Constructing Soil Dispersal Systems With Narrow Trenches

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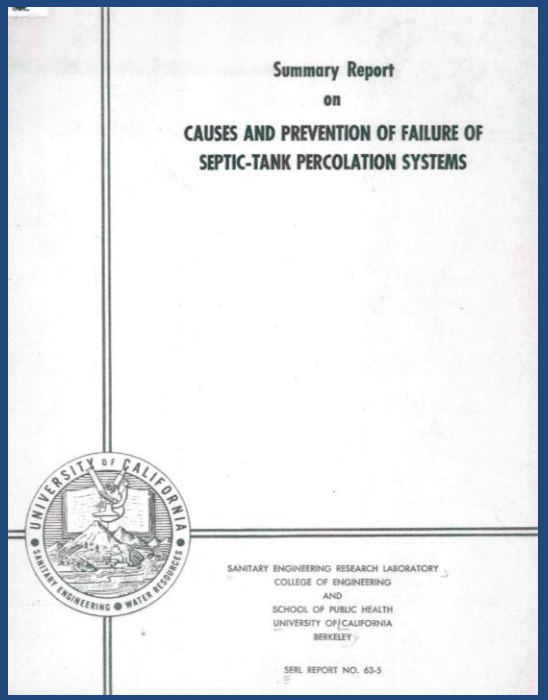
History – Onsite WW Treatment

- 1963 – McGauhey and Winneberger

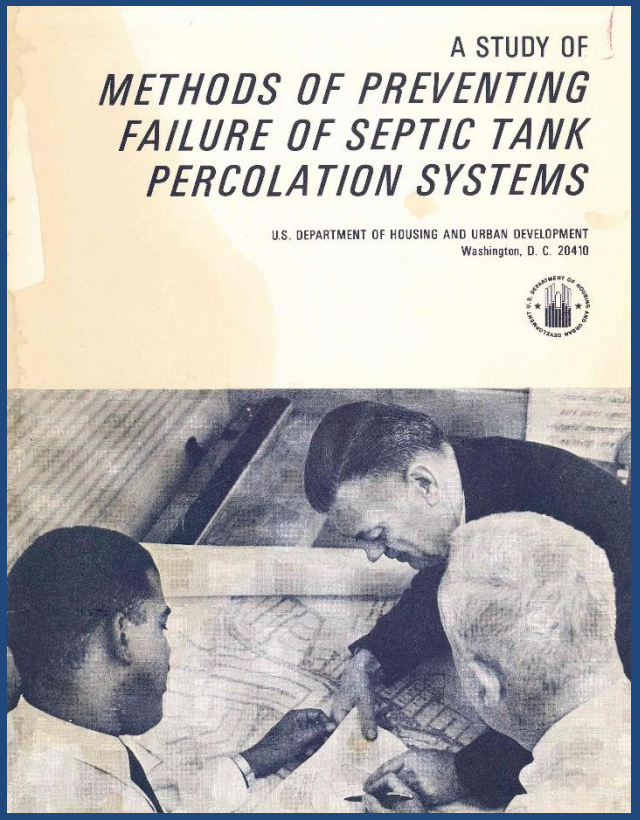
  published a “Summary Report” of what I would consider one of the most significant research subjects of that time entitled:

  “CAUSES AND PREVENTION OF FAILURE OF SEPTIC-TANK PERCOLATION SYSTEMS”



History – Onsite WW Treatment

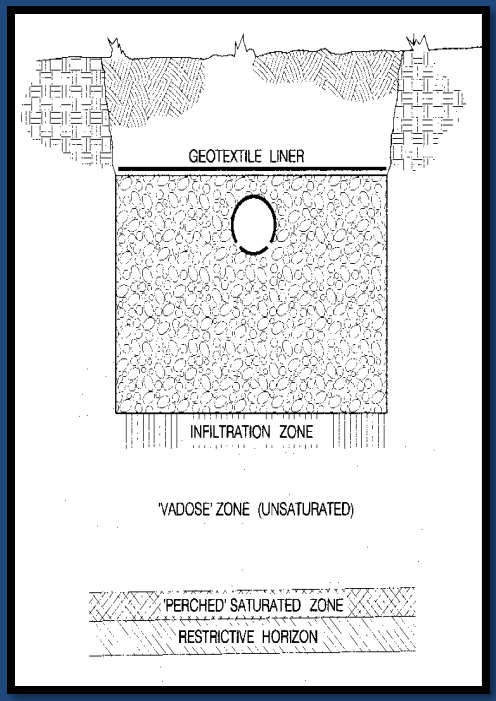
- 1967 – U.S. Department of Housing and Urban Development published a document based upon the work of McGauhey and Winneberger and others entitled:
- “A Study of METHODS OF PREVENTING FAILURE OF SEPTIC-TANK PERCOLATION SYSTEMS”



Findings Revisited

Importance of maintaining aerobic conditions in the soil in and around the infiltrative surface

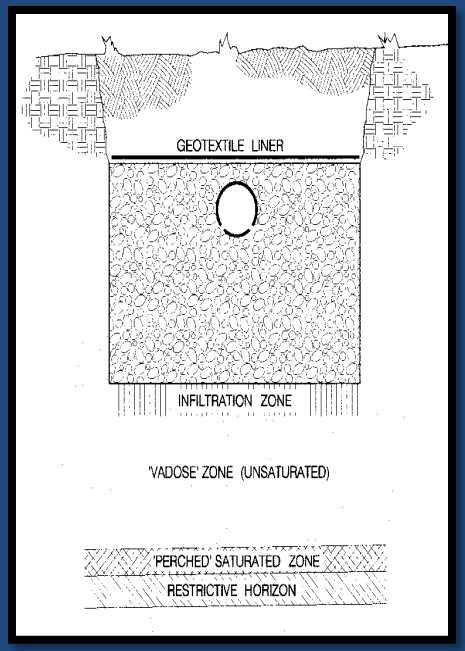
It is well documented that aerobic biological activity in the dispersal system is much more efficient than anaerobic biological activity, resulting in a greater longevity of the system



Findings Revisited

Continuous inundation of the infiltrative surface should be avoided

If the infiltration interface with the native soil is continuously inundated anaerobic conditions develop. Anaerobic conditions fed by organic matter in the wastewater effluent result in a buildup of ferric sulfide resulting in a black slime biomass that seals the soil pores and inhibit wastewater infiltration.



