Impacts of Whole House Reverse Osmosis Systems on Septic Systems

Presented by:

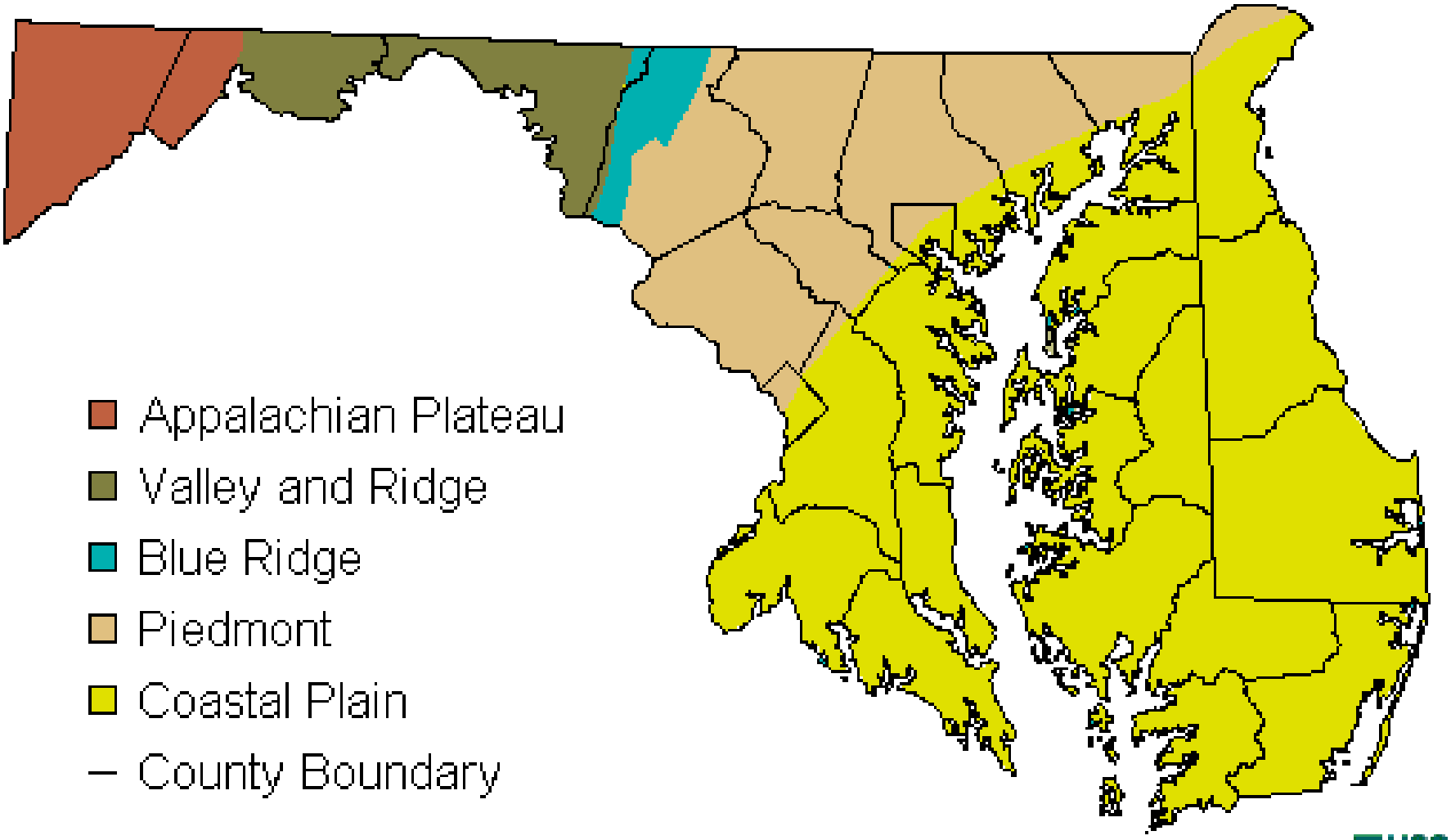
Kevin Koepenick, L.E.H.S.

