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Critical Challenges. Practical Solutions.

Energy & Environmental Research Center (EERC)

Minnesota Senate Energy Committee

St. Paul, Minnesota

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Kevin Connors

Assistant Director for Regulatory Compliance and Energy Policy

OUR FACILITIES

254,000 SQ FT OF FACILITIES

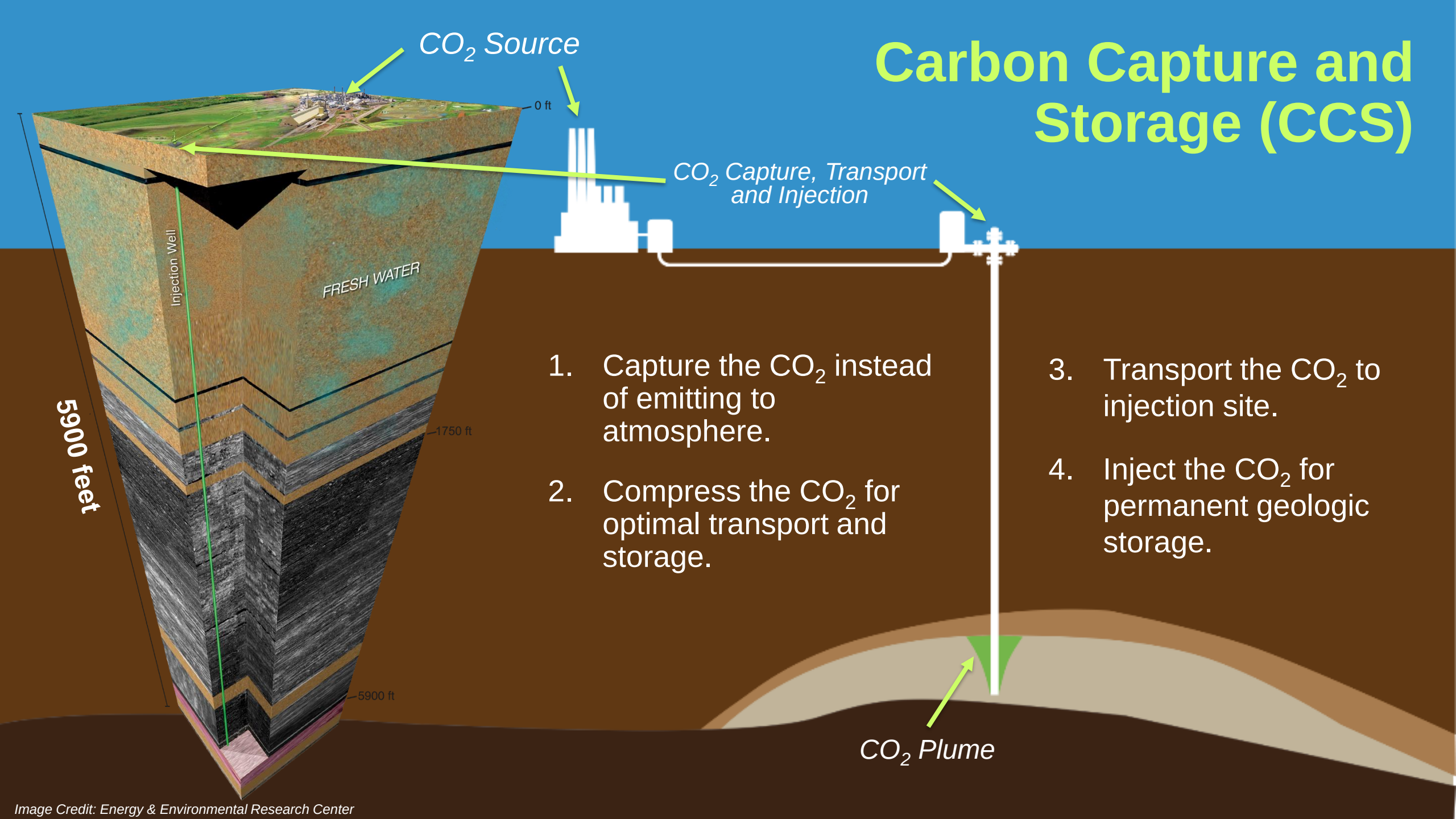
CORE RESEARCH PRIORITIES

- Coal Utilization & Emissions
- Carbon Management
- Oil & Gas
- Alternative Fuels & Renewable Energy
- Energy–Water

CARBON MANAGEMENT

Global leader in the area of CO_2 capture, utilization, reduction, and storage. Experienced resource for industry and government in fossil fuels and biomass.

Carbon Capture and Storage (CCS)



1. Capture the CO_2 instead of emitting to atmosphere.
2. Compress the CO_2 for optimal transport and storage.
3. Transport the CO_2 to injection site.
4. Inject the CO_2 for permanent geologic storage.

