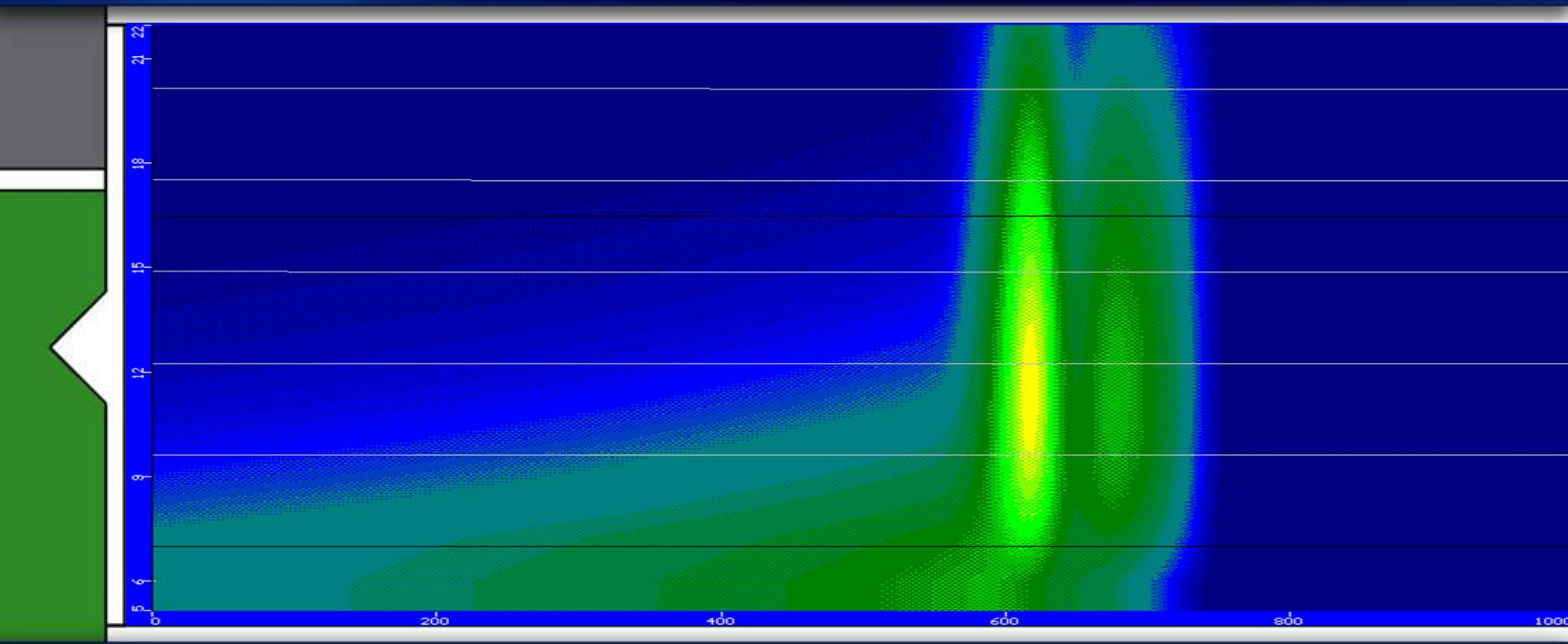
Remediation Technology Symposium (RemTech) 2012

Challenges to Site-Specific Assessment at Salt and Fertilizer-Impacted Sites



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Outline

- Alberta Tier 1 and Tier 2
- Site-specific assessment options
- Case History
- Challenges and Solutions (?)

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Alberta Tier 1 Guidelines (Salt & Fertilizer Impacts)

GUIDELINES	SALT	FERTILIZER
References	Salt Contamination Assessment & Remediation Guidelines, Alberta Environment, 2001 Alberta Tier 1, 2010	Alberta Tier 1, 2010
Soil	Based on ED and SAR Chloride guidelines not provided	None
GW	Tier 1 guidelines for chloride	Tier 1 guidelines for nitrate, nitrite, etc.

Standard Alberta Tier 2 Approaches

- Standard Tier 2
  - Pathway elimination
  - Guideline adjustment
- Standard Tier 2 may not work at salt and fertilizer contaminated sites:

>300 m does not rule out FAL

DF4 eqn does not represent main attenuation mechanism

A 5 m isolating layer may not protect an underlying DUA

Alberta Tier 2 Approaches (DF4 Calculation)

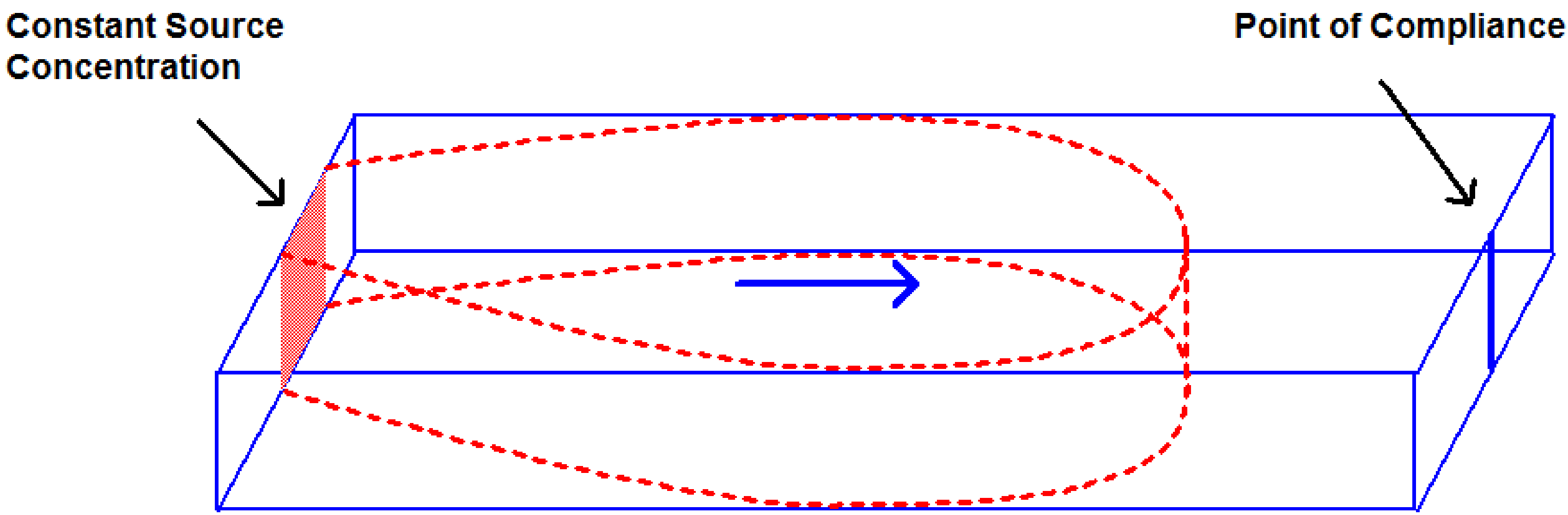
- Alberta default DF4 formula
  - Quantifies attenuation in groundwater from underneath the source to a receptor
  - Based on constant source concentration. Does not include source depletion
  - Does not include rainfall infiltration
  - Calculates the maximum concentration (Cmax) at the receptor after a sufficiently long time (For chemicals not subject to biodegradation, DF4 ≈ 1)

