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## A Jurisdiction Review of Groundwater (Drinking Water) Pathway Assessments

Sheila Duchek, M.Sc., P.Geo.



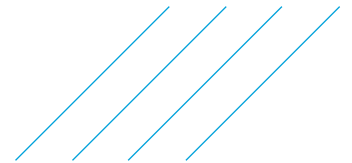
## Our vision

We strive to be the premier engineering solutions partner, committed to delivering complex projects from vision to reality for a sustainable lifespan.



## Outline: Drinking Water Protection Jurisdiction Review

- › Purpose – Why?
- › Canadian Policies
  - › Alberta
  - › British Columbia
  - › Saskatchewan
  - › Manitoba
  - › Ontario
  - › Quebec
- › International Policies
  - › United Kingdom
  - › Germany
  - › United States – Florida
  - › United States – Kansas
  - › United States – Nevada



## Shout Outs!

**THANK  
YOU!**



- › British Columbia – Jenna Seitz, *P.Geo.*
- › Saskatchewan – Alexis Harvey, *Ph.D.*
- › Manitoba – Kelsey Rutherford, *B.Sc., P.Eng*
- › Ontario – David Tarnocai, *M.Sc., P.Geo.*
- › Quebec – Luis Bayona, *géo., M.Sc.*
- › United Kingdom – Duncan Cartwright
- › Florida – Bradley Bayne, *PG*





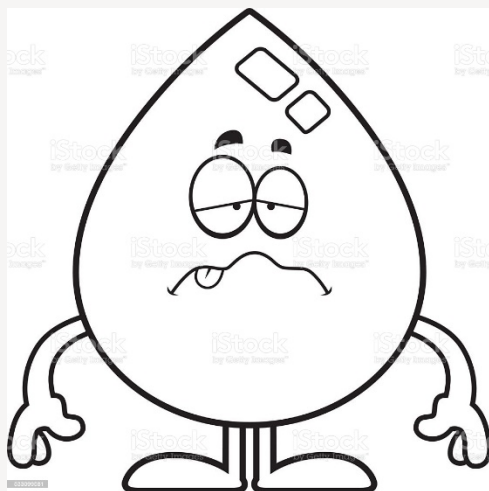
## The Problem



## The Problem

Groundwater  
Monitoring  
Programs

Remediation  
Targets



Risk  
Assessments

Risk  
Management  
Plans

## What is the purpose of this talk?

- › Exposure to other management strategies for contamination near and within groundwater resources
- › Alternatives for supporting lines of evidence
- › Gain insight to the minds of the regulatory authorities
- › May bring to light new points of discussion that would otherwise have not been considered
- › Precedent may prove to be incredibly influential in similar cases
- › Fundamental tenets are likely the same; improving policy and adapting to changes for future policies.



# Select Canadian Jurisdictions



## British Columbia: Protocol 21

### Key Points of Protocol 21:

- › Is aquifer currently used for a drinking supply?
- › Could aquifer be a future drinking supply?
  - › Aquifer hydraulic properties: yields, thickness, composition (fill)
  - › Water Quality
- › BC Water Resource Atlas
- › Natural Confining Barriers



Ministry of  
Environment and  
Climate Change Strategy

## ***PROTOCOL 21 FOR CONTAMINATED SITES***

### **Water Use Determination**

Prepared pursuant to Section 64 of the  
*Environmental Management Act*





BRITISH  
COLUMBIA

## BC Water Resources Atlas

Navigation

Markup

Query

Analysis



Full Extent



Zoom In



Zoom Out



Pan



Back



Forward



Print



Identify



Albers



Lat / Long



UTM

Navigation Tools

Printing

Location I...

Zoom To

Layers



I want to...

Filter Layers...



Filter



Operational Layers

- ☒ Aquifers
- ☒ Water Wells
- ☒ Water Licensing
- ☒ Dams
- ☒ Flood Protection / Dikes
- ☒ Snow Survey Sites
- ☒ Geology
- ☒ Hydrometric
- ☒ Water Quality and EMS
- ☒ Watersheds



<https://maps.gov.bc.ca/ess/hm/wrbc/>



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# British Columbia's Protocol 21: Current and Future Drinking Water Use Evaluation for Unconsolidated Aquifers

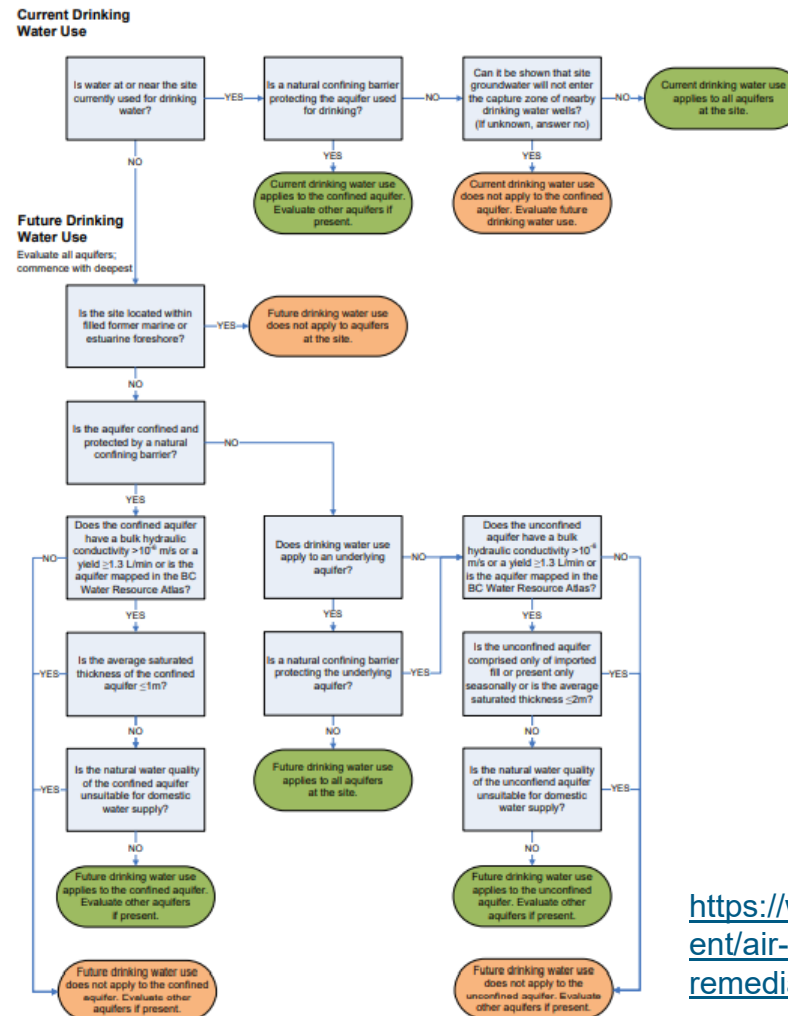


Figure 1. Current and future drinking water use evaluation for unconsolidated aquifers.

[https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/protocol\\_21.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/protocol_21.pdf)

