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LOCATING ON-SITE HOME SEWAGE TREATMENT SYSTEMS

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Living outside areas served by municipal sewer and water calls for careful attention to detail when a sewage treatment system is being planned. Sometimes the prospective lot buyer-home owner overlooks the importance of a site evaluator (the person employed to evaluate the site's potential for construction of a septic tank-waste treatment system and well water service). There needs to be frequent communication between the evaluator and prospective homeowner every step of the way.

Before a lot is purchased as a building site, there should be written into the purchase agreement contract that its validity is contingent on location of suitable soils on the lot for the sewage treatment system. This should be done before signing any final purchase contract. The investment in the site evaluation can save money and hardship later on.

The following recommended procedures for a complete site evaluation are intended as a guide to prospective homeowners and site evaluators. Additional or different information might be required by local units of government and these must be checked out. The recommendations here should be considered the absolute minimum for an adequate site evaluation.

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Establishing Priorities

The three major items to consider in developing a lot are the locations of the house, water supply well, and the sewage treatment system. Usually major concerns to the owner of an undeveloped lot are the location, aspect, view, and type of house proposed. However, additional projected improvements including a driveway, garage, patio, or swimming pool may conflict with the area most suited for on-site sewage treatment. It is important that the site evaluation for the treatment system be discussed at an early stage in the development plans for the lot.

It is a rare instance where each of the desired improvements can be located exactly where the lot purchaser wants. Priorities will have to be established and tradeoffs are inevitable. All of this should be discussed before the physical investigation of the actual site for the sewage treatment system.

After lot boundaries have been established, the process of selecting locations for the various improvements begins. A careful evaluation should be made of topography, land forms, vegetation (including large trees the owner may want to preserve, or cattails which indicate a high watertable), drainageways, recent construction activities which may have disturbed or removed the top soil, and any physical features affecting the site (figure 1). Notice the location of agricultural drain tiles on the lot. These were installed to reduce the level of saturated zones of water in the soils below the rooting depth of plants. This means that under normal conditions the soils have excess water during wet periods which can reduce crop growth and yields. It is important to maintain the drainage provided by this tile to avoid any future wetness problems. For example, if a basement were excavated in one of the tile lines, it could mean a basement full of water in the next hard rain.

Both the owner and site evaluator should have a plan on paper which can be tested against the actual lot. Since it is much easier to remove lines on paper than to physically move structures, water wells, or other improvements, this is the time to determine suitability of the proposed locations (figure 2). Before the site evaluator makes the first boring, all of the preliminary planning mentioned here should be completed.

Figure 1. Topography of lot using 2 foot contours to emphasize significant landscape differences.

