TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

State Water Quality Certification of Section 404 Permits

One of the requirements for obtaining a U.S. Army Corps of Engineers Section 404 permit is certification from the Texas Commission on Environmental Quality (TCEQ) that the discharge to be permitted will comply with state water quality standards. Because these reviews are done under the authority of Section 401 of the federal Clean Water Act, they are referred to as Section 401 certification reviews.

Every state sets its own water quality standards. They serve many purposes, including acting as the yardsticks for measuring whether the quality of each body of water in the state is kept at the level necessary to perpetuate the human and aquatic life that has historically existed there. In allowing pollutants to be added to state water (which includes a broad range of substances such as chemicals, concrete, rock, sand, or other materials), both the federal and the state governments are required to be sure that the discharge will not create a condition that will impair the ability of life existing in or depending on the water to survive and reproduce. The state is charged with confirming that the federal permit accomplishes this. The TCEQ is the agency with primary responsibility for making sure we adopt and enforce state water quality standards. It conducts 401 certification reviews to ensure that Texas is involved in decisions made by the federal government that affect the quality of the water resources of this state.

The 401 certification program is also an important component for protecting our coastal resources under the Texas Coastal Management Program (CMP). The CMP is designed to accomplish goals set by the state legislature for coastal resource protection and to meet specific requirements for an approved plan under the federal Coastal Zone Management Act (CZMA). Certain activities, such as discharges of material authorized by Section 404 permits, must be consistent with the state CMP when they occur within the coastal zone boundary. Projects that are granted 401 certification are deemed to be consistent with the CMP.

Section 404 permits often involve impacts to wetlands, which, like all waters, are the responsibility of the state. Through 401 certification reviews of Section 404 permit applications, TCEQ is able to preserve these resources and the functions they perform in maintaining human and aquatic uses of state waters. Efforts to avoid and/or minimize adverse impacts to wetlands are taken to retain the important functions these water bodies provide for maintaining and improving water quality. The presence of wetlands on a site can provide important water quality benefits. Wetlands act like sponges, and can soak up and retain runoff, slowing down surface water, which reduces erosion and sedimentation downstream. By holding water, even temporarily, wetlands also remove and retain nutrients, process organic wastes and reduce sediment before the water continues downstream. Some wetlands also recharge underground aquifers that provide drinking water. Because wetlands are among the most biologically productive natural ecosystems in the world, many fish, wildlife, and plants also depend on wetlands for habitat, including a large portion of the threatened and endangered species that survive in Texas.

March 5, 2001

401 Certification Program Description:

TCEQ is developing a tiered system of review for all individual Section 404 permit applications based upon project size and the amount of state water affected. The extent of 401 certification review will vary between the different tiers, as well as the type of wetland affected.

Tier I:

Generally, for small projects that affect less than three acres of waters in the state, or less than 1500 linear feet of streams, TCEQ has determined that incorporating certain best management practices (BMPs) and other requirements into the project will sufficiently address the likelihood that water quality will remain at the desired level. For those projects, no further 401 review will be necessary if the permittee agrees to include those BMPs and requirements in their project which makes them part of their Section 404 permit. These BMPs are designed to minimize impacts to water quality. If a project has a combination of impacts that exceed the threshold or is submitted after the fact, it does not qualify as a Tier I project. For purposes of calculating the Tier 1 threshold, one acre of impact is considered equal to 500 linear feet of impact. Applicants desiring to utilize BMPs for Tier I projects must include a signed Tier 1 checklist with their application for an individual Section 404 permit. The checklist must incorporate all applicable BMPs for the proposed project, which the applicant has chosen to implement. If a complete checklist is submitted, no further review or certification by the TCEQ is required (unless an exception to Tier 1 applies C see below). When the permit is issued, the BMPs and other provisions of the checklist become part of it, and failure to implement any of them is a violation of the permit. Applicants who do not wish to incorporate all provisions of the checklist into their project or desire to use alternatives may seek individual 401 review and certification from TCEQ. The TCEQ will periodically review alternative BMPs for inclusion in the checklist.

The required BMPs and descriptions of each are included in this packet.

Exceptions:

Projects that impact certain types of rare or ecologically significant wetlands are not eligible for inclusion in Tier I and will require individual review, even if they are under the size threshold. These wetlands are identified by the Corps in its regional conditions to the Nationwide Permits in Texas, and include the following habitats:

> Pitcher plant bogs, swamps dominated by bald cypress and tupelo gum tree species, the area of Caddo Lake within Texas that is designated as a Ramsar Wetland of International Importance, mangrove marshes and coastal dune swales.

