MASSACHUSETTS

GST™ Leaching Systems

Design Manual for
Pressure and Gravity Applications

April 2020

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Introduction

The GST™ Leaching System (GST), is an adaptation of the time proven stone leaching system. This traditional leaching system has been improved with the use of a removable form to accurately shape and construct leaching fingers along the sides of a central distribution channel. The fingers are typically constructed with ½" – ¾" washed stone and are surrounded with ASTM C-33 sand. These fingers serve to increase the sidewall surface area by more than six times that of a traditional stone leaching trench. Additionally, the narrow profile of the leaching fingers and central distribution channel, combined with the uniform profile of the sand treatment media, serve to enhance oxygen transfer efficiencies. Enhanced oxygen transfer results in better treatment of the wastewater pollutants and a leach field with a longer lifespan. GST can be configured with standard gravity, pressure and/or time dosed distribution

The GST is available 6", 12", 18", 24", 30", and 36" tall, 37" or 62" wide.

Geomatrix products are the result of intensive research and development, including in-house and third-party testing. Test reports are available by contacting Geomatrix.

While some codes do not require the use of pressure distribution(PD), treatment units, flow equalization or SoilAir, Geomatrix, highly recommends the use of these features to enhance treatment and system lifespan, especially where high flows and challenging waste streams are present.

Designing a GST System

GST Leaching Systems shall be designed in accordance with all State regulations and local regulations. GST can be installed in trench configurations or beneath a stone bed to increase the effective basal surface area beneath the bed.

Contact Geomatrix with any questions you may have and for design assistance with non-single family residential or commercial applications.

GST is typically constructed with ½" – ¾" washed stone and are surrounded with ASTM C-33 or other approved sand.

GST can be utilized in H-20 situations provided that a minimum of 12" of suitable load bearing cover is utilized above the GST system.

In the instance when GST is installed deep or below impervious areas that limit oxygen transfer, the use of SoilAir should be evaluated.

Use Tables 1 thru 5 for system sizing.

GST in Trench & Bed Configurations

GST can be installed in a trench configuration in native soil or trench and bed configurations in a sand fill package. GST can be loaded at a maximum loading rate of 0.74 gallons per day per square foot of surface area; please refer to Tables 1 – 5. A minimum of 2 inches of sand meeting the requirements of 310 CMR 15.255(3) be placed beneath the GST. A minimum of 2 inches of this specification of sand should be installed on the sides and the ends of the GST.

Gravity or Pressure Distribution (PD) may be utilized. PD can utilize a conventional pump or HyAir™ pump.

System Design Steps

1. Determine Soil Loading Rate using Table 1.
2. Determine the square footage of GST required by utilizing the appropriate Loading Rate, Number of Bedrooms.
3. Determine the Length of GST required using Tables 2 and 3, the GST model, and the square footage of GST required, as calculated in step 2.
4. Determine the sand and stone required based on Table 4.
5. If installing in a sand bed, determine minimum sand bed sizing using Table 5, Percolation Rate, Soil Class, and Number of Bedrooms. Massachusetts requires a minimum sand bed of 400 sq. ft.

System sizing is inherently related to cost. While more surface area is always beneficial, the cost per acre of land, additional construction costs, septic fill, septic tank/pretreatment efficiency, leaching system components, etc. must be balanced against the type of use, useful life and performance of the system.

Ultimately what and how much the user puts down the drain will determine the ultimate system lifespan and performance. Performance testing and Government standards do not necessarily address all situations/users.

When a leaching system is not being used, the organic matter that has accumulated over time can dry out and breakdown in a process similar to composting. Zoned systems can be utilized to run and rest portions of the system and facilitate this resting process if the use pattern of the system will not naturally facilitate it. Inorganic materials that are put down the drain will be unaffected and not breakdown.

The use of SoilAir can greatly enhance rest intervals and the breakdown of organic clogging matter. If a SoilAir system is not installed when the system is constructed, the installation of an air introduction point is advisable to allow rejuvenation of the system should this be necessary at some point in the future.

A frank, honest discussion between the designer and the property owner about how the system will be utilized is the best way to determine what type of design, specific components and what sizing/safety factor is best to apply to any given design. Geomatrix encourages the designer and property owner to make the system as big as possible; but any final design is ultimately a compromise between cost, performance and longevity. If cost is not an issue...designing as conservatively as possible is encouraged.

As there are many variables affecting septic systems performance, when possible, increasing surface area is beneficial. Designing at the highest approved hydraulic loading rate, just because it is allowed, may not be in the property owners best long-term interest.

Contact Geomatrix with any questions you may have and for design assistance with non-single family residential or commercial applications.

