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Battelle

... Putting Technology To Work

Bioslurping Introduction and Theory

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Overview of Presentation

- Overview of Free-Product Recovery Technologies
- Bioslurping Technology Description
- Implementation Guidance
- Case Studies
- Questions and answers

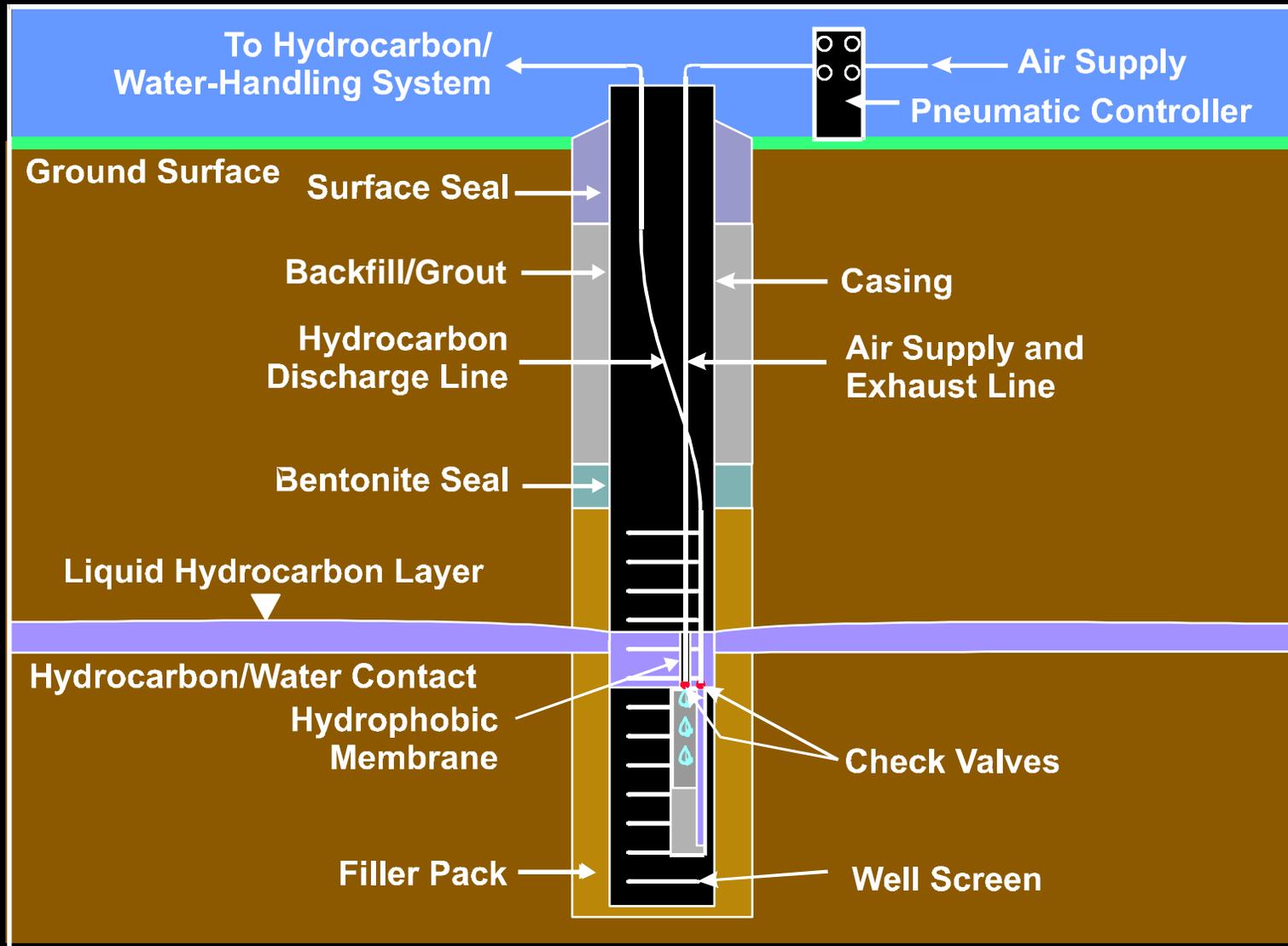
Free-Product Recovery Technologies

- Skimming Technologies
- Drawdown Technologies
- Vacuum-Enhanced Technologies

Free-Product Recovery

- Opportunistic
- Speculative (no guarantees)
- Inability to recover fuel does not constitute failure