Baltimore County Department of Environmental Protection and Sustainability

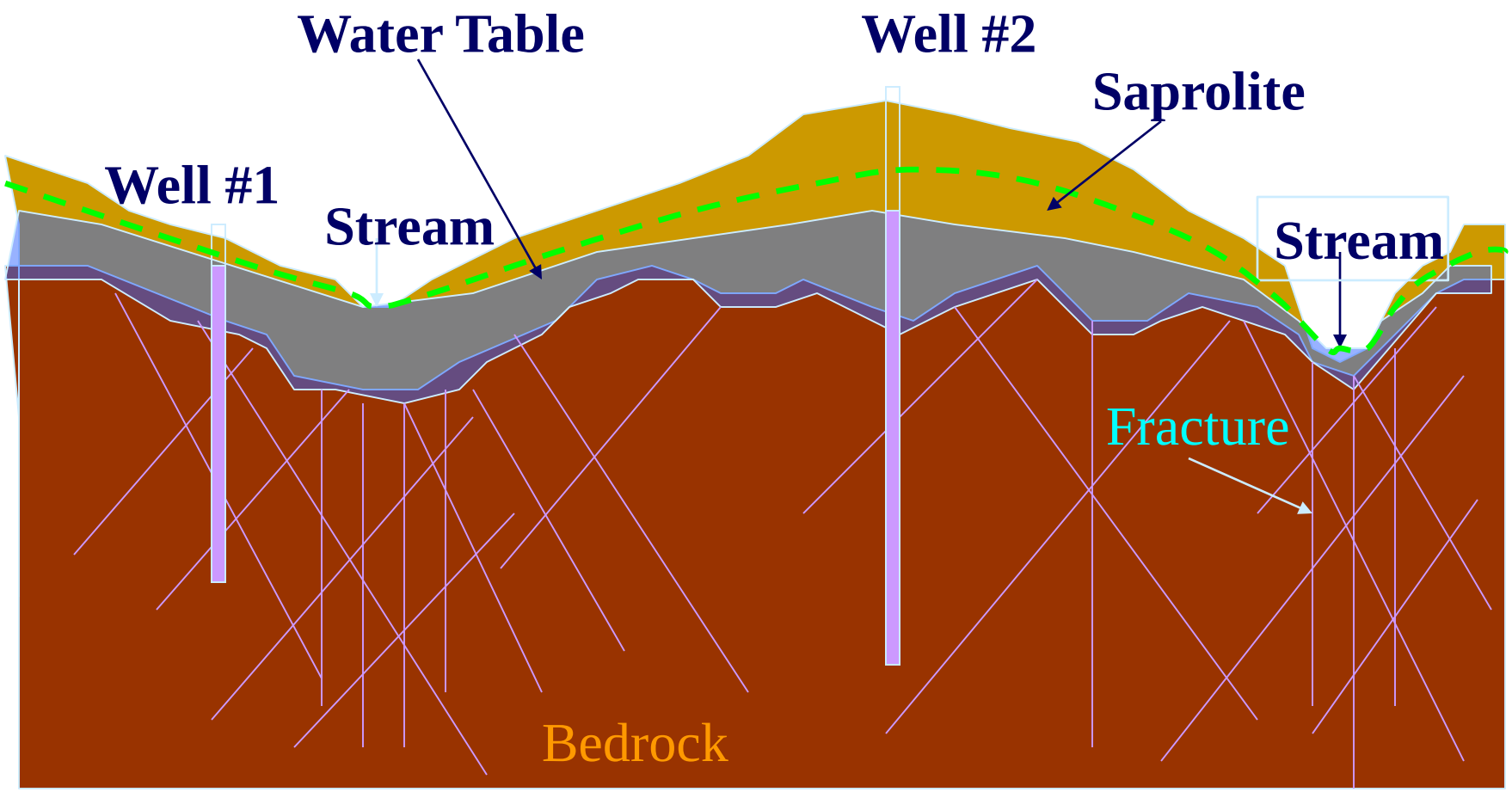
Overview

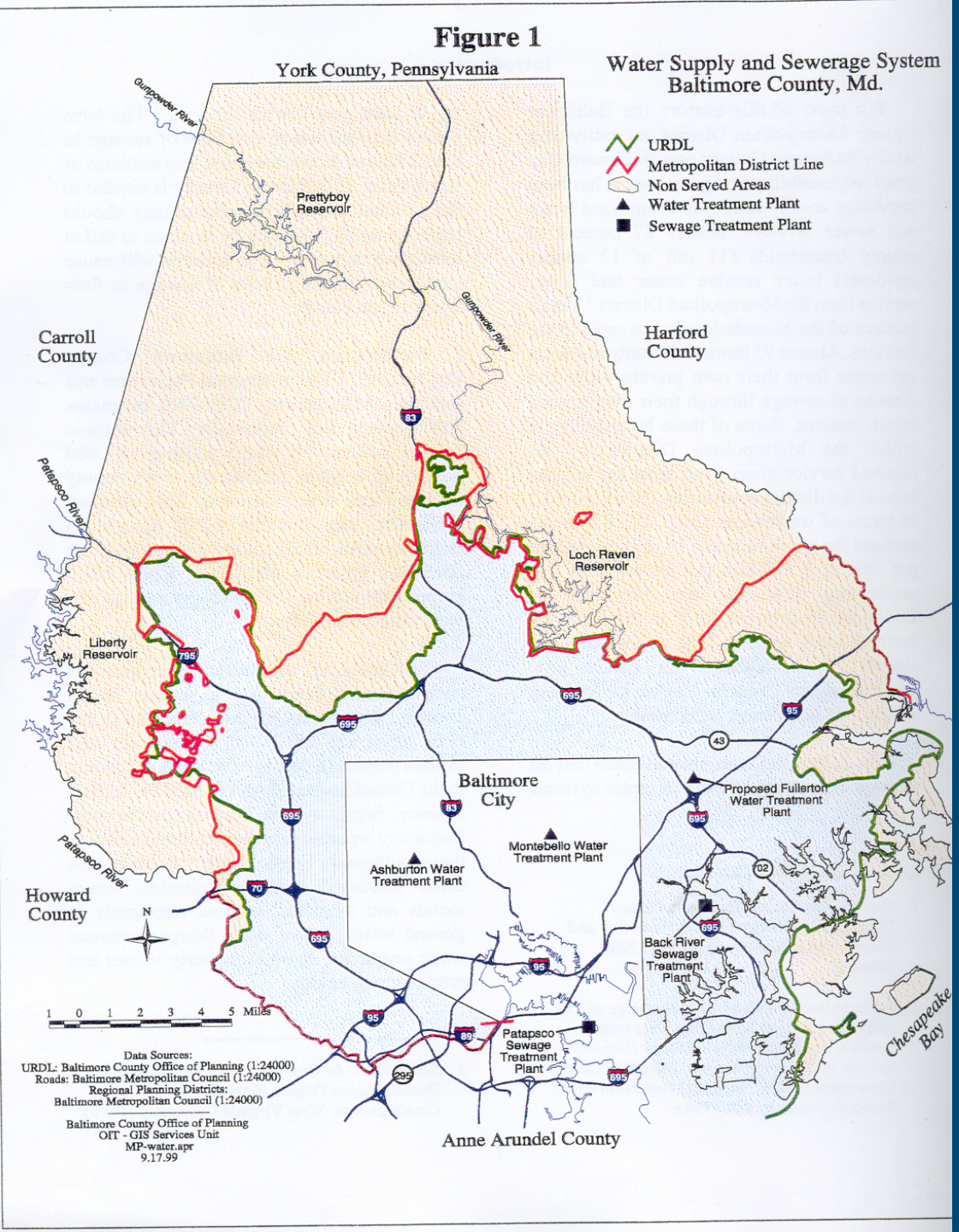
- ➔ Natural Ground Water Quality and Typical Water Treatment in Piedmont
- ➔ Observed Trends in Wells Contaminated by Road Salt
- ➔ Options for Addressing Road Salt Comtamination
- ➔ Addressing Wastewater from R/O Systems

