Guidance for Federal Land Management in the Chesapeake Bay Watershed

Implementation Measures to Control Nonpoint Source Nutrient and Sediment Pollution and Protect Water Quality

Implementation Measures for Agriculture

Source Control and Avoidance

Cropland

A-1. Base P application on P saturation in soils as follows:

- If the soil P saturation percentage is above 20 percent, do not apply manure or commercial fertilizer that contains P to cropland, grazing or pasture land.
- When soil P saturation percentage allows for application (i.e., is below 20 percent saturation), apply up to an N-based rate.
- Also, implement a soil P monitoring plan to ensure that soil-P levels are staying steady over time.
- If soil P saturation percentage is increasing, adjust manure applications to P-based rate and use commercial N fertilizer to make up the difference; if levels exceed 20 percent P saturation, no longer apply P.

A-2. Maximize N fertilizer use efficiency to maximize the net benefit from the lowest-needed amount of manure, biosolids, or commercial N fertilizer entering the cropland system. Whenever N fertilizer is applied where manure has already been applied, reduce N fertilizer rates according to the N credit of the manure that was applied. That N credit will vary depending on the amount, timing, type, and method of manure that was applied.

A-3. Replace high nutrient loading crops in high-risk areas for water quality effects with sound alternatives.

A-4. (1) Retire highly erodible lands (HELs) from cropland and replace the crop with perennial native vegetation, or (2) develop and implement a soil conservation plan to reduce sheet and rill erosion to the Soil Loss Tolerance Level (T) as well as a nutrient management plan.

A-5. When using commercial fertilizer, give credit for manure nutrients. When commercial fertilizer is used, provide for the proper storage, calibration, and operation of chemical fertilizer nutrient application equipment.

Animal Agriculture

A-6. Formulate animal feeds to reduce nutrient concentration in manure, improve the manure N:P ratio in relation to crop needs, and/or eliminate toxic substances such as arsenic in manure used as fertilizer. Align the N:P ratio of the manure to be equal to (or greater than) the N:P ratio of the crop need.

A-7. Safely and strategically apply (with properly calibrated equipment), store, and transport manure.

- Liquid manure storage systems including tanks, ponds, and lagoons (e.g., NRCS Practice Code 313 Waste Storage Facility) should be designed and operated to safely store the entire quantity and contents of animal manure and wastewater generated, contaminated runoff from the facility, and the direct precipitation from events in the geographic area, including chronic rain.
- Dry manure (i.e., stackable, greater than or equal to 20 percent dry matter), such as that produced in poultry and certain cattle operations, should be stored in production buildings, storage facilities, or otherwise covered to prevent precipitation from coming into direct contact with the manure and to prevent the occurrence of contaminated runoff. When necessary, temporary field storage of dry manure (e.g., poultry litter) may be possible under protective guidelines (e.g., NRCS Practice Code 633 Waste Utilization).
- For manure and litter storage, the AFO should maintain sufficient storage capacity for minimum critical storage period consistent with planned utilization rates or utilization practices and schedule.

A-8. Exclude livestock from streams and streambanks and provide alternative watering facilities and stream crossings to reduce nutrient inputs, streambank erosion, and sediment inputs and to improve animal health.

A-9. Process/treat through physical, chemical, and biological processes facility wastewater and animal wastes to reduce as much as practicable the volume of manure and loss of nutrients.

In-Field Control

A-10. Manage nutrient applications to cropland to minimize nutrients available for runoff. In doing so:

- Apply manure and chemical fertilizer during the growing season only

- Do not apply any manure or fertilizer to saturated, snow-covered, or frozen ground
- Inject or otherwise incorporate manure or organic fertilizer to minimize the available dissolved P and volatilized N
- Apply nutrients to HELs only as directed by the nutrient management plan, while at the same time implementing all aspects of the soil conservation plan

A-11. Use soil amendments such as alum, gypsum, or water treatment residuals (WTR) to increase P adsorption capacity of soils, reduce desorption of water-soluble P, and decrease P concentration in runoff.

A-12. Use conservation tillage or continuous no-till on cropland to reduce soil erosion and sediment loads except on those lands that have no erosion or sediment loss.

A-13. Use the most suitable cover crops to scavenge excess nutrients and prevent erosion at the site on acres that have received any manure or chemical fertilizer application. Cover crops should be used during a non-growing season (including winters) or when there is bare soil in a field.

A-14. Minimize nutrient and soil loss from pasture land by maintaining uniform livestock distribution, keeping livestock away from riparian areas, and managing stocking rates and vegetation to prevent pollutant losses through erosion and runoff.

A-15. Where drainage is added to an agricultural field, design the system to minimize the discharge of N.

Edge-of-Field Trapping and Treatment

A-16. Establish manure and chemical fertilizer application buffers or minimum setbacks from in-field ditches, intermittent streams, tributaries, surface waters, open tile line intake structures, sinkholes, agricultural well heads, or other conduits to surface waters.

A-17. Treat buffer or riparian soils with alum, WTR, gypsum, or other materials to adsorb P before field runoff enters receiving waters.