Table 1

Percolation vs. Loading Rate

	Loading Rate			
Perc. Rate min/inch	SOIL† CLASS I GPD/sqft	SOIL‡ CLASS II GPD/sqft	SOIL‡ CLASS III GPD/sqft	SOIL*‡ CLASS IV GPD/sqft
≤5	0.74	0.60	-	-
6	0.70	0.60	-	-
7	0.68	0.60	-	-
8	0.66	0.60	-	-
10	-	0.60	-	-
15	-	0.56	0.37	-
20	-	0.53	0.34	-
25	-	0.40	0.33	-
30	-	0.33	0.29	-
40	-	-	0.25	-
50	-	-	0.20	0.20
60	-	-	0.15	0.15

* - Must be reviewed by Geomatrix

† - GST can be installed directly in native soils

‡ - Requires a minimum of 2” approved sand beneath GST

Table 2

GST APPROVED EFFECTIVE LEACHING AREA IN TRENCH CONFIGURATION (SF/LF)

Product Name	Dimensions (W x H)	Effective Leaching Area Approved (SF/LF)	Edge to Edge Spacing (Inches)
GST 3706	37" x 6"	6.68֍	6
GST 3712	37" x 12"	8.35	6
GST 3718	37" x 18"	10	12
GST 3724	37" x 24"	11.69	12
GST 6206	62" x 6"	6.68	6
GST 6212	62" x 12"	8.35	6
GST 6218	62" x 18"	10	12
GST 6224	62" x 24"	11.69	12

֍– these ELA values are per MADEP and do not reflect the actual surface area of the applicable GST Model. Please be aware that the MADEP has uprated the GST 3706 at an ELA/LF that is greater than the actual surface area per linear foot. Geomatrix has conducted all testing based on the actual surface area per linear foot of the respective GST Model.

Geomatrix recommends that designers specifying the GST 3706 utilize an ELA of 5.7 sq. ft/lf. All other GST Models have been derated by the MADEP. Please contact Geomatrix with any questions.

Table 3
GST APPROVED EFFECTIVE LEACHING AREA IN BED CONFIGURATION (SF/LF)

Product Name	Dimensions (W x H)	Effective Leaching Area Approved (SF/LF)
GST 3706	37" x 6"	5.71
GST 3712	37" x 12"	5.71
GST 3718	37" x 18"	5.71
GST 3724	37" x 24"	5.71
GST 6206	62" x 6"	9.19
GST 6212	62" x 12"	9.19
GST 6218	62" x 18"	9.19
GST 6224	62" x 24"	9.19

– these ELA values are per MADEP and do not reflect the actual surface area of the applicable GST Model. Geomatrix has conducted all testing based on the actual surface area per linear foot of the respective GST Model.
Geomatrix recommends that designers specifying the GST 3706 utilize an ELA of 5.7 sq. ft/lf. All other GST Models have been derated by the MADEP. Please contact Geomatrix with any questions.

Table 4
Sand and Stone Volume Guide

62" series

Product Name	Amount of ¾" Stone Required	Amount of ASTM C-33 Sand Required
	Yards per Linear Foot	
GST 6206	0.20	0.25
GST 6212	0.27	0.35
GST 6218	0.35	0.46
GST 6224	0.43	0.56

37" series

Product Name	Amount of ¾" Stone Required	Amount of ASTM C-33 Sand Required
	Yards per. Linear Foot	
GST 3706	0.16	0.18
GST 3712	0.19	0.25
GST 3718	0.22	0.32
GST 3724	0.25	0.39

Table 5

Minimum Sand Bed Sizing

Perc Rate min/inch	2 Bedroom @220GPD				3 Bedroom @330GPD				4 Bedroom @440GPD			
	SOIL CLASS				SOIL CLASS				SOIL CLASS			
	CLASS I	CLASS II	CLASS III	CLASS IV	CLASS I	CLASS II	CLASS III	CLASS IV	CLASS I	CLASS II	CLASS III	CLASS IV
≤5	400	400	-	-	400	400	-	-	400	440	-	-
6	400	400	-	-	400	400	-	-	400	440	-	-
7	400	400	-	-	400	400	-	-	400	440	-	-
8	400	400	-	-	400	400	-	-	400	440	-	-
10	-	400	-	-	-	400	-	-	-	440	-	-
15	-	400	400	-	-	400	535	-	-	471	714	-
20	-	400	400	-	-	400	582	-	-	498	776	-
25	-	400	400	-	-	495	600	-	-	660	800	-
30	-	400	455	-	-	600	683	-	-	800	910	-
40	-	-	528	-	-	-	792	-	-	-	1056	-
50	-	-	660	660	-	-	990	990	-	-	1320	1320
60	-	-	880	880	-	-	1320	1320	-	-	1760	1760

