Integration and Management of Subsurface Data to Support Remedial Decisions

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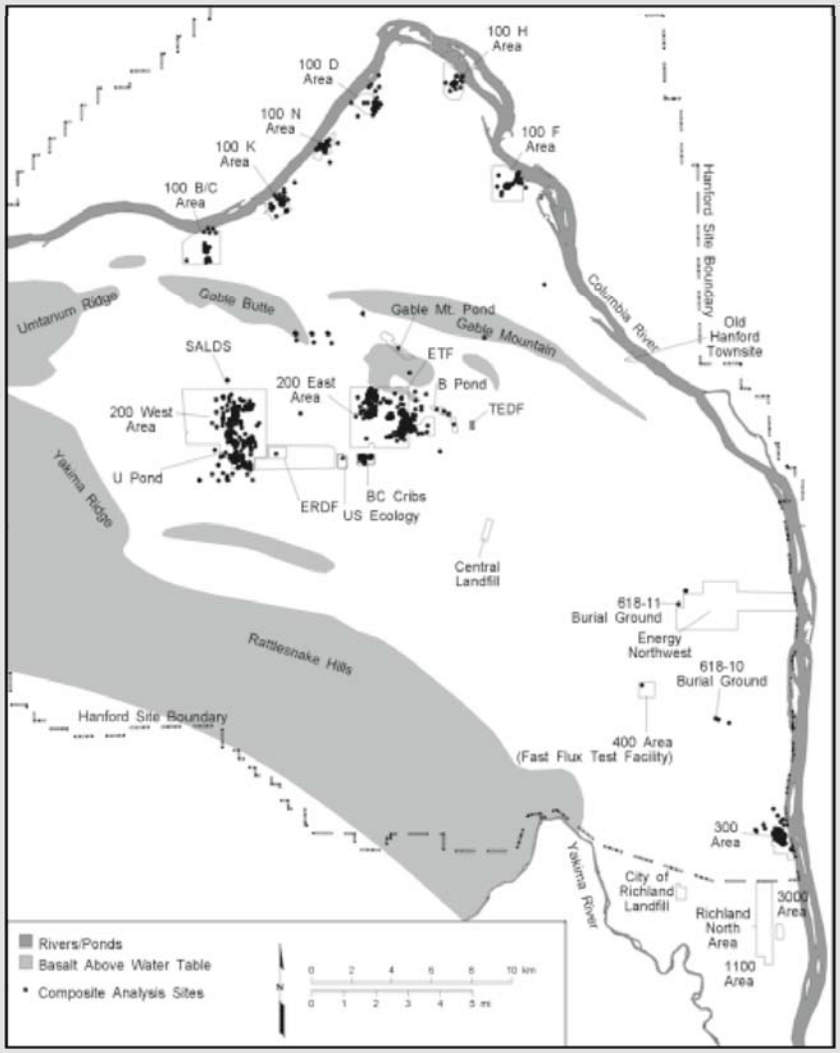
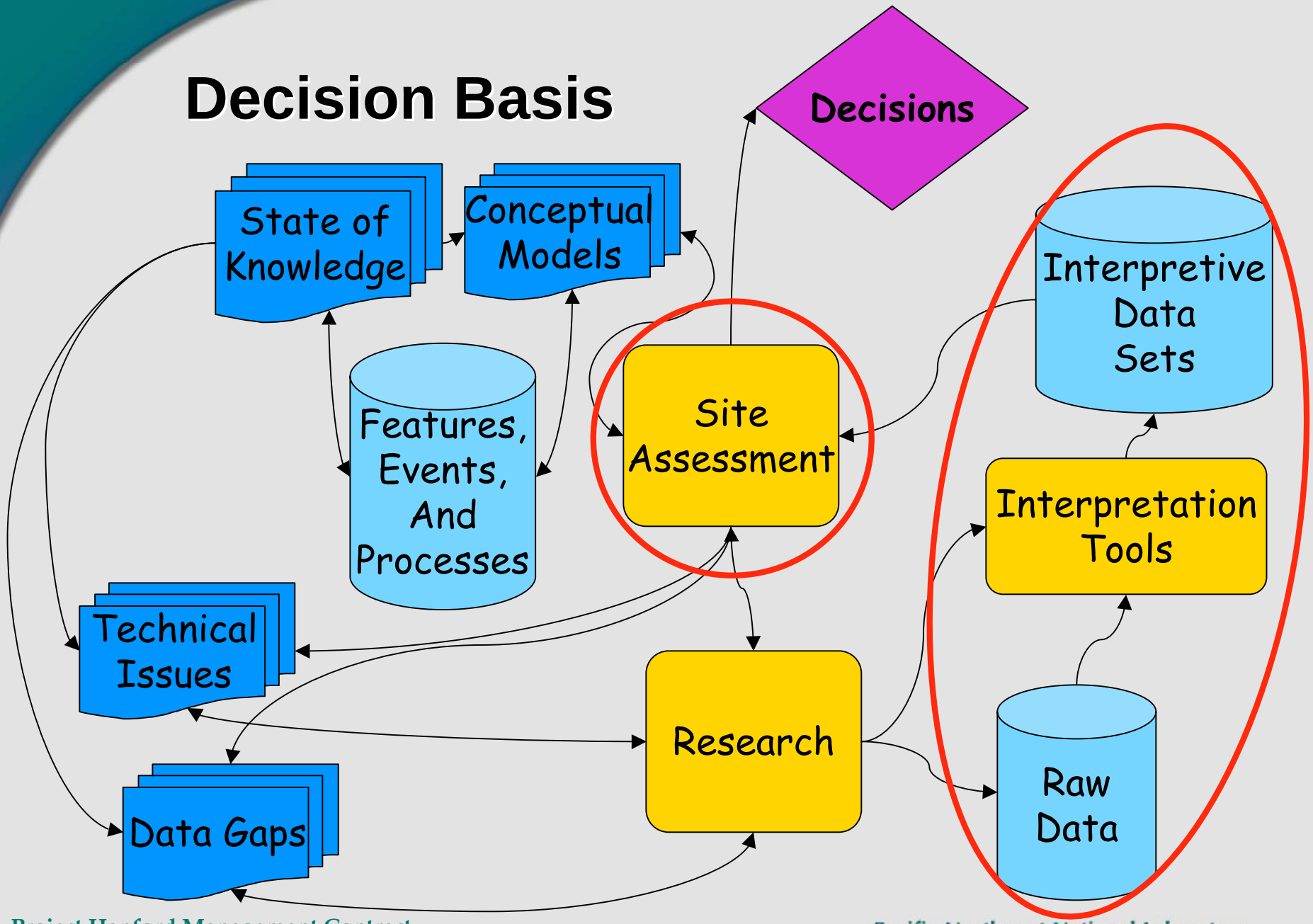
The large number and diversity of remedial decisions has led to the need for