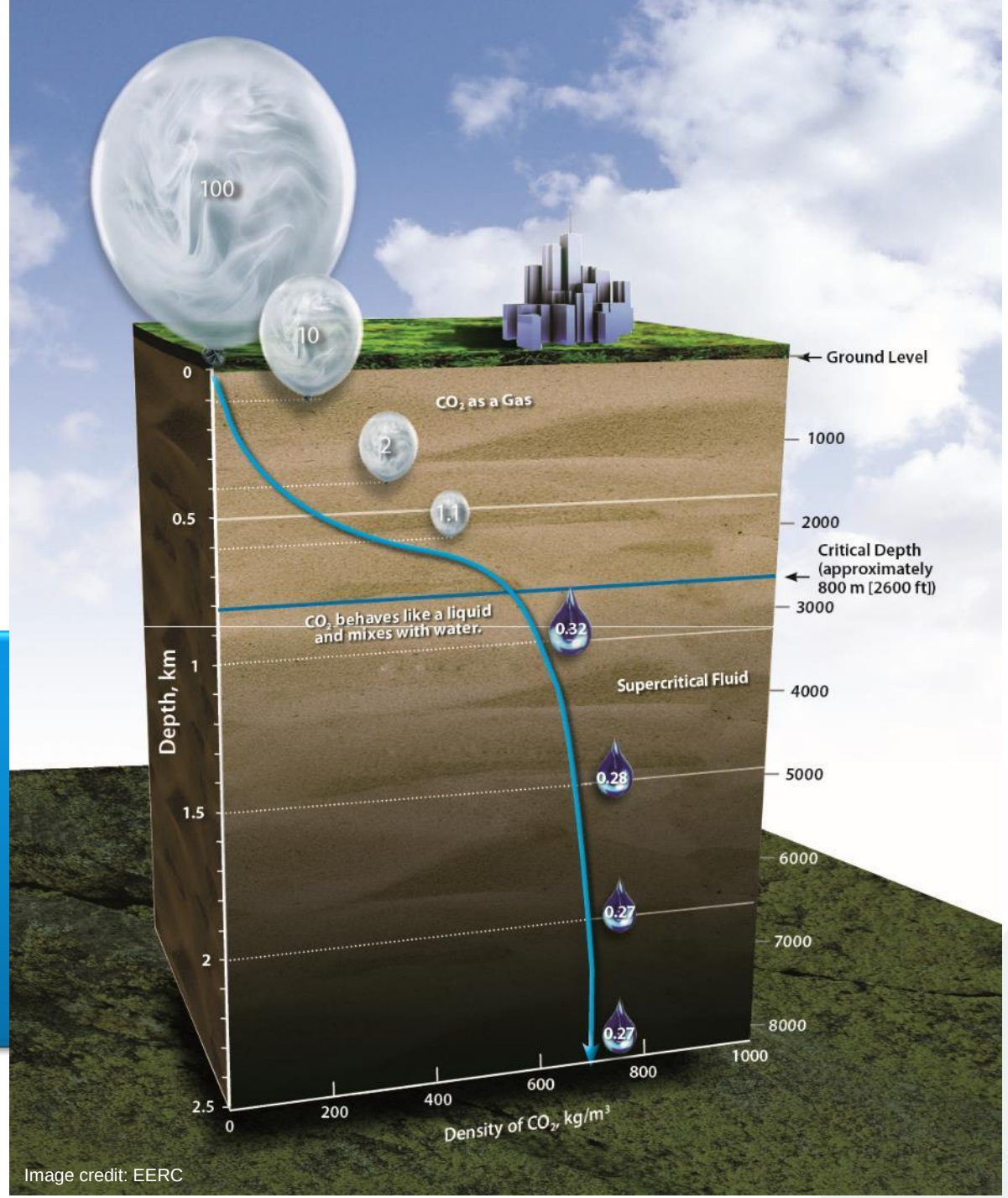
Image Credit: Energy & Environmental Research Center

CRITICAL SUBSURFACE CHARACTERISTICS

- Depth
- Porosity/permeability
- Good cap rock
- Appropriate salinity
- No natural leakage pathways

Depth

- Below approximately 2600 ft, CO_2 becomes a supercritical fluid.
- CO_2 will behave like a liquid.
- High density of the CO_2 allows for more storage in a given volume.



