

Subsurface Characterization Under Challenging Conditions

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Outline

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 - ▶ Geological setting and well network
 - ▶ Flow zone identification and monitoring
- ▶ Transmissivity Profiling
 - ▶ Profiling procedures
 - ▶ Brief comparison of results for two different profiling methods
- ▶ Water FLUTe Multilevel Systems
 - ▶ System overview and emplacement procedures
 - ▶ Construction and installation adaptations for artesian conditions
- ▶ Summary
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Objectives of Presentation

- ▶ The primary objective of this presentation is to:
 - ▶ Discuss how transmissivity profiling and multilevel Water FLUTe installations were performed under deep flowing artesian conditions, with a review of the:
 - ▶ Complicating factors;
 - ▶ Associated problems; and
 - ▶ Solution methods
 - ▶ Demonstrate the benefits of multilevel systems and review some of the recent advancements with the technology

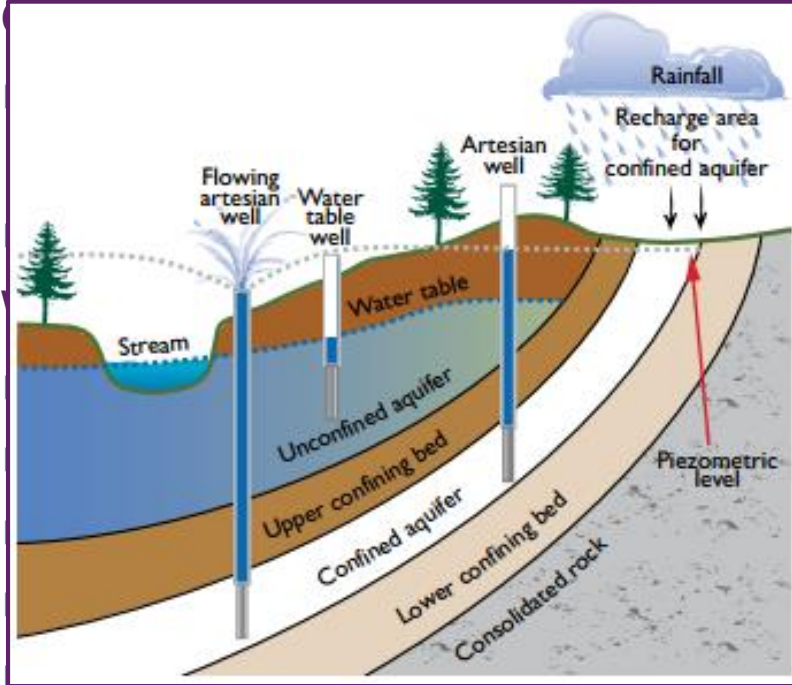


Overview of Confidential Site

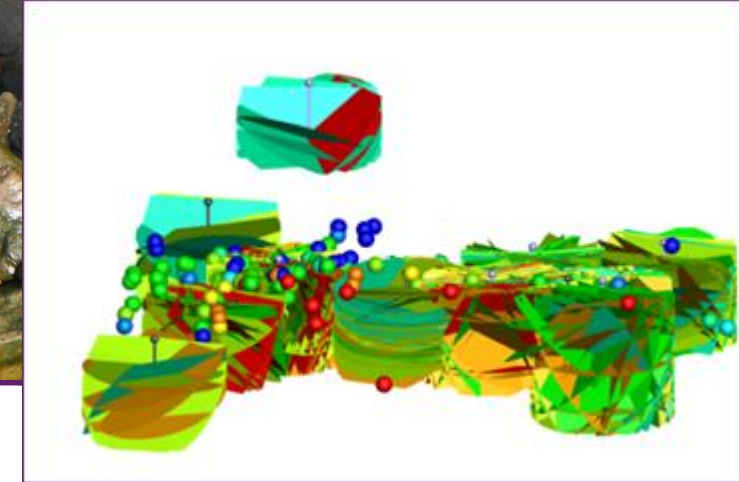
► Location

- Eastern Canada
- Structural Syncline (geographical low)