Tier II:

Any project that does not qualify for a Tier 1 review or for which the applicant elects not to incorporate Tier I criteria or prefers to use alternatives will be considered a Tier II project. Tier II projects are subject to an individual certification review by TCEQ. This review will be done consistent with streamlining practices developed by the TCEQ and U.S. Army Corps of Engineers. A Tier II 401 Certification Questionnaire and Alternative Analysis Checklist are included in this packet.

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Tier I (Small Projects) Checklist
(Attachment 1)

Incorporation of BMPs into a proposed project will allow an individual Section 404 permit application to proceed without further review by Texas Commission on Environmental Quality (TCEQ). The basic standards for the BMPs described in items I-III are included in this packet. Tier I projects are those which will result in a direct impact of three acres or less of waters in the state or 1500 linear feet of streams. If a project has a combination of impacts that exceed the threshold or is submitted after the fact, it does not qualify as a Tier I project (one acre of impact is considered equal to 500 linear feet of stream). The provisions of the checklist, including BMPs selected by an applicant, will become part of the Section 404 permit. If an applicant fails to implement these provisions and BMPs, the permit is subject to enforcement. Applicants who do not wish to incorporate all the provisions of the checklist into their project or desire to use alternatives may seek individual 401 review and certification from the TCEQ.

I. Erosion Control

Disturbed areas must be stabilized to prevent the introduction of sediment to adjacent wetlands or water bodies during wet weather conditions (erosion). *At least one* of the following best management practices (BMPs) must be maintained and remain in place until the area has been stabilized. Please check the BMP(s) you will incorporate into your project.

- 9 Temporary Vegetation
- 9 Blankets/Matting
- 9 Mulch
- 9 Sod

II. Post-Construction TSS Control

After construction has been completed and the site is stabilized, total suspended solids (TSS) loadings shall be controlled by *at least one* of the following BMPs. Please check the BMP(s) you will incorporate into your project.

- 9 Retention/Irrigation
- 9 Extended Detention Basin
- 9 Vegetative Filter Strips
- 9 Constructed Wetlands
- 9 Wet Basins

III. Sedimentation Control

Prior to project initiation, the project area must be isolated from adjacent wetlands and water bodies by the use of BMPs to confine sediment. *At least one* of the following BMPs must be maintained and remain in place until project completion. Please check the BMP(s) you will incorporate into your project.

- 9 Sand Bag Berm
- 9 Silt Fence
- 9 Triangular Filter Dike
- 9 Rock Berm
- 9 Hay Bale Dike

Dredged material shall be placed in such a manner that prevents sediment runoff into water in the state, including wetlands. Water bodies can be isolated by the use of one or more of the required BMPs identified for sedimentation control. These BMPs must be maintained and remain in place until the dredged material is stabilized.

Hydraulically dredged material shall be disposed of in contained disposal areas. Effluent from contained disposal areas shall not exceed a TSS concentration of 300 mg/L.

IV. Contaminated Dredge Material

If contaminated dredge material that was not anticipated or provided for in the permit application is encountered during dredging, operations shall cease immediately. Pursuant to ' 26.039 (b) of the Texas Water Code, the individual operating or responsible for the dredging operations shall notify the commission=s emergency response team at (512)463-7727 as soon as possible, and not later than 24 hours after the discovery of the material. The applicant shall also notify the Corps that activities have been temporarily halted. Contaminated dredge material shall be remediated or disposed of in accordance with TCEQ rules. Dredging activities shall not be resumed until authorized in writing by the Commission.

AContaminated dredge material@ is defined as dredge material which has been chemically, physically, or biologically altered by man-made or man-induced contaminants which include, but are not limited to Asolid waste@, Ahazardous waste@ and Ahazardous waste constituent@ as those terms are defined by 30 TAC Chapter 335, APollutants@ as defined by Texas Water Code ' 26.001 and AHazardous Substances@ as defined in the Texas Health and Safety Code, '361.003.

V. Wetland Mitigation Requirements

Where wetland mitigation is determined to be necessary by the U.S. Army Corps of Engineers (Corps), the applicant must satisfy the minimum success criteria established by the Corps including wetland hydrology, hydrophytic vegetation and two years of monitoring. If that criteria includes less than two years of monitoring, the applicant may request water quality certification under Section 401.

VI. Coastal Zone Management Act

In accordance with 31 TAC '506, all projects located in the coastal zone boundary shall be consistent with the Texas Coastal Management Program.

Applicant should sign and return the original statement and completed checklist to the U.S. Army Corps of Engineers and send a copy to the TCEQ. Questions regarding the checklist should be directed to the TCEQ.

