NEZ PERCE TRIBE SOIL LANDFARMING GUIDANCE

Section 1 – Soil Landfarming Guidance

This Guidance is developed pursuant to the direction found in the Section 6-10 of the Nez Perce Tribe Contaminated Site Cleanup Guidance.

The Nez Perce Tribe supports and encourages the controlled use of landfarming to assist in the remediation of site contamination within the Nez Perce Reservation. Landfarming, when properly managed, is an environmentally sound and cost-effective method of treating soils containing organic chemicals. The process operates very much like a crop farm, except that the "crop" is composed of microorganisms which are usually capable of using hydrocarbons as a food source. Landfarming may eventually enable appropriate reuse of the treated soil and minimize disposal of waste soil to landfill, while providing for adequate protection of human health and the environment.

The objective of landfarming is to reduce or eliminate organic compounds from a soil matrix, using microbes to either transform the compounds into compounds of less environmental concern, or to mineralize those compounds to simple compounds (such as carbon dioxide, methane, and water). The process is almost always aerobic, meaning that oxygen is the primary electron acceptor in the microbial degradation process, but almost certainly has an unavoidable anaerobic component due to the nature of the soil.

This guidance does not provide direction on the methods of landfarming, rather it outlines appropriate management measures that can minimize environmental impacts arising from the process.

Section 2 – Soil Landfarming Guidance – Suitability for Landfarming. Landfarming is not a new concept and is being increasingly used as a relatively economical environmental remediation technology. For the purpose of this guidance, landfarming is defined as an accelerated process using microorganisms (indigenous or introduced) and other manipulations to degrade and detoxify organic substances to less toxic or potentially harmless compounds, such as carbon dioxide and water, in a confined and controlled environment.

A clear distinction must be made between (1) a process which incorporates fuel products or sludges into soil to affect their treatment (i.e., "making clean soil dirty"), and (2) using the process to treat soils which have been affected by fuel or other hydrocarbon spills ("making dirty soil clean"). WRD only approves the use of landfarming where the process is used to treat already contaminated (dirty) soil.

(a) Chemicals Generally Suitable for Landfarming.

(1) In General. Landfarming is suitable for the treatment of a variety of organic chemicals, including:

(i) Volatile organic compounds,

(ii) Benzene, toluene, ethyl benzene, xylene (BTEX) compounds,
(iii) Phenolic compounds,
(iv) Polycyclic aromatic hydrocarbons (PAHs) (particularly the simpler aromatic compounds),
(v) Petroleum hydrocarbons, or
(vi) Nitroaromatic compounds.

(2) Treatability Ranges.

Waste Type	Typical Treatable Ranges (mg/Kg)	Potential % Degradable Ranges	Associated Issues
Petroleum/ Hydrocarbon Oil and Grease	<100 – 80,000 (dependent on composition)	>99 – <50 (dependent on composition)	Generic designation for a mixture of petroleum and/or other hydrocarbon oils and greases as measured by various analytical procedures. Fractions(s) of hydrocarbons actually present and/or detected may vary greatly depending on the extraction and analytical methods. Can be interferences for PO&G from non-petroleum hydrocarbons (natural plant and animal oils and greases) even with pre-treatment of laboratory samples.
Total Petroleum Hydrocarbons (TPH)	<100 – 80,000 (dependent on composition)	>50 – <99 (dependent on composition)	Generic designation for a mixture of petroleum hydrocarbons as measured by various analytical procedures. Fraction(s) of hydrocarbons actually present and/or detected may vary greatly depending on the extraction and analytical methods. Can be interferences from non-petroleum hydrocarbons (natural plant and animal oils and greases) even with pre-treatment of laboratory samples.
Crude Oil	<100 – 80,000	50 – 80 (dependent on composition)	Variable % degradation dependent on crude oil type, analytical method, and extent of heavy ends.
Condendates	<100 – 10,000	90 – >99 (dependent on composition)	Variable but light composition. Volatilization may be significant for lighter fractions.
Gasoline	<100 – 10,000	90 – >99 (dependent on composition)	Variable but light composition. Volatilization may be significant unless weathered.
Diesel Fuel	<100 – 50,000	95 – >99 (dependent on composition	Some odor and volatiles issues. Repeated applications and weathered fuels may result in more concentrated heavy ends.
Fuel Oil #2	<100 – 80,000	>90	Some odor and volatiles issues. Repeated applications and weathered fuels may result in more concentrated heavy ends. The degree of timely remediation is dependent on the original concentration in soils.
Fuel Oil #4	<100 – 80,000	50 – 80	Little odor and volatiles issues. Repeated applications and weathered fuels may result in more concentrated heavy ends. The degree of timely remediation is dependent on the original concentration in soils.