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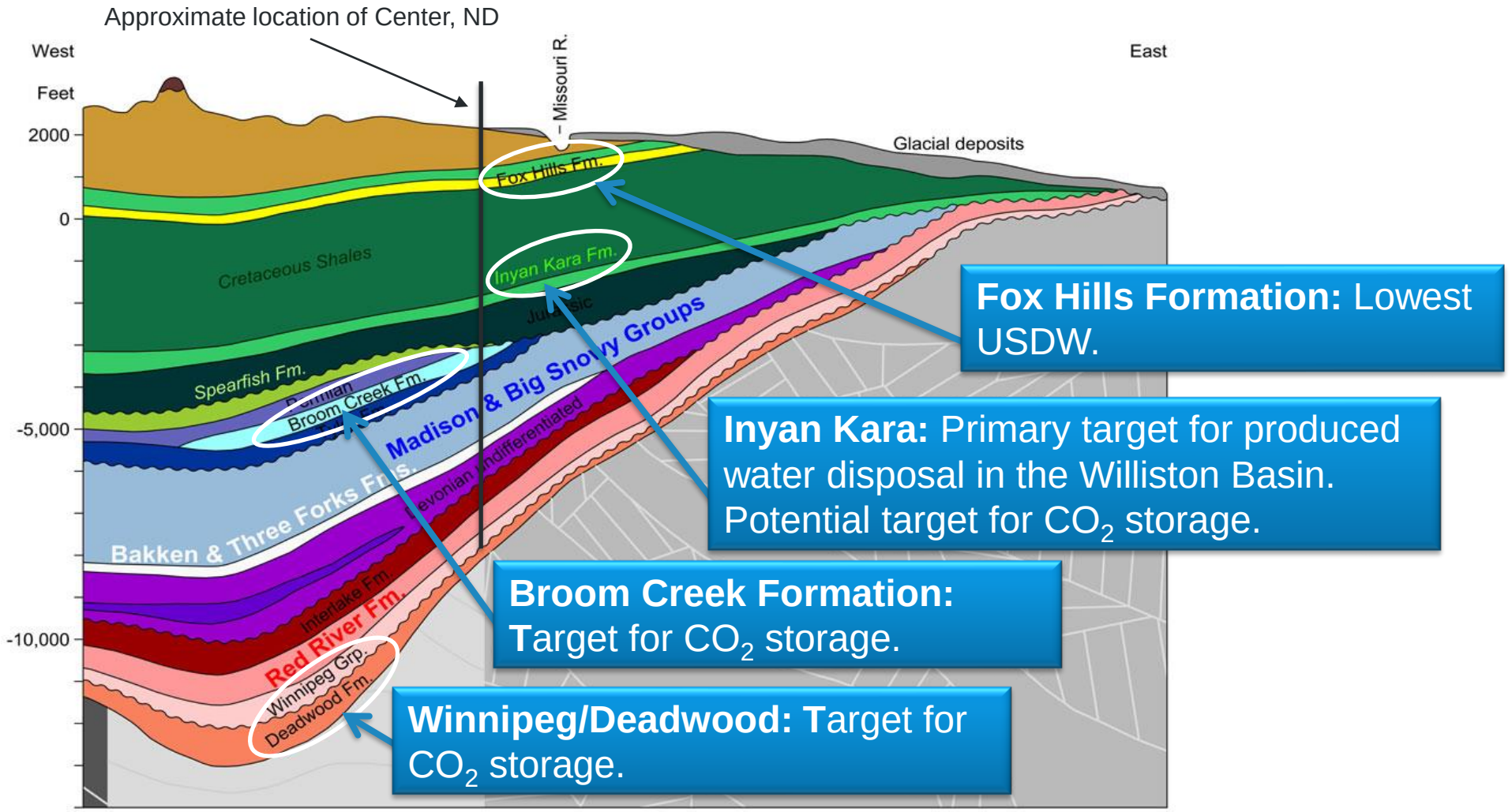
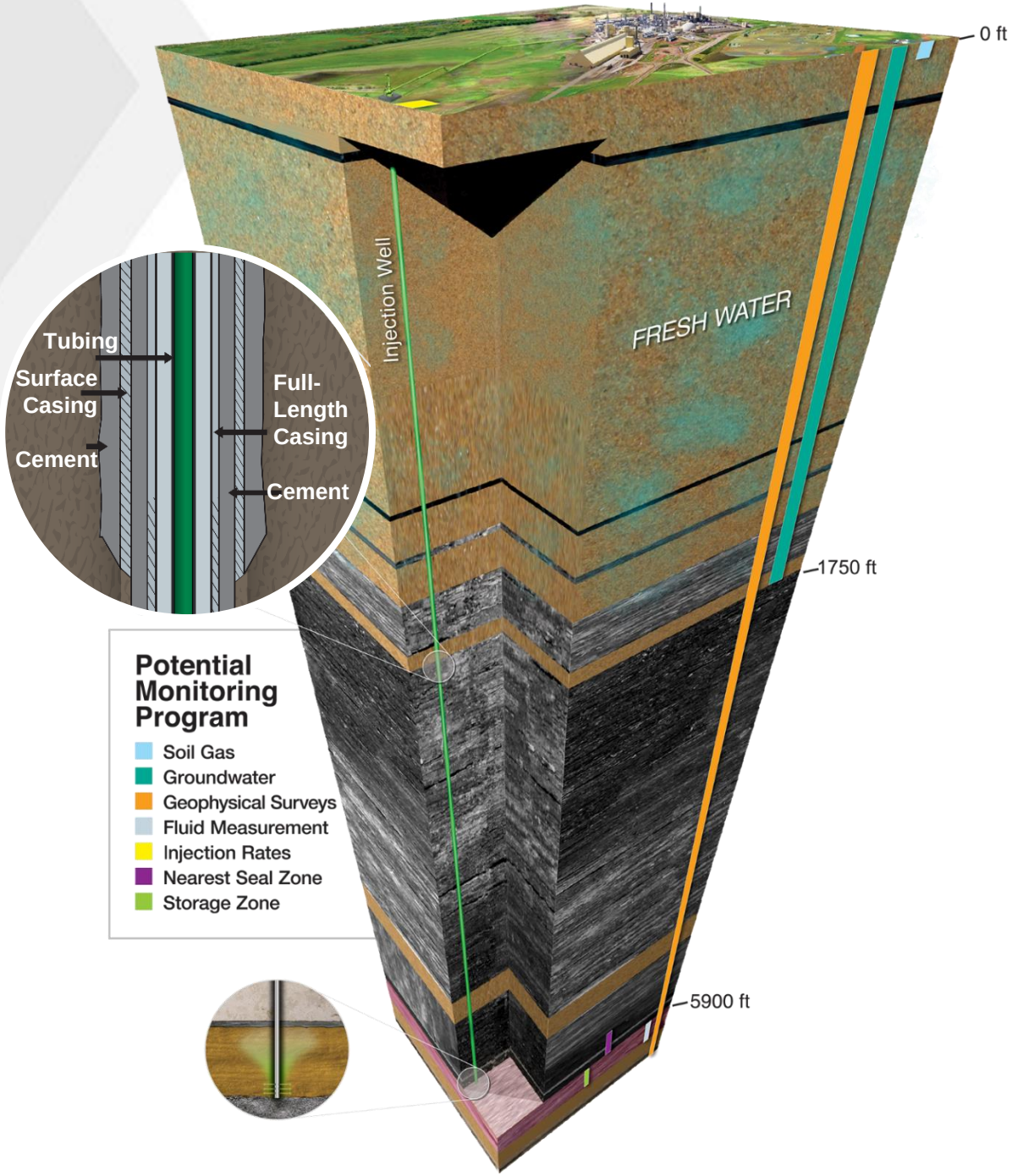
POROSITY AND PERMEABILITY