Findings Revisited

Water movement in soil is complex with conflicting forces at work

Water movement is a result of:

- Gravity
- Capillary attraction (stronger than gravity)
- Degree of saturation
- Soil permeability
- Soil structure
- Soil drainage

Findings Revisited

Nature of clogging of percolation fields

McGauhey & Winneberger found that the clogging of the soil is a physical phenomenon resulting from the interaction of chemical, physical and microbiological processes. So even this is complex.

Research at the time found that soil clogging is a "**surface phenomenon confined to the top half centimeter"** except in soils with larger grain sizes.

Findings Revisited

Weekness of bottom area as a primary infiltrative surface

McGauhey & Winneberger stated after research that:

“. . . The bottom area of the percolation trench is essentially *useless* as an infiltration surface in the long-term infiltration of sewage into soil.”

Findings Revisited

Weekness of bottom area as a primary infiltrative surface per McGauhey & Winneberger

1. Construction practices using excavation equipment can cause smearing and compaction
2. Silting of the bottom of excavations with fines when rainfall event occurs during construction

Findings Revisited

Weekness of bottom area as a primary infiltrative surface per McGauhey & Winneberger

3. The weight of stone used as a distribution media can blind portions of the infiltrative surface.

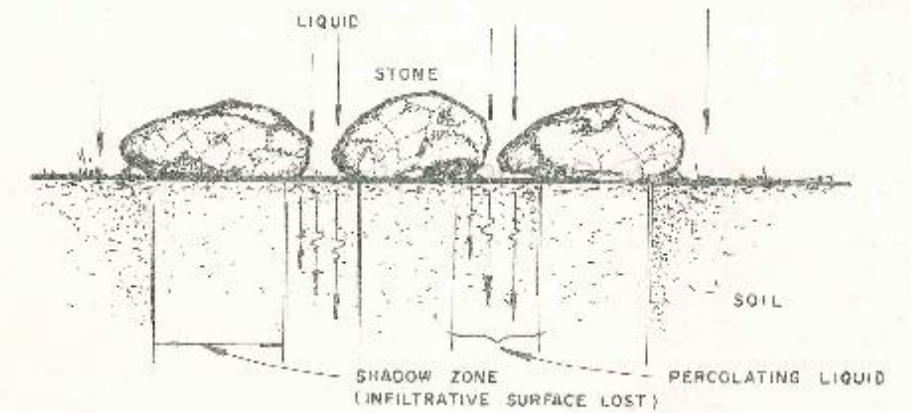


FIGURE 7. LOSS OF INFILTRATIVE CAPACITY BY ABRUPT CHANGE IN PARTICLE SIZE

Findings Revisited

Weekness of bottom area as a primary infiltrative surface per McGauhey & Winneberger

4. Organic matter in the wastewater will feed biomass on the stone and sidewalls, which will eventually slough off to accumulate on the bottom and clog the infiltrative surface.
5. Fine silt and sand from backfill above or from dirty stone will migrate downward and accumulate on the bottom area contributing to the clogging of the infiltrative surface.

Findings Revisited

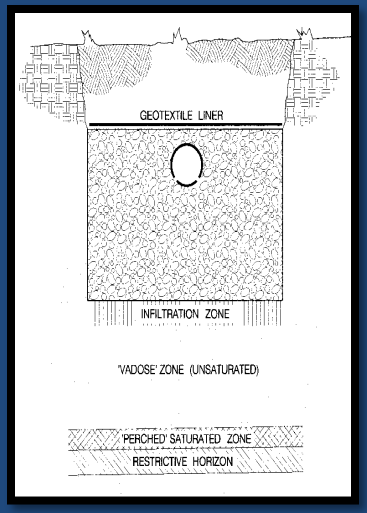
Weekness of bottom area as a primary infiltrative surface per McGauhey & Winneberger

6. Soil pores at the stone/soil interface where silt and biomass accumulate will stay saturated for long periods of time and become anaerobic unless the system is rested for long periods of time. Once anaerobic ferric sulfide develops and a sealing mat forms that slows or stops the movement of water into the soil.

Findings Revisited

Weekness of bottom area as a primary infiltrative surface per McGauhey & Winneberger

7. Soil absorption systems in the form of **beds** will perform much like buried pond bottoms, rather than infiltration systems.
8. “Continuous inundation of the soil is to be avoided if biological clogging is to be minimized.”



Findings Revisited

Weekness of bottom area as a primary infiltrative surface per McGauhey & Winneberger

9. “… clogged bottom surfaces showed little tendency to recover infiltrative capacity after resting a few hours, whereas the sidewalls regained their original infiltrative capacity in the same period of rest.”
10. “… sidewall clogging rate is independent of the sewage loading rate in G/SF/day, being far more dependent upon the dosing and resting cycle.”

Findings Revisited

Weekness of bottom area as a primary infiltrative surface per McGauhey & Winneberger

11. And: "Contrary to common assumption, clogging experiments show **the trench bottom to be of minor importance as an infiltrative surface** …"
12. The infiltrative capacity of systems that are left open to precipitation events during construction can be severely lost by the washing of fines from spoils piles into the system, clogging the infiltrative surface.

Findings Revisited

Weekness of bottom area as a primary infiltrative surface

In comparing the bottom of the excavation to the sidewall area available McGauhey & Winneberger state:

"… the **bottom** of the excavation is of **secondary importance** as an infiltrative surface."

Regarding Sidewalls

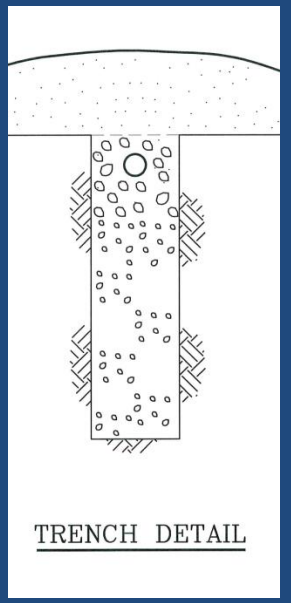
The advantages of the sidewall area as a primary infiltrative surface

1. "The important principal underlying the design of trench systems is that trench **widths** should be kept at the practical **minimum**."
2. Side by side comparisons indicated that narrow trenches operated continuously without ponding while the "wide trench" exhibited continuous ponding in similar soils.