Alberta default DF4 model

Little attenuation from Source to PoC

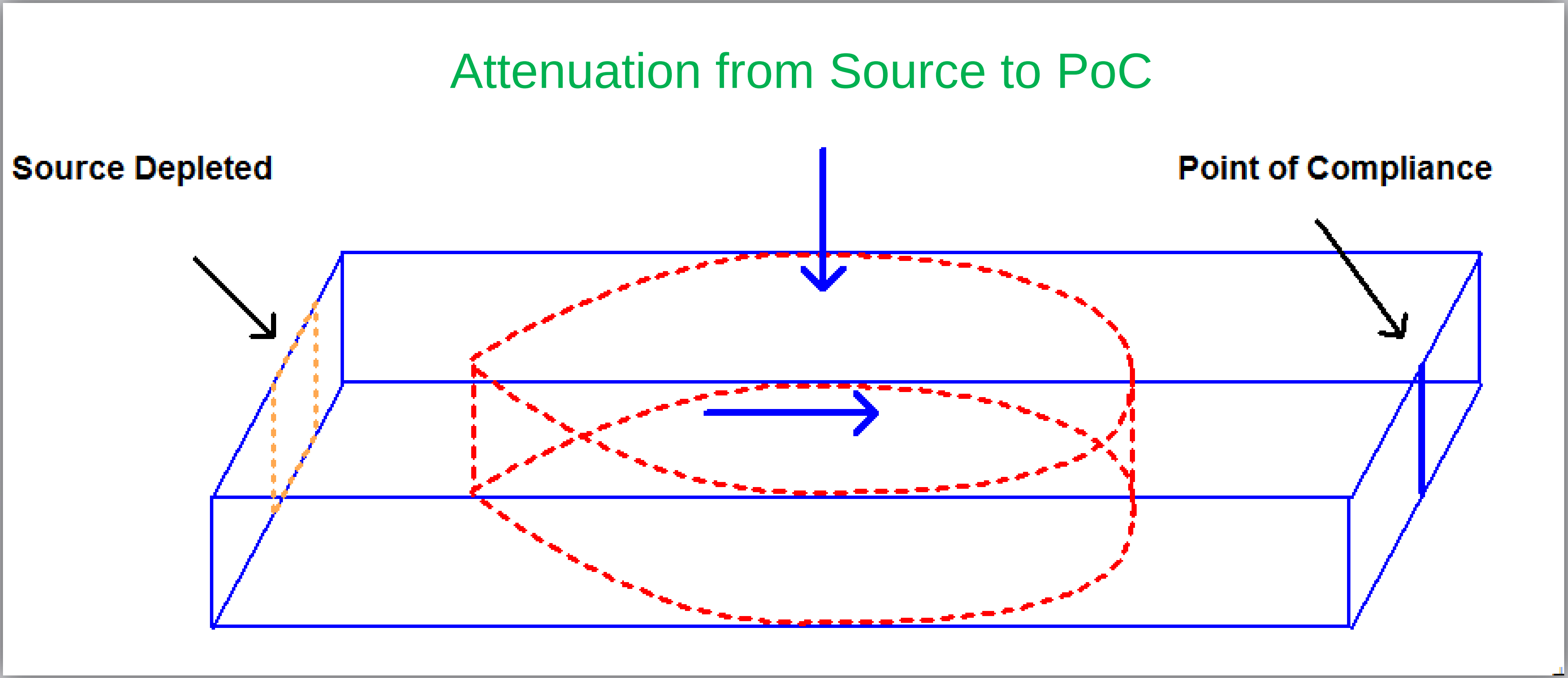
Does not include infiltration

DF4 ≈ 1



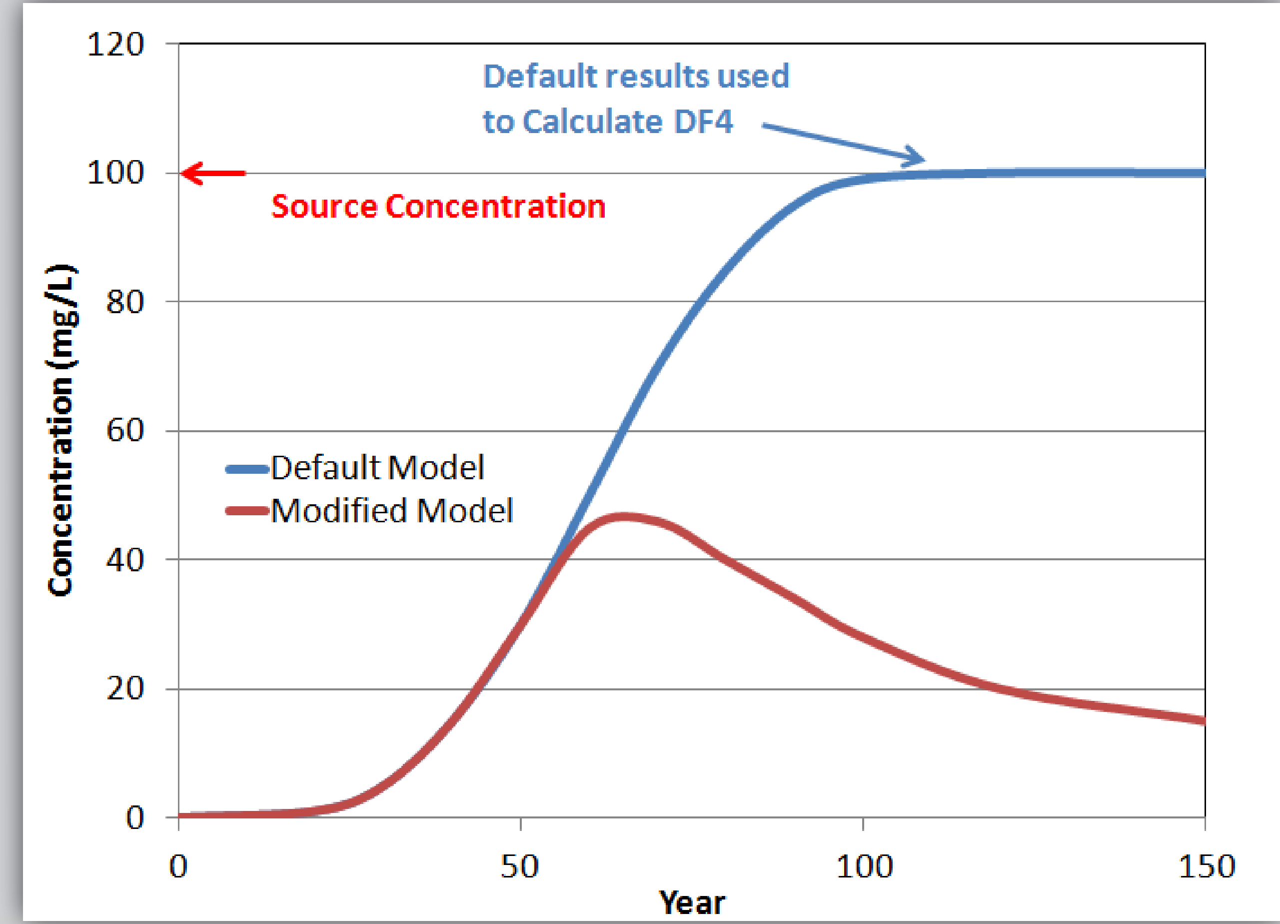
Alberta Tier 2

DF4 model with source depletion and infiltration



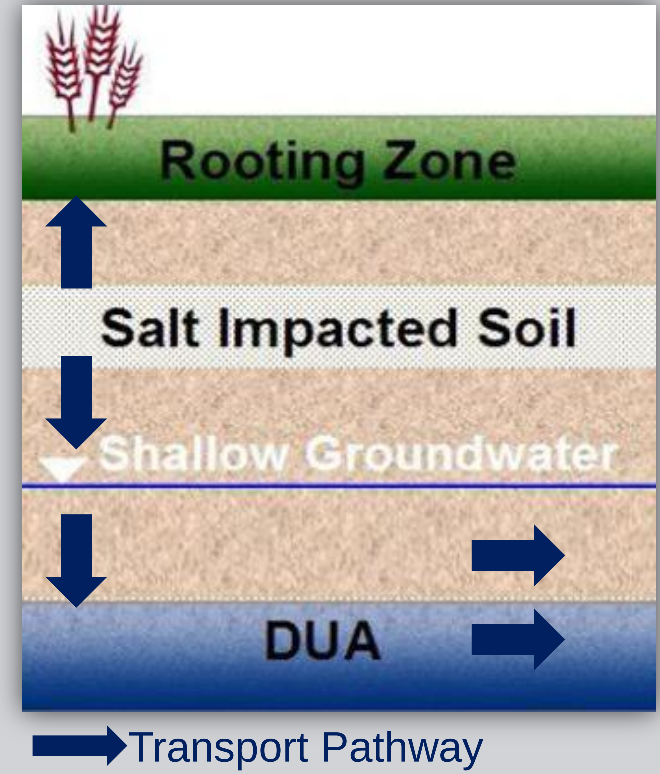
Alberta Tier 2

Predicted concentrations at point of compliance



Alberta Tier 2 Approaches (SST)