Physiographic Provinces of Maryland and Delaware



Occurrence of Ground Water in the Piedmont

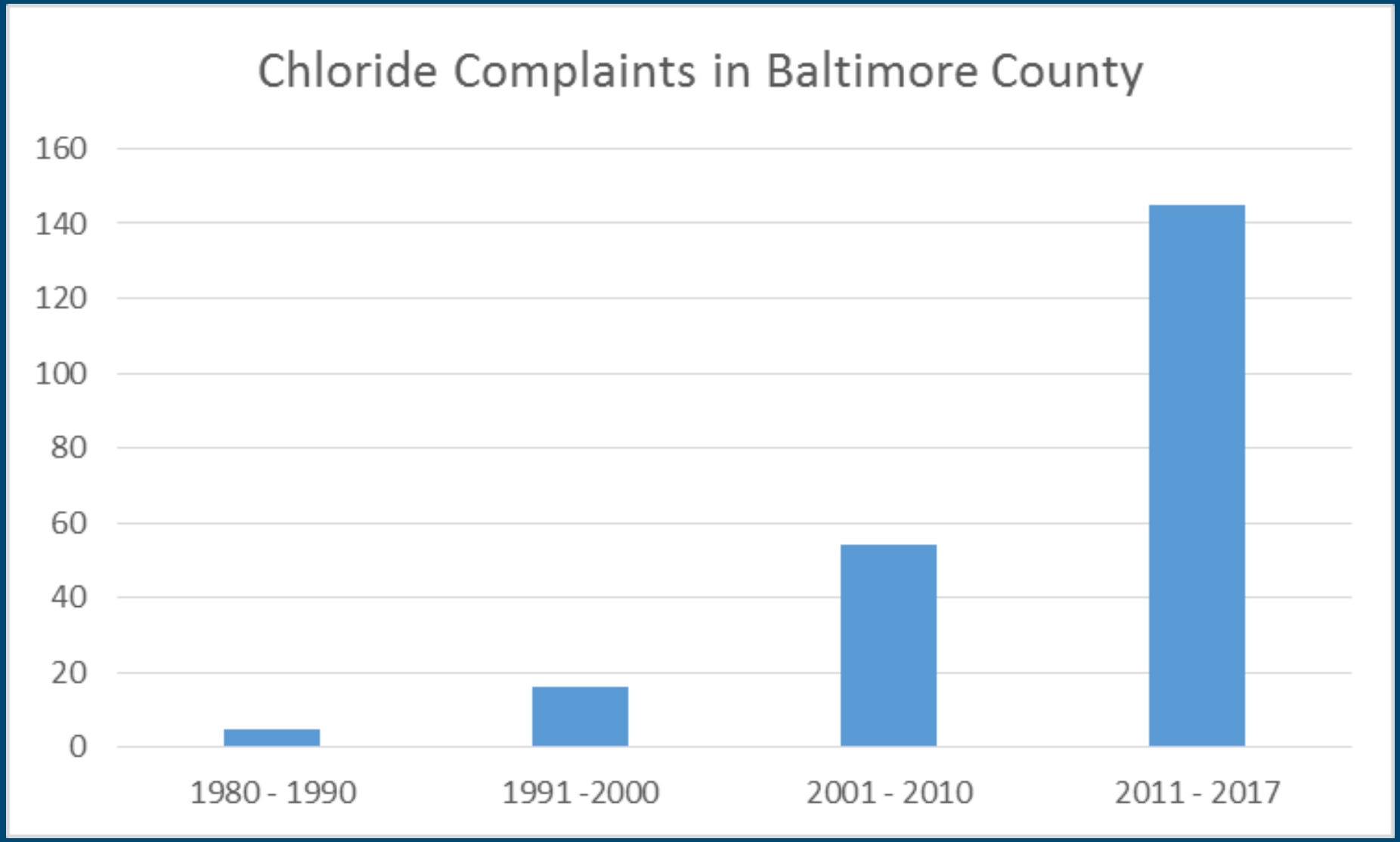


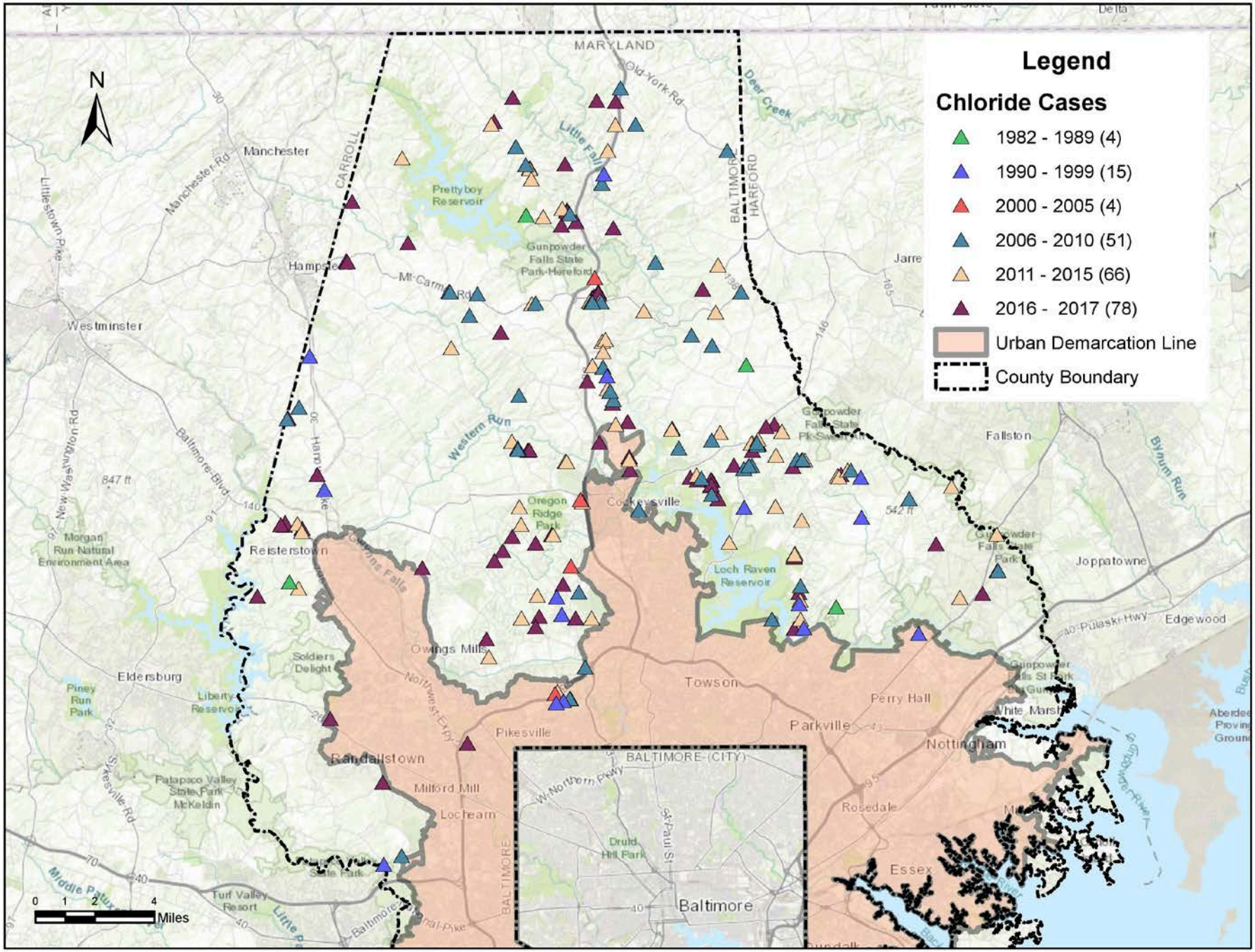


Roughly 10 % or 85,000 Baltimore County Residents Rely on an Estimated 36,000 Private Well Systems

Natural Water Quality in the Piedmont

Concern	Treatment Option
Low pH	Neutralizer (Calcium Carbonate)
Iron	Softener (Ion Exchange)
Manganese	Softener (Ion Exchange)
Radium	Softener (Ion Exchange)


Chloride Complaints in Baltimore County
160
140
120
100
80
60
40
20
0
1980 - 1990
1991 -2000
2001 - 2010
2011 - 2017


Legend
Chloride Cases
1982 - 1989 (4)
1990 - 1999 (15)
2000 - 2005 (4)
2006 - 2010 (51)
2011 - 2015 (66)
2016 - 2017 (78)
Urban Demarcation Line
County Boundary
N
MARYLAND
Manchester
Westminster
Hampstead
Reisterstown
Eldersburg
Randallstown
Owings Mills
Towson
Parkville
Perry Hall
Nottingham
Fallston
Joppatowne
Edgewood
Essex
Baltimore
BALTIMORE (CITY)
Pikesville
Cockeysville
Loch Raven Reservoir
Prettyboy Reservoir
Gunpowder Falls State Park-Hereford
Oregon Ridge Park
Western Run
Deer Creek
Bynum Run
Rosedale
Druid Hill Park
Patapsco Valley State Park McKeldin
Turf Valley Resort
Morgan Run Natural Environment Area
Piney Run Park
Liberty Reservoir
Soldiers Delight
Milford Mill
Locheam
White Marsh
0 1 2 4
Miles

Domestic Well Complaint Concentrations 2014-2015

- Chloride Range: 341 – 1361 ppm
  Chloride Ave: 567 ppm

- Sodium Range: 45 – 575 ppm
  Sodium Ave: 196 ppm

- Sodium/Chloride Ratio: 9 – 60%

Typical Homeowner Complaints

- → Replacing Water Heater Every 2 years
- → Frequent Leaks (from corrosion)
- → Can’t Drink Water Due To Taste
- → Dry, Itchy Skin / Hair Loss

Corrosion

What is the Cause?