Fuel Oil #6 (Bunker "C")	<100 – 80,000	40 – 60	Little odor and volatiles issues. Repeated applications and weathered fuels may result in more concentrated heavy ends. The degree of timely remediation is dependent on the original concentration in soils.
Kerosene	<100 – 50,000	90 – >95	Some volatilization, smaller aromatics can be major constituents, but good biodegradability.
Lubricants	<100 – 80,000	50 – >80 (dependent on composition)	Composition dependent. Care should be taken that metal and other additives are not inhibitory or resistant to degradation.
Hydraulic Oils	<100 – 80,000	50 – >80 (dependent on composition)	Synthetics and additives may reduce the biotreatability of these wastes but the true hydrocarbons content is typically biotreatable.
Motor Oils	<100 – 80,000	80 – >95 (dependent on composition, additives and use)	Synthetics and additives may reduce the biotreatability of these wastes but the hydrocarbon content is typically biotreatable. Used motor oils are typically more difficult to degrade due to composition changes, metals, etc.
Simple Polycyclic Aromatic Hydrocarbons (PAH)	<10 – 10,000	25 – >95 (dependent on composition and concentrations of various PAHs)	Some volatilization with members of the naphthalene compounds. Progressively longer half-lives as the number of aromatic rings and molecular weight increases.
The above table assumes unweathered hydrocarbons. Weathered hydrocarbons are harder to degrade because the residuals are typically the larger and/or more complex constituents, which are more resistant to biodegradation. Similarly, hydrocarbons accumulated from numerous spills, releases, or applications in the same area will be proportionally higher in these same difficult to degrade constituents.			

*Table taken from the U.S. Army Corps of Engineers, *Bioremediation Using Landfarming Systems,* ETL 1110-1-176, 28 June 1996.

(b) Chemicals Generally Not Suitable for Landfarming. Landfarming is generally ***not*** a suitable treatment option for soils containing:

(1) Heavy metals (e.g. arsenic, cadmium, chromium, copper, lead, mercury, selenium, silver, etc…),
(2) Complex (high molecular weight) PAHs,
(3) Chlorinated hydrocarbons,
(4) Chlorinated dioxins,
(5) Salts, or
(6) Land disposal restricted wastes.

Section 3 – Soil Landfarming Guidance – Stages of Landfarming Projects. There are generally three stages to a soil landfarming project. The first two stages may not be necessary for some small-scale landfarming processes. However, for large-scale projects, the completion of stages one and two may result in considerable cost and time savings. When considering landfarming, the use of suitable on-site structures (such as sheds) should be examined. These structures may assist in mitigating environmental problems that may be associated with landfarming. The stages of landfarming projects are:

(a) Lab-Based Study. A laboratory-based study to determine the biodegradability of chemical substances and the ability of the indigenous or introduced micro-organisms to degrade them; generally performed off site.

(b) Pilot Trial. A pilot trial, either on site or in the laboratory or a combination of both, to provide further data necessary for the design of the full-scale treatment.

(c) Landfarm Installed. Full-scale landfarming, conducted on site or at an approved location/facility.

Section 4 – Soil Landfarming Guidance – Use of Landfarming. WRD endorses the use of controlled landfarming, particularly when the treated soil is suitable for reuse (e.g. on-site backfill), thereby reducing disposal of waste soil to landfill.

(a) Cleanup Hierarchy. The following is a hierarchy for site cleanup or management, outlined below from the most preferred (1) to the least preferred (4):

(1) On-site treatment of the chemical substances to reduce risk to an acceptable level,

(2) Off-site treatment of excavated soil to reduce risk to an acceptable level, after which the treated soil is returned to the site,

(3) Disposal of affected soil to an approved landfill,

(4) Containment of soil on site with a properly designed barrier, and appropriate institutional controls (for more information on use of institutional controls, see Nez Perce Tribal Code § 14-3-7). This cleanup method is only available for contaminants with a low risk of off-site migration.