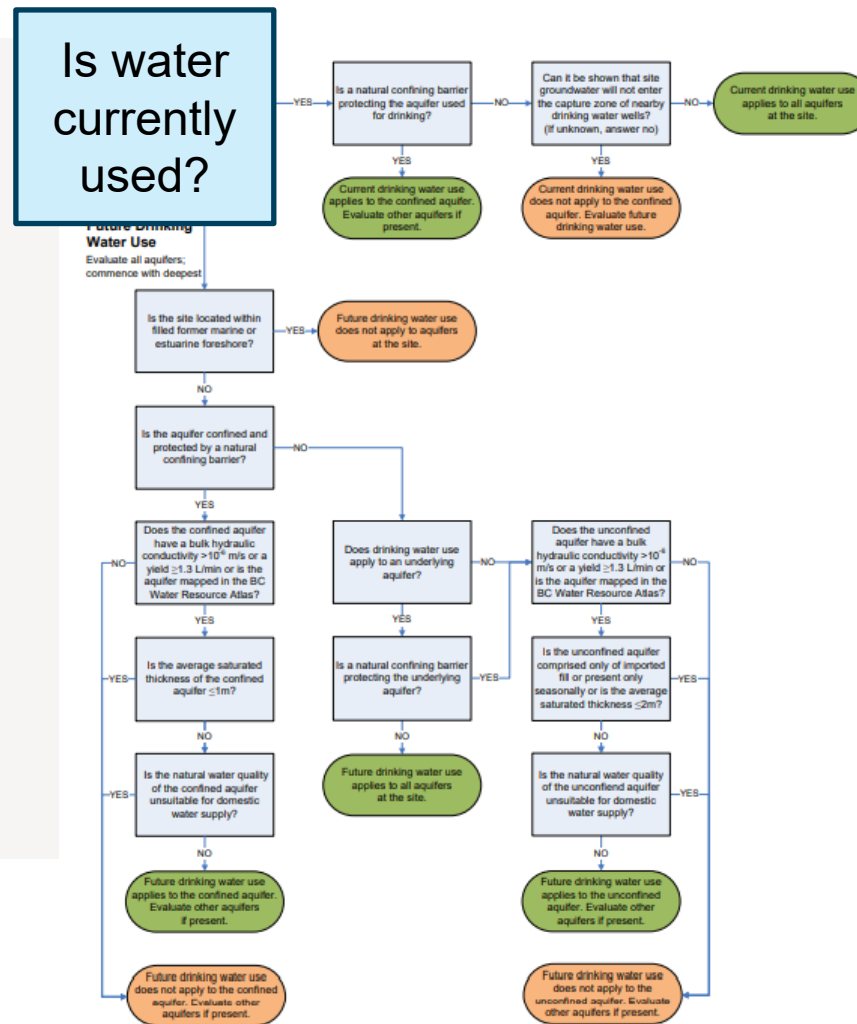


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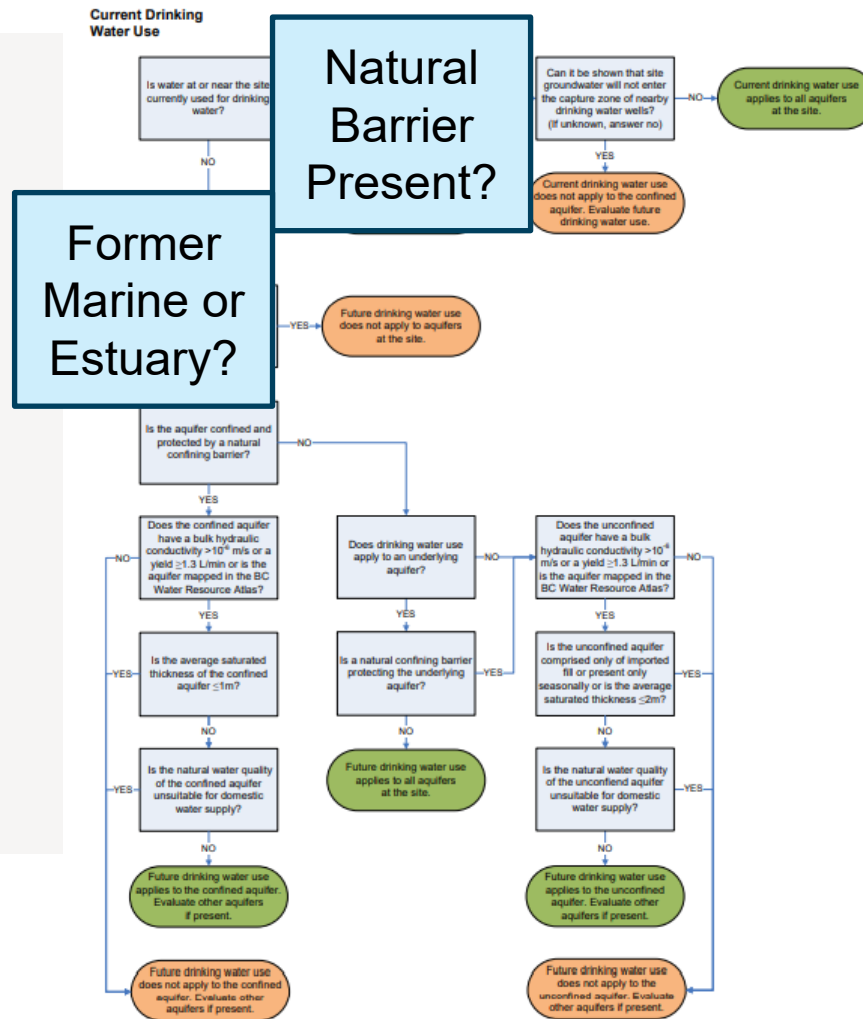


Figure 1. Current and future drinking water use evaluation for unconsolidated aquifers.



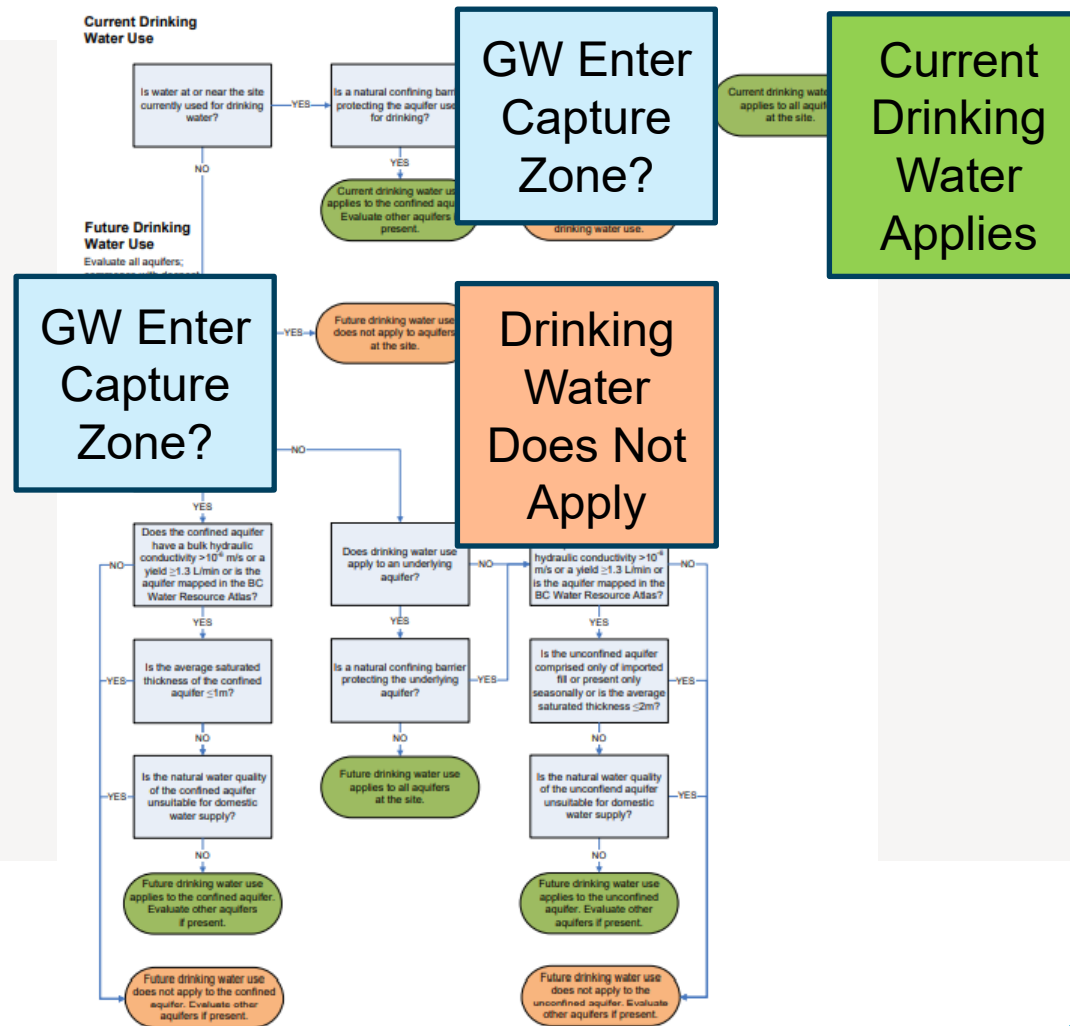


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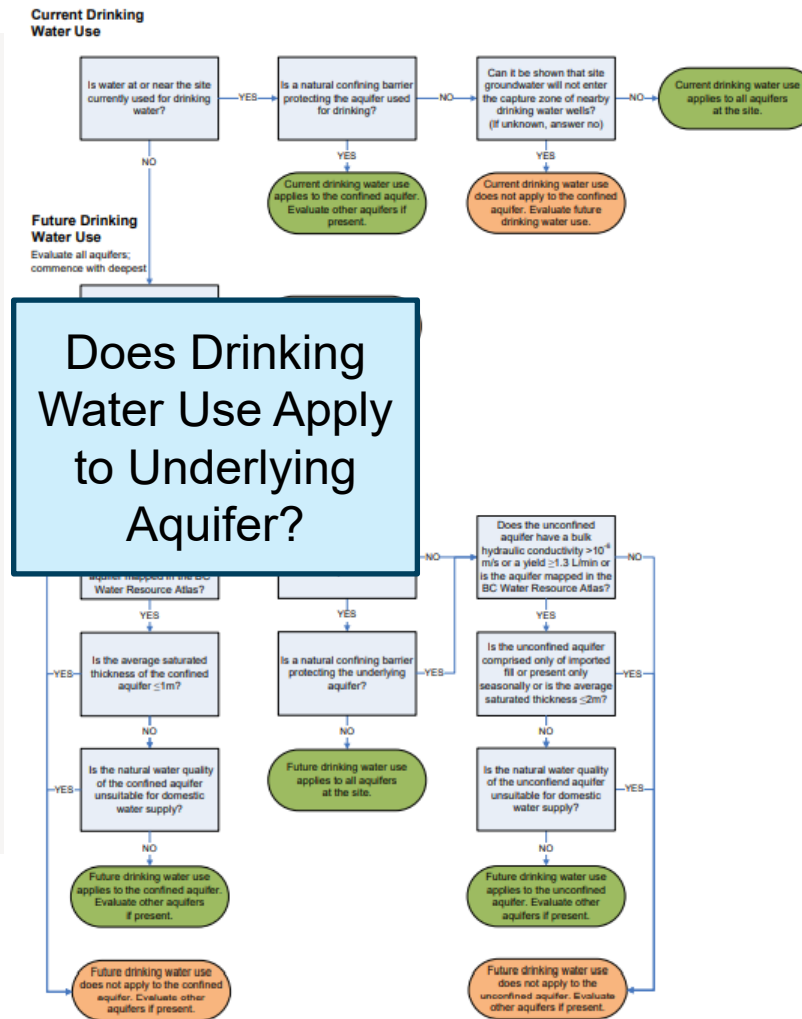