Pneumatic Skimming Pump



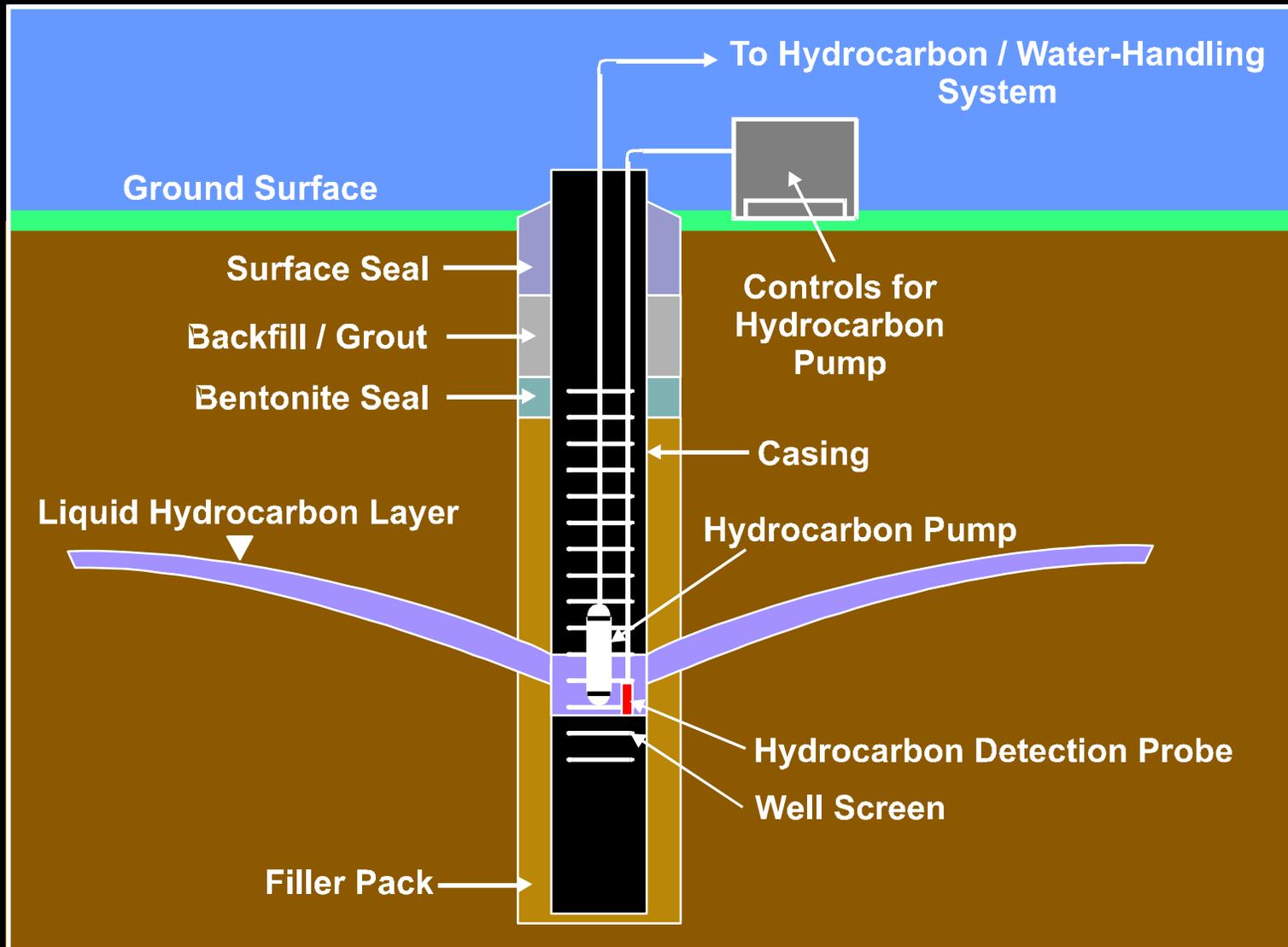
Skimmer Technology Features

- Passive
- Driven by gravity
- Does not require water or vapor treatment