(b) Site Assessment. Before starting a landfarming project, the nature and extent of the chemical substances in the soil should be assessed; then the need for remediation can be considered along with the treatment options available. An appropriate landfarming strategy can then be developed and implemented.

It is important to recognize that chemical-affected soils may contain substances that are not suitable for landfarming. This should be considered when determining the feasibility of landfarming, the need for alternative remediation treatments, and the reuse or disposal of treated soil. See 14-7-2(a)(2) for more information on substances treatable by landfarming.

The management of landfarming will depend on the nature and concentration of chemical substances, as well as the proximity of the landfarming process to sensitive environments and human activities. WRD considers that any proposal for landfarming should demonstrate adequate safeguards for the protection of human health and the environment. Considerations include the control, minimization and monitoring of emissions or discharges from the landfarming process.

Section 5 – Soil Landfarming Guidance – Landfarming Requirements.

(a) Introduction. Landfarming is an aboveground process that involves placing affected soil on a prepared surface and aerating it by regular turning. Soil amendments (for example, fertilizers) are sometimes added. The movement of oxygen through the soil pile promotes aerobic degradation of organic chemicals. Landfarming is a passive form of remediation and generally requires an extended timeframe.

The operator should provide WRD with information detailing the origin, quantity and nature of waste material and the proposed method of landfarming. Operators of ongoing facilities should provide to WRD an annual summary of information relating to all waste materials received and subjected to landfarming during the preceding twelve months. Alternatively, for short-term projects, the summary should be provided within two months after completion.

(b) Site Approvals. Prior to planning, the owner or operator should contact WRD for site approval. WRD will only disapprove a landfarming site if the conditions are not condusive to landfarming and/or the use of the site for landfarming activities poses a potential threat to the environment and natural resources of the Nez Perce Tribe.

(c) Planning. WRD will determine the need for the following plans on a case-by-case basis based on the complexity of the site, volume of soil to be processed, and types and amounts of hydrocarbons to be treated.

(1) Treatability Study. Treatability studies are done to determine the suitability of one or more technologies for the remediation or treatment of a waste. The suitability of landfarming, as determined by biotreatability studies which can involve chemical, physical, and biological studies, all focus on determining the biological treatability of a waste. Biotreatability studies simply involve monitoring the disappearance of a waste's constituents of concern over time due to microbial activity from indigenous or exogenous (added) microorganisms. To prove that treatment is primarily biological, an accounting (mass balance) estimation of all the various mechanisms of removal is made (volatilization, leaching, chemical destruction, etc.). When done correctly, treatability studies will not only demonstrate the efficacy of the technology but provide information/data for the design of the full-scale process.

For the study data to be of use, each phase must have controls. These controls include the standard QA/QC type of processes for sampling, analysis, and data evaluation, but also experimental controls, variations of the basic test protocol. These variations provide a means of testing the hypothesis that biological processes and environmental variables or amendments can result in the removal or disappearance of the wastes. Typical experimental controls include abiotic (killed or inhibited microbes) tests, unamended tests (no nutrients, etc.), and perhaps microbial augmentation tests. Treatability studies are usually performed in increasingly complex phases, with each phase providing information to design the next phase. This allows cessation of the effort if an earlier phase indicates that the approach is unsuitable.

Treatability studies are made to determine:

(i) Biodegradability of key chemical(s),
(ii) Biological activity indicated by the rate of oxygen consumption or carbon dioxide generation,
(iii) Degradation rates of chemical substance(s),
(iv) The need for microbial degrading species and their effects on degradation rates.

(2) Landfarm Management Plan. Two management plans should be prepared for landfarming processes—a Landfarm Management Plan, which outlines the management and control of the landfarming process itself; and an Environmental Management Plan, discussed in subsection (3) below. They can be prepared separately or together as a remediation management plan. If prepared as a single document, the same level of detail is required, but this may reduce duplication.

