CITY OF LEBANON
Storm Drainage Master Plan

CHAPTER 10

10.0 WATER QUALITY

Storm water quality issues are receiving increased public and agency interest. "Non-point source" loads are naturally occurring or man-made contaminants which are dissolved or suspended by storm runoff and transported by that runoff to waterways of interest. They are generally of low concentrations but can cause cumulative impacts. These non-point source loads are distinguished from the "point source" loads, such as those which are intentionally discharged at some tolerable concentration at sewage treatment plants.

This chapter discusses types of non-point source contamination, frequently cited sources of those contaminants, common methods of contaminant removal, regulatory climate, and recommendations.

10.1 TYPES OF NON-POINT SOURCE CONTAMINANTS

Non-point contaminants can include the following:

Nutrients (such as phosphorous and nitrogen)

Nutrient contaminants can result from such sources as leaking septic or sanitary systems, domestic animal wastes, application of fertilizers to lawns or crops, detergents (washing cars), and from decaying plant debris.

In excess, nutrients are a problem to streams because they act as fertilizers for any aquatic plant life. If excessive nutrients are present and other factors such as temperature and sunlight are suitable, then heavy algae blooms will result. As the nutrients are used up, the stream can no longer support such dense blooms and the algae dies, often forming a foul smelling scum on the surface. This scum is eventually digested by naturally occurring "aerobic" bacteria in the streams, but in doing so the bacteria consume dissolved oxygen from the stream. When the water is heavily fouled with rotting algae, this oxygen demand can exceed the oxygen available in the stream and no dissolved oxygen remains to support the fish population. In the absence of dissolved oxygen, "anaerobic" bacteria flourish. These bacteria generally
produce foul smelling by-products, such as sulfur dioxide and hydrogen sulfide. The result is a "dead" stream. The above description is certainly "worst case". Under normal circumstances, this photo-chemical process

occurs naturally and, with tolerable nutrient loads, streams can successfully assimilate this type of contaminant.

Sediment

Sediment is considered to be a non-point source contaminant because, in excess quantities, it can cause turbidity in streams and can gradually reduce the flood storage and conveyance capacities of slow moving creeks.

Sediment transport is the consequence of erosion. Erosion can occur at construction sites, along poorly protected banks of fast moving creeks or ditches, from agricultural fields, and from landscaped areas.

Bacteria

Generally, the bacteria of concern are those which result from human or animal wastes. While some bacteria are not harmful for human ingestion in themselves, they are frequently indicators for other harmful bacteria and viruses. Fecal coliform bacteria contaminants originate as wastes from warm-blooded animals including humans and can be introduced into the watershed from leaking septic or sanitary systems, combined sewer overflows, and from domestic animal or pet feces.

Organic Compounds and Solvents (benzene, oil, gasoline, and tri-chloro-ethane etc.)

Organic compounds can be soluble or insoluble in water and they can be lighter or heavier than water.
Light floating solvents such as gasoline or oil will often be transported by surface "sheet" flow. In small quantities, these substances will be adsorbed by plants and soils along the way, will be broken down by oil-philic bacteria, will evaporate, or will be carried further downstream. Large quantities, such as those which result from an actual surface spill will often be detected. Leaking underground fuel tanks, on the other hand, can contribute to ground water contamination for years without detection. Leaking fuel will generally migrate downward until the water table is reached and then will migrate along the surface gradient of the water table.

Heavier-than-water insolubles such as TCE will tend to migrate downward though the soil horizons rather than be transported by surface runoff.

Soluble organics, such as anti-freeze (ethylene glycol), are difficult to remove and will be transported as one with storm runoff and stream flow. Some of these soluble organics will be broken down to simpler compounds naturally and will be assimilated by natural biological processes in the waterway.

Activities of concern include domestic oil changing, steam cleaning, degreasing, industrial activities, underground fuel tanks, use of pesticides, and improper disposal of household cleaners, paint, etc.

