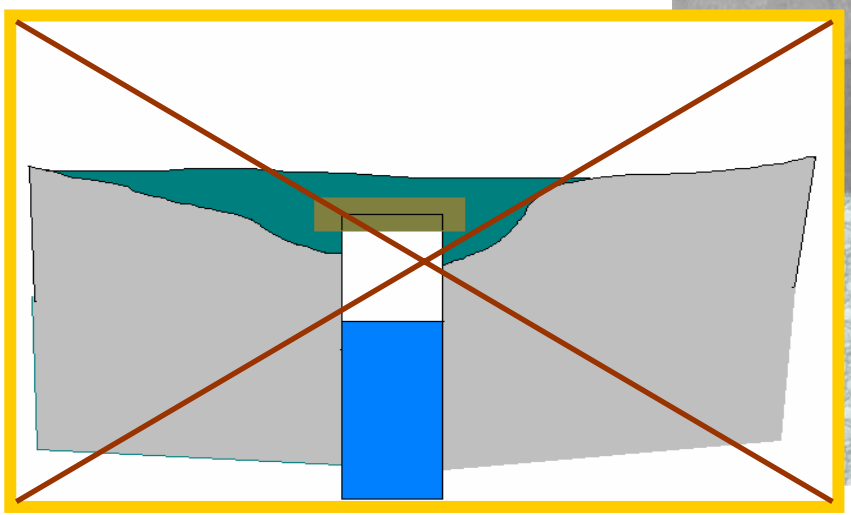
Environmental Farm Plan: www.albertaefp.com

…Landscaping

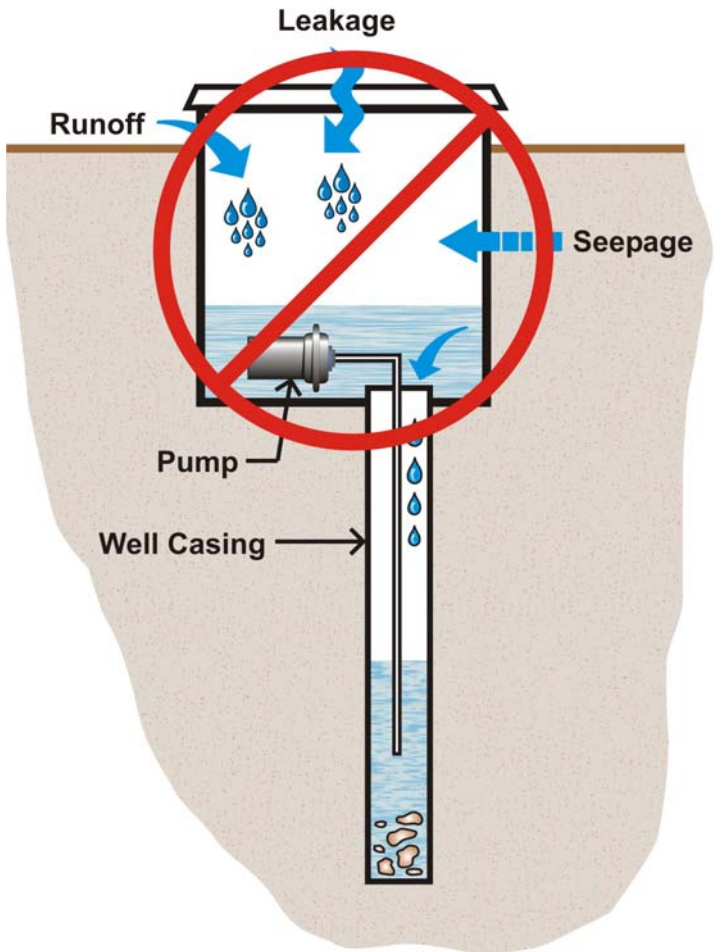
- Top of well at about 1 ft above ground