►



►



Overview of Confidential Site

► Deep Well Network

Well Properties					RAS Testing	FLUTe™ Profiling & Instrumentation		
Well ID	Drilled Depth (m)	Casing Depth (m)	Water Level (mbTOC)	Artesian Flow Rate (Lpm)	Geophysical / Hydrophysical	Transmissivity Profiling	Water FLUTe™ System	Monitoring Zones
BH-0	307.5	15.2	12.89		✓		✓	15
BH-1	244.0	13.1	13.29			✓		
BH-2	183.0	13.4	Artesian (2.95)	38	✓		✓	10
BH-3	106.0	N/A	20.59		✓		✓	10
BH-4	132.0	18.3	0.51		✓		✓	14
BH-5	83.8	N/A	Artesian (0.06)	N/A		✓		
BH-6	97.5	17.8	Artesian (1.71)	166	✓	✓	✓	12
BH-7	91.4	15.2	0.49		✓	✓	✓	8
BH-8	76.2	12.2	Artesian (2.97)	225	✓	✓	✓	10
BH-9	91.4	17.7	9.93		✓	✓	✓	13
BH-10	100.5	15.2	10.53		✓	✓	✓	9
BH-11	100.6	15.2	Artesian (7.92)	<20	✓	✓	✓	15
BH-12	122.5	18.3	Artesian (1.83)	30	✓	✓	✓	10
BH-13	160.0	18.3	7.04		✓		✓	11
BH-14	85.3	17.7	5.57		✓		✓	14
BH-15	137.5	18.0	13.38		✓		✓	10
BH-16	304.8	100.6	11.56		✓	✓		
BH-17	185.9	17.8	3.25		✓	✓	✓	12
BH-18	138.1	15.2	Artesian (3.59)	75	✓		✓	10
BH-19	131.4	15.5	Artesian (2.50)	75	✓	✓		
BH-20	121.9	15.3	Artesian (8.61)	225	✓	✓	✓	12
Total	2,237			Total	19	13	17	195
				Artesian	8	7	7	79

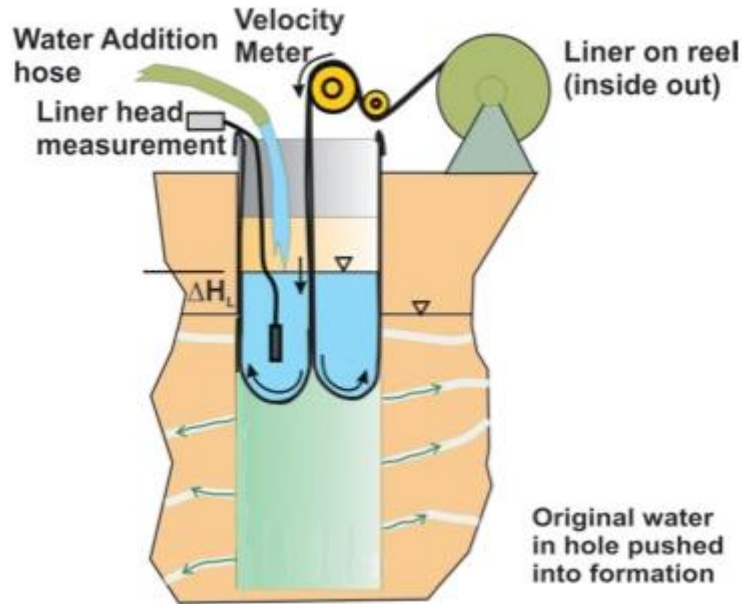
 Water FLUTe

Flow Zone Identification and Monitoring

- ▶ Typical goal of hydrogeological characterizations is to:
 - ▶ Understand groundwater flow regime; and
 - ▶ Determine contaminant distribution.
 - ▶ Based on the hydrogeological characterization:
 - ▶ Contaminant fate and transport can be predicted; and
 - ▶ Monitoring and remediation systems can be designed.
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- ▶ Flow zone identification methods
 - ▶ RAS geophysical and hydrophysical testing
 - ▶ FLUTe transmissivity profiling
 - ▶ Instrumentation
 - ▶ Water FLUTe multilevel systems