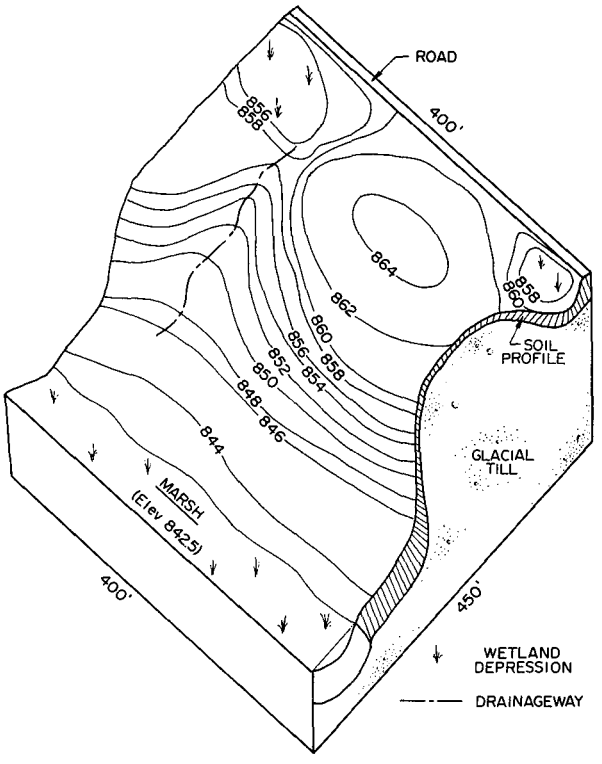
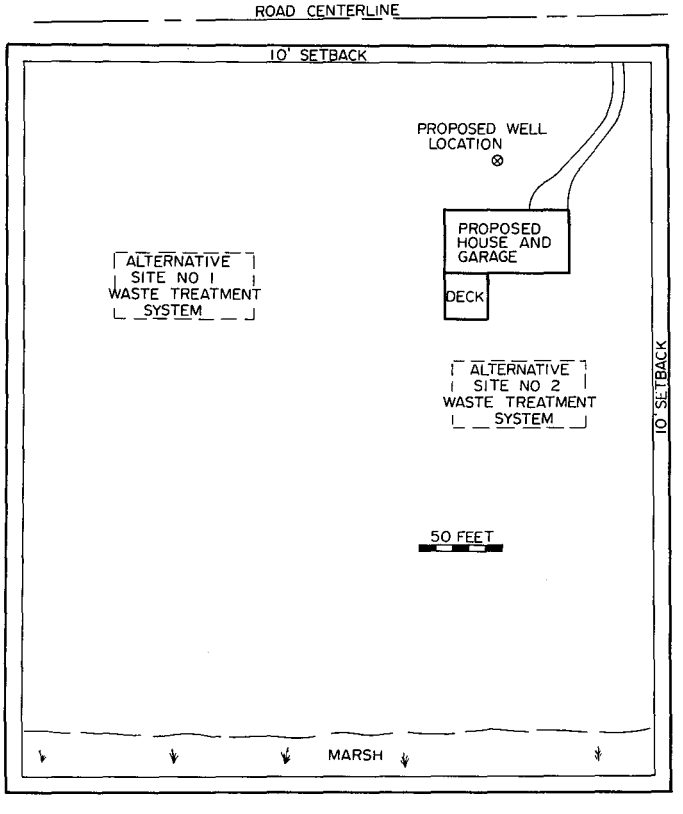


Figure 2. Homeowner's original concept of where the improvements should be located on the lot. Two potential treatment system sites are indicated. (Lot concept plan)



Soils Information

To provide for proper sewage treatment, the soil treatment system must be located in suitable soil.

Presently 31 counties have a detailed soil survey map. An accelerated soil survey program is underway to complete detailed soil surveys for the entire state by 1990. These show the occurrence and distribution of each kind of soil and are a good starting point for the lot owner. The delineated areas on the soils map are called "mapping units" which consist primarily of the soil for which the unit is named and soils with similar characteristics. In addition there are areas within the unit consisting of soils that are different. Soil types occupying an acre or more within the mapping unit are indicated by a series of map symbols. The minimum size of the mapping unit, however, depends on the scale of the printed map. The smallest mapping unit area designated is about 3 acres. This means that the soils map itself cannot be used to determine the suitability of a specific site. Yet, the soil survey information is still useful as background and an indication of potential problems which may be encountered on the lot. The local Soil and Water Conservation District can often provide unpublished soils information if a county lacks a published soil survey.

The crests of knolls and hills as well as slightly sloping portions of hills are likely areas for placement of waste treatment systems. Depressions, drainage swales that collect runoff from the surrounding area, and excessively steep slopes (figure 1) should be avoided.

Future landscaping plans must be considered to provide access to the site not only during the construction phase but afterward so the septic tank can be pumped periodically.

Indicating two or three potential waste treatment sites on the lot provides additional flexibility if the primary site is unsuitable. Some sanitary ordinances require locating two areas suitable for a waste treatment system on a lot.

After this preliminary information has been obtained and evaluated, the site evaluation in the field can begin.

Site Evaluation

To locate the sewage treatment system properly, soil texture, the presence of soil mottling, direct water table measurement, and land slope should be thoroughly evaluated. The first step in conducting the site evaluation is to make a soil boring at least 3 feet deeper than the bottom of the proposed seepage trenches at the approximate center of the proposed system.

The first boring determines the presence of soil mottling or a water table. Soil mottling indicates the presence and depth of seasonally occurring water tables during dry periods. Water tables can be measured directly during wet periods by leaving the boring hole open for at least 24 hours.

Well-drained soil is often brown or red, while poorly drained soil is gray. The color difference is due to the periodic water saturation. Mottled soils consist of spots of gray and brown or gray and red. Where mottled soil occurs, it is assumed the soil is saturated during wet periods (unless the area has been artificially drained).

Depth to soil mottling determines the depth at which soil treatment trenches can be placed, since there needs to be a 3 foot vertical separation between the trench bottom and seasonal water tables (figure 3).