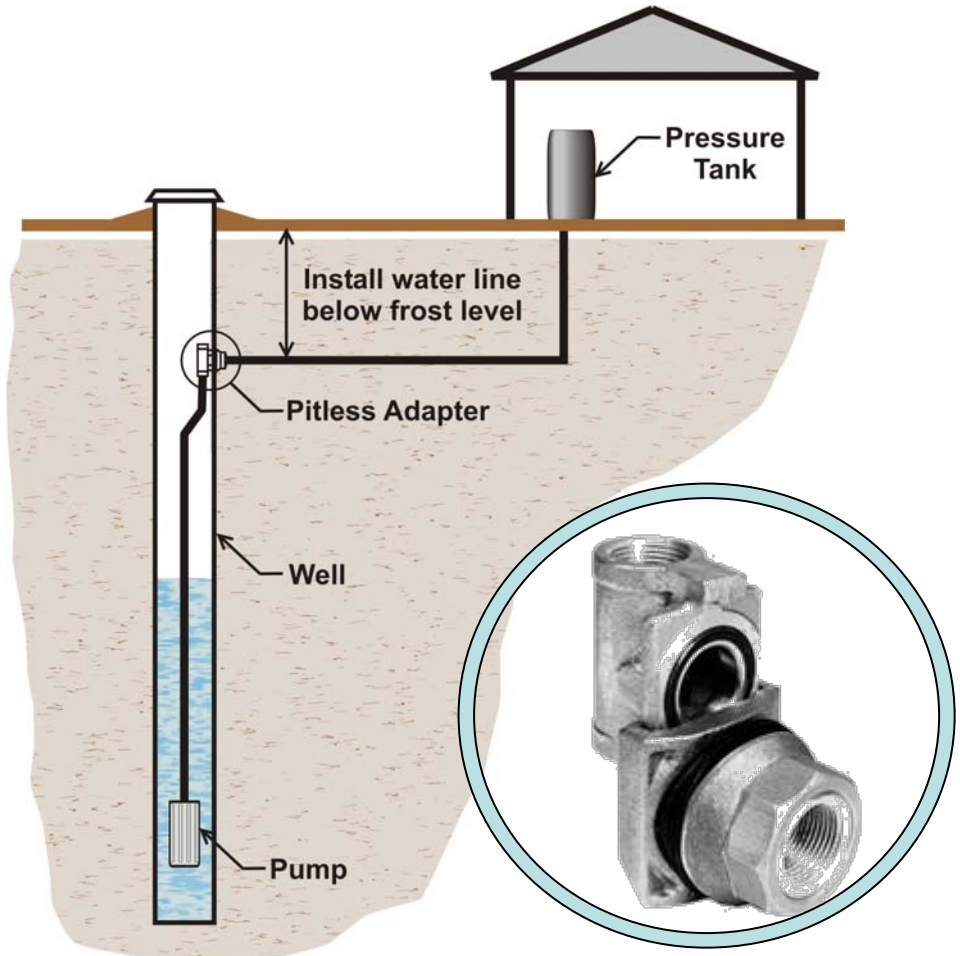


- Surface Mounding (slope away from well to prevent surface pooling and contamination)



