Chapter 3
Maintaining the Storm Sewer System

This chapter of the Toolbox describes various maintenance practices for the separate storm sewer system and provides a few easy tips for conducting the work in a way that helps protect the environment:

- Inspecting the system
- Cleaning and repairing storm sewer pipes and storm drain inlets
- Cleaning ditches and stream channels
- Maintaining detention ponds and other stormwater treatment devices

A handy storm sewer system checklist is provided on the next page.

Storm Sewer Checklist

Use this checklist of clean water tips as a guide for conducting water quality-friendly maintenance practices. Refer to the rest of this chapter for details regarding each clean water tip.

Practice	Done ✓	Clean Water Tip	Tip #
Culvert/Pipe		Inspect at least every 5 years	1
		Use long-lasting measures	2
		Use rodding for roots	3
		Prevent chemical pollution	4
		Target maintenance to area in need	5
		Install debris traps before cleaning	6
Catchbasin/Inlet		Inspect catchbasin every 6 mths	7
		Inspect inlets once a year	8
		Dispose of debris properly	9
Channel/Ditch		Inspect once a year	10
		Avoid overcleaning	11
		Alternate cleaned sections	12
		Dispose of sediments properly	13
Stream Channel		Keep records of problem areas	14
		Control pollution sources	15
		Stabilize erosion areas	16
		Revegetate with native species	17
		Dispose of sediments properly	18
Detention Pond		Inspect once a year	19
		Monitor drain times (24-72 hrs)	20
		Maintain vegetative buffer	21
		Dispose of debris properly	22
Other Facilities		Inspect once a month	23
		Monitor sediment build-up	24
		Check for clogged filter	25
		Dispose of debris properly	26
Retrofit Facilities		Consider retrofits w/ WQ benefits	27
		Match retrofits to land use	28

The importance of inspection

Why inspect? Regular maintenance of the storm sewers is important for flood control, structural integrity, and water quality reasons. This chapter suggests how often to clean, based on what other communities have found. But, ultimately each agency should determine the best schedule to meet its needs. The way to do this is through a routine inspection program.

In addition to helping determine how often to clean, regular inspection of the storm sewer system will identify problems. Small problems such as clogged inlets and illegal dumping can be addressed in short order before they cause serious damage or harm. Greater problems such as large amounts of silt build-up or streambank erosion should be studied further to identify the source of the problem and plan the best solution. Other problems that routine inspections might uncover are collapsed pipe and leaking joints. Both of these situations can saturate soils and cause sinkholes and flooding. Failing pipes can also allow dirt and sediment to enter stormwater, which carries the material out to streams and rivers.

How often to inspect? A good rule of thumb is to conduct inspection of storm drain inlets, ditches, channels, ponds and other treatment facilities at least once a year, prior to the beginning of the rainy season (August-September). Complete inspections early enough so that repairs can be made during dry weather. Catchbasins should be inspected at least once every six months. Some stormwater treatment devices, such as oil/water separators, may require more frequent inspection. For these, check the manufacturer's specification or other design guidance handbooks. Sewer pipes and culverts should be inspected every three to five years, or in response to a reported problem. Most agencies inspect their sewer pipes six inches or larger with a TV camera, and pipes 36 inches or larger with a walk-through inspection. All other parts of the system are inspected visually.

What to look for during an inspection? Look for excessive silt build-up, erosion, unusual algal growth, cracked or collapsed pipes, misaligned joints, and other signs of problems such as a sheen on the water surface, discolored water, or an unpleasant odor. Check with product manufacturers or stormwater handbooks for advice on what to look for when inspecting more sophisticated treatment devices such as flow splitters and diverters. When a problem is noted, take steps to correct the problem, or route this information immediately to

the appropriate individual(s) in your organization who can respond. If needed, develop a good response plan to ensure quick follow-up in the future.

Culvert/pipe cleaning and repair

Description:

A culvert is a relatively short section of pipe usually designed to convey flow under or away from a roadway. Because of its semi-open nature, it is prone to blockages from vegetation, trash, and other debris in addition to sediment. Localized flooding indicates the existence of problems. Inspection is usually a simple visual observation. Cleaning procedures also tend to be relatively easy, due to access from the open end, although it often requires some hand work. Most maintenance crews have an assigned territory and know which culverts are likely to cause flooding problems. In Western Oregon, routine inspections are typically conducted after large storms and in the fall, prior to the rainy season. At that time, culverts showing signs of structural failure are targeted for repair or replacement.

