

1998 ONSITE PEAT SEWAGE TREATMENT SYSTEMS ASSESSMENT
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Background

The State of Maine has regulated onsite sewage disposal since 1929, to varying degrees. Over the years, the Maine State Plumbing Code, Subsurface Wastewater Disposal Rules (Rules) and their antecedents have been updated to reflect changing technology and areas of regulatory emphasis. Relevant to this report was the inclusion of onsite peat sewage treatment systems (peat systems) in the Rules as experimental systems in 1982. This inclusion was at least partly in response to interest from the regulated community, in alternative technology to allow development of properties with limiting features which otherwise would have prohibited development. Inclusion of peat systems in the Rules was based largely upon data gathered during more than a decade of research and development performed by Dr. Joan L. Brooks, Ph.D. at the University of Maine at Orono in the 1970's and 1980's. In October of 1988 peat systems were upgraded from experimental system status to general use status. Appendix C of the Rules provides a fairly technical set of design and installation criteria for peat systems (reference: CMR 241). However, Appendix C also advises in a distinctly non-technical manner, that proper compaction levels can be achieved "... by an adult walking on (the peat) with snowshoes..." to reach a predetermined density specified in Appendix C.

Appendix C to the Rules is attached as Appendix A to this report.

In the summer of 1996, the Department of Human Services, Bureau of Health, Division of Health Engineering (DHE) was made aware of an unusually high number of problematic peat systems in southern Maine. Specifically, peat systems which had malfunctioned prematurely were reported in and around Westbrook. These reported failures occurred generally within five years of commencement of use, some as soon as the first year. In many of these instances, use of peat systems in regulated residential subdivisions was required by the Maine Department of Environmental Protection (MDEP) as a condition of approval, to mitigate potential off site transport of nitrogen compounds (principally nitrate nitrogen) to surface and ground water supplies. Subsequent to some preliminary site inspections, and meetings with concerned homeowners and elected officials, DHE returned peat systems to experimental status¹ in February of 1997, pending the results of an onsite assessment of the problem. Due to a critical staff shortage, this assessment did not begin until March of 1998. No designs were submitted for DHE review subsequent to February of 1997.

¹Among other criteria, all individual experimental system designs must be individually reviewed and approved by DHE prior to installation.

Assessment

The efficacy of peat as a wastewater treatment medium, particularly from the perspective of nutrient and pathogen reduction, has been well documented by many researchers over the past 20-plus years, and was not the focus of this assessment. Rather, the assessment focused on specific installations and the causes of specific malfunctions. Although it was not possible or practical for DHE to inspect each of the reported installations, every effort was made to ensure that a representative number of systems were inspected. All references to totals in this report are based upon the responses DHE received; there may be other systems of which DHE is not aware.

In March of 1998, DHE staff implemented an assessment of peat systems. The first step was to identify the locations and number of peat systems which had been installed. To this end, DHE mailed questionnaires to all appointed Local Plumbing Inspectors (LPI's) in Maine, to licensed Site Evaluators (SE's) via DHE's semi-annual newsletter, and to a list of developer contacts provided by MDEP staff. While the response rate from LPI's and SE's was very good, it was not total. Therefore, a list of sites which were not included in the responses was subsequently provided to DHE by Dr. Brooks. After sorting through the responses and the list, DHE staff developed a list of potential sites for inspection from 156 reported installations. These included sites which had no reported problems, as well as known malfunctions, to form a basis of comparison.

Between May 11, 1998 and August 4, 1998 68 of the 156 reported peat system installations were inspected. These systems served single family dwelling units, with the following exceptions: one two-family apartment unit in Stockton Springs, and a large system serving the Cadillac Mountain Visitor Center at Acadia National Park. The inspections were performed by Linda Robinson, Sanitarian, Jay Hardcastle, State Site Evaluator, and myself, all from the Wastewater and Plumbing Control Program, DHE; David Rocque, Maine State Soil Scientist, Maine Department of Agriculture; and Dr. Joan L. Brooks. Minimally, Mr. Rocque and I were present at each system inspection. The communities in which the inspections were performed were Bar Harbor, Beals, Brunswick, Buxton, Deblois, Eddington, Falmouth, Gorham, Hancock, Hermon, Jonesport, New Gloucester, Steuben, Stockton Springs, Westbrook, and Windham. The ages of the systems ranged from two years to twenty years. When their schedules allowed, the LPI's for the community were present as well. The designers were also contacted if their identities were known to DHE. Of the peat systems inspected, all but seven manufactured module installations in Stockton Springs were built on site.

