

# STORMWATER OPERATIONS AND MAINTENANCE MANUAL

*The Meadows  
Ferndale, WA.*

**Prepared for:**

**THE MEADOWS, LLC**  
c/o Weden Engineering, LLC  
2636 Nubgaard Road  
Ferndale, WA 98248

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**Prepared by:**



**WEDEN ENGINEERING, LLC**  
Civil Engineering • Land-Use Planning • Project Management

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PO Box 3246 / 2636 Nubgaard Rd | Ferndale, WA |  
98248 | 360-380-1363 | 360-384-3615 fx

[info@wedenengineering.com](mailto:info@wedenengineering.com)  
[www.wedenengineering.com](http://www.wedenengineering.com)

*Weden Project No. 1308*

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## 1. INTRODUCTION

Properly maintained stormwater systems keep sites from flooding and can help reduce surface water and ground water pollution. Drainage systems are often in or near areas that are also fish and wildlife habitat.

This manual helps storm sewer owners operate and maintain the site's stormwater facilities in a way that conforms to regulations protecting fish and wildlife. This manual is based on guidelines presented in the Department of Ecology's *2005 Stormwater Management Manual for Western Washington (2005 SMMWW)*.

The stormwater facilities on-site will be privately owned and maintained. This manual describes each of the stormwater system components, how they are intended to operate, and what maintenance activities shall be followed.

Facilities include 6 detention ponds, catch basins and associated conveyance system. Facilities are designed to operate with a minimum of maintenance; however some maintenance will be required.

Operation and maintenance of the proposed on-site stormwater management facilities includes training designated personnel on the appropriate inspection, record-keeping, and maintenance procedures. Stormwater facilities should be inspected bi-annually to ensure proper operation, and inspections should also be made during and immediately after a large storm event.



## 2. PROJECT INFORMATION

Project Name:	The Meadows PUD
Location:	2717 Thornton Road Ferndale, WA 98248
Owner:	The Meadows, LLC
Engineer & Contact:	Eric Weden, PE Toni Van Male, PE Weden Engineering, LLC 22636 Nubgaard Road Ferndale, WA 98248
Reporting Spills to soils:	WA Department of Ecology Toxics Cleanup Program (800) 407-7170
Reporting Spills to water:	WA State Emergency Management Division (800) 258-5990  National Response Center (800) 424-8802

### 2.1. Project phasing

The development of The Meadows PUD will be in three phases. Stormwater facilities will be completed as condition of each plat, as approved by the City of Ferndale. The homeowners association will be majority owned by the developer, and the association will have increasing ownership as phases are completed.



## 3. DRAINAGE FACILITY DESCRIPTIONS

### 3.1. Major facilities

The stormwater facilities include 5 detention ponds with associated outlet flow control structures, catch basins and associated conveyance pipes and appurtenances that convey flow from residences and roads to each of the respective ponds. The following are brief descriptions of the facilities.

- **Detention Pond.** This open and bermed basin temporarily stores stormwater runoff during rain events and slowly releases them through an outlet control structure. The ponds will be planted with natural appearing vegetation which enhance the wildlife habitat and will require less maintenance as the vegetation will not be mowed or disturbed unless it interferes with the pond functioning.
- **Control Structure/ Flow Restrictor.** Flow control structures and flow restrictors direct or restrict flow in or out of facility components. Outflow controls on detention facilities are a common example where flow control structures slowly release stormwater at a specific rate. The flow is regulated by a combination of orifices (holes with specifically sized diameters) and weirs (plates with rectangular or “V” shaped notch). Lack of maintenance of the control structure can result in the plugging of an orifice. If these flow controls are damaged, plugged, bypassed, or not working properly, the facility could overtop or release water too quickly. This could damage streams, habitat, and property.
- **Catch Basins.** A catch basin is an underground concrete structure typically fitted with a slotted grate to collect stormwater runoff and route it through underground pipes. Catch basins can also be used as a junction in a pipe system and may have a solid lid. Catch basins are located throughout the site, connecting stormwater pipes and conveying flow to the dry pond. Storm sewer pipes convey stormwater. Pipes are built from many materials and are sometimes perforated to allow stormwater to infiltrate into the ground. Stormwater pipes are cleaned to remove sediment or blockages when problems are identified. Stormwater pipes must be clear of obstructions and breaks to prevent localized flooding. All stormwater pipes should be in proper working order and free of the possible defects listed below.