A Landfarming Management Plan should be prepared for all landfarming activities. At a minimum, the Landfarming Management Plan should include the following information:

(i) Volume of soil to be treated and the concentrations of all relevant chemical substances, as well as their source and characteristics,
(ii) Remediation target concentrations and predicted time for achieving these targets,
(iii) The planned uses or destination of treated material, and options for material not successfully treated and/or containing other chemical substances,
(iv) Suitability of site for the landfarming program,
(v) Proposed construction of facility,
(vi) Proposed management details—including reporting and corrective action,
(vii) Details of treatment process, e.g. mixing, stockpiling area, bulking agents or other additives—sources, nature and mixing processes
(viii) Details of stormwater collection and leachate treatment systems,
(ix) Details of water and nutrient recycling to maintain soil moisture (as far as practicable) or, if not recycled, the details of treatment and disposal,
(x) Details of main water connections to ensure the protection of the water supply, using reduced pressure zone (RPZ) valves or similar,
(xi) Methods of extraction and treatment of volatile compounds before release to the atmosphere,
(xii) Details of proposed soil sampling program and analytical procedures—sample numbers, parameters, frequency, and
(xiii) Details of the landfarm performance monitoring program.

(3) Environmental Management Plan. An Environmental Management Plan should be prepared for all landfarming processes. Specific Environmental Management Plan items to be considered for the effective management of environmental issues associated with landfarming include:

(i) Environmental monitoring of the landfarming process—e.g. air quality monitoring within the site and at site boundaries—to ensure no on- or off-site adverse impacts, including proposed methods for recording, assessing and dealing with problems and complaints,
(ii) Information on subsurface soil conditions, in particular permeability and the potential to retard chemical substances resulting from site activities,
(iii) Information on the suitability of materials to be used to construct the low permeability liner for the base and stormwater ponds, if applicable (see Appendix),
(iv) Details of stockpile management—including planned containment, management and monitoring measures to prevent migration of odor, vapor, dust and leachate from the stockpiled soils to underlying soil and groundwater,
(v) Hydrogeological information, including depth to groundwater, water quality, flow direction, existing groundwater users (including locations relative to site) and consideration of the need for a groundwater monitoring program,
(vi) Details of how volatile gases will be processed, including modeling if necessary to address volatile organic vapors in the soil and dust generated during mixing, transfer and loading, to ensure compliance with EPA policies and guidelines,
(vii) Measures taken to prevent or limit emissions of dust and odor during the delivery of waste material for landfarming, and during stockpile movement and management, and
(viii) Detailed site plans showing location of infrastructure, separation distances, adjacent land uses, sensitive receptors, human receptors, and locations of surface water bodies.

(d) Best Management Practices.

(1) Location of Landfarms. As landfarming will probably release emissions directly to the atmosphere, it should not be used where it may have an adverse effect on sensitive receptors, and particularly in built-up or residential areas. As a remediation option, landfarming is ineffective in treating substances such as metals and complex PAHs, but may be useful for some volatile organic chemicals. WRD considers that landfarming may be an acceptable form of remediation only:

(i) On large isolated sites that are remote from potentially susceptible receptors, or
(ii) Within approved WRD-licensed facilities where conditions are included in the WRD authorization.

(2) Construction of Landfarms. The following BMPs may apply to the construction of landfarms for the remediation of contaminated soil. Areas that are to be used for the landfarming of waste may be required to contain the following controls for construction of landfarms on less than favorable conditions or impervious surfaces:

(i) Be surrounded by a berm constructed to ensure containment of stormwater and leachate and prevent infiltration of external stormwater,

(ii) Be constructed using approved materials so that all leachate is either confined to the lined area or directed to a leachate evaporation/storage basin,
(iii) Be constructed with a minimum gradient of 2% so that the final floor level has a gradient sufficient to enable surface water and leachate to drain to suitably lined sumps,
(iv) Contain lined sump(s) which collect the leachate from the pad surface
(v) Be constructed with drainage facilities from the sump to an external leachate evaporation/storage basin.

(3) Landfarming Process. Landfarming processes should be undertaken in accordance with the following requirements:

(i) All waste subjected to landfarming processes should be covered to prevent or limit emissions of vapors or particle matter, and to prevent the escape of leachate or other substances during periods of high precipitation.
(ii) Measures should be taken to prevent or limit emissions of dust and odor during the delivery of waste material for landfarming and during any rotation or movement of stockpiles.
(iii) Waste materials for landfarming are not to be combined with other waste or mixed with virgin materials or any other waste, unless:

(A) The source of waste display the same type of contamination, or
(B) Scientific principles justify that mixing of wastes will favorably enhance the landfarming process and not cause or promote unfavorable interactions between chemical substances, or cause new chemical substances to be introduced to the waste.