Well Pits vs. Pitless Adapters

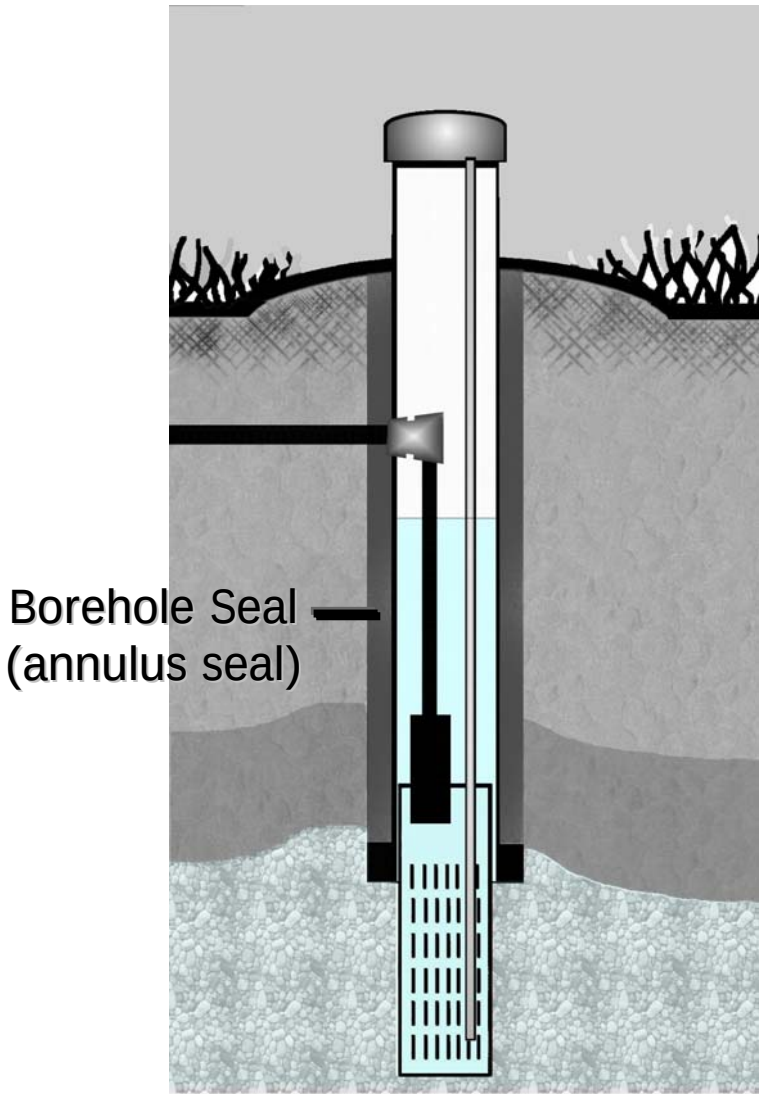




…Vermin-proof Well Cap

…Watertight Borehole Seal

Well Aware

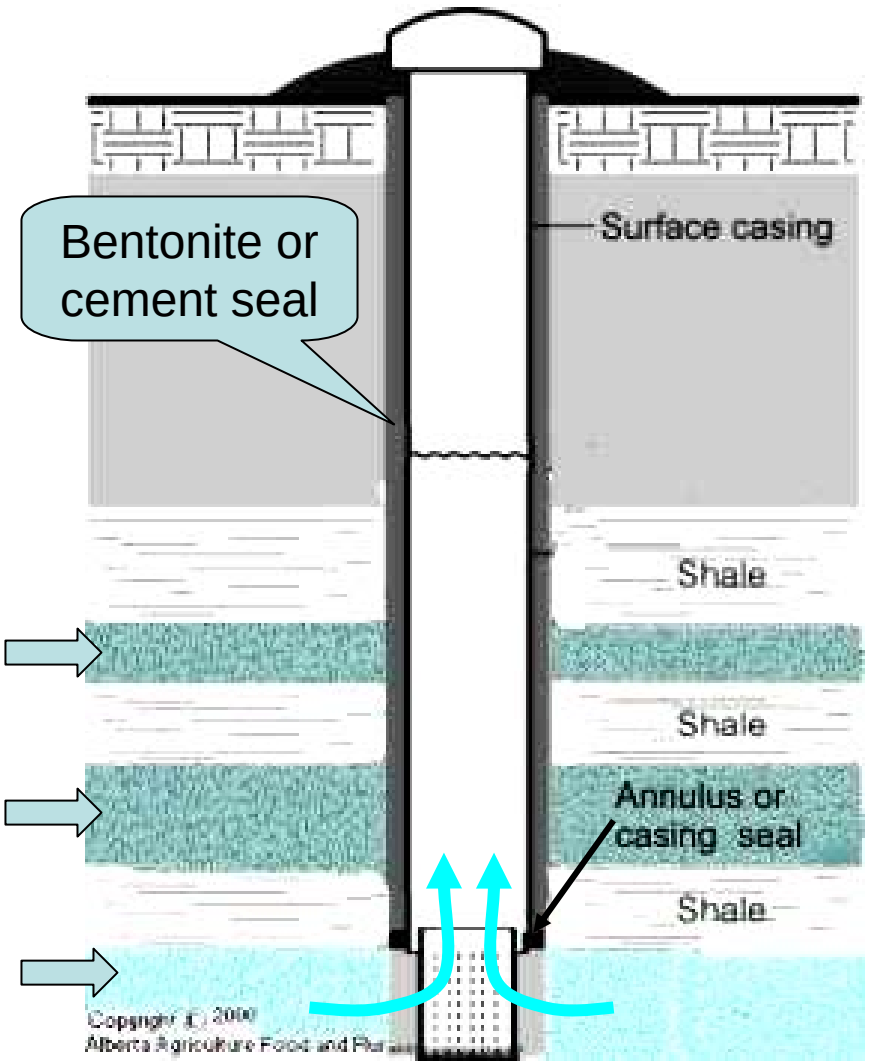


…Single Aquifer Source

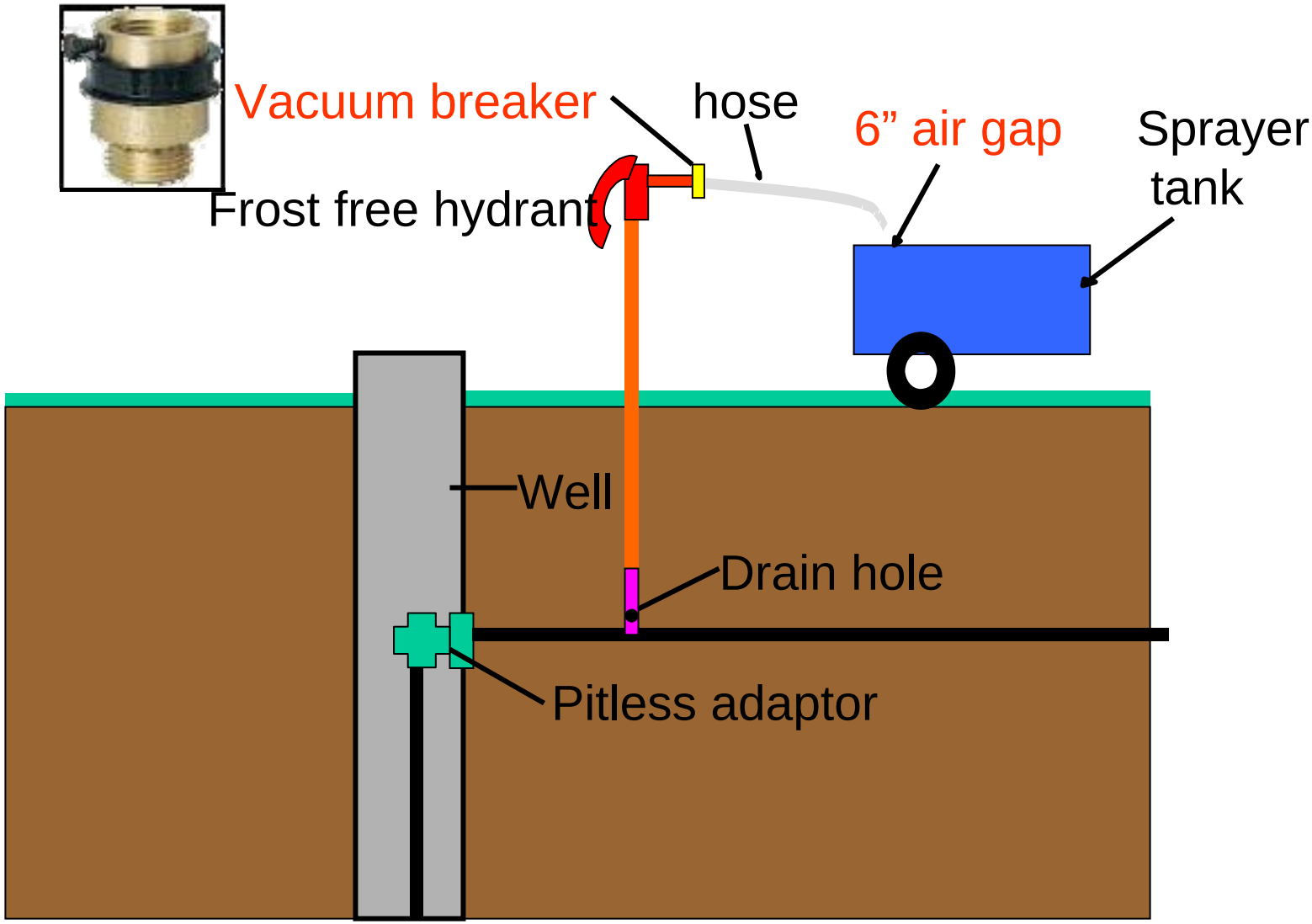
Poor quality aquifer (hard)

Poor quality aquifer (hard)