Metals (primarily lead, cadmium, copper, and zinc),

Trace metals are a concern because of their potential toxic effect on aquatic life and their potential impact on drinking water supplies downstream. Metals in the stream sediments can enter the food chain through bottom feeding species and benthic (clams, etc.) organisms.

Metals are often adsorbed by sediments and remain in the stream bed near their source unless the sediment itself is washed downstream by a storm event.

Significant metal contaminants can be produced by industrial processes, leaded gasoline, the wearing of brake shoes and tires, etc.

10.2 COMMON METHODS OF REMOVAL

Different types of contamination can be reduced with varying degrees of success by using known techniques for removal.

Nutrient Removal

Nutrients, where they originate in high concentrations, such as from failed septic systems and leaking sanitary sewers, can be most easily controlled at the source rather than trying to treat the diluted flow further downstream. Once they are in-stream, nutrients are most effectively removed by passage through an area where plant uptake of the nutrients is significant. These areas can be naturally occurring or man-made grassy swales, streambeds, detention ponds, or wet ponds. In each, the objective is maximize the amount of surface contact and contact time with the plants. Phosphorous remains with the plant growth or adsorbed by bottom sediments, and will be re-dissolved by future flows when the vegetation ultimately decays or when agitating flows occur. Phosphorous can only be permanently removed from the waterway by removal of the plant growth such as by mowing a grassy swale and then disposing of the clippings elsewhere.

Sediment Removal

In all cases, erosion can be reduced substantially through proper management at the source. Construction sites are often heavy contributors because land is

generally left unprotected. Techniques such as straw bales, silt fences, woven matting, detention ponds, and temporary swales can be used to slow the velocity of storm water runoff to the extent that most of the transported sediments will be deposited and will remain on the site. Another technique which can be used in addition to the above methods is to require graveled exit routes from sites to remove most of the mud from vehicle tires prior to the vehicle leaving the site.

Some sediment, such as windblown dust or car dirt, will inevitably get transported by storm water runoff. Sumped catch basins with inverted syphons can be used with moderate success to remove coarser sediments. These same style catch basins will also tend to remove the trace metals which tend to adhere to such sediments, oils and greases.

Bacteria Removal

Fecal Coliform bacteria are to be expected in all surface streams. The concern when the colonies present reach high numbers is that it is likely that other more dangerous pathogens may be present. High concentrations are not generally caused by normal surface activity in the watershed but rather by such specific contributors as failed septic systems, leaking sewer pipes, or by a dead animal in the stream.

The most effective solution for bacterial contamination is to pinpoint the source through selective testing in the affected watershed and to eliminate the source.

Once in the runoff stream, the same removal options as described under nutrient removal above will have some beneficial effect, but if the primary sources are removed, specific downstream treatment methods are not generally required.

Organic Compounds and Solvent Removal

Oils and grease on pavements can often be effectively removed by catch basins of the syphon type. The floating grease and oils are retained in the catch basin until cleanout. Some significant fraction of the greases and oils will also be removed by the grassy swale and detention options discussed under the nutrient removal section above.

Where oils are stored in bulk or are loaded/off-loaded in quantity, the Department of Environmental Quality (DEQ) requires a "Spill Prevention, Containment, and Control" (SPCC) Plan. This plan requires, among other things, that a means to contain oil spills be installed at facilities which regularly handle bulk quantities of oil. Such measures, if implemented, are effective at controlling major spills at specific commercial and industrial sites.

Spill prevention plans do not prevent an individual, however, from pouring crankcase oil in a catch basin. Education and the availability of a convenient recycle or disposal alternative are the keys to minimizing this source.

Properly used, many household cleaners, herbicides and pesticides are a great convenience and are generally not a major threat to the environment. However, improperly used or disposed of, they can be a cause for concern. Again, the method to minimize these sources is through education about the proper use and disposal of these chemicals.