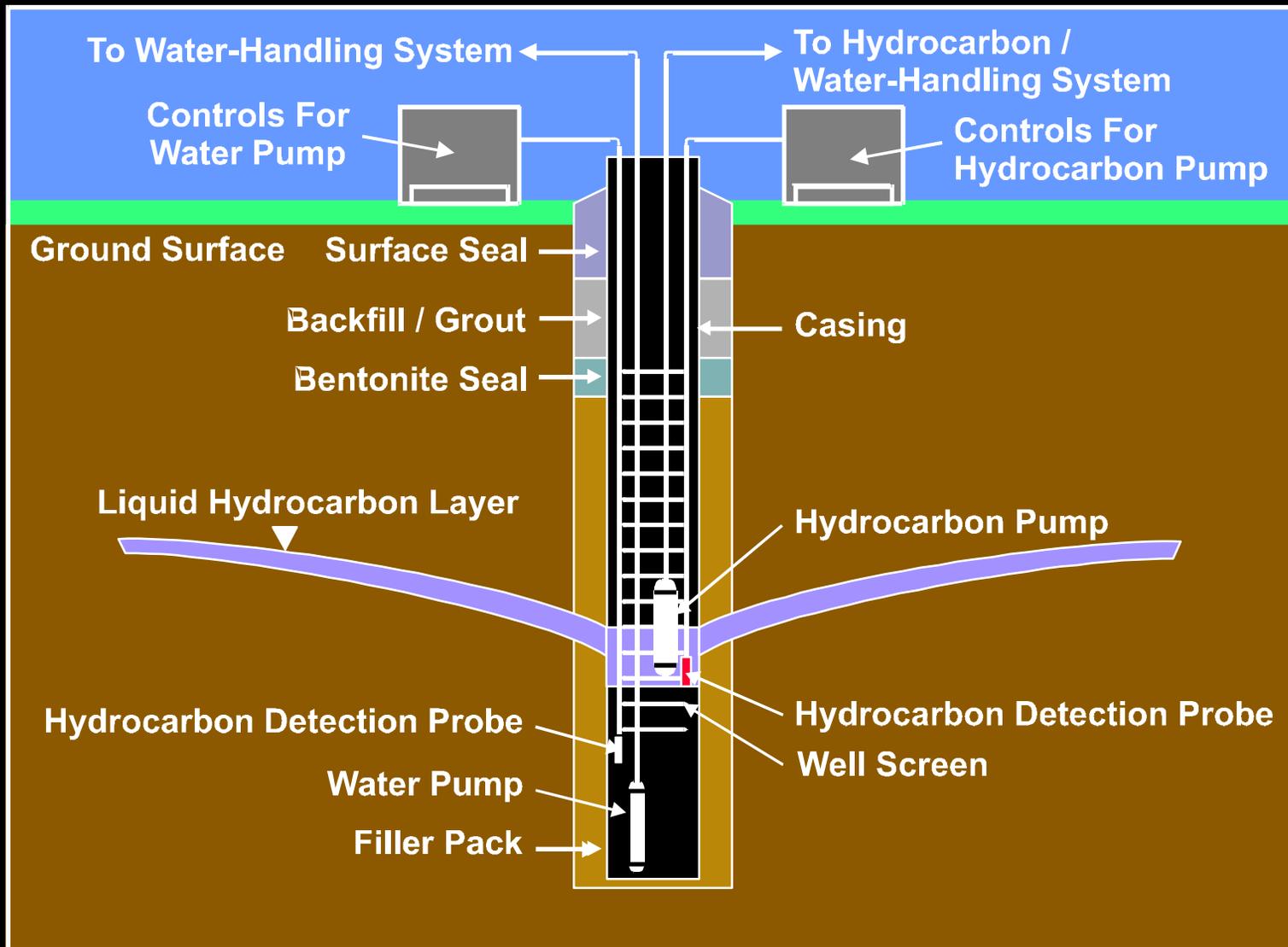
Skimmer Technology Limitations

- No vadose zone treatment
- Will not work at all sites
- High capital cost per well
- Downhole equipment requires maintenance

