

Grouting of Casing in Karst with a Borehole Liner

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at

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Energy Development and Enhancement by
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Topics:

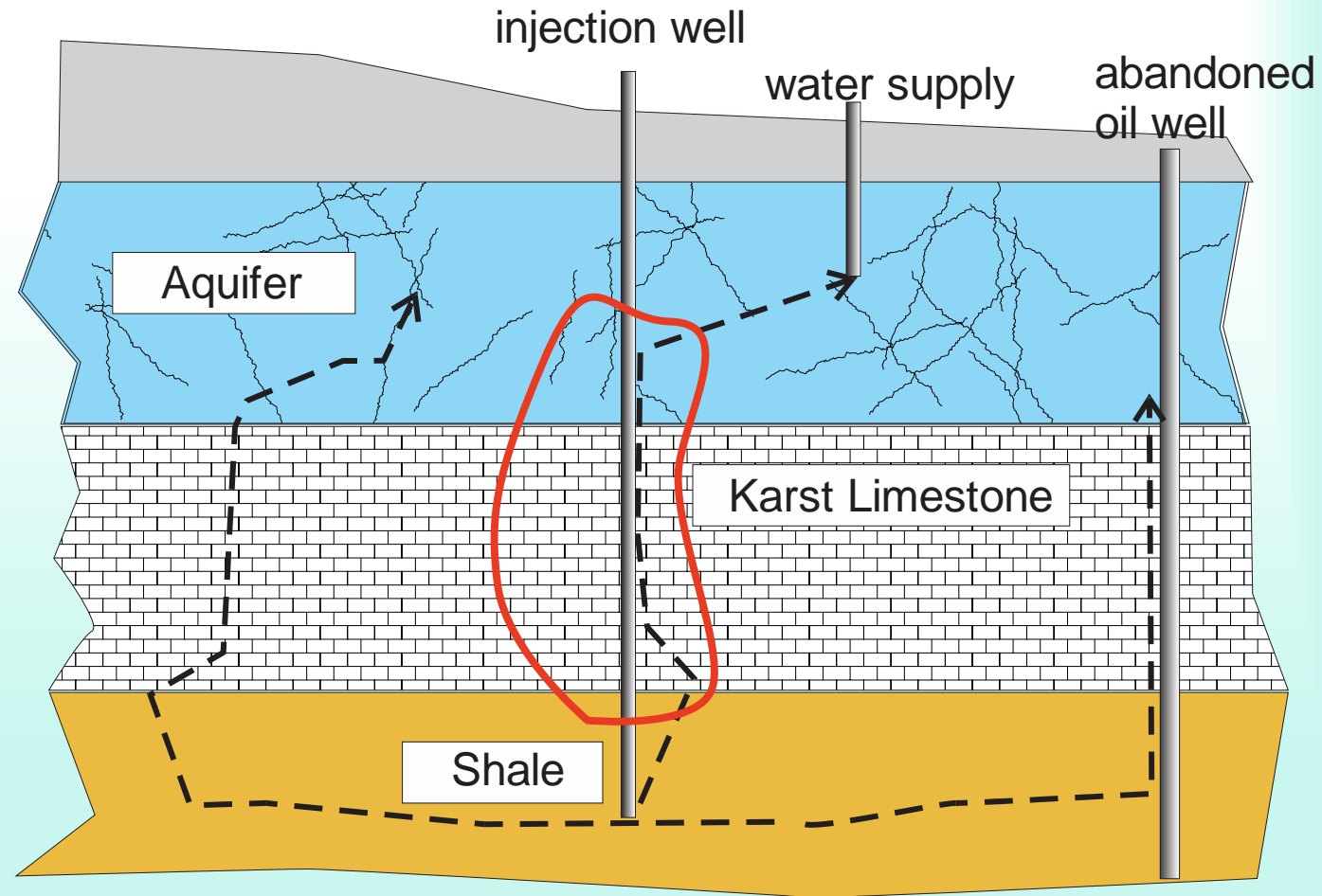
- The problem in Karst formations
- How a borehole liner is installed
- How the casing can be installed with the liner
- The grouting of the casing
- Variations that may be needed

The potential problems, only one discussed.