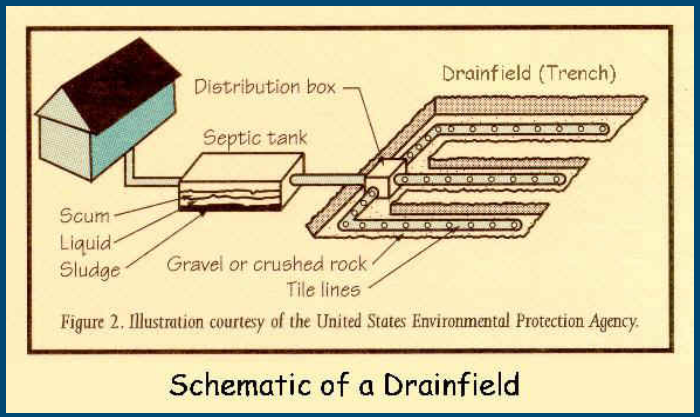
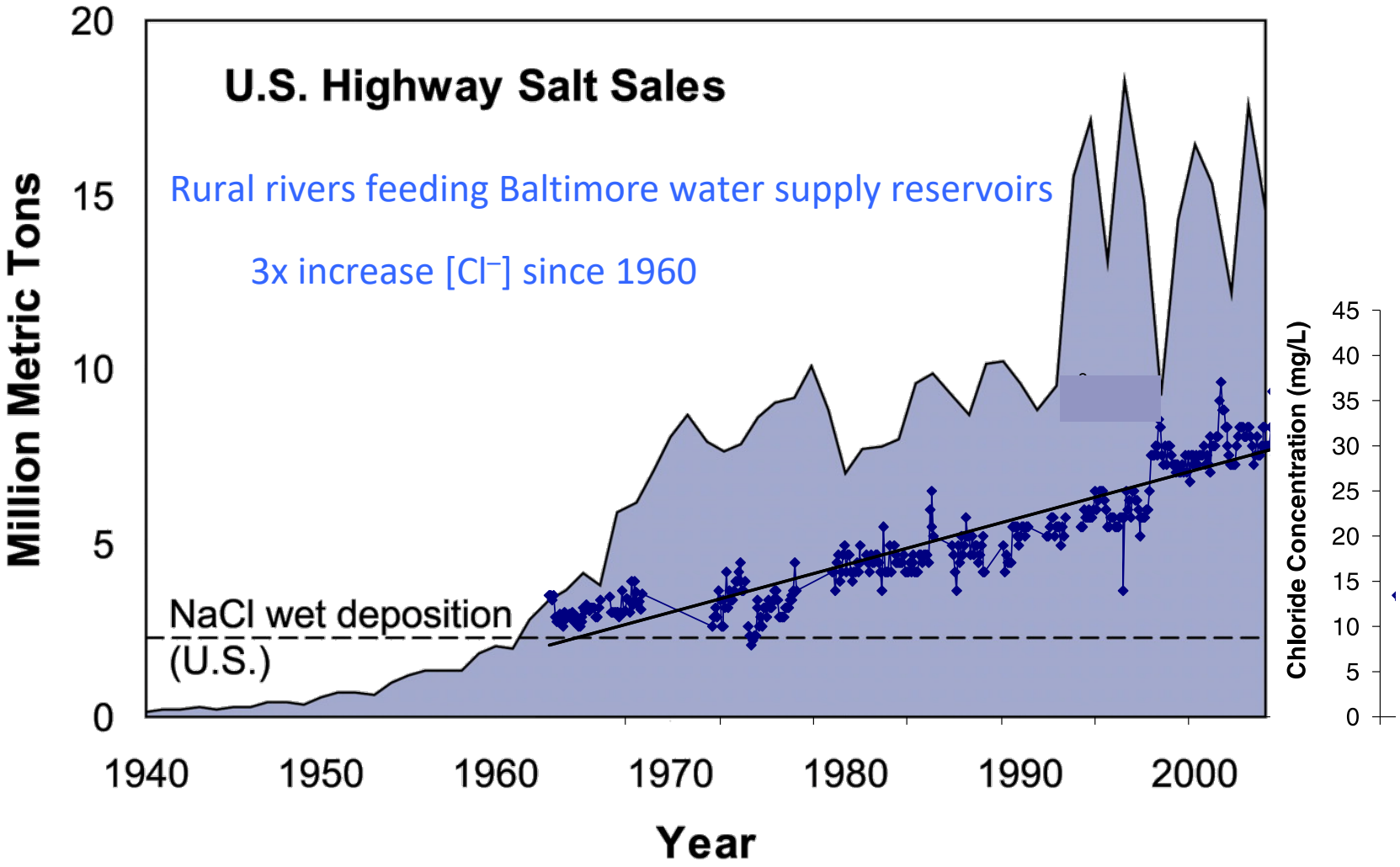


Figure 2. Illustration courtesy of the United States Environmental Protection Agency.