Perc Rate min/inch	5 Bedroom @550GPD				6 Bedroom @660GPD				Add'l Bedroom @110GPD			
	SOIL CLASS				SOIL CLASS				SOIL CLASS			
	CLASS I	CLASS II	CLASS III	CLASS IV	CLASS I	CLASS II	CLASS III	CLASS IV	CLASS I	CLASS II	CLASS III	CLASS IV
≤5	446	550	-	-	535	660	-	-	89	110	-	-
6	471	550	-	-	566	660	-	-	94	110	-	-
7	485	550	-	-	582	660	-	-	97	110	-	-
8	500	550	-	-	600	660	-	-	100	110	-	-
10	-	550	-	-	-	660	-	-	-	110	-	-
15	-	589	892	-	-	707	1070	-	-	118	178	-
20	-	623	971	-	-	747	1165	-	-	125	194	-
25	-	825	1000	-	-	990	1200	-	-	165	200	-
30	-	1000	1138	-	-	1200	1366	-	-	200	228	-
40	-	-	1320	-	-	-	1584	-	-	-	264	-
50	-	-	1650	1650	-	-	1980	1980	-	-	330	330
60	-	-	2200	2200	-	-	2640	2640	-	-	440	440

Basic Design Considerations

If the system is configured for gravity distribution, dosing volume does not inherently apply. SoilAir may be used to better distribute a gravity dose to the GST.

In gravity systems, GST pipe will be 2 - 4 inch perforated pipe.

A minimum cover depth of 6 inches shall be present above the GST system. Suitable cover material above the distribution pipe is clean sandy fill and topsoil that is suitable for growing grass.

Minimum perimeter sand fill beyond the GST on a sand bed shall be 12 inches. The cover material should be final graded at a 2% pitch over the GST system and for 24 inches beyond the outermost edge of the GST. If cover material over the GST is above the original grade, it shall maintain the 2% pitch for a minimum of 24 inches beyond the outermost edge of the GST and then run at a 3:1 slope to original grade.

Remember to follow these design parameters when designing and installing GST:

- Preservation of the native soil between trenches and minimizing its disruption and compaction during construction is essential to maintaining soil structure and therefore water and gas movement in the soil around the trenches. For this reason, construction is to be trench-by-trench when possible unless a layer of specified sand is utilized as a continuous base beneath, around and covering the GST;

- Keep the top of the GST shallow, ideally 6-12 inches below finish grades. When cover increases above 24 inches, use of SoilAir should be evaluated. Try to keep cover depth as consistent as possible over the laterals to balance air flux rates through the soil;

- Keep the bottoms of the GST laterals level;

- Separation from the seasonal high water table is (a) four feet in soils with a recorded percolation rate of more than two minutes per inch and (b) five feet in soils with a recorded percolation rate of two minutes or less per inch unless otherwise approved;

- Provide for lateral pipe drainage and maintenance access;

- Avoid working in soils with fines present that are moist or wet because they can easily smear and compact;

- Scarify the drain field base before installing components.

When reviewing a site and developing a design, it is best to position the GST laterals parallel to ground surface contours. This will help make it easier to keep drain field base elevations uniform. Designing perpendicular to a surface contour will mean that the down gradient end of the drain field trench being shallow-placed, whereas the upgradient end will be much deeper. Leaching systems that are parallel with surface contours also have a larger hydraulic window which minimizes soil saturation.

When PD is used, the requirements of 310 CMR 255(2) shall not apply. Pressure dosing must be designed in accordance with Massachusetts Guidance Document Policy #BRP/DWM/WpeP/G02-2. The pressure distribution effluent rates in 310 CMR 15.242(1)(b) can be utilized. Small frequent doses of effluent to the GST are preferred over fewer larger doses; however, rest/reaeration intervals must also be proved for; 4 – 8 doses per day is typical. Pump chambers should preferably be designed with float switches controlling high water alarm, pump on/off and low water/redundant off. A dose counter is recommended. Time dosing can also enhance performance.

Pump systems shall comply with the requirements of 310 CMR 231(6) with regard to the requirement of duplex pumps.

Soil excavation and / or plantings within a minimum of five feet of the system are not permitted unless a root barrier is utilized. Contact Geomatrix for design assistance.

System can be installed as close as 20 feet from a building cellar wall.

GST systems may be designed with an irregular shape to fit site specific conditions.

An appropriately sized conventional system and reserve area for a conventional system are required for future upgrades.

Trenches constructed at different elevations shall be designed to prevent effluent from the higher trench(es) flowing into the lower trench(es). 310 CMR 15.251(3).