Areas of periodically saturated soils can disrupt operation of the sewage treatment system. When the trenches are installed in a saturated soil zone, effluent entering the system during wet periods cannot move away and will either come to the surface or back up into the house. These saturated zones often are unrelated to the existing regional water tables or surface waters because zones of unsaturated materials generally separate the two.

Land slope should be estimated for the proposed system. Knowledge of the land slope assists in the system's design and in selecting the effluent distribution method. Steeply sloping land areas should be avoided to reduce construction problems. However, some contractors will install trenches along the contour on slopes as great as 30 percent. While such construction is difficult and costly, the sewage treatment system will function properly when correctly installed.

Soil texture can be used to estimate the percolation rate which is then used to estimate the size of the treatment area which will need to be investigated.

Figure 3. Interpretation of soil mottling.

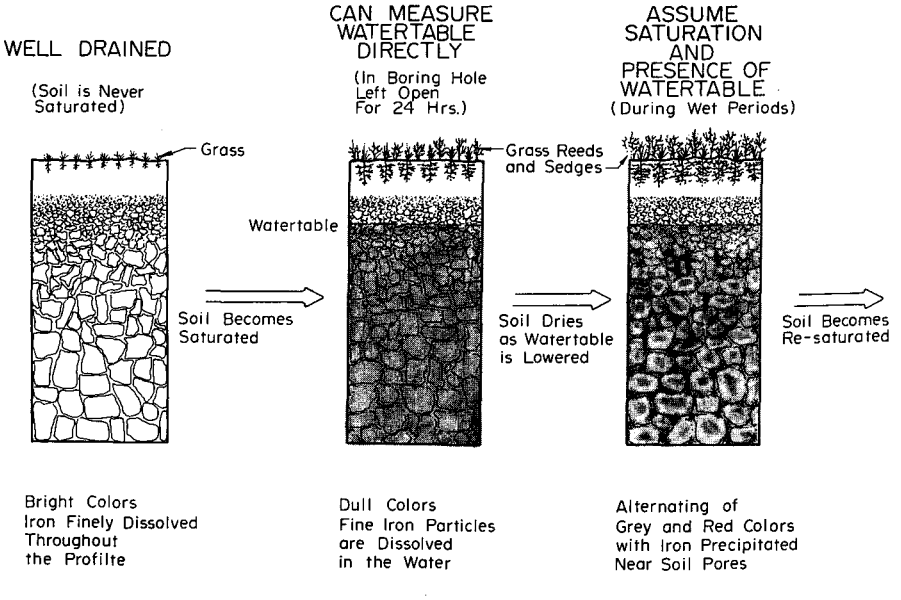


Table 1. Soil characteristics and required areas for sewage treatment

Percolation rate, minutes per inch	Soil texture	Soil treatment area in square feet per gallon of waste per day[a]
Faster than 0.1[b]	Coarse sand	Soil too coarse for sewage treatment[b]
0.1 to 5	Sand	0.83
6 to 15	Sandy loam	1.27
16 to 30	Loam	1.67
31 to 45	Silt loam	2.00
46 to 60	Clay loam	2.20
Slower than 60[b]	Clay	Use sewage treatment mounds or alternative systems

[a] *For trenches only, the bottom areas may be reduced if more than 6 inches of rock is placed below the distribution pipe; for 12 inches of rock below the distribution pipe the bottom areas can be reduced by 20 percent; a 34 percent reduction for 18 inches; and a 40 percent reduction for 24 inches.*

[b] *Soil is unsuitable for standard soil treatment units. Use sewage treatment mounds or alternative systems.*

Table 2. Estimated sewage flows in gallons per day

Number of bedrooms	Type of residence[a] I	II	III	IV
2	300	225	180	60%
3	450	300	218	of
4	600	375	256	values
5	750	450	294	in
6	900	525	332	Type I,
7	1,050	600	370	II, or III
8	1,200	675	408	Columns

[a] Type I: *The total floor area of the residence divided by the number of bedrooms is more than 800 square feet per bedroom; no more than two of the following water-use appliances are installed: automatic washer, dishwasher, water softener, garbage disposal or self-cleaning humidifier in furnace.*
Type II: *More than 500 square feet of total residence floor area per bedroom and no more than two of the water-use appliances.*
Type III: *Less than 500 square feet of total residence floor area per bedroom and no more than two of the water-use appliances.*
Type IV: *Type I, II, or III but with no toilet wastes discharged into the sewage system.*

