Guidance for Cover Systems as Soil Performance Standard Remedies

PUB-RR-709

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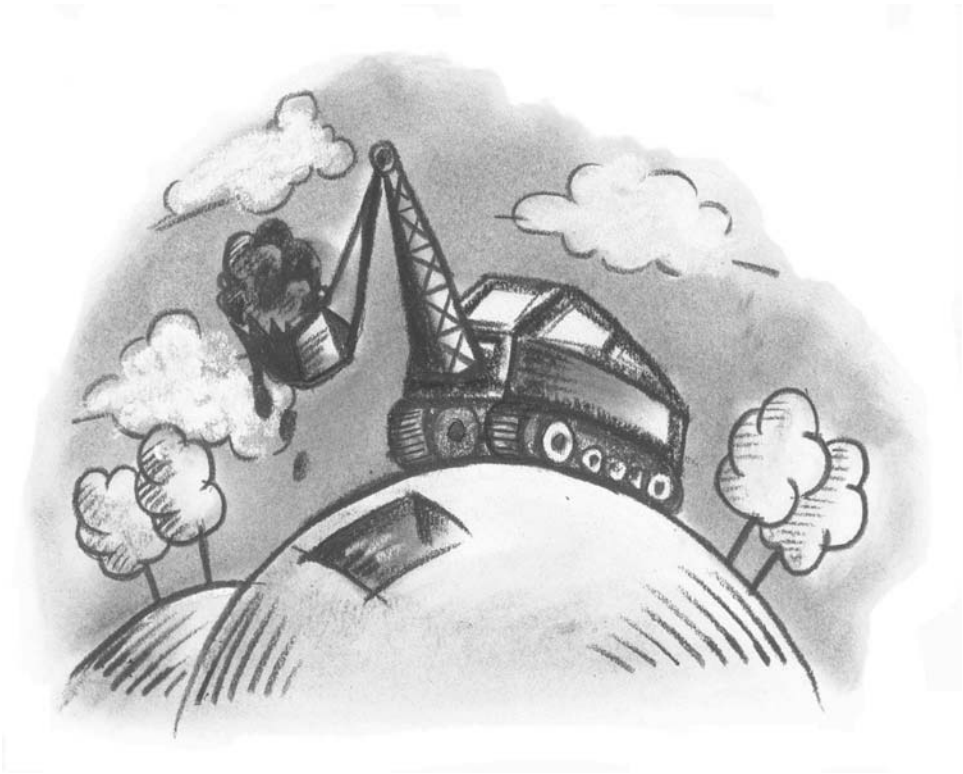

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1) Purpose, Disclaimer and Revisions

a) This guidance is intended to provide remedy selection, design, construction and operation and maintenance (O&M) concepts, including specific examples, for cover systems for soil performance standard remedies. It is written for responsible persons who are conducting remedial actions and Remediation and Redevelopment (RR) Program staff who are reviewing submittals prepared by responsible persons. The guidance provides implementation and review procedures for RR staff.

Note: This document is not a detailed engineering design manual. Persons who design and construct cover systems should already have an understanding of detailed design and construction standards and acceptable engineering practice.

Note: This document was revised in October, 2006 to account for statutory changes that gave the Department the authority to require and enforce land use limitations or conditions in closure letters. Those limitations or conditions are intended to replace the requirements previously included in deed restrictions.

b) Disclaimer. This document is intended solely as guidance, and does not contain any mandatory requirements except where requirements found in statute or administrative rule are referenced. This guidance does not establish or affect legal rights or obligation, and is not finally determinative of any of the issues addressed. This guidance does not create any rights enforceable by any party in litigation with the State of Wisconsin or the Department of Natural Resources. Any regulatory decisions made by the Department of Natural Resources in any matter addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.

This guidance is based on requirements found in chs. NR 140, NR 720, 722, 724, 726, 746 and 750, Wis. Adm. Code; the Hazardous Substance Spill Law, s. 292.11, Wis. Stats., the Environmental Repair Statute, s. 292.31, Wis. Stats., and the Groundwater Law, s. 160.23 and 160.25, Wis. Stats.

c) Contact and revisions. This guidance will be updated as needed. Questions, comments and concerns may be sent to Gary Edelstein, P.E. - RR/5, WDNR, P.O. Box 7921, Madison, WI 53707, phone number 608-267-7563, email: gary.edelstein@wisconsin.gov.

2) General Discussion and Related Guidance

a) General. A general description of soil performance standard remedies is provided in the guidance document Guidance on Soil Performance Standards, RR-528, which has been revised to account for this guidance and recent rule changes relating to public participation.

b) Cover systems. One kind of performance standard soil remedy is a cover system. Covers can be used to address the direct contact and migration to groundwater pathways. They may also be used to address the migration to surface water, wetlands and endangered habitats pathway.

c) Related guidance. When using this guidance, the following documents may be helpful. Using these documents is encouraged where appropriate.

i) Guidance on Soil Performance Standards, RR-528
http://dnr.wi.gov/org/aw/rr/archives/pubs/RR528.pdf

Note: The document Guidance on Soil Performance Standards contains introductory information and definitions, including a clarifying definition of the term “soil performance standard”.

ii) Guidance on Case Close Out and the Requirements for Institutional Controls and VPLE Environmental Insurance, RR-606 http://dnr.wi.gov/org/aw/rr/archives/pubs/RR606.pdf

iii) Application of Soil Performance Standards Guidance, RR-676 http://dnr.wi.gov/org/aw/rr/archives/pubs/RR676.pdf

3) Rule Requirements and Use of this Guidance

a) General. The general rule requirement for soil performance standard remedies is outlined in NR 720.19(2): "PERFORMANCE STANDARD. If selected, a performance standard shall be established for a remedial action so that the remedial action is operated and maintained, in compliance with chs. NR 722 and 724 when those chapters are applicable to the site or facility, until the lowest concentration that is practicable is achieved or a permanent engineering control is maintained, or both, so that the residual contaminants left in the soil do not pose a threat to public health, safety and welfare or the environment.