GEOLOGIC STORAGE OF CARBON DIOXIDE

REGIONAL SOURCES AND SEDIMENTARY BASINS

WILLISTON BASIN SALINE STORAGE OPPORTUNITIES

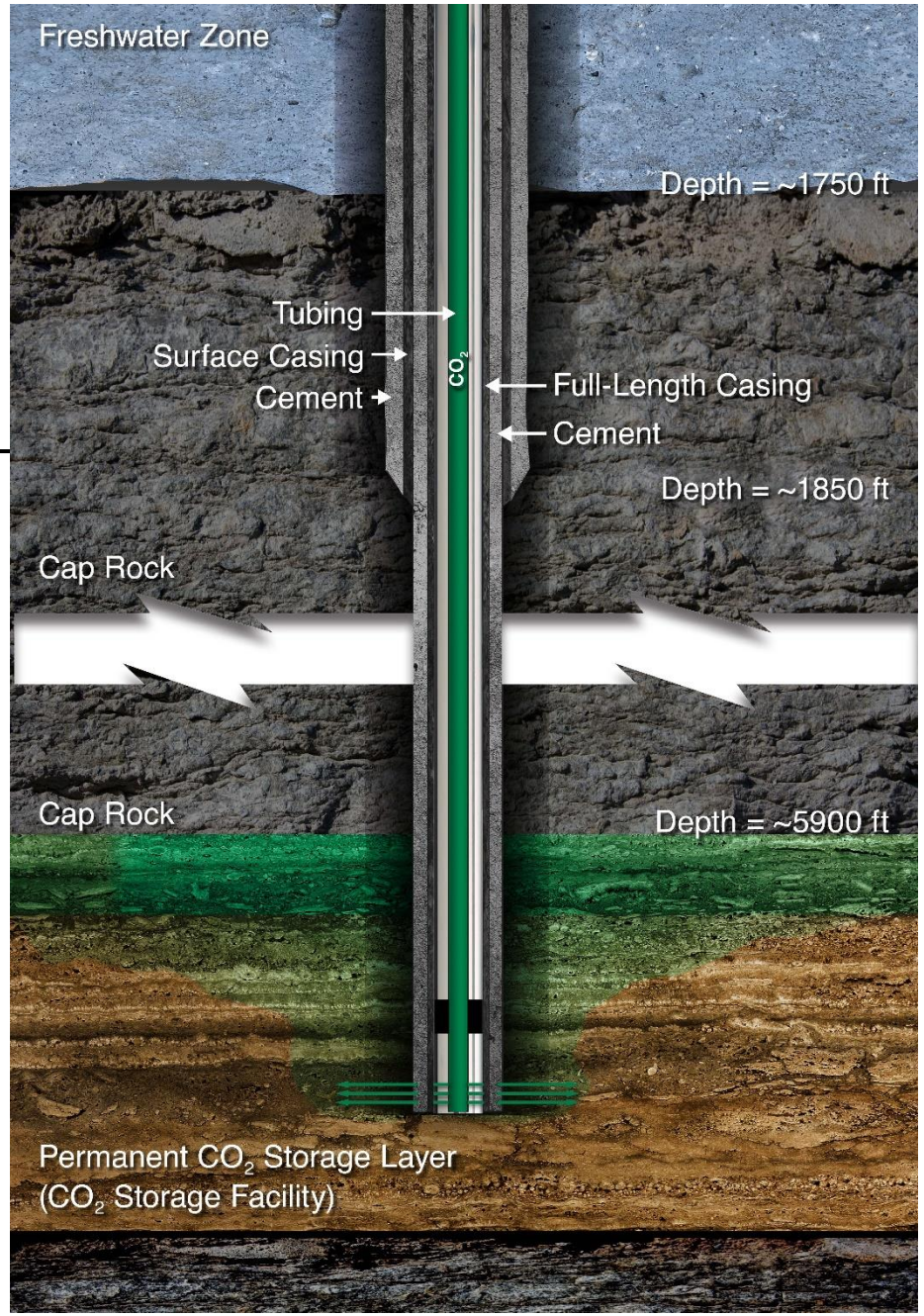




ENSURING HUMAN SAFETY AND PROTECTING THE ENVIRONMENT

DRINKING WATER PROTECTION

A layer of steel casing and a layer of durable, long-lasting cement isolate the freshwater aquifers, protecting them from drilling fluids and saltwater from deeper layers.

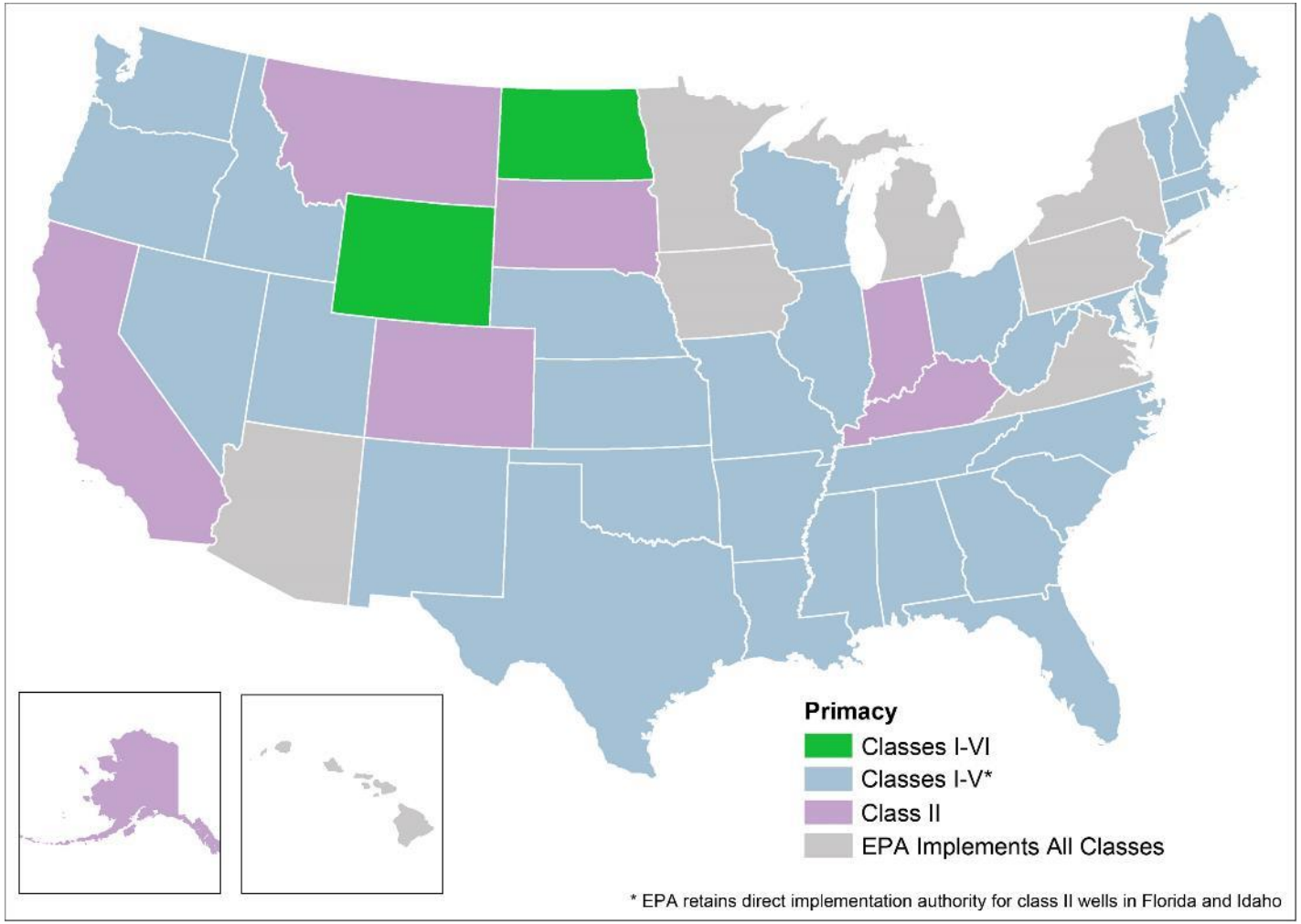


REGULATING GEOLOGIC STORAGE OF CARBON DIOXIDE

UNDERGROUND INJECTION CONTROL CLASS VI PRIMACY

UIC Program Standards:

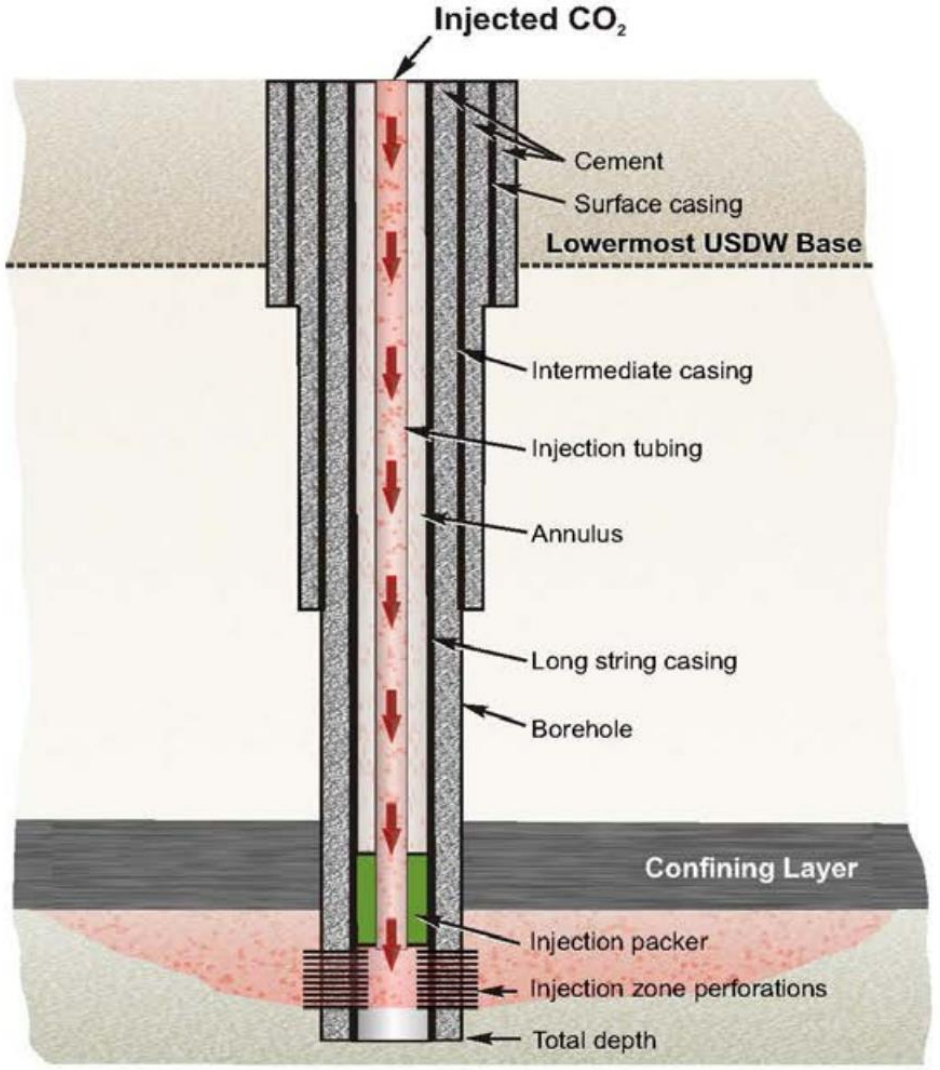
1) **Protection of underground sources of drinking water (USDW)**
2) Injection zone
3) Confining zones (upper and lower)
4) Area of review and corrective action
5) Wellbore integrity demonstration



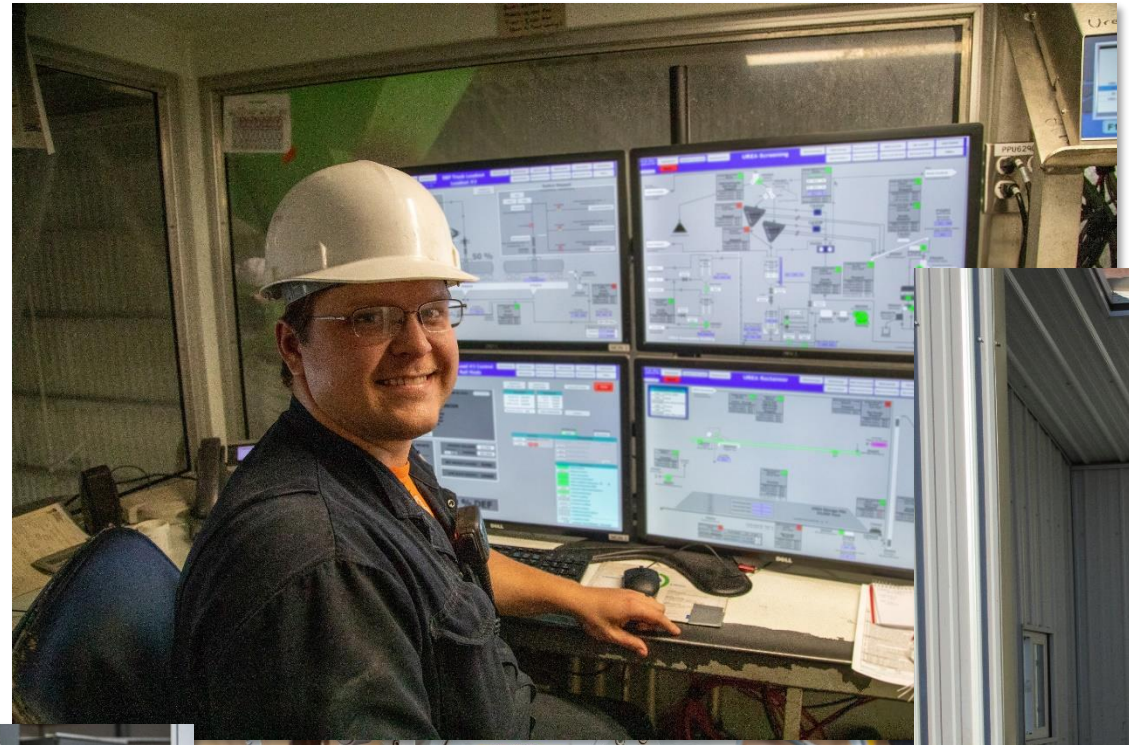
Class I	Class II	Class III	Class IV	Class V	Class VI
Hazardous and nonhazardous fluids (industrial and municipal wastes).	Brines and other fluids associated with oil and gas production, including CO_2 EOR.	Fluids associated with solution mining of minerals.	Hazardous or radioactive wastes. This class is banned by EPA.	Nonhazardous fluids into or above a USDW and are typically shallow.	Injection of CO_2 for long-term storage.

