Part IV(b)

Best Management Practices for Erosion, Sediment, and Velocity Control Continued...

Good Housekeeping Practices
Inlet Protection

BENEFITS

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**Description:** Inlet protection devices consist of a variety of manufactured sediment barriers and products, which are used to filter runoff before it enters the storm sewer system.

**Typical Uses:** Inlet protection is considered the last line of protection against releasing sediment into the stormwater system or a water body. Inlet protection should be considered around all stormwater intakes and culverts that accept runoff from disturbed areas.

**Advantages:**
- Provide one last opportunity to remove suspended particles from stormwater runoff.
- Areas requiring protection are easy to identify during both planning and construction.

**Limitations:**
- Available practices are not effective at removing fine particles.
- May be used improperly as the sole method of erosion and sediment control.
- Require high level of maintenance.
- Limited to treating runoff from areas of 1 acre or less.

**Longevity:** Varies by product; until sediment accumulates and clean out is required

**SUDAS Specifications:** Refer to Section 9040, 2.18 and 3.24
Inlet Protection

- Consist of a variety of manufactured sediment barriers and products that are used to filter runoff before it enters the storm sewer system.

- Considered the last line of protection against releasing sediment into the stormwater system or a water body.

- Use around all stormwater intakes and culverts that accept runoff from disturbed areas.
Siltsaver Curb Inlets
Placement Recommendations

- NEVER completely block off an inlet; it causes a safety hazard by flooding the roadway and the sediment-laden water will just pass by to the next inlet.
- On a sideslope consider several j-hooks on uphill side
- Don’t force water to an offsite inlet that drains to a permanent stormwater feature such as a retention basin etc.
It is important to monitor inlets during construction and to remove them after the project is completed.
Beehive Intake Protection
Stabilized Construction Entrance

**Description:** A stabilized construction entrance is a temporary, stabilized layer of large aggregate that is located at any point where traffic enters or leaves a construction site and enters a public road or other paved areas. Effectiveness depends on length, depth of rock, frequency of use, and maintenance of temporary rock entrance.

**Typical Uses:** Used where construction vehicles leave a construction site and enter onto a public street. The purpose of the rock entrance is to prevent mud from being tracked out onto the roadway, where it can cause plugging of storm sewers and fugitive dust problems.

**Advantages:**
- Low cost (based on stone availability) and easily installed.
- Helps prevent tracking of mud onto public streets, reducing fugitive dust and clogged storm sewers.
- Provides stable exit/entrance for construction traffic.

**Benefits**

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A stabilized construction exit is a temporary, stabilized layer of large aggregate that is located at any point where traffic leaves a construction site and enters a public road or other paved areas.

Effectiveness depends on length, depth of rock, frequency of use, and maintenance of temporary rock exit.

Used where construction vehicles exit a construction site onto a public street. (Must protect all entrances, not just the main entrance.)

The purpose of the rock exit is to prevent mud from being tracked out onto the roadway, where it can cause plugging of storm sewers and fugitive dust problems.
Installation and Maintenance

- Use fabric under rock, 2-3” clean rock, 6-12” deep
- When pore spaces filled time to replace or refresh
- Other options include rumble strips, reusable pads, tire washing
# Sediment Basin

## Description:
Sediment basins, like sediment traps, are temporary structures that are used to detain sediment-laden runoff long enough to allow a majority of sediment to settle out. Sediment basins are larger than sediment traps, serving drainage areas between 5 and 100 acres.

Sediment basins use a release structure to control the discharge, and normally have an emergency spillway to release the flow from larger storms. If properly planned, the basins may also serve as permanent stormwater management facilities, such as detention basins or permanent sediment removal structures.

## Typical Uses:
Used below disturbed areas where the contributing drainage area is greater than 5 acres. Basins require significant space and the appropriate topography for construction.

## Advantages:
- Can greatly improve the quality of runoff being released from a site by removing suspended sediment on a large-scale basis.