(iv) Care should be taken to ensure that additional pollutants are not introduced during the landfarming process.

(4) Process-Oriented Considerations. Landfarms should be constructed and operated with the following considerations in mind:

(i) Temperature. Microbial metabolism is temperature-dependent. Conventional wisdom holds that the effective, practical biodegradation process essentially stops at or below 50° F; acceptable degradation rates occur above 70° F, and the temperature range of 90°-100° F is considered optimal. However, microorganisms may perform degradation at lower temperatures if they are acclimated. Higher operating temperatures are encountered in composting processes.
(ii) Initial Application. Upon initial application, the soil should be spread out evenly on the site. The soil should be tilled, using deep rakes or rippers, to create as much surface area soil exposure as possible. The soil should appear light and fluffy. Additionally, a layer of organic material can be supplemented into the soil to prevent rain crusts.

(iii) Nutrient Balance. The "crop" being grown in landfarming is microbes. The appropriate nutrient balance for their good growth can be approximated from the microbes' composition. However, just as microbial growth is not instantaneous, the requirement for specific nutrients is not instantaneous. These nutrients can be continuously applied at levels matching the microbial growth rate, or to match the microbes organic carbon consumption rate. WRD encourages frequent nutrient sampling, and the appropriate additional of nutrients when necessary on an agrinomic basis. However, over-application of nutrients may contribute to water quality violations. Agricultural or garden fertilizers are effective sources for nutrients in landfarming.
(iv) pH Concerns. Aerobic degradation processes usually produce carbon dioxide as a principal product, and acidic organic intermediates or end products. This can render soil pore water acidic if complex buffering counter ions are not present. Monitoring and control of pH is necessary so the soil does not become so acidic that the microbes become inactive or die. Hydrated lime ($Ca(OH)_2$) is the usual agent used to control the pH in the landfarm.
(v) Tillage. Tilling (cultivation) of the landfarm is generally disfavored after the original application. Tilling should only be used sparingly, where oxygen depletion is shown to be occurring. If the soil tilth is destroyed, the soil will need to be amended with manure or straw to improve the soil properties.
(vi) Moisture. Microbes cannot usually access waste constituents, nutrients or oxygen if those materials are not dissolved in water. The cells must also maintain water within the cell or the concentrations of internal salts, organics and other dissolved species will increase to the point of precipitation and damage to the cell metabolic systems. Many of the enzymes responsible for transporting nutrients and waste constituents into the cells are physically stable only when hydrated (surrounded by water). The optimal water balance of the landfarming system is actually variable, depending on the soil's affinity for water. If the microbes cannot retain water and lose it to the soil particles, the degradation process will slow or stop. Excess water can fill the soil pore spaces and prevent air entrainment and infiltration. Excess water can also leach out many of the nutrients and carry them vertically below the cultivation zone. Site moisture content should be assessed to determine the optimal target moisture content. Water is typically added to the treatment cell using a pump from a collection sump or tank, and hoses with sprinklers to disperse the water across the cell. In some designs, nutrients may be added to the water in the collection tank prior to sprinkling to assure complete dispersal of the nutrients. Field water measurements utilize a variety of tensiometers or moisture meters, which measure soil water content on several bases, such as soil suction, resistivity or conductivity.
(vii) Use of Cover Crops. After the first year, cover crops may be planted as a way to introduce additional oxygen into the soil remediation process, and to increase biological activity within the soil matrix.
(viii) Other Process Oriented Considerations.

(A) Potential Physical Constraints. Anecdotal evidence suggests high concentrations of oil and grease, tar, viscous residuals, etc. can physically block the pore spaces of the soils limiting mass transfer of nutrients, water, and oxygen into the soils and "smothering" the landfarm process. A general rule-of-thumb in the environmental remediation industry is to avoid oil and grease greater than 8-10% (80-100,000 mg/Kg) without a successful biotreatability study.

(B) Additional Process Oriented Guidance. For more information, operators can refer to the Army Corps of Engineers Guidance: *Design Considerations for Landfarms*. ETL 1110-1-176, APPENDIX A (June 1996).