> Note: Examples of performance standards include the allowable rate of infiltration by soil contaminants into the groundwater after a membrane liner has been installed, or the rate or percentage of removal efficiency offered by an in-situ treatment system at a specific site or facility. At a site or facility where an engineering control is being considered for selection, in accordance with the requirements of ch. NR 722, an engineering control may be selected even though the soil contaminants exceed a residual contaminant level."

b) Engineering control. A cover system is an engineering control, as defined in NR 700.03(17): " "Engineering control" means an action designed and implemented to contain contamination and minimize the spread of contamination within a media or to another media. Engineering controls include, but are not limited to: the installation of a cover with low permeability; groundwater extraction and treatment; slurry walls; solidification; and stabilization."

c) Alternatives analysis. Under NR 722.07, appropriate remedial action alternatives must be evaluated to address contaminated soil. At some sites where soil contamination extends over a large area or where contaminant levels are high, a soil performance standard cover remedy may not be appropriate. Soil removal and treatment or disposal or consolidation of soil may be more appropriate at those types of sites.

d) Closure requirements. In accordance with the requirements of Wisconsin Act 418, which became effective on June 3, 2006, land use limitations and maintenance requirements can be imposed at a site or facility where a performance standard cover is used for a soil remedy through enforceable conditions in closure letters.

e) Design and implementation under the rules. Under these rules, a cover system must be designed and implemented to contain and minimize the spread of contamination within the media already contaminated or to other media. Cover systems may be selected as a remedial action to address contaminated soils in accordance with the identification, evaluation and remedy selection requirements in NR 722. Selected remedies, including cover systems, must be protective for as long as the soils exceed residual contaminant levels (RCLs), as required by NR 720.19(2), 722.09(2) and (3). A cover system may be an appropriate remedy, provided that the design, construction and O&M is adequate to contain and minimize the spread of contamination for as long as the soils exceed RCLs. Following the guidelines in this document can help assure adequacy and protectiveness.

> Note: This guidance doesn't apply to the 4-foot separation distance risk screening criteria created by rule in NR 746.06(2)(c). It shouldn't be assumed that the promulgation of the 4 foot distance in that rule means that 4 feet of soil must always be used for a performance standard cover; as noted below, the design criteria are determined on a site by site basis.

f) Lack of promulgated specific design criteria and use of this guidance. The NR 700 rule series contains no specific engineering design standards or criteria for soil performance standard cover systems. Therefore, determinations of what engineering design to use for a soil performance standard remedy is a site by site decision. Responsible persons who are conducting remedial actions and RR staff who are reviewing submittals prepared by responsible persons should use this guidance to make these site by site decisions. This guidance outlines the overall general design goals for cover systems and recommends certain specific design standards, which are based on best engineering practice under the general design goals. Finally, this guidance outlines specific examples of acceptable designs.

g) Only applicable to soil. A soil performance standard under NR 720.19(2) may only be used as a remedy to address contaminated soil as defined in NR 700.03(58): "Soil" means unsaturated organic material, derived from vegetation and unsaturated, loose, incoherent rock material, of any origin, that rests on bedrock other than foundry sand, debris and any industrial waste.

> Note: The Department interprets the definition of soil to include the smear zone, which is the area where free product occurred in the soil and was then smeared across the soil when the water table fluctuated between historic high and low water table elevations. This is outlined in the guidance factsheet "Smear Zone Contamination", PUB-RR-712, available at: http://dnr.wi.gov/org/aw/rr/archives/pubs/RR712.pdf

Areas of widespread imported natural soil fill fall under the definition of "soil" in NR 700.03(58). Areas of waste fill, including areas filled with foundry sand, industrial waste, ash and demolition debris are considered to be landfills, not soil fill. For cleanup purposes, areas of waste fill should be managed as landfills. Regional Project Managers can use case by case judgment when considering areas of fill that are mixtures of soil and some waste. Regional Project Managers may determine that areas that are mostly soil with an extremely small percentage of relatively inert waste may be considered soil fills under this guidance. The burden is on the persons responsible for addressing the site to show Regional Project Managers that the area of fill meets the characteristics of soil fill.

> Note: Some of the design and implementation concepts for newly constructed and engineered cover systems discussed in this guidance may be appropriate for application to landfill remedial actions, but they would not be soil performance standard remedies. Landfill cover systems might be designed to achieve different remedial goals than soil performance standard covers.

4) General Goals for all Covers.

The design, construction and maintenance of a cover system should be implemented to address the following concerns, where appropriate:

a) Erosion from precipitation, surface water flows or wind

b) Cracking and deterioration from natural forces, including water saturation and freeze/thaw cycles and expected human activities/use on the cover

c) Incompatible human activities such as digging, gardening and construction

d) Settlement and shifting

e) Damage from migration of groundwater into the cover

f) Contaminant migration, including migration to the surface of the cover and vapor migration

5) General Design Concepts – Direct Contact Cover System

a) Multiple pathways. This section only discusses cover designs addressing the direct contact exposure pathway; however, a cover can be designed to address more than one pathway. Multiple pathway cover systems are discussed in the subsequent sections.

b) Design goal. In addition to the general design goals in Section 4, the design must prevent direct contact exposure to contaminated soil by humans for as long as the soil remains contaminated above direct contact RCLs. Cover system designs should take into account site specific factors, including, but not limited to:

i) Effectiveness in meeting the general design goals in Section 4;

ii) Current and known planned land use;

Note: Potential future activities that could result in creating an exposure pathway to the soil should be accounted for through the use of land use limitations or conditions in closure letters.

iii) Surrounding land use (for example, sites in or near residential areas may need a more protective cover);

iv) The nature of the contaminants (concentrations, mobility and toxicity, etc.);

v) How long contaminant concentrations will remain above RCLs;

vi) Other measures to be used to prevent access (such as a fence and guards);

vii) The quality of the cover system construction and the O&M and inspection program for the site (Note: O&M is discussed in a subsequent section); and

viii) The reliability of the assurances that access restrictions, O&M and inspections will be accomplished for as long as the soil contaminant concentrations remain above RCLs.

c) Soil covers. Soil covers may be used to prevent direct contact exposure to contaminated soils. Generally, a 2-foot thickness of clean soil should be placed over the contaminated soil. Soil covers should be vegetated to prevent erosion and deterioration. Therefore, at least 6 inches of topsoil, with appropriate seeding or sod, to establish a good growth of grass should be placed on top of the clean soil. If topsoil is used, then consideration can be given to reducing the minimum thickness of the clean soil layer by the same amount as the topsoil layer thickness. Other materials, such as gravel or bark, may substitute for vegetated topsoil, as discussed below. The slope for clean soil with vegetated topsoil direct contact cover should normally not be steeper than 3:1 (H:V), but preferably no steeper than 4:1 or, better, 5:1. Steeper slopes may be considered on a case by case basis if it can be shown that erosion will be adequately controlled through additional design features and/or O&M. Steeper slopes will generally call for an evaluation of the need for slope reinforcement to provide long-term stability.

d) Pavement covers. Pavement systems may be used to prevent direct contact exposure to contaminated soils. Contaminated soil particles can work their way to pavement surfaces where pavement settlement, cracking, freeze/thaw cycles, weathering and deterioration are not adequately addressed in the design, construction and maintenance of the cover. Settlement and shifting can greatly increase the chances of this occurring as well. Therefore, sites where settlement and shifting are a potential problem may not be candidates for

pavement direct contact covers. Pavement material should have appropriate bottom base soil preparation (grading, recompaction, dewatering, etc., as appropriate), sufficient base course to minimize freeze/thaw problems, settling and shifting which can cause the development of cracks. Designs that minimize long-term maintenance needs should be evaluated. There should be an appropriate layer of base material placed over the contaminated soil before the pavement material is placed. Concrete pavement may be more resistant to the problems described in this paragraph than asphalt, depending on the design.