### 3.2. Residential Facilities

In addition to the facilities capturing and dispersing the combined runoff, the following individual residential lots will disperse flow from their roofs and/or driveways to adjacent wetlands.

**Table: THE MEADOWS- Dispersed Lot Summary**

Basin ID	Lots with Dispersion
A	109-112, 117, 136-138, 145-149, 151-152, 156
B1	62 - 71, 81 - 83
B2	58-60, 118, 121-124
C1	50-54
C2	27- 33
C3	34, 37-42, 49



## 4. MAINTENANCE STANDARDS FOR DRAINAGE FACILITIES

The facility-specific maintenance standards contained in this section are intended to be conditions for determining if maintenance actions are required as identified through inspection. They are not intended to be measures of the facility's required condition at all times between inspections. In other words, exceedence of these conditions at any time between inspections and/or maintenance does not automatically constitute a violation of these standards. However, based upon inspection observations, the inspection and maintenance schedules shall be adjusted to minimize the length of time that a facility is in a condition that requires a maintenance action.

### 4.1. Catch Basins, Detention Ponds and Flow Control Structures

The following facility-specific maintenance standards are excerpts from Volume V of the *2005 SMMWW*.

- Detention Ponds
- Control Structures (Outlet Flow Control Structure)
- Catch Basins



#### 4.6 Maintenance Standards for Drainage Facilities

The facility-specific maintenance standards contained in this section are intended to be conditions for determining if maintenance actions are required as identified through inspection. They are not intended to be measures of the facility's required condition at all times between inspections. In other words, exceedence of these conditions at any time between inspections and/or maintenance does not automatically constitute a violation of these standards. However, based upon inspection observations, the inspection and maintenance schedules shall be adjusted to minimize the length of time that a facility is in a condition that requires a maintenance action.

**Table 4.5 – Maintenance Standards**

##### No. 1 – Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Any trash and debris which exceed 5 cubic feet per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size garbage can). In general, there should be no visual evidence of dumping.  If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Trash and debris cleared from site.
	Poisonous Vegetation and noxious weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public.  Any evidence of noxious weeds as defined by State or local regulations.  (Apply requirements of adopted IPM policies for the use of herbicides).	No danger of poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with local health department)  Complete eradication of noxious weeds may not be possible. Compliance with State or local eradication policies required
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants  (Coordinate removal/cleanup with local water quality response agency).	<del>No contaminants or pollutants present</del>
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired. (Coordinate with local health department; coordinate with Ecology Dam Safety Office if pond exceeds 10 acre-feet.)



## No. 1 – Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
	Beaver Dams	Dam results in change or function of the facility.	Facility is returned to design function.  (Coordinate trapping of beavers and removal of dams with appropriate permitting agencies)
	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site.  Apply insecticides in compliance with adopted IPM policies
	Tree Growth and Hazard Trees	Tree growth does not allow maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access or maintenance, do not remove  If dead, diseased, or dying trees are identified  (Use a certified Arborist to determine health of tree or removal requirements)	Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood).  Remove hazard Trees
Side Slopes of Pond	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion.  Any erosion observed on a compacted berm embankment.	Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.  If erosion is occurring on compacted berms a licensed civil engineer should be consulted to resolve source of erosion.
Storage Area	Sediment	Accumulated sediment that exceeds 10% of the designed pond depth unless otherwise specified or affects inletting or outletting condition of the facility.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
	Liner (If Applicable)	Liner is visible and has more than three 1/4-inch holes in it.	Liner repaired or replaced. Liner is fully covered.

## No. 1 – Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
Pond Berms (Dikes)	Settlements	<p>Any part of berm which has settled 4 inches lower than the design elevation.</p> <p>If settlement is apparent, measure berm to determine amount of settlement.</p> <p>Settling can be an indication of more severe problems with the berm or outlet works. A licensed civil engineer should be consulted to determine the source of the settlement.</p>	Dike is built back to the design elevation.
	Piping	<p>Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue.</p> <p>(Recommend a Geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.</p>	Piping eliminated. Erosion potential resolved.
Emergency Overflow/ Spillway and Berms over 4 feet in height.	Tree Growth	<p>Tree growth on emergency spillways creates blockage problems and may cause failure of the berm due to uncontrolled overtopping.</p> <p>Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm.</p>	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A licensed civil engineer should be consulted for proper berm/spillway restoration.
	Piping	<p>Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue.</p> <p>(Recommend a Geotechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.</p>	Piping eliminated. Erosion potential resolved.
Emergency Overflow/ Spillway	Emergency Overflow/ Spillway	<p>Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of out flow path of spillway.</p> <p>(Rip-rap on inside slopes need not be replaced.)</p>	Rocks and pad depth are restored to design standards.
	Erosion	See "Side Slopes of Pond"	