(5) Monitoring Practices. An important part of the landfarming process is the monitoring of the progress of treatment and the system's response to changes in the controlling parameters. Therefore, several measurements should be taken during landfarming to indicate directly or indirectly how successfully the microbes are transforming or mineralizing the waste. These consist of:

(i) Collective Hydrocarbon Content. Collective hydrocarbon parameters include Total Petroleum Hydrocarbons (TPH or TPHC), Hydrocarbon Oil and Grease (HO&G), Total Organic Carbon (TOC), and Purgeable Organic Carbon (POC). These methods (other than TOC) are based on extracting the hydrocarbon materials into a solvent and measuring the hydrocarbon content of the solvent mixture through a detector system (usually IR or GC). The methods differ in the detection method and choice of solvents. TOC is measured by oxidizing the sample and measuring the carbon dioxide produced in the oxidation. The measurement of collective hydrocarbons is particularly useful when dealing with fuel spills or sludges, where the mixture may contain hundreds or thousands of specific hydrocarbon compounds. As the treatment progresses, the hydrocarbon content should be reduced as progress toward mineralization occurs. It is not generally practical to track the degradation of fuel products by chemical constituent, but a collective parameter allows the progress to be measured in a general way.

(ii) Air Emissions. Landfarming sites should be chosen to avoid air quality concerns. Sites located near sensitive populations (e.g. residential dwellings etc…) or with soil conditions that pose potential air quality concern should be avoided. As a result, air quality monitoring should be unnecessary. However, air quality sampling may be required on a site-specific basis at the determination of WRD or other Tribal division. Air samples serve three purposes in landfarming: to verify compliance with any site air monitoring plan; to measure hydrocarbon emissions for material balance calculations; and to measure the carbon dioxide concentration in or above the treatment cell which can be used as an index of microbial respiration. Air monitoring plan and emissions requirements are determined on a site-specific basis and should be verified prior to developing or implementing the monitoring plan. These tests may be performed using field instruments and meters, or by collecting air samples for laboratory analysis. Air monitoring requirements should be determined during the design phase so that appropriate air monitoring specifications can be written. The air monitoring plan will be developed from the designer's air monitoring specification.

(d) Reporting Requirements. WRD recommends that, on completion of the landfarming program, a report be issued which documents all of the activities undertaken, particularly:

(1) The final concentrations of chemical substances in the soil following landfarming,

(2) The fate of the treated soil and the details of how it was, or is to be, managed to ensure the adequate protection of human health and the environment,

(3) If material was disposed off site, the classification of the materials for disposal and evidence of appropriate disposal, including evidence of disposal at a RCRA, Subtitle D permitted facility, if necessary.

(e) Validation (Post-remediation). The time frame for landfarming is often case-specific. Treatment is complete only when targets have been achieved, or it can be demonstrated that the chemicals of concern do not pose a risk to human health or the environment. In determining the end-use suitability of soil, WRD recommends that:

(1) Landfarmed soils are sampled and tested to determine their suitability for reuse or landfill;

(2) If the treated materials are only suitable for disposal to landfill, the classification of the materials for disposal is to be made by an environmental professional;

(3) The suitability of landfarmed soils for use as a resource is assessed and the results are compared with suitable criteria;

(4) The concentrations of chemical substance should be less than, or equal to, the target criteria. Criteria should demonstrate that the residual concentration of a chemical substance will not pose a risk to human health and/or the environment, including leaching to groundwater;

(5) The number of samples collected and analyzed for the validation of landfarmed and stockpiled soil should be adequate to provide a statistically reliable result, taking into account the intended use of the soil;

Section 6 – Soil Landfarming Guidance – Post-Closure Care Requirements. The purpose of post-closure care is to finalize waste treatment of the remaining soil while monitoring for any unforeseen long-term changes in the system. Generally, sites should be chosen so that no ongoing maintenance should be required. Sites will not be considered closed until no additional maintenance is required.

However, the following actions may be required on a case-by-case basis in order to reach final closure:

(1) Maintain vegetative cover;

(2) Continue run-on control system;

(3) Control wind dispersal of hazardous constituents;

(4) Continue air monitoring on the site at its perimeter; and

Section 7 – Soil Landfarming Guidance –Commercial Landfarming Facilities. Design and construction should be based on site-specific factors, taking into account the nature of the chemical substances and the site conditions (e.g. soil and hydrogeology). WRD will provide its assessment of facilities on a case-by-case basis based on site-specific factors and overall need in the community, including consideration of factors necessary to protect human health and welfare and the environment.