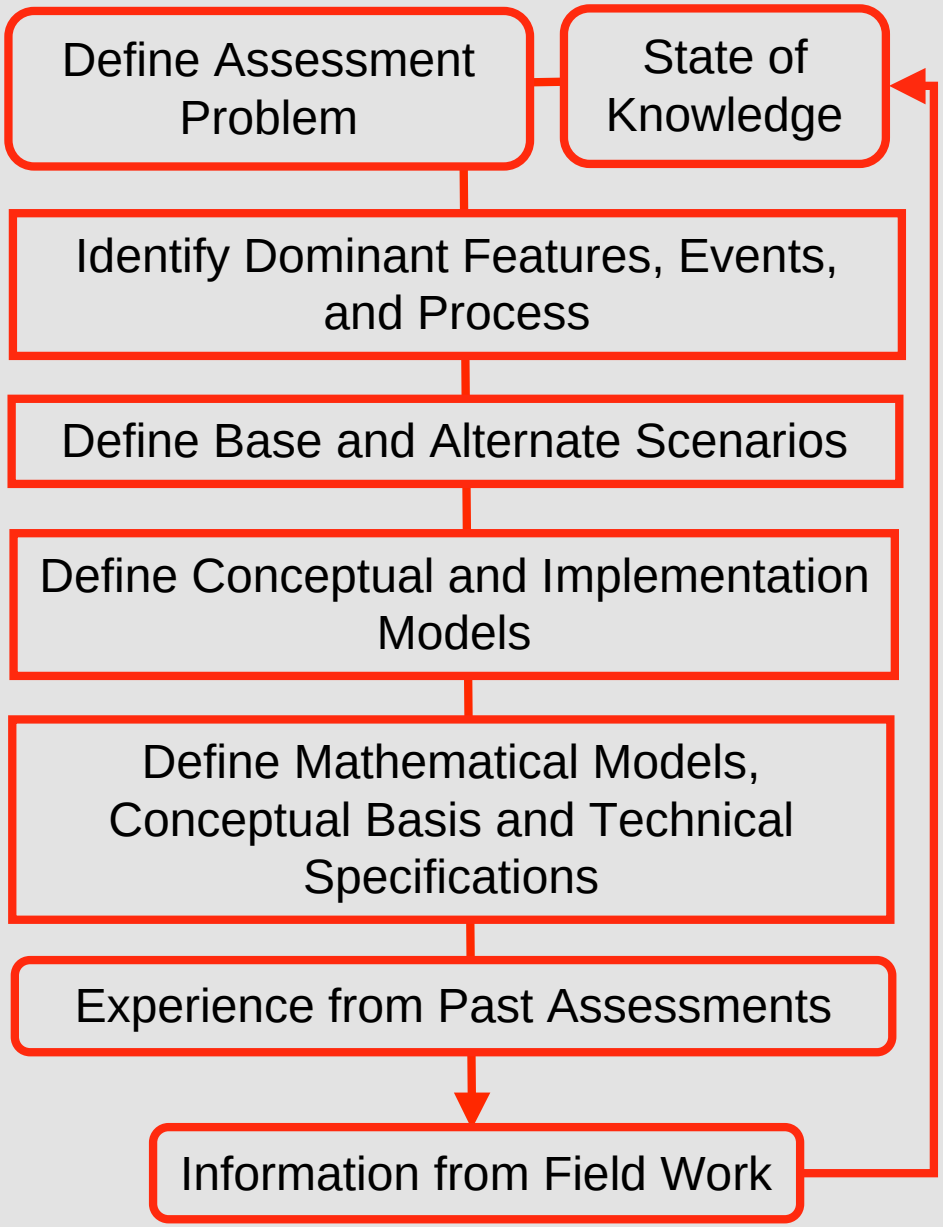
- Systematic approach to develop conceptual models and parameter assignment
- Assemble, integrate and manage vast amounts of raw data
- Develop rigorous interpretation and translation tools to produce conceptual models
- Assessment-specific parameter estimates that are traceable, reproducible, defensible, and internally consistent.



Decision Basis



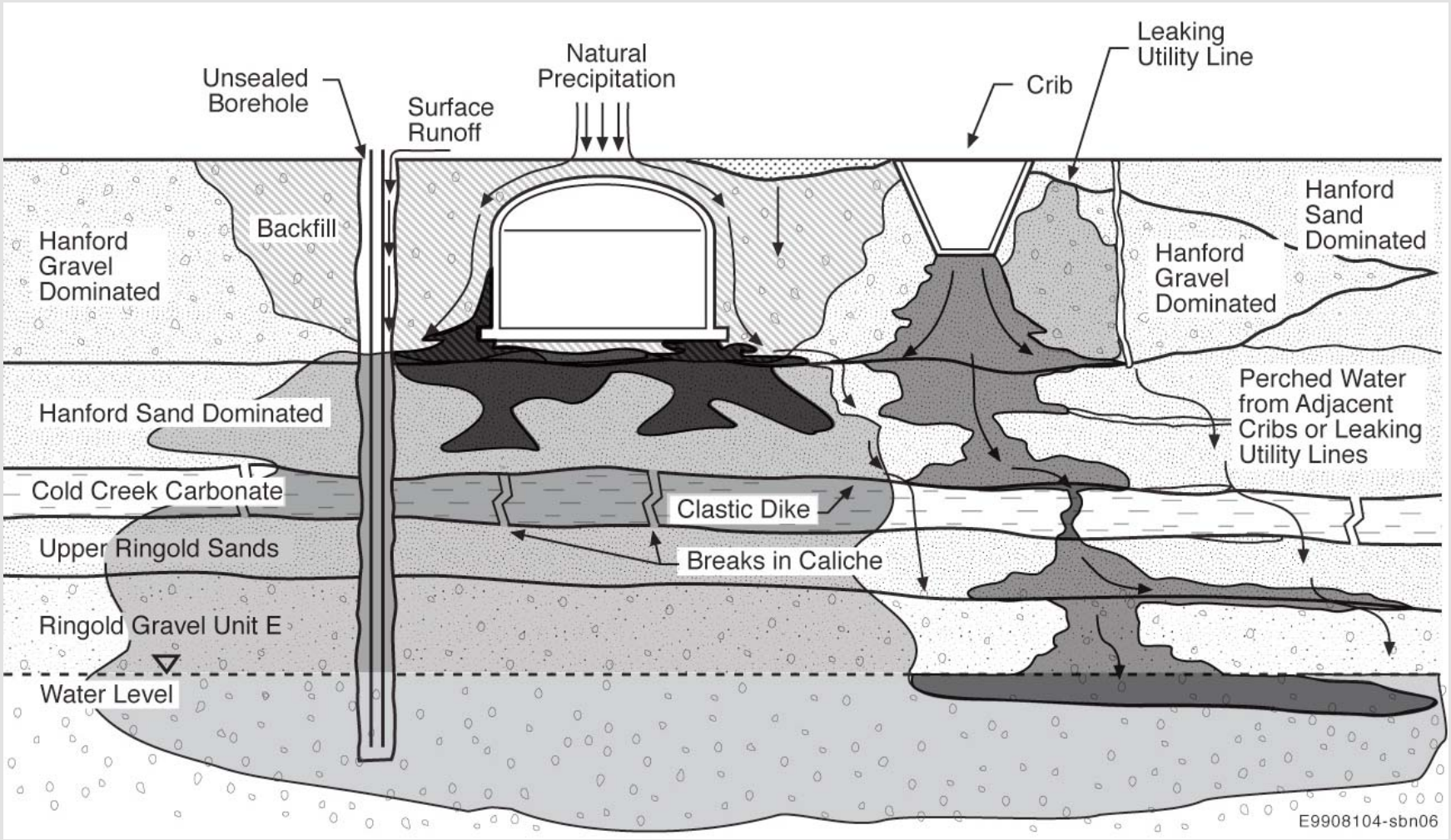
General approach for development of conceptual models based on the features, events, and processes (FEP) methodology