It is recommended that an inspection port shall be installed on every row of GST. The inspection port – PN: IPGST15 consists of a 4” PVC Tee with two slotted openings on the T ends. A threaded plug on top prevents debris from entering the inspection port. These inspection ports are designed to be stable and not move upwardly or downwardly over the life of the system. This will allow confirmation of the bottom elevation of the leaching system during inspection or at any time afterwards. It is also possible to monitor effluent ponding levels through this port. If it is ever necessary to pump the leaching system out, the inspection port will prevent a “posthole” from being formed as occurs when an open bottom pipe is utilized for pumping from. The inspection ports can be finished in a valve box to be flush with grade.

GST Excavation Requirements

The soil between the dispersal trenches shall remain undisturbed when possible. If the presence of boulders or other obstacles make trench construction impractical, the entire leach field area may be excavated as necessary, backfilled with suitable sand fill such as ASTM C-33 or other approved sand to the design elevation of the bottom of trench and the GST constructed and backfilled in C-33 sand or other approved sand.

Gravity Distribution Design Parameters

Parallel distribution shall be utilized whenever possible.

Laterals for gravity systems are 2 - 4 inch SCH40 or 4 inch SDR35 perforated pipe with minimum ½ inch perforations.

A state approved effluent filter shall be utilized.

Pressure Distribution Design Parameters (PD)

Generally, the pressure transport pipe from the septic tank or treatment unit to the GST is 1½ - 4 inch PVC pipe (Class 200 minimum). The actual pipe size will depend upon such factors as distance, pump head, scour velocity, frictional losses and desired pressure at the distal orifices. The transport pipe should be sloped either back to the pump tank or HyAir vessel or toward the GST to drain the line after each dose. In some cases, it may be better to slope the transport line in both directions. This should be done to prevent freezing in cold weather. An anti-siphon device should be used where any chance of siphoning of the pump tank may occur.

GST distribution manifolds are typically 1 ½ - 4 inch SCH.40 PVC. Distribution laterals are typically 1 - 2 inch schedule 40 PVC. Size will vary depending on design and site conditions. Distribution laterals should have flow equalization valves installed to provide equal flow of effluent to all rows when GST laterals are at different elevations. Flow equalization valves are often installed in the pump chamber for easy operation, protection from damage and prevention of freezing. A disconnect/throttle valve should be installed downstream of the pump throttle and shut off flow to the GST piping.

PD systems should be designed in accordance with all state and local rules and with less than 10% flow differential from the first to last orifice whenever possible; software is available from Geomatrix.

Orifice holes should be oriented in a downward (six o'clock) direction and be spaced according to the dosing requirements of the system. During fabrication of the distribution lateral, a new/sharp drill bit should be used to assure as smooth an orifice as possible. Any loose and connected drill shavings should be removed from the pipe with a bottle brush on an extension.

Geomatrix GeoGuard™ orifice shields must be installed over the orifice holes and glued in place with PVC primer and glue.

Typical designs should account for a minimum of two feet of head pressure at the distal end of each GST distribution lateral.

Design software for pump, lateral line, transport pipe, manifold, orifice size and additional head loss is available by emailing request to info@geomatrixsystems.com.

Two SCH40 PVC 45 degree elbows or equivalent 90 degree sweep elbows (also called turn ups) shall be attached to the distal end of each GST distribution lateral to facilitate setting and measuring distal head, maintenance and inspection. A standard 90 degree elbow should not be utilized because it will interfere with maintenance activities. The open end (upward end) of the sweep needs to be closed off with either a ball valve or threaded plug or cap. These turn ups also serve as distal head ports for measuring and setting distal head on the GST laterals at different elevations.

The installation of a pressure filter, approved by Geomatrix, is recommended between the pump and the laterals on PD systems. The Sim/Tech STF-100 is preapproved.

Zoned Drain Fields and Trenches at Different Elevations

Smaller sized pumps can be used on larger drain fields and still maintain adequate distal head by utilizing automatic sequencing valves, such as those manufactured by K Rain. These valves automatically direct flow to each respective zone or distribution lateral, in a prescribed order.

Site conditions may not facilitate installing all the drain field trenches at the same elevation. In these situations, distribution valves can be used to provide uniform wastewater distribution; alternatively, throttle valves can be utilized for the same purpose. Access points must be installed for each valve. Valves can be located in the pump tank or in the valve boxes.

Drain Field Cover

Drain field cover shall be a minimum of 6 inches over the top of the GST distribution pipe. Uniform cover depth and composition over the drain field results in consistent oxygen transfer to the entire system. The final grade over and around the drain field should direct storm water sheet flow away from drain field.