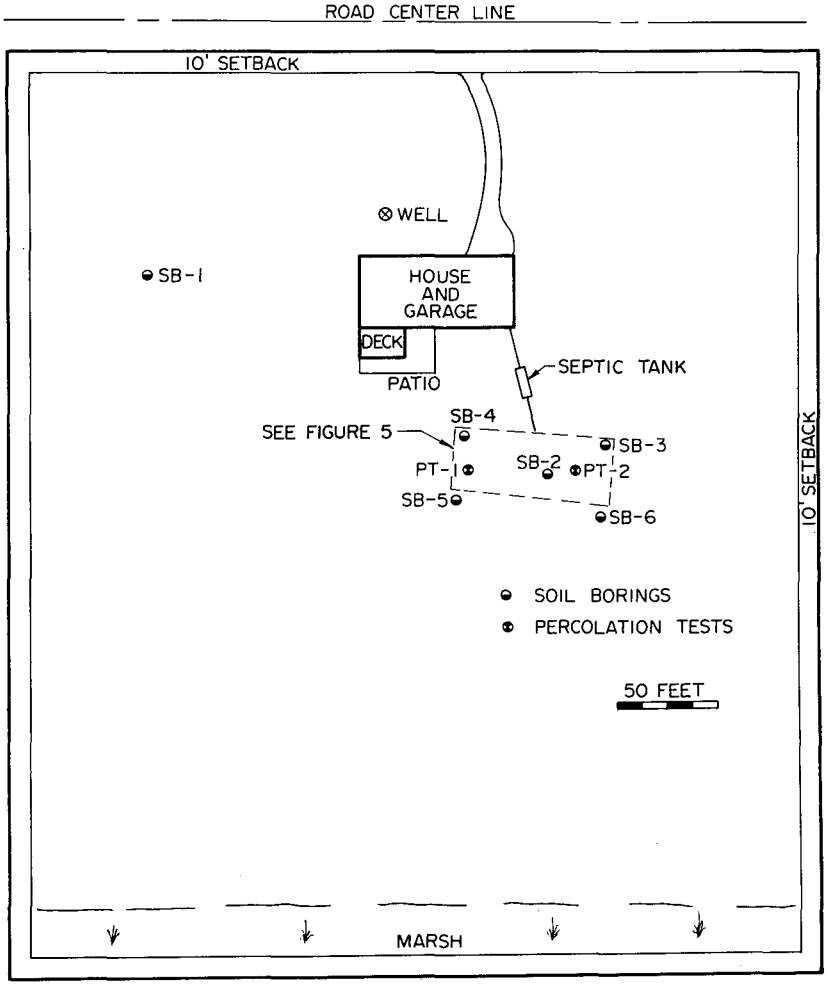
The estimated percolation rate is used to determine the absorption area (table 1) and the estimated sewage flow rate of the residence is determined from table 2. While soil texture is not an absolute indicator of the percolation rate, it can provide helpful preliminary information. The "feel method" is commonly used to evaluate soil texture which should be evaluated every 12 inches on a site or whenever the texture changes noticeably to the touch.

The first soil boring conducted on this lot indicated mottling at a 12 inch depth (figure 4). Alternative waste treatment site 1 was rejected on the basis of a high water table although at the time of the boring there was no water apparent in the hole.

Soil boring 2 was made in the center of alternative waste treatment site 2. There was no indication of soil mottling to a depth of more than 5 feet. Soil texture was estimated using the "feel method." The texture was a loam at the depth of the proposed system. On this basis the percolation rate was estimated at from 16 to 30 minutes per inch (mpi) (table 1).

Using *Town and Country Sewage Treatment,* AG-BU-1360, as a reference, a soil with a percolation rate in the 16 to 30 mpi range would require 1.67 square feet of trench bottom area per gallon of waste per day (table 1). However, if 12 inches of rock are placed under the distribution pipe in the trench, a recommendation where trees are present or likely to be present, the bottom area can be reduced by 20 percent to 1.34 square feet per gallon per day. Since a four bedroom, type I house was being installed on the lot, the estimated sewage flow was 600 gallons per day which required 600 x 1.34 = 800 square feet of trench bottom area (table 2). The trenches were 30 inches wide, so a total of 320 lineal feet was required. This could be accomplished with four 80-foot runs. The trenches were to be spaced approximately 8 feet on centers with total width required of approximately 32 feet.