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GP#2 Requirement

- For common drainage locations that serve an area with more than 10 disturbed acres at one time, a temporary or permanent sediment basin providing 3,600 cubic feet of storage per acre drained shall be provided where attainable until final stabilization of the site has been achieved.

- The 3,600 cubic feet of storage area per acre drained does not apply to flows from offsite areas and flows from onsite areas that are either undisturbed or have undergone final stabilization where such flows are diverted around the sediment basin.
Outlet Structures

- Utilize outlet structures that withdraw water from the surface when discharging from basins, provide and maintain natural buffers around surface waters and direct storm water to vegetated areas to both increase sediment removal and maximize storm water infiltration.

- Use of skimmers
Sediment Basins

- Sediment basins are temporary structures to detain sediment to allow settling.

- Located downstream of disturbed areas larger than 5 acres. (*Sediment traps* - located downstream of disturbed areas of 5 acres or less).

- Catches drainage from areas 5-100 acres in size.

- Controls discharge with a release structure.

- Can serve as a permanent sediment removal structure.
Sediment Basin (5 - 100 acre drainage)

Slope stabilization

Inlet/Outlet protection
Sediment Basins

- Those converted to Retention Basins need skimmer device and outlet protection
- Those converted to Detention Basins need subsurface drainage, skimmer device, and slope stabilization
Maintenance

- Skim water from surface, most clarified
- May need flocculants if a lot of fine clay particles-difficult to settle out
- Restabilize side slopes
- Dredge if filled
Sediment Trap (less than 5 acres drainage area)
Rock embankment used for outlet
would allow for exact sizing of the outlet, are available. However, these equations require that the porosity of the stone be known. In addition, an adjustment would need to be made to account for clogging of the voids over time. These criteria are difficult to determine, therefore, it is recommended that the width of the embankment be based upon the drainage area as indicated in the following table:

Table 7E-13.01: Embankment Widths for Sediment Traps

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<tr>
<th>Contributing Drainage Area (acre)</th>
<th>Embankment Width (feet)</th>
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<tbody>
<tr>
<td>1</td>
<td>4</td>
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<tr>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>12</td>
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Source: Roberts, 1995 (FHWA)
Sediment Traps

- Placement - located at lowest point in construction site
- Sizing based on settling velocities of the soil particles
Flocculents

Description: Flocculents are natural materials or a class of chemicals that cause colloidal particles (clay) to coagulate. The coagulated particles group together to form flocs that will settle out of detained stormwater.

Typical Uses: Used in conjunction with sediment basins and sediment traps to remove suspended clay and fine silt particles from stormwater runoff prior to discharge.

Advantages:
• Ability to remove fine particles that would not settle out otherwise.
• Increases the percentage of fines removed during the detention period.
• May be used to remove suspended particles during dewatering operations.

Limitations:
• Requires specific dosing of the appropriate flocculent to achieve proper sedimentation.

BENEFITS

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Source: Applied Polymer Systems, 2006
How it works

- Coagulants are chemicals added to turbid stormwater to aid in the removal of suspended colloidal particles.
- Negatively-charged soil particles are attracted to the positively-charged coagulant particles. These particles stick together and form a larger, neutrally-charged particle called a floc.
- Since the colloidal particle forms a neutrally-charged floc, it no longer repels other particles, and can combine with other floc particles.
Can’t use just any coagulant, some harmful to fish and other aquatic life

Chitosan made from crustacean shells safe for aquatic life
Dewatering

Photos courtesy of Dwayne Stenlund, MNDOT
Dewatering: Dewatering box with slash wood mulch filter
Rock filter

Floating Skimmer
**Flotation Silt Curtain**

**Description:** A flotation silt curtain (also called a turbidity curtain) consists of a geosynthetic fabric that is suspended vertically in a body of water. The top of the curtain is attached to floats, and the bottom is weighted.

**Typical Uses:** Flotation silt curtains are used when construction occurs in a water body or along a stream bank or shoreline. Flotation silt curtains prevent sediment, which is stirred up during construction, from migrating out of the work area and into the rest of the water body.