Transmissivity Profiling

“Ideal” Scenario



Complicating Factors

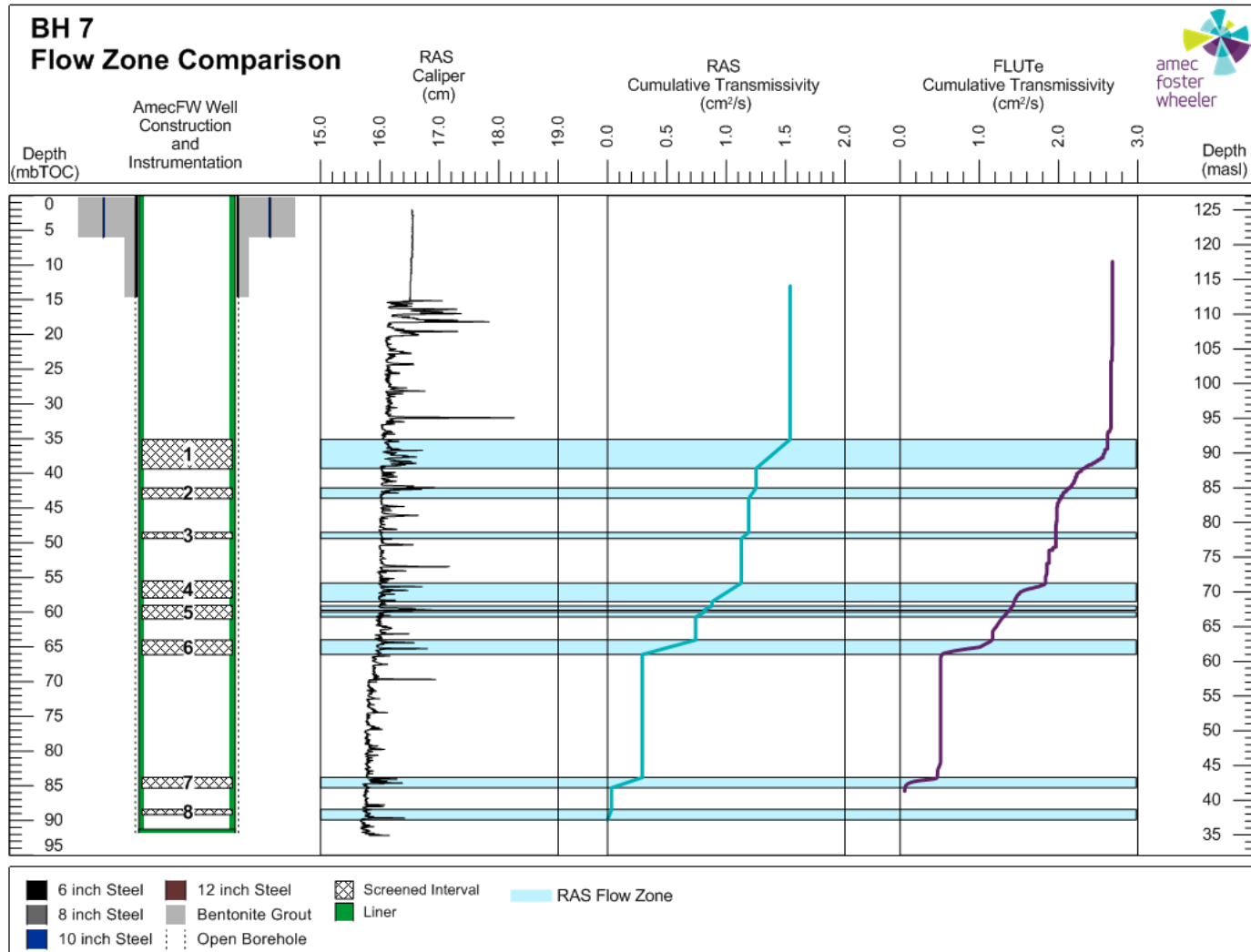
- ▶ Artesian Head
 - ▶ > 9.0 mags (29.5 feet)
- ▶ Artesian Flow Rate
 - ▶ > 225 lpm (60 gpm)