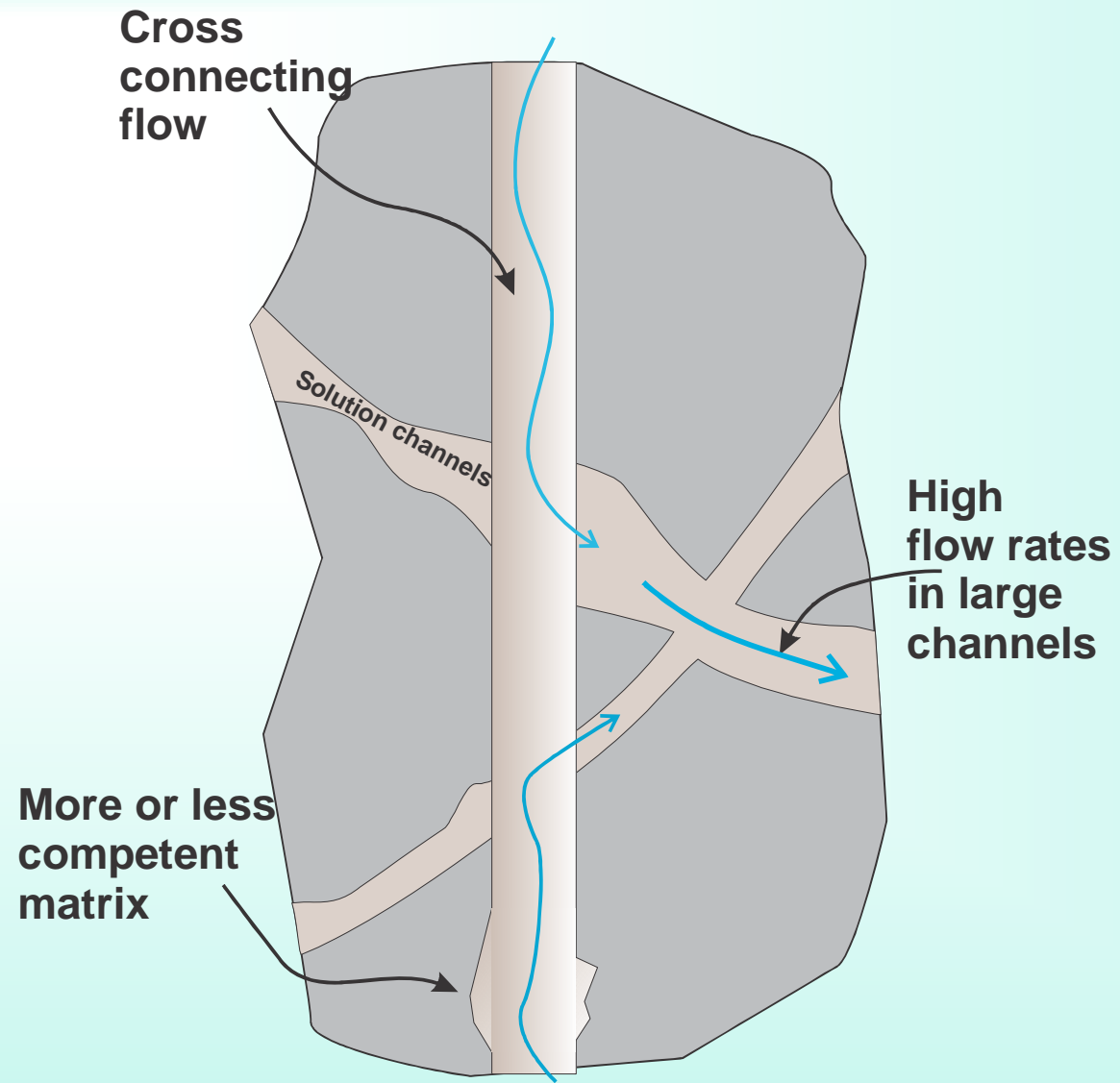
1. Flow via injection boring

2. Flow via fractures

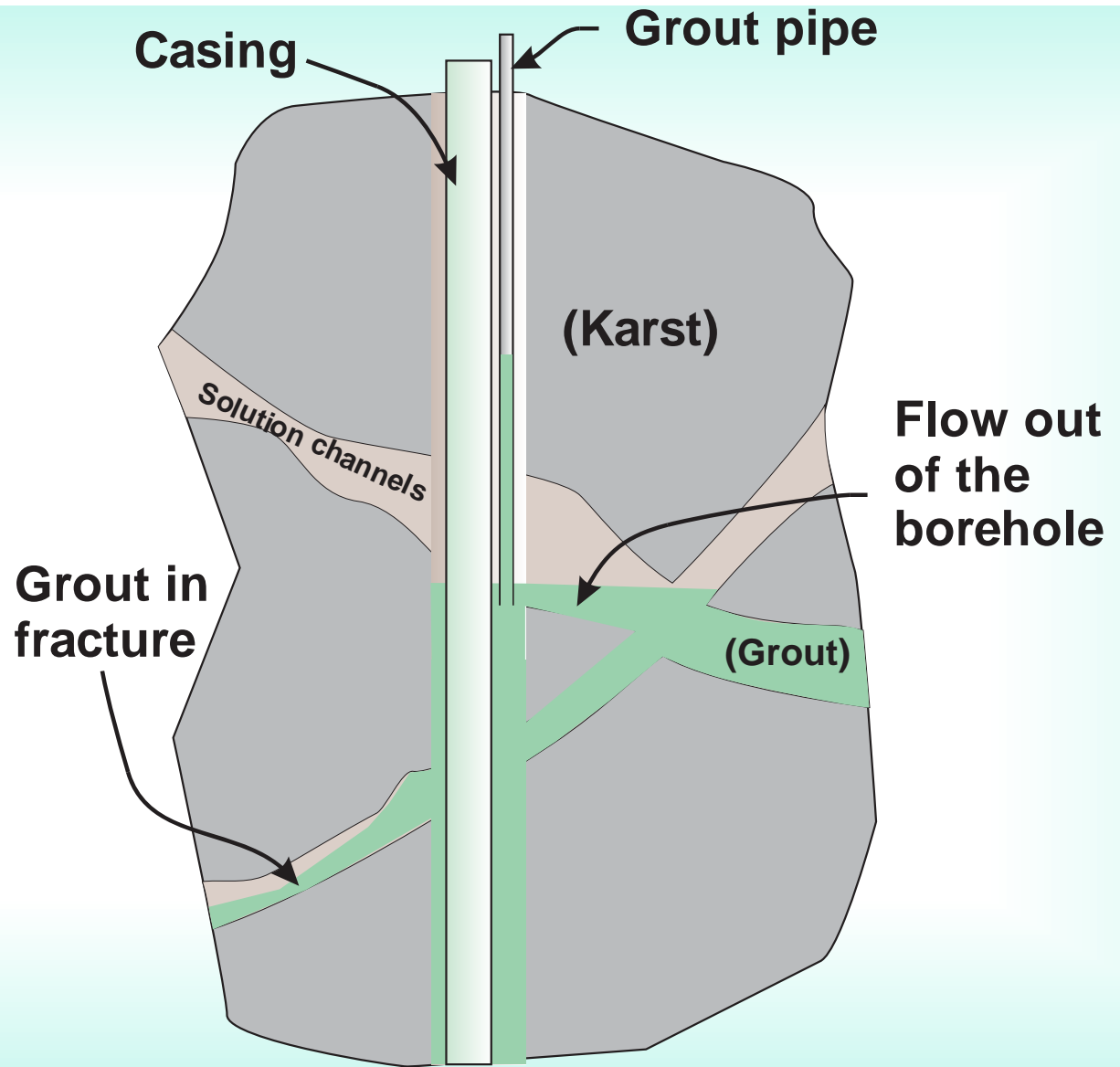
3. Old poorly sealed oil wells



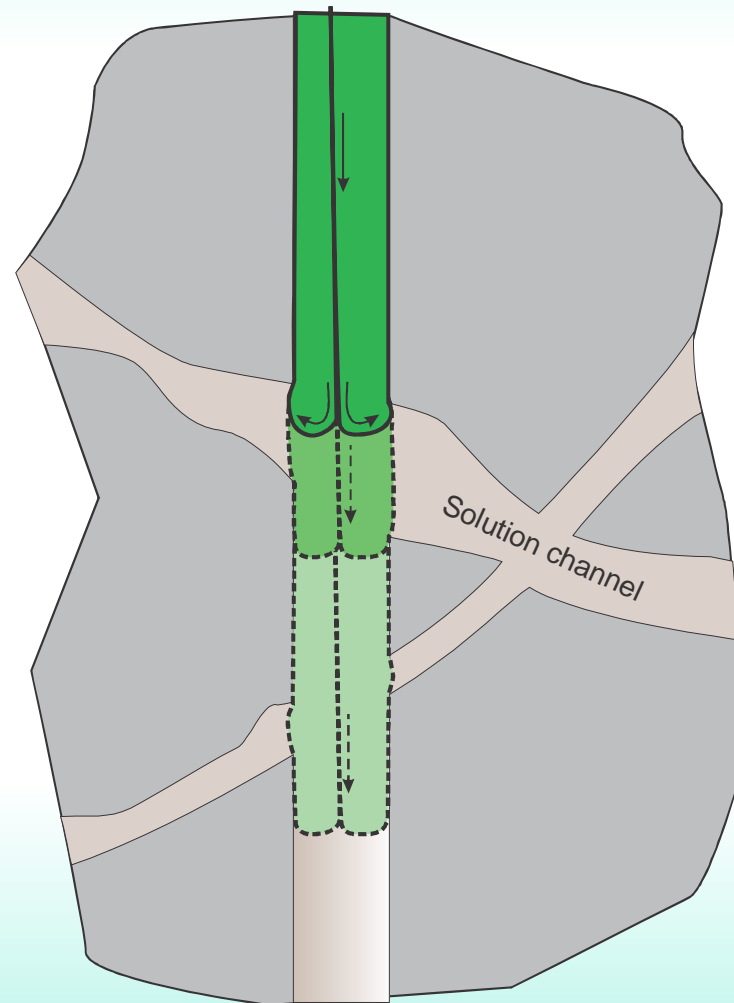