**Advantages:**
- Allows for containment of sediment-laden water within a water body.
- Protects contained water from turbulence, allowing particles to fall out of suspension.

**Limitations:**
- Limited to use only in areas where other erosion and sediment control practices cannot be used.
- Cannot stop the flow of a significant amount of water.
- Must not be used to filter entire stream flow.
- Difficult to move fine-sized silt particles.

**Benefits**

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Flotation Curtains

- Geosynthetic fabric suspended vertically in a body of water such as a lake or river
- Top is attached to floats and bottom is weighted
- Prevents sediment from getting stirred up during construction
- Three different types based on strength and flow through
Velocity Controls
Check Dams

**Description:** Check dams, sometimes called ditch checks, consist of a vertical barrier constructed across swales, ditches, and waterways. These structures are most commonly constructed of erosion stone, although silt fence and manufactured devices are also used. Straw bales were used at one time, however, due to their high rate of failure and low level of effectiveness, their use is severely limited.

**Typical Uses:** Check dams are used to control the velocity of concentrated runoff in ditches and swales, and to prevent gully erosion until the channel can be stabilized. The structures may also provide some sediment removal benefits, however this is not their primary function.

**Advantages:**
- Highly effective at reducing flow velocities in channels.
- Simple to construct.
- Low maintenance.
Check Dams

- Check dams, sometimes called ditch checks, consist of a vertical barrier constructed across swales, ditches, and waterways.

- Check dams are used to control the velocity of concentrated runoff in ditches and swales, and to prevent gully erosion until the channel can be stabilized.

- The structures may also provide some sediment removal benefits, however this is not their primary function.

- Rock, silt fence, filter socks, triangular silt dikes
Elevation of the toe of the upstream check dam is equal to the elevation of the crest of the downstream check dam. This allows the water between the check dams to pond, resulting in a greatly reduced flow velocity.

As a rule, check dams should not be spaced closer than 20 feet in order to allow for proper maintenance. If slopes and check dam height call for a spacing closer than 20 feet, a Rolled Erosion Control Product or Turf Reinforcement Mat should be considered as an alternative.

**Figure 7E-7.02:** Typical Check Dam Spacing  
(From SUDAS Specifications Figure 9040.6)
Rock Check Dams
Erosion stone complying with Iowa DOT Article 4130.04
Triangular Silt Dike

- Fast & Easy Installation
- Effective Sediment Control
- Conforms to Rough Terrain
- Lightweight & Durable
Length of 40” (1 meter)
Height of 9” (230 mm)
Inside width of 11” (270 mm)
Weight of 2.2 pounds (1 kilogram)
Silt Fence, Filter Socks
Maintenance

- Clean out impounded sediment
- Repair rills, washout areas
- May have to add more check dams
- Use in combination with other practices
Silt Fence and Straw Bales

Silt Fence on the downside of the drainage way

Staked straw bales upagainst silt fence on the uphill side
Temporary Earth Diversion Structures

Description: Consists of an excavated swale, berm, or combination of the two, constructed in such a manner as to direct water to a desired location.

Typical Uses: Diversion structures are used to intercept surface and shallow subsurface flows and divert this water away from disturbed areas, active gullies, and critically eroding areas. Diversion structures can also be constructed along slopes to reduce the slope length, intercepting and carrying runoff to a stable outlet point or letdown structure.

Advantages:
- Reduces the volume of flow across disturbed areas, thereby reducing the potential for erosion.
- Breaks up concentration of water on long slopes.
- Maintaining a separation between clean water and sediment-laden water allows sediment basins and traps to function more efficiently.

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Source: Clackamas County, 2000
Diversion Structure

- Consists of an excavated swale and/or berm constructed to direct water away from disturbed land areas likely to be erodible.

- Diversion structures can also be constructed along slopes to reduce the slope length, intercepting and carrying runoff to a point stable outlet point or letdown structure.