Inspections

Inspections generally consisted of questioning the homeowners (if present) about their use habits, a visual inspection of the property and siting, and a physical inspection of the actual peat system. The physical inspections consisted of excavating one or more inspection pits in and adjacent to the peat bed, occasionally core or other materials sampling, and examination of the septic tank outlets and/or effluent distribution boxes when possible. If the homeowners were not present, inspections were restricted to visual inspections only, for signs of malfunction, absent consent of the Local Plumbing Inspector. The exception to this practice was in Hermon, since the designer (Dr. Brooks) was in the inspection party and was personally familiar with the homeowners in the subdivision.

As stated, a total of 68 individual peat systems were inspected. Four of those systems were found to be severely malfunctioning, evidenced by surface discharge and/or wastewater backup into the structure served by the system. Seven systems were found to be incipient malfunctions, wherein the disposal beds were either hydraulically saturated, physically unable to accept effluent, and/or discharging effluent directly into the seasonal high groundwater table. Five systems were determined to be stressed, in that while they were functioning, they appeared to be doing so at their upper design limits, with little capacity for additional loading. Therefore, 16 of the 68 systems inspected were technically malfunctioning. The remaining peat systems inspected were in fair to excellent condition, including all six of the seasonal use-only systems inspected.²

Further, 29 of the peat systems inspected were not installed in conformance with the Rules, to varying degrees of severity. These nonconforming installations included, in no particular order: over compaction of the peat media, use of unapproved pipe bedding stone, use of unapproved distribution pipe, use of stone containing excessive fine particles, use of stone exceeding the size criterion of the Rules, alleged use of excessively dry peat during construction, unapproved use of alternating layers of peat media and stone contrary to the Rules, total lack of pipe bedding stone, covering the peat bed with soil or other materials contrary to the Rules, and/or use of garbage grinders ("dispose-alls") contrary to designer recommendations.

Lack of owner maintenance was observed at several sites, evidenced by a proliferation of woody shrubs and small trees in the peat beds, contrary to generally accepted practice for any type of disposal area. An extreme example of this last observation is an eight year old system in Windham that serves seven dwellings (four year round and three seasonal), which continues to function well despite use of only one of its two beds due to an out of level distribution box, and despite the presence of numerous medium sized trees and shrubs in the peat medium. Several homeowners reported that they

²*The module systems in Stockton Springs were rehabilitated by removing, loosening, and replacing the peat approximately one year ago. They were functioning at the time of inspection.*

had never pumped their septic tanks, or had done so only after problems became evident; however, pumping insoluble materials from septic tanks every three to five years is considered routine maintenance for onsite sewage disposal systems.

In the majority of inspected malfunctions where the information was available, it appears that designer oversight of the peat system installations was either on an intermittent "spot check" basis, or upon completion of the installation. In the majority of the observed properly functioning installations where the information was available, it appears that the designer provided oversight of the peat system installations during most of the installation process.

In several communities, the LPI has changed since the time of the installations, so data regarding LPI follow up is inconsistent.

The results of the assessment are attached as Appendix B to this report.