- SST is a database of analysis results from computer codes HYDRUS-1D and 3DADE



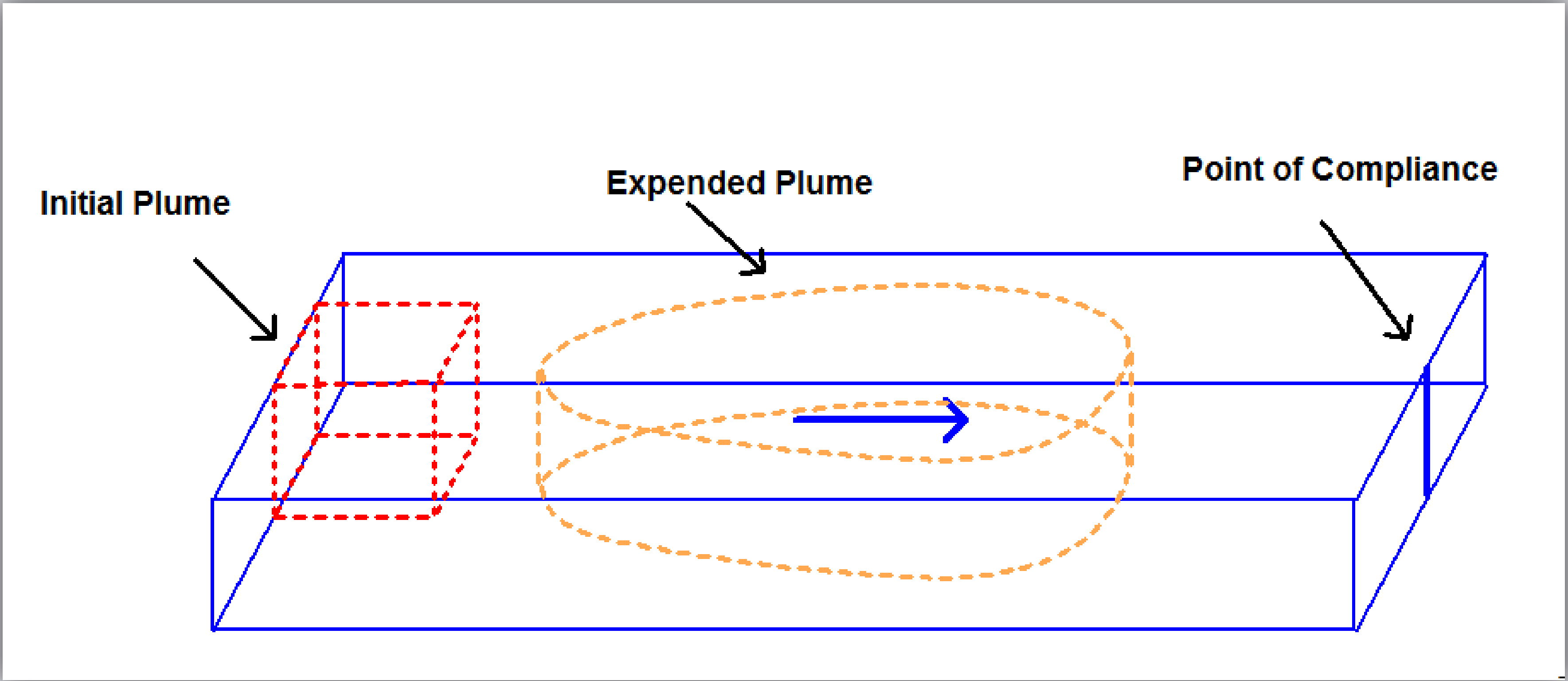
site-specific data required

HYDRUS-1D:
Upward transport in vadose zone and downward transport in vadose and saturated zone.

3DADE:
Lateral transport to FAL receptor and downward transport to DUA.

From: 2010 SST help file

A conceptual model for 3DADE



Site-specific Risk Assessment (SSRA or Tier 2C)

So, SST is a good tool. Why go beyond it?

- Site conditions may violate assumptions

  e.g. source length limitations in SST

- More realistic (often less stringent) guidelines can be generated and remediation effort can be reduced
- Better ability to represent complex site conditions

Protect receptors with less cost

Remediate more sites

References

http://parsharesites.parsons.com/corp/Training/PerformanceManagementHelp/Wiki%20Pages/Home.aspx

Case Study – Site A

- A former oilfield facility in Central Alberta
- Agricultural land use
- Underlain by clayey till strata (qualified as fine texture) with discontinuous sand layers
- Groundwater table at ~6 m below grade
- Salt impact defined by [Cl-] > 100 mg/kg stretches ~ 90 m in groundwater flow direction
- Groundwater by [Cl-] > 10000 mg/L in some wells
- No DUA within the maximum depth of drilling (12 m)
- FAL receptor (River) at ~200 m downgradient

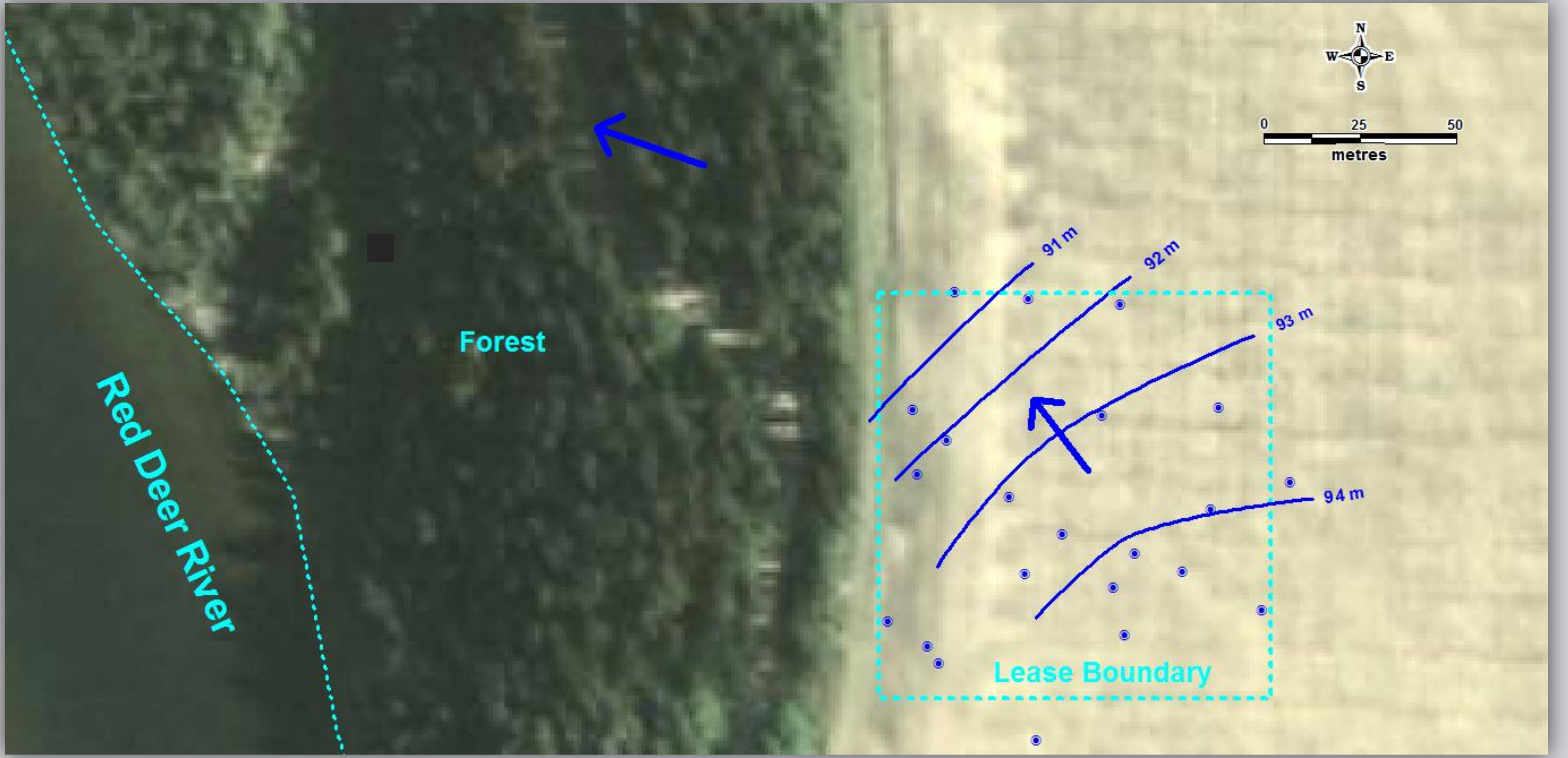
TOO MUCH TEXT!

Site A: Why go beyond SST ?

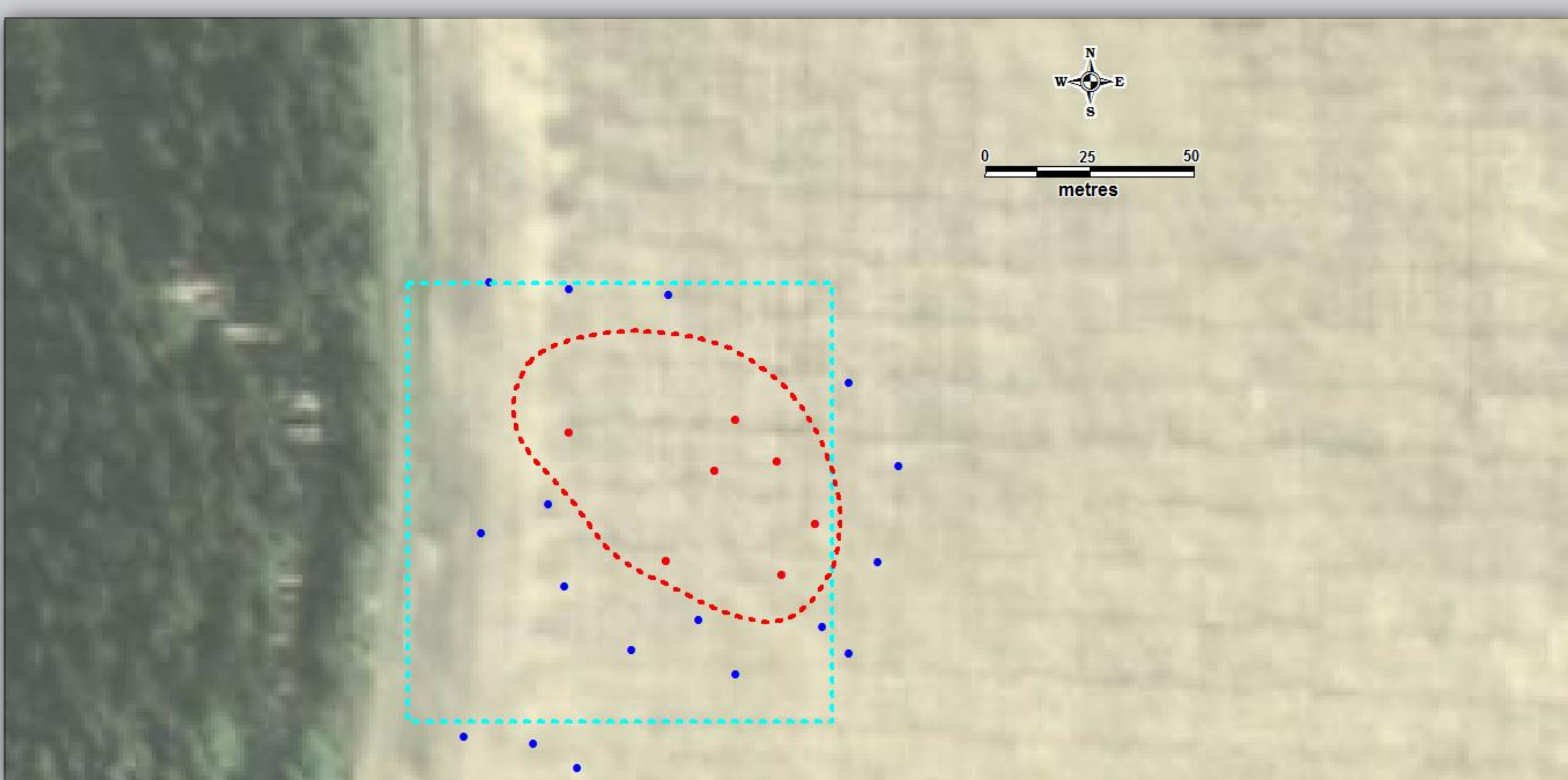
- SST indicates ~ **30,000 m^3** excavation required
  - Due to stringent guidelines to protect FAL receptor
- Site-specific modeling indicates ~ **10,000 m^3** excavation required
  - Using Modflow/MT3D model to simulate migration to FAL
  - Able to model spatial variations in source areas