Regarding Sidewalls

The advantages of the sidewall area as a primary infiltrative surface

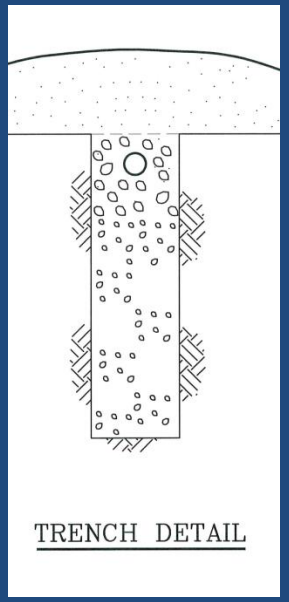
3. Sidewall areas are less vulnerable to smearing and compaction during construction
4. Sidewalls are less prone to clogging from fines washed into the excavation if precipitation occurs during construction



Regarding Sidewalls

The advantages of the sidewall area as a primary infiltrative surface

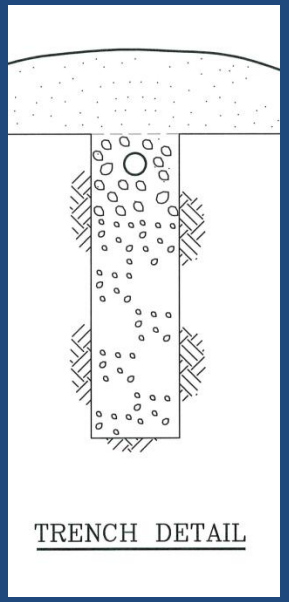
5. Any bio-growth that occurs within the system will tend to wash from the sidewalls and accumulate in the bottom of the system, leaving sidewalls free



Regarding Sidewalls

The advantages of the sidewall area as a primary infiltrative surface

6. The fluctuating water levels in the trench tend to keep the sidewall areas aerobic
7. Intermittent resting of the system will encourage aerobic conditions and prevent the precipitation of ferrous sulfide, anaerobic conditions and eventual clogging of the soil



Other Recommendations

McGauhey & Winneberger recommend these other design features for soil "percolation systems" ---

1. Ideally the entire infiltrative surface should be loaded uniformly to prevent "creeping failure" (for instance – pressure distribution)
2. Periodic resting will maintain aerobic conditions and extend the life of the system (for instance – timed dosing)

Other Recommendations

McGauhey & Winneberger recommend these other design features for soil "percolation systems" ---

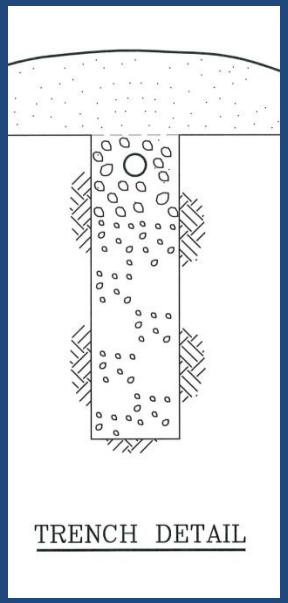
3. The use of a distribution box is "**essentially useless**" per U.S. Public Health Service sponsored research in 1958
4. The infiltrative capacity of the native soil interface is enhanced by minimizing the particle size differential between the distribution media (stone, etc.) and the native soil

Other Recommendations

Regarding the spacing of narrow trenches . . . McGauhey & Winneberger :

5. “Theoretically there is no reason why trench spacing . . . should be greater than twice the sidewall depth . . .”

Solution for small spaces???



Other Recommendations

Also recommended by McGauhey & Winneberger was this construction advisory:

Open excavations that would allow precipitation events to wash silt into open excavations must be avoided.

Trench Design

McGauhey & Winneberger recommended this type of trench configuration . . .

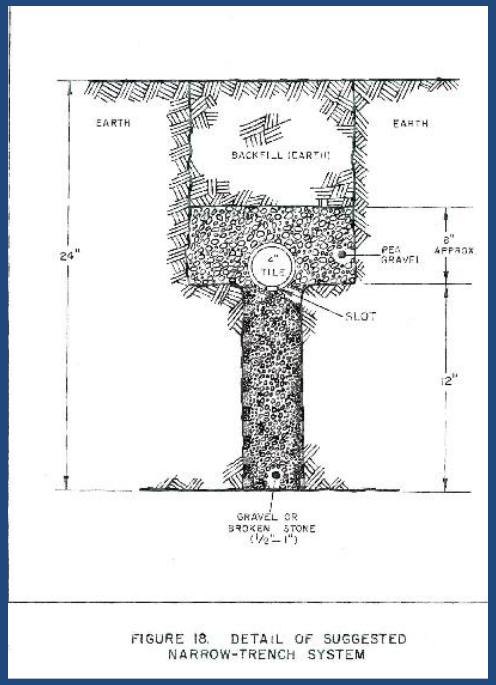


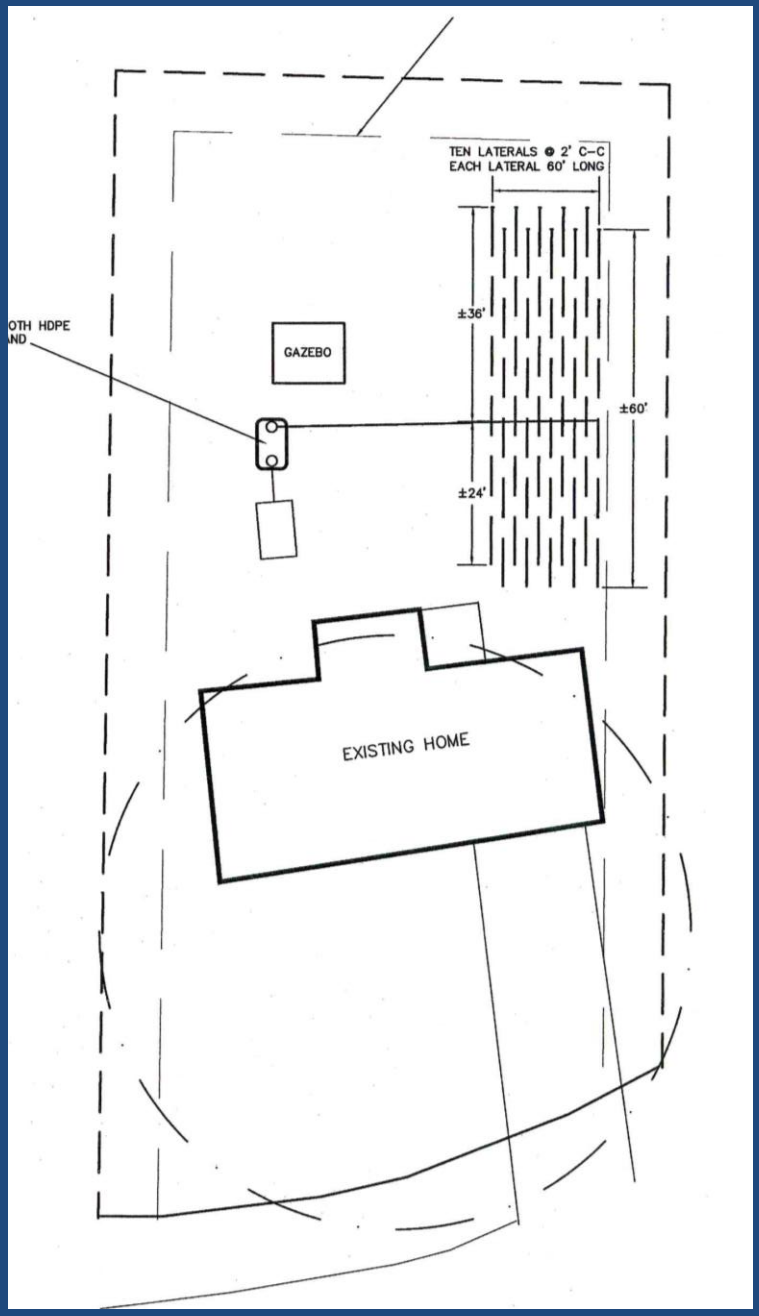
FIGURE 18. DETAIL OF SUGGESTED NARROW-TRENCH SYSTEM