Figure 4. Final location of improvements after the site has been properly evaluated.



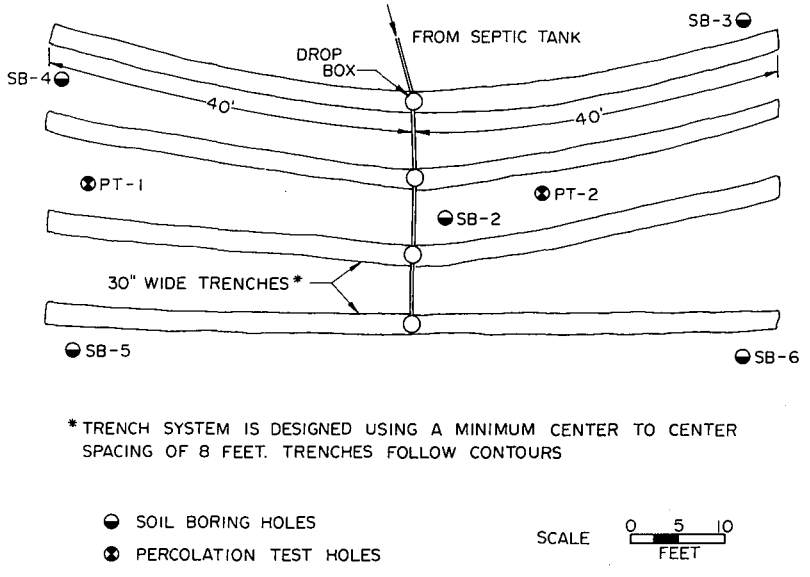
The site evaluator did additional soil borings at the corners of an area approximately 32 x 80 feet. Soil conditions were not significantly different from soil boring 2.

Only after this adequate area of suitable soil was located were percolation tests conducted. Since the soil texture at the depth of the trenches was not different, two percolation tests were conducted in the area of the system (figures 4 and 5). The percolation test procedure used was that given in the Minnesota Pollution Control Agency's adopted standards (WPC-40). The average percolation rate determined by the two tests was 25 mpi. Since this is within the estimated range, the size of the system did not change.

The system was then designed with the 80-foot trenches on the contour so that the length of all trench bottoms were level (figure 5). Drop boxes were indicated to distribute the effluent since this was a sloping site.

After the site has been evaluated, the location of the sewage treatment system, water supply well, the house, and pertinent structures should be conspicuously staked. The area of the proposed sewage treatment system, and the alternate site if required, must be protected from any disturbance during the other construction activities.

Figure 5. Proposed soil treatment system design with soil borings and percolation test hole locations.



Final Report

The prospective homeowner should receive a detailed final report of the site evaluation. It should include results of each of the soil boring test holes including notation of texture, depths to mottling and water tables. Percolation test data, both the field readings and calculated percolation rate, should be included. A sample form which could be used for reporting the results is given in *How to Run a Percolation Test,* AG-FO-0583, which can be requested from county extension offices.

Data should be kept and presented in a neat and professional manner. Each of the boring holes and percolation test holes should be located on a scale sketch map of the lot which should also include the location of the house, driveway, patio, and other improvements. Location of the sewage treatment system and water supply well should be indicated with setback distances specified (figure 4).

This map and data may then be submitted with the application to the local agency which issues permits for on-site sewage treatment systems.

Additional Information

The following additional publications about sewage treatment systems may be requested from county extension offices or the Distribution Center, 3 Coffey Hall, 1420 Eckles Ave., University of Minnesota, St. Paul, MN 55108 The first two listed are particularly useful for site evaluation and design of on-site sewage treatment systems.

- *How to Run a Percolation Test,* AG-FO-0583,
- *Town and Country Sewage Treatment,* AG-BU-1360
- *Get to Know Your Septic Tank,* AG-FO-0639
- *Shoreland Sewage Treatment,* CD-BU-0503

Other Information Sources

- County extension director
- City or county zoning administrator
- Extension agricultural engineers and soil scientists at the University of Minnesota
- Local Soil and Water Conservation District Offices
- Minnesota Pollution Control Agency
- Minnesota Department of Natural Resources
- Minnesota Department of Health
- Minnesota On-Site Sewage Treatment Contractors Association