> Note: An existing pavement cover may not have been designed and constructed to meet all the design concepts above. However, an existing pavement cover can be an acceptable direct contact remedy at many sites, such as smaller petroleum contamination sites. Appendix 2 includes examples of this sort of remedy.

Gravel layers should be protected with a geotextile if they are in contact with contaminated soil, in order to prevent the migration of contaminated soil into the gravel. The geotextile should be designed to maintain its effectiveness for as long as the soil remains contaminated above RCLs. Consideration should be given in the design for gravel acting as a preferential flow path for upstream or upgradient infiltrating surface water or groundwater, where the water could discharge at a lower point that is paved. Slopes should not be so steep as to allow for shifting, slumping or cracking. The intended use of the area to be covered by pavement should be accounted for in the design. Areas with high traffic loads will need to meet minimum requirements for well-traveled roads. Area with lower traffic loads, such as storage areas and parking lots should meet low to medium volume design requirements. Examples of how to perform a low to medium volume design for asphalt and concrete using normal industry standards is provided in Appendix 1. Generally, WI DOT pavement design procedures and specifications should be followed. WI DOT specifications are available at their Extranet site (free registration required): https://trust.dot.state.wi.us/extntgtwy/dtidcons/constnds/cmm/cmm.htm

> Note: Chapter NR 216 requires that parking lot projects that disturb greater than 5 acres obtain a stormwater construction permit. That rule is being revised to change the requirement to apply to projects that disturb greater than 1 acre, to be consistent with federal requirements. More information on the Department's stormwater management program is available at their web site: http://dnr.wi.gov/org/water/wm/nps/stormwater.htm

e) Buildings or structures. An existing or new building or structure may be used to prevent direct contact exposure to contaminated soils, provided the building slab (bottom of a building without a basement) or basement meets the general design goal in Section 4. Buildings with badly cracked slabs or basement floors or walls in contact with contaminated soil should have the cracks repaired. Dirt floors in buildings should be treated like any other portion of the site with bare soils. Buildings located on soils that are subject to shifting and settlement that can cause significant future cracking in slab, floors or walls may also be unacceptable. If vapor migration is a concern, then the migration must be prevented or the source of vapors treated or removed. Vapor migration is further discussed in paragraph (h), below.

f) Other materials.

i) The following materials, by themselves, are generally not acceptable for a direct contact cover system, because contaminated soil could easily migrate through them. However, they may be substituted for the 6 inches of vegetated topsoil portion of the soil direct contact cover system using the thickness indicated:

(1) Gravel – thick enough to prevent erosion, 6 inches recommended

(2) Bark, wood chips – thick enough to prevent erosion and replaced as it deteriorates

ii) Geotextiles – A woven or nonwoven geotextile is not acceptable for a direct contact cover by itself, except as a very short-term temporary cover to prevent erosion. It may have use in:

(1) Preventing contaminated soil particles from migrating to clean layers, provided it can be shown that the geotextile will maintain its effectiveness for as long as the soil remains contaminated above RCLs;

(2) Providing a marking layer between the clean cover materials and contaminated soil; or

(3) Providing reinforcement and enhancing stability.

g) Horizontal extent. The cover should be designed and constructed to provide the design thickness of materials over all areas that have contaminant concentrations greater than the direct contact RCLs for the site. Design thickness should be maintained at least up to a line that is an equal distance between soil sampling locations where direct contact RCLs are exceeded and where they are not.

h) Volatile organic compound (VOC) contaminant migration. VOC contaminants contained in soil and shallow groundwater may be a source of contaminant vapors that can migrate, carrying the contaminants to locations that may not be currently contaminated. A cover may limit the upward vertical migration of vapors to the surface and force them to migrate horizontally to create new contamination in soil and groundwater; it may force the vapors into buildings, increasing indoor air contaminant concentrations. Vapors could migrate into the cover itself, contaminating the previously clean material and potentially damaging it (for example, certain VOCs can degrade asphalt or kill vegetation). The potential for vapor migration needs to be evaluated when considering cover systems. It may be necessary to treat or remove the sources of vapors or provide active or passive venting below and/or adjacent to a cover to remove soil vapors and prevent vapor migration.

Note: Separate guidance on vapor migration is planned.

6) General Design Concepts – Migration to Groundwater Cover System

a) Design goal. In addition to the general design goals, above, the design must minimize the migration of contaminants from contaminated soil to groundwater for as long as the soil remains contaminated above RCLs for the pathways being addressed. If the infiltration of surface water, precipitation or snow melt through contaminated soil needs to be significantly minimized, then the cover system should include a layer or layers that reduces such infiltration to the greatest extent practicable. The design of these types of cover systems should take into account site specific factors, including, but not limited to:

i) The nature of the contaminants (concentrations, longevity, solubility, recalcitrance, mobility and toxicity, etc.);

ii) How long contaminant concentrations will remain above RCLs;

iii) Depth of the contamination (Note: the deeper the contamination is, the less effective an infiltration barrier may be, or the barrier's horizontal extent may need to be expanded);

iv) Whether the additional infiltration above the amount allowed by the cover designs in this section for infiltration prevention would be acceptable and protective of the groundwater quality and allow groundwater remedial goals to be met;

v) The quality of construction and the operation, maintenance and inspection program for the site (Note: O&M is discussed in a subsequent section); and

vi) The reliability of the assurances that O&M and inspections will be accomplished for as long as the soil contaminant concentrations remain above RCLs.

b) Covers at natural attenuation sites. An existing or new cover constructed after other remedial actions are taken, such as tank or soil removal, may be acceptable because it provides enough infiltration reduction at a site with a stable or receding ground water contaminant plume. Natural attenuation sites normally have a number of mechanisms that are responsible for groundwater contaminant reduction, so an existing cover may be only one of those mechanisms and is not solely responsible for the contaminant reduction. An existing in-place or previously placed soil or pavement cover or a building could be used. For example, a pavement cover might be part of an appropriate groundwater natural attenuation remedy, provided that:

i) It is shown that the plume is stable or receding with the existing cover system;

ii) The presence or migration of soil vapors or VOCs is not a concern or has been addressed; and

iii) Other pathways, such as direct contact, are not of concern.

