

IMPLEMENTING POST-CONSTRUCTION STORM WATER REQUIREMENTS
AND STANDARDS

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Overview of Post-Construction Resources

Post-construction implementation and design resources include:



- Storm water post-construction technical standards ([Storm water post-construction technical standards](#))
 - Design requirements and considerations for planning, design, installation, and maintenance for a wide array of conservation practices.
 - Effective to implement post-construction performance standards.
- DNR guidance documents ([Publications/technical guidance](#))
 - Technical assistance for developing soil erosion control and storm water management plans and designing storm water management practices.
- Storm water presentations ([View presentations](#))
- Chapters NR 216 and NR 151, Wis. Adm. Code ([Chapter NR 216](#), [Chapter NR 151](#))
- [Construction Notice of Intent Requirement Checklist](#)

Subsequent portions of this document will expand on these resources.

What is a Post-Construction Site?

A post-construction site is a construction site regulated under ss. NR 151.11 or 151.23, Wis. Adm. Code, after construction is completed and final stabilization has occurred.

Specific requirements exist for post-construction sites:

 <p>Aerial photo of a phased development (DNR photo)</p>	<p>Non-Agricultural Performance Standards apply to construction sites subject to regulation under s. NR 151.11, Wis. Adm. Code.</p> <ul style="list-style-type: none">• Post-Construction Requirements: ss. NR 151.121 to NR 151.128, Wis. Adm. Code.
 <p>Roadway photo (DNR photo)</p>	<p>Transportation Facility Performance Standards apply to construction sites subject to regulation under s. NR 151.23, Wis. Adm. Code.</p> <ul style="list-style-type: none">• Post-Construction Requirements: ss. NR 151.241 to NR 151.249, Wis. Adm. Code.

Categorical Definitions and Common Methodologies

Definitions and Categories of “Development”

- Development - residential, commercial, industrial, or institutional land uses and associated roads. Note that development typically includes managed landscape/lawn areas associated with these areas.
- New development - development resulting from the conversion of previously undeveloped land or agriculture land uses.
- Redevelopment - areas where development is replacing older development that existed prior to October 1, 2004 (existing development).
- Existing development - development in existence on October 1, 2004, or development where a Notice of Intent (NOI) was received by the department or Department of Commerce on or before October 1, 2004.
 - Maintenance of effort - For redevelopment sites replacing older development that was subject to the post-construction performance standards on or after October 1, 2004, meet the TSS, peak discharge, infiltration, and protective areas standards applicable to the older development or meet the redevelopment standards, whichever are more stringent.

- In-fill area - undeveloped land in existing urban sewer service areas, that is surrounded by land developed prior to October 1, 2004, or developed land and man-made features where development cannot occur.
- “Common Plan of Development” refer to DNR guidance publication [“Construction Site definition - Common Plan of Development” Section NR 216.002\(2\), Wis. Adm. Code Guidance](#).

Methodology

“By Design”

- Applicant or applicant’s engineer selects and designs storm water construction and post-construction management practices to meet NR 151 performance standards.
- Treatment capability of post-construction practices demonstrated via modeling or equivalent means.
- Certain technical standards, such as Wet Detention Pond (1001), may provide sizing guidelines for achieving certain performance standards.
- A written storm water management plan summarizes design information and provides plans for post-construction practices.
- If NR 151 performance standards cannot be met, site-specific justification that the proposed design comes as close as practicable to meeting the performance standards is required. It is recommended that this documentation be discussed with storm water staff prior to NOI submittal.
- Plan must be implemented prior to a Notice of Termination being submitted.
- Typically, no post-construction monitoring of BMP effectiveness is required as the models used to design storm water practices are designed to achieve the desired performance.

“Average Annual”

- Based on average rainfall year (excluding winter season), not an individual storm event.
- Specific average annual rainfall years selected for use.
 - Madison, 1981; Green Bay, 1969; Milwaukee, 1969; Minneapolis, 1959; Duluth, 1975
- Rainfall input files for modeling are available for download. ([SLAMM and P-8 Models | STORM WATER TECHNICAL STANDARDS, MODELS AND BMPS | Wisconsin DNR](#))

“No Controls”

- “No Controls” model analysis based on anticipated model run of built conditions.
 - Assumes site has achieved stabilization (no erosion).
 - Assumes any development, buildings, or impervious surfaces are in place.
 - Assumes storm water Treatment BMPs are not in place.