Water Movement by Capillary Attraction

Verti-Grid ™ Product
for use in
Narrow Trenches

Case #1

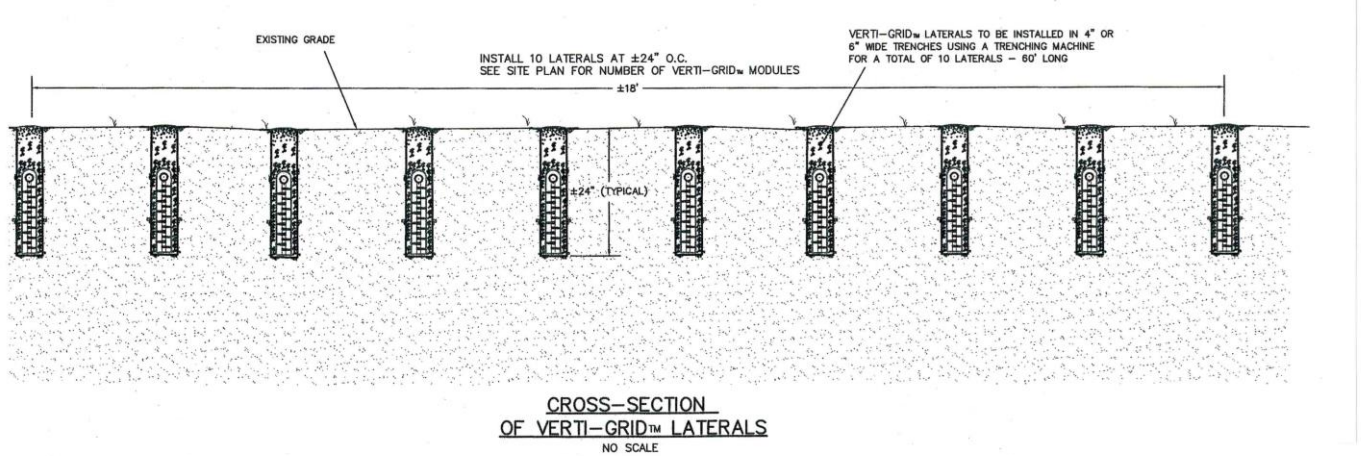
Kent County, MI

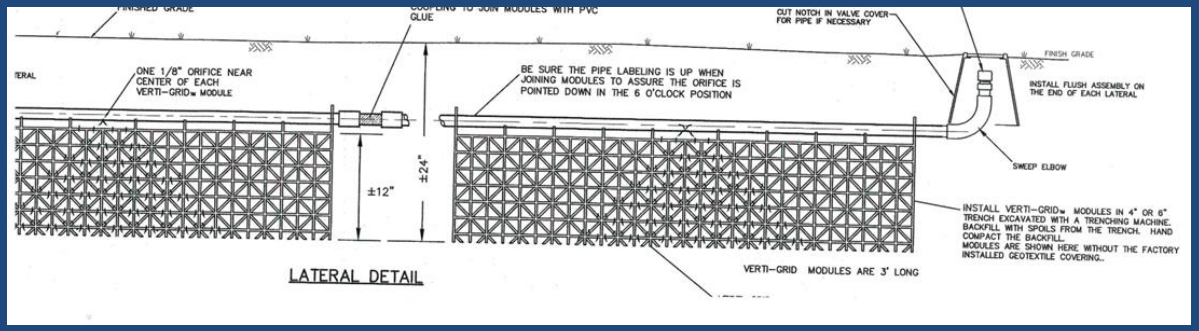


Bluehill Drive

Grand Rapids, MI

Verti-Grid™ Laterals





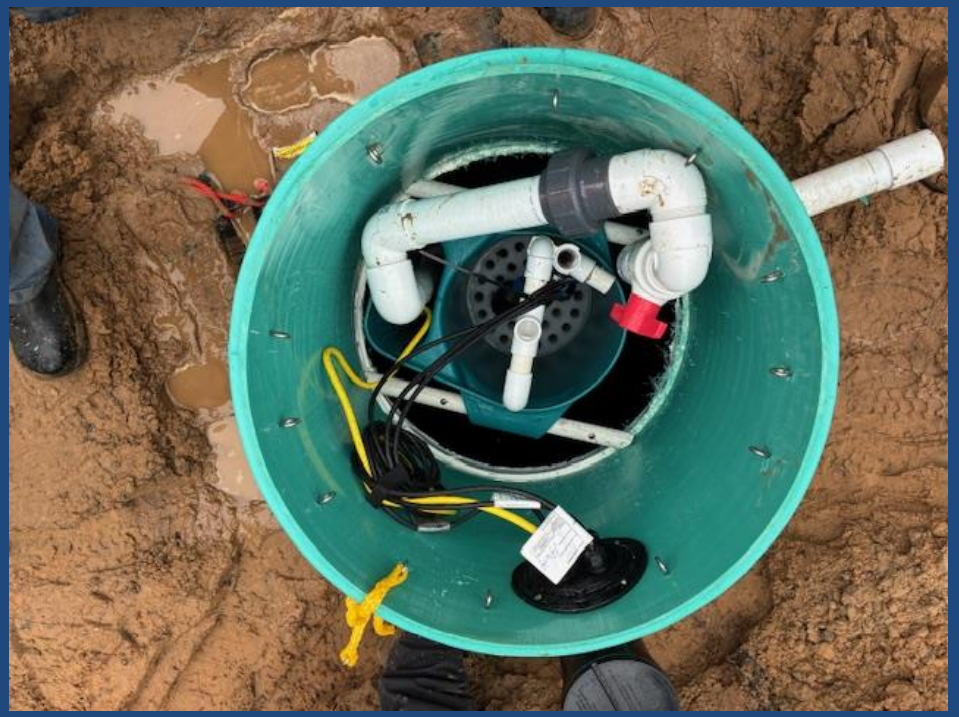
Excavation of Narrow Trenches