The Karst Situation



Errant Grout Flow out of Borehole

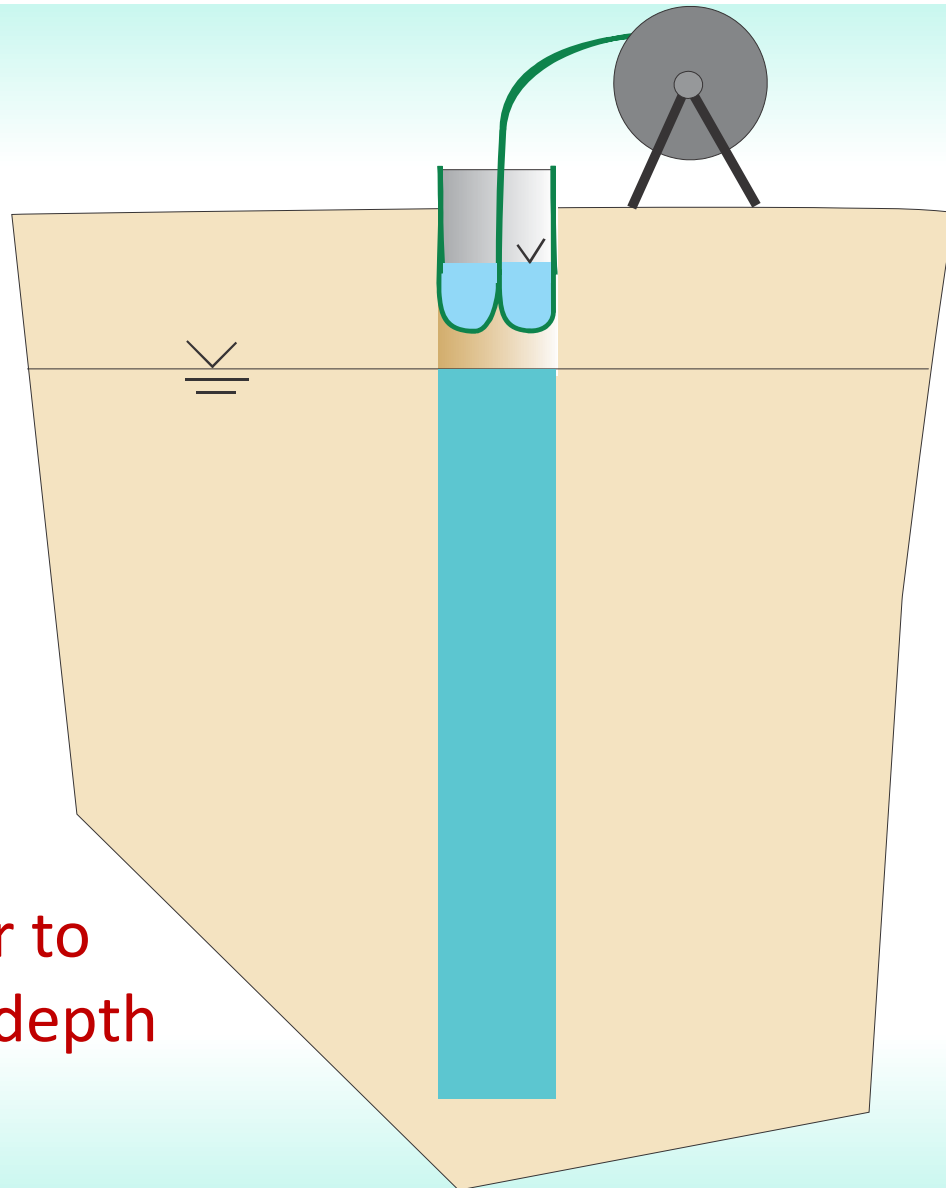


Liner everting through solution voids

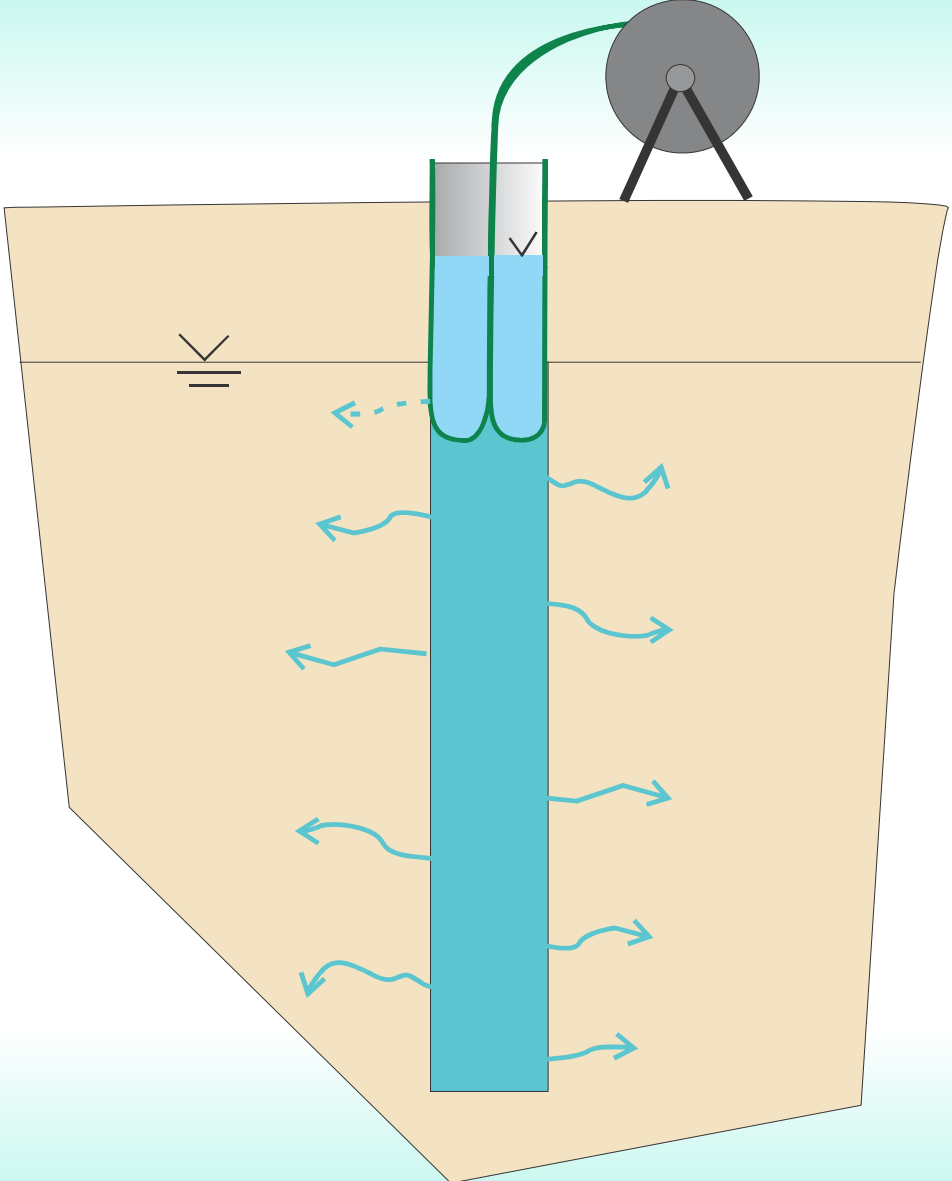