Non-Agricultural Performance Standards

Post-Construction Requirements (ss. [NR 151.121](#) to [NR 151.128](#), Wis. Adm. Code)

⚠ Note that section NR 151.12 applied to NOIs received from October 1, 2002 to October 1, 2004. This section’s applicability is retained for reference where maintenance of effort may take effect.

Applicability & Exclusions

Applies to:

- Construction site Notice of Intents (NOIs) received after January 1, 2011.
- Transportation facility construction projects that are part of a larger common plan of development, such as a residential or industrial development (Refer to DNR guidance publication [“Construction Site definition – Common Plan of Development” Section NR 216.002\(2\), Wis. Adm. Code Guidance](#)”).

Exclusions:

- Agricultural facilities and practices.
- Underground utility construction except for associated above ground structures.
- Sites with less than 10% connected imperviousness provided it has <1 acre of cumulative impervious surface (See “Disconnecting” Impervious Area section).

Overall Design Requirements


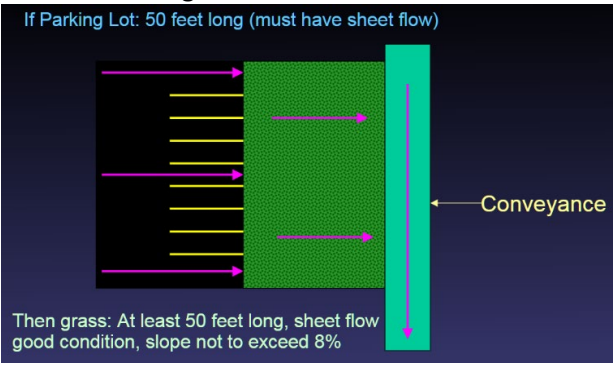
- Develop a Storm Water Management Plan compliant with s. NR 216.47, Wis. Adm. Code including:

Design of post-construction storm water management treatment BMPs that meet the following performance standards:	
TSS Water Quality (NR 151.122)	Reduce total suspended solids (TSS) carried in runoff from the site: <ul style="list-style-type: none">○ 80% for new development and infill○ 40% for redevelopment runoff from parking lots and roadways
Peak Discharge (NR 151.123)	Maintain or reduce peak runoff rates to the pre-development conditions for the 1-yr and 2-yr, 24-hr events
Infiltration (NR 151.124)	Infiltrate runoff volumes applicable to the development from the post-developed site as compared to pre-development conditions
Protective areas for lakes, streams and rivers, and wetlands (NR 151.125)	Maintain a vegetated area to serve as a transitional zone between development and water resources to filter pollutants and reduce flow velocity

- Maintenance of effort applies if the original development was previously subject to post-construction performance standards.
- Treatment BMPs must be installed and maintained in accordance with the design plans.
- Fueling & vehicle maintenance areas shall contain no visible sheen.

“Disconnecting” Impervious Areas

- Refer to DNR guidance publication [“Modeling Post-Construction Storm Water Management Treatment”](#).

Guidelines for Residential Roofs	Guidelines for Other Impervious Surfaces
<ul style="list-style-type: none"> To consider 1- and 2- family residential roofs as disconnected, the flow path must: <ul style="list-style-type: none"> Be over a pervious area in good condition Be at least 20’ long 	<ul style="list-style-type: none"> Source area flow length may not exceed 75 feet Source area and pervious area must be graded for sheet flow Pervious area must be: <ul style="list-style-type: none"> In good condition, < 8% slope Have a flow length at least as long as the contributing impervious area’s length 

Total Suspended Solids (TSS) Performance Standard ([NR 151.122](#))

On an annual average design basis, reduce TSS discharge from the post-development condition* by:

Development Type	TSS Reduction
New Development	80%
In-fill	80%
Redevelopment	40% from parking areas and roads

* *△ the reduction is not a comparison of pre- and post-development condition*

- TSS control requirement must be met prior to discharge to waters of the state.
- Project sites that occur in areas of both new and redevelopment may prorate TSS reduction standards (TSS reduction between 40% and 80%) ([see section example](#)).
- For redevelopment sites:
 - Parking and/or road areas may be treated to a higher level to compensate for under-treated parking and/or road areas.
 - Treating roof and landscape areas cannot be used to compensate for untreated parking and/or road areas.
 - No TSS reduction credit is given for reducing the amount of existing parking and/or road area. 40% TSS reduction is not a comparison of pre- and post-development condition.