Excavation of Narrow Trenches

Assembly of Modules

Connections at Center Manifold

Dosing Pump Installation



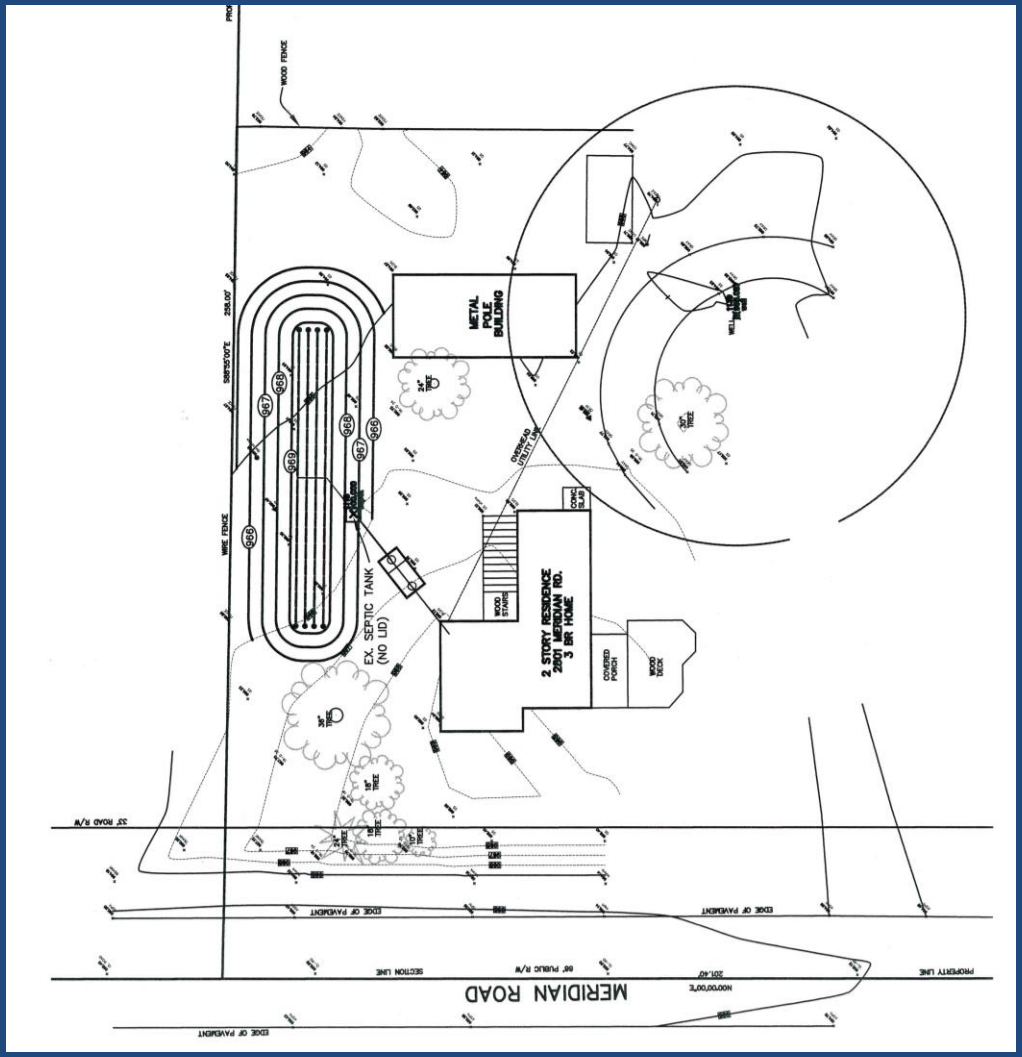
Secondary Safety Device on Risers

Performance Testing
After Installation

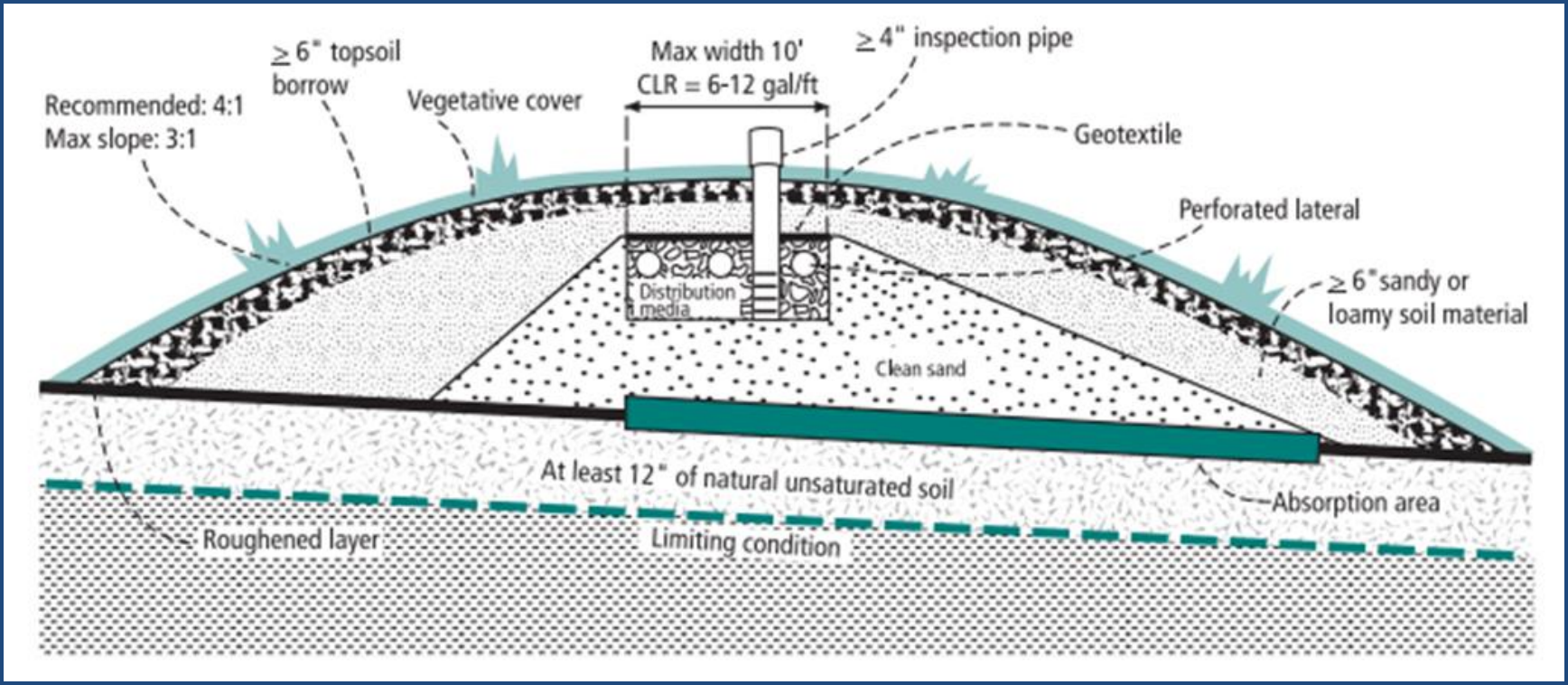
Case #2

Ingham County, MI

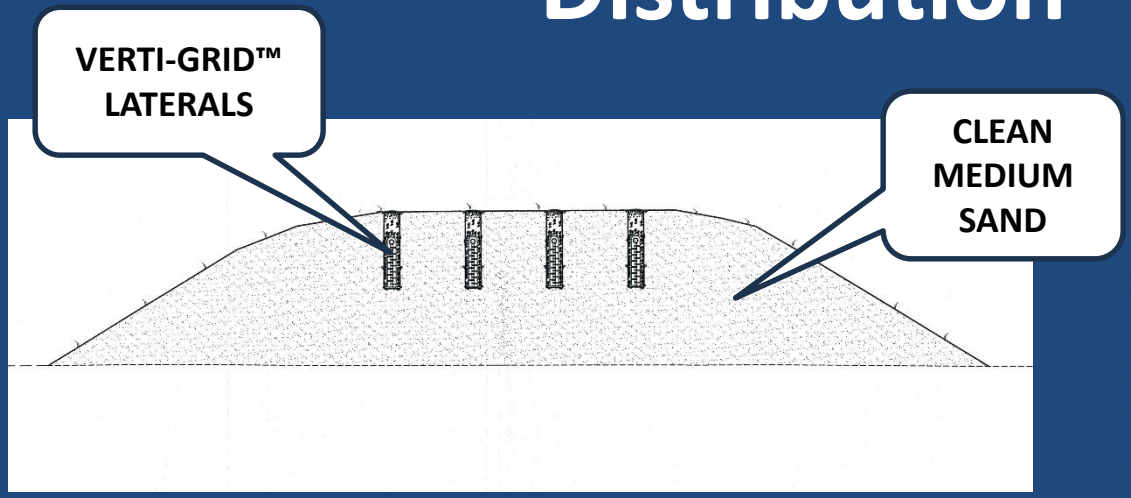