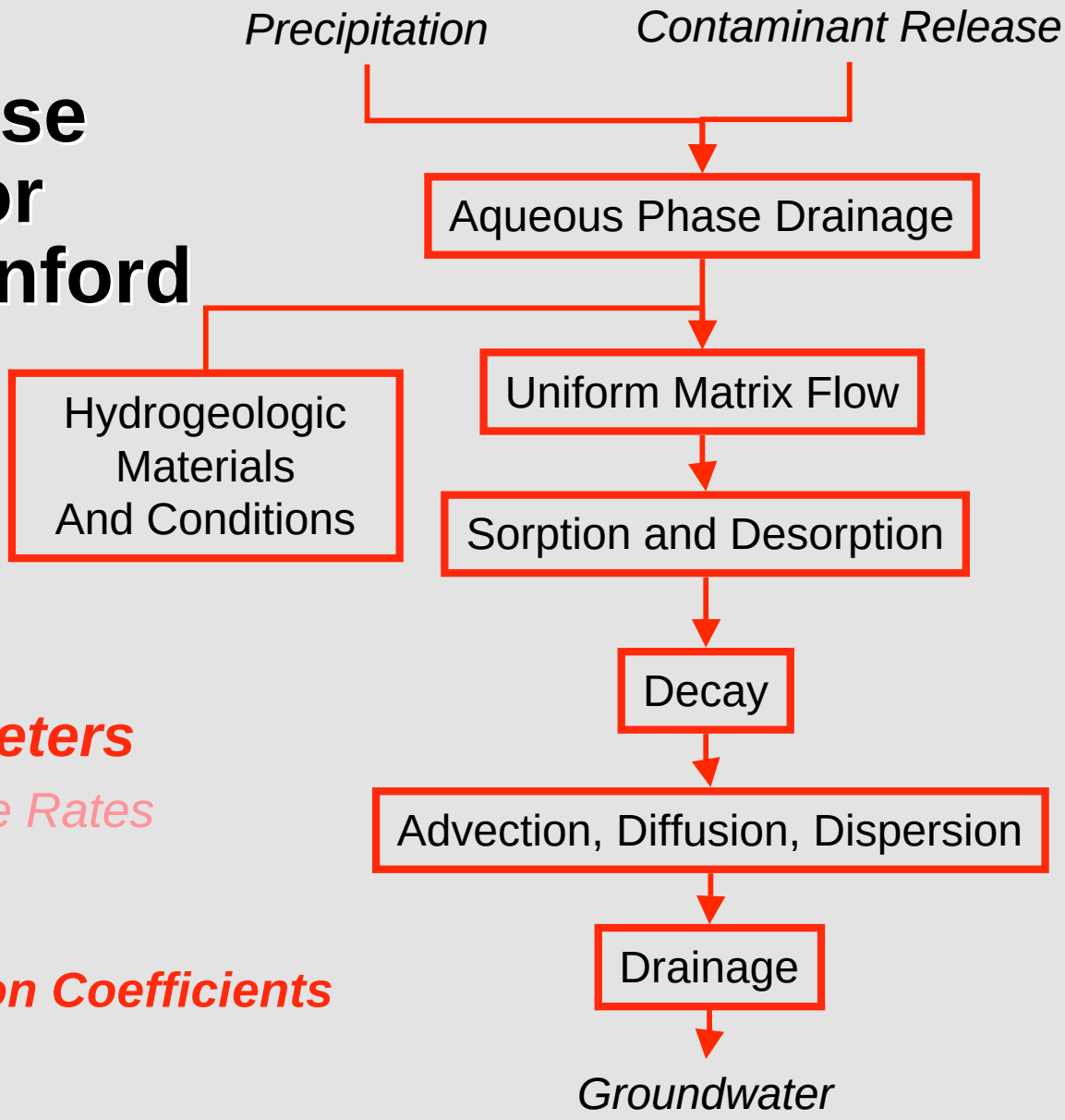
(after Last et. al. 2004 and Bailey and Billington, 1998)

General Conceptual Model

(after Caggiano, 1996 and Johnson and Chou, 1998)



Dominant Vadose Zone Factors for Large-Scale Hanford Assessments



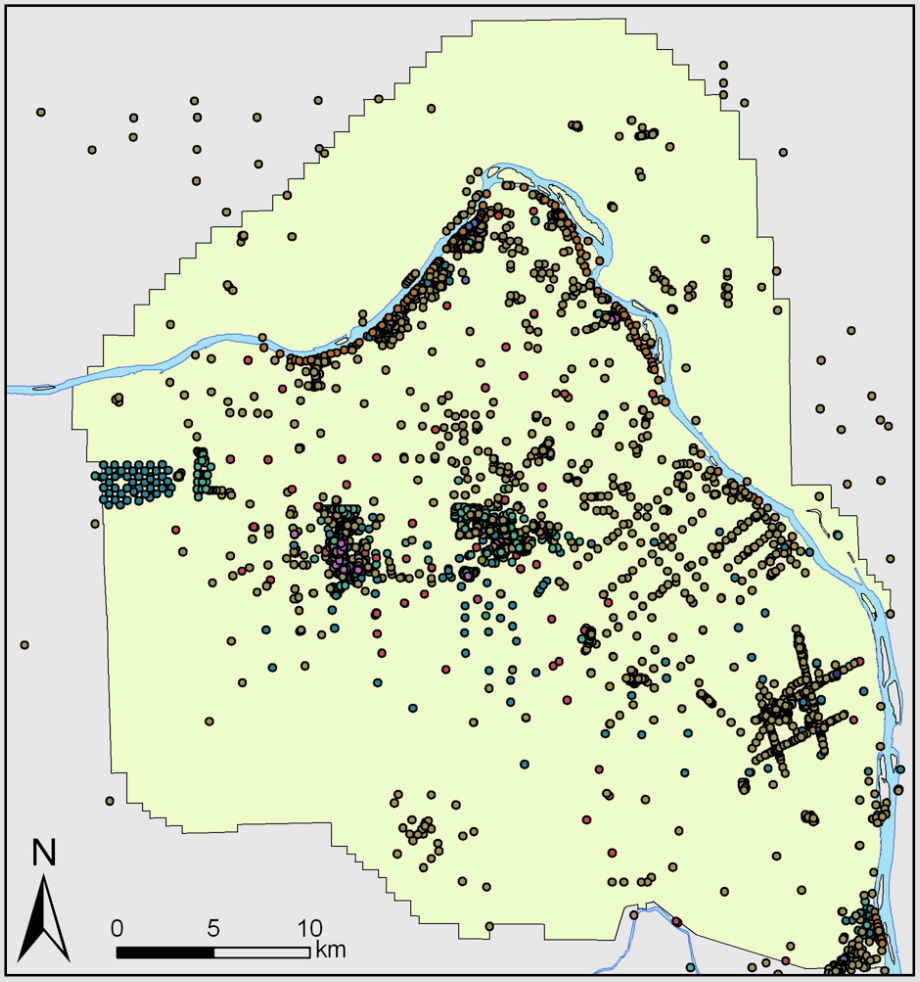
(after Last et. al. 2006)

Primary Input Parameters

- *Recharge/Deep Drainage Rates*
- ***Hydrostratigraphy***
- ***Hydraulic Properties***
- ***Contaminant Distribution Coefficients***