- Maintenance and repair needed on eroded areas, washouts.
Temporary Diversion
Level Spreaders

Description: A level spreader is a low-cost method to convert small volumes of concentrated runoff into sheet flow and release it onto an area stabilized by existing vegetation.

Typical Uses: Level spreaders are commonly used at the outlet of a diversion structure or sediment removal structure to convert concentrated flow to uniform sheet flow prior to releasing the runoff onto stabilized downstream slopes. Level spreaders are also used to convey runoff from impervious surfaces, such as parking lots, onto vegetated areas or into detention basins.

Advantages:
- Widely used BMP due to ease of installation and availability of materials.
- Low cost and simple to construct.

Limitations:
- Flows from a level spreader should be limited to clean, diverted runoff, or runoff that has been passed through a sediment trap.
Level Spreader

- A level spreader is a low-cost method to convert small volumes of concentrated runoff into sheet flow and release it onto an area stabilized by existing vegetation.

- Level spreaders are commonly used at the outlet of a diversion structure or sediment removal structure to convert concentrated flow to uniform sheet flow prior to releasing the runoff onto stabilized downstream slopes.

- Level spreaders are also used to convey runoff from impervious surfaces, such as parking lots, onto vegetated areas or into detention basins.
Rock Chutes and Flumes

**Description:** Rock chutes and flumes are devices used to convey concentrated flows down an embankment or slope to a lower level without causing erosion.

**Typical Uses:** Commonly used as a permanent feature at the release point where runoff enters a ditch, stream, or lake. They are also used as a temporary measure to stabilize the inlet slope to a sediment trap or basin.

**Advantages:**
- Stabilizes slopes and areas where high flow volumes occur.
- Prevents further erosion at entrance to sediment removal devices, reducing the required cleanout frequency.

**Limitations:**
- May not be considered aesthetically pleasing for permanent installations.
- May be a relatively expensive measure for temporary structures.

**Benefits**

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Rock Chutes and Flumes

Rock chutes are devices used to convey concentrated flows down an embankment or slope to a lower level without causing erosion.

Commonly used as a permanent feature at the release point where runoff enters a ditch, stream, or lake.

They are also used as a temporary measure to stabilize the inlet slope to a sediment trap or basin.
Maintenance

- Replace revetment stone-rock when needed
- Use large enough revetment stone
Rip Rap

Description: Rip rap is a common method of protecting a channel downstream of a storm sewer or culvert outlet from erosion. A layer of crushed stone placed on the bottom and sides of the channel protects the channel and dissipates the energy of the high velocity flow.

Typical Uses: Used at the outlet of storm sewer pipes, roadway and driveway culverts, and at any point concentrated runoff enters a channel.

Advantages:
- Widely used method of erosion protection.
- Materials are readily available in most areas.
- Effective at reducing scour when properly designed and installed.

Limitations:

Source: Mississippi State University

BENEFITS

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Rock Outlet Protection

- Rock outlet protection is a common method of protecting a channel downstream of a storm sewer or culvert outlet from erosion.

- A layer of crushed stone placed on the bottom and sides of the channel protects the channel and dissipates the energy of the high velocity flow.

- Used at the outlet of storm sewer pipes, roadway and driveway culverts, and at any point concentrated runoff enters a channel.
Flow Transition Mats

Description: Transition mats are a synthetic alternative to using rip rap.

Typical Uses: Used to dissipate energy and prevent scour at the transition from highly concentrated flow outlets to channel flow.

Advantages:
- Vegetated condition is more aesthetically pleasing than rip rap.
- Installation can be mowed with conventional equipment.
- May be utilized as a temporary measure.
- May be more economical than other “hard-armor” methods.
- Installation does not require any heavy equipment.

Limitations:

BENEFITS

Flow Control

Erosion Control

Sediment Control

Runoff Reduction

Flow Diversion

Source: ScourStop, 2006
Flow Transition Mat

- Transition mats are a synthetic alternative to using riprap.

- Used to dissipate energy and prevent scour at the transition from highly concentrate flow outlets to channel flow.

