Considerations for Class I Industrial and Municipal Waste Disposal Wells for Industrial Wastewater

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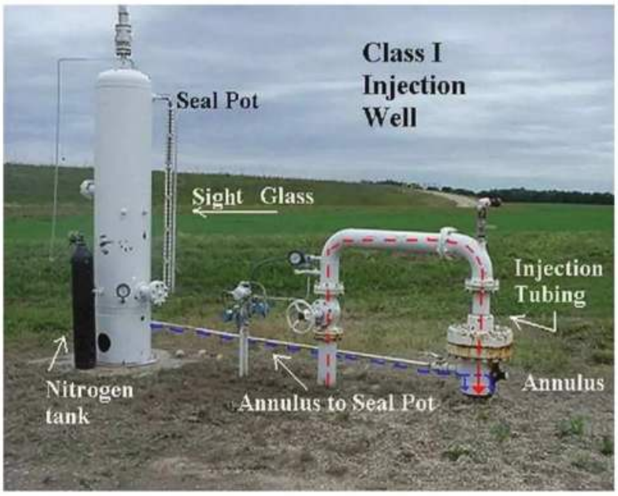

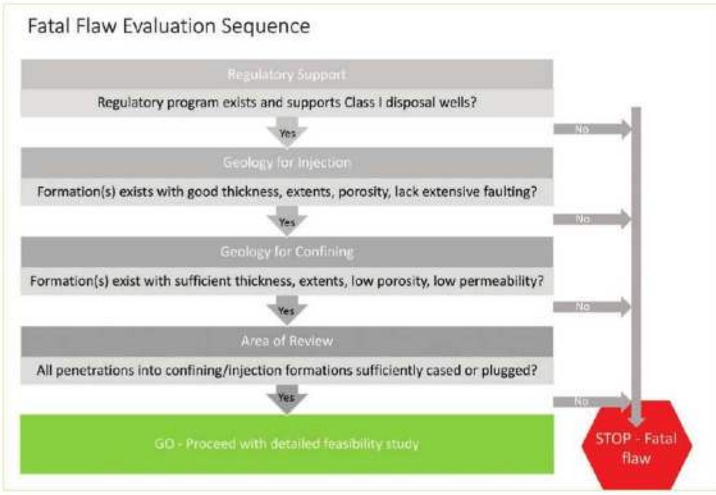

The technology of safe wastewater sequestration into deep formations has been in use for more than 60 years. As deep well injection is gaining interest in the management of industrial wastewater, one of the more frequently asked questions is whether an injection well is feasible in a specific location.

Detailed feasibility studies dive deep into the many considerations that are the basis for a preliminary deep well injection system design, estimated costs to drill and operate, determination of a return on investment, and project schedule. But first, you'll want to gather enough information to move forward confidently with an investigation.

Find the Fatal Flaws First

The diagram above illustrates a high-level process for identifying obstacles that may represent a fatal flaw to Class I injection well construction and operation in a particular location.

We'll walk through this evaluation sequence to determine whether additional resources are justified to study injection well technologies for your facility by answering two questions:

1. Does a local regulatory program support deep well injection?
2. Is the local geology sufficient for an injection well?

Does a Local Regulatory Program Support Deep Well Injection?

The US Environmental Protection Agency (USEPA) regulates injection wells under the 1974 *Safe Drinking Water Act* with stringent criteria governing the construction and operation of injection wells for industrial wastewater (for more information, please visit *www.epa.gov/uic*). There are six defined classes of injection well types, each based on the type of disposal activity. Class I wells are useful for injecting non-hazardous or hazardous industrial process fluids into deep, isolated rock formations.

Thirty-one states and three territories are the permitting authorities, with primacy delegated to its regulatory program that meets or exceeds the minimum standards established by the USEPA. One of ten regional USEPA offices issues permits and regulates Class I injection wells in the nation's balance, where authority remains with the USEPA. Most USEPA regions, states, and territories have a favorable outlook on the construction and operation of injection wells. Although permitting hazardous injection wells in some states is permissible, you can expect a more robust permitting effort and additional costs for financial assurance.

Following a determination that injection wells are permissible at a specific location, it's important to identify whether active or plugged Class I injection wells exist within the respective state. The technology of wastewater sequestration into deep formations has been in use for many decades, so the absence of active or abandoned injection wells in an area where regulatory support is present may raise flags related to permitting hurdles or the sufficiency of the local geology.

We've prepared a table containing Class I industrial injection wells' permissibility and existence by state, current at this publication. It is a compilation of various USEPA regions, states, and territories program websites. Since the concentration of total dissolved solids defines protected aquifers, those with 10,000 mg/L or less are considered potential underground sources of drinking water and are, therefore, strictly prohibited from injected fluids.

Is the Local Geology Sufficient for an Injection Well?

Considerations for suitable geologic conditions include rock formations that provide sufficient capacity for injected fluids while preventing the upward migration of injected fluids into protected drinking water aquifers. You'll find regional and local geological information through public sources like the US Geological Survey, state geological surveys, local oil and gas associations, universities, and private clearinghouses.