Technical Basis

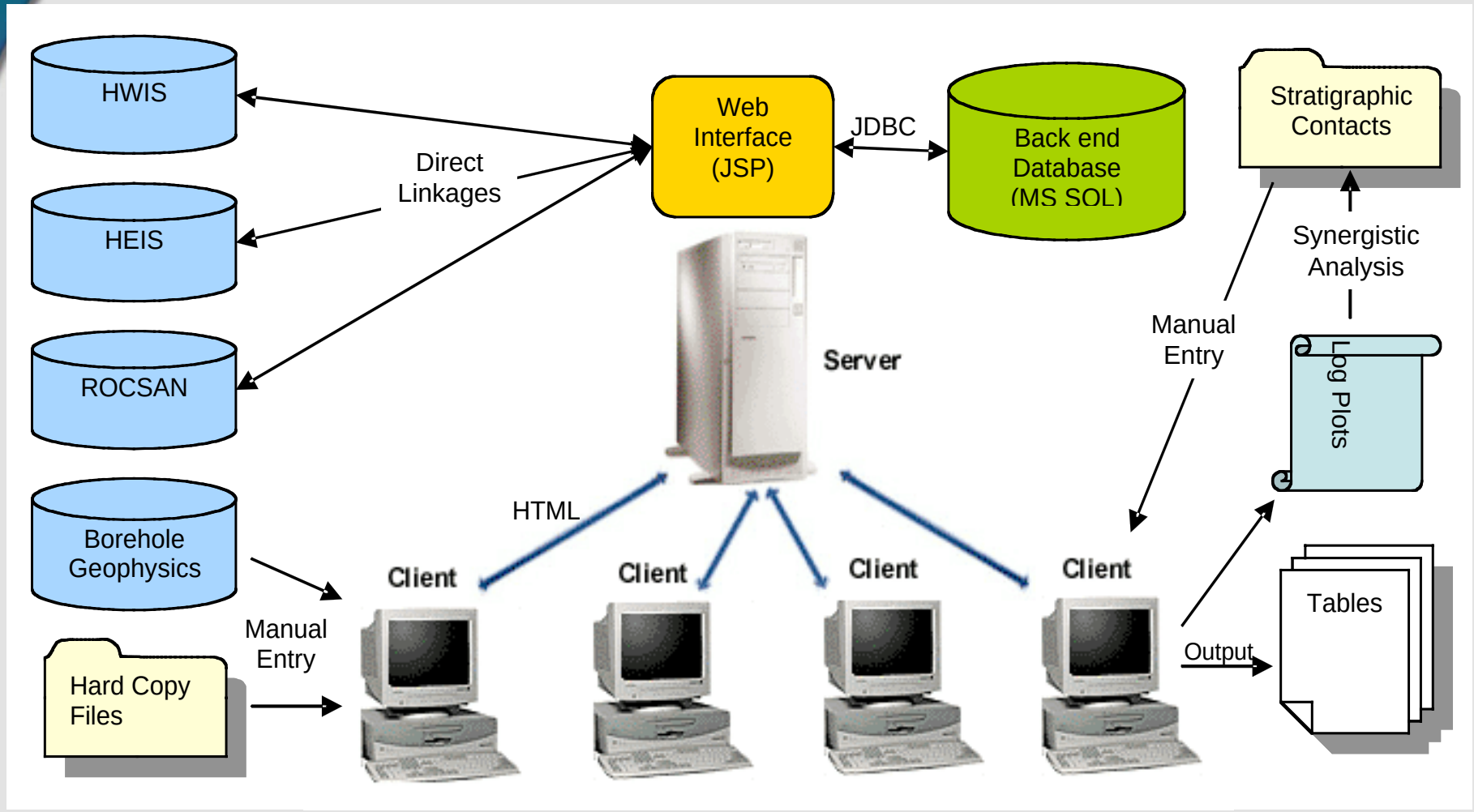
- Over 7,500 boreholes/wells
- Thousands of borehole geophysical logs
- Thousands of physical, hydraulic, and geochemical property measurements
  - Particle-size
  - $CaCO_3$
- 100's of Surface Geophysical Surveys
  - GPR, EM, Magnetometer, Resistivity
- 60 years worth of radiological and chemical monitoring data
- 60 years worth of scientific study



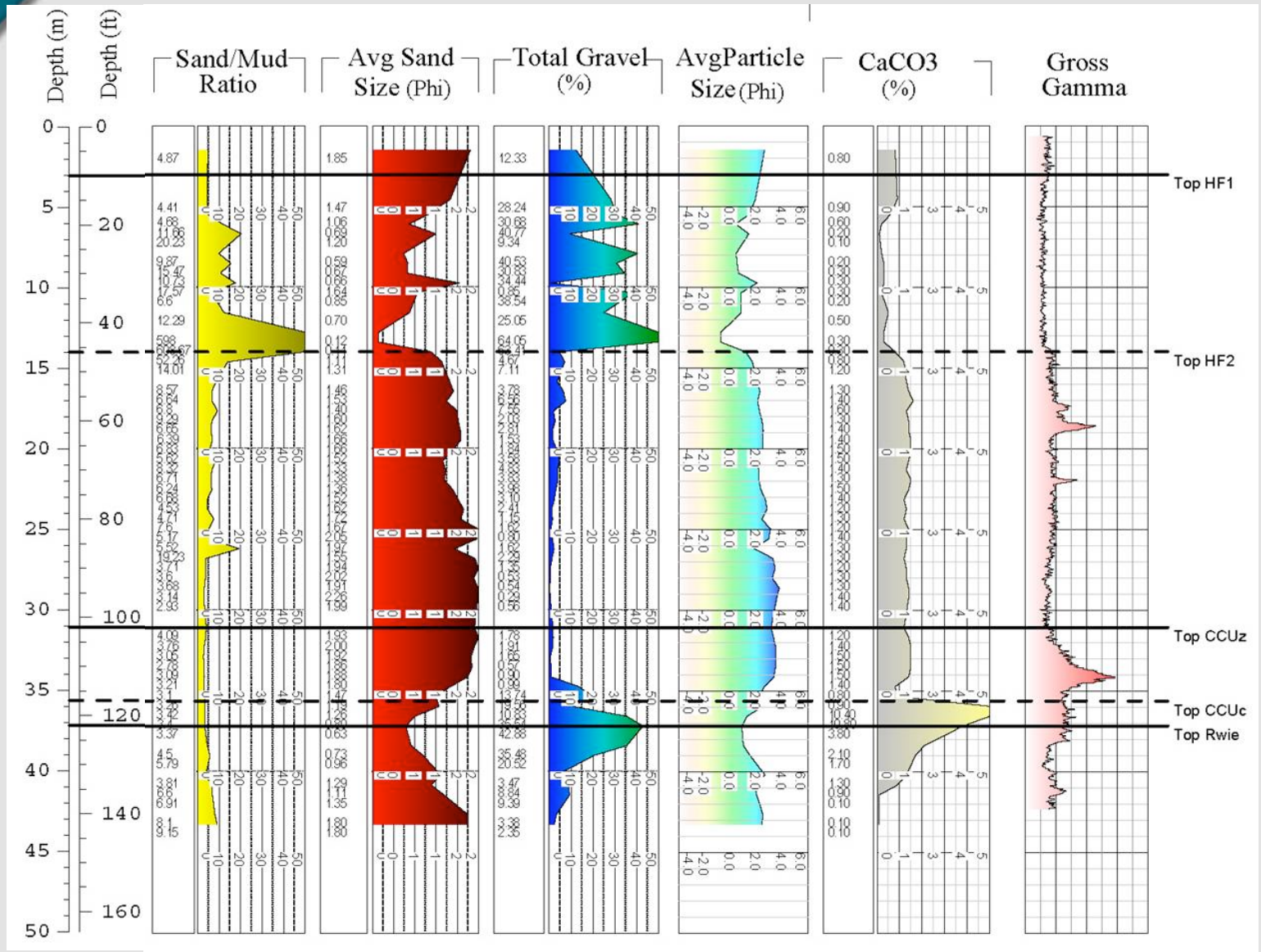
Borehole Geologic Data

- Driller's Logs
- Geologist's Logs
- Archived Samples
  - Grab Samples
  - Splitspoon Samples
  - Core Samples
- Borehole Geophysics
- Aquifer Tests
- Physical Analyses
- Chemical Analyses