Use site-specific modeling for FAL and DUA and SST for the other pathways

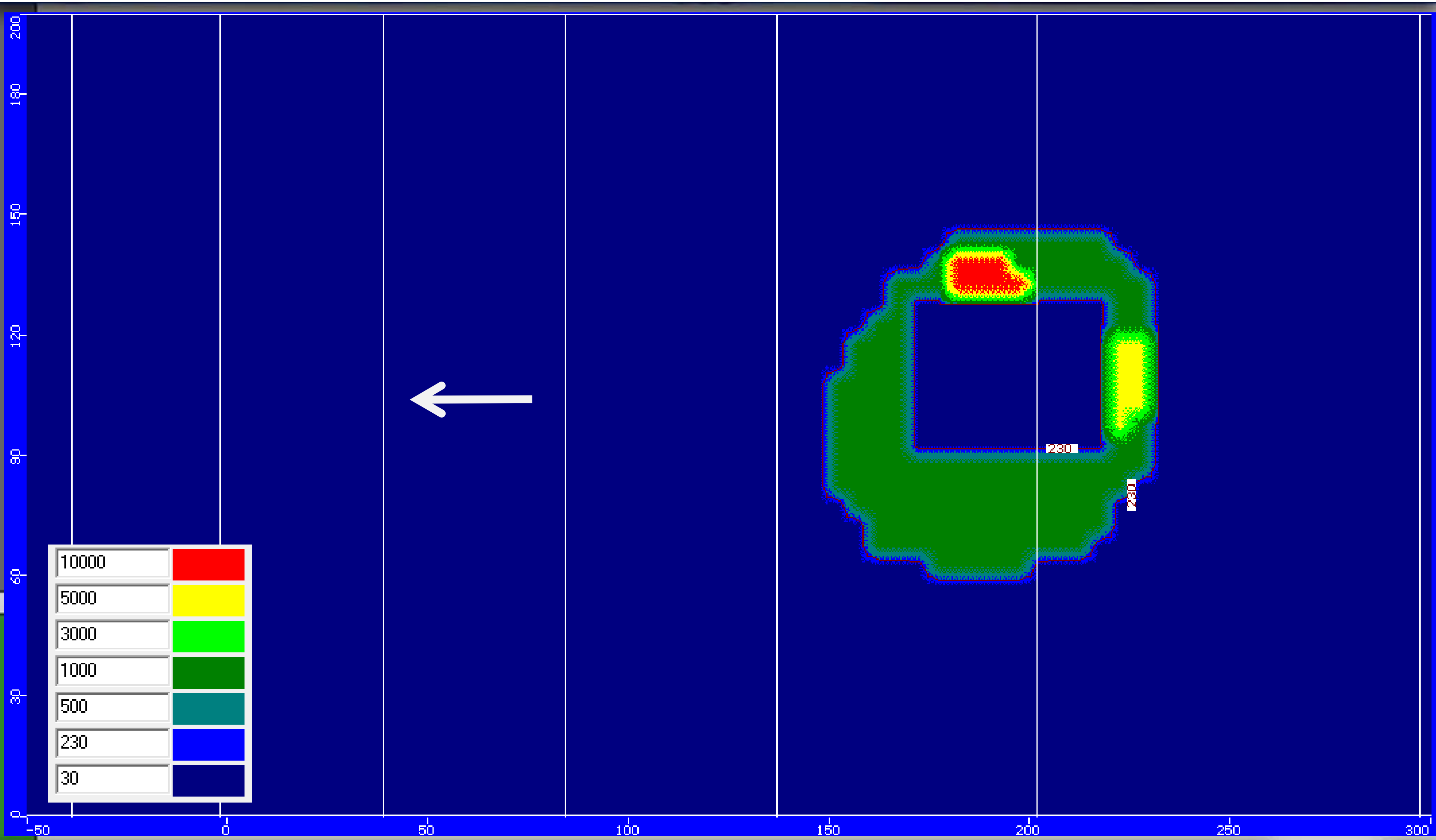
Site A: Site Plan



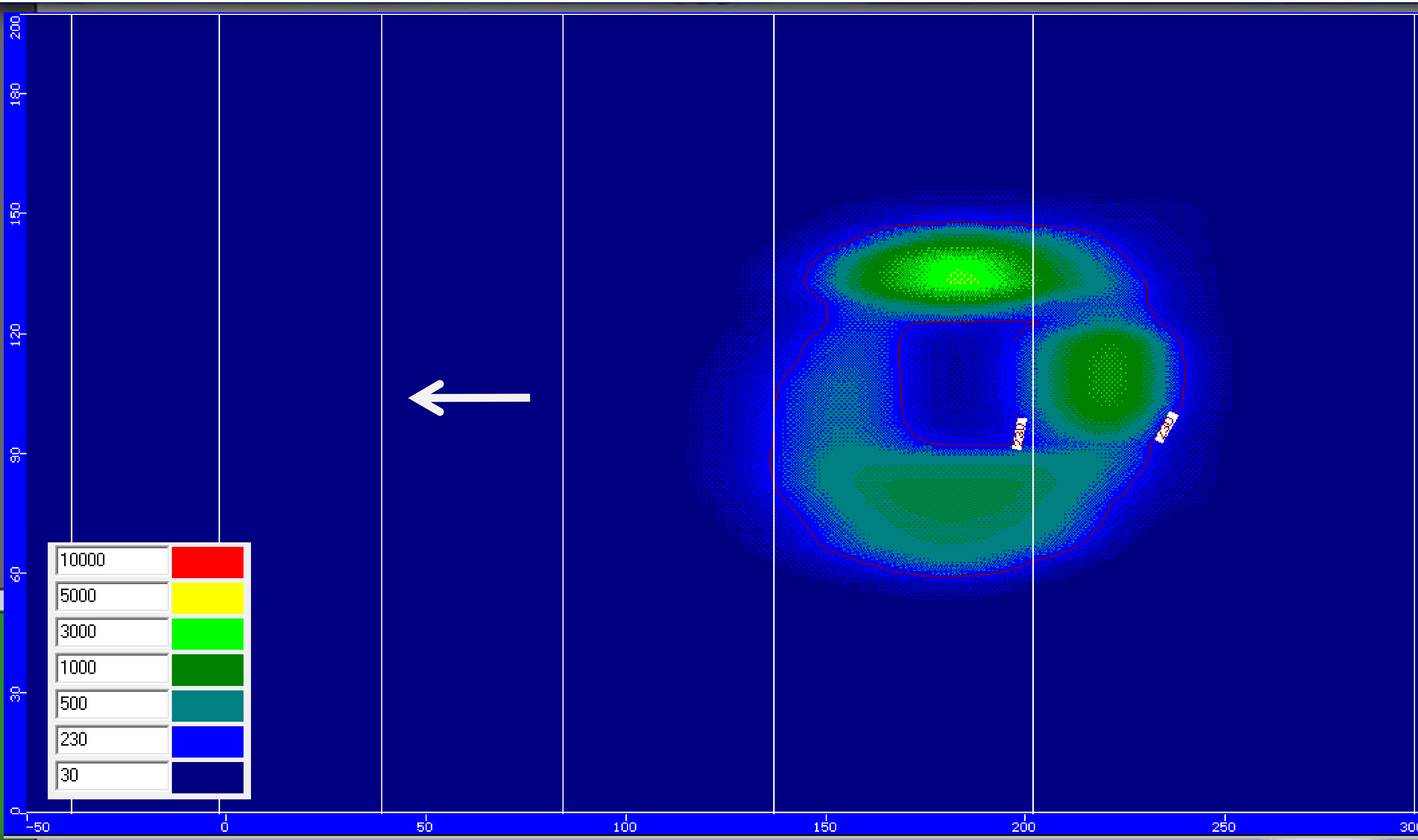