U.S. Army Corps of Engineers
Regulatory Branch (CESWF-PER-R)
P.O. Box 17300
Fort Worth, Texas 76102
Phone: (817) 886-1731
Fax: (817) 886-6493

Water Quality Assessment Section - 401 Coordinator
Texas Natural Resource Conservation Commission
MC-150
P.O. Box 13087
Austin, Texas 78711
Phone: (512)239-5366
Fax: (512)239-4420

Applicant=s Name (please print):_____

Corps Project Manager or Regulatory Specialist (if known):

_____

Permit Number (if known):_____

I will incorporate all of the above requirements and selected BMPs (Items I, II and III) into my proposed project. I understand that these requirements and BMPs as described above will be part of my Section 404 permit, and failure to implement any of them will constitute a permit violation.

Date:_____

Applicant Signature:_____

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Tier II 401 Certification Questionnaire
(Attachment 2)

The following questions seek to determine how adverse impacts will be avoided during construction or upon completion of the project. If any of the following questions are not applicable to your project, write not applicable (ANA@) and continue.

Please include the applicant=s name as it appears on the Corps of Engineers= permit application (and permit number, if known) on all material submitted. The material should be sent to:

Texas Commission on Environmental Quality
Attn: 401 Coordinator (MC-150)
P.O. Box 13087
Austin, TX 78711-3087

I. Impacts to surface water in the state, including wetlands

A. What is the area of surface water in the state, including wetlands, that will be disturbed, altered or destroyed by the proposed activity?

B. Is compensatory mitigation proposed? If yes, submit a copy of the mitigation plan. If no, explain why not.

3. Please complete the attached Alternatives Analysis Checklist

II. Disposal of waste materials

A. Describe the methods for disposing of materials recovered from the removal or destruction of existing structures.

B. Describe the methods for disposing of sewage generated during construction. If the proposed work establishes a business or a subdivision, describe the method for disposing of sewage after completing the project.

C. For marinas, describe plans for collecting and disposing of sewage from marine sanitation devices. Also, discuss provisions for the disposing of sewage generated from day-to-day activities.

III. Water quality impacts

A. Describe the methods to minimize the short-term and long-term turbidity and suspended solids in the waters being dredged and/or filled. Also, describe the type of sediment (sand, clay, etc.) that will be dredged or used for fill.

B. Describe measures that will be used to stabilize disturbed soil areas, including: dredge material mounds, new levees or berms, building sites, and construction work areas. The description should address both short-term (construction related) and long-term (normal operation or maintenance) measures. Typical measures might include containment structures, drainage modifications, sediment fences, or vegetative cover. Special construction techniques intended to minimize soil or sediment disruption should also be described.

C. Discuss how hydraulically dredged materials will be handled to ensure maximum settling of solids before discharging the decant water. Plans should include a calculation of minimum settling times with supporting data. (Reference: Technical Report, DS-7810, Dredge Material Research Program, GUIDELINES FOR DESIGNING, OPERATING, AND MAINTAINING DREDGED MATERIAL CONTAINMENT AREAS) If future maintenance dredging will be required, the disposal site should be designed to accommodate additional dredged materials. If not, please include plans for periodically removing the dried sediments from the disposal area.

D. Describe any methods used to test the sediments for contamination, especially when dredging in an area known or likely to be contaminated, such as downstream of municipal or industrial wastewater discharges.

Tier II
Alternatives Analysis Checklist

I. Alternatives
   A. How could you satisfy your needs in ways which do not affect surface water in the state?
   B. How could the project be re-designed to fit the site without affecting surface water in the state?
   C. How could the project be made smaller and still meet your needs?
   D. What other sites were considered?
      1. What geographical area was searched for alternative sites?
      2. How did you determine whether other non-wetland sites are available for development in the area?
      3. In recent years, have you sold or leased any lands located within the vicinity of the project? If so, why were they unsuitable for the project?
   E. What are the consequences of not building the project?

II. Comparison of alternatives
   A. How do the costs compare for the alternatives considered above?
   B. Are there logistical (location, access, transportation, etc.) reasons that limit the alternatives considered?
   C. Are there technological limitations for the alternatives considered?
   D. Are there other reasons certain alternatives are not feasible?

III. If you have not chosen an alternative, which would avoid impacts to surface water in the state, explain:
   A. Why your alternative was selected, and
   B. What you plan to do to minimize adverse effects on the surface water in the state impacted.

IV. Please provide a comparison of each criteria (from Part II) for each site evaluation in the alternatives analysis.

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Description of BMPs (Tier I Projects)
(Attachment 3)

EROSION CONTROL BMPs

Temporary Vegetation

Description: Vegetation can be used as a temporary or permanent stabilization technique for areas disturbed by construction. Vegetation effectively reduces erosion in swales, stockpiles, berms, mild to medium slopes, and along roadways. Other techniques such as matting, mulches, and grading may be required to assist in the establishment of vegetation.