Untreated Areas

“Site” is the area of land disturbance:

- TSS standard is a site standard, not a BMP standard.
- Calculate TSS load for entire post-construction site under no controls (TL).
- Calculate TSS load reduction for post-construction site captured by treatment BMPs (CL).

$$\frac{CL}{TL} > 80\% \text{ (new development)}$$

- If CL/TL is < 80% consider:
 - Increasing load reduction in captured areas to offset uncaptured areas.
 - Treating uncaptured impervious surface separately with additional BMPs.

Loads from Off-Site Drainage

Site is not responsible for TSS reduction from off-site areas draining to the site but must factor in hydrology for Treatment BMP efficiency. Options and considerations for off-site loads may include:

- Divert off-site drainage.
- Include off-site hydrology in Treatment BMP calculations for proper BMP performance (Refer to DNR guidance publication [“Modeling Post-Construction Storm Water Management Treatment”](#)).

Prorated Example: New and Redevelopment

- An area weighted loading calculation:
 - Separately calculate total load (TL) under no controls for both new development and redevelopment.
 - Reduction Load Goal = (40% (TL under redevelopment) + 80% (TL under new development)).
- Only area subject to TSS controls should be included in proration.

EXAMPLE SITE:

- 100-acre project site including new and redevelopment area:
 - 20 acres of redevelopment as commercial parking lot development (assuming 500 lbs/acre TSS).
 - 80 acres of new medium density residential (assuming 200 lbs/acre TSS).
- Calculate Total Load:

Total Load (TSS) No Controls	
(Redevelopment) Commercial Parking Lot	$20 \text{ acres} \times 500 \frac{\text{lbs}}{\text{acre}} = 10,000 \text{ lbs}$
(New Development) Medium Density Residential	$80 \text{ acres} \times 200 \frac{\text{lbs}}{\text{acre}} = 16,000 \text{ lbs}$
Total Site	26,000 lbs

- Calculate Site TSS Load Reduction Needed:

Load (TSS) Reduction Needed	
Redevelopment	$\left(20 \text{ acres} \times 500 \frac{\text{lbs}}{\text{acre}}\right) \times 40\% \text{ control} = 4,000 \text{ lbs}$

New Development	$\left(80 \text{ acres} \times 200 \frac{\text{lbs}}{\text{acre}}\right) \times 80\% \text{ control} = 12,800 \text{ lbs}$
Total Load Reduction Goal	16,800 lbs

- Calculate Overall Percent Load Reduction for Site Needed:

$$\frac{\text{Total Goal}}{\text{Total Load}} = \frac{16,800 \text{ lbs}}{26,000 \text{ lbs}} = 0.65 = 65\% \text{ TSS reduction needed sitewide}$$

Peak Discharge Performance Standard ([NR 151.123](#))

- Reduce peak runoff rates from post-construction conditions to pre-development conditions for the 1-year and 2-year, 24-hour storm events.
- Does not apply to:
 - Redevelopment sites.
 - In-fill development < 5 acres.
 - Where discharge is directly to a lake > 5,000 acres or a stream or river segment draining more than 500 square miles (Refer to map in [“Modeling Post-Construction Storm Water Management Treatment”](#)).
- Use NR 151 maximum TR-55 CNs for pre-development runoff calculation:

Table 2. Maximum Pre-Development Runoff Curve Numbers

	HSG A	HSG B	HSG C	HSG D
Woodland	30	55	70	77
Grassland	39	61	71	78
Cropland	55	69	78	83