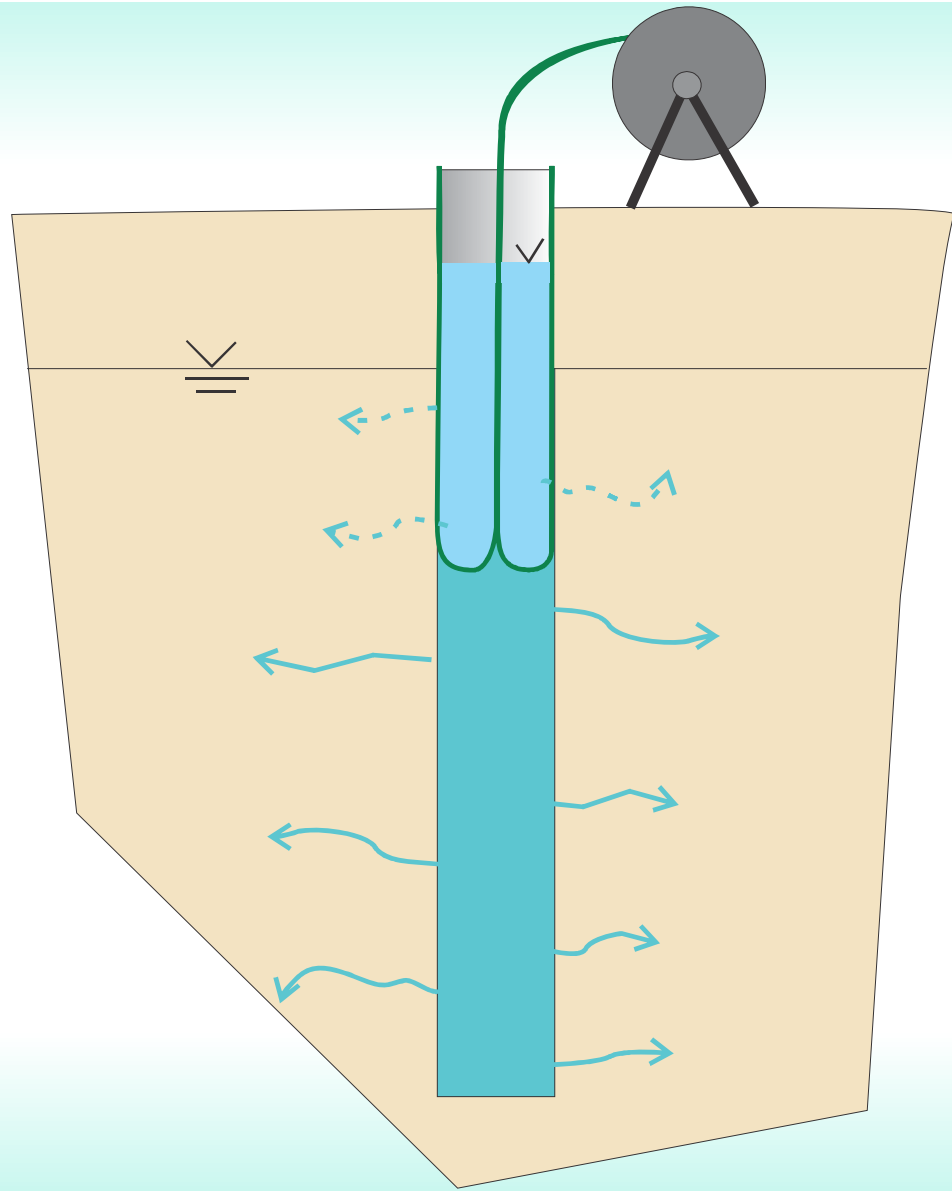
The following sequence illustrates:

1. The liner eversion to half its length
2. The attachment of the casing to the liner
3. The attachment of the grout tube to the casing
4. The subsequent propagation of the liner to the full length of the borehole with additional casing joints added as the liner descends.
5. The grout injection through the grout tube.