Materials:

$ The type of temporary vegetation used on a site is a function of the season and the availability of water for irrigation.

$ Temporary vegetation should be selected appropriately for the area.

$ County agricultural extension agents are a good source for suggestions for temporary vegetation.

$ All seed should be high quality, U.S. Dept. of Agriculture certified seed.

Installation:

$ Grading must be completed prior to seeding.

$ Slopes should be minimized.

$ Erosion control structures should be installed.

$ Seedbeds should be well pulverized, loose, and uniform.

$ Fertilizers should be applied at appropriate rates.

$ Seeding rates should be applied as recommended by the county agricultural extension agent.

$ The seed should be applied uniformly.

$ Steep slopes should covered with appropriate soil stabilization matting.

Blankets and Matting

Description: Blankets and matting material can be used as an aid to control erosion on critical sites during the establishment period of protective vegetation. The most common uses are in channels, interceptor swales, diversion dikes, short, steep slopes, and on tidal or stream banks.

Materials:

New types of blankets and matting materials are continuously being developed. The Texas Department of Transportation (TxDOT) has defined the critical performance factors for these types of products and has established minimum performance standards which must be met for any product seeking to be approved for use within any of TxDOT=s construction or maintenance activities. The products that have been approved by TxDOT are also appropriate for general construction site stabilization. TxDOT maintains a web site at http://www.dot.state.tx.us/insdtdot/orgchart/cmd/erosion/contents.httm which is updated as new products are evaluated.

Installation:

$ Install in accordance with the manufacturer=s recommendations.

$ Proper anchoring of the material.

$ Prepare a friable seed bed relatively free from clods and rocks and any foreign material.

$ Fertilize and seed in accordance with seeding or other type of planting plan.

$ Erosion stops should extend beyond the channel liner to full design cross-section of the channel.

$ A uniform trench perpendicular to line of flow may be dug with a spade or a mechanical trencher.

$ Erosion stops should be deep enough to penetrate solid material or below level of ruling in sandy soils.

$ Erosion stop mats should be wide enough to allow turnover at bottom of trench for stapling, while maintaining the top edge flush with channel surface.

Mulch

Description: Mulching is the process of applying a material to the exposed soil surface to protect it from erosive forces and to conserve soil moisture until plants can become established. When seeding critical sites, sites with adverse soil conditions or seeding on other than optimum seeding dates, mulch material should be applied immediately after seeding. Seeding during optimum seeding dates and with favorable soils and site conditions will not need to be mulched.

Materials:

$ Mulch may be small grain straw which should be applied uniformly.

$ On slopes 15 percent or greater, a binding chemical must be applied to the surface.

$ Wood-fiber or paper-fiber mulch may be applied by hydroseeding.

$ Mulch nettings may be used.

$ Wood chips may be used where appropriate.

Installation:

Mulch anchoring should be accomplished immediately after mulch placement. This may be done by one of the following methods: peg and twine, mulch netting, mulch anchoring tool, or liquid mulch binders.

Sod

Description: Sod is appropriate for disturbed areas which require immediate vegetative covers, or where sodding is preferred to other means of grass establishment. Locations particularly suited to stabilization with sod are waterways carrying intermittent flow, areas around drop inlets or in grassed swales, and residential or commercial lawns where quick use or aesthetics are factors. Sod is composed of living plants and those plants must receive adequate care in order to provide vegetative stabilization on a disturbed area.

Materials:

$ Sod should be machine cut at a uniform soil thickness.

$ Pieces of sod should be cut to the supplier=s standard width and length.

$ Torn or uneven pads are not acceptable.

$ Sections of sod should be strong enough to support their own weight and retain their size and shape when suspended from a firm grasp.

$ Sod should be harvested, delivered, and installed within a period of 36 hours.

Installation:

$ Areas to be sodded should be brought to final grade.

$ The surface should be cleared of all trash and debris.

$ Fertilize according to soil tests.

$ Fertilizer should be worked into the soil.

$ Sod should not be cut or laid in excessively wet or dry weather.

$ Sod should not be laid on soil surfaces that are frozen.

$ During periods of high temperature, the soil should be lightly irrigated.

$ The first row of sod should be laid in a straight line with subsequent rows placed parallel to and butting tightly against each other.

$ Lateral joints should be staggered to promote more uniform growth and strength.

$ Wherever erosion may be a problem, sod should be laid with staggered joints and secured.

$ Sod should be installed with the length perpendicular to the slope (on the contour).

$ Sod should be rolled or tamped.

$ Sod should be irrigated to a sufficient depth.

$ Watering should be performed as often as necessary to maintain soil moisture.

