



GUIDELINE 7 – LAND TREATMENT OF PETROLEUM CONTAMINATED SOIL: SINGLE APPLICATION SITES

North Dakota Department of Environmental Quality - Division of Waste Management
4201 Normandy St., Bismarck, ND 58503-1324

Telephone: 701-328-5166 ● Fax: 701-328-5200 ● Email: solidwaste@nd.gov

Website: <https://deq.nd.gov/wm>

Updated 9-2023

I. Introduction

The North Dakota Department of Environmental Quality (Department) encourages land treatment of petroleum contaminated soil as an alternative to landfill disposal. Land treatment preserves soil resources and saves limited landfill capacity. If the soil cannot be land treated it must be disposed properly at facilities permitted or approved by the Department. A list of permitted treatment and disposal facilities is on the Department's website (see Links at the end of this document).

Residual amounts of petroleum hydrocarbons may be broken down by aerobic bacteria common to good surface soils (and compost operations). Land treatment of wastes can be effective when approached scientifically, using naturally occurring soil microorganisms to biodegrade petroleum. Some volatilization of petroleum hydrocarbons will also occur during the process.

This document provides information on suitable site and soil characteristics, land application procedures, soil sampling procedures, and the Department's approval requirements for applicants proposing a single-use site for land treatment of petroleum contaminated soil.

General Permit Number GP-LT0000 has been issued by the Department for single-use land treatment sites for petroleum contaminated soil. All applicants must submit the Department form titled "Land Treatment Site Application," which must be approved by the Department before any contaminated soil is delivered to the site. All land treatment activities must follow the conditions of the General Permit. If an applicant desires any variances to the General Permit, such as non-listed types of petroleum contaminants or multiple uses of the treatment site, the applicant must apply for an individual solid waste management permit for a land treatment facility following the procedures in North Dakota Administrative Code (NDAC) Section 33.1-20-02.1-03. Variances will not be approved for oil-based drilling cuttings or other wastes that do not readily break down due to the presence of longer-chain hydrocarbon molecules (asphaltenes, paraffins, etc.) and/or waste containing salt, metals, or other contaminants. Applicants must also follow all local zoning requirements.

II. Background Information

The minimum information which should be provided to the Department with the application includes:

- A. Name, address, telephone, and email of the operator (Permittee).
- B. Name, address, telephone number, and approval of the landowner.

- C. Land treatment site location description (township, range, section, and quarter section).
- D. Topographic and soil survey maps with the proposed land treatment site outlined and a map scale presented.
- E. A schematic diagram of the land treatment site, including water control structures.
- F. Estimated volume of soil to be land treated.
- G. Projected date of soil application.
- H. Site and soil characteristics (see below).
- I. Proposed land application procedures (see below).
- J. Proposed sampling, tillage, and reporting schedule (see below).
- K. Any previous history of waste disposal activities at the proposed site.

III. Site and Soil Characteristics

Published soil survey information (available through local Natural Resources Conservation Service offices or online) provides an excellent reference for site slope, depth to ground water, and soil type for most locations in North Dakota. If specific soil information is not available or if more detailed soil information is required, a Professional Soil Classifier can be utilized to determine site-specific soil conditions. Soil borings or trenching, and/or a hydrogeologic evaluation, may be required to evaluate the proposed land application site. The recommended site and soil characteristics for a land treatment site are as follows:

- A. Relatively level site slope: 6 percent maximum.
- B. Minimum depth of three feet to seasonal high-water table for most soils.
- C. Soil characteristics:
 - 1. Permeability: slow to moderate, less than two inches per hour. Areas underlain by highly permeable (sandy) soils, very slowly permeable soils, or sodium affected soils must be avoided.
 - 2. pH: minimum pH of 6.5, neutral or slightly alkaline preferred.
 - 3. Nutrients: soils with moderate to high levels of fertility and organic matter are preferred.