Findings and Conclusions

- The overwhelming majority of site-built malfunctioning peat systems are located in the communities between and including the New Gloucester-Falmouth-Buxton area (reference: Appendix B). It is also in these communities that the largest number of nonconforming installations were reported. This strongly suggests a localized misunderstanding of the design and installation criteria for peat systems on the part of the designer(s) and/or installer(s). Of particular note, those systems which were found to have alternating layers of stone and peat, clearly not in conformance with the specifications in the Rules, were all located in this area.
- The installations which included a high level of designer oversight of the installation process, also are those which were found to be in the best physical and operating condition. In fact, the eight year old system in Windham previously noted received such oversight and it continues to function well, even though it had been neglected in terms of bed maintenance. This trend strongly suggests that designer oversight during installation is beneficial, perhaps necessary.
- DHE erred by failing to include easily understood peat system installation guidelines for installers. Peat systems are a complex proposal, with which most sewage disposal system installers are not familiar. The guidelines therefore should have been easily understood by the average sewage disposal system installer, and separate from the technically oriented design criteria within the Rules. The Rules' colloquial instructions for compacting the peat beds by snowshoeing on them may have been well intentioned, but none the less, this was hardly a scientific or consistently interpreted standard.

- Onsite peat sewage treatment systems can work well, if properly designed, installed, and maintained. DHE is persuaded that the systems inspected included a sufficient number of functioning systems to attest to this. However, the design and installation quality appears to be both critical to the success or failure of an individual system, and much more sensitive to errors than conventional systems.
- Lack of standardized qualifications for onsite sewage disposal system installers generally impedes efforts to assure consistent quality of onsite sewage disposal system installations statewide, but this is much more evident in peat system installations due to the greater sensitivity of these systems to installation error.
- Lack of owner maintenance appears to be a secondary contributory factor to the malfunctions compared to improper installation, in some cases.

Recommendations

1. DHE should reclassify peat systems from experimental systems to engineered systems. The benefits of doing so would include mandatory involvement of a Professional Engineer in designing any engineered system, and mandatory designer oversight of installations as a standard condition of approval. Further, DHE would be able to review all such designs for conformance with the design specifications in the Rules. This would require changes to the Rules. This would have a financial impact upon applicants in the form of increased engineering, review, and permit fees.
2. DHE should create a separate set of installation guidelines for peat systems, separate from the technical design standards. These should be easily understood by all sewage disposal system installers, particularly those without specific engineering or technical backgrounds. This would require changes to the Rules. This would not have a financial impact.
3. DHE should investigate the potential for training sewage disposal system installers in the installation of peat systems. This could be problematic to do onsite, but the potential exists for use of seminars, videotapes, or other mechanisms. Absent a change in the Rules or legislation, this program would have to be voluntary on the part of the installers. Financial impact is unknown, although likely to be minimal.
4. The Maine Legislature may wish to consider creation of some type of program to assist homeowners by funding, in part or whole, repairs to or replacements of the malfunctioning peat systems. This program should exclude systems which were not designed in conformance with the Rules, as these systems arguably did not fail due to shortcomings in the Rules, but rather to errors on the part of the designers. This would likely entail new legislation. Financial impact is unknown, although likely to be significant.

5. The State of Maine should investigate the potential of establishing a demonstration site for innovative and alternative onsite wastewater treatment systems, similar to those of several other states. Such a site could be operated in association with the University of Maine, or a similar institution. This would likely entail new legislation or rules. Financial impact is unknown, although likely to be significant.

Finally, this office would be remiss in failing to acknowledge the assistance provided by Dr. Joan L. Brooks, David Rocque, the Local Plumbing Inspectors, and the Site Evaluators. Most importantly, the Division thanks all the homeowners who kindly allowed us to inspect their peat systems. We are grateful for their cooperation and assistance.

James A. Jacobsen, Manager
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APPENDIX A

CHAPTER 23

PEAT DISPOSAL SYSTEMS

SECTION 2300.0 GENERAL BACKGROUND ON TYPES OF PEAT

2300.1 General: See Appendix K. This Section was moved to Appendix K.

SECTION 2301.0 CONSTRUCTION TECHNIQUES

2301.1 General: See Chapter 12 for general construction techniques.

2301.2 Suitable sites: Suitable sites for installing peat disposal fields are the same as for other types of disposal fields. See Chapters 4, 6, and 7.

2301.3 Site preparation: Site preparation for peat disposal fields shall be the same as it is for any disposal field authorized under this code. See Chapter 12.