Specific industrial and commercial activities may be of concern depending on the types of chemicals which are used, stored, or manufactured on the site and also depending on how well those chemicals are prevented from being washed into the runoff stream during a rainfall event. It is possible to require the type and amounts of potentially hazardous chemicals which are used, stored, or manufactured on site to be reported to the City. The City would then be aware of the potential risk at the site and could consider measures which could reduce specific risks, or specific types of risks, if appropriate.

Trace Metal Removal

Trace metals can be added to the runoff stream from both diffuse as well as from concentrated sources. Diffuse sources cannot be controlled at the source but significant removal value can be achieved through the use of sump type (inverted syphon) catch basins and through the use of the removal alternatives discussed for nutrients above. Specific industrial sources are best controlled at the site of origin.

The following advantages and disadvantages are associated with the following types of removal methods:

Grassy Swales, Wet Ponds, and Detention Ponds

Advantages:

- Can often be integrated into landscaped or greenway areas
- Can often be planned to serve multiple drainage purposes such as detention and storm water conveyance, in addition to water quality enhancement
- Can serve to create opportunities for wildlife habitat enhancement within an urban setting

Disadvantages:

- Are more difficult and time consuming than piped systems to maintain
- Consume more dedicated surface area than piped systems (which can be aligned in roads)

Sumped and Syphoned Catch Basins

Advantages:

- Are effective in removal of sediments, trace metals which tend to adhere to those sediments, oils, and greases
- Do not consume land area

Disadvantages:

- Are more time consuming to clean than "un-sumped, self-cleaning" catch basins
- Access for maintenance of catch basin leads more difficult
- Must be cleaned frequently to be of any value, since turbulence from flow through the catch basin will tend to re-entrain the oil and suspend the sediments.
- Disposal of sediments is currently a problem. The sediments may some day be considered hazardous waste.

10.3 AGENCY CLIMATE

The regulatory trend is clearly toward more stringent water quality requirements. It is expected that the US Environmental Protection Agency (EPA) will soon adopt rules which will require the identification, testing and monitoring of storm water outfalls. These rules are part of the implementation of the National Pollution Discharge Elimination System (NPDES) for storm water discharges (40 CFR Parts 122, 123, 124, and 504). This procedure, as currently drafted, will initially apply only to cities which are larger in population (over 100,000) than the City of Lebanon. Smaller cities would be required to
comply with reporting requirements in subsequent years. These rules, as currently drafted do not establish limits for discharge; they will establish inventory, sampling, testing and reporting requirements. However, as information on storm water discharges is collected, it is expected that limits on discharged concentrations of contaminants will eventually be established for storm drain outfalls.

10.4 RECOMMENDATIONS

Although the future storm water quality regulations have not yet been finalized by the EPA, the direction is apparent and several steps may be prudent to take in anticipation of the actual implementing rules. The following actions are recommended with respect to storm water quality:

1. **Water Quality Sampling**

   It is recommended that the City initiate a modest water quality sampling program. This program has several goals:

   A. To document the current level of non-point source loading which might provide the basis for reasonable future allocation limits.

   B. To provide information which may serve to locate and eliminate specific illicit inflows or flows which otherwise excessively impact the water quality of storm runoff.

   C. To provide information which may help to more accurately estimate the impact from future development and to determine if it will be necessary to implement any more demanding water quality measures with the watershed.

2. **Catch Basin Types**

   It is recommended that the City consider adoption of the syphon style of catch basins for public street drainage as well as for private facilities and that this style be used as new catch basins are built or as old catch basins are replaced within the normal schedule of maintenance and improvements.

3. **Preservation of Open Channel Waterways**

   It is recommended that natural existing open channel waterways be retained as such to the extent possible, rather than allow their replacement with piped systems. Exceptions to this policy should include situations where the waterway cannot be maintained sufficiently free from encroaching vegetation or human activities to prevent flooding of adjacent lands due to such encroachment.

4. **Require Water Quality Facilities for Large Developments**

   It is recommended that commercial and industrial developments resulting in more than 10 acres of impervious surface be required to construct water quality treatment facilities as described in Chapter 9, "Drainage System Standards," section 9.10.