$ The first mowing should not be attempted until the sod is firmly rooted.

$ Not more than one third of the grass leaf should be removed at any one cutting.

SEDIMENT CONTROL BMPS

Sand Bag Berm

Description: The purpose of a sandbag berm is to detain sediment carried in runoff from disturbed areas. This objective is accomplished by intercepting runoff and causing it to pool behind the sand bag berm. Sediment carried in the runoff is deposited on the upstream side of the sand bag berm due to the reduced flow velocity. Excess runoff volumes are allowed to flow over the top of the sand bag berm. Sand bag berms are used only during construction activities in streambeds when the contributing drainage area is between 5 and 10 acres and the slope is less than 15%, i.e., utility construction in channels, temporary channel crossing for construction equipment, etc. Plastic facing should be installed on the upstream side and the berm should be anchored to the streambed by drilling into the rock and driving in AT@ posts or rebar (#5 or #6) spaced appropriately.

Materials:

$ The sand bag material should be polypropylene, polyethylene, polyamide or cotton burlap woven fabric, minimum unit weight 4 oz/yd 2, mullen burst strength exceeding 300 psi and ultraviolet stability exceeding 70 percent.

$ The bag length should be 24 to 30 inches, width should be 16 to 18 inches and thickness should be 6 to 8 inches.

$ Sandbags should be filled with coarse grade sand and free from deleterious material. All sand should pass through a No. 10 sieve. The filled bag should have an approximate weight of 40 pounds.

$ Outlet pipe should be schedule 40 or stronger polyvinyl chloride (PVC) having a nominal internal diameter of 4 inches.

Installation:

$ The berm should be a minimum height of 18 inches, measured from the top of the existing ground at the upslope toe to the top of the berm.

$ The berm should be sized as shown in the plans but should have a minimum width of 48 inches measured at the bottom of the berm and 16 inches measured at the top of the berm.

$ Runoff water should flow over the tops of the sandbags or through 4-inch diameter PVC pipes embedded below the top layer of bags.

$ When a sandbag is filled with material, the open end of the sandbag should be stapled or tied with nylon or poly cord.

$ Sandbags should be stacked in at least three rows abutting each other, and in staggered arrangement.

$ The base of the berm should have at least 3 sandbags. These can be reduced to 2 and 1 bag in the second and third rows respectively.

$ For each additional 6 inches of height, an additional sandbag must be added to each row width.

$ A bypass pump-around system, or similar alternative, should be used on conjunction with the berm for effective dewatering of the work area.

Silt Fence

Description: A silt fence is a barrier consisting of geotextile fabric supported by metal posts to prevent soil and sediment loss from a site. When properly used, silt fences can be highly effective at controlling sediment from disturbed areas. They cause runoff to pond which allows heavier solids to settle. If not properly installed, silt fences are not likely to be effective. The purpose of a silt fence is to intercept and detain water-borne sediment from unprotected areas of a limited extent. Silt fence is used during the period of construction near the perimeter of a disturbed area to intercept sediment while allowing water to percolate through. This fence should remain in place until the disturbed area is permanently stabilized. Silt fence should not be used where there is a concentration of water in a channel or drainage way. If concentrated flow occurs after installation, corrective action must be taken such as placing a rock berm in the areas of concentrated flow. Silt fencing within the site may be temporarily moved during the day to allow construction activity provided it is replaced and properly anchored to the ground at the end of the day. Silt fences on the perimeter of the site or around drainage ways should not be moved at any time.

Materials:

$ Silt fence material should be polypropylene, polyethylene or polyamide woven or nonwoven fabric. The fabric width should be 36 inches, with a minimum unit weight of 4.5 oz/yd, mullen burst strength exceeding 190 lb/in 2 , ultraviolet stability exceeding 70%, and minimum apparent opening size of U.S. Sieve No. 30.

$ Fence posts should be made of hot rolled steel, at least 4 feet long with Tee or Y-bar cross section, surface painted or galvanized, minimum nominal weight 1.25 lb/ft 2, and Brindell hardness exceeding 140.

$ Woven wire backing to support the fabric should be galvanized 2@ x 4@ welded wire, 12 gauge minimum.

Installation:

$ Steel posts, which support the silt fence, should be installed on a slight angle toward the anticipated runoff source. Post must be embedded a minimum of 1 foot deep and spaced not more than 8 feet on center. Where water concentrates, the maximum spacing should be 6 feet.

$ Lay out fencing down-slope of disturbed area, following the contour as closely as possible. The fence should be sited so that the maximum drainage area is 3 acre/100 feet of fence.