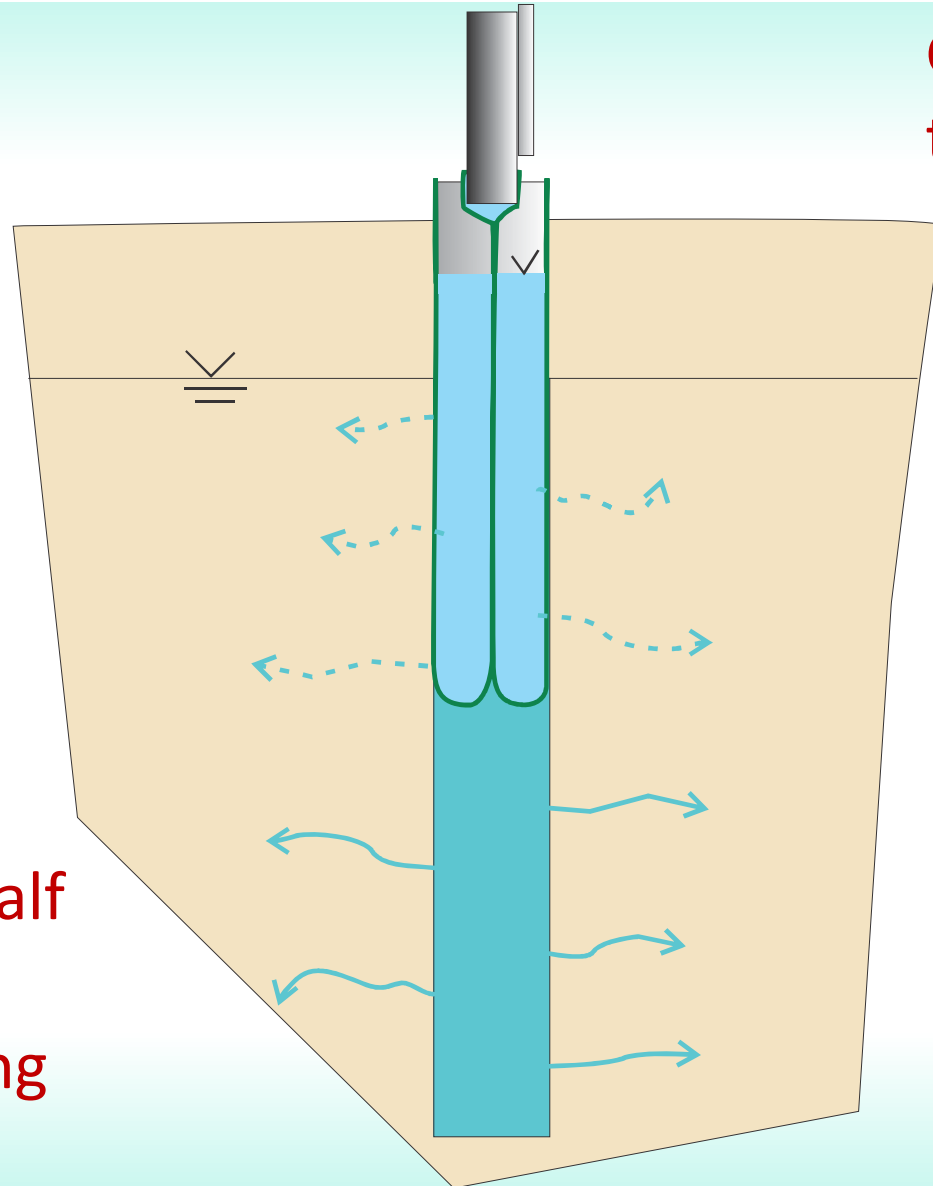


Evert the liner to
half the hole depth

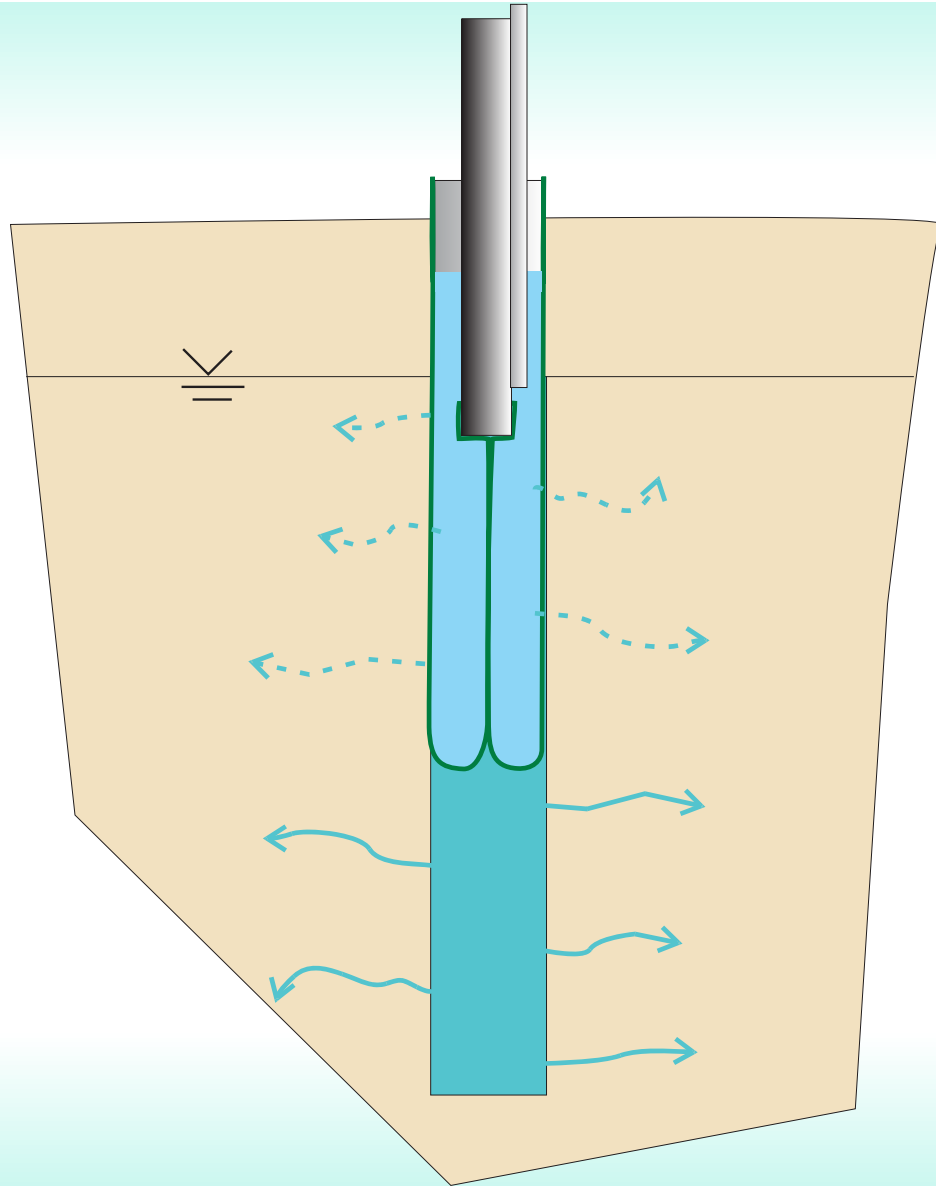