Site A: Cl^- > 100 mg/kg, 0.3 m – 7.0 m



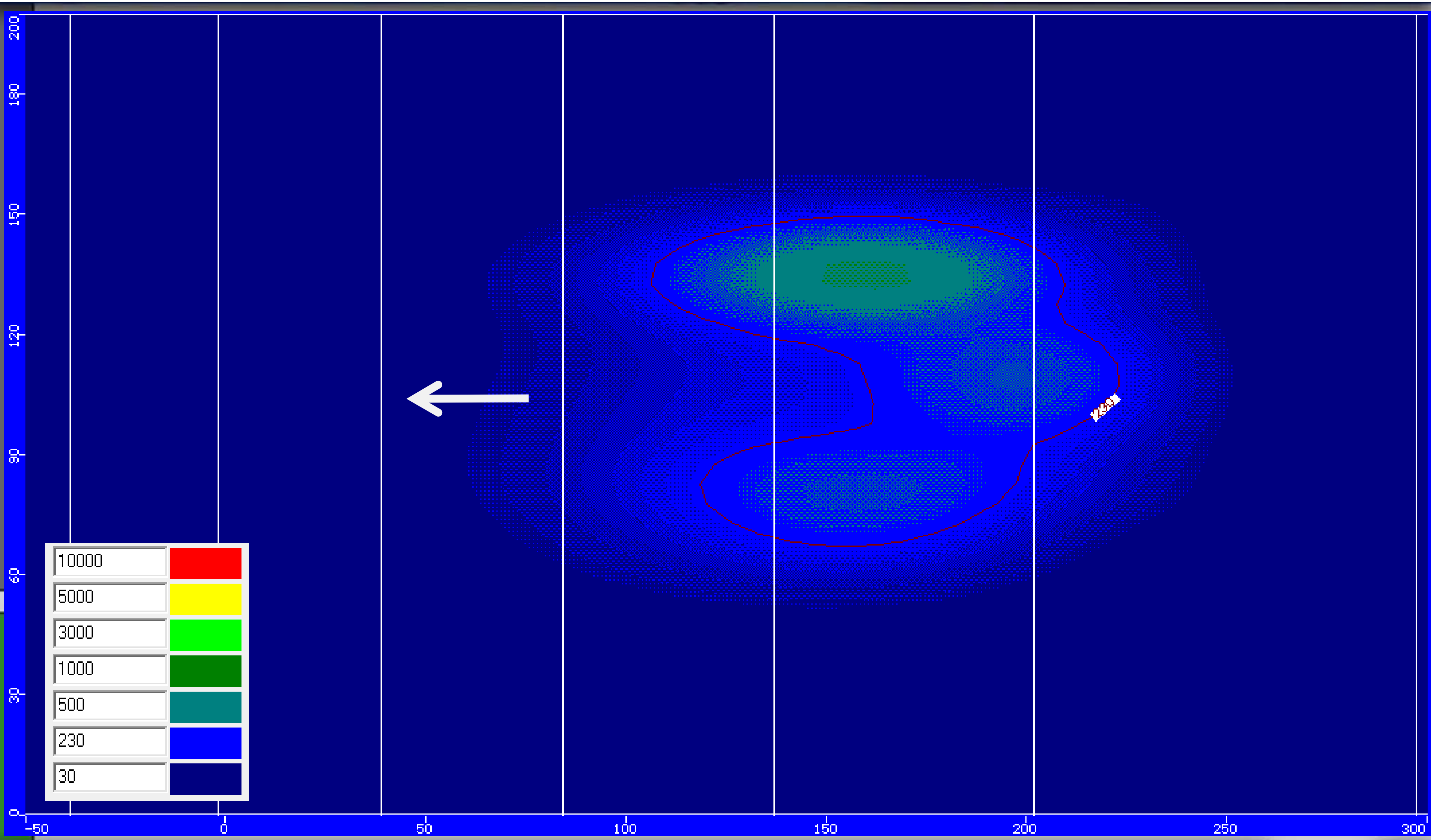
Site A: Predicted [Cl-] (mg/L) at 0 Year



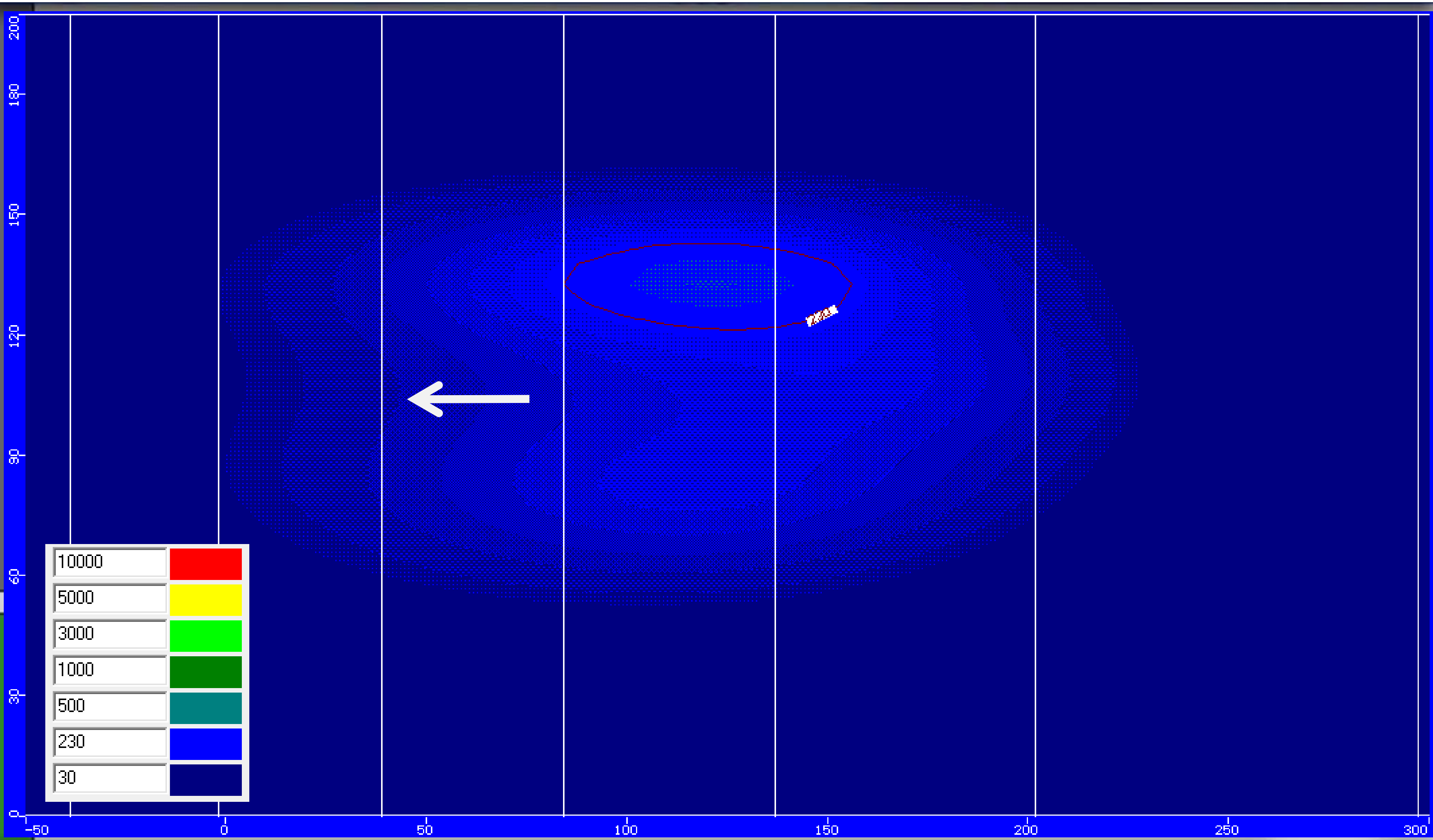
Site A: Predicted [Cl-] (mg/L) at 10 Years