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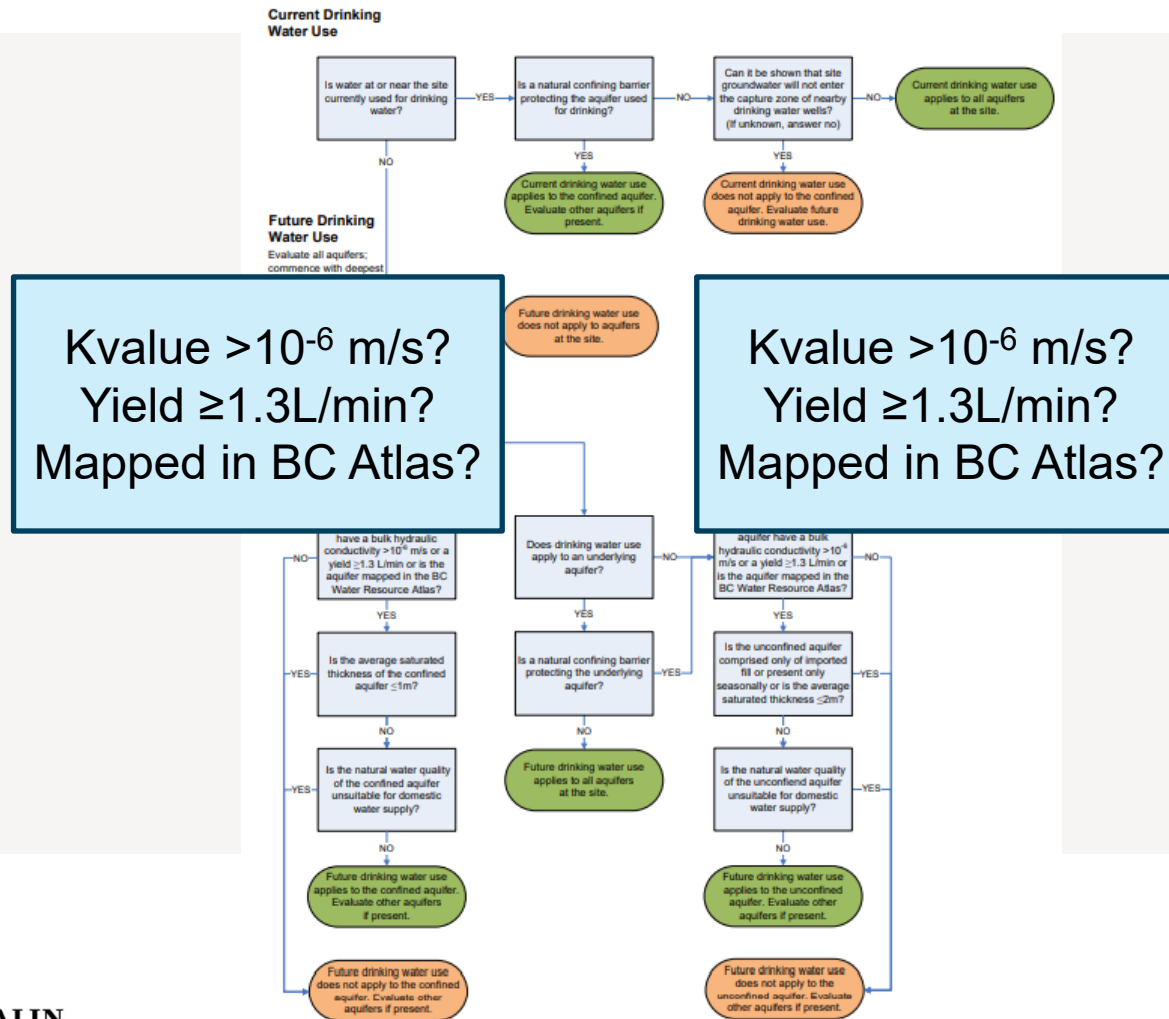


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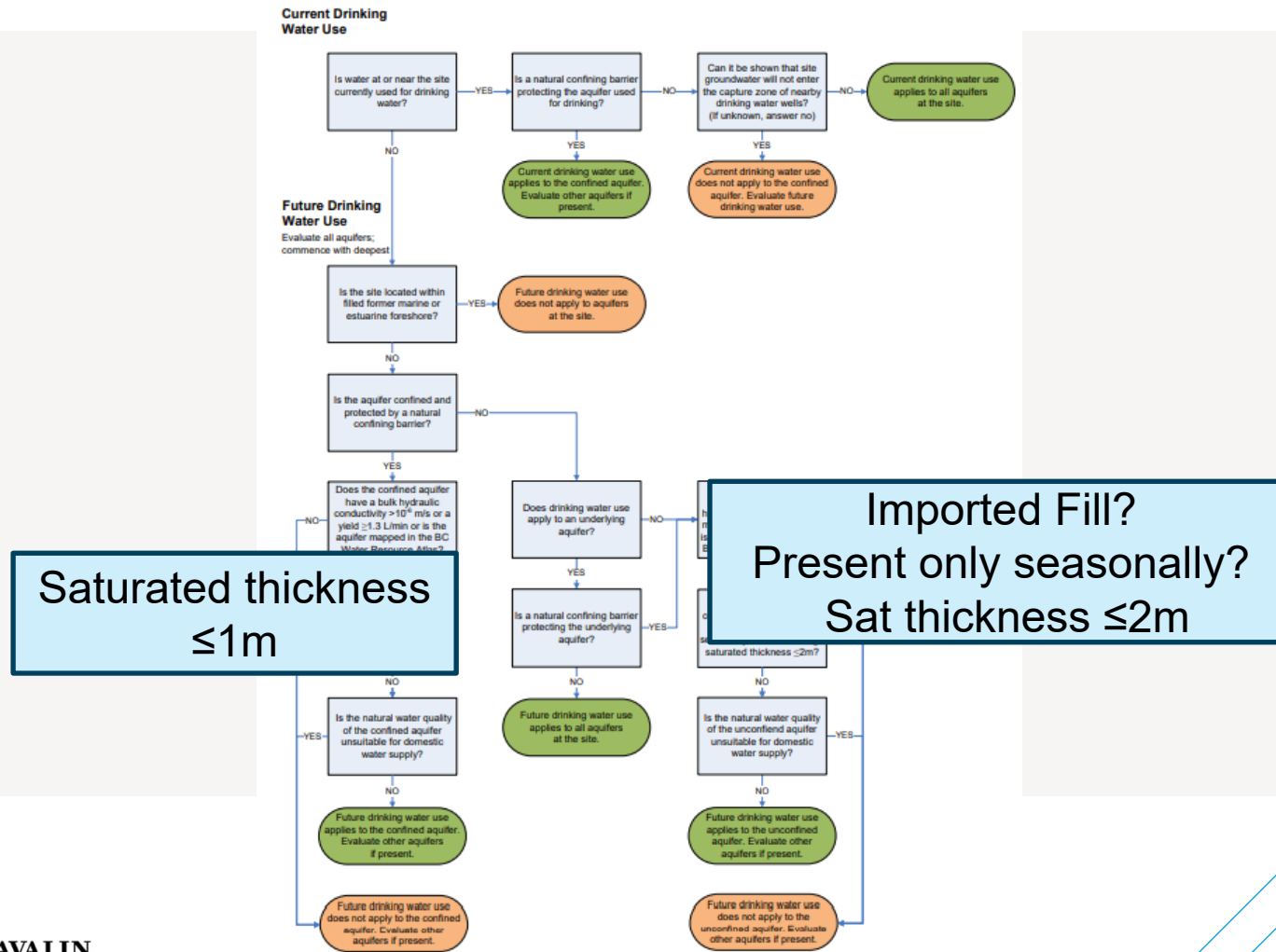