CLASS VI INJECTION WELLS

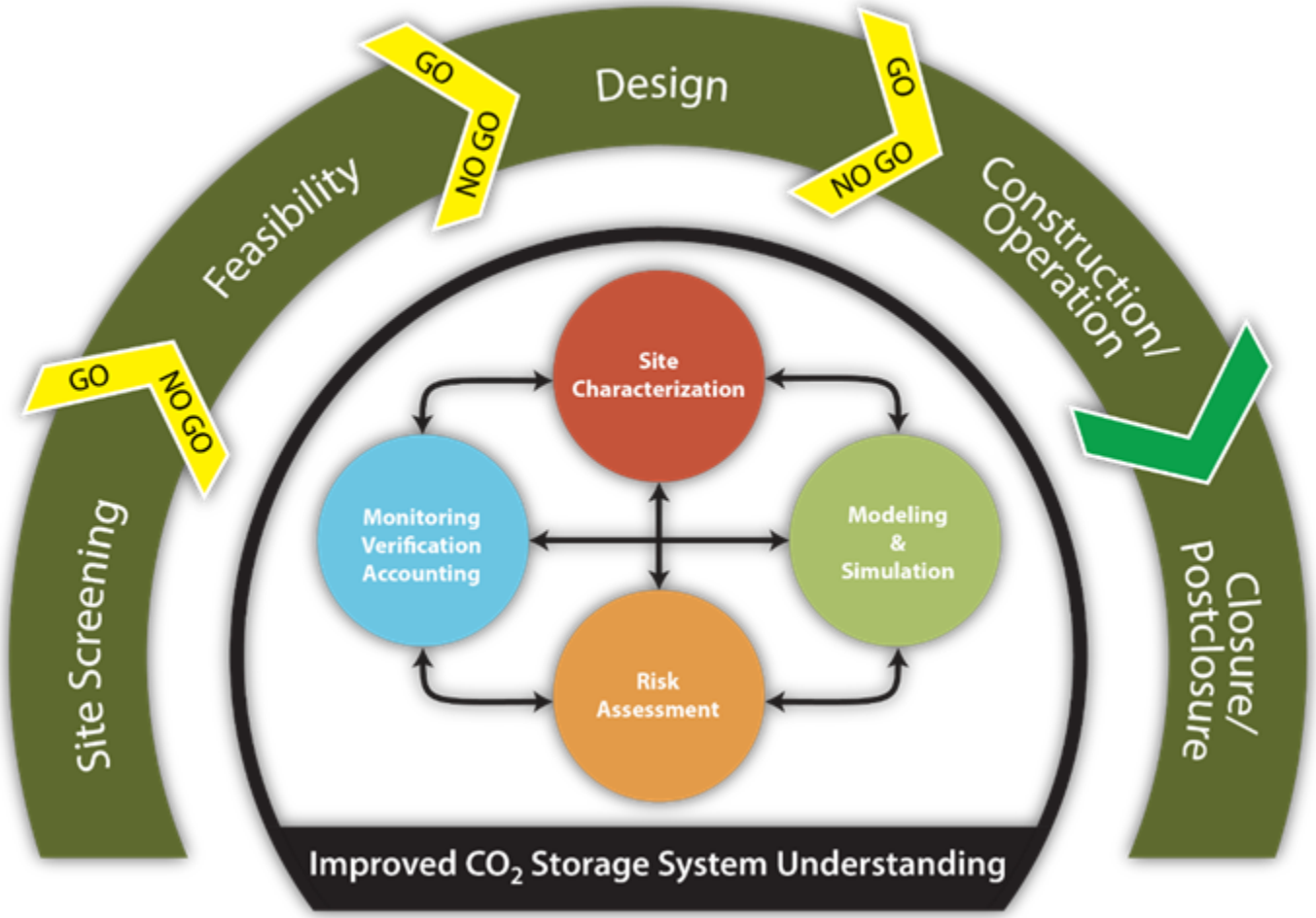
- Class designated for CO_2 injection wells as required by the U.S. Environmental Protection Agency (EPA) under the Safe Drinking Water Act.
- Material costs are increased over other well types (corrosion resistance, increased tensile/compressive strength, etc.).
- Injection target formation total dissolved solids (TDS) content cannot be less than 10,000 milligrams per liter.