#### No. 4 – Control Structure/Flow Restrictor

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris removed.
	Structural Damage	Structure is not securely attached to manhole wall.	Structure securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure in correct position.
		Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
	Any holes--other than designed holes--in the structure.	Structure has no holes other than designed holes.	
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
		Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
		Gate is rusted over 50% of its surface area.	Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Manhole	See "Closed Detention Systems" (No. 3).	See "Closed Detention Systems" (No. 3).	See "Closed Detention Systems" (No. 3).
Catch Basin	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).

## No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No Trash or debris located immediately in front of catch basin or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch  (Intent is to make sure no material is running into basin).	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
		Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.

## No. 5 – Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
	Contamination and Pollution	See "Detention Ponds" (No. 1).	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure.  (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

## No. 6 – Debris Barriers (e.g., Trash Racks)

Maintenance Components	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier cleared to design flow capacity.
Metal	Damaged/ Missing Bars.	Bars are bent out of shape more than 3 inches.	Bars in place with no bends more than 3/4 inch.
		Bars are missing or entire barrier missing.	Bars in place according to design.
		Bars are loose and rust is causing 50% deterioration to any part of barrier.	Barrier replaced or repaired to design standards.
	Inlet/Outlet Pipe	Debris barrier missing or not attached to pipe	Barrier firmly attached to pipe

## No. 7 – Energy Dissipaters

Maintenance Components	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
External:			
Rock Pad	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad replaced to design standards.
	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design standards.
Dispersion Trench	Pipe Plugged with Sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe cleaned/flushed so that it matches design.
	Not Discharging Water Properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a "sheet flow" of water along trench). Intent is to prevent erosion damage.	Trench redesigned or rebuilt to standards.
	Perforations Plugged.	Over 1/2 of perforations in pipe are plugged with debris and sediment.	Perforated pipe cleaned or replaced.
	Water Flows Out Top of "Distributor" Catch Basin.	Maintenance person observes or receives credible report of water flowing out during any storm less than the design storm or its causing or appears likely to cause damage.	Facility rebuilt or redesigned to standards.
	Receiving Area Over-Saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Internal:			
Manhole/Chamber	Worn or Damaged Post, Baffles, Side of Chamber	Structure dissipating flow deteriorates to 1/2 of original size or any concentrated worn spot exceeding one square foot which would make structure unsound.	Structure replaced to design standards.
	Other Defects	See "Catch Basins" (No. 5).	See "Catch Basins" (No. 5).

## 4.2. Individual Residential Roof and / or Driveway Dispersion systems

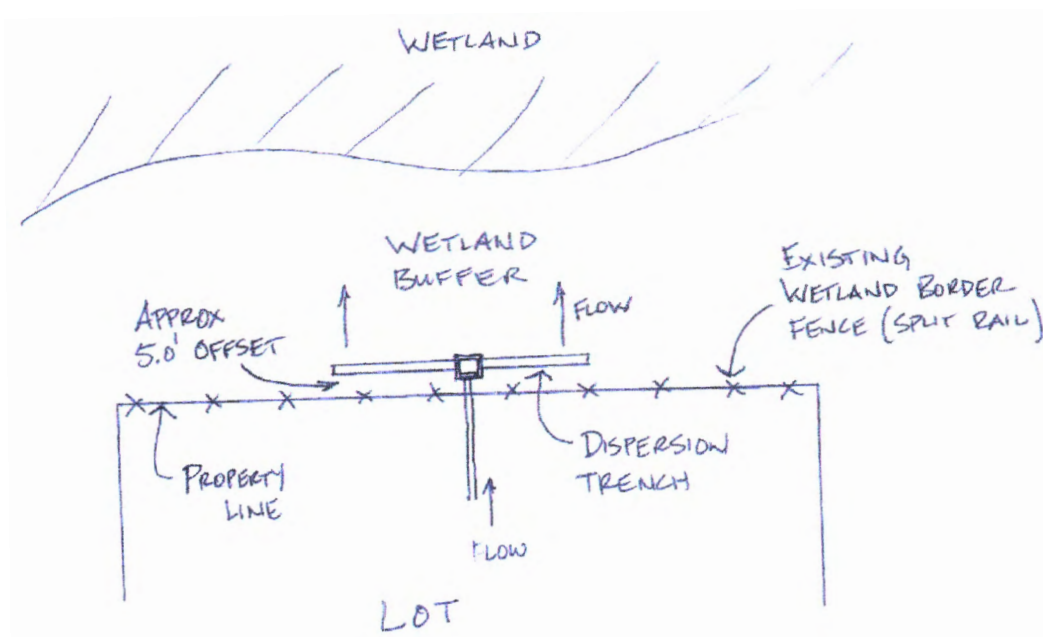
Sample designs provided by the Washington State Department of Ecology for roof down spout and / or driveway dispersion systems follow for the residences designated to have their roof and driveway runoff disperse directly to recharge adjacent wetland areas, (see section 3.2).