The area directly above and adjacent to any septic drain field should be protected from heavy vehicle traffic and excess weight loads before, during and post construction. On all construction projects, it is recommended that the proposed drain field location be staked and flagged/fenced to prevent encroachment. If vehicle encroachment is expected to be a problem before, during or after construction, some structure, such as garden timbers, railroad ties,

fences or walls should be used to protect the drain field area. The drain field area should be free of debris and planted with grass. Impermeable materials and structures should not be installed or stored over the drain field unless SoilAir is utilized to enhance aeration. When possible, trees and shrubs should be kept a minimum distance of ten feet from the drain field. If trees and shrubs must be closer than ten feet from the drain field, root barriers can be utilized to prevent roots from entering the drain field; contact Geomatrix for design assistance. Roots from nearby moisture loving trees such as willow, black locust and red maple may cause problems with roots clogging or otherwise damaging the drain field lateral. If a root barrier is not utilized, greater setback distances are recommended for these tree species.

Septic Do's and Don'ts

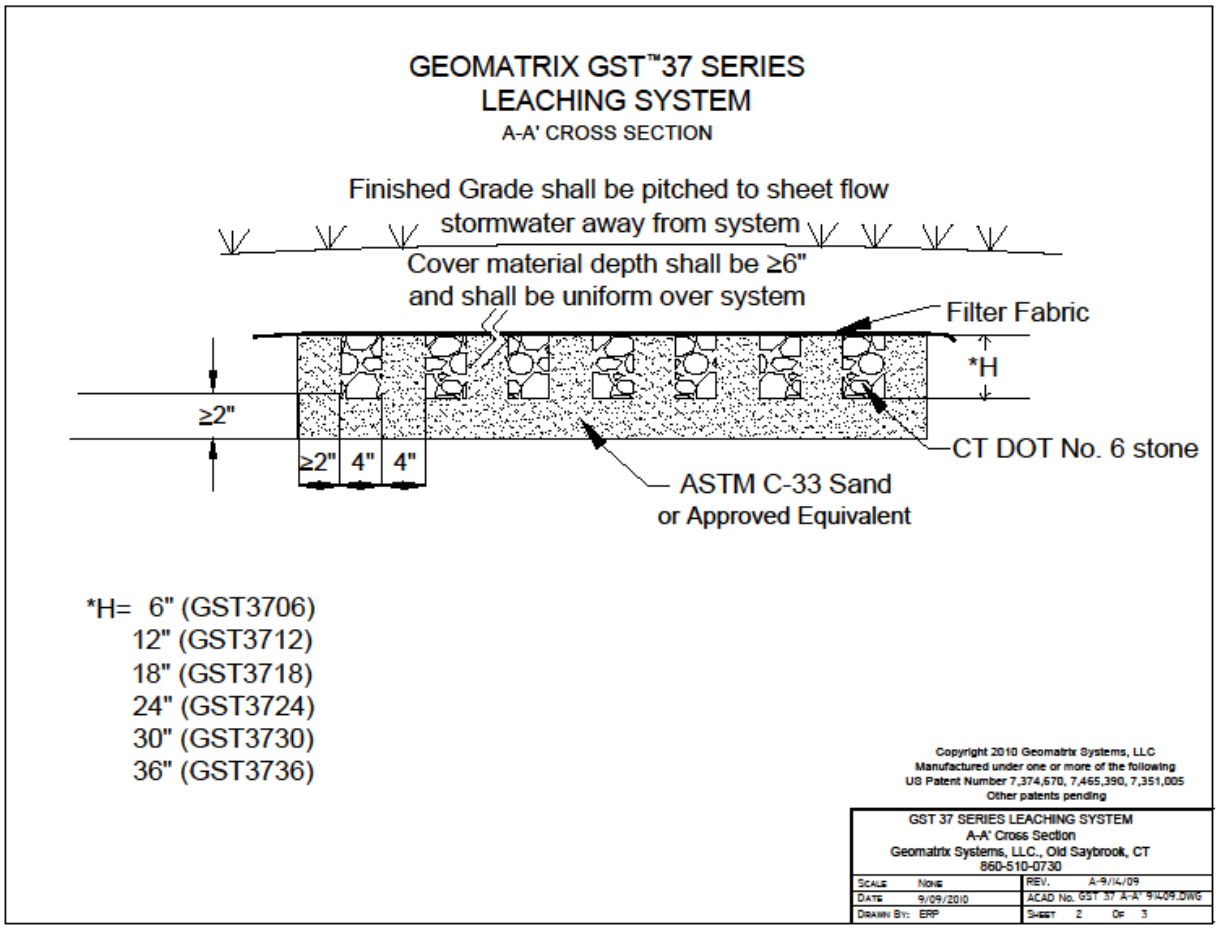
Do:

- Conserve water to reduce the amount of wastewater that must be treated and disposed.
- Repair any leaking faucets and toilets.
- Only discharge biodegradable wastes into system.
- Restrict garbage disposal use.
- Divert downspouts and other surface water away from your drain field & tanks.
- Keep your septic tank cover accessible for tank inspections and pumping.
- Have your septic tank pumped regularly and checked for leaks and cracks.
- Call a professional when you have problems.
- Compost your garbage or put it in the trash.