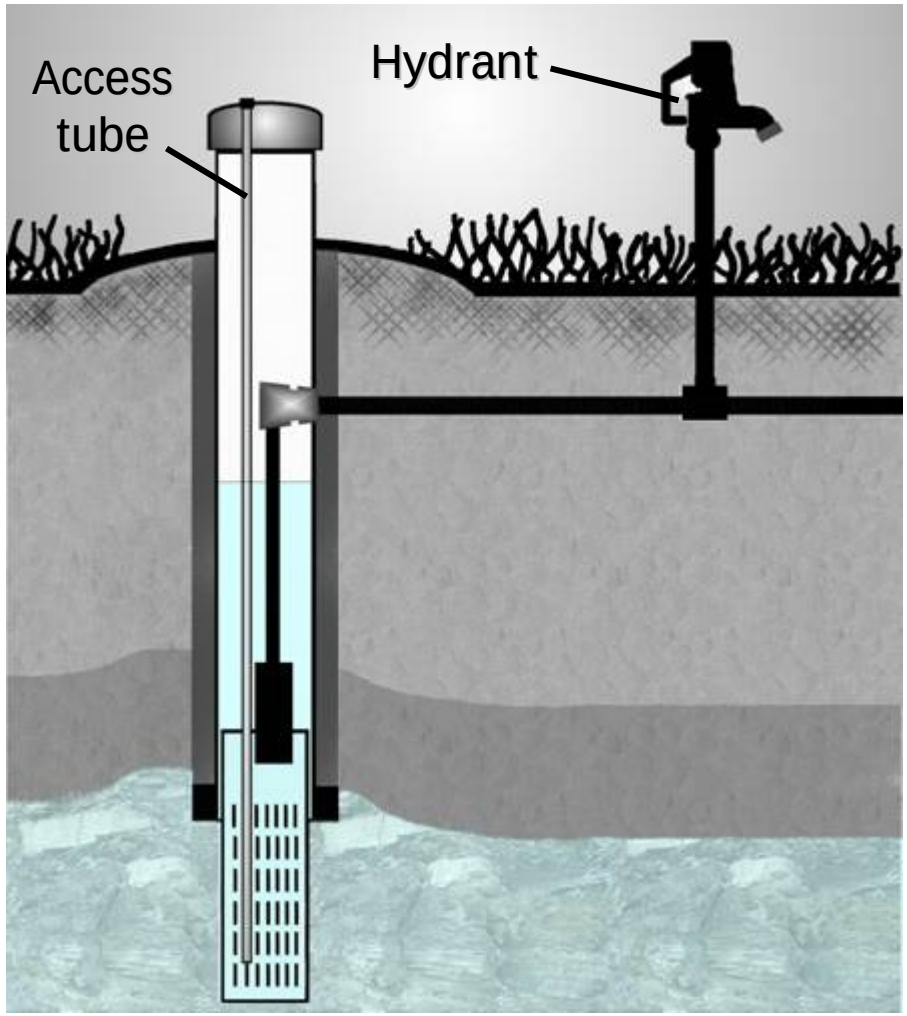
Good quality aquifer (soft)



…Backflow Prevention



…User Friendly



Preventative Maintenance

… systematic approach of scheduled inspections, regular monitoring and preventative treatments to prevent the premature deterioration of a water well supply.

Benefits of Preventative Maintenance

- Inspections and Monitoring
  - -alerts owner to changes in well performance and water quality before the problem becomes severe
  - - one step in providing a “safe” water supply
- Preventative treatments
  - -extend well life/reduce frequency of well rehabilitation or well replacement
  - -reduce pumping costs
  - -restore lost pumping capacity

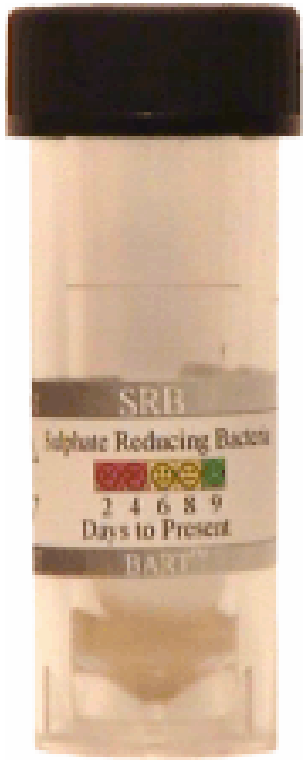
1. Inspect Your Well & Property

- **Monthly (Seasonally) Inspection:**
  - ☑ Well cap secure, vents unblocked
  - ☑ No gap around well casing
  - ☑ No ground settling or water ponding around well
  - ☑ Setbacks between well and potential contaminants
  - ☑ Manure, fertilizers not over-applied
  - ☑ Pressure tank & water treatment system operating properly
  - ☑ Septic system working properly

2. Test Your Well Water

- Test for coliform **bacteria** twice a year
- Routine water chemistry test every two years
- Test when water quality **changes**

Biological Monitoring for Nuisance Bacteria



- **BART™ (Biological Activity Reaction Test) A Patented Test System for detecting the presence and activity levels of selected groups of nuisance bacteria that are often involved in the biofouling of a water well**

Beyond Routine Monitoring

Arsenic – MAC 10 µg/L (ppb)