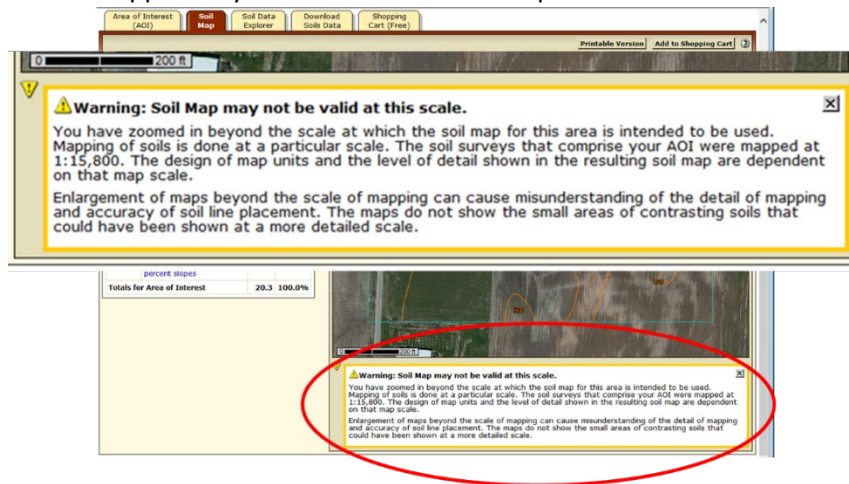
Note: Where the pre-development condition is a combination of woodland, grassland, or cropland, the runoff curve number should be pro-rated by area.

- Use “good” hydrologic condition CNs for other land uses.
- Refer to DNR guidance publication [“Modeling Post-Construction Storm Water Management Treatment”](#).
- To avoid delays at local levels, stricter local municipal or county ordinances may be used (Example: Local ordinance require use of meadow to represent pre-development conditions).

Infiltration Performance Standard ([NR 151.124](#))

- Required infiltration volume for the site is based on the connected impervious level of the development and the volume infiltrated in the pre-development condition.
 - Refer to DNR guidance publication [“Meeting infiltration performance standard of ch. NR 151”](#).
 - If centralized areas are not suitable for infiltration, then decentralized infiltration must be evaluated.
 - Refer to DNR guidance publication [“Modeling Post-Construction Storm Water Management Treatment”](#).
 - Performance is analyzed based on the average annual rainfall condition:

- $Rainfall(cf) - Runoff(cf) = Infiltration(cf)$
 - Pretreatment areas do not count towards effective infiltration area sizing "cap" requirements under ss. NR 151.12(5)(c) or NR 151.124.
- Locations of infiltration practices
 - Check proposed location of infiltration practices relative to direct conduits to groundwater, wells, and areas of contamination.
 - Filtering layer and separation distance requirements depend on source area ([NR 151.124\(4\)\(b\)](#)):
 - [NR 151.002\(14r\)](#) provides the definition of "filtering layer".
 - On-site soil information is required for designing infiltration facilities and to support any claim that the site is exempt from infiltration. [Please see DNR Technical Standard 1002](#) for guidance on how to evaluate a site for infiltration, including the number and depth of soil borings, pits, etc. that are appropriate.
 - Where separation distance is limited, consider infiltration of roof runoff.
 - Infiltration can be optional based on-site evaluation findings of clay soil types (NR 151.124(4)(c)2.) or restrictive on-site **measured** infiltration rates (NR 151.124(c)1.)
 - **⚠ exemption is not based on design infiltration rates from [DNR Technical Standard 1002](#).**
 - Must have on-site soil data.
 - Refer to DNR guidance publication for guidance on potential barriers to infiltration
- Web Soil Survey mapping, alone, is not appropriate for designing infiltration facilities nor to support any claim that a site is exempt from infiltration.



Pretreatment

- Pretreatment requirements prior to infiltration exist to protect groundwater and infiltration practices from premature maintenance needs:
 - Groundwater Protection:
 - Covered by other NR 151 infiltration sections and technical standard criteria.
 - Compost additions may be used to create filtering layer (Refer to DNR guidance publication ["Modeling Post-Construction Storm Water Management Treatment"](#)).

- Clogging Prevention and Treatment BMP Maintenance:
 - Clogging is a concern for all filtration/infiltration practices including some NR 151 pre-treatment practices (i.e., biofilters, permeable pavement).
 - Long term maintenance and inspection plans should address clogging.
 - Use professional judgement and technical standards to evaluate clogging potential.
 - Larger drainage areas and/or higher loading source areas may require additional pretreatment.
 - Technical standards contain pretreatment design content.
- Underground infiltration practices are similar to infiltration basins in function and also require pretreatment and access for maintenance.