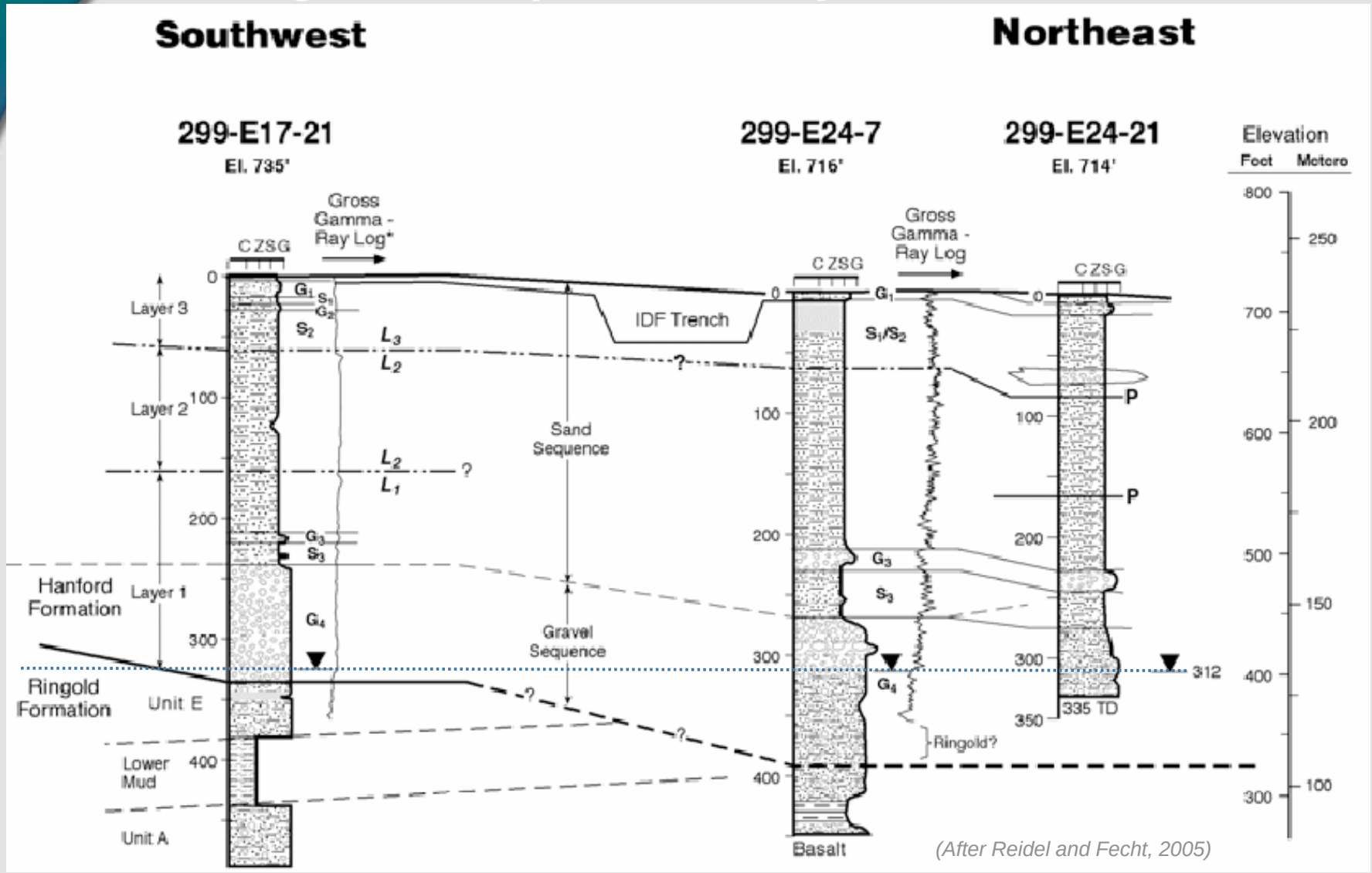
The Integrated Borehole Geologic Information System Approach