Site A: Predicted [Cl-] (mg/L) at 50 Years

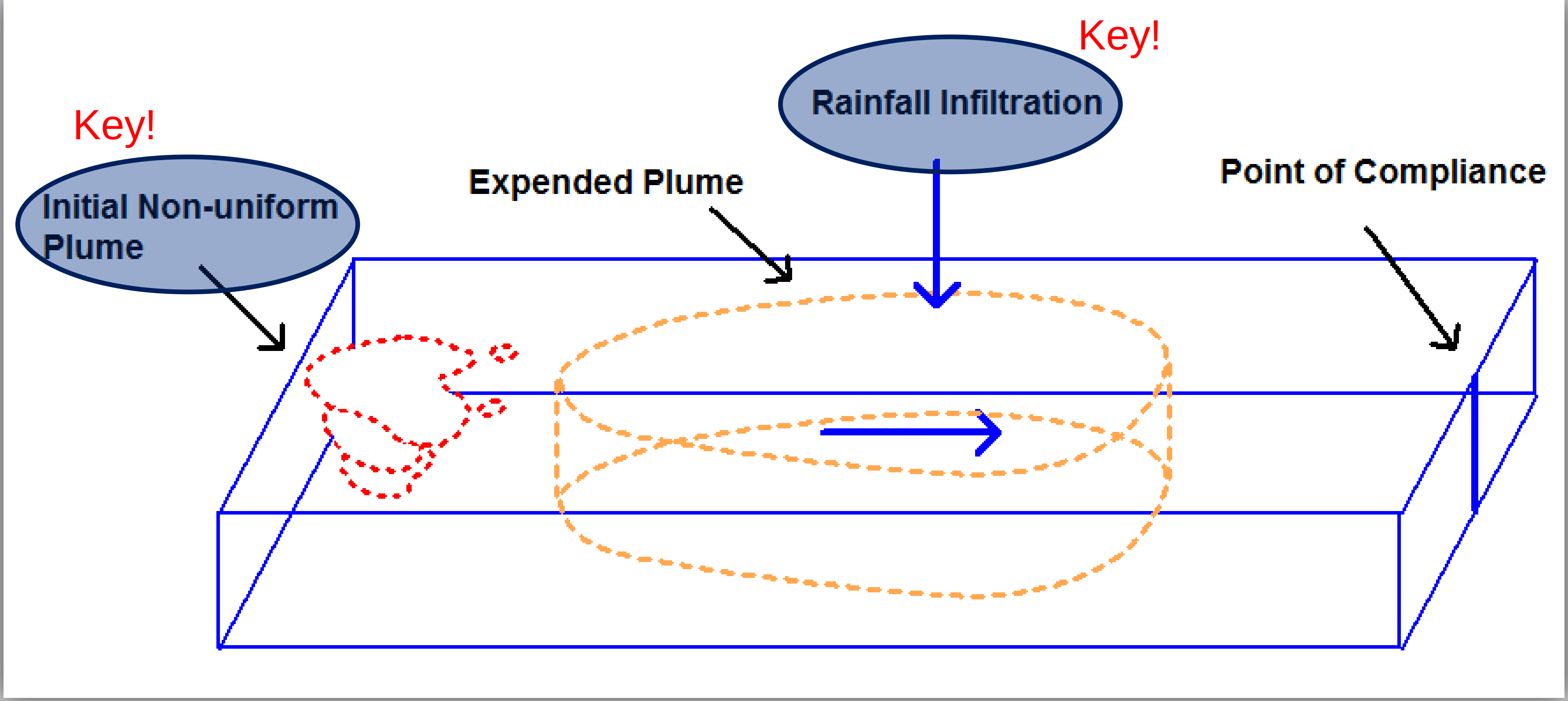


Site A: Predicted [Cl-] (mg/L) at 100 Years



Site A: Why SSRS is less conservative ?

Concept of Site-specific Model



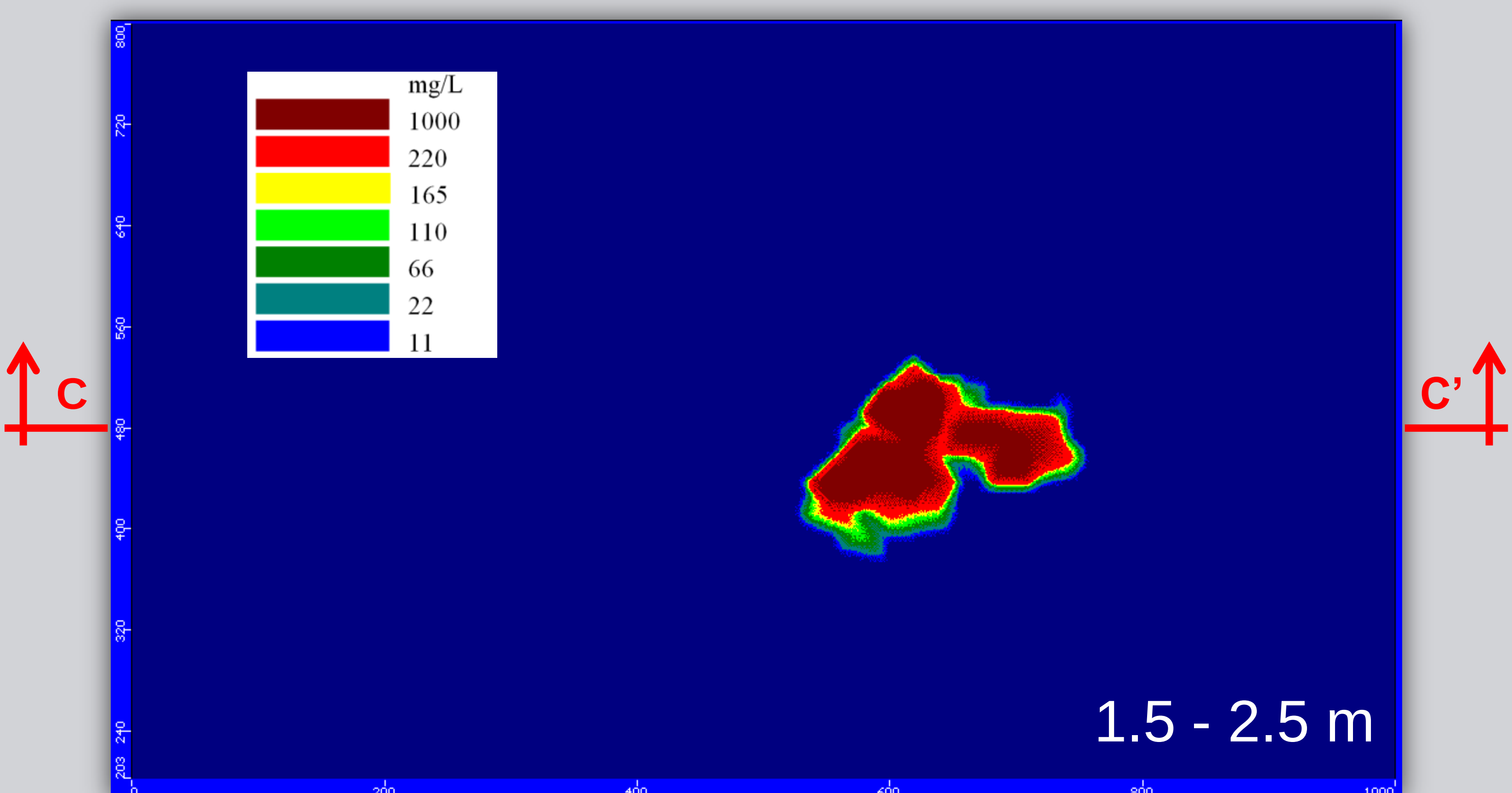
Challenges: to Site Specific Assessment

- Never have sufficient data
- Additional effort and cost sometimes difficult to justify
  - Additional data and labour cost
  - Longer decision-making process
  - Uncertainty regulatory approval
- Lack of industry-wide standards and regulatory guidance
  - Some components inherently depend on regulatory policy decisions