Generally, cropland areas are preferred for land treatment. The Department may make exceptions to the recommended criteria on a site-specific basis.

Adequate soil nitrogen and phosphorus levels are critical for bacterial growth and effective land treatment of contaminated soil. Soil nitrogen and phosphorus tests are

recommended to determine if minimum fertility levels exist at the land treatment site, and if fertilizer application is necessary. See Section VI.C for details on soil fertility sampling and testing. The amount of soil nitrogen necessary for effective land treatment is based on a ratio of parts per million (ppm) total petroleum hydrocarbons (TPH) to ppm nitrogen (N). The Department considers a TPH:N ratio of 100:2 acceptable. Adequate extractable soil phosphorus levels are also required for effective land treatment.

Recommended land treatment site fertility levels are listed in the following table. The table illustrates what fertility levels are required to maintain a TPH:N ratio of 100:2 at specific total hydrocarbon concentrations. Using results from soil fertility testing, one can determine if fertilizer should be added to the treatment site. For example, assume soil contaminated with 2000 ppm total hydrocarbons is land treated. If soil fertility tests indicate the six-inch surface layer contains 40 pounds per acre nitrogen, an additional 40 pounds per acre nitrogen should be added to the treatment site. Extractable soil phosphorus levels should be maintained in the 20 to 30-pound per acre range.

Soil Contaminant Concentration	Fertility Requirements (Pounds Per Acre)	
	Nitrate-Nitrogen	Extractable Phosphorus
1000 ppm TPH	40	20-30
1500 ppm TPH	60	20-30
2000 ppm TPH	80	20-30
2500 ppm TPH	100	20-30
3000 ppm TPH (or greater)	120	20-30

NOTE: Fertility levels assume four-inch soil application thickness. Maintain proportionally lower fertility levels for thinner soil application. Fertility levels should not exceed 120 pounds per acre nitrate-nitrogen or 30 pounds per acre extractable phosphorus. One part per million equals approximately two pounds per acre (1 ppm = 2 lbs./ac.).

IV. Excluded Areas

As stated in General Permit Number GP-LT0000, a petroleum-contaminated soil land treatment site shall not be located in any of the following areas:

- A. Within 200 feet of any surface water body;
- B. Within 200 feet of any stream that appears as a broken or solid blue line (or a purple line) on a USGS topographic map;
- C. Within 500 feet of an occupied dwelling unless the owner(s) provides written permission. (Occupied dwelling exception: Any occupied dwelling constructed less than 500 feet from a petroleum-contaminated soil land treatment site after an initial general permit authorization has been granted will not be grounds to prevent future authorization renewals under this general permit);
- D. Within 100 feet of a property boundary, unless the adjacent property owner(s) provides written permission;

- E. Within a delineated wellhead protection area;
- F. Within 250 feet of any private well or 1,000 feet of any public well which supplies drinking water for human consumption;
- G. Within the incorporated limits of any municipality;
- H. Within 50 feet of a 100-year floodplain;
- I. Where the depth to an aquifer is less than 20 feet;
- J. Where the primary subsurface material is sand or gravel (as determined by the Unified Soil Classification System) within 20 feet of the ground surface;
- K. On land that has an average slope greater than six percent; or
- L. In an area that adversely affects wildlife, recreation, aesthetic value of an area, or any threatened or endangered species.

V. Land Application Procedures

Recommended procedures for land application are described below. The Department will consider exceptions on a site-specific basis.