CO_2 IS MONITORED EVERY STEP OF THE WAY



ADAPTIVE MANAGEMENT APPROACH



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THANK YOU

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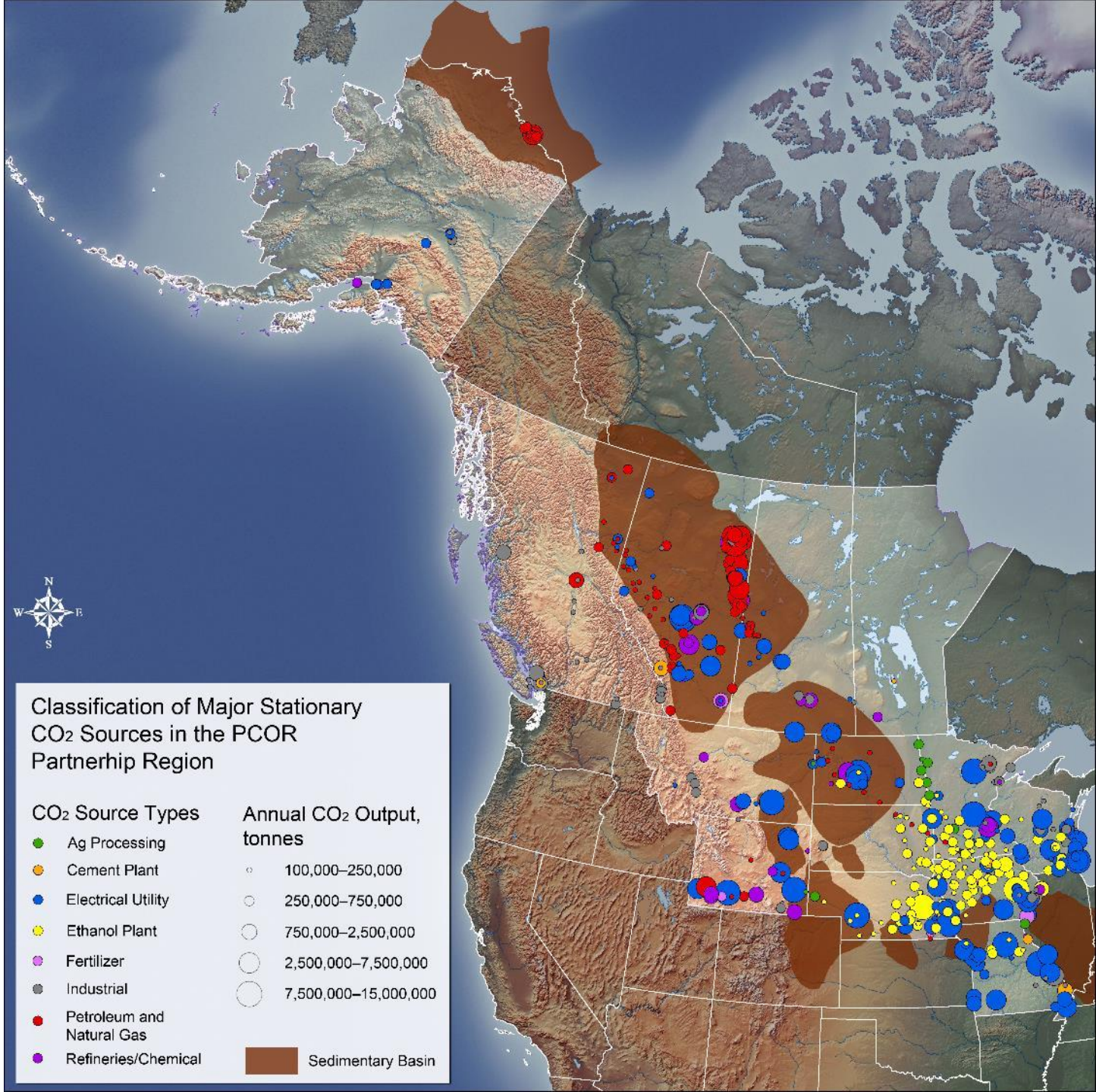