SECTION 2302.0 PEAT DISPOSAL FIELD DESIGN AND INSTALLATION

2302.1 Weather: Peat disposal fields shall not be installed when the ground or the peat material is frozen.

2302.2 Low pressure distribution: Low pressure distribution is not allowed in peat disposal fields.

2302.3 Minimum width: The minimum recommended width of a peat disposal field is 5 feet.

2302.4 Maximum width: The maximum recommended width of a peat disposal field is 20 feet.

2302.5 Maximum length: The maximum recommended length of a peat disposal field is 50 feet with end manifold and 100 feet with central manifold.

2302.6 Distribution pipe sizing: Gravity dosed distribution pipes shall consist of 4 inch diameter perforated pipe.

2302.7 Distribution pipe dosing: Dose to a maximum of 1/2 gallon per linear foot of 4 inch diameter pipe.

2302.8 Distribution pipe placement and bedding: The distribution pipes and bedding in peat disposal fields shall meet the following requirements:

2302.8.1 Distance from outer limits: The distribution pipes shall be installed 2.5 feet from the outer limits of the peat disposal field;

2302.8.2 Distances center-to-center: The distribution pipes shall be 2.5 feet on center;

2302.8.3 Connecting the ends of each distribution pipe: The distribution pipes shall be connected at each end with solid piping;

2302.8.4 Distribution box: If a distribution box is used it shall be located outside the limits of the peat and meet the requirements of section 1104.0;

2302.8.5 Stone beneath and on the sides of the distribution piping: The distribution pipes shall be installed over the center line of a 10 inch wide and 4 inch deep layer of 3/8 inch washed crushed rock. Additional 3/8 inch washed stone shall be placed on either side of the pipe to a 3 inch width. All stone shall be washed before its delivery to the site. No stone may be placed above the pipe;

2302.8.6 Stone under the peat: A minimum of 6 inches of 3/8 inch clean crushed rock or clean coarse sand shall be placed at the bottom of the peat disposal field; and

2302.8.7 Depth of peat: There shall be a minimum of 24 inches of peat below the bottom of the distribution lines and a minimum of 8 inches of peat above the top of the distribution lines.

2302.9 Compaction of the peat: The depth of peat layers depends on the moisture content at the time of the installation. At 50% moisture content (on a dry weight basis) install in 8 to 12 inch lifts. At 60% moisture, install in 12 to 16 inch lifts. The peat lifts should be hand raked and compacted by an adult walking on it with snowshoes until an in-place bulk density of 6.2 to 9.4 pounds/cubic foot (on a dry-weight basis) is reached. No construction equipment or lawn rollers may be used to compact the peat.

2302.10 Surface treatment: No fill material may be placed over the top of the peat. Instead, the peat shall extend to the mineral soil surface of the original ground, or the fill on each side, and shall be crowned at a slope of 3%. The surface of the peat may be left bare, seeded with lawn grasses, or planted with shallow rooted vegetation so as to

blend into the natural surroundings. Deep-rooted vegetation shall not be allowed to grow on the surface of a peat disposal field.

2302.11 Vehicular and pedestrian traffic: No portion of any peat disposal field may be located under a paved area, driveway, or roadway.

SECTION 2303.0 PEAT TYPE AND CONDITION

2303.1 Type of peat: Ideally, the peat should be air-dried, milled, unscreened, bulk-loaded Sphagnum peat with a pH of 3.5 to 4.5, a von Post degree of decomposition of H4, a moisture content of 50% to 60%, an organic content of 95% or greater, and an ash content of 5% or less. The peat should not have been dried to less than 40% at any time during production.