- A. Contaminated soil should be applied only when the land is tillable, but no earlier than April 1 and no later than November 1. If contaminated soil is to be stockpiled, it should be in an area where surface water run-on and runoff are controlled.
- B. Surface water run-on and runoff should be diverted or contained around storage and treatment areas. Ditches and berms up slope of the site should divert surface water run-on around and away from the treatment area. Surface water runoff must not cause degradation of any streams, rivers, wetlands, lakes, etc. Berms, ditches, or impoundments down slope of the site may be needed to contain and store any contaminated runoff during precipitation events.
- C. Generally, contaminated soil should not be applied more than four inches thick. Thinner applications may be required on a site-specific basis. If sufficient land area is not available to spread the soil at a depth of four inches, the Permittee may request approval from the Department to spread at a maximum depth of six inches. A six-inch application may not be appropriate for heavier petroleum products or for heavily contaminated soil due to the longer time frame that will be needed to complete the treatment. Soil application rates for specific application thicknesses are as follows:
 - 1. 535 cubic yards/acre at 4-inch spreading thickness
 - 2. 400 cubic yards/acre at 3-inch spreading thickness
 - 3. 270 cubic yards/acre at 2-inch spreading thickness
 - 4. 135 cubic yards/acre at 1-inch spreading thickness

(1 cubic yard = 27 cubic feet, 1 acre = 43,560 sq. ft.)

The petroleum loading rate should not exceed 2 percent or 20,000 parts per million (ppm) TPH as diesel, fuel oil or gasoline in the soil to be land applied. This corresponds to approximately 67 barrels (2800 gallons) per acre for soil applied four inches thick and contaminated with petroleum.

- D. Contaminated soil application method (spreader, dozer, grader, etc.) should be specified.
- E. Land applied soil should be incorporated (mixed) with the upper four to six inches of native soil within 48 hours after application. Fertilizers should be broadcast either just before or just after contaminated soil application, but prior to contaminated soil incorporation. Fertilizer should be added as necessary to maintain an optimum TPH:N ratio of 100:2 and extractable phosphorus levels of 20-30 pounds per acre. Addition of compost, manure, straw etc. is helpful.
- F. To enhance hydrocarbon breakdown, the soil should be tilled at least four times during the land application season. Less frequent tillage may not provide adequate aeration and mixing and, therefore, may slow hydrocarbon breakdown. More frequent tillage could be done if soil moisture is adequate, soil compaction is not a problem, and wind erosion can be controlled.

For fields where petroleum contaminated soil is land applied prior to July 1, tillage may not be needed in subsequent years. However, soil monitoring should continue until contamination is below levels, as outlined in Section VI.D. For land applications after July 1, a minimum of four tillage operations are probably necessary (excluding the period from November 1 to April 1), unless soil monitoring results are below the post-treatment standards.

Active land treatment must continue until all soil at the treatment site meets a post-treatment standard of 10 parts per million (ppm) or less Gasoline Range Organics (GRO) and 100 ppm or less Diesel Range Organics (DRO).

- G. Depending on site conditions, climatic conditions, and other factors, measures to control soil moisture and wind erosion and to improve the soil bacterial culture may be necessary. If the soils are excessively dry, addition of moisture to the site may be necessary (ponded surface runoff water could be used). Optimum soil moisture content is 50-70 percent of the soil water holding capacity. More frequent tillage or site drainage may be necessary if the site is wet. The incorporation of grass or legume hay is advised to help control wind erosion and improve soil aeration. If the soil is deficient in organic matter and/or oil-degrading soil bacteria, the addition of inoculants, rotted manure, mature compost, or topsoil is advised.

VI. Soil Sampling Requirements

- A. Contaminated stockpiled soil: Soil samples are necessary to evaluate and document contamination levels in the soil to be treated. Obtain a composite soil sample by digging a minimum of one foot into the pile at least three places within the pile before collecting subsamples. To avoid cross-contamination, subsamples should be taken using clean disposable gloves (and other clean sampling utensils) at each sample location (refer to NDDEQ "Procedures for the Collection of Soil Samples at Underground Storage Tank (UST) Sites"). Mix

equal portions of each subsample to obtain a composite sample. Completely fill each sample vial so that no headspace exists, wipe soil from the vial threads, and seal the vial using a cap with a Teflon septum. Label the vial, wrap it in aluminum foil, and place in a covered cooler with ice for transport to a laboratory for analysis.