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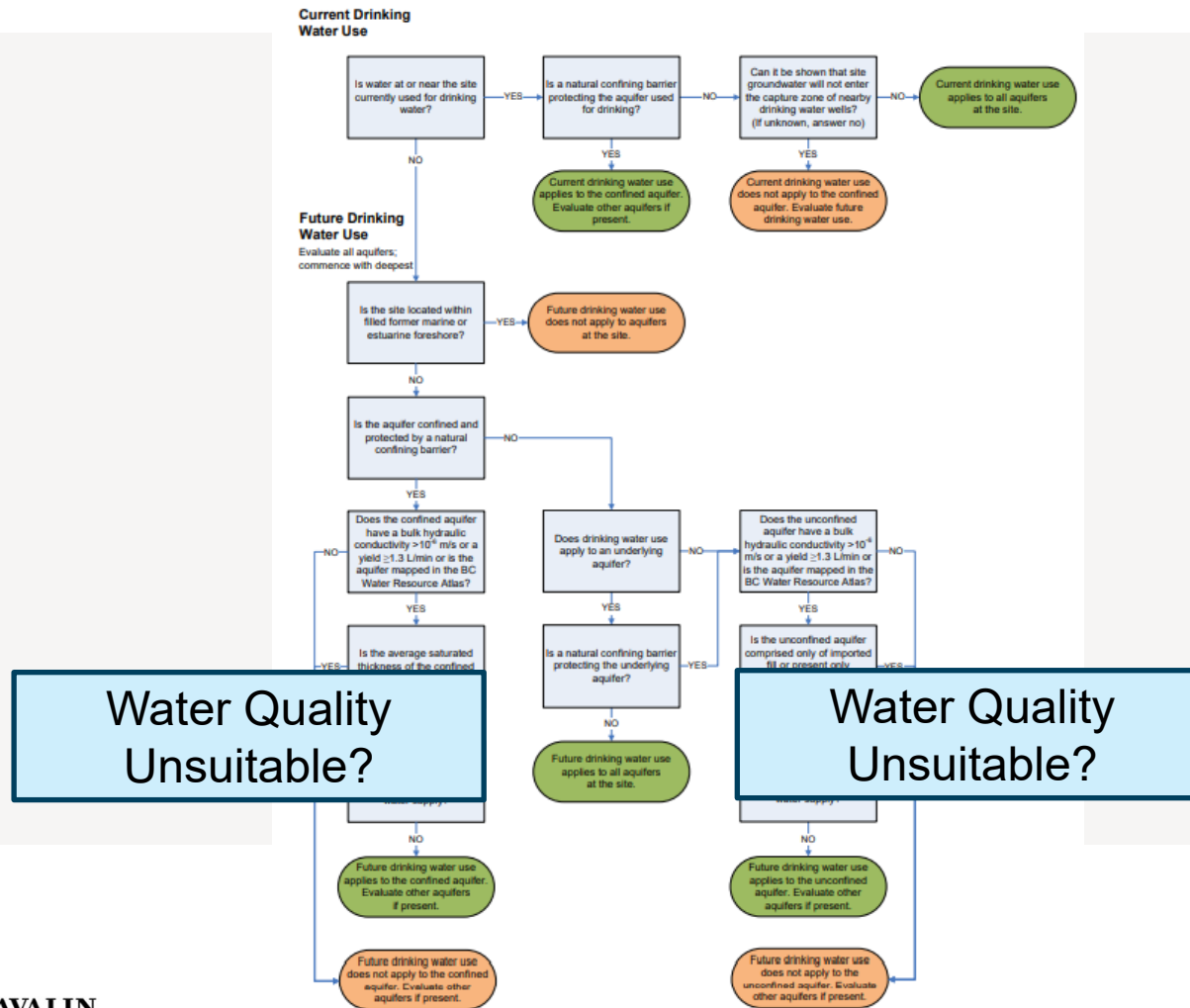
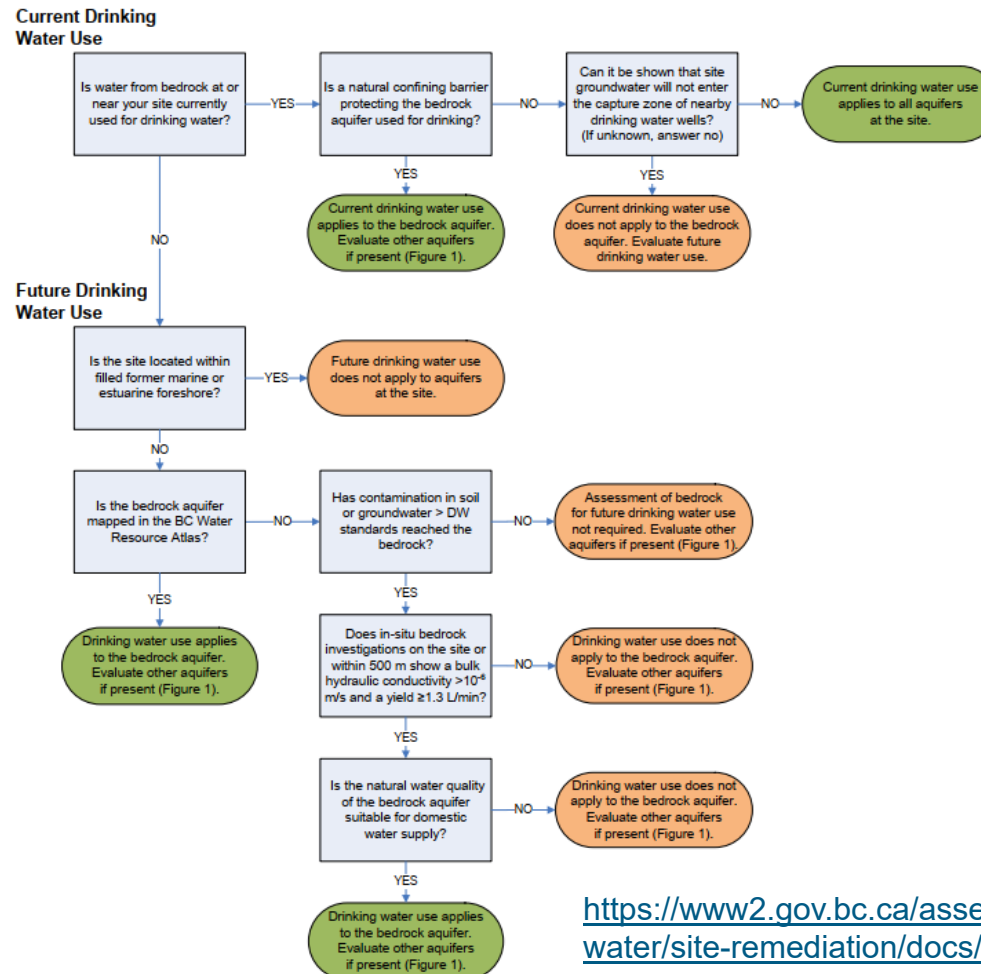


Figure 1. Current and future drinking water use evaluation for unconsolidated aquifers.



# British Columbia's Protocol 21: Current and Future Drinking Water Use Evaluation for Bedrock Aquifers



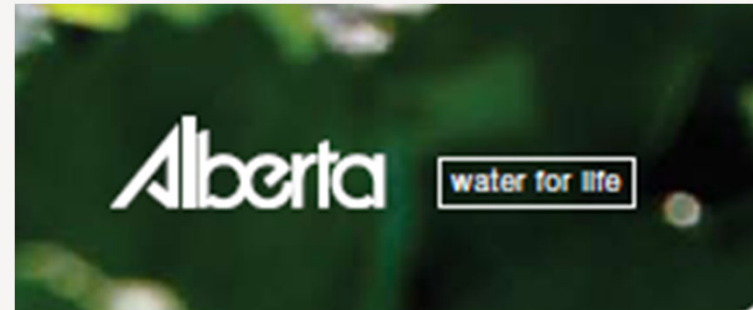
[https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/protocol\\_21.pdf](https://www2.gov.bc.ca/assets/gov/environment/air-land-water/site-remediation/docs/protocols/protocol_21.pdf)

Figure 4. Current and future drinking water use evaluation for bedrock aquifers.

## Alberta's Water For Life

The policy has three goals:

- › safe, secure drinking water supply
- › healthy aquatic ecosystems
- › reliable, quality water supplies for a sustainable economy