Don't:

- Flush sanitary napkins, tampons, condoms, cigarette butts, diapers, wipes and such products into your system.
- Dump solvents, oils, paints, paint thinner, disinfectants, pesticides or poisons down the drain.
- Dig in your drain field or build anything over it.
- Plant anything other than grass over your drain field.
- Drive over your drain field or compact it in any way.

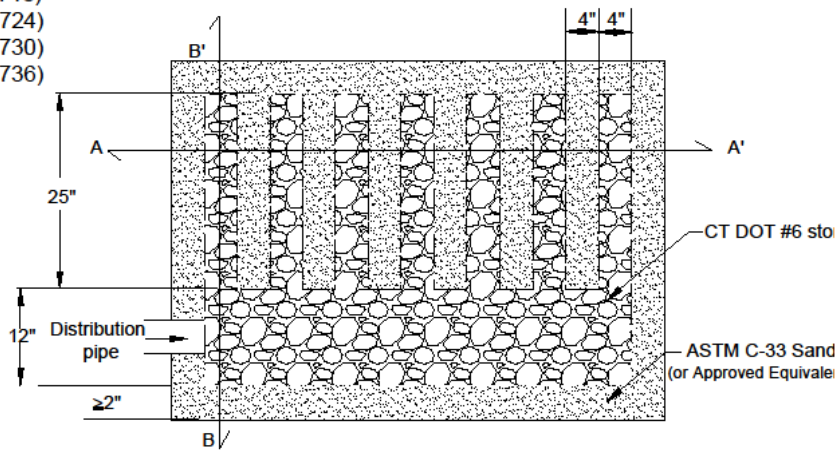
GST Schematics



6" (GST3706)
12" (GST3712)
18" (GST3718)
24" (GST3724)
30" (GST3730)
36" (GST3736)

GEOMATRIX GST™37 SERIES LEACHING SYSTEM

Plan View

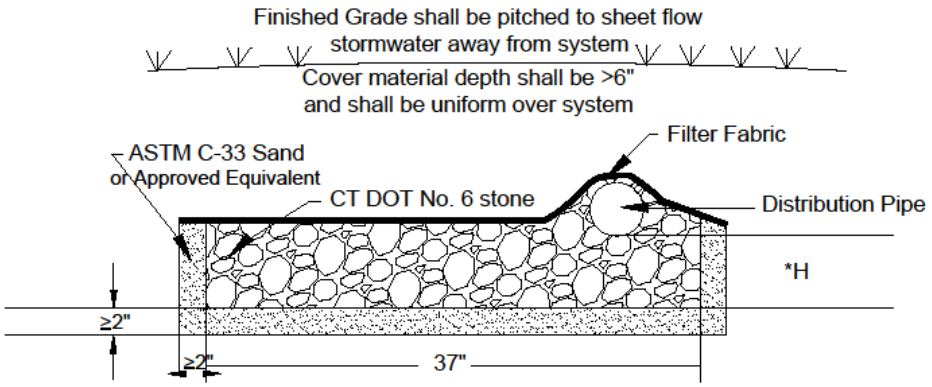


Distribution Pipe:
SDR 35 or Schd. 40, ASTM D-1785 PVC pipe for gravity applications
Schd. 40, ASTM D-1785 PVC pipe for pressure applications

GST 37 SERIES LEACHING SYSTEM Plan View Geomatrix Systems, LLC., Old Saybrook, CT 860-510-0730	
Scale: None	Rev. B-9/09/10
Date: 9/09/2010	ACAD No. GST37 Plan View
Drawn By: ERP	Sheet 1 Of 3