- Can get some undercutting if not properly placed.
Temporary Pipe Slope Drains

**Description:** Temporary slope drains consist of a pipe or tubing, installed from the top to the bottom of a disturbed slope. The drain transports concentrated runoff down the slope to a stabilized outlet, reducing the potential for erosion caused by runoff flowing over the disturbed slope.

**Typical Uses:** Used to transport concentrated runoff collected by a diversion structure, down a slope to a stable outlet or channel.

**Advantages:**
- Highly effective method for transporting runoff down a disturbed slope with minimal erosion.
- Easily constructed.
- Materials may be reused.

**Limitations:**

**BENEFITS**

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Source: Mississippi State University
Temporary Slope Drain

- Temporary slope drains consist of a pipe or tubing, installed from the top to the bottom of a disturbed slope.

- The drain transports concentrated runoff down the slope to a stabilized outlet, reducing the potential for erosion caused by runoff flowing over the disturbed slope.

- Used to transport concentrated runoff collected by a diversion structure, down a slope to a stable outlet or channel.
Temporary Stream Crossings

- Culverts
- Fords (Missouri Crossings)
- Bridges
Temporary Stream Crossings

- Avoid disrupting fish movement and migration
- Use clean, non-toxic materials
- Limit to low flow situations when possible
Good Housekeeping Best Management Practices for Pollution Prevention
Good Housekeeping Pollution Prevention Practices

- Staging area
- Concrete, paint, grout, spec mixer, mortar washout areas
- Solid Waste: Construction debris containment and handling
- Sanitary Waste: Porta-Potty locations
- Vehicle maintenance
- Chemical storage and handling areas
- Spill kit and prevention
Staging Area

- Stabilized entrance and parking area
- Sometimes location of SWPPP signage
- Construction trailer
- Equipment parking
- Storage of chemicals
- Porta-Potties
Concrete Washout

- Concerns: washout has high pH, similar to Drano
  IDNR refer to EPA guidance-lined systems

- Advances in technology also address contamination of on-site soils with washout
Stormwater Best Management Practice
Concrete Washout

Minimum Measure
Construction Site Stormwater Runoff Control

Subcategory
Good Housekeeping/Materials Management

Description of Concrete Washout at Construction Sites

Concrete and its ingredients
Concrete is a mixture of cement, water, and aggregate material. Portland cement is made by heating a mixture of limestone and clay containing oxides of calcium, aluminum, silicon and other metals in a kiln and then pulverizing the resulting clinker. The fine aggregate particles are usually sand. Coarse aggregate is generally gravel or crushed stone. When cement is mixed with water, a chemical reaction called hydration occurs, which produces glue that binds the aggregates together to make concrete.

Concrete washout
After concrete is poured at a construction site, the chutes of

Construction workers should handle wet concrete and washout water with care because it may cause skin irritation and eye damage. If the washwater is dumped on the ground (Fig. 1), it can run off the construction site to adjoining roads and enter roadside storm drains, which discharge to surface waters such as rivers, lakes, or estuaries. The red arrow in Figure 2 points to a ready mixed truck chute that’s being washed out into a roll-off bin, which isn’t watertight. Leaking washwater, shown in the foreground, will likely follow similar...
Best Management Practice Objectives

The best management practice objectives for concrete washout are to:
(a) Collect and retain all the concrete washout water and solids in leak proof containers, so that this caustic material does not reach the soil surface and then migrate to surface waters or into the ground water.