- skin lesions, cancer, nervous system disorders

Selenium – MAC 0.01 mg/L

- nervous and circulatory systems, hair loss

Manganese – AO is < 0.05

- metallic taste, black staining

Other Trace metals

Carbon Dioxide

- spurting at tap or milky water

Organics (hydrocarbons), Radionuclide

Heterotrophic plate Count (HPC) –

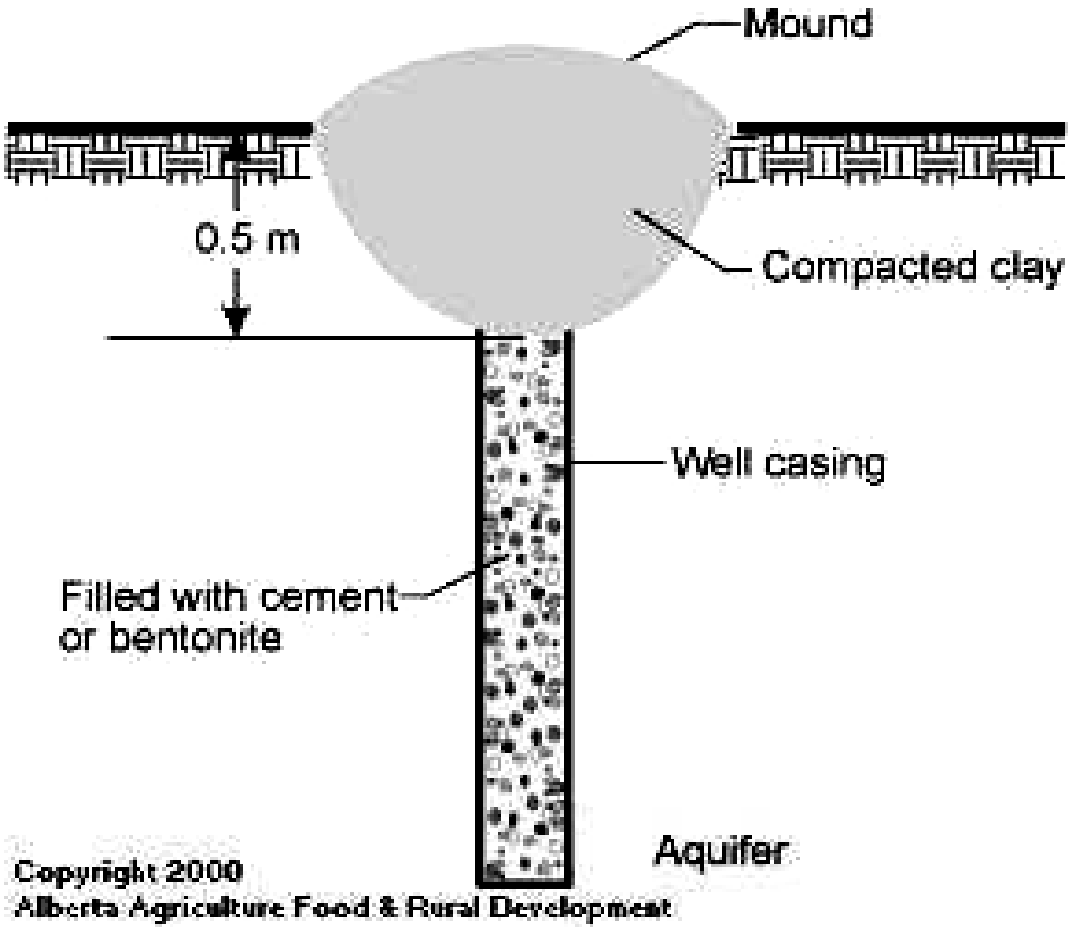
- high levels may indicate biofouling
- >500 retest for coliform bacteria

Rural Water Quality Information Tool

- Web-based
  - Input your test results
  - Tells you suitability of your water for different uses:
    - Drinking, livestock, irrigation, etc.

www.agric.gov.ab.ca/app84/loadMain

3. Plug Old Holes



http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/wwg414

4. Manage Land Activities

Environmental Farm Plan: www.albertaefp.com

5. Keep Good Records

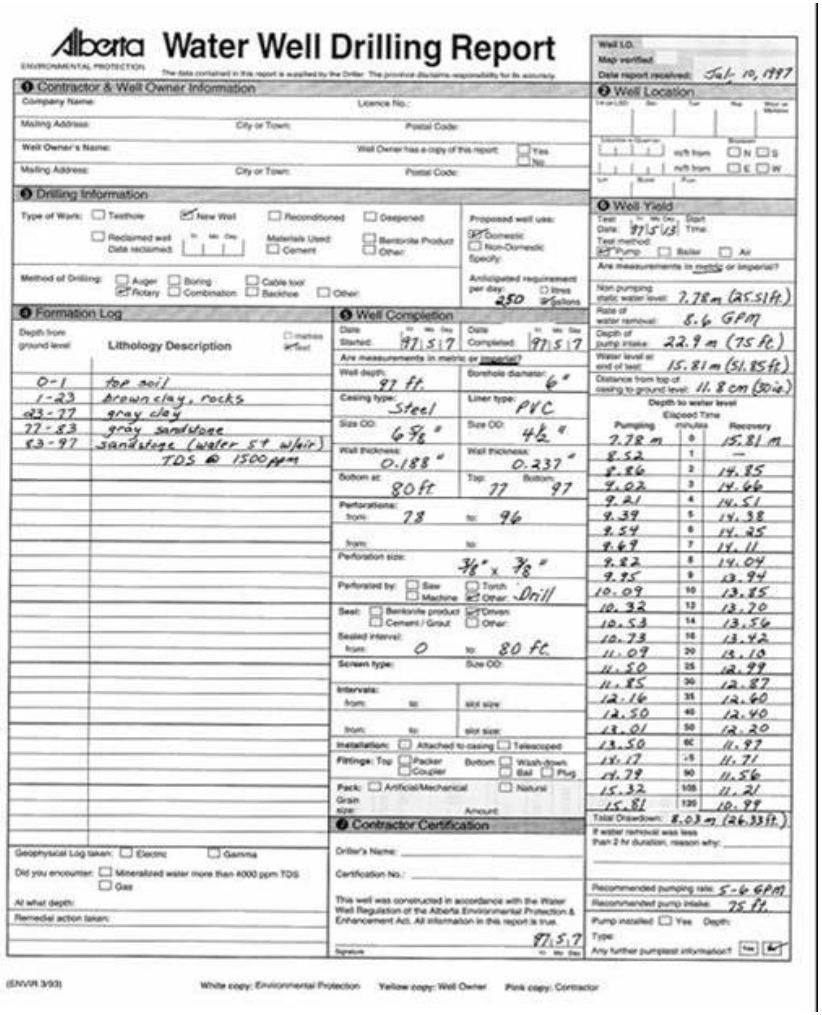
Well maintenance diary

Date Completed:	Action:
2006-08-04 Sample	extended casing above ground, landscaped around

Water quality testing diary

Date Tested:	Parameters:	Result:
2006-08-04 Sample	minerals / metals / bacteria	normal

www.wellaware.ca



Alberta Water Well Drilling Report

ENVIRONMENTAL PROTECTION

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.:
Map verified:
Date report received: Jul. 10, 1997

1 Contractor & Well Owner Information

Company Name: Licence No.:
Mailing Address: City or Town: Postal Code:
Well Owner's Name: Well Owner has a copy of this report: ☐ Yes ☐ No
Mailing Address: City or Town: Postal Code:

2 Drilling Information

Type of Work: ☐ Testhole ☑ New Well ☐ Reconditioned ☐ Deepened ☐ Reclaimed well Date reclaimed: ☐ Cement ☐ Bentonite Product ☐ Other:
Proposed well use: ☑ Domestic ☐ Non-Domestic Specify:
Method of Drilling: ☐ Auger ☐ Boring ☐ Cable tool ☑ Rotary ☐ Combination ☐ Backhoe ☐ Other:
Anticipated requirement per day: 250 ☐ litres ☑ gallons

3 Formation Log

Depth from ground level (☐ metres ☑ feet)	Lithology Description
0-1	top soil
1-23	brown clay, rocks
23-77	gray clay
77-83	gray sandstone
83-97	sandstone (water at wheir) TDS @ 1500 ppm

Geophysical Log taken: ☐ Electric ☐ Gamma
Did you encounter: ☐ Mineralized water more than 4000 ppm TDS ☐ Gas
At what depth:
Remedial action taken:

4 Well Completion

Date Started: 97/5/7 Date Completed: 97/5/7
Are measurements in metric or imperial?
Well depth: 97 ft. Borehole diameter: 6"
Casing type: Steel Liner type: PVC
Size OD: 6 5/8" Size OD: 4 1/2"
Wall thickness: 0.188" Wall thickness: 0.237"
Bottom at: 80 ft Top: 77 Bottom: 97
Perforations: from: 78 to: 96
Perforation size: 3/8" x 7/8"
Perforated by: ☐ Saw ☐ Torch ☐ Machine ☑ Other: Drill
Seal: ☐ Bentonite product ☑ Driven ☐ Cement / Grout ☐ Other:
Sealed interval: from: 0 to: 80 ft.
Screen type: Size OD:
Intervals: from: to: slot size:
Installation: ☐ Attached to casing ☐ Telescoped
Fittings: Top: ☐ Packer ☐ Coupler Bottom: ☐ Wash down Ball ☐ Plug
Pack: ☐ Artificial/Mechanical ☐ Natural Grain size: Amount:

5 Contractor Certification

Driller's Name:
Certification No.:
This well was constructed in accordance with the Water Well Regulation of the Alberta Environmental Protection & Enhancement Act. All information in this report is true.
Signature 97/5/7

6 Well Location

Lot Block Plan
m/ft from ☐ N ☐ S
m/ft from ☐ E ☐ W

7 Well Yield

Test: Date: 97/5/15 Start Time:
Test method: ☑ Pump ☐ Bailer ☐ Air
Are measurements in metric or imperial?
Non-pumping static water level: 7.78 m (25.51 ft.)
Rate of water removal: 8.6 GPM
Depth of pump intake: 22.9 m (75 ft.)
Water level at end of test: 15.81 m (51.85 ft.)
Distance from top of casing to ground level: 11.8 cm (30 in.)

Depth to water level

Pumping	Elapsed Time minutes	Recovery
7.78 m	0	15.81 m
8.52	1	—
8.86	2	14.85
9.02	3	14.66
9.21	4	14.51
9.39	5	14.38
9.54	6	14.25
9.69	7	14.11
9.82	8	14.04
9.95	9	13.94
10.09	10	13.85
10.32	12	13.70
10.53	14	13.56
10.73	16	13.42
11.09	20	13.10
11.50	25	12.99
11.85	30	12.87
12.16	35	12.60
12.50	40	12.40
12.01	50	12.20
13.50	60	11.97
14.17	75	11.71
14.79	90	11.56
15.32	105	11.21
15.81	120	10.99

Total Drawdown: 8.03 m (26.33 ft.)
If water removal was less than 2 hr duration, reason why:
Recommended pumping rate: 5-6 GPM
Recommended pump intake: 75 ft.
Pump installed: ☐ Yes Depth:
Type:
Any further pumptest information? ☐ ☑

(ENVIR 3/93) White copy: Environmental Protection Yellow copy: Well Owner Pink copy: Contractor

- Reports filled out by drillers after a water well has been drilled
- Location of adjacent/abandoned wells
- Water quality analysis reports
- Water level measurements
- Records of maintenance or repair

6. Disinfect the well

- Yearly, if you have **symptoms** of biofouling
- Following **change** in water clarity, color, odor or taste
- Immediately after installing a **new well**
- After well, pump or any part of plumbing is opened for **repairs** or maintenance
- Following contamination by **flood water**
- When water quality tests show presence of **coliform** bacteria
- Must be done regularly to be effective
- Not effective in poorly maintained wells

Dosage and Types of Chlorine

- Dosage - 200 milligrams per liter (Water Act)
- Liquid – sodium hypochlorite is 5.25 % (household bleach) or 12 % (industrial bleach) strength
- Too much chlorine is less effective and can damage a well

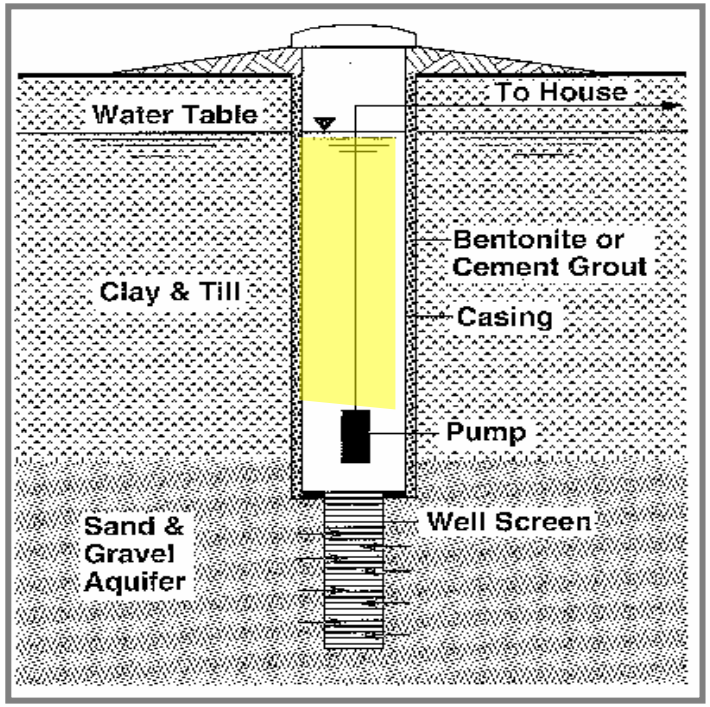
Effect of pH on Chlorine Effectiveness in Water

Water pH	Biocidal Effectiveness	Oxidative Effectiveness
5.5	100 %	0 %
8.0	12 %	88 %
9.0	2 %	98 %
10.0	< 1 %	> 99 %

Note: pH Reduction can dramatically increase the effectiveness of chlorine in high pH waters.