Ingham County Repair
Meridian Road, Leslie, MI

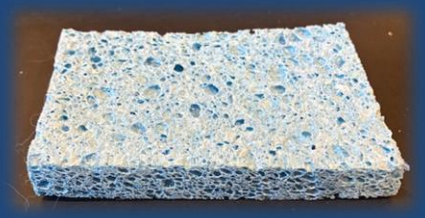


Traditional Mound Installation



Sand Mound with Pressure Distribution





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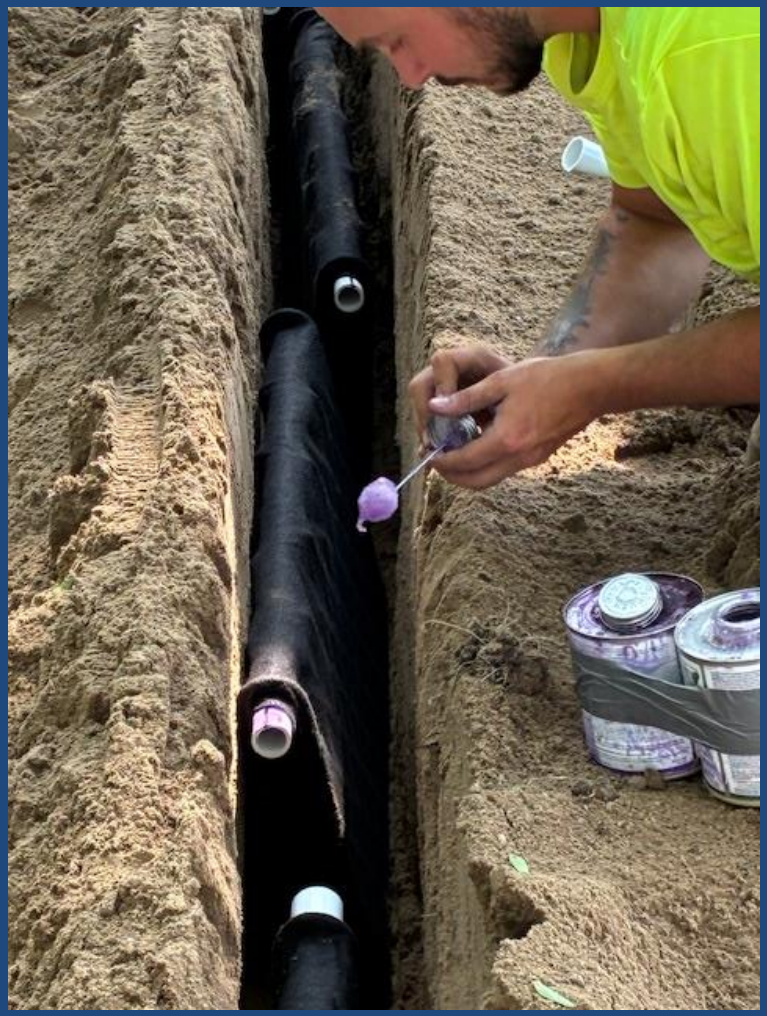
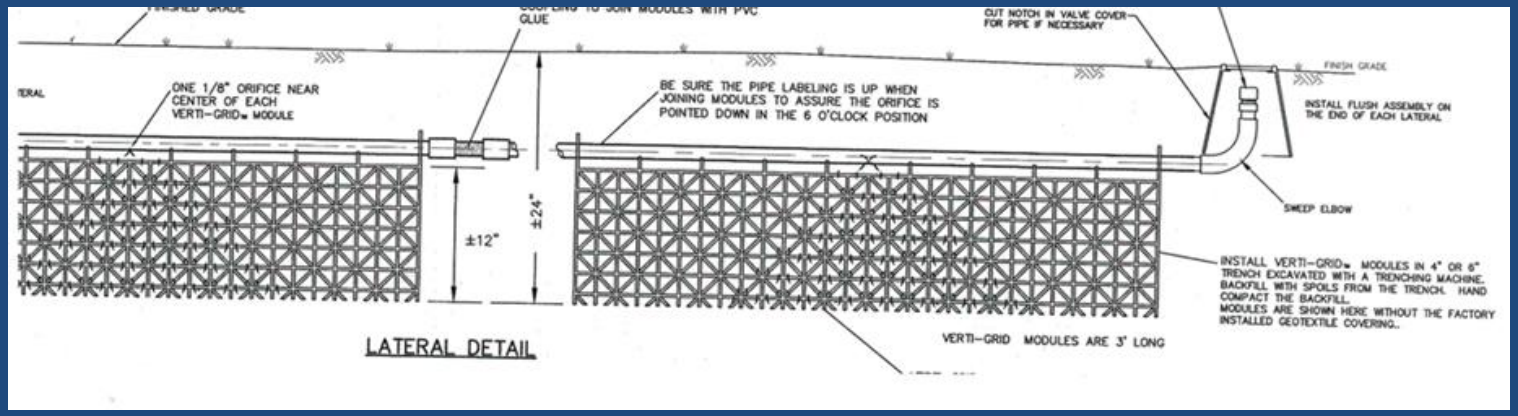
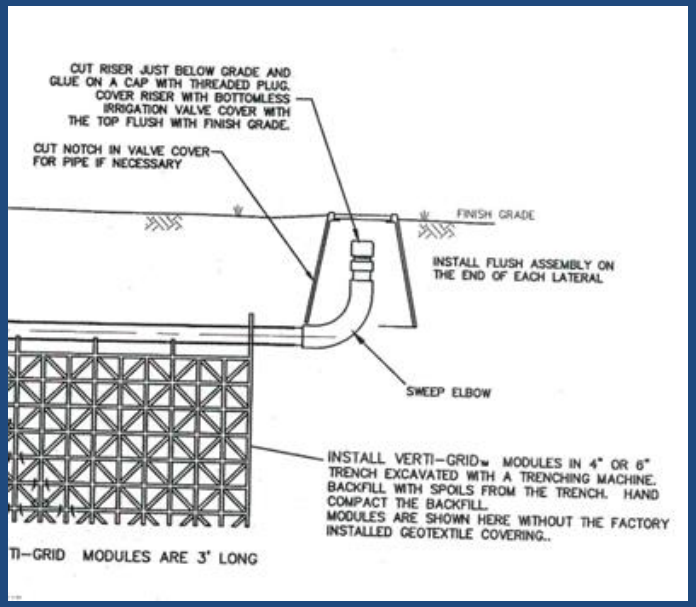