<https://www.alberta.ca/water-for-life-strategy.aspx>



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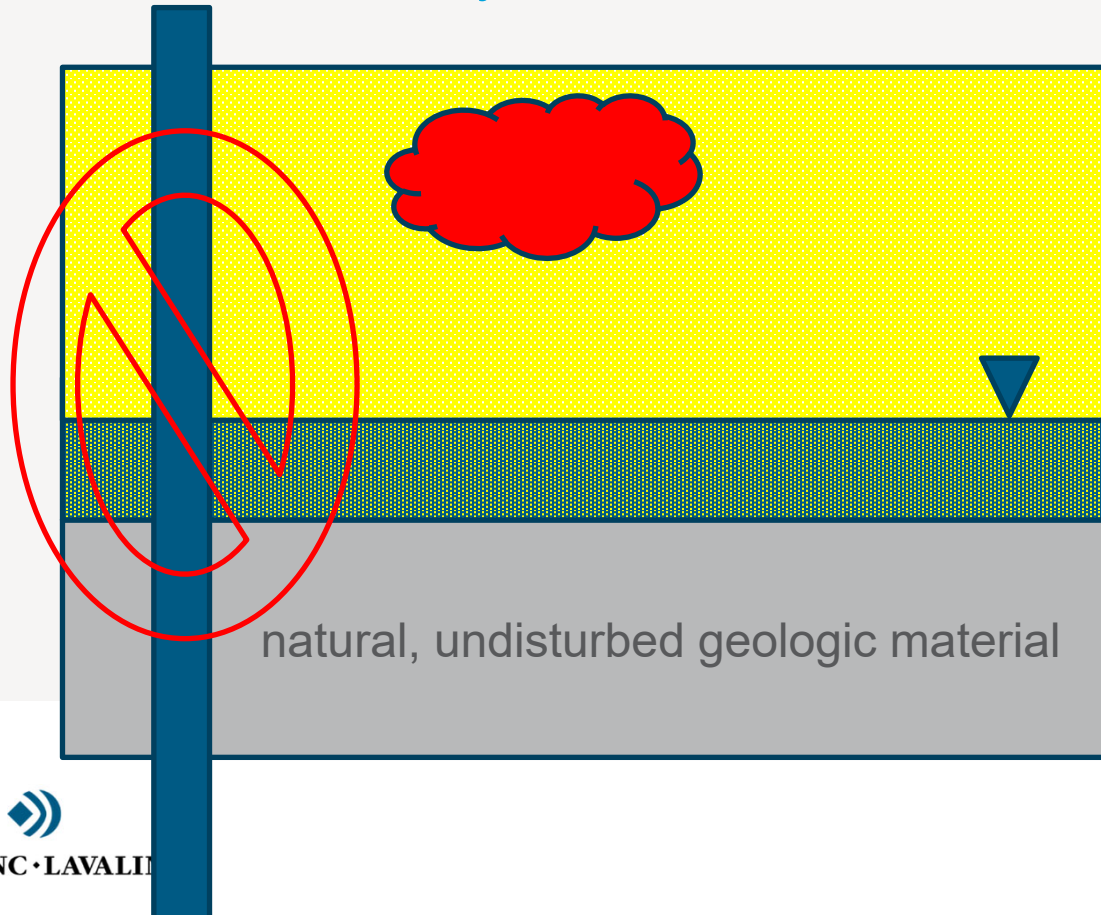
## **Alberta Tier 2 Soil and Groundwater Remediation Guidelines**

January 10, 2019

<https://open.alberta.ca/publications/1926-6251>



## Alberta DUA Pathway Exclusion Assessment



Is  $K < 1 \times 10^{-6}$  m/s?

Is barrier >5 m thick?

Is  $K < 1 \times 10^{-7}$  m/s?



# Saskatchewan

## Endpoint Selection Standard

Saskatchewan Environmental Code



<http://www.environment.gov.sk.ca/Default.aspx?DN=04d5ace5-487f-4f08-9a05-c494dce3e202>



Saskatchewan Ministry of Environment

## GUIDANCE DOCUMENT: Impacted Sites



Government  
of  
Saskatchewan

<http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=9ebfbc0e-9f39-4078-8d70-7c949af2e91c>



## Saskatchewan



Potable groundwater pathway for soils can be eliminated if:

1. Only PHCs or BTEX; no other contaminants are present; **and**
2. Either:
  - › controls prevent contaminant from reaching a potable water aquifer
  - › groundwater present at the site does not meet the definition of a potable water aquifer
  - › contaminant will attenuate to less than the endpoint value before reaching potable water aquifer

Potable groundwater pathway may also be eliminated if:

1. the impacted site is less than 500 m outside the city boundary; **and**
2. there are no water wells within 500 m of the site; **and**
3. water is supplied that is safe for human consumption



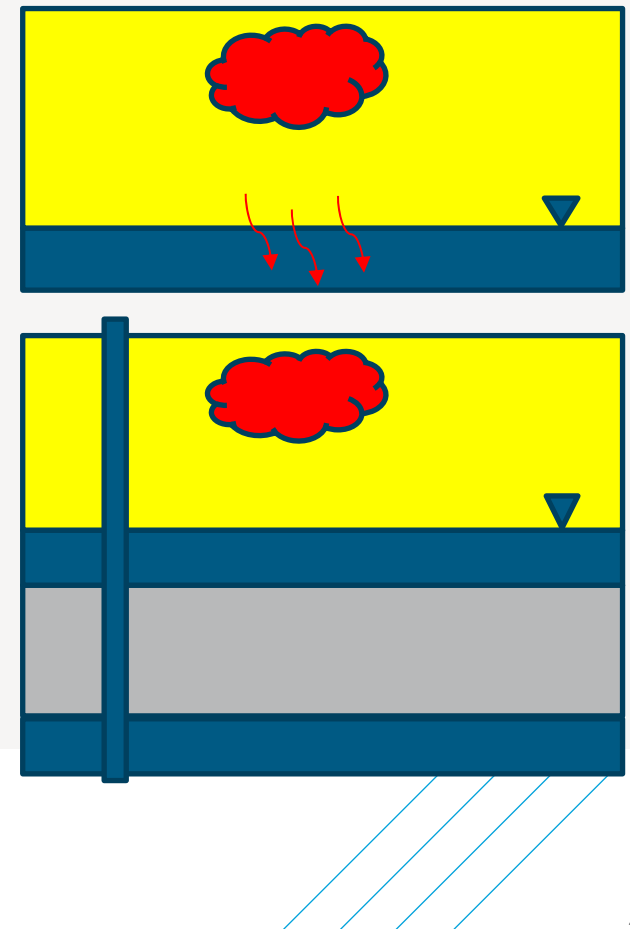
## Saskatchewan

If soil impacts have not reached groundwater, consider soil properties and connectivity to water table.

The potable groundwater pathway - applicable where groundwater is (or has potential) for domestic use.

Therefore, applicability is determined by:

- › Is a potable water aquifer present?
- › If so, is there a geologic barrier between the plume and the aquifer?



Manitoba



THE CONTAMINATED SITES REMEDIATION ACT  
(C.C.S.M. c. C205)

**Contaminated Sites Remediation Regulation**

[https://gov.mb.ca/sd/pubs/waste\\_management/contams/groundwater\\_criteria.pdf](https://gov.mb.ca/sd/pubs/waste_management/contams/groundwater_criteria.pdf)



MANITOBA

THE CONTAMINATED SITES  
REMEDATION ACT

C.C.S.M. c. C205

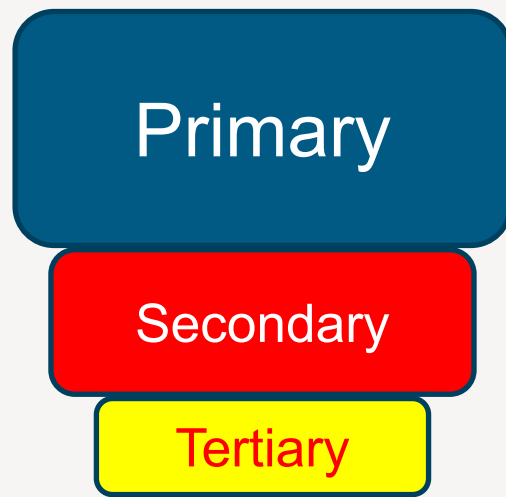
LOI SUR L'ASSAINISSEMENT DES  
LIEUX CONTAMINÉS

c. C205 de la C.P.L.M.



<https://web2.gov.mb.ca/laws/statutes/ccsm/pdf.php?cap=c205>

Manitoba



Canadian Council Ministers of the Environment

Ontario Ministry of the Environment

Alberta Environment and Parks



Ontario



**Environmental Protection Act**  
**Loi sur la protection de l'environnement**

**ONTARIO REGULATION 153/04**

**RECORDS OF SITE CONDITION — PART XV.1 OF THE ACT**





# Safe Drinking Water Act, 2002

## S.O. 2002, CHAPTER 32

**Consolidation Period:** From April 19, 2021 to the e-Laws currency date.

Last amendment: 2021, c. 4, Sched. 10, s. 7.



## Ontario: Record of Site Condition Application

You must apply potable water guidelines if:

- › the boundaries of the property are within 250 m of a municipal drinking water system (as defined in the Safe Drinking Water Act, 2002) AND
- › land use type is NOT specified as agricultural or other use

A Drinking Water System could be:

- › area designated: a well-head protection area
- › other designation identified by the municipality for protecting groundwater
- › areas with a well used (or intended for use) as a source of water for human consumption or agriculture