Pipes are longer than culverts and more likely to be deeper underground and located in areas such as backyards where access is difficult. Inspection and cleaning of pipes generally requires confined space entry training and procedures. That's the bad news. The good news is that pipes are less likely than culverts to become clogged. Tree roots, sediment buildup, collapse and poor alignment are all causes of blockage problems. In a survey conducted in Seattle in the 1970's, over half of sewer maintenance involved root growths, and about one third of pipes clogged due to sand deposits. Structural failure was reported as rare, unless the pipes were installed incorrectly. Problems with tree roots occur mostly in smaller, older pipes at shallow depths (12 inches or less, 1950's or earlier, and less than 10 feet in depth). Willows, poplars, cottonwoods, and other moisture-loving trees tend to be the most common culprits.

Culvert and pipe cleaning is usually done in response to flooding complaints. The main sources of maintenance problems in culverts and pipes are sediment accumulation, entry of roots and infiltration and inflow. Commonly used cleaning methods to remove sediments from storm sewer pipes (roughly in order of increasing cost) are:

- **Jet cleaning/ Vactor cleaning.** Jet cleaning flushes the sewer with water and collects the material flushed from the sewer in a basket as it gravity flows down the pipe. A vactor assembly is often combined with the jet to vacuum out the flushed water and debris.
- **Sewer balls** are placed in the upstream end of the sewer and forced through the pipe by a jet of water. There are many variations in terms of the sewer balls; some are ridged, for instance, causing them to spin and more thoroughly clean the pipe. This technique can be risky in terms of damage to pipes and is generally more common in Europe than the U.S.
- **Rodding** involves pushing cleaning tools through the sewer to clear blockages.
- **Bucket machines** drag buckets along a line from manhole to manhole to clear sewers.

There are four main ways to control root infiltration in sewer pipes:

- Construct infiltration-free systems.
- Seal joints or defects in existing pipes to prevent entrance of roots.
- Cut and physically remove root formations in the pipes.
- Kill roots with chemical applications.

☑ Clean Water Tips:

1. **Inspect sewer pipes and culverts at least every five years.** Schedule TV or walk-through inspections in order to identify and eliminate water quality and other structural problems.
2. **Use long-lasting cleaning measures.** For root removal, build-out and block-out are more permanent and have the least water quality impacts. These methods can last for 20 years or more. Removal of roots with power rodders with an attached cutting tool (clean-out), on the other hand, is effective for only three to twelve months. According to a study done by Sullivan in 1977, chemical applications tend to be effective for three to five years, if the pipes are temporarily blocked during application to increase residence time. However, there's always the risk that using chemicals will add pollution to stormwater.

3. **Use rodding instead of chemicals for removing roots.** Rodding is effective at removing roots, and to a lesser degree, sediment buildup.

4. **Prevent chemical pollution.** If chemicals must be used to kill roots, block pipes downstream of the application to prevent chemicals from traveling downstream. This also increases chemical effectiveness by increasing contact time with the roots. Foam chemicals are also more effective than liquid to increase the contact time and better fill the pipe. When the job is completed, vacuum the chemical residue and dispose of properly. Note that this residue may be regulated as a hazardous waste.

5. **Target maintenance to sewers most in need.** Perform maintenance only on those pipes which really need it. Sediment buildup depends on several factors, including sewer size and gradient. For most storm sewers that are sized and placed correctly, silt will begin to build up immediately after cleaning and reach an equilibrium within a few weeks or months. These pipes can go for years without requiring sediment removal. If sewer slopes are too gradual, however, the sewers are at risk of clogging. An optimization model developed for the City of Portland in 1995 showed these minimum slopes necessary to avoid clogging:

   - 2.1% for 8-12 inch pipes
   - 0.9% for 13-24 inch pipes
   - 0.3% for 25-47 inch pipes

6. **Install downstream debris traps before cleaning sewers.** Use baskets or other materials to trap silt and debris and a vacuum hose to collect it, instead of flushing the materials downstream.