$ The toe of the silt fence should be trenched in with a spade or mechanical trencher, so that the down-slope face of the trench is flat and perpendicular to the line of flow. Where fence cannot be trenched in (e.g., pavement or rock outcrop), weight fabric flap with 3 inches of pea gravel on uphill side to prevent flow from seeping under fence.

$ The trench must be a minimum of 6 inches deep and 6 inches wide to allow for the silt fence fabric to be laid in the ground and backfilled with compacted material.

$ Silt fence should be securely fastened to each steel support post or to woven wire, which is in turn attached to the steel fence post. There should be a 3-foot overlap, securely fastened where ends of fabric meet.

Triangular Filter Dike

Description: The purpose of a triangular sediment filter dike is to intercept and detain water-borne sediment from unprotected areas of limited extent. The triangular sediment filter dike is used where there is no concentration of water in a channel or other drainage way above the barrier and the contributing drainage area is less than one acre. If the uphill slope above the dike exceeds 10%, the length of the slope above the dike should be less than 50 feet. If concentrated flow occurs after installation, corrective action should be taken such as placing rock berm in the areas of concentrated flow. This measure is effective on paved areas where installation of silt fence is not possible or where vehicle access must be maintained. The advantage of these controls is the ease with which they can be moved to allow vehicle traffic and then reinstalled to maintain sediment

Materials:

$ Silt fence material should be polypropylene, polyethylene or polyamide woven or nonwoven fabric. The fabric width should be 36 inches, with a minimum unit weight of 4.5 oz/yd, mullen burst strength exceeding 190 lb/in 2 , ultraviolet stability exceeding 70%, and minimum apparent opening size of U.S. Sieve No. 30.

$ The dike structure should be 6 gauge 6@ x 6@ wire mesh folded into triangular form being eighteen (18) inches on each side.

Installation:

$ The frame of the triangular sediment filter dike should be constructed of 6@ x 6@, 6 gauge welded wire mesh, 18 inches per side, and wrapped with geotextile fabric the same composition as that used for silt fences.

$ Filter material should lap over ends six (6) inches to cover dike to dike junction; each junction should be secured by shoat rings.

$ Position dike parallel to the contours, with the end of each section closely abutting the adjacent sections.

$ There are several options for fastening the filter dike to the ground. The fabric skirt may be toed-in with 6 inches of compacted material, or 12 inches of the fabric skirt should extend uphill and be secured with a minimum of 3 inches of open graded rock, or with staples or nails. If these two options are not feasible the dike structure may be trenched in 4 inches.

$ Triangular sediment filter dikes should be installed across exposed slopes during construction with ends of the dike tied into existing grades to prevent failure and should intercept no more than one acre of runoff.

$ When moved to allow vehicular access, the dikes should be reinstalled as soon as possible, but always at the end of the workday.

Rock Berm

Description: The purpose of a rock berm is to serve as a check dam in areas of concentrated flow, to

intercept sediment-laden runoff, detain the sediment and release the water in sheet flow. The rock berm should be used when the contributing drainage area is less than 5 acres. Rock berms are used in areas where the volume of runoff is too great for a silt fence to contain. They are less effective for sediment removal than silt fences, particularly for fine particles, but are able to withstand higher flows than a silt fence. As such, rock berms are often used in areas of channel flows (ditches, gullies, etc.). Rock berms are most effective at reducing bed load in channels and should not be substituted for other erosion and sediment control measures further up the watershed.

Materials:

$ The berm structure should be secured with a woven wire sheathing having maximum opening of 1 inch and a minimum wire diameter of 20 gauge galvanized and should be secured with shoat rings.

$ Clean, open graded 3- to 5-inch diameter rock should be used, except in areas where high velocities or large volumes of flow are expected, where 5- to 8-inch diameter rocks may be used.

Installation:

$ Lay out the woven wire sheathing perpendicular to the flow line. The sheathing should be 20 gauge woven wire mesh with 1 inch openings.

$ Berm should have a top width of 2 feet minimum with side slopes being 2:1 (H:V) or flatter.

$ Place the rock along the sheathing to a height not less than 18@.

$ Wrap the wire sheathing around the rock and secure with tie wire so that the ends of the sheathing overlap at least 2 inches, and the berm retains its shape when walked upon.

$ Berm should be built along the contour at zero percent grade or as near as possible.

$ The ends of the berm should be tied into existing upslope grade and the berm should be buried in a trench approximately 3 to 4 inches deep to prevent failure of the control.

Hay Bale Dike

Description: The purpose of a hay or straw bale dike is to intercept and detain small amounts of sediment-laden runoff from relatively small unprotected areas. Straw bales are to be used when it is not feasible to install other, more effective measures or when the construction phase is expected to last less than 3 months. Straw bales should not be used on areas where rock or other hard surfaces prevent the full and uniform anchoring of the barrier.