Municipality must agree to, in writing, acceptance of a non-potable designation





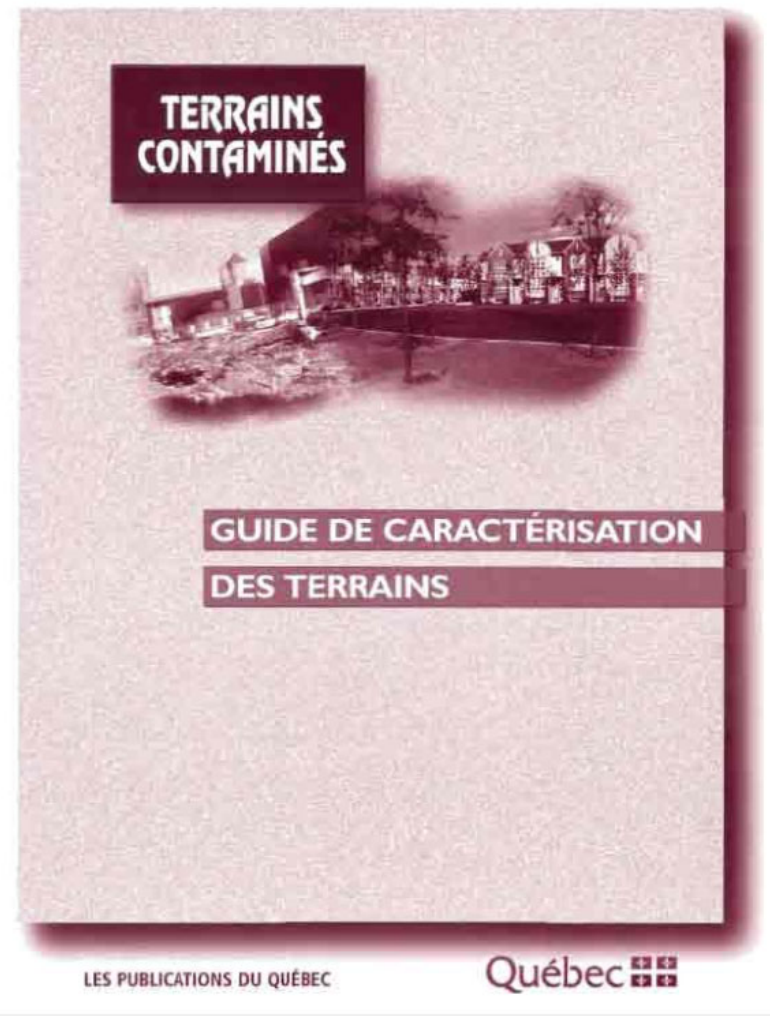
## POLITIQUE DE PROTECTION DES SOLS ET DE RÉHABILITATION DES TERRAINS CONTAMINÉS

Plan d'action  
2017-2021

[https://www.environnement.gouv.qc.ca/  
sol/terrains/politique/index.htm](https://www.environnement.gouv.qc.ca/sol/terrains/politique/index.htm)



[https://www.environnement.gouv.qc.ca/sol/  
terrains/guide/guidecaracterisation.pdf](https://www.environnement.gouv.qc.ca/sol/terrains/guide/guidecaracterisation.pdf)



Drinking water criteria that apply to potable water supplies depend on the aquifer classification. There are three classes of aquifers:

- › ‘*Classe I*’ – Proven irreplaceable water supply, good deliverability
- › ‘*Classe II*’ – Proven source currently used (or could be) for water supply
- › ‘*Classe III*’ – Not an aquifer (insufficient quality, quantity or withdrawal extraction is not economical)

Drinking water criteria applies to Class I and II aquifers. Decontamination of groundwater must be conducted if impacts move offsite or if land-use changes.

# United States Jurisdictions

## Florida – 62-520

- › Defines the classes of Groundwater within Florida.
- › The higher the quality of groundwater in the aquifer (i.e., potable), the more protection required, and so water quality standards most stringent.
- › These aquifers are currently being used for potable water supply or could be used for such in the future.
- › Lower quality aquifers may be naturally high in chlorides because of seawater.

<https://floridadep.gov/waste/waste-cleanup>



## Florida – 62-777

- › Cleanup Target Levels (cleanup criteria) for groundwater, surface water, and soils.
- › 62-777 references 62-550 (the Aquifer Classification Statute) because it provides the most important criteria for drinking water.
- › For a site to be considered “clean”, it generally must achieve both the soil and groundwater criteria in 62-777.
- › Florida ranks their contaminated sites by priority: so a site off in the swamp would be given a lower priority by the State.
- › 3 site classes with priorities: “petroleum, dry cleaning, waste facilities”

<https://floridadep.gov/waste/petroleum-restoration>



## Florida – 62-780

- › FDEP allows certain sites to achieve “No Further Action with Conditions”
- › Contaminated groundwater (exceeds DW standards and 62-777 criteria) is allowed to remain, but with conditions:
  - › the groundwater plume is  $\frac{1}{4}$  acre or smaller (1000m<sup>2</sup>)
  - › the plume is stable or shrinking
  - › there is no threat to a drinking water supply
  - › no on-going source (soil contamination) is present
- › In these cases, FDEP imposes an “institutional” control, prohibit installing groundwater wells AND limits disturbances of the contaminated water.
- › The institutional control follows the property deed.



## Kansas

Antidegradation guidance presents three tiers for maintaining and protecting water quality and designated uses:

- › Tier 1 protection of highest quality
- › Tier 2 protection of high-quality waters, based on assigned designated use
- › Tier 3 special protection for Outstanding Resource Waters

## KANSAS ANTIDEGRADATION POLICY



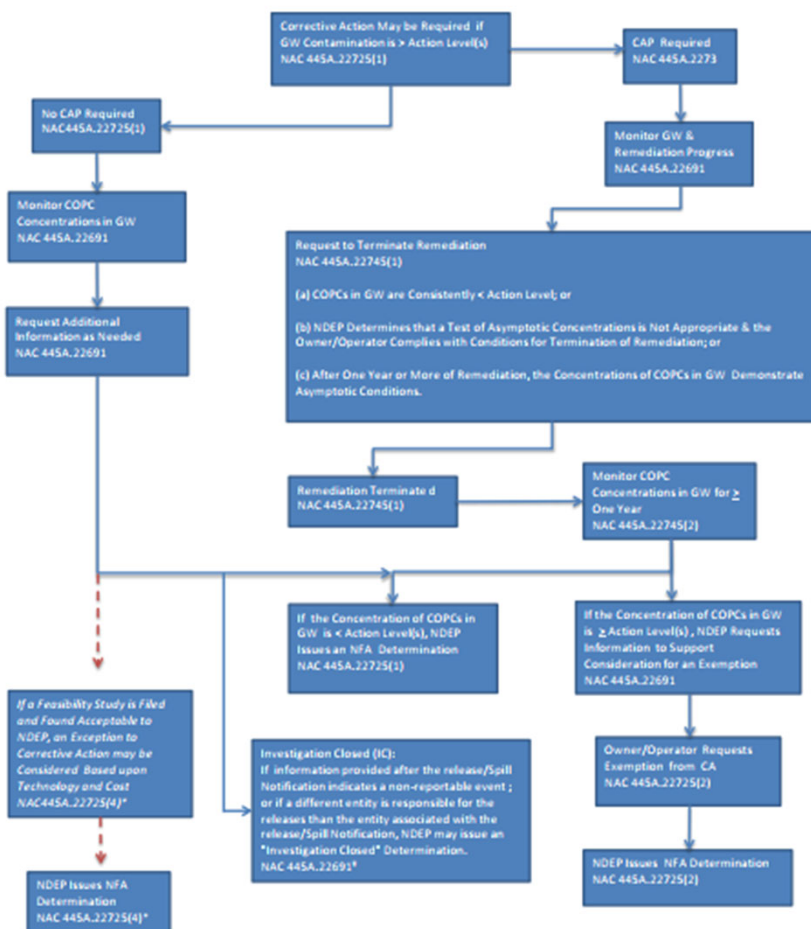
<https://www.kdheks.gov/tmdl/download/>



# Nevada

## Pathways to Closure For BCA Cases with Groundwater Contamination

June 2014



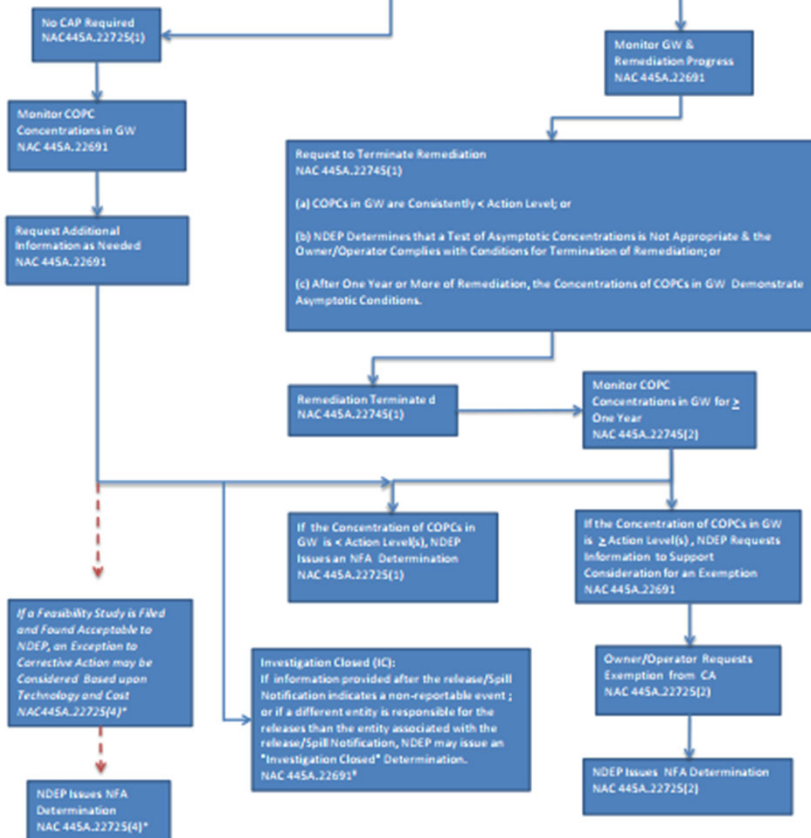
[https://ndep.nv.gov/uploads/env-sitecleanup-guidance-docs/Path to Closure Process.pdf](https://ndep.nv.gov/uploads/env-sitecleanup-guidance-docs/Path%20to%20Closure%20Process.pdf)