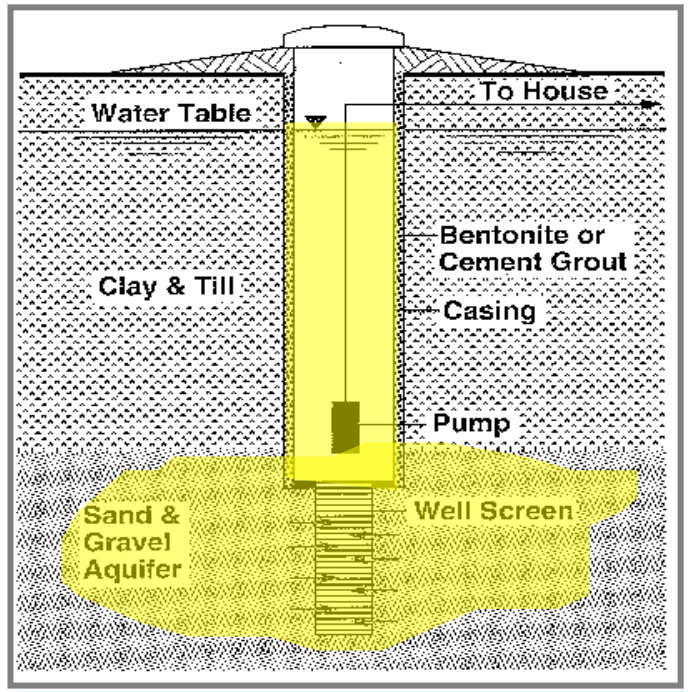
Methods of Shock Chlorination

1. Simple Chlorination



Poor results!!

2. Bulk Displacement



Much better results!!

Step by step procedures for

‘Shock Chlorination of Small Diameter Wells’

‘Modified Procedure for Large Diameter Wells (24-36 inches)’

provided in the Fact Sheets or Water Wells Manual

Water Wells That Last for Generations:
www.agric.gov.ca/water/wells or (780) 427-2700

Poorly Maintained Wells

- Shock chlorination may not work on **poorly maintained** wells – must be professionally cleaned FIRST and then the pH of the treatment water adjusted with acid.
- Well Rehabilitation - Job for a **professional** well driller
  - Often extremely dangerous

Diagnostic Procedures

- Discussion with the Well Owner
- Evaluation of existing well records if available (i.e. water quality, drillers report, water level records, well production tests)
- Water quality analysis (i.e. chemical and microbiological)
- Visual inspection of the well site, toilet tank, pump and drop line
- Water level measurements and production tests

Things to consider

- What are the problems (i.e. loss in yield, change in water chemistry, increased microbial activity, taste, odour, discolouration, gas in the water, sand pumping)
- When were the problems first observed?
- Are the problems ongoing or seasonal?
- Has there been any increased demand on the well or changes in the operation?
- Has there been any increase in power usage?
- Consider other wells on the property including stand-by or abandoned wells.

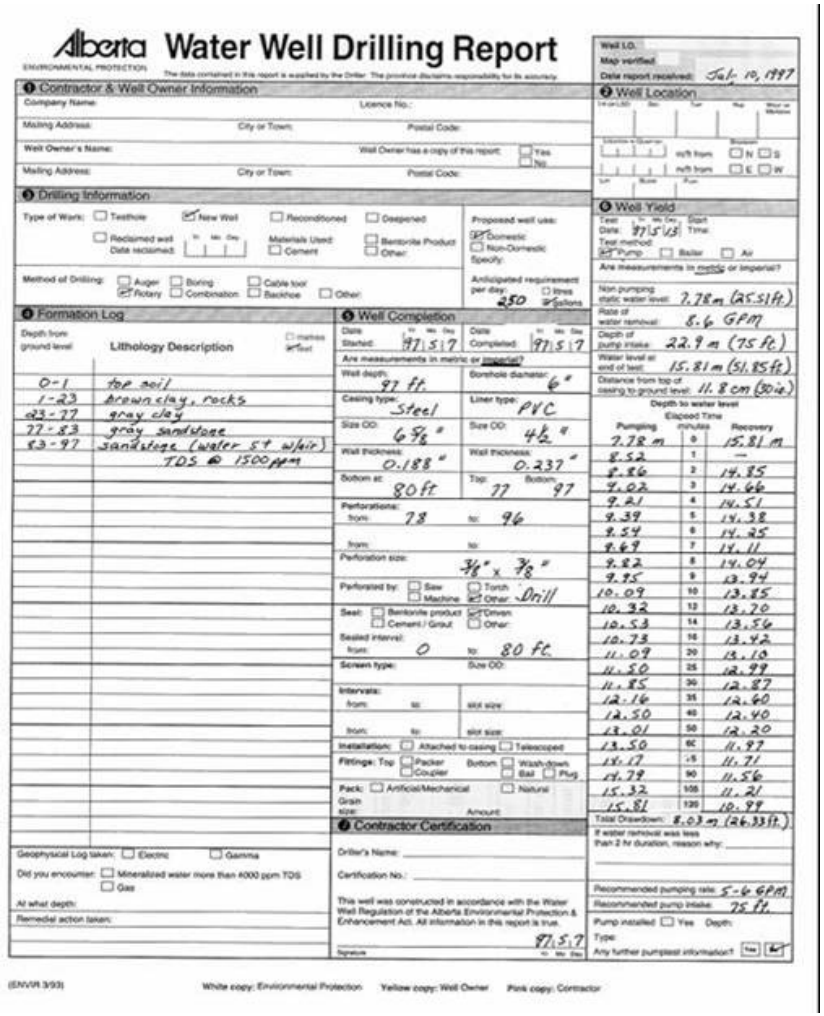
Diagnostic Procedures
Drillers report

- **Look for**
- Possible Well construction problems

  -Poor or improperly located seal

  -Multi-aquifer completions

  -Pump in screened area
- Higher than recommended pump rates
- Losses in yield
- Age



Alberta ENVIRONMENTAL PROTECTION **Water Well Drilling Report**

The data contained in this report is supplied by the Driller. The province disclaims responsibility for its accuracy.