“Our” Scenario



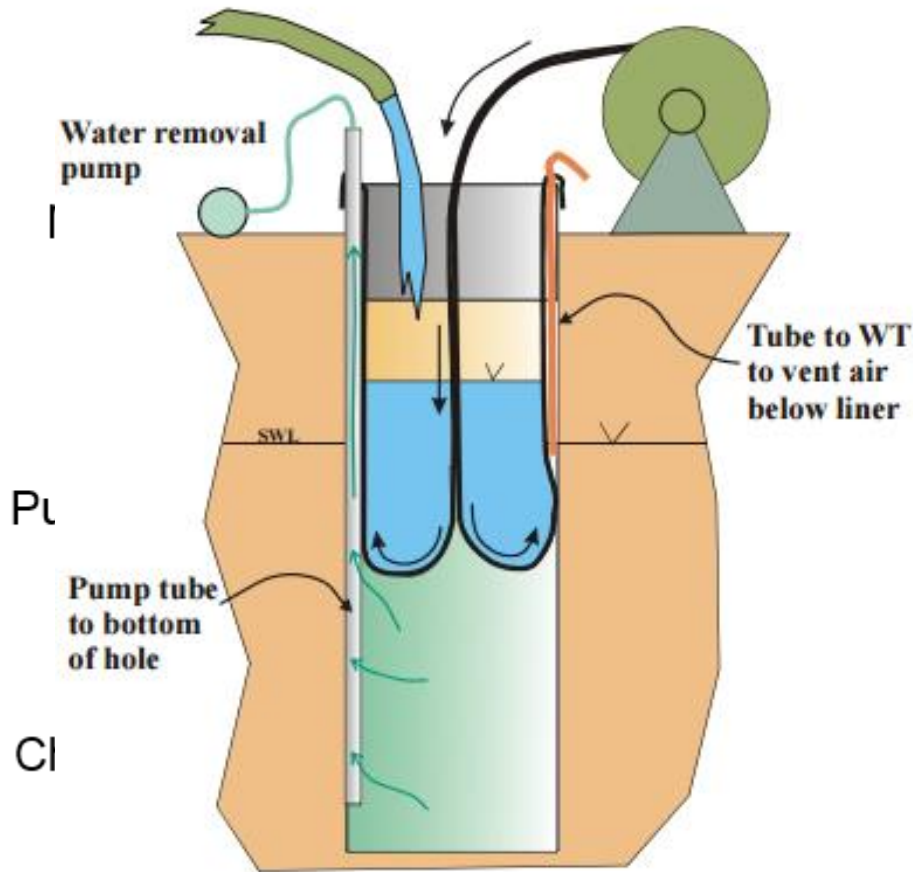


Data Comparison – RAS Inc. Vs. FLUTe

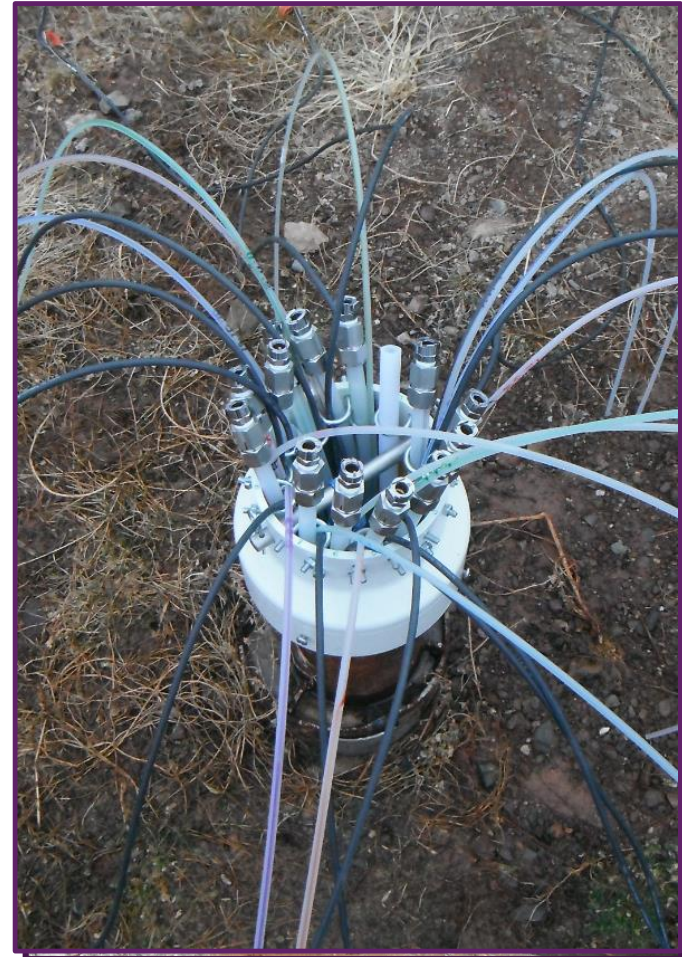


Water FLUTe Multilevel

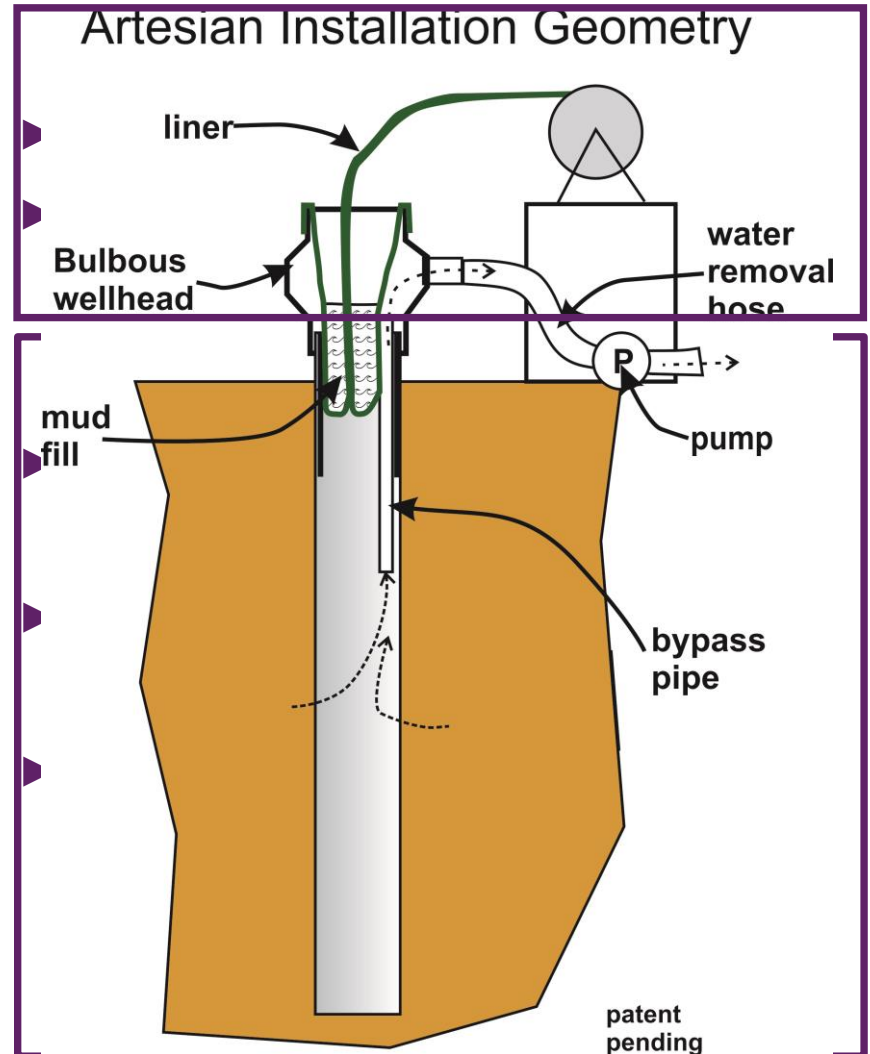
Water FLUTe Pump System



Water FLUTe Test Wellhead

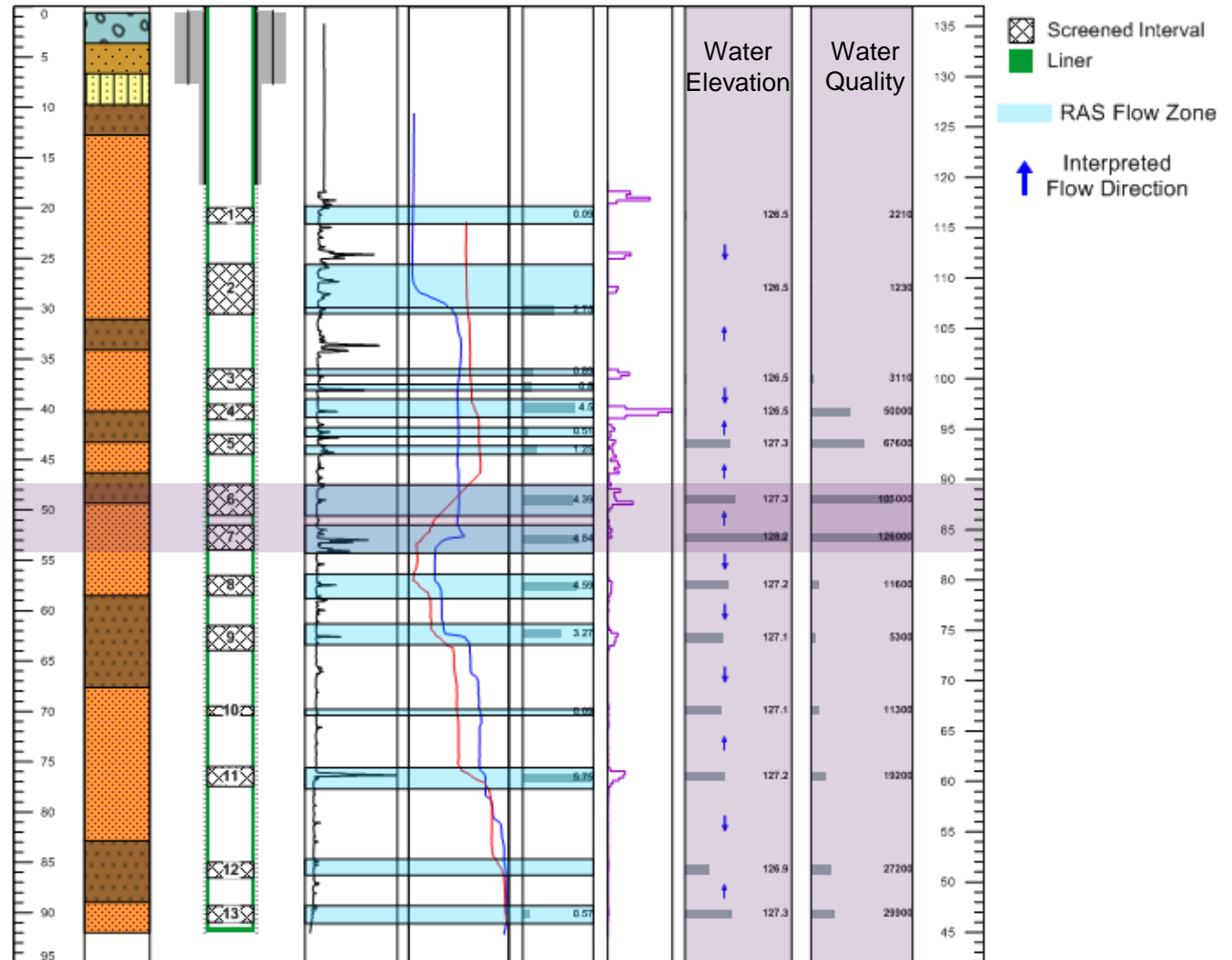


Water FLUTe Multilevel Systems





Sample Well Log Data



Summary

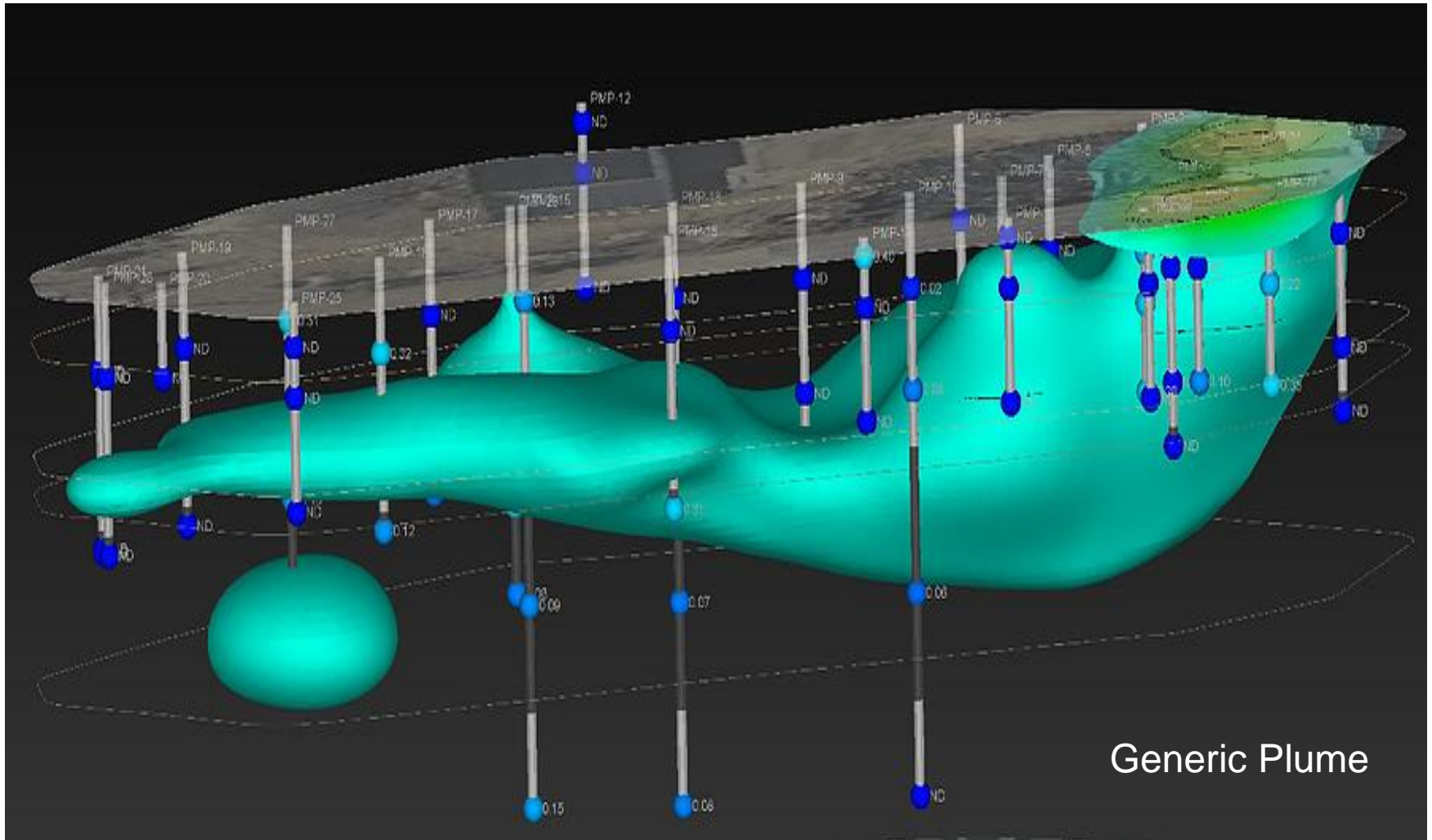