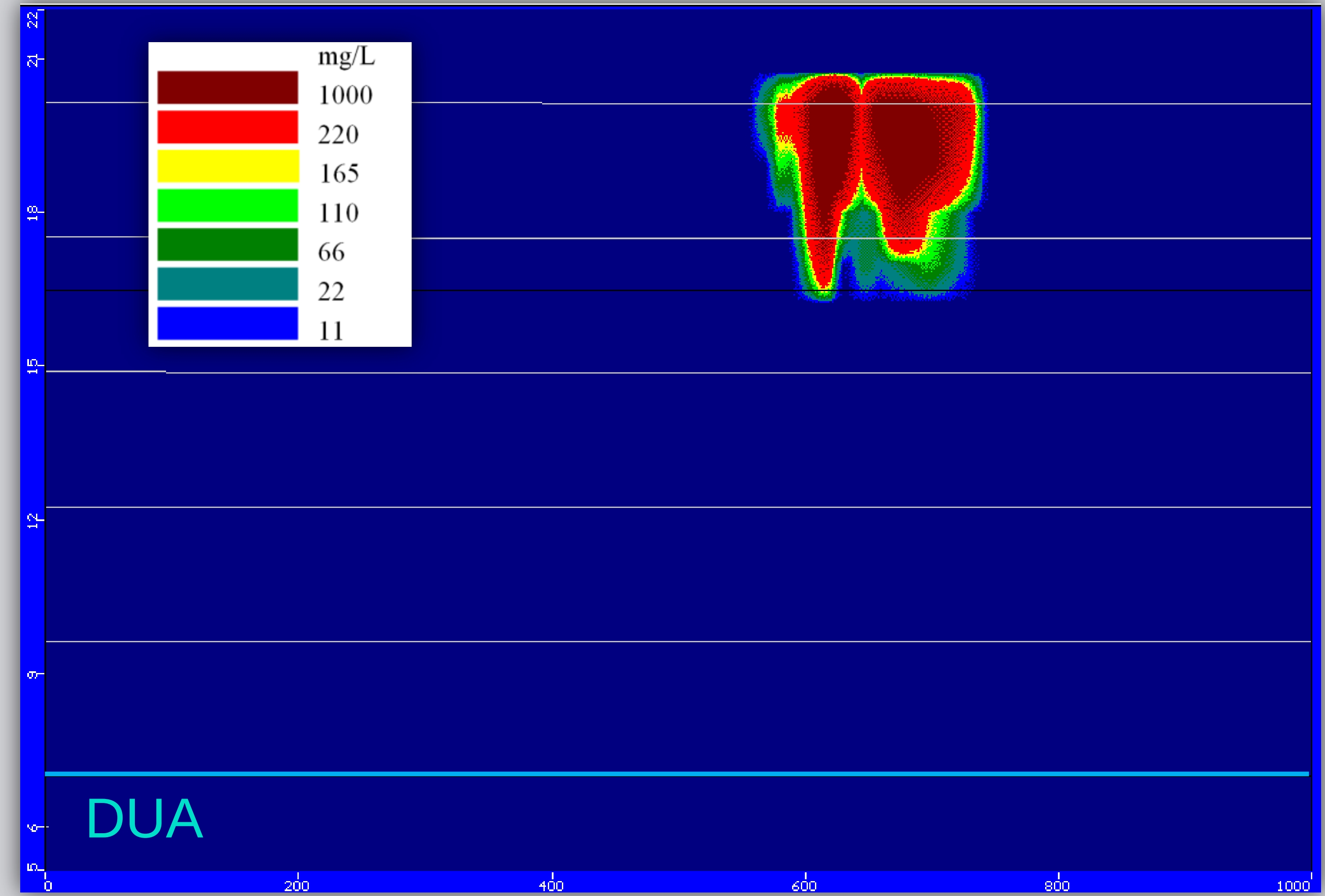
Challenges: An Example DUA Model

- A Modflow/MT3D model to simulate Chloride migration to a potential DUA
- Depth to DUA is assumed to be 15 m bgs (max depth of drilling)
- SST guidelines are governed by DUA pathway and suggest excavation to 3.5 m
- Site-specific model concluded excavation to 1.5 m required to meet SCARG
- But a number of questions remain …

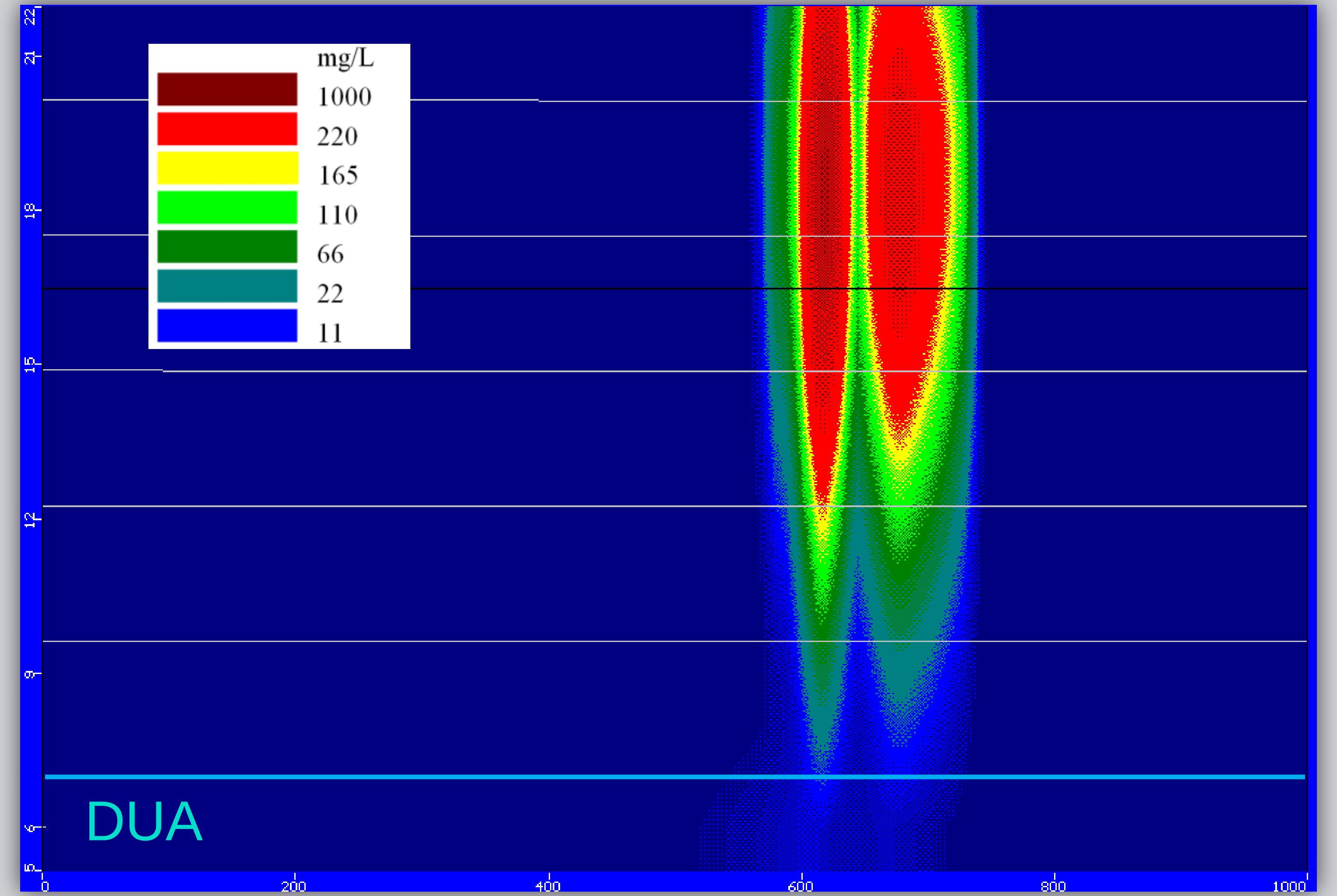
Challenges: Plan Showing Concentrations (Year 0)



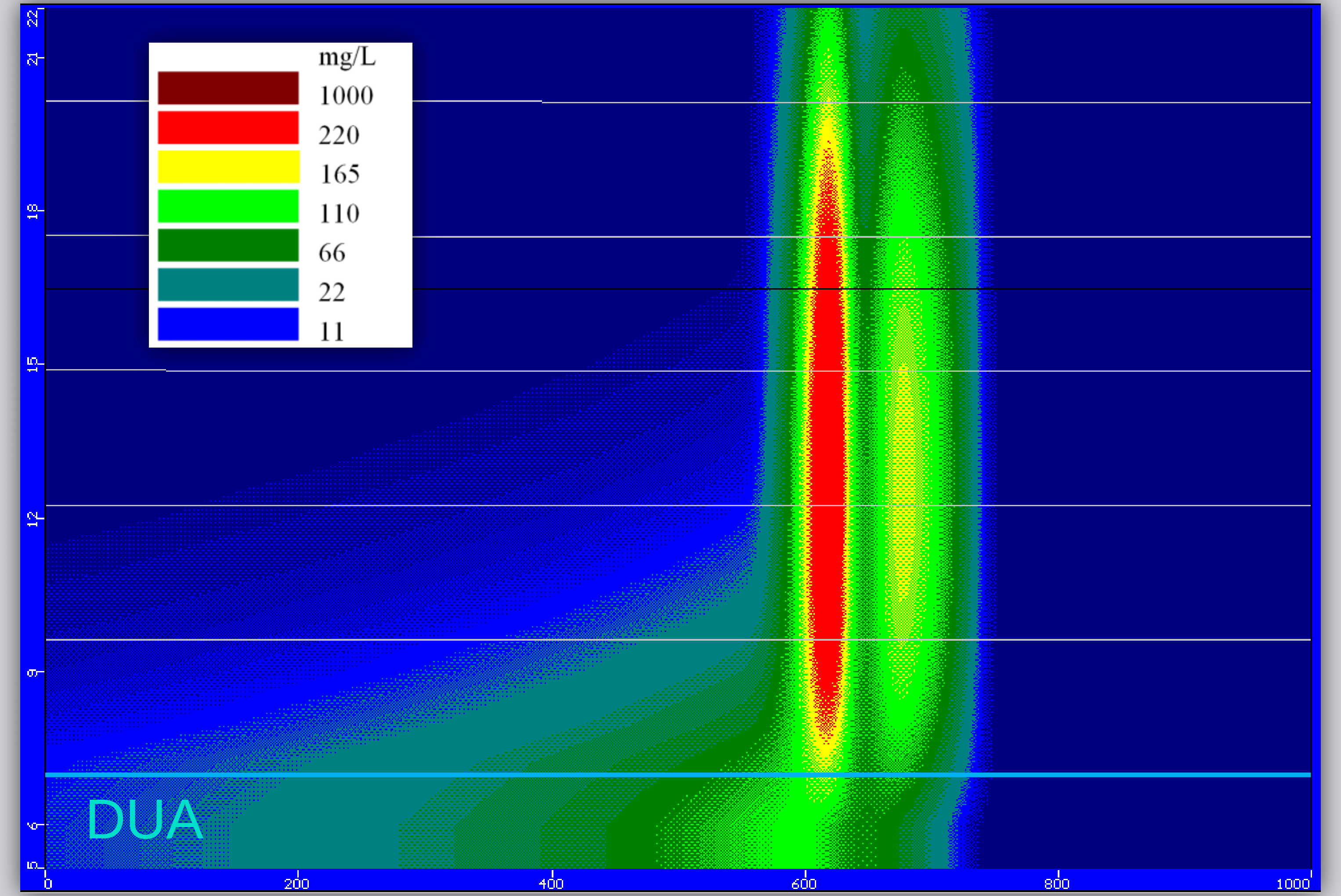
Challenges: Cross Section C - C' (Year 0)