# Nevada

Pathways to Closure

June 2014

## GW Contamination > Action Levels



[https://ndep.nv.gov/uploads/env-sitecleanup-guidance-docs/Path to Closure Process.pdf](https://ndep.nv.gov/uploads/env-sitecleanup-guidance-docs/Path%20to%20Closure%20Process.pdf)

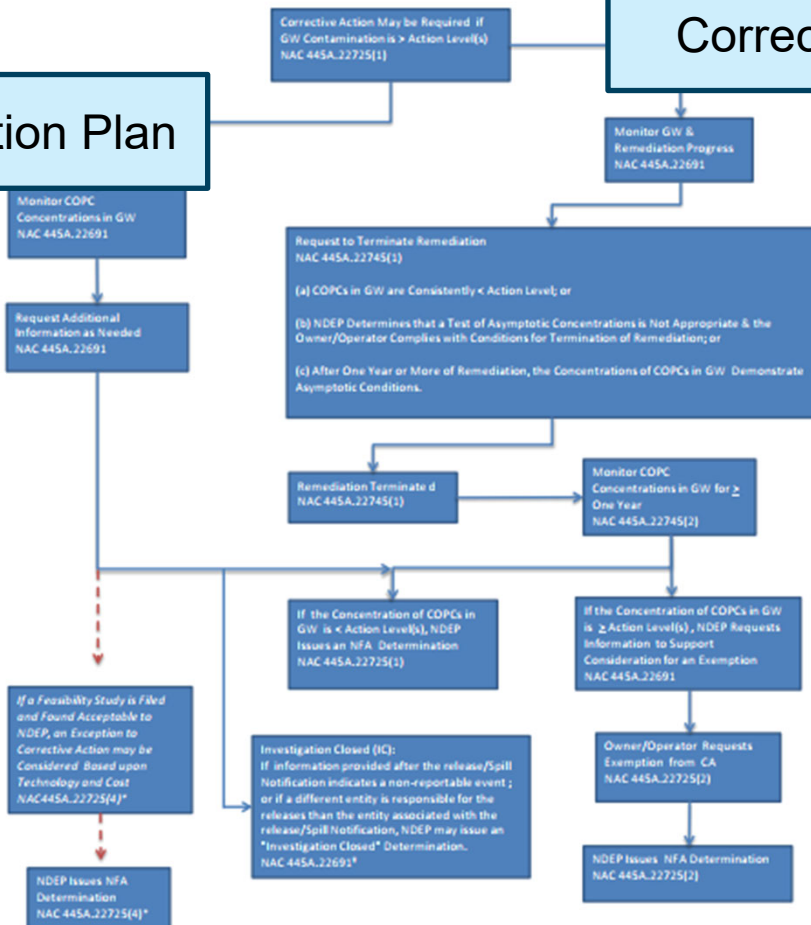
Nevada

No Corrective Action Plan

Pathways to Closure  
For BCA Cases with Groundwater Contamination

June 2014

Corrective Action Plan

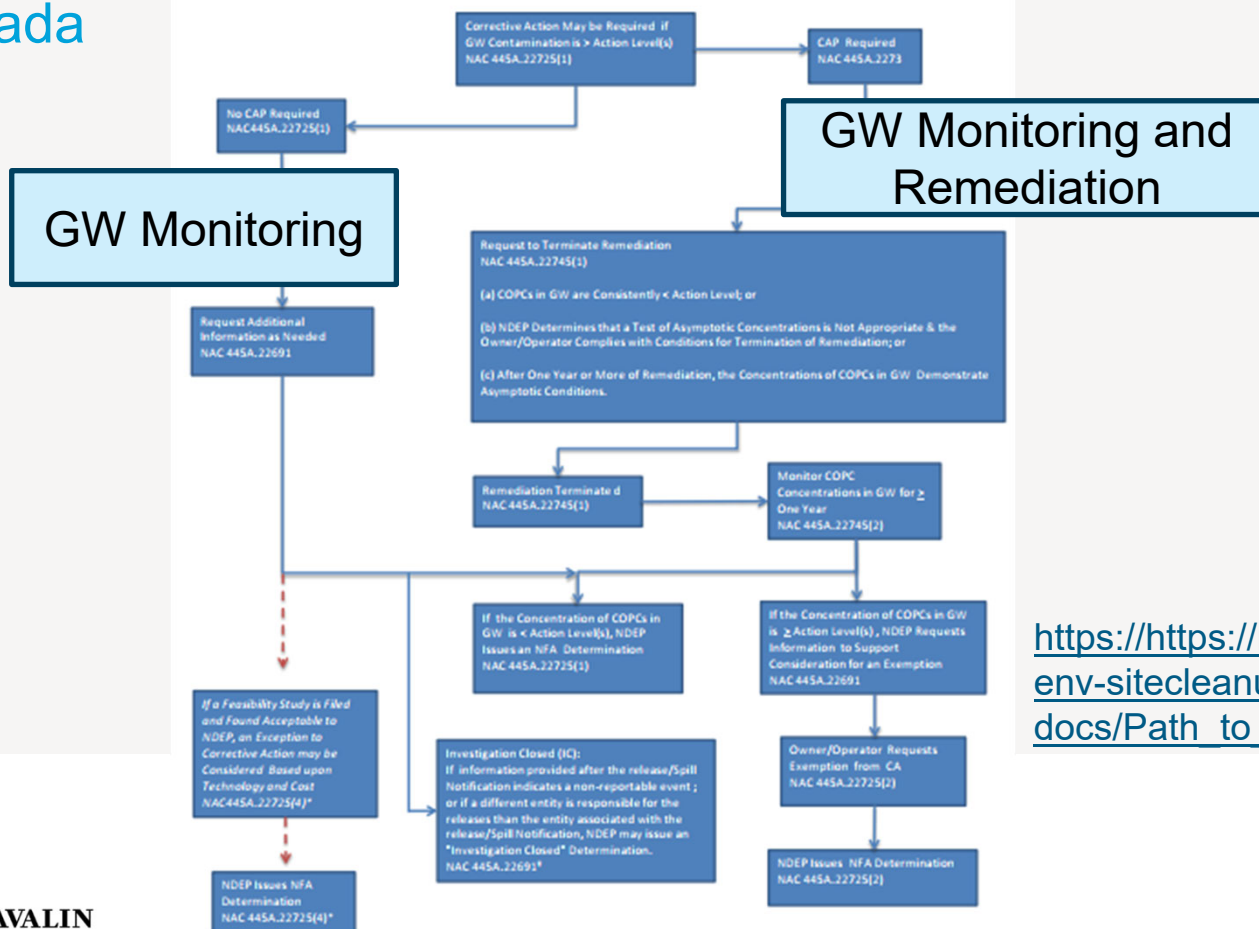


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# Nevada

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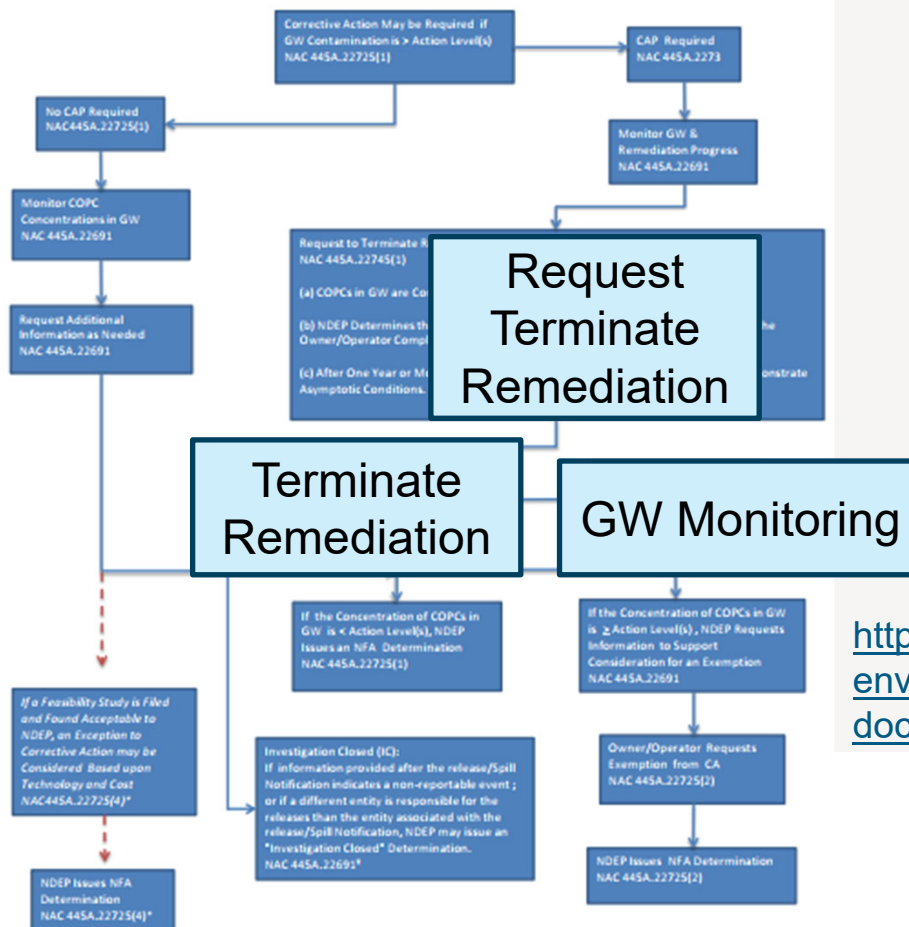
June 2014