- B. The number of soil samples should be based on the following table:

Volume of Soil (cubic yards)	Number of Samples
<10	0
10-50	1
50-500	2
500-1000	3
1000-2000	4
2000-4000	5
Each additional 2000	One additional sample

Analyses must be performed by a Department-certified laboratory. Packaging, storage, preservation, and shipping of soil samples shall be conducted according to directions provided by the laboratory. Laboratory soil analysis must be conducted for TPH as both Gasoline Range Organics (GRO) and Diesel Range Organics (DRO) by EPA method SW-846 8015 or other comparable method. If heavy oil is suspected then TPH as Oil Range Organics (ORO) should also be performed. Other analysis such as lead, benzene, ethylbenzene, toluene, xylenes, and/or toxicity characteristic leaching procedure (TCLP) may be necessary depending on the product involved or site conditions.

- C. Land application site soil fertility level determination: A composite of several representative soil samples from the top six inches of native soil should be collected to evaluate fertility status of the proposed land application site. The composite sample should be handled and prepared for analysis in accordance with the procedures recommended by the soil testing laboratory to be used.

Soil fertility samples should be analyzed for nitrate-nitrogen, extractable phosphorus, and pH according to methods accepted by the North Dakota State University Soil Testing Laboratory (https://www.ndsu.edu/snrs/services/soil_testing_lab/). Nitrate-nitrogen levels are generally reported in pounds per acre, whereas extractable phosphorus levels are generally reported in ppm. To convert pounds per acre to ppm, divide by two. Conversely, to convert ppm to pounds per acre, multiply by two. For example, 80 pounds per acre nitrate-nitrogen equals 40 ppm, and 10 ppm extractable phosphorus equals 20 pounds per acre.

- D. Follow-up monitoring: Follow-up monitoring is required to assess and document hydrocarbon treatment progress. At a minimum, the Permittee shall collect one composite sample per acre in the Fall of each year, though more frequent monitoring may be beneficial (see table below). For post-treatment final closure testing, the Permittee shall collect a minimum of one composite sample per acre. Each composite sample must consist of a minimum of four representative samples taken from a depth of four inches. Samples need only be analyzed for

TPH as GRO and GRO; however, the Department may require sampling for additional constituents under some circumstances.

During the year of land application, samples should be taken at the times specified below until soil analytical results indicate that post-closure standards have been reached for all areas of the land treatment site.

<u>Land Application Date</u>	<u>Soil Sampling in First Year</u>
Before July 1	Once in August & once in October
July 1 to September 15	Once in October
After September 15	None

Sampling in subsequent treatment years should include three samples taken approximately in June, August, and October, unless results indicate that post-closure standards have been reached for all areas of the land treatment site.

Refer to Department form titled "Soil Monitoring Results for Land Treated Petroleum Contaminated Soil" for reporting results.

VII. Land Use and Zoning

The General Permit site application form requires information from the landowner and local officials. Careful planning and compliance with state rules helps to assure local authorities and citizens that the waste will be properly managed. Coordination with local emergency managers, county agents, and/or local health districts may suffice for local zoning approval under emergency conditions, contingent upon concurrence by local (county) planning personnel. It is the responsibility of the Permit Applicant to be in compliance with all local land use and zoning requirements.

VIII. Submittal and Approval Process

Applications for coverage under General Permit Number GP-LT0000 must be initiated and completed by the waste generator or their legal designee. The form titled "Land Treatment Site Application," should be completed and submitted with the maps and information to the Department. Arrangements should be made with the Department for a site inspection. The site inspection will be done by either Department staff, by an individual authorized by the Department (e.g., local government officials), or by a qualified environmental professional whose evaluation is subject to Department review and approval. If approved, the inspector will sign and date the application form. On a site-specific basis, a site inspection may not be required.