(b) Recycle 100 percent of the collected concrete washout water and solids.
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<th>pH Value</th>
<th>Examples</th>
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<td>ACIDIC</td>
<td>pH = 0</td>
<td>Battery acid</td>
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<td>pH = 1</td>
<td>Sulfuric acid</td>
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<td></td>
<td>pH = 2</td>
<td>Lemon juice, Vinegar</td>
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<td>pH = 3</td>
<td>Orange juice, Soda</td>
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<td></td>
<td>pH = 4</td>
<td>Acid rain (4.2-4.4)</td>
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<td></td>
<td>pH = 5</td>
<td>Acidic lake (4.5)</td>
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<tr>
<td></td>
<td>pH = 6</td>
<td>Bananas (5.0-5.3)</td>
</tr>
<tr>
<td></td>
<td>pH = 7</td>
<td>Clean rain (5.6)</td>
</tr>
<tr>
<td></td>
<td>pH = 8</td>
<td>Healthy lake (6.5)</td>
</tr>
<tr>
<td></td>
<td>pH = 9</td>
<td>Milk (6.5-6.8)</td>
</tr>
<tr>
<td></td>
<td>pH = 10</td>
<td>Pure water</td>
</tr>
<tr>
<td></td>
<td>pH = 11</td>
<td>Sea water, Eggs</td>
</tr>
<tr>
<td></td>
<td>pH = 12</td>
<td>Baking soda</td>
</tr>
<tr>
<td></td>
<td>pH = 13</td>
<td>Milk of Magnesia</td>
</tr>
<tr>
<td></td>
<td>pH = 14</td>
<td>Ammonia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Soapy water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bleach</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Liquid drain cleaner</td>
</tr>
</tbody>
</table>

Concrete Washout pH
CONCRETE WASHOUT

PART 1 - GENERAL

1.01 SECTION INCLUDES
Concrete Washout

1.02 DESCRIPTION OF WORK
Provide and maintain concrete washout system.

1.03 SUBMITTALS
Comply with Division 1 - General Provisions and Covenants.

1.04 SUBSTITUTIONS
Comply with Division 1 - General Provisions and Covenants.

1.05 DELIVERY, STORAGE, AND HANDLING
Comply with Division 1 - General Provisions and Covenants.
2.01 CONCRETE WASHOUT

Provide a concrete washout system that retains all concrete washwater and complies with one of the following:

A. Manufactured Washout Containment:
   1. Concrete Washout Containers: Provide roll-off type metal container that is leak-proof and designed specifically for collection of concrete and concrete washwater. When concrete pumper trucks are utilized, provide a ramp or other means to allow access for pumper trucks.
   2. Concrete Washout Collection Bags: Provide leak-proof collection bags designed specifically for collection of concrete and concrete washwater.
   3. Chute Washout Box: Provide ready mixed trucks with on-vehicle chute washout system to collect concrete washwater for return to the ready mixed plant.

B. Non-Manufactured Containment:
   1. Below-grade System: For excavated pits, provide an impermeable plastic liner with a minimum thickness of 10 mils.
   2. Above-grade Containment: For containment areas constructed from earthen berms, provide a double thickness of impermeable plastic liner with a minimum thickness of 10 mil per sheet.

C. Prohibited Products: Silt fence, unlined hay bales, unlined earthen embankments, and other practices that may allow concrete washwater to leak out of the containment area or to come in direct contact with the ground are not allowed.
Chute Wash-out Reclamation Systems

- Newer technology
- Washout on-site, reclaim aggregate
- Take wash water back to source for proper treatment
Roll-Off System

- Contain waste and remove from site
- Some materials can be recycled.
Bag System

- Contain wash water
- Remove waste from site
- Minimize soil contamination
Waste Storage and Handling

- Paint, grout, thinners, spec waste management
- Container method
- Contact local officials for disposal
Solid Waste Management
Covered Roll-offs for Wind Protection

- Litter is pollution
- Use a tarp
- Want neat and tidy site for site appearance and marketing purposes
On-site Sanitary Waste Management

- Available on-site
- Located in practical areas
- Staked down
Vehicle Maintenance

- Conducted on leak-proof pads
- Away from stormdrains
- Recycle fluids
- Inspect and repair leaky vehicles
Chemical Handling and Storage:

Secondary Containment

- Many choices available for containment structures
- Want material resistant to tank contents
Chemical Storage: Spill Kit

- Educate staff on location and response procedures, city staff, police, fire department, IDNR numbers

- Absorbent pads, sponges, socks, gels