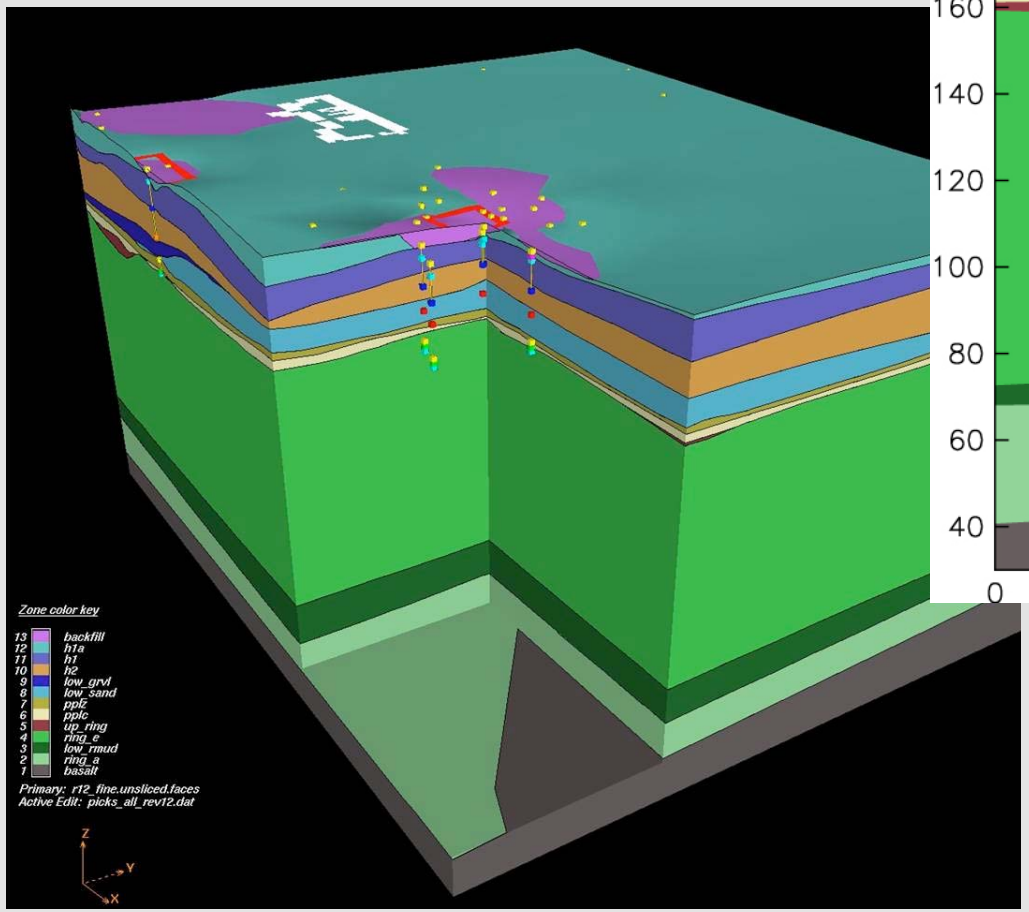
Synergistic Analysis of Borehole Data

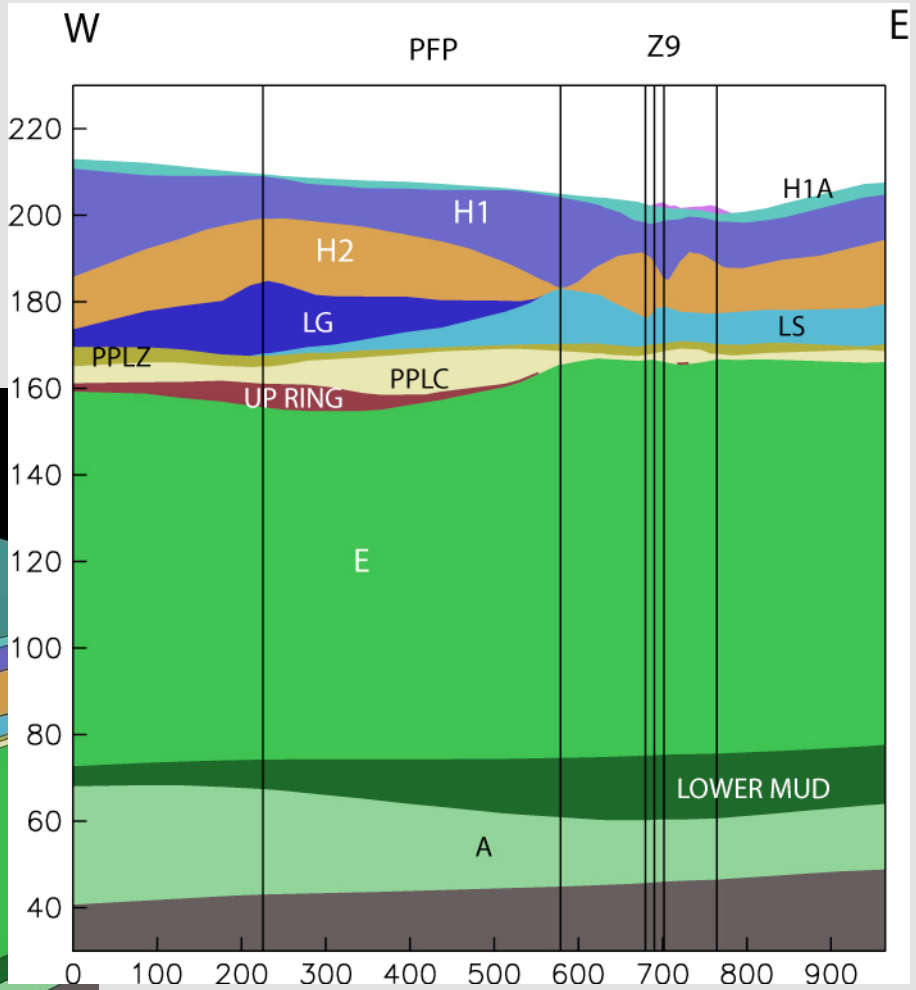


Cross Section Through Integrated Disposal Facility, 200 East Area



Spatial Modeling of the Geologic Framework





Hanford Geotechnical Databases

- Over 37,500 records stored in seven databases available through the Virtual Library or in Microsoft Access™ format residing on an internal PNNL server managed using SoilVision[1]

™ Trademark of Microsoft Corporation
[1] SoilVision Systems Ltd., Saskatoon, SK

- Data Types (Borehole Information, Grain size, Moisture Content, Water Retention, Saturated/Unsaturated Hydraulic Conductivity, Bulk Density, Particle Density, Compaction, Thermal Properties)

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ROCSAN Module - Sieve Percentage Report

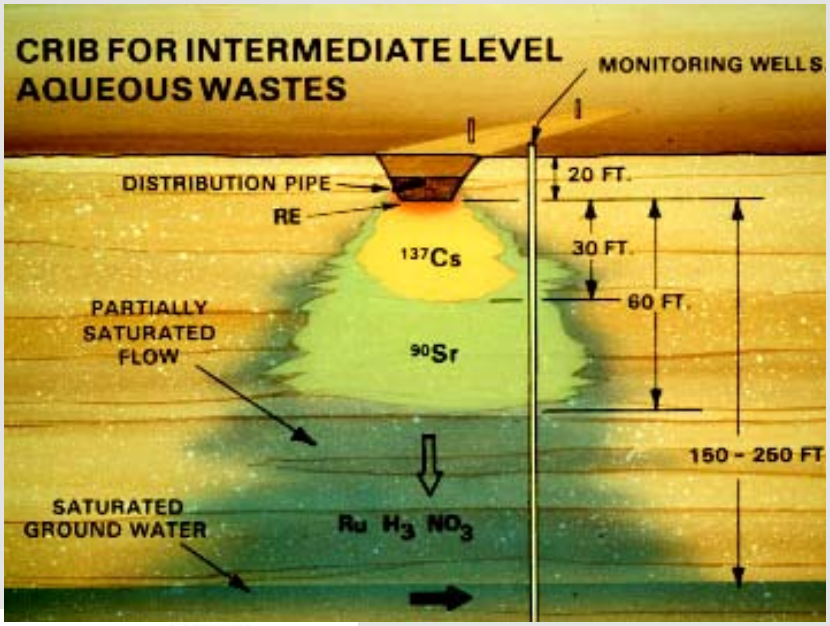
Well Name: 299-W15-5

Sieve Weight Percent Report for Location: 299-W15-5

Interval Bottom (ft)	$CaCo_3$%	Split Weight (gms)	Gravel Wt %	Sand Wt %	Mud Wt %	Litho Class	Gravel (Wt. %)		Sand (Wt. %)					Mud (Wt. %)	
							Fine Pebble	Very Fine Pebble	Very Coarse	Coarse	Medium	Fine	Very Fine	Silt	Pan
							4mm	2mm	1mm	0.5mm	0.25mm	0.125mm	0.0625mm	0.0372mm	-
5	0.50	136.10	0.00	81.36	18.64	(m)S	0.00	0.00	1.10	4.97	13.45	28.80	33.04	10.38	8.26
10	0.50	158.20	0.00	83.51	16.49	(m)S	0.00	0.00	0.69	4.91	13.09	30.90	33.92	9.69	6.80

Hanford Geochemical Databases

- Petrologic, minerologic, and bulk rock geochemical data base (including Cation exchange capacity)
- Partitioning Coefficients



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K_d - K_d Table

Filtering Mode: Species

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Species: Uranium (U(VI))

Sediment	Solution	Method	Kd	Equil Time.	Reference
B19136	Simulated HGW	Batch-desorb	7.61	7	Um et al. 2005
B19136/B19137	Simulated HGW	Batch	0.37	7	Um et al. 2005

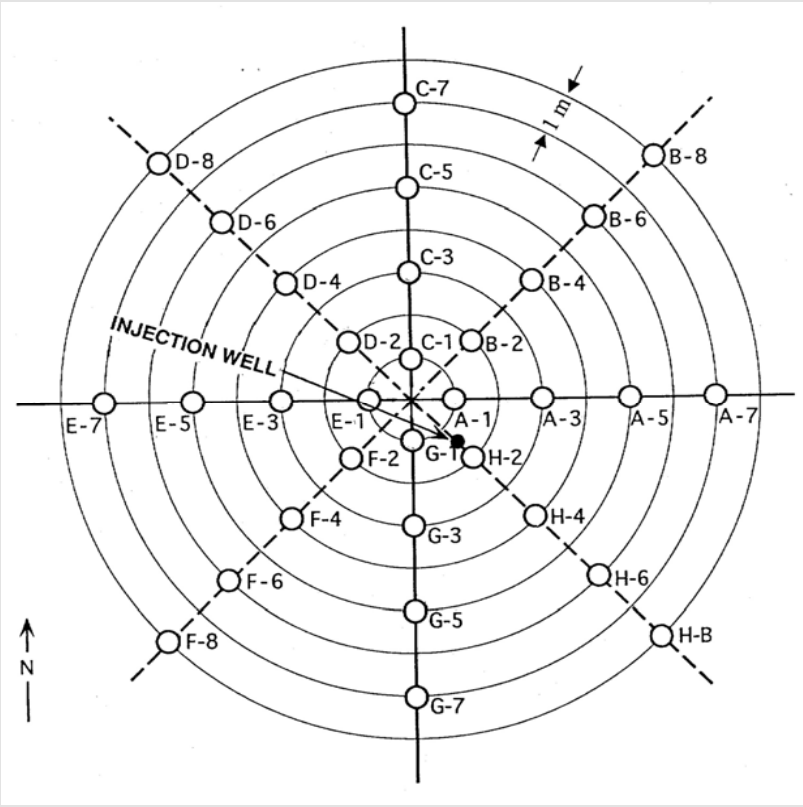
Not a Simple Layer Cake
- Very Heterogeneous and Anisotropic -