Note: Appropriate assurance(s)/requirement(s), as discussed in Section 10, below, such as a land use limitations or conditions in closure letters, would normally be part of this type of remedy.

c) Waste Program design. Generally, the design under s. NR 504.07 for landfill covers is an acceptable significant infiltration prevention cover design. However, sections NR 504.07(2), grading layer and (3), support layer for low strength can be deleted from cover design if the contaminated soils are stable and can be regraded. Slopes shouldn't exceed 4:1 (H:V). Protecting the infiltration barrier portion of the cover system from frost is an important part of the design. In some instances, a geosynthetic composite liner (GCL) may be used in place of the clay component in the landfill cover design. The Waste Program guidance on the use of GCLs is "Guidance for the Use of Geosynthetic Clay Liners (GCOs) at Solid Waste Facilities", Publ-WA-823-00, available on the Internet at: http://dnr.wi.gov/org/aw/wm/publications/solid/publwa823.pdf. Clay and geosynthetics requirements are contained in chs. NR 504, 514, and 516.

d) Specialized pavement designs. Specialized asphalt pavement mixes exist that have been shown to minimize infiltration to a much greater extent than standard pavement materials and may be considered as a significant infiltration prevention cover system by themselves with the appropriate thickness of base material. If a specialized asphalt layer is selected as a hydraulic barrier, specialty designers and contractors will be needed in order to ensure that proper materials and construction techniques are utilized.

Note: An EPA sponsored SITE demonstration at the Dover, DE Air Force Base showed a specialty asphalt mix to have a hydraulic conductivity of about 1x10-8 cm/sec and standard asphalt to have about 1x10-4 cm/sec.

e) Standard pavement designs. A standard pavement cover may be part of a performance standard groundwater natural attenuation remedy as described in b), above, because it isn't the only remedial mechanism being used. Standard pavement with at least 6 inches of appropriate base material may be substituted for the vegetated topsoil layer in the landfill cover design, above.

f) Buildings or structures. An existing or new building or structure may be used to prevent infiltration into contaminated soils, provided the building has a sound roof and roof runoff is managed to minimize runoff infiltration into contaminated soils.

g) Multiple pathway designs. A cover system that meets the requirements for prevention of infiltration will likely be acceptable for prevention of direct contact and surface water, wetlands and endangered habitats

runoff migration. It should be evaluated under the guidelines in this document for the pathways being addressed.

h) Horizontal extent. The discussion of this topic for direct contact designs applies to this section, substituting groundwater RCLs for direct contact RCLs, unless the cover is a multiple pathway design. An increase in horizontal extent beyond that outlined for direct contact may be necessary to address deeper soil contamination.

i) VOC contaminant migration. The discussion of this topic for direct contact designs applies to this section. Covers designed to minimize infiltration can be very effective at preventing contaminant migration to groundwater, however, they also encourage horizontal vapor migration. Vapor migration must be addressed.

7) General Design Concepts – Runoff Migration to Surface Water, Wetlands and Endangered Habitats Cover System

a) Design goal. In addition to the general design goals, above, the design must minimize the migration of contaminants from contaminated soil to surface water, wetlands and endangered habitats via overland runoff for as long as the soil remains contaminated above RCLs for the pathways being addressed. (Note: Methods other than or in addition to covers could address this pathway. For example, a sedimentation pond or other acceptable erosion control methods may be used.) Cover system designs should take into account site specific factors, including, but not limited to:

i) The nature of the contaminants (concentrations and toxicity, etc.);

ii) How long contaminant concentrations will remain above RCLs;

iii) The quality of construction and the operation, maintenance and inspection program for the site (Note: O&M is discussed in a subsequent section); and

iv) The reliability of the assurances that O&M and inspections will be accomplished for as long as the soil contaminant concentrations remain above RCLs.

b) Direct contact design acceptable. The design for a direct contact cover, above may be used for prevention of runoff from contaminated soils, including the criteria for reducing or increasing the thickness of layers. Generally, to prevent erosion, cover design should use lower slopes, slow down water velocities, and use good cover vegetation. Acceptable cover vegetation is described in the design for a direct contact cover, above.

c) Buildings or structures. An existing or new building or structure located over contaminated soils may be used to prevent runoff from contaminated soils provided the building has a sound roof and roof runoff is managed to minimize impacts to surface water, wetlands and endangered habitats.

d) Multiple pathway designs. A cover system that meets the requirements for prevention of direct contact or to minimize infiltration will likely be acceptable for prevention of surface water, wetlands and endangered habitats runoff migration.

e) Horizontal extent. The discussion of this topic for direct contact designs applies to this section, substituting surface water runoff RCLs for direct contact RCLs, unless the cover is a multiple pathway design.

8) General Construction Concepts

Note: Several of the following concepts may not apply to existing in-place covers that are used as a performance standard remedy because they are already constructed.

a) Grading. The contaminated soil layer should be graded to provide an even, acceptable base for construction of the cover.

b) Soil layers. Soil borrow sources should be identified prior to construction to assure the material meets minimum requirements and isn't contaminated. Borrow sources for clay layers that are part of an infiltration barrier should be identified specifically and soil quality tests provided to show that the soil will meet Waste Program clay layer requirements under NR 504.06(2)(a). The proposed borrow source should be shown to have adequate quantities of clay to construct the cover. Guidance on investigation of borrow sites is contained in NR 512.15. Soil layer portions (including soil used in pavement base) of cover systems should be placed in uncompacted lifts of 1 foot or less and then compacted. Clay layers that are part of an infiltration barrier should be placed and compacted in accordance with Waste Program cover and liner requirements (see NR 504 and NR 516).

c) Pavement. Asphalt and concrete mixes should meet the requirements in Section 5(d), above. Asphalt should be applied in an even layer with a pavement machine to control thickness as opposed to being spread from a pile.