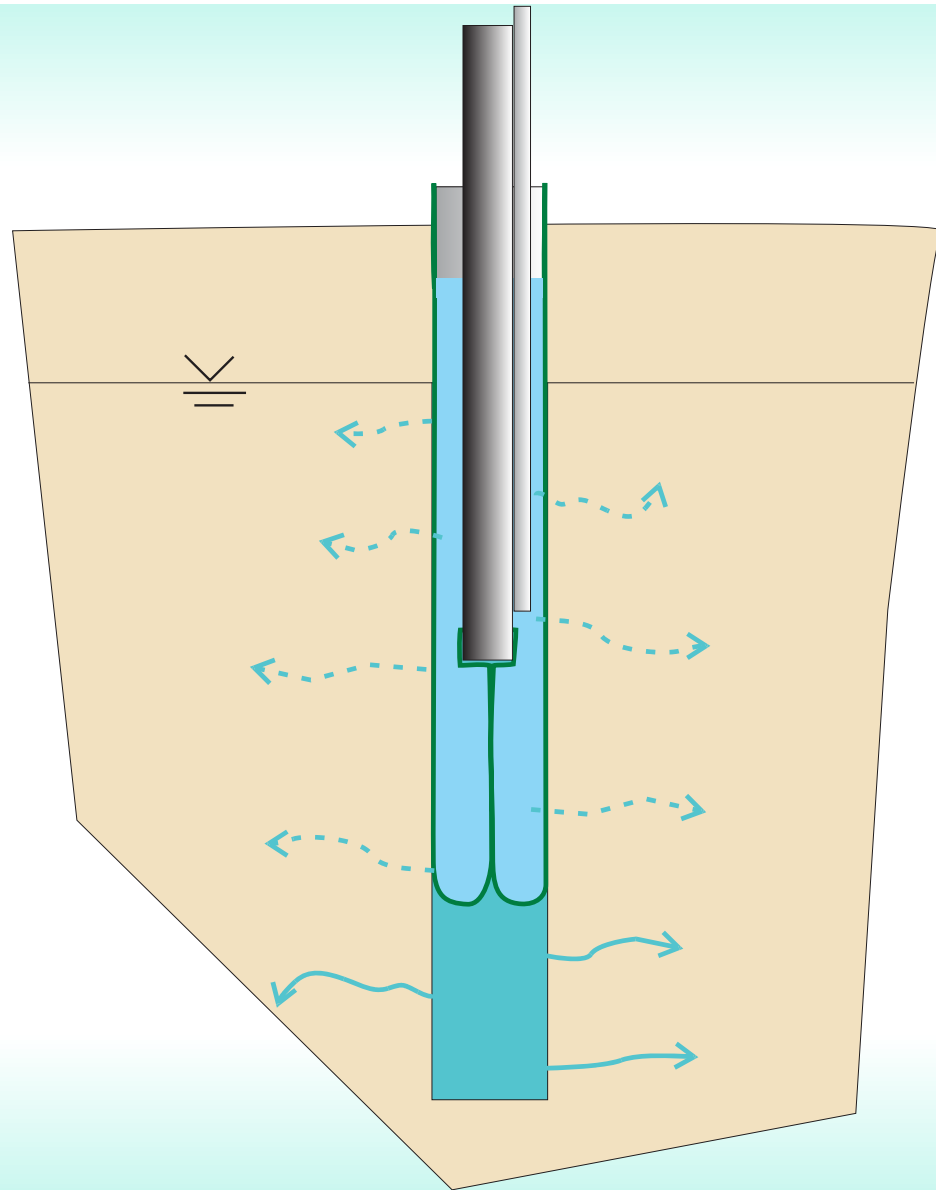


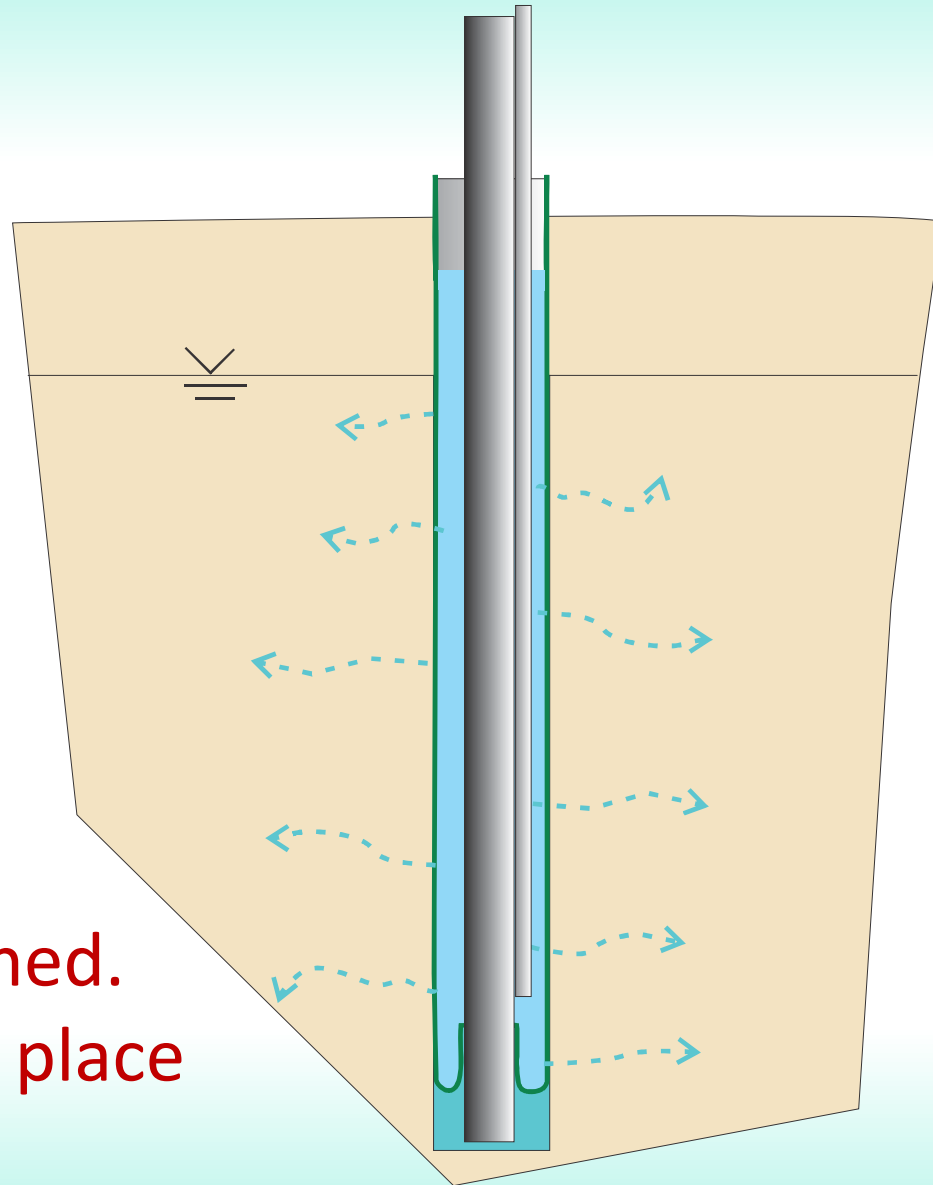
Grout line is attached to the casing.