Catchbasin/inlet cleaning and repair

Description

Catchbasin/inlet cleaning and repair has traditionally been performed to respond to localized flooding problems in streets. Catchbasins are inlets at the curb with a small trap (usually six inches to one foot deep) below the sewer pipe. These devices help to clean stormwater because particles in street runoff settle into the trap before the water enters the storm sewers. Catchbasins require regular cleaning of the sediment trap to be effective (see below). Since the late 1960's,

however, most agencies have stopped using catchbasins and are installing "self-cleaning" storm drain inlets instead. The inlets do not trap sediments and don't need cleaning unless they are plugged. Cleaning for either catchbasins or inlets can be done by hand (e.g., with a clamshell or shovel) or with a vacuum truck.

☑ Clean Water Tips:

7. **Inspect and clean catchbasins every six months.** Unlike inlets, catchbasins need to be cleaned even if they are not plugged, in order to receive the water quality benefits. Studies have shown that when 50 percent of the trap is filled, efficiency drops a lot. Therefore, to protect water quality, inspect catchbasins every six months and clean them out before they are half-full. Larger cities in Oregon have found that catchbasins in high traffic areas and in areas near construction sites may require more frequent cleaning. Many will also need cleaning each fall when the trees drop their leaves.

8. **Inspect and clean storm drain inlets once a year.** A good rule of thumb is to inspect inlets at least once a year before the rainy season, and clean them as needed based on the observations. However, inlets in problem areas may need cleaning several times a year to respond to complaints. In these cases, its usually worthwhile to track down the source of the problem and eliminate it, so that the cleaning schedule becomes more reasonable.

9. **Dispose of sediments and debris properly.** The sediment removed from a catchbasin may contain high levels of pollutants. It must be tested to determine if the waste is hazardous. Hazardous wastes must be disposed of in a licensed hazardous waste landfill. See Chapter 7 for more information. Collected leaves may be landfilled, or if possible, composted. Additional regulations for disposal of wastes cleaned out of stormwater facilities may be published by federal and state regulatory agencies in the future.

Drainage channel (ditch) maintenance

Description:

Removal of silt, debris, and overgrown vegetation helps to maintain the flood control capacity of drainage ditches. Sediment and debris

removal may also improve water quality downstream by removing the pollutants contained in those deposits. However, leaving some vegetation in place helps to prevent erosion, trap sediment, and filter stormwater. Maintenance frequency for ditches will vary and should be based on problems identified during inspection.

☑ Clean Water Tips:

10. **Inspect and clean ditches and channels once a year.** Generally, sediments need to be removed annually and mowing is necessary several times during the growing season. Small amounts of sediment or debris may be removed by hand. Larger deposits may require heavy machinery, such as a backhoe or specialized ditch cleaning equipment.

11. **Do not overclean.** Leave some vegetation along the banks of channels to help stabilize the soil and prevent erosion.

12. **Alternate cleaning.** When cleaning ditches, use machines to clear select sections and leave untouched sections in between to allow for filtering of stormwater and settling of sediments. The sections not cleaned on the first pass may be cleaned once the vegetation has reestablished itself in the previously cleaned sections.

13. **Dispose of sediments properly.** The sediment removed from a ditch may contain high levels of pollutants; if so, it should be disposed of properly. See previous note in this chapter about testing requirements to determine disposal options, and also refer to Chapter 7.

Natural stream channel maintenance

Description:

Like ditches, removal of silt, debris, trash, and overgrown vegetation helps to maintain the flood control capacity of stream channels. Sediment and debris removal may also improve water quality downstream by removing the pollutants contained in those deposits. However, leaving some vegetation in place can help prevent erosion, trap sediment, and filter stormwater. Care should be taken not to disturb wildlife or aquatic life in the stream, including any riparian vegetation which is needed for the wildlife to survive. Agencies

usually clean stream channels in response to complaints or a field staff's observation of a problem. Much of the maintenance work in natural streams is done by hand. When necessary, large sediment deposits may need to be removed by heavy machinery.

Unlike maintenance of man-made (and regularly cleaned) ditches, most of the maintenance of natural stream channels in Oregon requires permits from the Division of State Lands [(503)378-3805], and coordination with Oregon Department of Fish and Wildlife (ODFW), Habitat Conservation Division [(503) 872-5255]. This is particularly important for salmon-bearing streams. The permits specify a window of time for doing the work, as well as restrictions on how much
disturbance is allowed.

☑ Clean Water Tips:

14. **Keep records of problem areas.** Keep records of problems and complaints, and schedule more frequent cleaning of these areas accordingly.