9) General O&M Concepts

a) Plan. An O&M plan must be prepared and submitted as required by NR 724.13(2) and kept up to date and revised as necessary as required by NR 724.13(4). It must outline the items listed in those subsections, including a description of normal maintenance activities, a contingency plan should problems develop, a description of any routine monitoring and a description of record keeping and reporting. Maintenance plans can also be required as a condition of closure in accordance with s. 292.12(2), Wis. Stats.

b) Soil cover maintenance. Vegetated soil covers should maintain a grass layer, with no bare spots or erosion. Deep rooted vegetation that could have the roots tap into the contaminants and bring them into the vegetation itself should be avoided at sites with very high levels of metals contamination to prevent the creation of a new potential exposure pathway from contaminated branches and leaves. Top layers of gravel or bark should be maintained to minimize vegetation growth and deterioration by promptly replacing the material when those problems are noted.

c) Pavement maintenance. Maintain pavement to repair cracks and deterioration promptly. Repairs can include an appropriate sealant, and, if necessary replacement of portions of the pavement.

d) Utilities and buildings. The O&M plan should outline how any utility work that may affect the cover will be managed so the cover's integrity is maintained. If a building is part of or is the performance standard cover, then the plan should outline how it will be inspected and maintained and how any building work will be managed so that the building's effectiveness as a cover is maintained.

e) Inspections. All cover systems should be inspected at least annually in the spring; a greater frequency may be required if necessary. It may be appropriate to have a higher frequency of inspection during the first year or two (monthly to quarterly) to account for the establishment of vegetation and to detect any settlement. Less frequent inspections (spring, summer and fall) can then be used until the cover is stabilized.

f) Progress reports. Inspection results and documentation of repairs and implementation of the contingency plan must be provided in regular progress reports in accordance with NR 724.13(3). Project Managers

may allow these documents to be kept at the site on a case-by-case basis, provided the responsible person is granted permission to do so in writing.

10) Assurances and Land Use Limitations or Conditions

a) Land use limitations or conditions in closure letters. Generally, a land use limitations or conditions in closure letters should be required at sites that have soil performance standard cover system remedies so that future owners/users of the site are aware of the contaminated soil, the cover system and the maintenance requirements for the cover. The conditions should outline any maintenance and reporting requirements for the performance standard cover sytem.

> Note: The Department intends to revise the discussion of land use limitations or conditions in guidance documents RR-528 and RR-606 (described in Section 2(c), above) to account for the requirements of Wisconsin Act 418, which became effective on June 3, 2006. This statutory change gives the Department the authority to impose land use limitations and maintenance requirements at a site or facility where a performance standard cover is used for a soil remedy through enforceable conditions in closure letters. The enforceable conditions take the place of closure conditions requiring deed instruments.

b) Maintenance agreements. It may be necessary to require written agreements and assurances that outline who will be responsible for maintaining the cover system and implementing contingencies under an O&M plan and how they will fund it. This can be important at sites where the owner may not have the financial resources to do so or someone other than the owner is taking on that responsibility.

c) GIS Registry. Sites with soil contamination exceeding RCLs at closure must be entered into the Department's GIS Registry of Closed Remediation Sites, in accordance with NR 726.05(2)(a)3.

> Note: Sites with groundwater contaminant concentrations exceeding NR 140 enforcement standards at the time of closure must also be entered into the GIS Registry.

11) Submittals and Review by RR Staff

a) Closure reviews. Closure submittals should outline the pathway to closure, including how contaminated soils are addressed. If a soil performance standard cover has been implemented to address contaminated soil, then the closure submittal must contain a description of that cover. The submittal must describe how it meets the requirement to be protective for as long as the soils exceed RCLs, as required by NR 720.19(2), 722.09(2) and (3). As-built plans meeting the requirements of NR 724.15 may have to be submitted with the closure submittal if needed to document and describe the construction of a more complicated cover system. Documentation of assurances and institutional controls should be submitted. The discussion in the closure submittal of how the remedy is protective may include the criteria outlined in this guidance and how the criteria were considered when developing the remedial action. Information for the GIS registry (for soils) must be submitted in accordance with NR 726.05(2)(a)3. RR staff may deny closure if the cover system isn't protective. RR staff may require additional actions to ensure the cover system is protective in order to allow closure. These actions may include improvements in the design, improvements in the O&M plan, the addition of or changes to land use limitations or conditions in closure letters or maintenance agreements.

> Note: Section 3.1 of the Guidance on Soil Performance Standards, RR-528, discusses verification and monitoring prior to case closure. It may be necessary to conduct monitoring activities prior to requesting closure in order to verify the effectiveness of a cover. For example, it may be necessary to conduct groundwater monitoring prior to closure to verify the effectiveness of a cover that addresses the migration to groundwater pathway at a site with soil contaminants that are

not biodegradable or easily biodegraded, such as heavy metals and certain chlorinated organic compounds.

b) Other reviews. Responsible persons are encouraged to provide other submittals for review, with the appropriate NR 749 review fee, prior to the closure submittal, especially at more complicated or difficult sites. Such reviews will better ensure that closure is granted when the closure request is submitted. Submittals can include site investigation reports/results, preliminary design plans, remedial action option reports and descriptions of proposed assurances and institutional controls. These submittals can be used to make demonstrations in advance that a design is appropriate for the site, using the criteria outlined in this guidance.

c) Plan submittals. All design and engineering plans for cover systems must be submitted in accordance with NR 724 and prepared by a qualified professional engineer in accordance with NR 712. These include:

i) Preliminary design proposals

ii) Design plans (but not necessarily for existing, in-place covers)

iii) As built plans (but not necessarily for existing, in-place covers)

d) RR staff review assistance. RR Project Managers may need assistance reviewing submittals for complicated or difficult sites or sites that require the assistance of an engineer. Project Managers should consult with their supervisor and decide where to obtain assistance, based on the type of submittal and the issues under consideration. Assistance could be obtained from:

i) A RR Engineer in the same region

ii) A WA Engineer in the same region, provided the WA Supervisor agrees

iii) Bureau technical staff

iv) The regional closure committee

v) The Standards and Streamlining Team

12) PCB Contamination Under the Federal Toxic Substances Control Act (TSCA)

a) Regulations. U.S. EPA has promulgated remediation regulations for sites contaminated with PCBs that are enforced by U.S. EPA. The rules are intended to be self-implementing if the site meets certain conditions and there is no groundwater contamination. Otherwise, the responsible persons are expected to contact U.S. EPA and obtain the necessary approvals for their remedial approach. The Department does not enforce these requirements. Responsible persons are required to conduct remedial actions that meet both the TSCA and NR 700 rule series requirements at sites with PCB contamination. Therefore, cover systems to address PCB soil contamination must meet both the federal and state requirements.

b) One Cleanup Program Memorandum of Agreement (MOA) with U.S.EPA and implementation by RR staff. The Department has entered into a MOA with U.S. EPA that provides a process for responsible parties to seek expedited coordinated review for certain categories of sites contaminated with PCBs. Under that process, Project Managers will coordinate closure reviews and approvals with U.S. EPA. The MOA and related documents and forms may be found at:

http://dnr.wi.gov/org/aw/rr/cleanup/ocp.htm

For other PCB sites that are not subject to the MOA expedited coordinated review process under the MOA, Project Managers are encouraged to obtain a short description of how a site cleanup meets the federal requirements before a closure request is reviewed by the Department. However, given that the Department isn't responsible for enforcing the federal requirements, if a responsible party refuses to provide that information, then the closure request may be processed, and the Project Manager is encouraged to notify U.S. EPA Region 5 TSCA staff about the site and that refusal.

c) TSCA cover standards. The self-implementing rules contain minimum cover standards for direct contact scenarios. Information on the federal requirements may be found at: http://www.epa.gov/opptintr/pcb/index.html

The federal PCB TSCA regulations are available at:

http://www.access.gpo.gov/nara/cfr/cfrhtml_00/Title_40/40cfr761_00.html

The PCB concentration levels that trigger the regulations are specified in section 761.1 of Volume 40 of the Code of Federal Regulations.