A sufficient injection zone consists of formation(s) with adequate thickness, high porosity, and permeability that can accept the fluids at the proposed injection rate and pressure required to handle the anticipated disposal volumes. These are typically high porosity limestone, dolomites, or sandstones at depths exceeding 3,000 feet.

Shale, low permeability limestone, or a sequence of rock types low in porosity and permeability act as 'caprocks,' creating a confining zone. These are typically 200 to 1,000 feet above the injection zone but below the base of the protected underground drinking water sources.

Class I Industrial Disposal Wells – January 2022

State/Territory	Permissible	Existing	State/Territory	Permissible	Existing
Alabama	No	No	**New Jersey**	Yes	No
Alaska	Yes	Yes	**New Mexico**	Yes	Yes
Arizona	Yes	No	**New York**	Yes	No
Arkansas	Yes	Yes	**North Carolina**	No	No
California	Yes	Yes	**North Dakota**	Yes	Yes
Colorado	Yes	Yes	**Ohio**	Yes	Yes
Connecticut	Yes	No	**Oklahoma**	Yes	Yes
Delaware	No	No	**Oregon**	No	No
Florida	Yes	Yes	**Pennsylvania**	Yes	No
Georgia	No	No	**Rhode Island**	No	No
Hawaii	No	No	**South Carolina**	No	No
Idaho	No	No	**South Dakota**	Yes	No
Illinois	Yes	Yes	**Tennessee**	Yes	Yes
Indiana	Yes	Yes	**Texas**	Yes	Yes
Iowa	Yes	No	**Utah**	Yes	No
Kansas	Yes	Yes	**Vermont**	No	No
Kentucky	Yes	Yes	**Virginia**	Yes	Yes
Louisiana	Yes	Yes	**Washington**	Yes	Yes
Maine	No	No	**West Virginia**	No	No
Maryland	No	No	**Wisconsin**	Yes	No
Massachusetts	No	No	**Wyoming**	Yes	Yes
Michigan	Yes	Yes	**Wash. D.C.**	Yes	No
Minnesota	Yes	Yes	**Puerto Rico**	Yes	No
Mississippi	Yes	Yes	**Virgin Islands**	Yes	No
Missouri	No	No	**American Samoa**	Yes	No
Montana	Yes	No	**Navajo Nation (Indian)**	Yes	No
Nebraska	Yes	Yes	**Fort Peck (Indian)**	Yes	No
Nevada	No	No	**Commonwealth of Northern Mariana Islands**	Yes	No
New Hampshire	Yes	No	**Guam**	No	No

Artificial penetrations may consist of oil and gas wells and mining and exploration boreholes. A lack of artificial penetrations within approximately two miles of the desired injection well reduces the potential for artificial vertical migration pathways for injected fluids to reach the protected drinking water aquifers. In some cases, wells or boreholes may penetrate the top of the designated confining zone. In these cases, it is important to obtain abandonment records to demonstrate the occurrence of proper plugging so that the injected fluids stay in the injection zone.

A continuous, gentle subsurface geologic structure, lacking faulting and folding, is ideal for reducing the potential for injection-induced seismicity. Complex geologic structures, such as major faults, may act as natural vertical migration pathways for injected fluids to reach the protected drinking water aquifers. Some faults may have the potential to respond to the injection of fluids through seismic action. Although all jurisdictions don't require an evaluation of the induced seismicity component, it may have local implications in areas with dense oil and gas production.

This two-component evaluation helps identify high-level obstacles that may represent a fatal flaw in the installation or operation of an injection well. A detailed feasibility study may be the logical next

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step if your facility passes such an evaluation. Feasibility studies build upon the evaluation to provide you with specific information and requirements, including:

- Permitting with anticipated timeframes
- Public participation
- Siting and construction
- Monitoring and testing
- Reporting and record-keeping
- Financial assurance and closure
- Project schedule from permitting to operation
- Preliminary well design
- Budgetary level estimates

SCS' injection well team is available to address your questions on whether this disposal technology is appropriate for your facility.

Additional Resources

- **Video:** Leachate and Other Industrial Fluid Injections – *www.youtube.com/watch?t=2080&v=nTryNkeOvs8&feature=youtu.be*
- **Paper:** Managing Industrial Liquids – *https://indd.adobe.com/view/54713a48-4762-4930-9e75-4795d5fabad4*
- **Paper:** Deep Disposal Well Considerations for Leachate Management – *www.scsengineers.com/scs-white-papers/deep-well-injection-disposal-scs-engineers* •

About the Author

Stephanie Hill is a Professional Geologist licensed in Florida, Kentucky, Illinois, and Texas and is a key member of the Deep Well and Underground Injection Control practice. Her experience includes permitting and regulatory compliance for underground injection control and coal mining, hydrologic investigations, and identifying large-scale environmental impacts to surface and groundwater resources from various industry practices.

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