Protective Areas Performance Standard (NR 151.125)

- Must maintain or restore a vegetated buffer along surface waters and wetlands.
- Refer to DNR guidance publication, "[Protective Areas for Wetlands](#)", for wetland plant community types and associated protective areas.
- Buffer Widths:
 - Outstanding & Exceptional Resource Waters (ORW/ERW): 75-foot buffer
 - Lakes & Streams: 50-foot buffer.
 - Wetlands: 10 to 75-foot buffer, depending on type, quality, and size.
- Can the area be disturbed?
 - Yes, but only as necessary and it must be stabilized from erosion and restored to self-sustaining vegetation
- Treatment BMPs such as swales, wet detention basins, and other similar treatment BMPs are allowed within the protective area.

Fueling and Vehicle Maintenance Area Standard (NR 151.126)

- Design, install and maintain BMPs so that runoff that enters waters of the state has no visible petroleum sheen.
- BMPs to consider:
 - Enclose maintenance areas.
 - Canopy over fueling areas.
 - Divert runoff away from fuel/maintenance areas.
 - Adsorbent spills cleanup supplies.
 - Oil/water separator treatment.
 - Other measures as necessary.



BMP Design Considerations

BMP Treatment Credit

- Includes structural practices.
- Based on model runs with treatment BMPs.
 - Some DNR Technical Standards, such as Wet Detention Pond (1001), include a conservative design that may be used in place of a water quality model.

- For proprietary settling and filtering devices refer to the appropriate technical design standards
(https://dnr.wisconsin.gov/topic/Stormwater/standards/postconst_standards.html).
 - Proprietary sedimentation devices: predicting device efficiency using either Stokes' Law settling or device-specific efficiency data.
 - Proprietary filtration devices: considers filtration design life before maintenance, determining TSS reduction, filter sizing methodology.
- Municipal non-structural BMPs, such as street sweeping, are not appropriate. A developer will generally not have authority to ensure that street cleaning will be maintained, and it is not expected to provide enough TSS control to meet needed TSS reductions.

Regional Treatment

Regional BMPs may be used to demonstrate compliance with NR 151 performance standards provided the following apply:

- The BMP is not located within a navigable stream or meet the location requirements in s. NR 151.003.
- The BMP exists (or will exist) prior to the development requiring control of post-construction runoff.
- Information is provided showing the BMP is designed to handle runoff from the development and other contributory areas and provide adequate levels of treatment for **current regulations**.
- Information is provided documenting the BMP owner's permission for use of the BMP and provisions have been made for long-term BMP maintenance.

Water Quality Models

- Must be able to calculate pollutant loadings and reductions of BMPs for an average annual rainfall series (Examples: WinSLAMM and P8).
- Note that models such as WinSLAMM have "standard land use" files that may be appropriate.
- WinSLAMM and P-8 are not designed to route or evaluate peak flow reductions.
- Pondpack, HydroCAD, TR-20, HEC-1, HEC-HMS, SWMM are common tools used to route and evaluate peak flows, however, these tools are unable to evaluate BMP pollutant removal.
- Refer to DNR guidance publication "[Modeling Post-Construction Storm Water Management Treatment](#)".
- Input parameter files can be downloaded: [SLAMM and P8 Models](#).

Maximum Extent Practicable (MEP)

- Full attainment of a standard is required unless there are unique and site-specific condition(s) that result in MEP being less than full attainment.
- MEP definition takes into consideration the following:
 - Best available technology.
 - Cost-effectiveness.
 - Geographic features.
 - Other competing interests such as:
 - Natural and historic resource protection.
 - Human safety & welfare.

- If a performance standard is not fully achievable, then it must be met to the MEP.
 - ⚠ **Note that scenarios where MEP is appropriate are uncommon and dependent on site-specific constraints.**
 - Prior to submitting an NOI, reach out to discuss unique situations with DNR staff.
 - Keep an inventory of alternatives pursued and reasons why full attainment of standards is not achievable with these alternatives.

Conservation Design Concepts

- Cluster Development leads to less impervious areas (less runoff).
- Use of swales instead of sewers.
- Attempt to maintain natural hydrology of landscape.
- Protect Natural Areas.