13) Examples – Acceptable design, construction, implementation – See Appendix 2

Appendix 1 - Asphalt and Concrete Design Examples

ASPHALT

Structural Numbers (SN) for pavement structure based on relative quality of roadbed soil.[1]

Relative Quality of Roadbed Soil	Structural Number (SN)
Good (gravel, well drained, easily compactable soils)	2.9
Fair (stable, sandy, compactable soils)	3.0
Poor (topsoil, organic, poorly drained soils)	3.3

Commonly Required Base Coarse Depths (BCD), considering quality of roadbed soil in parentheses: 6" (Good), 8" (Fair), and 10" (Poor)*

*This number may be greater if unstable material is encountered.

Structural Surface Coefficients: Hot Mix Asphalt (HMA) 0.44 (determined by AASHTO)

Structural Base Coarse Coefficients (SBCC):
Crushed Stone 0.14 (determined by AASHTO)
Crushed Gravel 0.10 (determined by WisDOT)

Formula to determine thickness of asphalt required:

SN = (SBCC x BCD) + (HMA Structural Coefficient x Unknown Asphalt Thickness (UAT))

EXAMPLE:

3.0 = (0.14 x 8) + (0.44UAT)
3.0 = 1.12 + 0.44UAT
1.88 = .44UAT

UAT = 4.27"
Round to 4.5"

Use a 2.5" lower layer and a 2" upper layer for asphalt pavement.

Asphalt Concrete gradation 12.5 mm nominal maximum to be used for both the upper and lower layers with a maximum of three inches per layer.

[1] Determined by the American Association of State Highway (Transportation) Officials (AASHTO)

CONCRETE

Structural Numbers (SN) are not used in the determination of concrete pavement thickness.

Relative Quality of Roadbed Soil will correspond with thickness of concrete.

Good (gravel, well drained, easily compactable soils)	5" – 5 ½" concrete slab thickness
Fair (stable, sandy, compactable soils)	6" concrete slab thickness
Poor (topsoil, organic, poorly drained soils)	6 ½" – 7" concrete slab thickness

Base Coarse is 6 inches of high grade quality gravel.

Drainage condition must be fair at a minimum.

It should be noted that although the minimum slab thickness shown is 5 inches, the user should consider the use of a thicker slab since an overloaded truck may, in some case, severely damage thin slab placements.

Reference: AASHTO Guide for the Design of Pavement Structures, 1986

Appendix 2 - Performance Standard Cover Examples – Acceptable Design, Construction and Implementation

1) Example 1 – Direct Contact and Surface Water Runoff Pathways with New Cover

A former foundry has a 2-acre area with exposed surface soil contaminated with lead above direct contact residual contaminant levels (RCLs). The horizontal extent of the contamination is defined by soil sampling. Groundwater contamination is not detected. The area is in the 100-year floodplain, but not the floodway, of an adjacent river. Concentrations of lead and chromium in the surface soil exceed the sediment quality criteria values, determined based on surface water quality standards for the river. Future land use is expected to be parkland with a playground and picnic area, with no fencing or access barriers.

Decision making criteria: The design, construction and operation and maintenance (O&M) should prevent direct contact exposure, account for the current and future land use, lack of access barriers and prevent contaminated soil from reaching the river due to overland flow and erosion. The design should account for the fact that parkland isn't routinely or consistently watched or monitored. Levels of lead contamination in the soil are unlikely to decrease or change over time, so the remedy must be effective essentially into perpetuity. It's more likely that parkland floodplain land use and ownership won't vary over time as compared to privately owned land outside the floodplain. Because it's in the floodplain, the design should prevent damage from flooding. Under Water Regulation and Zoning Program requirements, easements may need to be obtained from upstream floodplain property owners to allow filling in the floodplain, if the filling increases upstream flood elevations.

Design: Two-foot clean soil cover with 6 inches of vegetated topsoil with wood chips substituting for topsoil in the playground area. Vegetation will be grass. The full thickness will extend at least halfway between the location of each soil boring showing contaminant concentrations above RCLs and the next boring showing concentrations below RCLs.

Construction: The entire area will be graded to provide an even surface appropriate for soil placement with at least a 2% slope to allow drainage and prevent ponding. Grading will not move contaminated soil beyond the horizontal bounds defined in the design. Clean soil will be placed in 2 lifts, with each lift compacted using heavy equipment to a compacted depth of 1 foot, for a total depth of 2 feet. Topsoil (and wood chips in the playground area) will be placed in a 6-inch lift above the clean soil, seeded and properly maintained until a good grass cover is established. The playground won't be erected and the area will not be opened to park users (a temporary fence will be used) until a grass cover is established.

O&M: The O&M plan describes annual inspections in the spring (quarterly during the first year while grass is established) with contingency plans to repair any bare spots or erosion. Wood chips in the playground area will be replaced (or added to) to make an acceptable play surface at appropriate intervals and when shown to be necessary by inspection. The grass will be mowed on a routine basis. The local park district will be responsible for implementing the plan. It may be appropriate to decrease inspection and maintenance frequency over time once grass is well established, given that land use is less likely to change over time.

Land use limitations or conditions in closure letters: Land use limitations or conditions will be included in the closure letter for the area with contaminated soil to limit activities that would disturb the cover or the soil and to require inspection/maintenance of the cover as appropriate. In addition, the

site will be placed on the Department's GIS Registry of Closed Remediation sites, providing the public with notification of the presence of the soil and the cover.

Closure submittal: The closure submittal package includes as-built plans prepared and sealed by a Professional Engineer, a statement certifying that the cover was built in accordance with the design and a copy of the O&M plan (Note: These items may be submitted before a closure submittal is prepared. The closure submittal could then refer to the earlier submittals). The information required for the GIS Registry for soil is also included.