Schematic of a Drainfield

Increased road salt use & Cl^- *in streams*



Jackson R. B., Jobbágy E. G. (2005) *PNAS*; Kaushal & Belt (2012) *Urban Ecosys*

Road Salt Usage in Baltimore County

Fiscal Year	Storm Events*	Est. Lane Miles Maintained by SHA	Tons of Salt Applied by SHA	Tons of Salt Applied by SHA/Lane Mile/Event	Est. Lane Miles Maintained by BC**	Tons of Salt Applied by BC	Tons of Salt Applied by BC/ Lane Mile/Event
2000	6	1558	31931	3.4	6400	41668	1.1
2001	6	1558	26741	2.9	6430	47051	1.2
2002	2	1561	14128	4.5	6465	24105	1.9
2003	15	1561	59054	2.5	6517	102042	1.0
2004	10	1561	47420	3.0	6537	73380	1.1
2005	10	1561	40804	2.6	6567	72232	1.1
2006	4	1561	22878	3.7	6587	33947	1.3
2007	7	1561	37697	3.4	6615	62858	1.4
2008	7	1561	30901	2.8	6640	47806	1.0
2009	10	1577	37210	2.4	6663	43632	0.7
2010	10	1577	55027	3.5	6682	94477	1.4
2011	12	1674	29592	1.5	6694	82504	1.0
2012	6	1674	11570	1.2	6701	10611	0.3
2013	18	1674	25666	1.4	6711	36902	0.3
2014	20	1674	97094	2.9	6722	125309	0.9
2015	18	1674	49929	1.7			
AVE	**10.06**		**38603**	**3**		**59901.6**	**1.0**

* According to SHA data

** Lane Miles Estimated by Multiplying Linear Road Miles by 2.5

Typical Softeners

- 1 to 3 regeneration cycles/ week @ 50-75 gallons / cycle over 1-2 hours
- Use about 1 lb salt for 50 -100 gallons of water usage
- Studies show softeners will increase chloride levels in septic tank from 70-100 mg/l to 1500 -2000 mg/l

Water Softeners

- → Assuming 18,000 Systems in BC
- → Using 50 lbs Salt/Month
- = 5,400 Tons of Salt/Year
- = 5% of Total Road Salt Applied

Septic Systems

→ Assuming 36,000 Systems in BC

→ Using 300 gal/Day @ 70 mg/l Cl-

= 80 Tons of Salt/Year

= < 0.1% of Total Road Salt Applied

Common Beliefs

- → Salt discharge from softeners will hydraulically overload the drainfield
- → Salt will reduce the permeability of the drainfield
- → Salt will kill off the “good” bacteria in the septic tank

Common Beliefs

- → Salt reduces settleability in the tank thereby increasing solids moving to the drainfield
- → Salt will reduce the effectiveness of an ATU and void manufacturer warranty
- → Salt will increase corrosivity of the wastewater affecting the life of the concrete components

How to Manage Address Wells Impacted with Chlorides

- ➔ Remove From Water Using Reverse Osmosis (Very Inefficient)
- ➔ Drill New Well

Problems Related to R/O Treatment

- ➔ High Cost ($15 K - $20 K)
- ➔ Very Inefficient (1-3 gallons of wastewater for each gallon of clean water)
- ➔ Hydraulic Capacity Concern for Septic Systems
- ➔ Soil Permeability Concerns

Typical OSDS Design

- 150 gallon/day/bedroom
- Loading Rates of 0.6 -1.2 gal/ft^2/day
- Assumes Septic Tank Effluent
- Typical 4 Bdrm Home = 1500 gal Septic Tank and (2) 75’ trenches 2’ wide and 4’ deep

Questions Raised by R/O Usage

- ➔ Should discharge go to Septic System?
- ➔ If Yes, How to size field system?
- ➔ What are the Design Criteria?
- ➔ Should the R/O wastewater be separated?