GEOMATRIX GST™37 SERIES LEACHING SYSTEM

B-B' CROSS SECTION

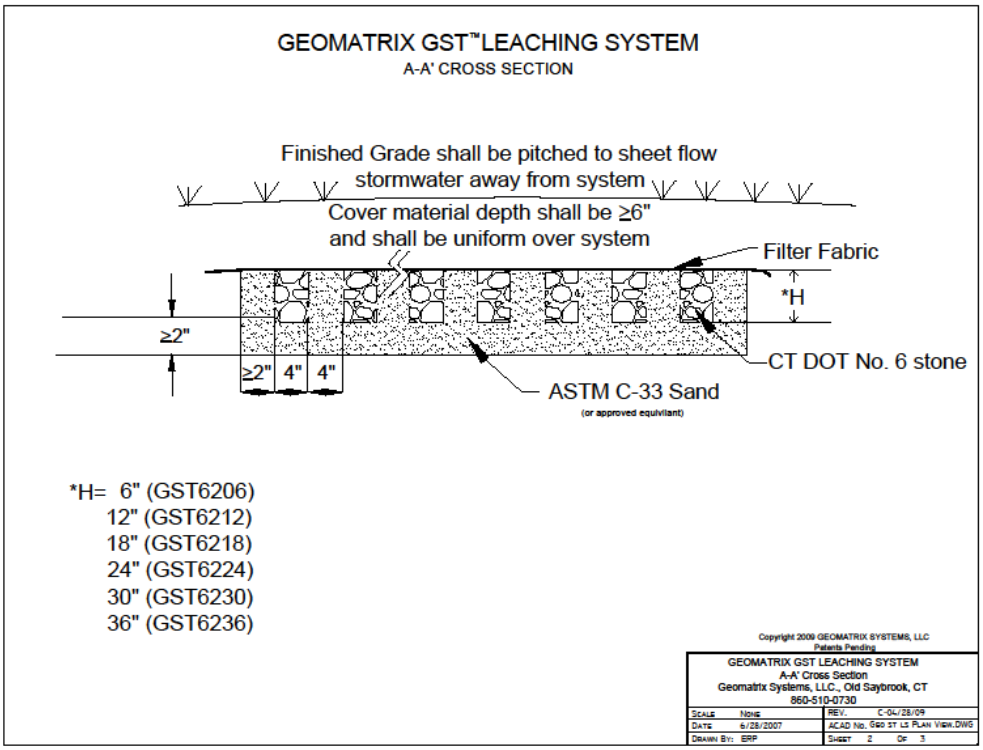


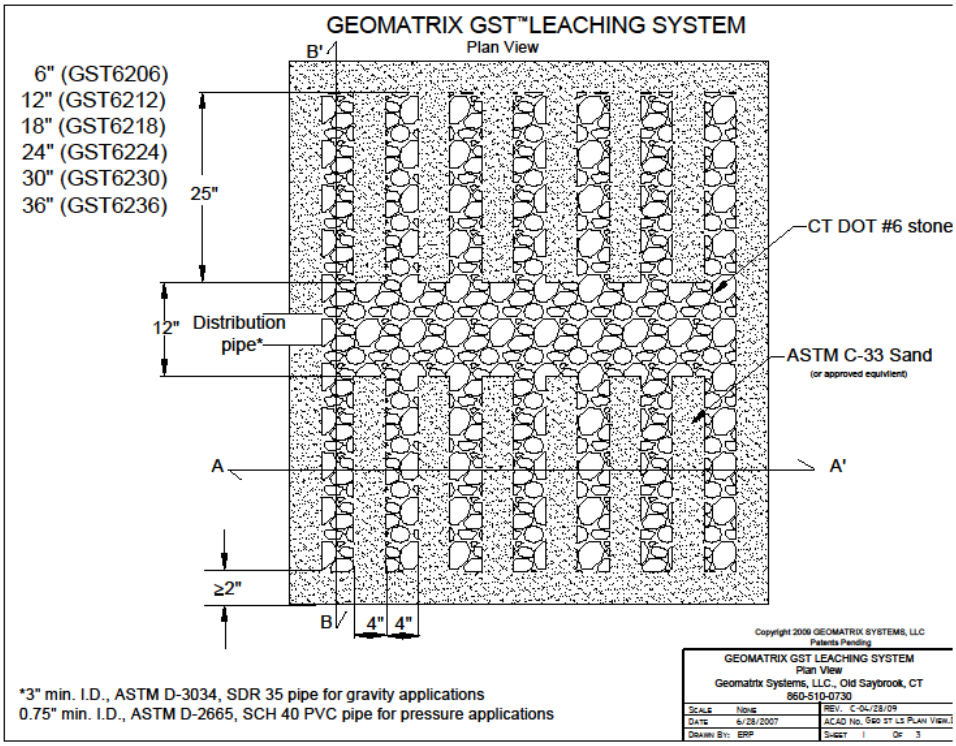
*H= 6" (GST3706)
12" (GST3712)
18" (GST3718)
24" (GST3724)
30" (GST3730)
36" (GST3736)

Distribution Pipe:
SDR 35 or Schd. 40, ASTM D-1785 PVC pipe for gravity applications
Schd. 40, ASTM D-1785 PVC pipe for pressure applications

GST 37 SERIES LEACHING SYSTEM B-B' Cross Section Geomatrix Systems, LLC., Old Saybrook, CT 860-510-0730	
Scale: None	Rev. B-9/9/10
Date: 9/09/2010	ACAD No. GST 37 B-B'.DW
Drawn By: ERP	Sheet 3 Of 3