SECTION 2304.0 SIZING PEAT DISPOSAL FIELDS

2304.1 Soil profile vs peat disposal field application rates: The required bottom area of peat disposal fields shall be determined using the following:

2304.1.1 Soil profile 6: Soil profile 6 require a peat disposal field application rate of 1 square foot per gallon per day;

2304.1.2 Soil profiles 4 and 5: Soil profiles 4 and 5 require a peat disposal field application rate of 1.25 square feet per gallon per day;

2304.1.3 Soil profiles 2, 3, and 7: Soil profiles 2, 3, and 7 require a peat disposal field application rate of 1.50 square feet per gallon per day;

2304.1.4 Soil profiles 1 and 8: Soil profiles 1 and 8 require a peat disposal field application rate of 1.75 square feet per gallon per day;

2304.1.5 Soil profile 9: Soil profile 9 requires a peat disposal field application rate of 2.0 square feet per gallon per day;

2304.1.6 Soil profile 11: Soil profile 11 is for alluvial soils that vary in texture. For design purposes, use the peat disposal field application rate from a soil profile listed above which best describes the texture encountered; and

2304.1.7 Site suitability: Site suitability for peat disposal fields is as prescribed in Chapter 7.

2304.2 All other aspects: In all other aspects, construction of a peat disposal field shall comply with Chapter 7, unless otherwise specified.

SECTION 2305.0 UNDER-DRAINED PEAT FILTERS

2305.1 Scope: Under-drained peat filters are designed to pre- treat septic tank effluent prior to its ultimate disposal in any disposal field authorized under this code. See Chapter 1.

2305.2 Polyethylene liner: The under-drained peat filter is placed in an excavation or fill material that is lined with an 18 mil polyethylene sheeting or equivalent.

2305.3 Final disposal in a disposal field: The effluent from the peat filter is conveyed to a separate disposal field for final disposal.

2305.4 Sizing the disposal field: The disposal field used for final disposal is sized according to Chapter 9 and sized at 90% of the minimum hydraulic loading rate required in Table 700.1. Field size may be further reduced based on Subsection 702.6.

SECTION 2306.0 OPERATION AND MAINTENANCE

2306.1 Garbage disposal: Garbage disposals should not be used with peat disposal fields. However, if such units are to be used, additional septic tank capacity (such as a second septic tank installed in series, or filters) shall be included in the system design to prevent suspended solids from entering the peat disposal field.

2306.2 Chemicals: Chemicals, other than normal household cleaners, shall not be disposed of in the disposal peat field. Examples of prohibited chemicals include paint, paint thinner, commercial grease and oil, darkroom chemicals, etc.

2306.3 Non-biodegradable materials: Non-biodegradable materials, such as diapers, sanitary napkins, etc., shall not be disposed of in a peat disposal system.

2306.4 Fencing: Fencing is required in heavy foot traffic areas such as school playgrounds, commercial establishments, or vehicular-traffic travel areas.

2306.5 Mowing: If a peat disposal field is planted with lawn grasses it should be mowed on a regular basis during the growing season with a walk-behind power or manual mower.

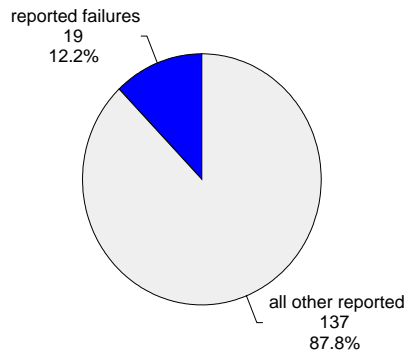
2306.6 Traffic: In addition to the above, peat disposal fields should be protected from the type of heavy foot traffic found on a school yard, playground, or ball court. Riding mowers, ATV's, snowmobiles, and other vehicles should not be allowed on peat disposal fields.

2306.7 Maintenance instructions: System owners shall be provided with a copy of the operation & maintenance requirements by the site evaluator.

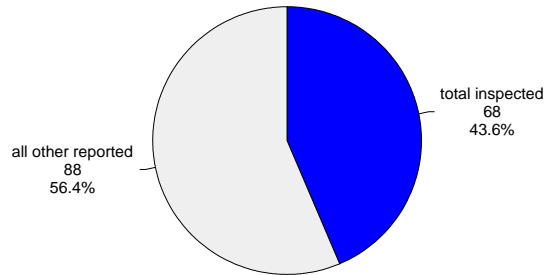
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APPENDIX B

1998 Peat Assessment Reported Installations



1998 Peat Assessment Reported Installations



1998 Peat Assessment Inspection Results