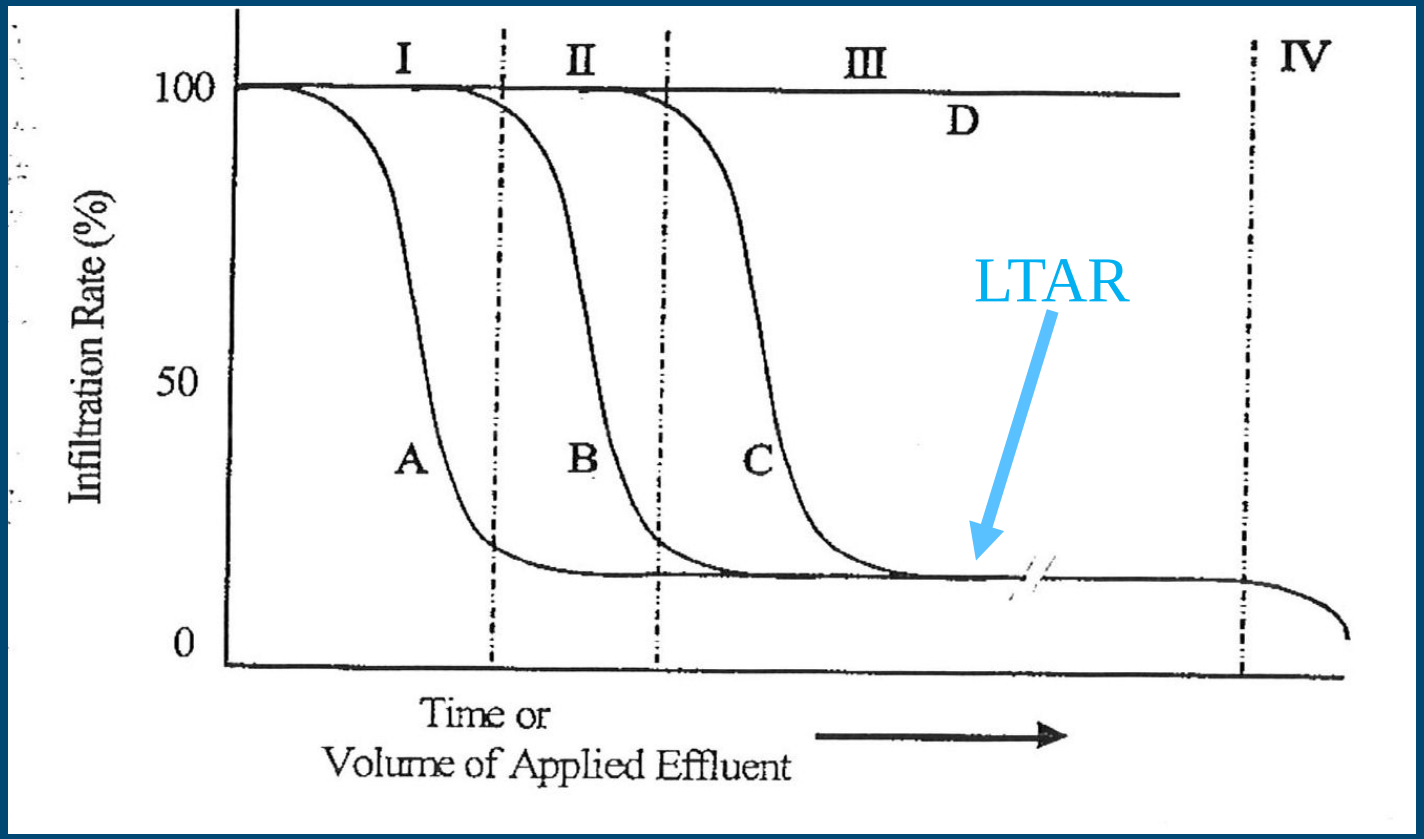
Maryland Regulation

- → Discharge to surface must be individually permitted by MDE
- → Discharge to Septic allowed provided adequate capacity
- → Bypass Tanks Recommended
- → 1/3 increase in L.R. Recommended

Other States

- → Rhode Island allows direct discharge to surface or OSDS
- → Massachusetts and Connecticut prohibit discharge to OSDS
- → Delaware – Need waiver to send to OSDS or can send to French drain
- → Penn. – Allows discharge to OSDS
- → Virginia – Allows discharge to OSDS

Study by Siegrist (1987)



Siegrist Article (2006) from Small Flows Quarterly

Table 3-Soil Classification Scheme for Selecting HLR_D Values for STU Design

Soil class	Representative soil textures with structures that yield the representative hydraulic conductivity values shown	Representative cleanwater hydraulic conductivity (gpd/ft^2)	Maximum daily hydraulic loading rate (gpd/ft^2)
Class I	Sand, loamy sand	250 (1000 cm/d)	12.5 (50 cm/d)
Class II	Sandy loam, loam, silt loam	25 (100 cm/d)	2.5 (10 cm/d)
Class III	Silty clay loam, clay loam	2.5 (10 cm/d)	0.25 (1 cm/d)

Effect of Sodium on the Soil

- → Many studies show decrease in H.C. for clay soils
- → Tyler et al.(1978) say softeners should not be a problem for H.C.
- → One study suggests using K Cl vs Na Cl
- → May not be an issue for deep trenches in saprolite

Current Approach in B.C.

- ➔ Evaluate the existing system, flows, and capacity
- ➔ Recommend Water Metering
- ➔ Recommend Separate Trench for R/O Wastewater with Obs. Ports
- ➔ Design on 2 x L.R. for STE

Questions ?