### Sizing & Construction

All building permit applications on lots requiring dispersion trenches for rainwater runoff as defined by this section shall prepare and submit a site plan as directed by the City, to scale, that includes the following information:

- Lot number and street address
- Property lines, fences, easements
- Footprint of all proposed improvements with dimensions (i.e. house/garage, driveway, patio, shed, graveled areas, etc.)
- Total impervious surface area proposed in square feet
- Calculated length of trench using formula given in 2005 SMMWW, Figure 5.1
- Location of trench adjacent to Lot
- Reference 2005 SMMWW, Figure 5.2 for construction details

Dispersion trenches shall be constructed within the conservation easement adjacent to the Lot line as shown below:



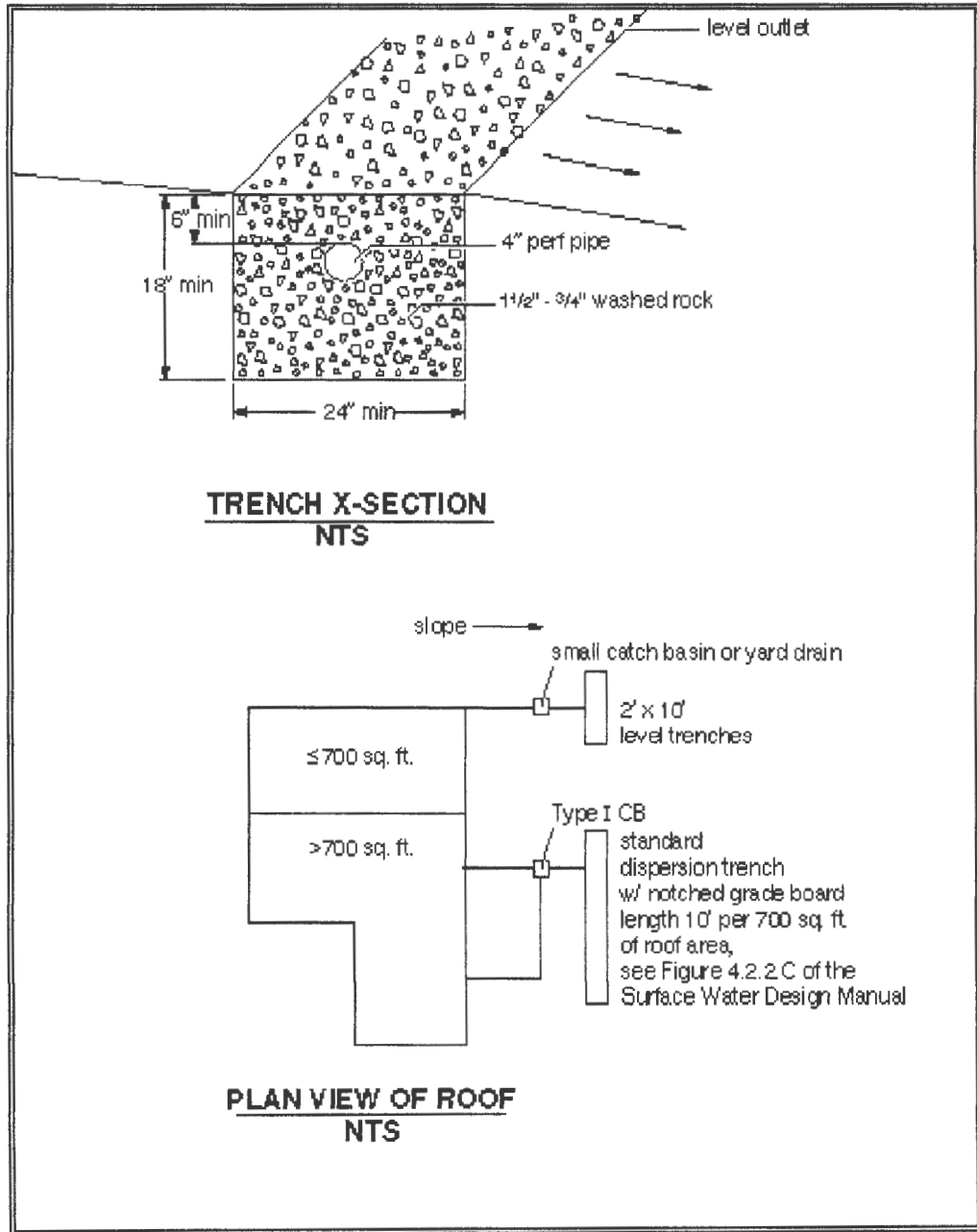


Figure 5.1 – Typical Dispersion Trench



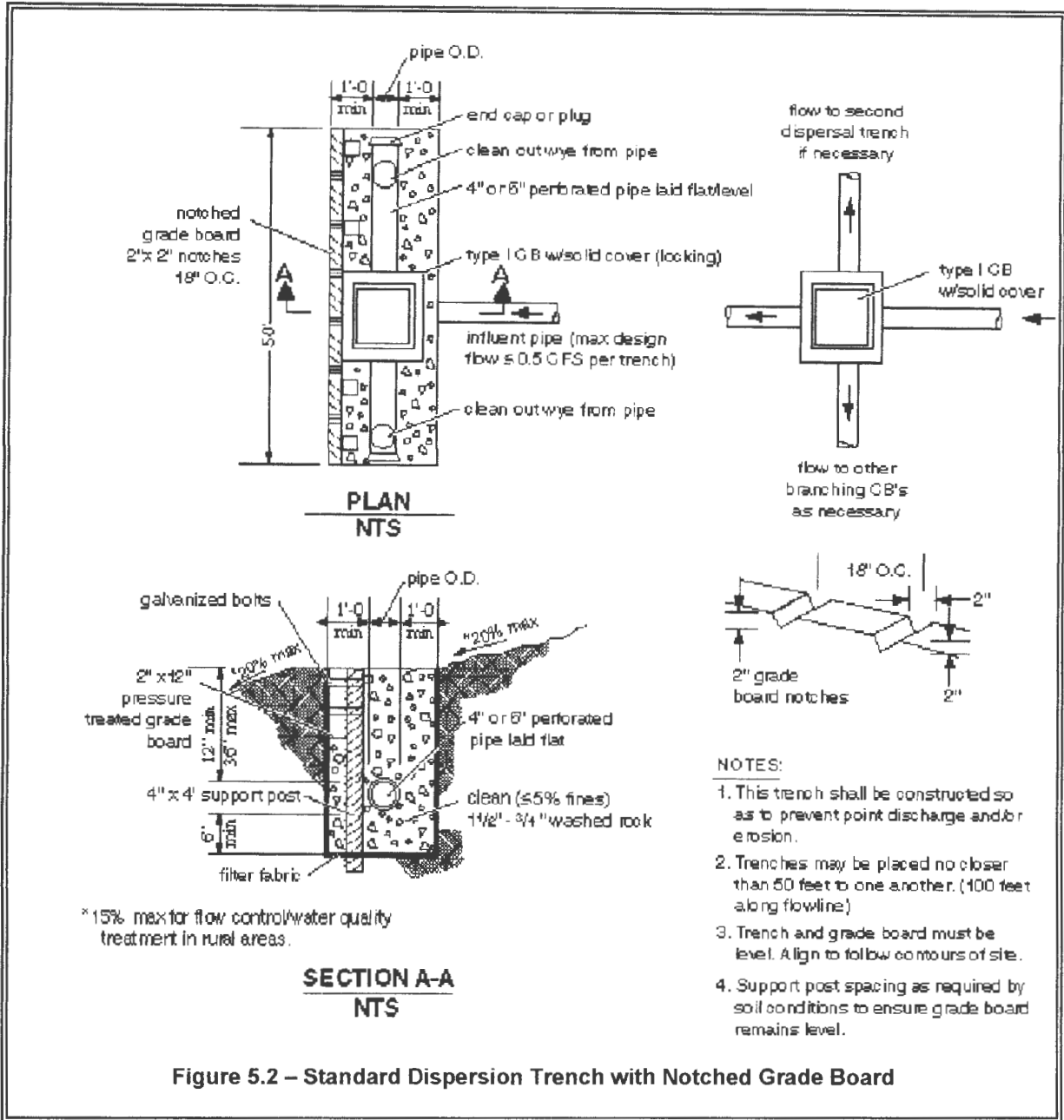


Figure 5.2 – Standard Dispersion Trench with Notched Grade Board

Driveways to slope towards adjacent wetlands.  
 Steep driveways may require trench drains to intercept and direct flow to the adjacent wetlands via the roof dispersion trench.