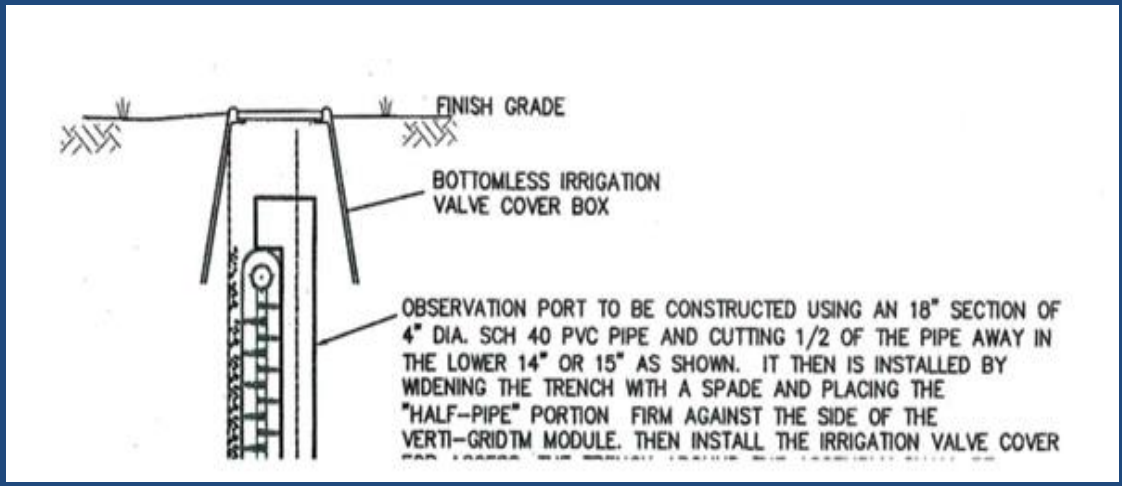
Sand Mound with Pressure Distribution

Verti-Grid™ Installation with Lateral Flush Assembly





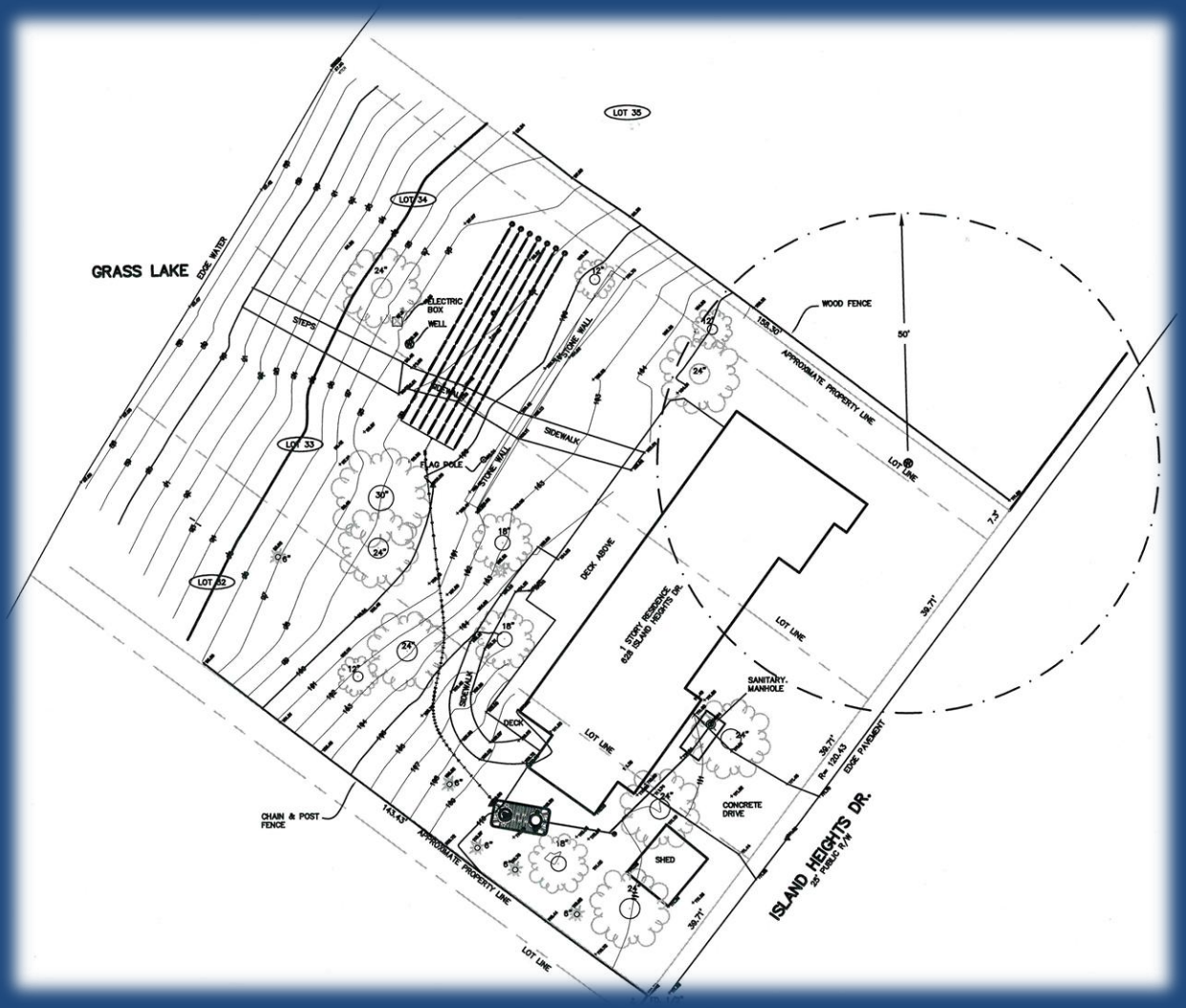
Inspection Port for Verti-Grid ™



Case #3

Jackson County, MI

Grass Lake Lot
Jackson County, MI



Grass Lake Lot System Repair

Grass Lake Lot System Repair

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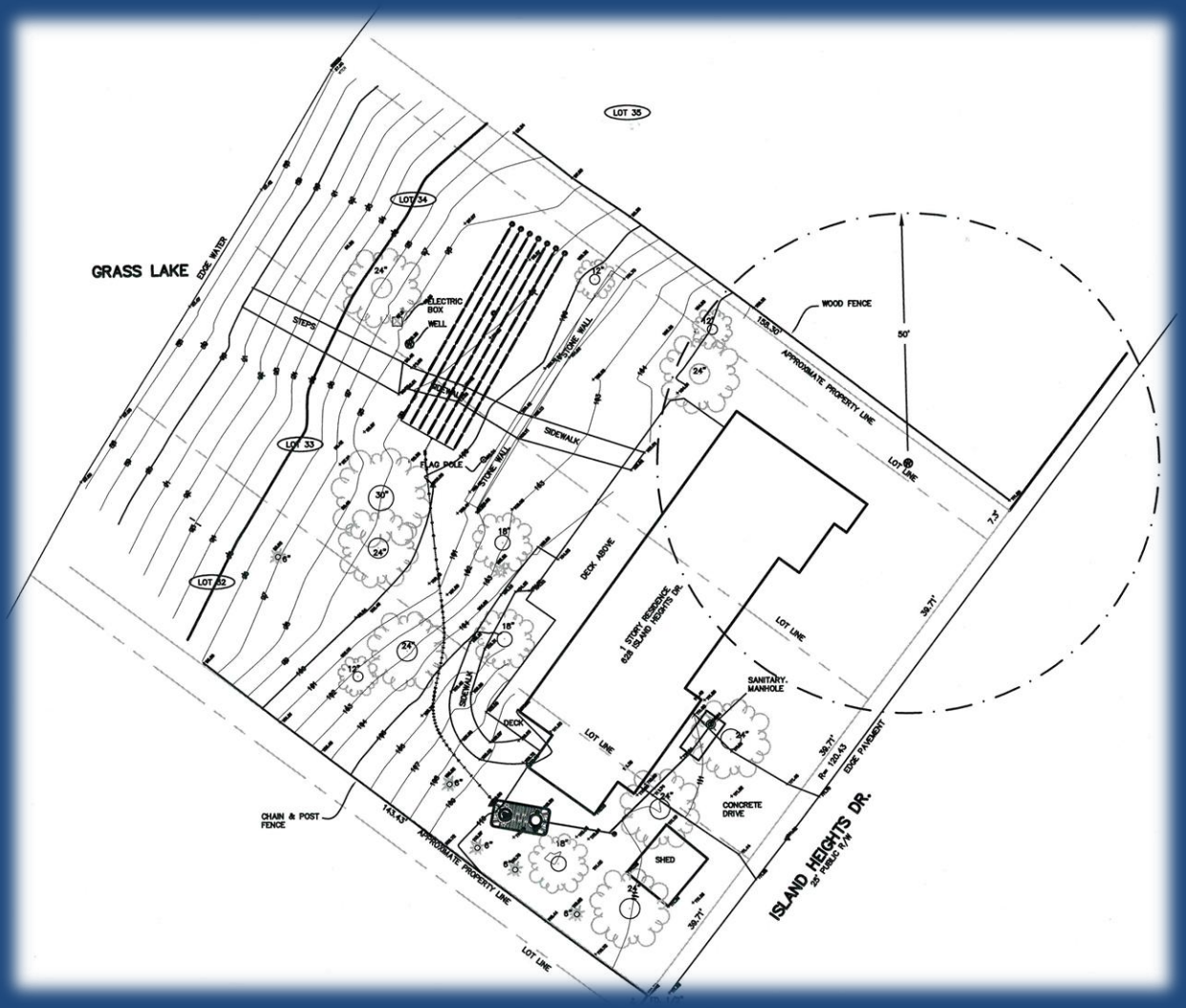

CONCLUSIONS

- **Building a soil dispersal system using narrow trenches to maximize sidewall absorption and dispersal is now possible with currently available products and tools.**
- **Based upon almost 60-year old research building soil dispersal systems to maximize sidewall absorption and minimize bottom area use is a "Method of preventing failure of septic tank percolation systems".**

Contact Information

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