# Nevada

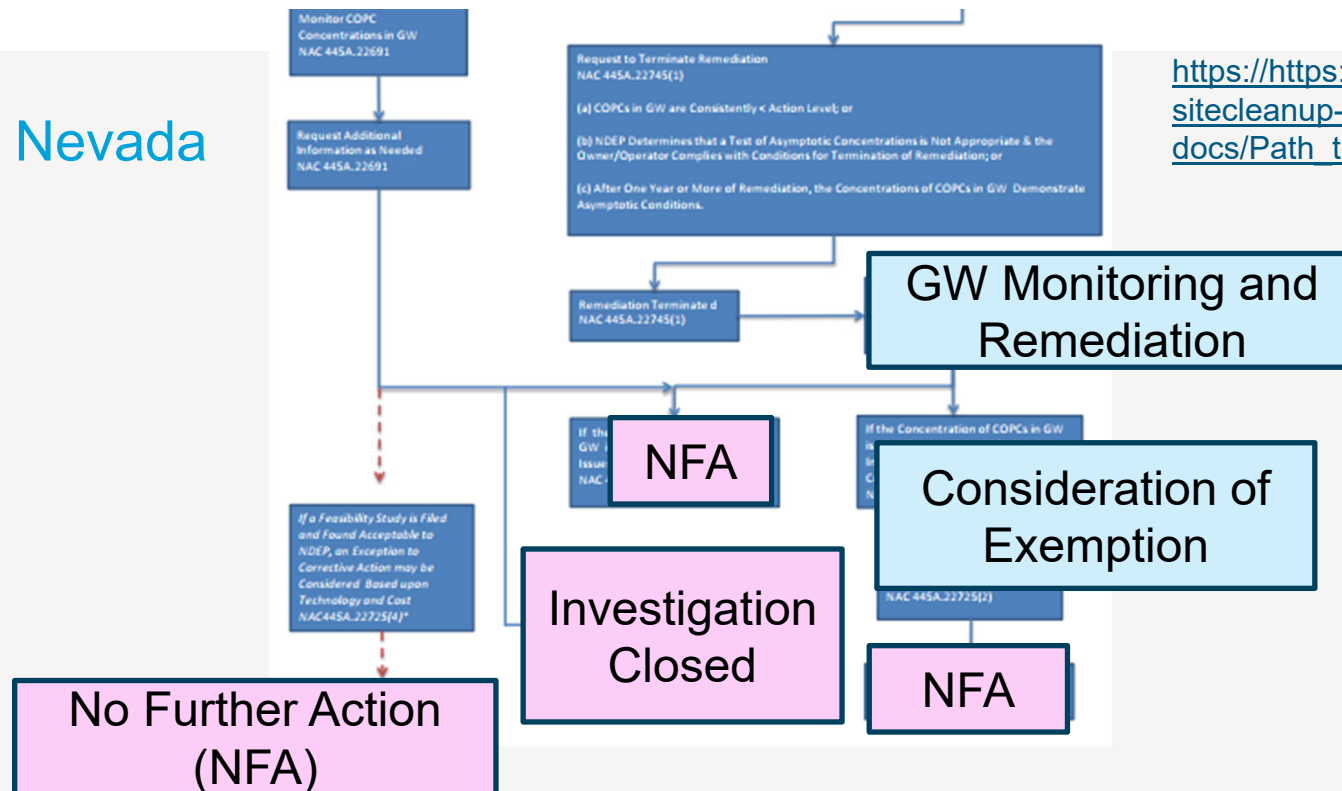
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# United Kingdom Jurisdictions



## UK's Regulatory Regime (legacy contaminated land sites only)

Two regulatory drivers for potentially contaminated land sites:

- › Planning Regime
  - › Development of a site under planning permissions
  - › Site conditions have to be 'suitable for use' and therefore, no unacceptable risks to human health or environment
- › Environmental Protection Act 1990: Part 2A.
  - › A specific legislation for management of Contaminated Land
  - › Initial onus is on Local Authorities to investigate and determine if specific land is contaminated or otherwise
  - › Principles are followed to manage legacy sites or developing brownfield land

Regardless of regulatory route, process of assessment is effectively the same



## UK's Risk Assessment Process (Water Environment)

Contaminated land sites assessment takes a risk-based approach – generally same for all of UK; Scotland has minor differences.

There are three key tiers to assessment:

1. Preliminary Risk Assessment – establish a conceptual site model and identify relevant sources, pathways and receptors
2. Generic Quantitative Risk Assessment – uses generic assessment criteria
3. Detailed Quantitative Risk Assessment – based on detailed site-specific information to understand fate and transport from a source to a compliance point

All tiers of assessment rely on site-specific information.

Certain receptors can be discounted if no source-pathway-receptor linkage.



## UK Groundwater (and Surface Water) Assessment Requirements

- › There is no explicit requirement to assess water resources, only relevant receptors
- › Most cases justify both drinking water and environmental quality standards and generally, risk is modelled independently
- › Outcomes of any quantitative risk assessment can be highly variable, even before the physical and chemical characteristics of the hydrogeological regime!



## Mandatory Compliance Point Distances

Receptor	Hazardous Substance Compliance Point Distance (m)	Non-hazardous Pollutant Compliance Point Distance (m)	Comment
Groundwater Resources – Principal Aquifer	50	250	Negligible opportunity to extend compliance point distances from default values
Groundwater Resources – Secondary Aquifers	50	250	Possible to extend compliance point distances under certain circumstances, where justification that the aquifer will unlikely have future resource potential
Unproductive Strata	No compliance point – assess as a pathway only	No compliance point – assess as a pathway only	Groundwater resources assessment not required
Surface Water Receptors	Distance from source to the point of groundwater entry immediately up-gradient of the surface water	Distance from source to the point of groundwater entry immediately up-gradient of the surface water	There is potential to allow for dilution in the surface water. However, this is only allowed under very limited circumstances

# Germany

## Groundwater Directive



Federal Ministry  
for the Environment, Nature Conservation  
and Nuclear Safety

- › Criteria for groundwater contaminant based on standards and procedures for assessment developed from uniform EU-wide quality standards
- › Each EU country derives national threshold values (national quality standards)



## Good VS Bad



Federal Ministry  
for the Environment, Nature Conservation  
and Nuclear Safety

- › The principal element of the German Groundwater Directive is to distinguish between “good” and “bad”.
- › Groundwater is “good” if the Directive values are not exceeded.
- › If the value is exceeded at one or more measuring sites, a site-specific investigation will determine whether the uses or (ecological) functions of groundwater are threatened. If so, the groundwater body is “bad”.
- › Reduction measures must be implemented if pollutant concentrations exceed 75% of a quality standard or threshold value.



## Protective Zones I, II and III



Federal Ministry  
for the Environment, Nature Conservation  
and Nuclear Safety

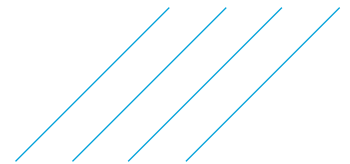
- › Drinking water security protects all regions from recharge area to user.
- › Three protection zones, with different restrictions in land-use.
  - › Protective Zone III – Zoning forbids various land-uses where impacts to groundwater may be a risk.
  - › Protective Zone II – Zoning protects against micro-organisms (bacteria, germs, viruses) that would die off within 50 days of entering zone
  - › Protective Zone I – within 10 m of a water supply well; includes restrictions from PZ I and II.





## Summary: Multiple Ways to Implement Drinking Water Protection

- › Classify aquifers based on how jurisdiction prioritizes, putting emphasis on most relevant aquifers for water use
- › Establish acceptable land uses areas or set-back distances to protect zones around water wells used for drinking water
- › Put emphasis on contamination zones
- › Consider the aquifers properties (transmissivity or deliverability)
- › Most jurisdictions do not require urban areas, supplied by municipalities for public health, to apply drinking water standards to impacted sites and are managed with other regulatory vehicles



*Our values are the essence of our company's identity.  
They represent how we act, speak and behave together,  
and how we engage with our clients and stakeholders.*

~~SAFETY~~

*We put safety at the heart of everything we do, to safeguard people, assets and the environment.*

~~INTEGRITY~~

*We do the right thing, no matter what, and are accountable for our actions.*

~~COLLABORATION~~

*We work together and embrace each other's unique contribution to deliver amazing results for all.*

~~INNOVATION~~

*We redefine engineering by thinking boldly, proudly and differently.*