Materials:

Straw: The best quality straw mulch comes from wheat, oats or barley and should be free of weed and grass seed which may not be desired vegetation for the area to be protected. Straw mulch is light and therefore must be properly anchored to the ground.

Hay: This is very similar to straw with the exception that it is made of grasses and weeds and not grain stems. This form of mulch is very inexpensive and is widely available but does introduce weed and grass seed to the area. Like straw, hay is light and must be anchored.

$ Straw bales should weigh a minimum of 50 pounds and should be at least 30 inches long.

$ Bales should be composed entirely of vegetable matter and be free of seeds.

$ Binding should be either wire or nylon string, jute or cotton binding is unacceptable. Bales should be used for not more than two months before being replaced.

Installation:

$ Bales should be embedded a minimum of 4 inches and securely anchored using 2@ x 2@ wood stakes or 3/8@ diameter rebar driven through the bales into the ground a minimum of 6 inches.

$ Bales are to be placed directly adjacent to one another leaving no gap between them.

$ All bales should be placed on the contour.

$ The first stake in each bale should be angled toward the previously laid bale to force the bales together.

POST-CONSTRUCTION TSS CONTROLS

Retention/Irrigation Systems

Description: Retention/irrigation systems refer to the capture of runoff in a holding pond, then use of the captured water for irrigation of appropriate landscape areas. Retention/irrigation systems are characterized by the capture and disposal of runoff without direct release of captured flow to receiving streams. Retention systems exhibit excellent pollutant removal but can require regular, proper maintenance. Collection of roof runoff for subsequent use (rainwater harvesting) also qualifies as a retention/irrigation practice, but should be operated and sized to provide adequate volume. This technology, which emphasizes beneficial use of stormwater runoff, is particularly appropriate for arid regions because of increasing demands on water supplies for agricultural irrigation and urban water supply.

Design Considerations: Retention/irrigation practices achieve 100% removal efficiency of total suspended solids contained within the volume of water captured. Design elements of retention/irrigation systems include runoff storage facility configuration and sizing, pump and wet well system components, basin lining, basin detention time, and physical and operational components of the irrigation system. Retention/irrigation systems are appropriate for large drainage areas with low to moderate slopes. The retention capacity should be sufficient considering the average rainfall event for the area.

Maintenance Requirements: Maintenance requirements for retention/irrigation systems include routine inspections, sediment removal, mowing, debris and litter removal, erosion control, and nuisance control.

Extended Detention Basin

Description: Extended detention facilities are basins that temporarily store a portion of stormwater runoff following a storm event. Extended detention basins are normally used to remove particulate pollutants and to reduce maximum runoff rates associated with development to their pre-development levels. The water quality benefits are the removal of sediment and buoyant materials. Furthermore, nutrients, heavy metals, toxic materials, and oxygen-demanding materials associated with the particles also are removed. The control of the maximum runoff rates serves to protect drainage channels below the device from erosion and to reduce downstream flooding. Although detention facilities designed for flood control have different design requirements than those used for water quality enhancement, it is possible to achieve these two objectives in a

single facility.

Design Considerations: Extended detention basins can remove approximately 75% of the total suspended solids contained within the volume of runoff captured in the basin. Design elements of extended detention basins include basin sizing, basin configuration, basin side slopes, basin lining, inlet/outlet structures, and erosion controls. Extended detention basins are appropriate for large drainage areas with low to moderate slopes. The retention capacity should be sufficient considering the average rainfall event for the area.

Maintenance Requirements: Maintenance requirements for extended detention basins include routine inspections, mowing, debris and litter removal, erosion control, structural repairs, nuisance control, and sediment removal.

Vegetative Filter Strips

Description: Filter strips, also known as vegetated buffer strips, are vegetated sections of land similar to grassy swales, except they are essentially flat with low slopes, and are designed only to accept runoff as overland sheet flow. They may appear in any vegetated form from grassland to forest, and are designed to intercept upstream flow, lower flow velocity, and spread water out as sheet flow. The dense vegetative cover facilitates conventional pollutant removal through detention, filtration by vegetation, and infiltration.

Filter strips cannot treat high velocity flows, and do not provide enough storage or infiltration to effectively reduce peak discharges to predevelopment levels for design storms. This lack of quantity control favors use in rural or low-density development; however, they can provide water quality benefits even where the impervious cover is as high as 50%. The primary highway application for vegetative filter strips is along rural roadways where runoff that would otherwise discharge directly to a receiving water, passes through the filter strip before entering a conveyance system. Properly designed roadway medians and shoulders make effective buffer strips. These devices also can be used on other types of development where land is available and hydraulic conditions are appropriate. Flat slopes and low to fair permeability of natural subsoil are required for effective performance of filter strips. Although an inexpensive control measure, they are most useful in contributing watershed areas where peak runoff velocities are low, as they are unable to treat the high flow velocities typically associated with high impervious cover. The most important criteria for selection and use of this BMP are soils, space, and slope.