Well I.D.
Map verified
Date report received: Sept. 10, 1997

1 Contractor & Well Owner Information

Company Name: Licence No.:
Mailing Address: City or Town: Postal Code:
Well Owner's Name: Well Owner has a copy of this report: ☐ Yes ☐ No
Mailing Address: City or Town: Postal Code:

2 Drilling Information

Type of Work: ☐ Testhole ☑ New Well ☐ Reconditioned ☐ Deepened ☐ Reclaimed well Date reclaimed: Yr Mo Day
Materials Used: ☐ Cement ☐ Bentonite Product ☐ Other:
Proposed well use: ☑ Domestic ☐ Non-Domestic Specify:
Method of Drilling: ☐ Auger ☐ Boring ☐ Cable tool ☑ Rotary ☐ Combination ☐ Backhoe ☐ Other:
Anticipated requirement per day: 250 ☐ litres ☑ gallons

3 Formation Log

Depth from ground level: ☐ metres ☑ feet

Lithology Description
0-1 top soil
1-23 brown clay, rocks
23-77 gray clay
77-83 gray sandstone
83-97 sandstone (water 5 ft w/air) TDS @ 1500 ppm

Geophysical Log taken: ☐ Electric ☐ Gamma
Did you encounter: ☐ Mineralized water more than 4000 ppm TDS ☐ Gas
At what depth:
Remedial action taken:

4 Well Completion

Date Started: Yr 97 Mo 5 Day 17 Date Completed: Yr 97 Mo 5 Day 17
Are measurements in metric or imperial?
Well depth: 97 ft. Borehole diameter: 6"
Casing type: Steel Liner type: PVC
Size OD: 6 5/8" Size OD: 4 1/2"
Wall thickness: 0.188" Wall thickness: 0.237"
Bottom at: 80 ft Top: 77 Bottom: 97
Perforations: from: 78 to: 96
from: to:
Perforation size: 3/8" x 3/8"
Perforated by: ☐ Saw ☐ Torch ☐ Machine ☑ Other: Drill
Seal: ☐ Bentonite product ☑ Driven ☐ Cement / Grout ☐ Other:
Sealed interval: from: 0 to: 80 ft.
Screen type: Size OD:
Intervals: from: to: slot size:
from: to: slot size:
Installation: ☐ Attached to casing ☐ Telescoped
Fittings: Top ☐ Packer ☐ Coupler Bottom ☐ Wash-down ☐ Bail ☐ Plug
Pack: ☐ Artificial/Mechanical ☐ Natural
Grain size: Amount:

5 Contractor Certification

Driller's Name:
Certification No.:
This well was constructed in accordance with the Water Well Regulation of the Alberta Environmental Protection & Enhancement Act. All information in this report is true.
Signature Yr 97 Mo 5 Day 17

6 Well Location

Lot or L.S.D. Sec. Twp. Rng. Mer. or Meridian
Distance to Quarter: m/ft from ☐ N ☐ S; m/ft from ☐ E ☐ W
Sub. Block Plan

7 Well Yield

Test Date: Yr 97 Mo 5 Day 13 Start Time:
Test method: ☑ Pump ☐ Bailer ☐ Air
Are measurements in metric or imperial?
Non-pumping static water level: 7.78 m (25.51 ft.)
Rate of water removal: 8.6 GPM
Depth of pump intake: 22.9 m (75 ft.)
Water level at end of test: 15.81 m (51.85 ft.)
Distance from top of casing to ground level: 11.8 cm (30 in.)

Depth to water level

Elapsed Time minutes	Pumping	Recovery
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25	11.50	12.99
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120	15.81	10.99

Total Drawdown: 8.03 m (26.33 ft.)
If water removal was less than 2 hr duration, reason why:
Recommended pumping rate: 5-6 GPM
Recommended pump intake: 75 ft.
Pump installed ☐ Yes Depth:
Type:
Any further pumpless information? ☐ Yes ☑

(ENVVR 3/93) White copy: Environmental Protection Yellow copy: Well Owner Pink copy: Contractor

Chemical Test	Use
Alkalinity (as CaCO3)	Used together with pH, hardness, calcium and magnesium to determine the possibility of carbonate scale
pH	Gives an indication of corrosive condition of water
Chlorides/nitrate	Change in chloride may indicate contamination or mixing of waters Increased nitrate may also indicate pollution
TDS (total inorganic and organic content)	Changes in TDS verify changes in specific ions (e.g. the dissolution of iron pyrite leading to an increase in iron and sulfide)
Iron	Increasing levels of iron indicate that oxidation is occurring (through biofouling or over pumping). Iron deposits are most likely to accumulate in the well and distribution system when oxidation is occurring and iron levels are in excess of 1.0 mg/L
Sulphate	Change in the concentration of sulphate may indicate the presence of certain bacteria and the possible cause of corrosion, deposits, taste or odor problems. Also high levels of sulphate combined with high levels of calcium can lead to calcium sulfate scaling
Manganese	Levels above 0.1 mg/L can result in significant accumulation and blockage

Resources

- Alberta Environment
- Alberta Agriculture, Food and Rural Development
- Prairie Farm Rehabilitation Administration
- Local Drilling Companies
- Alberta Water Well Drilling Association
- Local Public Health Inspectors
- Private Laboratories