Following these procedures does not guarantee approval of a site for coverage under the General Permit. The Department reserves the right to make any modifications or require remedial measures in the event of issues that are not protective of human health or the environment. Approval of coverage under the General Permit does not convey property rights of any sort or any exclusive privilege, nor does it authorize any injury to persons or property, any invasion of other private rights, or any infringement of state or local law or regulations. An approval does not supersede local zoning authority or any other requirements of any political subdivision of the state.

Compliance with terms of General Permit GP-LT0000 or approval does not constitute a defense to any order issued or any action brought under NDCC 23.1-08, NDAC 33.1-20, NDCC 23.1-04, NDAC 33.1-24, Sections 3013, 7003, or 3008(a) of RCRA, Sections 106(a), 104 or 107 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (42 U.S.C. et. seq.) or any other law providing for protection of public health or the environment.

IX. Annual Reporting

The Permittee shall submit an annual report to the Department, by March 1st of each year, for the previous year's petroleum-contaminated soil land treatment site activities. The report shall be submitted on the form provided by the Department and shall include the following information for the prior year:

1. The origin of soil received at the site;
2. The type of petroleum contamination in the soil;
3. The date soil was received;
4. The quantity of soil;
5. The date soil was spread;
6. The dates soil was treated (disked or aerated);
7. Documentation of any amendments to the soil;
7. Results of periodic and annual soil analysis monitoring;
8. A diagram showing where soil samples were collected;
9. A summary of any complaints or emergency events and the response by the Permittee.

X. Closure, Closure Report, and Closure Certification

When the Permittee has conducted soil analyses to verify that all soil at the site meets the post-treatment standards the Permittee may submit a Request for Closure to the Department. The request must include the same information as the Annual Report. Closure activities may not begin until the Request for Closure has been approved by the Department.

The final closure activities for the petroleum-contaminated soil land treatment site shall include:

1. Removal of any berms and water control structures and incorporating contours of the land treatment area(s) into the contours of the surrounding area;
2. Grading to prevent ponding of water;

3. Seeding and revegetating the entire closed site back to original vegetation conditions unless the site will be planted with a crop for harvest; and
4. The only food chain crop that may be produced on the closed land treatment area for two years following final closure is animal feed.

The Permittee shall complete all closure activities for the entire petroleum-contaminated soil land treatment site within 180 days of documenting that all soil meets the post-treatment standards and receiving closure approval from the Department. The Department may inspect the final closure and require additional closure work if closure has not been satisfactorily performed.

Upon completion of closure of the petroleum-contaminated soil land treatment site, the Permittee must provide the Department with a certification confirming that the site has been closed in accordance with the General Permit. The certification must be signed by the Permittee and by the landowner. Closure is not final until written approval is received from the Department.

XI. Financial Assurance

The Department will not typically require financial assurance for a site authorized under General Permit Number GP-LT0000 as long as the Permittee complies with the environmental laws and rules of the state and the conditions of this general permit. However, the Department reserves the right to require financial assurance if violations occur at the site or at any petroleum-contaminated soil land treatment site previously operated by the Permittee, or if unique circumstances dictate the need for financial assurance. If required, financial assurance shall comply with NDAC Chapter 33.1-20-14 and shall include funds sufficient to remove all waste from the site, transport and dispose of the waste at a permitted solid waste disposal facility, and complete closure in compliance with the conditions of the permit.

XII. Links

NDDEQ Division of Waste Management publications:
(scroll to "Land Treatment-Petroleum" under "Solid Waste Program")
<https://deq.nd.gov/WM/Publications.aspx>

Solid Waste Facilities for Treatment/Disposal Of Petroleum Contaminated Soils;
Land Treatment Variance Application;
Land Treatment Annual Report;
Soil Monitoring Results For Land Treated Petroleum Contaminated Soil.

Natural Resources Conservation Service – Web Soil Survey Maps
<https://websoilsurvey.sc.egov.usda.gov>

North Dakota Department of Water Resources – Online Aquifer Maps
<https://mapservice.dwr.nd.gov>