2) Example 2a – Direct Contact Pathway with Existing Cover

A former wood treating facility is now used as a parking lot and equipment storage area. One area has surface soil contaminated with arsenic above direct contact RCLs by past use of wood preservative, but is covered by asphalt pavement and a building which were constructed after wood treating operations ceased, but before any remedial investigation activities began. Groundwater contamination has not been detected. The existing asphalt pavement cover consists of 1 foot of sand and 6 inches of asphalt, as documented by plans for the parking lot and confirmed by borings through the pavement. The pavement is in reasonably good condition, with a few stress cracks that have been repaired over the years with tar sealant. The pavement extends up to the edges of the building. The building has no basement and was built on a concrete slab. The area is fenced and guarded by a security service.

Decision making criteria: The existing cover should prevent direct contact exposure, accounting for the current and future land uses, access restrictions, institutional controls and planned O&M. Right now, the area is fenced and guarded, which will help prevent unauthorized human exposure. The design of the existing pavement and its current condition is important. A good O&M program should be instituted. Institutional controls and maintenance agreements that will assure exposures will be prevented in the future due to land use or ownership changes are also important. Levels of arsenic contamination in the soil are unlikely to decrease or change over time, so the remedy must be effective essentially into perpetuity.

Design: The existing cover is in good condition and has a 1 foot base of sand which should be expected to prevent the arsenic contaminated soil from reaching the surface if the cover is properly inspected and maintained. If land use doesn't change and the cover isn't disturbed, then the protection would be expected to continue with proper maintenance and inspections.

O&M: The O&M plan describes annual inspections in the spring with regular maintenance and repair steps spelled out. Specific repair procedures for cracks and holes are described. The entire cover should be replaced at the end of the normal expected life of the asphalt – probably after about 20 to 25 years at the longest, so the plan should spell out how that will be done. A written maintenance agreement, such as an Environmental Repair contract between the responsible persons and the Department could be required.

Land use limitations or conditions in closure letters: Land use limitations or conditions will be included in the closure letter for the area with contaminated soil to limit activities that would disturb the cover or the soil and to require inspection/maintenance of the cover as appropriate. In addition, the site will be placed on the Department's GIS Registry of Closed Remediation sites, providing the public with notification of the presence of the soil and the cover.

Closure submittal: Documentation of the existing cover material thickness is provided, along with a copy of the O&M plan (Note: These items may be submitted before a closure submittal is prepared. The closure submittal could then refer to the earlier submittals). The information required for the GIS

Registry for soil will also be provided. The maintenance agreement or contract will be in place and documented in the closure submittal.

3) Example 2b – Direct Contact Pathway with Existing Cover

An existing operating gas station has historic discharges from surface spills and piping leaks that have been repaired. The area shown to have soil contamination from gasoline constituents is covered by asphalt pavement that is cracked and somewhat deteriorated with no areas of water ponding. Exact pavement and base material quality and depths aren't documented. Soil contaminants are just above RCLs for benzene at a few locations near the pump stations in the upper foot of soil directly below the existing asphalt. Soils are mostly sand with some silt. Vapor monitoring shows no problems with vapor migration. There are no nearby basements or utility trenches. Groundwater monitoring showed no groundwater impacts.

Decision making criteria: The existing pavement should prevent any significant direct contact exposure, accounting for the limited nature and extent of the soil contamination, soil types, expectation that the contaminants will naturally degrade to some extent, current and future land uses, access restrictions, institutional controls and planned O&M.

Design: Provided the pavement remains in place and properly maintained and inspected, this should prevent significant contaminants from coming to the surface and provide adequate protection against direct contact exposure. This will also be true if the land use is changed to another commercial use, as long as the existing pavement remains.

O&M: The O&M plan describes annual pavement inspections in the spring with regular maintenance and any repair steps spelled out.

Land use limitations or conditions in closure letters: Land use limitations or conditions will be included in the closure letter for the area with contaminated soil to limit activities that would disturb the cover or the soil and to require inspection/maintenance of the cover as appropriate. In addition, the site will be placed on the Department's GIS Registry of Closed Remediation sites, providing the public with notification of the presence of the soil and the cover.

Closure submittal: Documentation of the existing cover material nature and extent as can best be documented, documentation of the written maintenance agreement and a copy of the O&M plan will be submitted (Note: These items may be submitted before a closure submittal is prepared. The closure submittal could then refer to the earlier submittals). The information required for the GIS Registry for soil and groundwater will be submitted.

4) Example 3 – Groundwater Pathway with New Cover

An underground tank at a manufacturing facility was used to store chlorinated solvents used in cleaning painting lines. The piping from the tank leaked over time causing soil and groundwater contamination. Soils are sandy and depth to groundwater is 30 feet. The tank was removed, along with some contaminated soil, and a soil venting system is operated for several months in the source area but groundwater contaminant concentrations continue to increase. Soil contamination is deep enough to not present a direct contact risk at this time. The manufacturing facility needs to use the area above the source area for heavy equipment storage.

Decision making criteria: If it's shown that infiltration reduction through the soils is necessary to help reduce contaminant movement from the vadose zone to the groundwater, then an infiltration reduction

design cover is appropriate. It should be designed in conjunction with measures to help minimize horizontal movement of VOC vapors, as well as continuation of the removal of the VOCs from the source area soils over time. The remedial goal for this type of site should be a reduction in contaminant concentrations in the source area and groundwater such that groundwater quality standards are reached in a reasonable period of time. The cover should be designed to accommodate the planned use.

Design: A NR 504.07 landfill cover with pavement substituting for vegetated topsoil would be one acceptable design. Another may be 1 foot of clean sand base material and a 1-foot special infiltration prevention design asphalt mix. The soil venting system would continue to be operated and possibly expanded or improved to minimize horizontal migration of vapors and to continue to reduce source concentrations. This site would be a good candidate to encourage the submittal and review, with the appropriate fees, of the remedial action options report and design of the remedial actions ahead of the closure submittal.

O&M: The O&M plan describes annual inspections in the spring with regular maintenance and repair steps spelled out. Specific repair procedures for cracks and holes are described.

Closure options and future cover removal: Closure won't be granted until groundwater standards are reached or it can be shown that the remedial action including source controls actions, in conjunction with natural attenuation (NA) will achieve the groundwater standards in a reasonable period of time. In either of these cases, closure would be granted with the condition that the cover be maintained. In the future, if the RP/property owner wanted to pursue closure without the requirement for cover maintenance they would need to demonstrate through sufficient monitoring after the cover had been removed that groundwater quality standards continue to be achieved or that natural attenuation is a viable remedy.

Note: Sites with chlorinated solvent contamination may not always be candidates for NA closure.

Closure submittal:

- Cover Required. Contaminated soils remain in-place and an infiltration reduction cover is needed to minimize contaminant migration to groundwater. The closure submittal will include as-built plans prepared and sealed by a Professional Engineer and a statement certifying that the cover was built in accordance with the design. A copy of the O&M plan will be included.