- ▶ Transmissivity profiling and multilevel Water FLUTe systems have been successfully deployed and monitored in wells with:
 - ▶ Artesian Heads > 9.0 mags (29.5 feet)
 - ▶ Artesian Flows > 225 lpm (60 gpm)
- ▶ Providing 195 discrete monitoring intervals to further develop our hydrogeological characterization;
 - ▶ Understand groundwater flow regime; and
 - ▶ Determine contaminant distribution.

Other Benefits

- 17 Drilled Wells (Opposed to 195)
 - Minimize formation Disturbance
 - Faster implementation of monitoring network
- **Approx. 15-25% the Cost of Traditional methods**



Summary



Closing Remarks

- ▶ Largest artesian head and overflow rate
 - ▶ Transmissivity profile and Water FLUTe Installation
- ▶ Maximum depth of a Water FLUTe installation
- ▶ Most artesian ports in a Water FLUTe system
- ▶ First installation of ACT for monitoring artesian heads
 - ▶ ACT – Air Coupled Transducer
- ▶ First pre-pressurization of transducers in a Water FLUTe
 - ▶ Freezing conditions
- ▶ First use of a pressurized sealing well head
- ▶ First stainless steel Water FLUTe systems
- ▶ Patent pending for method/apparatus for artesian conditions

Acknowledgements

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FLUTe™

► RAS Inc.

- Bill Pedler
- Steve Truesdale



“Sometimes overcoming a challenge is as simple as changing the way you think about it”

Unknown



Questions