15. **Control pollution sources to streams.** The emphasis in natural streams should be prevention of water quality problems by eliminating sources of pollutants. Use proper erosion control measures for construction activities occurring near streams. Maintain buffer strips of vegetation between the stream and roadways or other paved areas. For buffer areas, native grasses, shrubs, and trees are more effective than manicured lawns in filtering pollutants as well as providing shade.

16. **Stabilize erosion areas.** Stabilize eroded banks and stream channels to prevent sediments from washing downstream. Consider "bioengineered" methods that use jute netting, staked live willows, and other natural means to keep the bank secure while vegetation is establishing. See Chapter 10 for reference documents which describe these methods. Use structural measures such as riprap and log walls sparingly, since these usually do not provide wildlife habitat or shade.

17. **Revegetate with native species.** Revegetate exposed and eroding stream banks with native vegetation as much as possible, and establish trees to shade the streams and lower water temperature. Nuisance plant species, including non-native Himalayan blackberries and English ivy should generally be

replaced with native species, which provide more environmental benefits. See the native planting reference documents listed in Chapter 10, and refer to the local regional offices of agencies such as ODFW. Get local volunteer citizens groups involved in planting activities, as a low-cost alternative to agency staff.

18. **Dispose of sediments properly.** The sediment removed from a stream bed, especially in urban areas, may contain high levels of pollutants and should be disposed of properly. See previous note in this chapter about testing requirements and proper disposal options, and also refer to Chapter 7.

Detention pond maintenance

Description:

Detention ponds provide temporary storage for stormwater, which allows sediments and pollutants to settle out of the water to the bottom of the pond. Most ponds in the past were designed to hold back flood waters and release it slowly to streams, but these days, agencies are installing ponds for water quality benefits as well. The effectiveness of a pond is based on its ability to hold a certain amount of water, or design volume, for at least 24 hours. This allows enough time for particles to settle out.

In order to maintain the pond's design capacity, silt must be removed from time to time. This is usually done using draglines or bucket dredges (when the pond contains water), or bulldozer/backhoe (when the pond is drained of water). However, unless construction activities or other highly erosive activities take place upstream, it may be twenty years or so before sediment removal is required. More frequently, maintenance is needed to remove trash and debris, mow, and remove blockages from the pond's outlet structure.

☑ Clean Water Tips:

19. **Inspect detention ponds annually.** Inspect ponds once a year, preferably, after large storms. Check for flooding, trash, excessive silt build-up, undue algal growth and other signs of pollution such as oil sheens, discolored water or unpleasant odors. Schedule cleaning if needed.

20. **Monitor drain times.** For the best water quality benefit, the pond should hold water for at least 24 hours. It should drain within 72 hours to avoid conditions which might increase water temperatures, deplete oxygen, and/or cause odors.

21. **Maintain and protect vegetative buffer around ponds.** As with natural channels, a buffer zone of vegetation should be left around the pond perimeter. Within the buffer strip the grass should be kept at a longer height and shrubs and trees encouraged for shade. Also take care to protect native vegetation and wetland plants in and around ponds.

22. **Dispose of sediments properly.** The sediment removed from a detention pond, especially in urban areas, may contain high levels of pollutants and should be disposed of properly. See previous note in this chapter about testing requirements and proper disposal options, and also refer to Chapter 7.

Maintenance of other stormwater treatment devices

Description:

Many other types of stormwater treatment devices exist and more are being invented all the time. Most fall into one of three categories:

- Settling devices that remove pollutants by settling, such as oil/water separators, sedimentation basins, vortex separators, and sedimentation manholes;
- Filtration devices that remove pollutants by filtration, including grassy swales, vegetated filter strips, compost filters, sand filters, and infiltration sumps;
- Facilities which remove pollutants by a combination of settling and filtration, such as wetlands.

Generally speaking, the settling devices are better at removing large loads of sediment and require less maintenance. Devices which use filtration measures tend to be overwhelmed by large loads of sediment and require more maintenance, but they are better at removing finer particles and associated pollutants which are suspended in water.

Because each type of treatment device treats stormwater differently, many agencies encourage them to be installed in series (e.g., a sedimentation basin followed by a wetland).

☑ Clean Water Tips:

23. Inspect monthly. Inspection frequencies for treatment devices will vary according to the amount of rain, presence of leaves and nearby construction activities. A good rule of thumb is monthly just before and during the wet season.

24. Monitor sediment build-up. Check stormwater setting devices and filters regularly for sediment build-up, and remove when about half of catchment area of filter capacity is reached.