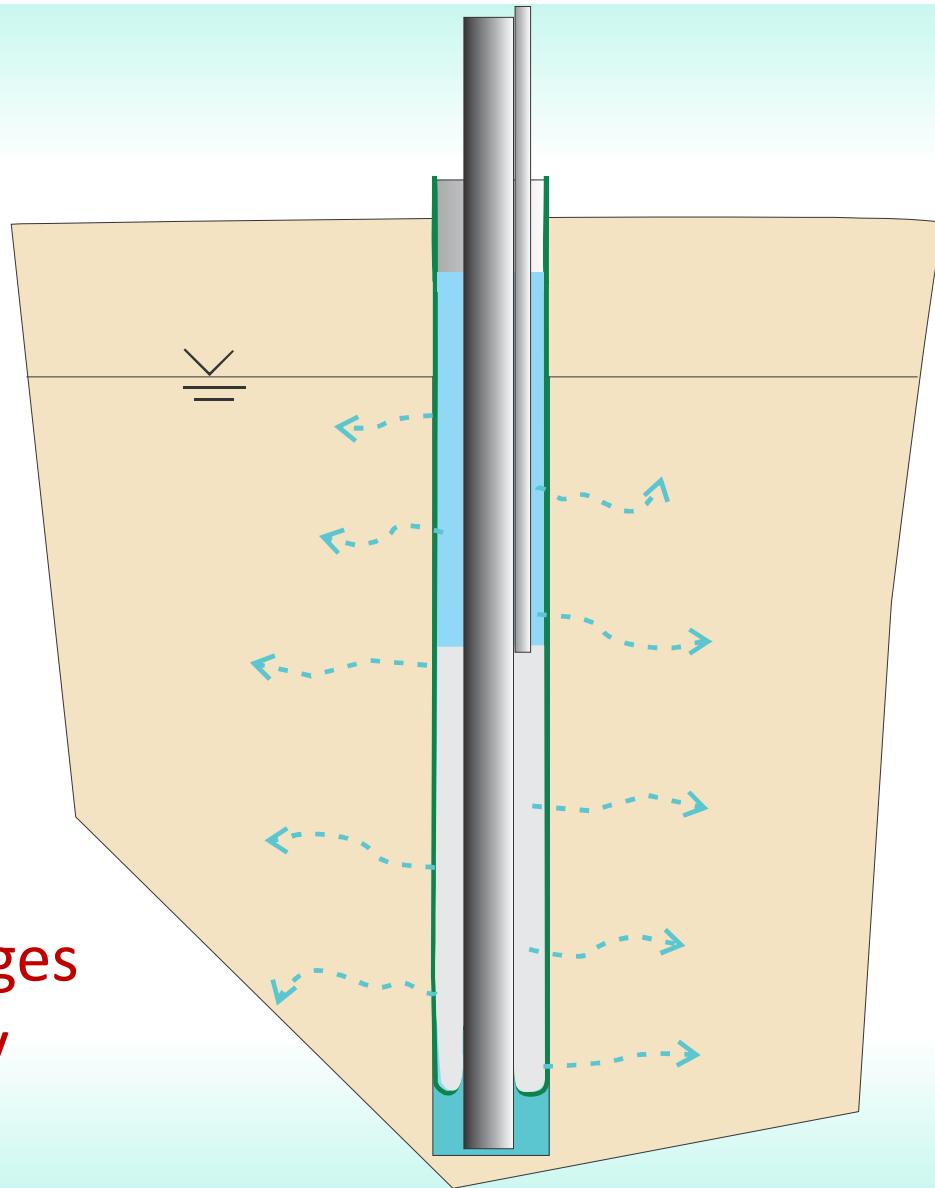
When liner is half the hole depth, attach the casing







The hole is lined.
The casing in place



Grout in stages
as necessary

Refinements of the procedure:

- Insert a tube to remove the water or drilling mud beneath the bottom end of the liner, if needed. Then deflate liner, remove the tube, and re-inflate the liner.
- Fair the end of the pipe and pad it to prevent damage to the liner as the pipe is descending.
- Control the casing descent with our system to only advance as fast as the liner propagation.
- Use a very high strength liner (200-400 lb/in. tensile strength)
- Use a heavy mud slug in the bottom of the liner to aid eversion, more dense than grout mix. This also reduces gas flow into end of liner and out of the casing.
- Grout in 100-150 ft lifts to reduce pressure on the liner until each lift is cured (~15-24hrs.)
- After the casing is in place, continue drilling at smaller diameter.

What is needed:

- FLUTE conversation with experienced hydraulic fracturing drillers and understanding of the current procedures, hardware and borehole environment.
- Visit an actual wellhead during the drilling and casing operation
- Consideration of how the liner installation might work with:
 - Mud filled holes of various mud densities
 - Lost circulation situations
 - Gas rising in the drilling fluids
 - Access limitations to the open borehole
 - Borehole pressures expected
 - Formation pressures expected
- Comparison of the liner approach with current practice. Potential modifications??
- Consideration of other flexible liner methods for related problems and other leak paths.

FLUTe has extensive relevant liner installation experience:

- 18 years in the flexible liner business
- Liner augmentation of horizontal drilling
- Grouted many liners in artesian wells
- 19 patents on flexible liner methods
- 3 inch to 3 foot diam. liners installed in a wide variety of situations.
- Liners installed through casing as the casing is removed.
- Liners installed in many karst borings.

But, no experience in Oil or Gas wells yet.

Installations of multi-level sampling liners



For pressure and water quality measurements



Conclusion:

- There may be a use of flexible borehole liners to improve the seal of the casing in karst formations.
- The improved seal could be achieved with substantial savings in grout used to seal borehole and reduction of the risk of leakage to shallow aquifers
- The sealing liner may have an additional benefit in reduction of the explosive gas rising in the drilling mud during the casing installation.
- Other cost reductions may be possible such as the sealing of lost circulation zones.

Thanks for your attention.

Questions?

Our web site has extensive information on the mechanics of flexible liners: www.flut.com

Otherwise call us at 505-930-1154 or 505-852-0128
We have a booth in the exhibit area for discussions.