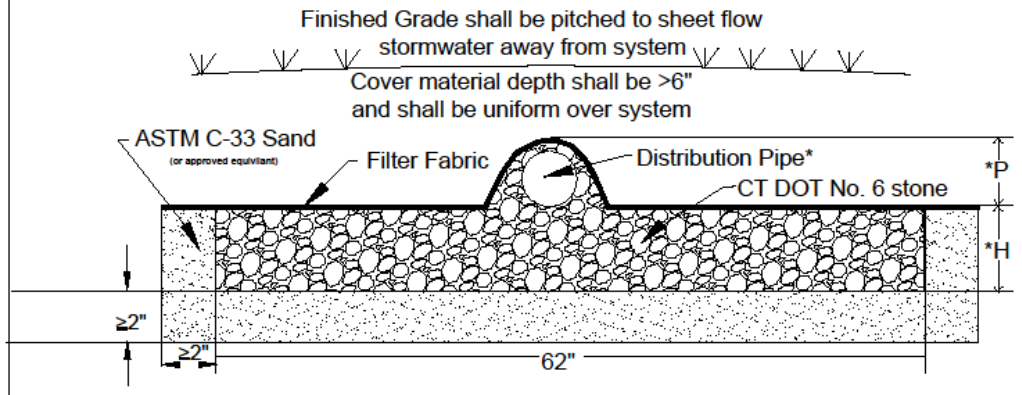
GST 62” Series





GEOMATRIX GST™LEACHING SYSTEM

B-B' CROSS SECTION



*H= 6" (GST6206)
12" (GST6212)
18" (GST6218)
24" (GST6224)
30" (GST6230)
36" (GST6236)

*P= 2" - 5.5"

*3" min. I.D., ASTM D-3034, SDR 35 pipe for gravity applications
0.75" min. I.D., ASTM D-2665, SCH 40 PVC pipe for pressure applications

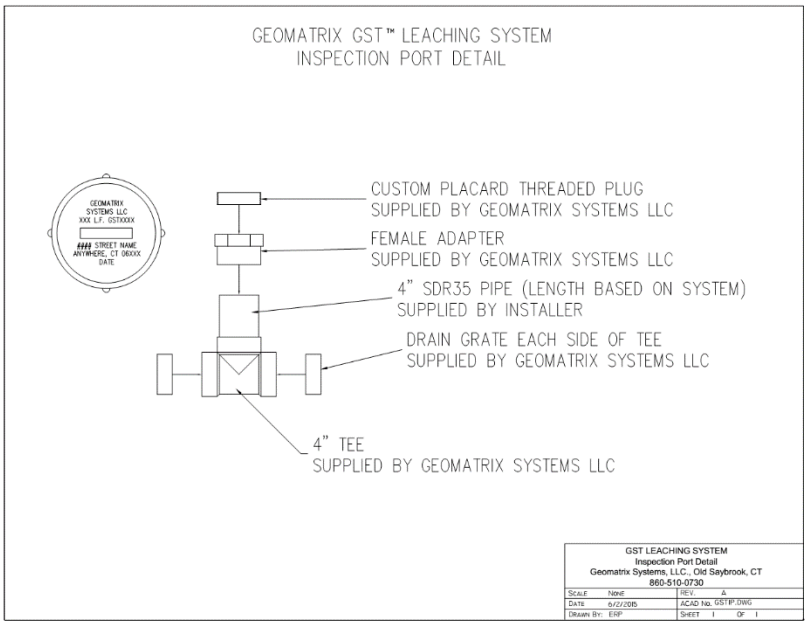
GEOMATRIX GST LEACHING SYSTEM
B-B' Cross Section
Geomatrix Systems, LLC., Old Saybrook, CT
860-510-0730

Scale:	None	Rev.	C-04/28/09
Date:	6/28/2007	ACAD No.	Geo GLS B-B'.DWG
Drawn By:	ERP	Sheet	3 Of 3

Geomatrix Systems GST Inspection Port

PN: IPGST15

4” pipe provided by installer


GEOMATRIX GST™ LEACHING SYSTEM
INSPECTION PORT DETAIL
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STREET NAME
ANYWHERE, CT 06XXX
DATE
CUSTOM PLACARD THREADED PLUG
SUPPLIED BY GEOMATRIX SYSTEMS LLC
FEMALE ADAPTER
SUPPLIED BY GEOMATRIX SYSTEMS LLC
4" SDR35 PIPE (LENGTH BASED ON SYSTEM)
SUPPLIED BY INSTALLER
DRAIN GRATE EACH SIDE OF TEE
SUPPLIED BY GEOMATRIX SYSTEMS LLC
4" TEE
SUPPLIED BY GEOMATRIX SYSTEMS LLC
GST LEACHING SYSTEM
Inspection Port Detail
Geomatrix Systems, LLC., Old Saybrook, CT
860-510-0730
SCALE None
REV. A
DATE 6/2/2015
ACAD No. GSTIP.DWG
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SHEET 1 OF 1

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