25. Check for clogged filter. The most common cause of failure for filtration devices is clogging. If water is not draining through the filter it may need cleaning or replacement.

26. Dispose of sediments properly. The sediment removed from sedimentation and filtration facilities may have elevated levels of pollutants (particularly in industrial areas) and should be disposed of properly. See the discussion regarding testing requirements and disposal options previously in this chapter. Also refer to Chapter 7.

System retrofitting

Description:

In the past, flood control efforts have focused primarily on decreasing the volume or peak rate of water that abruptly enters waterways as a result of new development and an associated increase in paved surfaces. Traditional methods to reduce flooding include dry detention basins to temporarily detain and store water, channelization of drainage courses and streambank hardening to increase carrying capacity of the receiving stream, and floodplain restrictions that limit development in flood-prone streamside areas. These types of flood control measures were not designed to control stormwater pollution caused by increased urbanization. The historical focus was on quantity control, not quality control.

Today, urban planners and designers recognize the importance of designing systems with both flood control and pollutant removal in mind. This works for new facilities, but existing facilities may require modifying, or retrofitting. Projects might include enlarging structures, changing the inflow and outflow patterns, and increasing detention times. Retrofits can be done as stand-alone projects, or as a part of repair and replacement projects scheduled for the future. Usually retrofits are done on older parts of the storm sewers in areas that are already built out. With the premium on space, the following suggested measures are typically more feasible than large land-intensive facilities:

- Replace simple drain inlets with trapped catch basins.
- Install compost filters in manholes.
- Replace lawns with sustainable, low-maintenance native vegetation for greater pollutant filtering.

☑ Clean Water Tips:

27. Include water quality considerations in retrofits. If a storm sewer facility needs replacement because of poor condition, consider replacing it with one that also improves water quality. An example is replacing inlets with trapped catch basins.

28. Match retrofits to land use. Opportunities for retrofits of the storm sewer system often exist in older, more industrialized areas where pipes tend to be older. For retrofits, choose facilities that provide the best stormwater treatment benefits for the type of pollutants expected from the land use (e.g., industrial, commercial or residential).

Case Study -

The Unified Sewerage Agency Retrofits Facilities With Native Vegetation to Reduce Maintenance Burden

USA's field operations crews are responsible for maintaining more than 260 public stormwater pretreatment facilities. With 60 more coming on-line in 1998 alone, the maintenance burden could become overwhelming. So, how are they addressing the issue? USA says "shrub them up". More than 4800 trees and shrubs have been added to the neighborhood pretreatment ponds where mowing and access are difficult. Not only does it reduce long term maintenance costs, it also adds native plants back to the landscape and beautifies the often unattractive sites.

USA also requests that all new facilities be heavily vegetated with low maintenance, native plants. USA plans to promote an "Adopt-a-Facility" program in the near future, to get the neighbors involved in preserving these remaining open spaces.

Contact: Kendra Smith,
Unified Sewerage Agency of Washington County,
(503) 844-8118.

Research Notes -

Santa Clara Valley's Catch Basin and Storm Sewer Cleaning Study

In summer 1992, the Santa Clara Valley Nonpoint Source Pollution Control Program in California conducted a study to observe catch basin cleaning operations in a city and make recommendations for improvements. The following are the key study findings:

- Establish a committee to recommend new and innovative cleaning methods and establish minimum standards for catchbasin cleaning.
- Clean catch basins once a year in the fall, prior to the rainy season. Note: a study conducted later in 1993 by Alameda County, California indicated that its generally not cost-effective to clean catch basins more than twice a year.
- Develop reporting forms to record: date, street name, catch basin identification number, unusual observations, dry weather flows, amount of debris removed, location of catch basins not inspected and why, and follow-up required.
- Develop public education tools for distributing in problem areas, such as door hangers and informational brochures.
- Use vacuum trucks instead of flushing.

The study also found that many people were dumping illegally into catch basins or manholes. This included concrete contractors, pesticide applicators, carpet cleaning companies, pool maintenance companies, commercial painters and newspaper delivery people. Many of these situations contribute pollutants to stormwater, or deter maintenance staff from their inspection and cleaning duties. To address the problem, letters were sent to local trade associations in the Santa Clara Valley warning companies of penalties and fines and informing them of the negative environmental impacts of their actions.

Contact: Phil Mineart,
Woodward-Clyde, Oakland, CA,
(510) 893-3600.