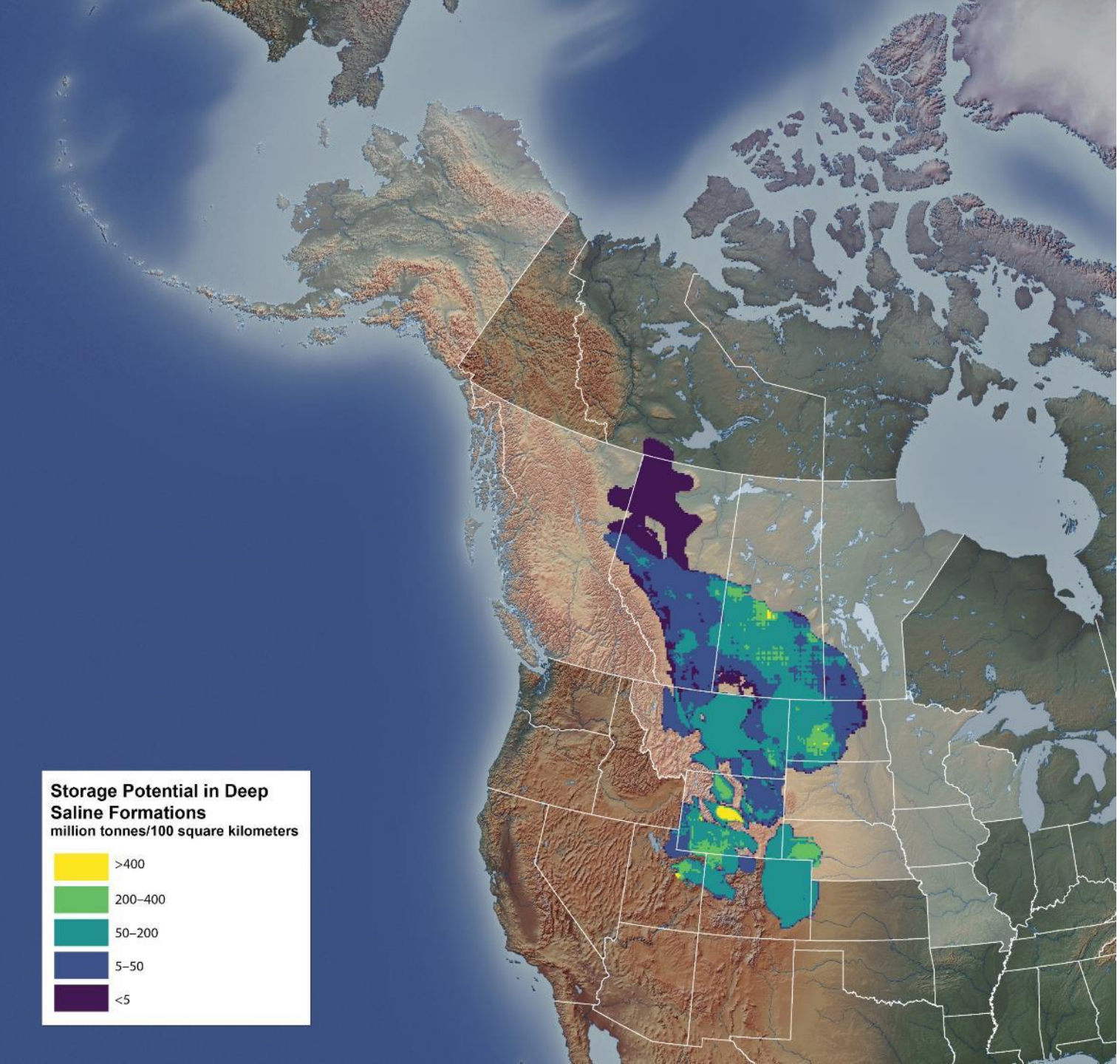

SALINE STORAGE POTENTIAL

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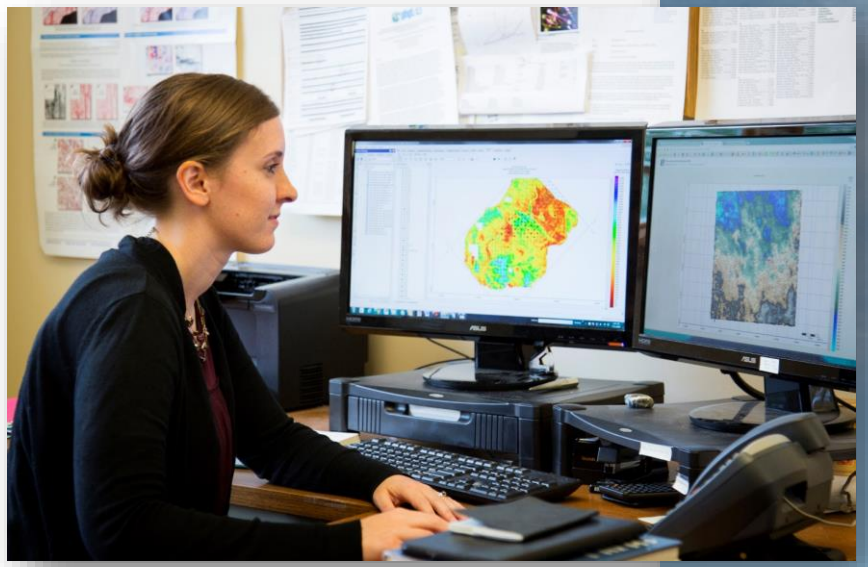
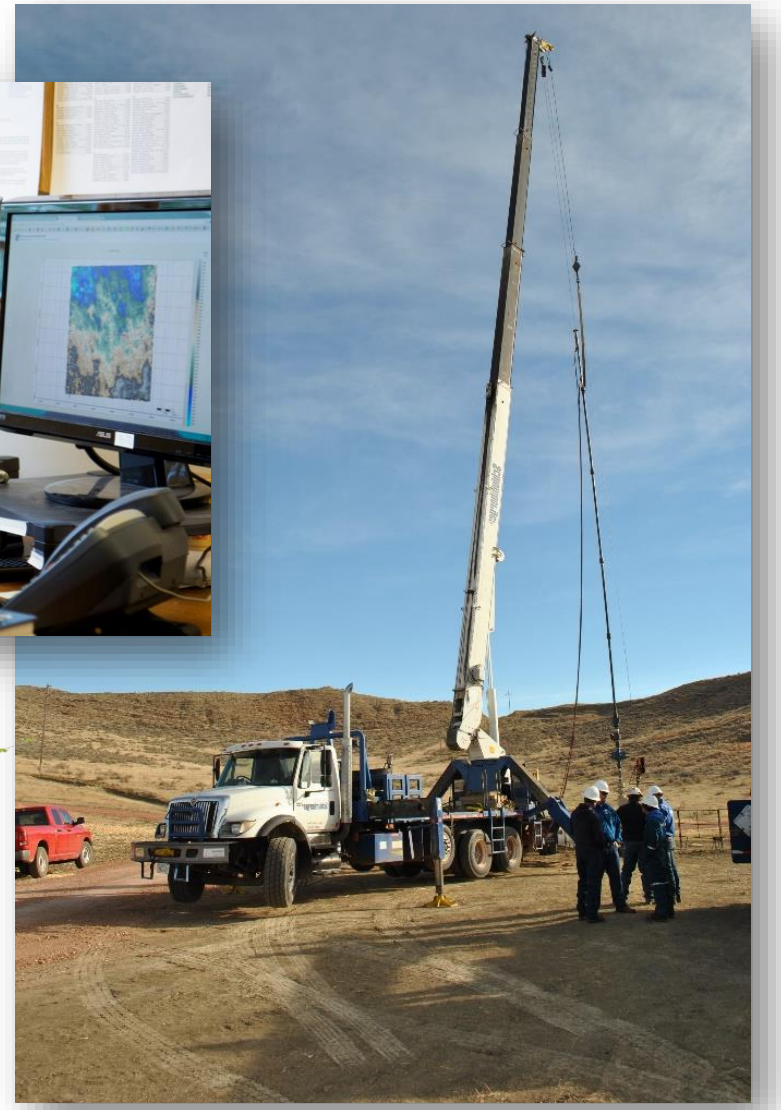
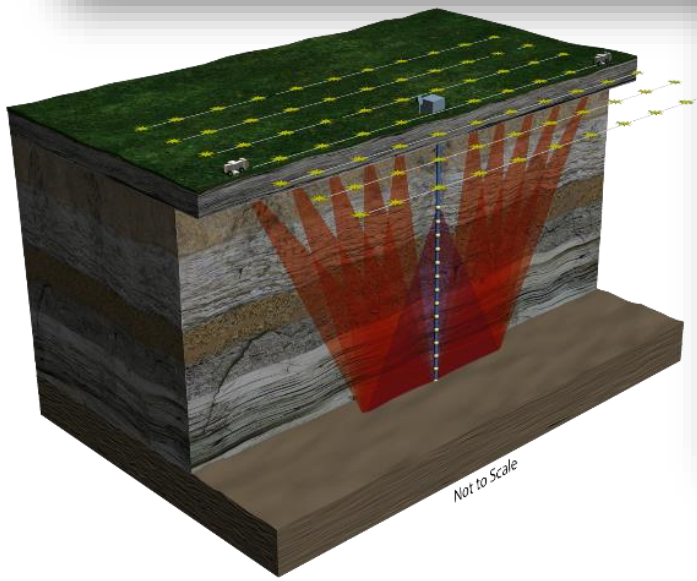
SUBSURFACE MONITORING IS DONE TO ENSURE CONTAINMENT

Regulations require periodic subsurface monitoring.







WATER MONITORING

Is done to confirm that current CO_2 levels match baselines taken before injection started.

SOIL GAS MONITORING