Single-Pump Drawdown



Dual-Pump Drawdown



Drawdown Technology Features

- Active
- Gravity-driven (cone of depression)
- No vapor treatment

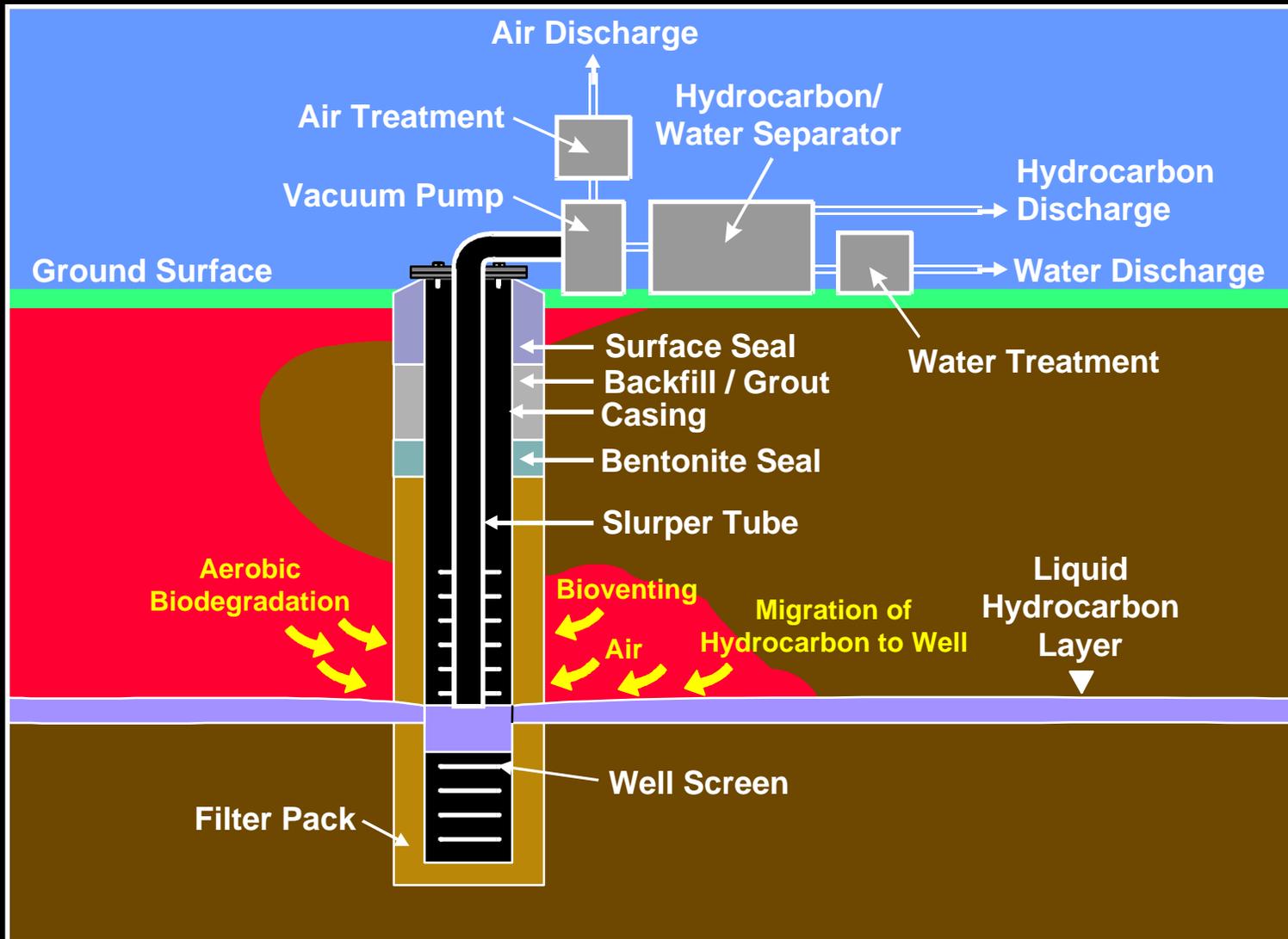
Drawdown Technology Limitations

- No vadose zone treatment
- Dependent on aquifer permeability (not feasible at many sites)
- High capital cost per well
- Extends smear zone (cone of depression)
- Often high water production rates: high-cost water treatment

Bioslurping

Process of utilizing vacuum dewatering technology to facilitate vacuum-assisted free-product recovery and bioventing to simultaneously recover free product and remediate the vadose zone.

Bioslurper System



Bioslurper Technology Features

- Enhanced LNAPL recovery via vacuum-enhanced pumping
- Simultaneous treatment of the vadose zone via bioventing
- Reduced ratio of groundwater extracted per gallon of fuel recovered compared to conventional dual-pump recovery systems
- Can be designed to dewater to expose contamination below the water table or for hydraulic control

Bioslurper Technology Features

- Designed to require only 1 pump to extract from multiple wells, reducing capital costs compared to dual-pump and skimmer technologies
- Applications possible to greater than maximum suction lift due to liquid entrainment
- Easy conversion of system to conventional bioventing system when LNAPL recovery activities are completed

Bioslurper Technology Features

- At low-permeability sites may be only feasible technology
- Highly adaptable to changing site conditions
- Has been demonstrated successfully at wide range of sites

Bioslurper Technology Limitations

- Water and vapor treatment
- Operation and maintenance
- May be less effective at deep, high-permeability sites

Why Use Bioslurping?

- Vadose zone treatment
- Significantly enhanced fuel recovery at most sites

Fuel Recovery Rates (gal/d)

	Skimmer (2d)	Bioslurper	Skimmer (1d)	Drawdown
Bolling 1	17	60	8.2	31
Bolling 2	0.86	1.1	NA	0.13
Andrews	8.7	79	0.70	NA
Wright-Patt	4.0	4.7	NA	2.5
Travis	0	3.9	0	3.8
Robins 1	11	48	5.0	12
Robins 2	1.4	3.2	NA	0.36
Kaneohe	0	2.4	0.050	0
Hickam	35	91	NA	410
Johnston Atoll	30	56	3.6	9.5

Questions and Answers