Wetland Impacts

- To protect the receiving wetland(s), storm water discharges associated with construction and post-construction performance standards shall be evaluated for compliance prior to discharge to the wetland(s).
 - The storm water construction permit only authorizes discharges to wetlands that comply with the wetland water quality standards of NR 103.
 - Maintain wetland hydrology.
 - How is the wetland receiving water (i.e., hydrologic connection)?
 - Where does water go when the wetland overflows?
 - Evaluate:
 - Current drainage area.
 - Proposed drainage area.
 - Flooding.
 - Soils.
 - Maintain comparable hydrology to the wetland between existing and proposed conditions. Reductions in peak flows to the wetland are acceptable if the overall runoff volume to the wetland is maintained.
 - Allow wetland water depth to fluctuate similar to existing condition. Increased ponding can impact the type of vegetation in the wetland.
 - Placing an outlet from a wetland above the normal saturation level might be appropriate to release excess water from internally drained wetland and still allow seasonal water level variation.
 - Implement BMPs to meet all applicable post-construction performance standards.

Transportation Facility Performance Standards

Post-Construction Requirements (ss. [NR 151.241-NR 151.249](#) Wis. Adm. Code)

Applicability & Exclusions

Application and implementation:

- State & locally administered highways, airports, harbors, trails & related projects.
- Sites with 1+ acre(s) of land disturbance.
- Implemented through NR 216.

Do not apply to projects where:

- Road reconditioning or resurfacing (see definitions in [NR 151.21](#)).
- Minor reconstruction of a highway (except protective area requirement applies) provided no conversion from vegetated conveyance to non-vegetated (e.g., conversion from swales to storm sewer).
 - “Minor reconstruction” means reconstruction that is limited to 1.5 miles in continuous or aggregate total length of realignment and that does not exceed 100 feet in width of roadbed widening. Minor reconstruction may still include a reconstruction site of more than 1.5 miles in length but is limited to reconstruction with less than 1.5 miles of realignment. This is intended to include:
 - Adding a turning or passing lane at an intersection.
 - Adding a traffic merge lane/ramp.
 - Road straightening at a hazardous intersection.
- Project site has less than 10% imperviousness and less than 1 acre of cumulative impervious.

Overall Design Requirements

- Develop a Storm Water Management Plan compliant with s. NR 216.47, Wis. Adm. Code.
- TSS controlled by design to MEP up to 80% for new construction, 40% for reconstruction unless meeting minor road reconstruction exemption.
- 1-year and 2-year 24-hour peak flow control to pre-construction peak flows.
- Highways and some roads exempt from infiltration requirements.
- Protective areas (buffers).
 - Refer to DNR guidance publication “[Design Considerations for Post-Construction Performance Standards for Public Trails near Waterways or Wetlands](#)”.
- Fueling & vehicle maintenance areas (no sheen).

Transportation Swale Treatment ([NR 151.249](#))

- Swale treatment is considered a MEP practice for most transportation facilities. Swales must:
 - Be vegetated to prevent erosion and provide treatment.
 - Carry a 2-year design storm < 1.5 fps for 200 feet or greater.
 - Comply with DNR Technical Standard 1005 ([Refer to DNR technical standard 1005](#)).
- ORW, ERW, 303d impacted receiving waters may require more than swale treatment.

Permitting

- WisDOT directed and supervised projects are covered under the Transportation Construction General Permit (TCGP), NR 216 and NR 151 requirements apply. Permitting is processed by Transportation Liaison staff ([Transportation projects | Wisconsin DNR](#)).
- Non-WisDOT road projects are covered under the construction site general permit but Transportation Liaison staff complete reviews for wetland and waterway impacts for transportation projects directed by local units of government.
- If wetland and/or waterway permitting is needed, separate applications are required.

- NR 216 permit coverage is separate from ch. 30 permit coverage.

Storm Water Management Plan (SWMP) NR 216.47

- SWMP must:
 - Identify how applicable NR 151 performance standards are met.
 - Include a description of the practices that will be installed and the reason they were selected.
 - Utilize DNR-approved technical standards. Where the design deviates from the technical standards, provide an explanation of how the alternate approach protects water quality and is justified.
 - Infiltration systems require:
 - Setbacks from wells.
 - On-site soil evaluation for groundwater protection and design concerns.
 - Long-term maintenance agreement required for permanent structures submitted with NOI, unless alternative arrangements with DNR staff have been made.
- Long-Term Maintenance
 - NR 151 and NR 216 require construction and maintenance of BMPs.
 - Provisions for long-term maintenance as required by NR 151 and NR 216 beyond termination of the permit. Inspection and maintenance plans are required for each practice.