Design Considerations: Vegetative filter strips can remove approximately 85% of the total suspended solids contained within the volume of runoff captured. Design elements of vegetative filter strips include uniform, shallow overland flow across the entire filter strip area, hydraulic loading rate, inlet structures, slope, and vegetative cover. The area should be free of gullies or rills which can concentrate flow. Vegetative filter strips are appropriate for small drainage areas with moderate slopes.

Maintenance Requirements: Maintenance requirements for vegetative filter strips include pest management, seasonal mowing and lawn care, routine inspections, debris and litter removal, sediment removal, and grass reseeding and mulching.

Constructed Wetlands

Description: Constructed wetlands provide physical, chemical, and biological water quality treatment of stormwater runoff. Physical treatment occurs as a result of decreasing flow velocities in the wetland, and is present in the form of evaporation, sedimentation, adsorption, and/or filtration. Chemical processes include chelation, precipitation, and chemical adsorption. Biological processes include decomposition, plant uptake and removal of nutrients, plus biological transformation and degradation. Hydrology is one of the most

influential factors in pollutant removal due to its effects on sedimentation, aeration, biological transformation, and adsorption onto bottom sediments.

The wetland should be designed such that a minimum amount of maintenance is required. The natural surroundings, including such things as the potential energy of a stream or flooding river, should be utilized as much as possible. The wetland should approximate a natural situation and unnatural attributes, such as rectangular shape or rigid channel, should be avoided.

Site considerations should include the water table depth, soil/substrate, and space requirements. Because the wetland must have a source of flow, it is desirable that the water table is at or near the surface. If runoff is the only source of inflow for the wetland, the water level often fluctuates and establishment of vegetation may be difficult. The soil or substrate of an artificial wetland should be loose loam to clay. A perennial baseflow must be present to sustain the artificial wetland. The presence of organic material is often helpful in increasing pollutant removal and retention. A greater amount of space is required for a wetland system than is required for a detention facility treating the same amount of area.

Design Considerations: Constructed wetlands can remove over 90% of the total suspended solids contained within the volume of runoff captured in the wetland. Design elements of constructed wetlands include wetland sizing, wetland configuration, sediment forebay, vegetation, outflow structure, depth of inundation during storm events, depth of micropools, and aeration. Constructed wetlands are appropriate for large drainage areas with low to moderate slopes.

Maintenance Requirements: Maintenance requirements for constructed wetlands include mowing, routine inspections, debris and litter removal, erosion control, nuisance control, structural repairs, sediment removal, harvesting, and maintenance of water levels.

Wet Basins

Description: Wet basins are runoff control facilities that maintain a permanent wet pool and a standing crop of emergent littoral vegetation. These facilities may vary in appearance from natural ponds to enlarged, bermed (manmade) sections of drainage systems and may function as online or offline facilities, although offline configuration is preferable. Offline designs can prevent scour and other damage to the wet pond and minimize costly outflow structure elements needed to accommodate extreme runoff events.

During storm events, runoff inflows displace part or all of the existing basin volume and are retained and treated in the facility until the next storm event. The pollutant removal mechanisms are settling of solids, wetland plant uptake, and microbial degradation. When the wet basin is adequately sized, pollutant removal performance can be excellent, especially for the dissolved fraction. Wet basins also help provide erosion protection for the receiving channel by limiting peak flows during larger storm events. Wet basins are often perceived as a positive aesthetic element in a community and offer significant opportunity for creative pond configuration and landscape design. Participation of an experienced wetland designer is suggested. A significant potential drawback for wet ponds in arid climates is that the contributing watershed for these facilities is often incapable of providing an adequate water supply to maintain the permanent pool, especially during the summer months. Makeup water (i.e., well water or municipal drinking water) is sometimes used to supplement the rainfall/runoff process, especially for wet basin facilities treating watersheds that generate insufficient runoff.

Design Considerations: Wet basins can remove over 90% of the total suspended solids contained within the volume of runoff captured in the basin. Design elements of wet basins include basin sizing, basin configuration, basin side slopes, sediment forebay, inflow and outflow structures, vegetation, depth of permanent pool, aeration, and erosion control. Wet basins are appropriate for large drainage areas with low to

moderate slopes.

Maintenance Requirements: Maintenance requirements for wet basins include mowing, routine inspections, debris and litter removal, erosion control, nuisance control, structural repairs, sediment removal, and harvesting.