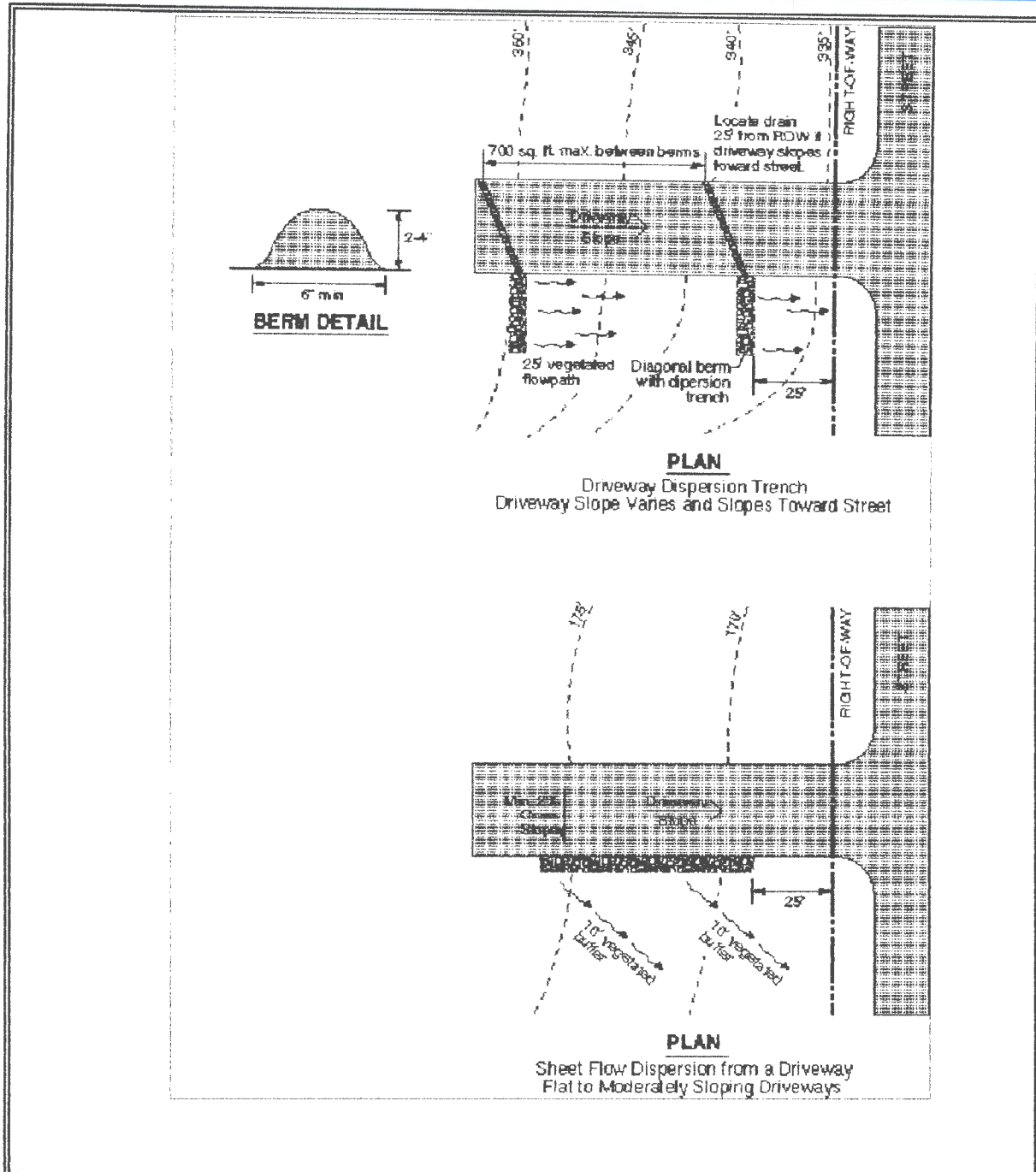


Figure 5.5 – Sheet Flow Dispersion for Driveways