Gravel-dominated Facies
In Pit #30, West of 200 East Area

Sand-dominated Facies at the
Integrated Disposal Facility, 200 East

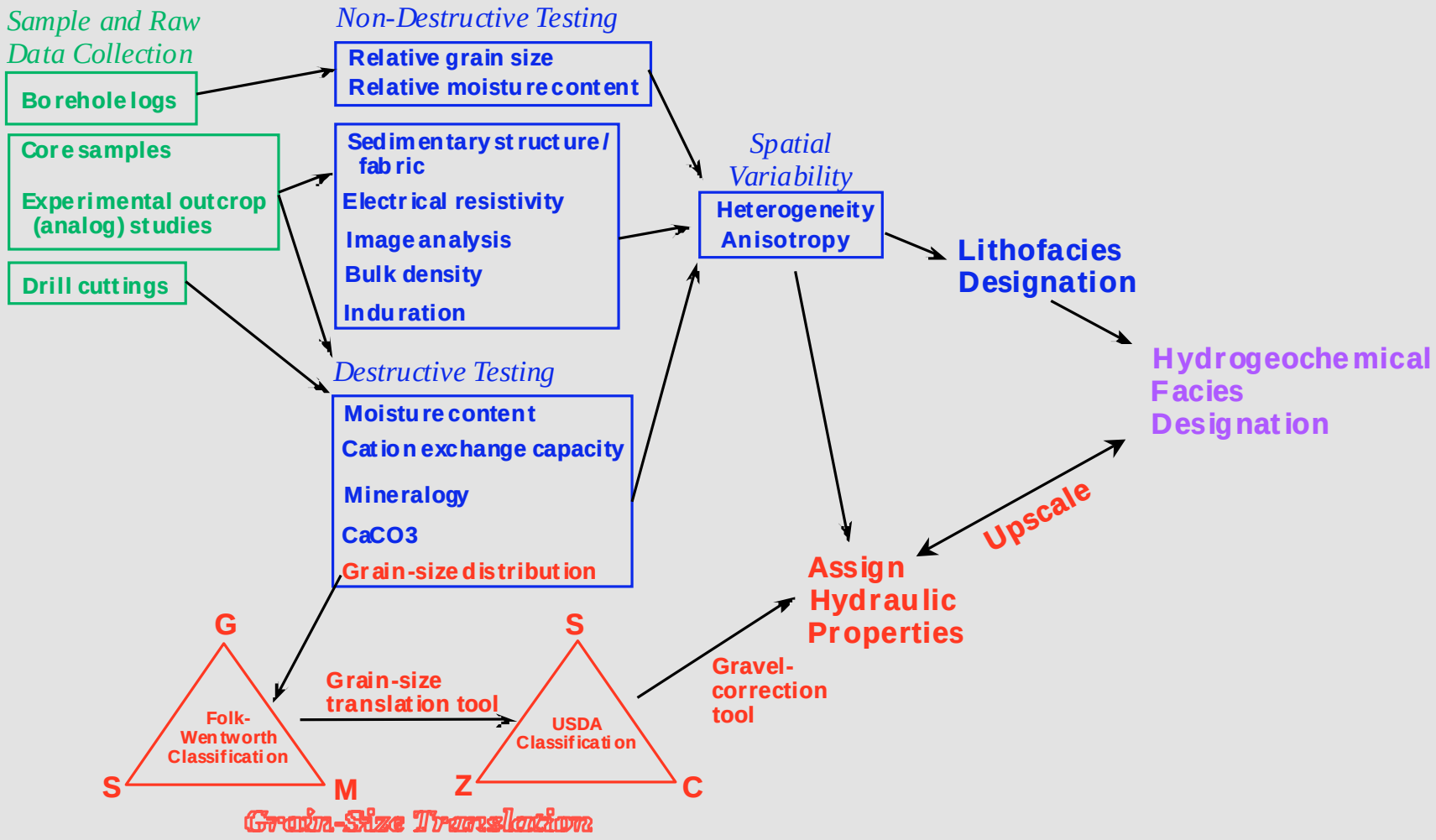
Upscaling and Testing

- Upscaling approaches are being developed to estimate effective large-scale properties from small-scale laboratory measurements of the heterogeneous sediments
- These techniques have been tested using moisture data collected from an injection well test site at the Vadose Zone Test Facility (also known as the Sisson and Lu site) in the 200 East Area.