- Future Closure without a Cover Requirement. If at some point in the future the RP/property owner decides they do not want an on-going cover maintenance requirement, at a minimum they would need to submit a revised closure request that includes sufficient groundwater monitoring data after cover removal to show that standards continue to be achieved or that natural attenuation is a viable remedy. It may also be necessary to implement additional source control actions. (Note: DNR would need to be notified before cover removal and subsequent monitoring begins).

In both instances the information required for the GIS Registry for soil and groundwater will be submitted if contaminated soils remain.

Land use limitations or conditions in closure letters: If a cover is required at closure, the closure letter will specify that the cover must be maintained in accordance with the approved maintenance plan. In addition, the letter will also indicate that if the contaminated soil is excavated in the future, the property owner at the time the soil is removed will need to analyze and ensure proper management of the material. If at some point in the future the RP/property owner can provide sufficient groundwater

monitoring data after cover removal to demonstrate the cover is no longer necessary, a new closure letter would be issued explaining this supersedes the previous closure letter. The requirement to analyze and ensure proper management if the soil is removed would still apply.

5) Example 4a - Groundwater and Direct Contact Pathways with Existing Cover

An existing operating gas station has historic discharges from underground tanks and piping that have been removed, along with some grossly contaminated soil near the contaminant source areas. The area shown to have soil contamination from gasoline constituents is covered by concrete pavement, consisting of 6 inches of sand and 4 inches of concrete. As is normal practice, the concrete was poured in slabs, with expansion joints between the slabs. The cover is showing no cracking or undue shifting or settlement, and there are no areas of water ponding. Soil contaminants are found starting at depths about 2 feet below the surface and exceed direct contact RCLs. Vapor monitoring in soils, nearby utility trenches and basements shows no problems with vapor migration. Groundwater monitoring is showing a receding contaminant plume.

Decision making criteria: The existing pavement cover and in-place soil above the contaminated soil should prevent direct contact exposure, accounting for the current and future land uses, access restrictions, institutional controls and planned O&M. In addition, the existing cover should provide enough infiltration reduction to act in concert with other mechanisms, that when viewed as a whole remedial concept for the site, provide for natural attenuation of the soil contaminants so the groundwater standards will be met in a reasonable period of time. Finally, any cover system should address vapor migration so contamination won't spread.

Design: The existing cover is in good condition and there is about 1.5 feet of natural clean soil below the concrete and base material to separate the contamination from the surface. Provided land use remains as a gas station or similar commercial use where the cover is properly maintained and inspected, contaminants should be prevented from coming to the surface and the remedy will provide adequate protection against direct contact exposure. Groundwater monitoring is showing a receding plume, which is a basis for showing that natural attenuation is working, and the existing cover is likely providing enough infiltration reduction to allow that process to be effective in dealing with any contaminants leaching to the groundwater from the contaminated soil. Soil vapor monitoring is showing that the existing cover isn't causing a horizontal vapor migration problem.

O&M: The O&M plan describes annual inspections in the spring with regular maintenance and repair steps spelled out. Specific repair procedures for cracks and holes are described. The gas station owner should agree in writing to carry out the inspections and maintenance.

Land use limitations or conditions in closure letters: Land use limitations or conditions will be included in the closure letter for the area with contaminated soil to limit activities that would disturb the cover or the soil and to require inspection/maintenance of the cover as appropriate. In addition, the site will be placed on the Department's GIS Registry of Closed Remediation sites, providing the public with notification of the presence of the soil and the cover.

Closure submittal: Documentation of the existing cover material thickness and extent, documentation of the written maintenance agreement and a copy of the O&M plan will be submitted (Note: These items may be submitted before a closure submittal is prepared. The closure submittal could then refer to the earlier submittals). The information required for the GIS Registry for soil and groundwater will be submitted. Groundwater and vapor monitoring results will be submitted.

6) Example 4b – Groundwater and Direct Contact Pathways with Existing Cover

An existing operating gas station has historic discharges from underground tanks and piping that have been removed, along with contaminated soil around and below the area where the underground tanks and piping have been removed. The area shown to have soil contamination from gasoline constituents is covered by asphalt pavement that is cracked and somewhat deteriorated with no areas of water ponding. Soil contaminants are found only below the area where the former underground tanks were removed, at depths greater than 4 feet, and exceed direct contact RCLs. Contamination may exist at shallow depths under an adjacent service center building built on a slab, but no soil sampling has taken place below the slab. The slab is in good condition. Vapor monitoring next to the building shows no problems with vapor migration. There are no nearby basements or utility trenches. Groundwater monitoring is showing a receding contaminant plume.

Decision making criteria: The existing pavement cover, in-place soil below the pavement and the building slab above the contaminated soil should prevent direct contact exposure, accounting for the current and future land uses, access restrictions, institutional controls and planned O&M. In addition, the existing cover and slab should provide enough infiltration reduction to act in concert with other mechanisms, that when viewed as a whole remedial concept for the site, provide for natural attenuation of the soil contaminants so the groundwater standards will be met in a reasonable period of time. Finally, any cover system should address vapor migration so contamination won't spread.

Design: The existing building slab is in good condition and there is sufficient clean soil below the asphalt and to separate the contamination from the surface. Provided the pavement remains in place and the slab is properly maintained and inspected, this should prevent contaminants from coming to the surface and provide adequate protection against direct contact exposure. This will also be true if the land use is changed to another commercial use, as long as the building slab and existing pavement remain. Groundwater monitoring is showing a receding plume, which is a basis for showing that natural attenuation is working, and the existing covers are likely providing enough infiltration reduction to allow that process to be effective in dealing with any contaminants leaching to the groundwater from the contaminated soil. Soil vapor monitoring showed that vapor migration isn't a problem near the building.

O&M: The O&M plan describes annual slab inspections in the spring with regular maintenance and any slab repair steps spelled out. The gas station owner should agree in writing to carry out the inspections and maintenance. The asphalt pavement and building slab shouldn't be removed.

Land use limitations or conditions in closure letters: Land use limitations or conditions will be included in the closure letter for the area with contaminated soil to limit activities that would disturb the cover or the soil and to require inspection/maintenance of the cover as appropriate. In addition, the site will be placed on the Department's GIS Registry of Closed Remediation sites, providing the public with notification of the presence of the soil and the cover.

Closure submittal: Documentation of the existing cover material thickness and extent, documentation of the written maintenance agreement and a copy of the O&M plan will be submitted (Note: These items may be submitted before a closure submittal is prepared. The closure submittal could then refer to the earlier submittals). The information required for the GIS Registry for soil and groundwater will be submitted. Groundwater monitoring results will be submitted.