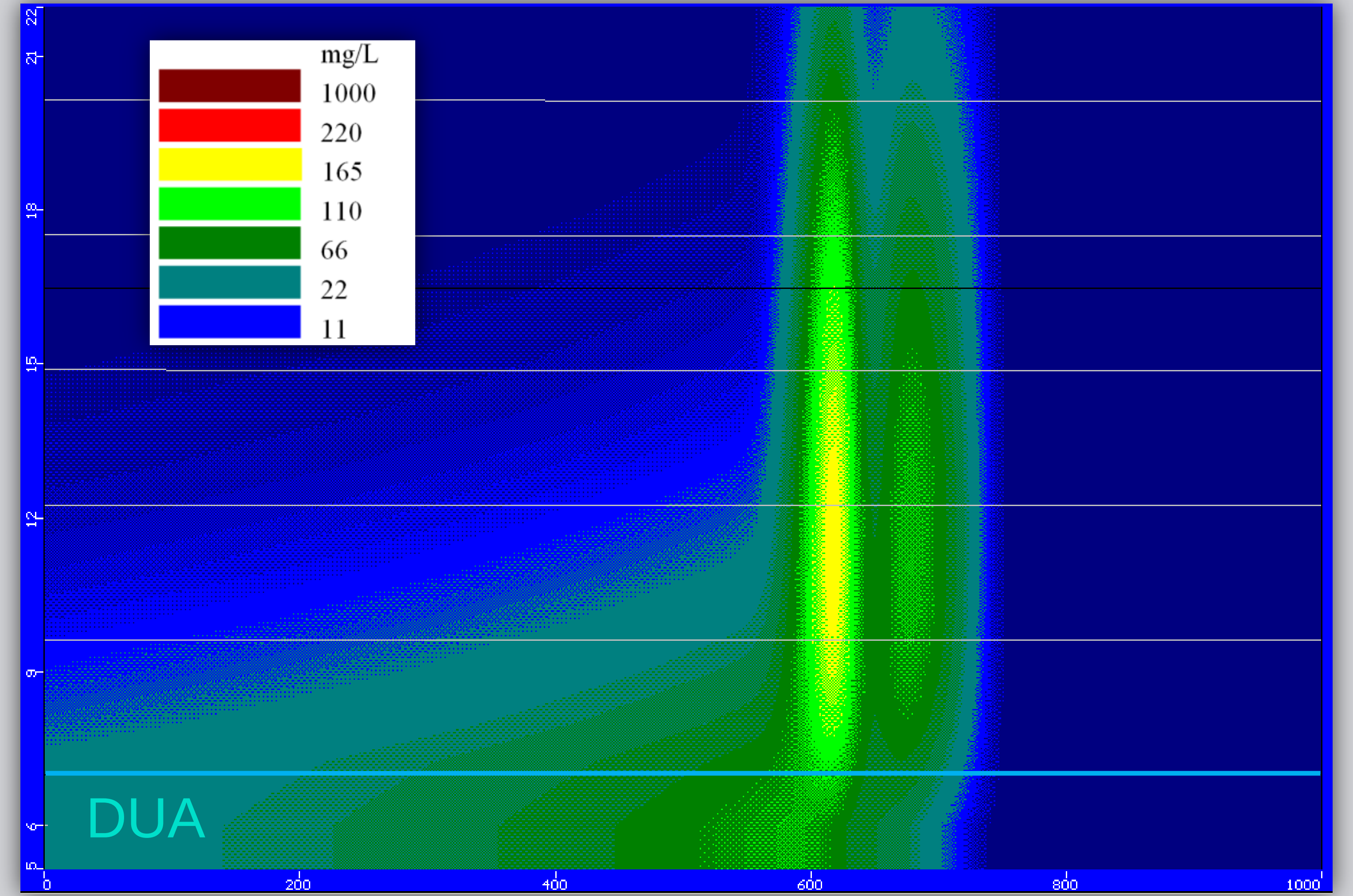
Challenges: Cross Section A-A' (Year 100)



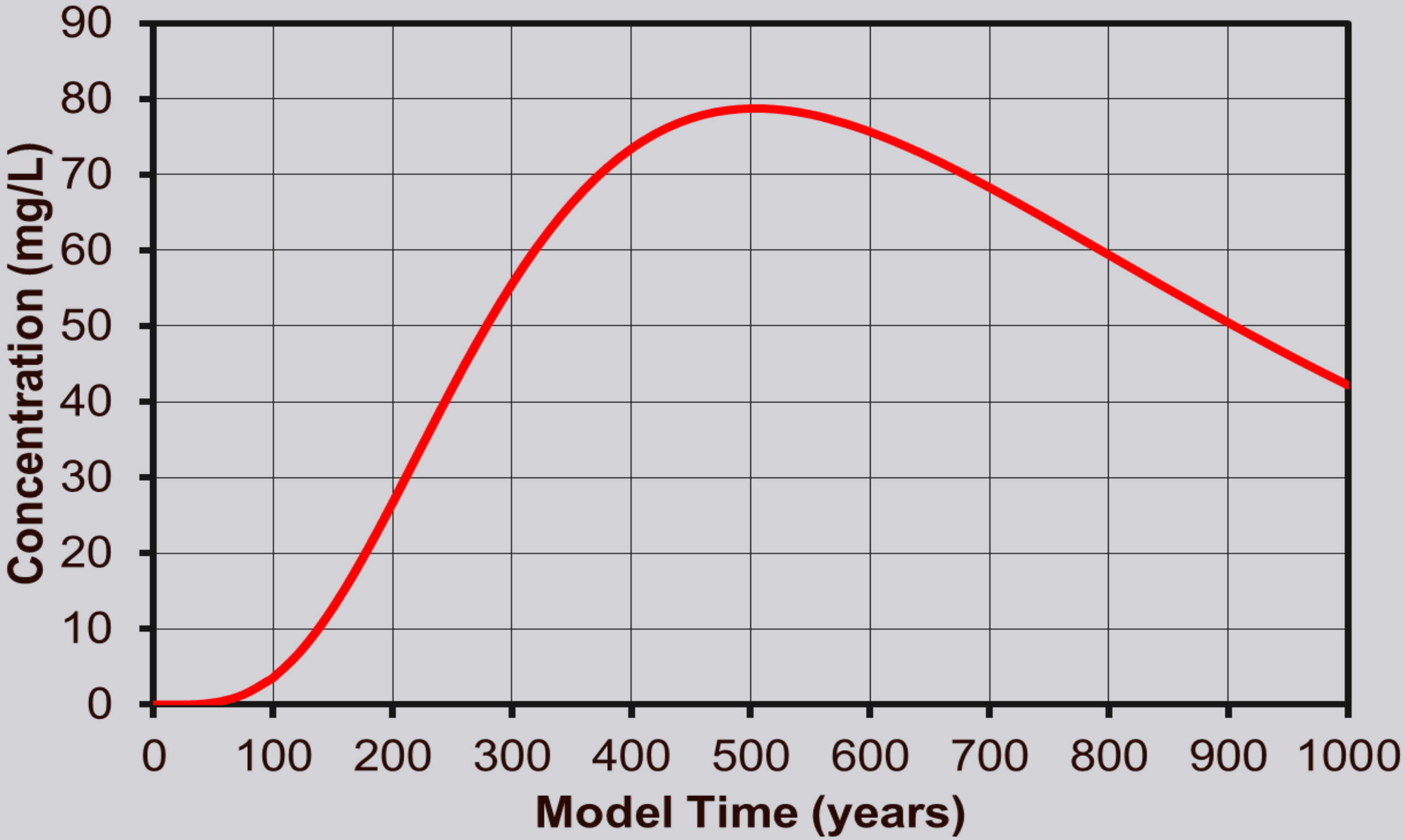
Challenges: Cross Section A-A' (Year 500)



Challenges: Cross Section A-A' (Year 800)



Challenges: Average [Cl^-] in DUA



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Challenges: Questions

- How to determine water flux to DUA?
  - There are different scientifically-defensible approaches that all produce different results:

Site-sp[illegible]lated

- How to determine mixing thickness of DUA?
- Etc.

Closing Remarks

- Site-specific assessment is useful at many salt and fertilizer contaminated sites to better represent site-specific conditions
- A number of site-specific assessment options require regulatory policy decisions as well as scientific evaluation
- Contaminant mass distribution in the source zone is probably one of the most important factors affecting the assessment results

Thank You!

- Questions…

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