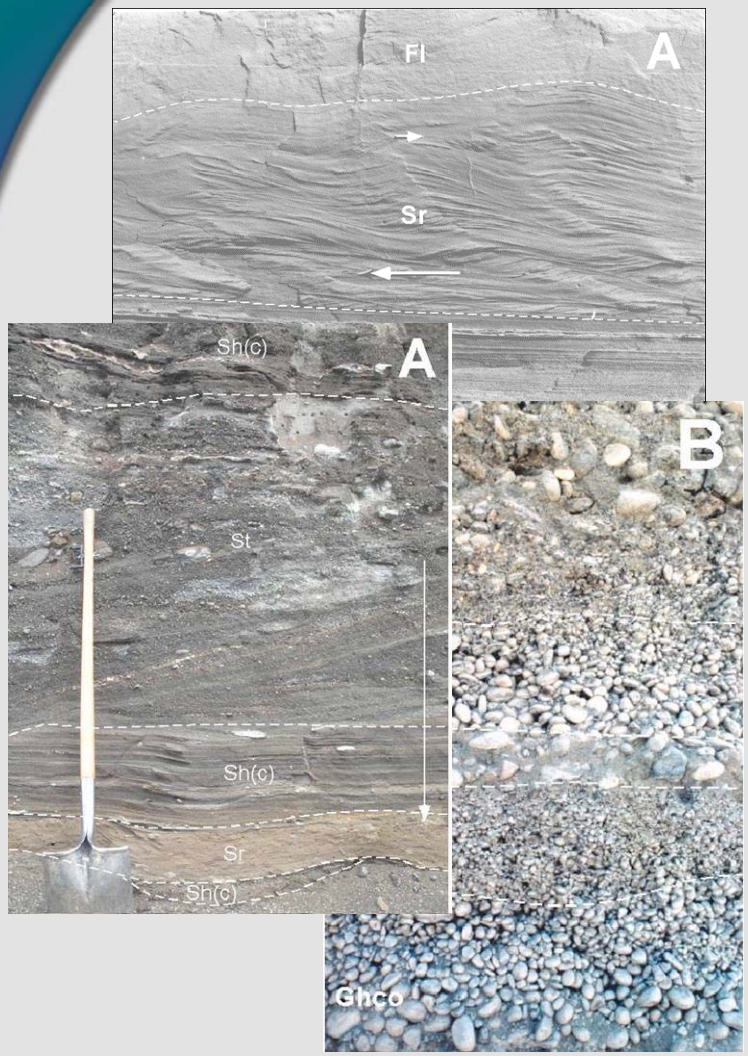


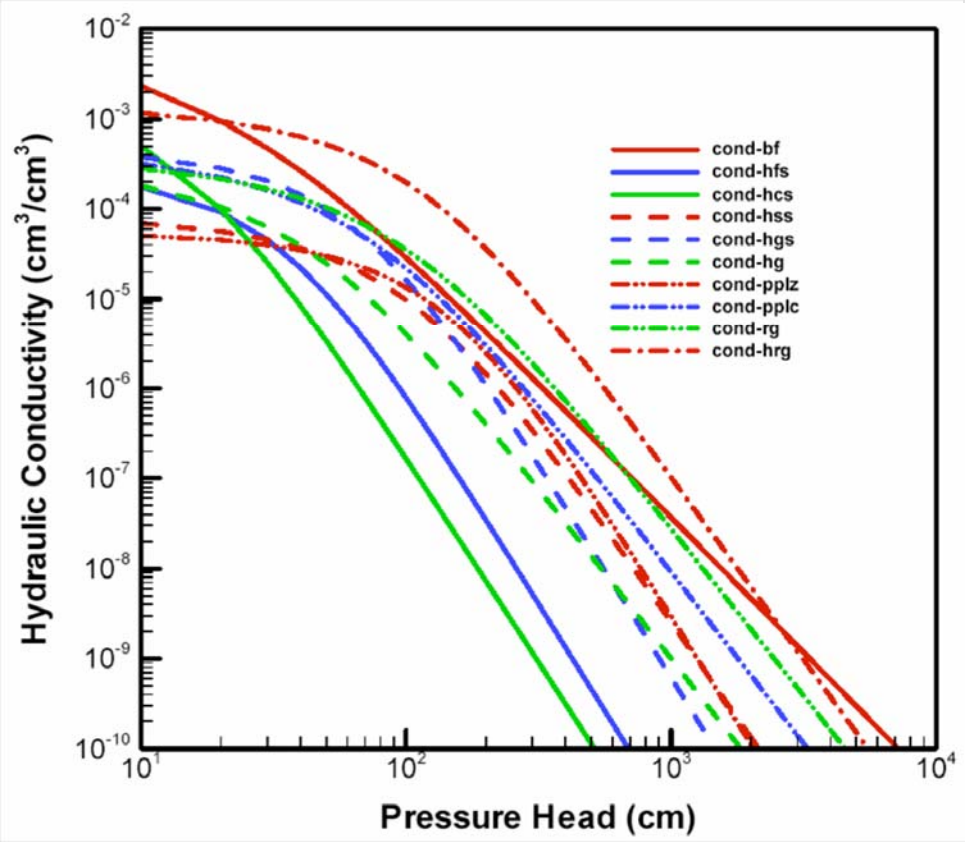
Plan view of the Sisson and Lu (1984) injection test site and well numbering scheme (after Gee, G. W. and A. L. Ward, "*Vadose Zone Transport Field Study*," PNNL-13679, Pacific Northwest National Laboratory, Richland, WA, 2001)

Integration of Raw Data Sets to Define Hydrogeochemical Facies



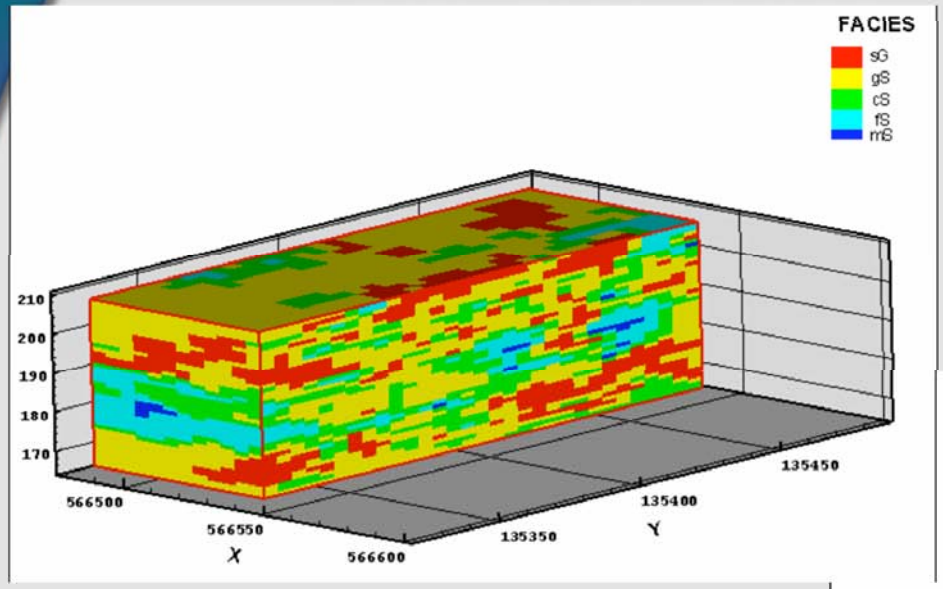
Assignment of Hydraulic Properties





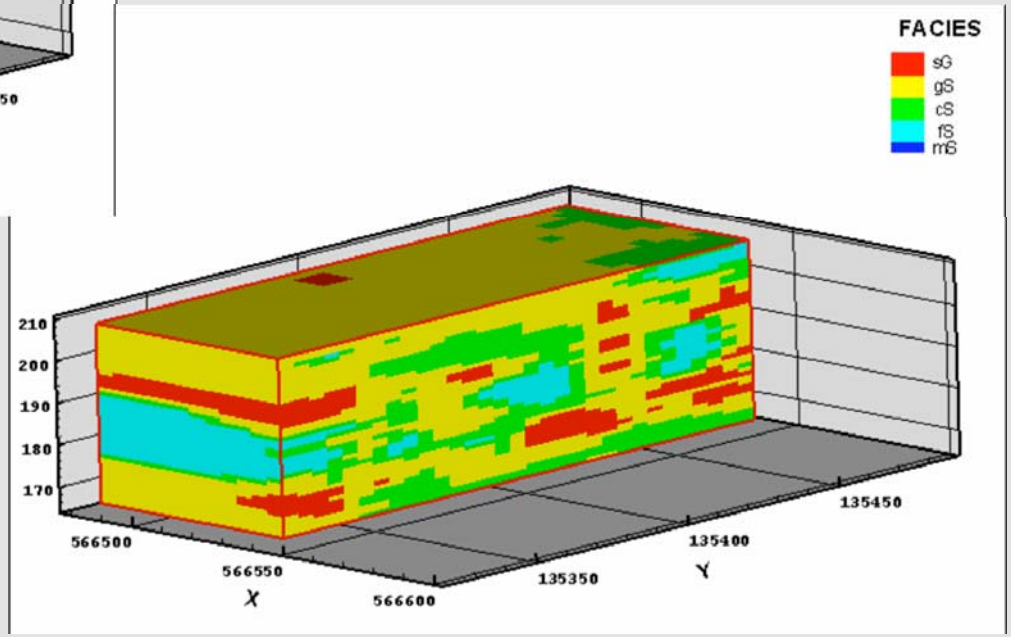
Mean lithofacies-specific hydraulic conductivity curves calculated from laboratory measured moisture retention characteristic and saturated hydraulic conductivity data using van Genuchten-Mualem equations *(After Last et. al. 2004)*

Geostatistical Simulations of Lithofacies Distributions or of Individual Flow and Transport Parameters



One of 100 Simulations

Most probable lithology from the 100 Simulations



Courtesy of Debbie A. Bush

Summary

- Uncertainty in the spatial distribution of flow and transport parameters are among the primary contributors to overall uncertainty in site assessments.
- Understanding the subsurface architecture provides valuable insights for scaling and constraining the spatial distribution of transport parameters.
- Efforts are being made to
  - assemble, integrate and manage vast amounts of raw subsurface data
  - identify and map different lithofacies
  - develop rigorous interpretation and translation tools
  - facilitate selection of assessment-specific parameter estimates at the appropriate scale(s) that are traceable, reproducible, defensible, and internally consistent.