A-18. Restore wetlands and riparian areas from adverse effects. Maintain nonpoint source abatement function while protecting other existing functions of the wetlands and riparian areas such as vegetative composition and cover, hydrology of surface water and groundwater, geochemistry of the substrate, and species composition.

A-19. For both new and existing surface (ditch) and subsurface (pipe) drainage systems, use controlled drainage, ditch management, and bioreactors as necessary to minimize off-farm transport of nutrients.

A-20. Manage runoff from livestock production areas under grazing and pasture to minimize off-farm transport of nutrients and sediment.

Implementation Measures for Urban and Suburban Areas

Development or redevelopment projects with a footprint that exceeds 5,000 square feet should use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the watershed and site with regard to the temperature, rate, volume, and duration of flow. (Note: This is based on the approach adopted by Congress for federal facilities in section 438 of the Energy Independence and Security Act, 2007)

U-1. Maximize infiltration, evapotranspiration, and harvest and use practices on-site, to the maximum extent technically feasible. Examples of these practices include the following

- Bioretention cells or raingardens
- Green streets, right-of-way and parking lot designs and retrofits
- Cisterns and interior and exterior use of runoff
- Green roofs
- Tree planting and urban forestry
- Soil amendments and turf management

U-2. Implement policies to preserve or restore predevelopment hydrology with regard to the temperature, rate, volume and duration of flow, or more restrictive if needed for site-specific water quality protection. Implement at the regional, watershed, and site scales, as appropriate. Consider the following factors: land use, hydrology, geomorphology, and climate. Use Options 1 or 2 or similar performance-based approaches to achieve the desired hydrological goals:

- Option 1: Retain the 95th Percentile Rainfall Event (simplified method)
- Option 2: Conduct site-specific hydrologic analysis

U-3. Use planning and development techniques to direct development to areas where development will

- Have fewer impacts on water quality
- Preserve the integrity of healthy watersheds
- Achieve local objectives for infrastructure management and sustainability

U-4. Use conservation design and LID techniques to

- Minimize the hydrologic impacts of the development and preserve natural drainage ways to the extent feasible

- Integrate green infrastructure (GI)/LID practices into the design and construction of the development, to the extent feasible and preferably at the neighborhood scale

U-5. Examine federal facilities planning guidance, design manuals, and policies (municipalities would examine codes and ordinance, and industry or other facilities would examine corporate policy directives and guidance) for opportunities to revise and update

- Street standards and road design guidelines
- Parking requirements
- Setbacks (requirements for long driveways, and the like)
- Height limitations (encourage density where appropriate)
- Open space or natural resource plans
- Comprehensive plans or facility master plans

U-6. Examine and revise transportation, right-of-way, and parking lot policies, guidance, and standards to reduce impervious areas and water resource impacts.

U-7. Minimize directly connected impervious areas in new development, redevelopment, and in retrofits by

- Disconnection of downspouts
- Infiltration of runoff onsite (preferably through bioretention practices)
- Product substitution, e.g., use of permeable paving materials
- Harvest and use of runoff onsite
- Construction of green roofs

U-8. Restore streams, floodways, and riparian areas to mitigate channel erosion and sedimentation and enhance the pollutant removal capacity of these areas.

U-9. Reduce the impacts of existing impervious areas through redevelopment and infill policies and strategies and identify and implement incentives for redevelopment that encourage the use of GI/LID designs and practices

- Retrofit existing urban areas to achieve the desired performance goals
- Assess candidate sites, prioritize, and implement practices based on expected cumulative benefit to the subwatershed or watershed
- Assess retrofit potential of significant runoff sources such as streets, highways, parking lots, and rooftops.
- Develop and implement redevelopment programs that identify opportunities for a range of types and sizes of redevelopment projects to mitigate water resource impacts that

- Establish appropriate redevelopment stormwater performance standards consistent with the goal of restoring predevelopment hydrology with regard to the temperature, rate, volume and duration of flow, or more restrictive if needed for site-specific water quality protection, as determined by the appropriate regulatory authority for the region or site
- Include development of an inventory of appropriate mitigation practices (e.g., permeable pavement, infiltration practices, green roofs) that will be encouraged or required for implementation at redevelopment sites that are smaller than the applicability threshold
- Include site assessment to determine appropriate GI/LID practices
- Review facility planning documents and specifications (as well as any applicable codes and ordinances) and modify as appropriate to allow and encourage GI/LID practices
- Implement GI/LID demonstration projects
- Incentivize early adopters of GI/LID practices
- Maximize urban forest canopy to reduce runoff
- Conduct soil analyses and amend compacted urban soils to promote infiltration

Reduce Pollutant Concentrations by implementing source control measures and treatment practices as necessary to meet water quality goals

Source Control/Pollution Prevention

U-10. Identify the pollutants of concern (POCs) to help target the selection of pollution prevention/source control that are most appropriate, for example, nutrients and sediment.

U-11. Implement pollution prevention/source control practices, i.e., nonstructural, programmatic efforts as basic, routine land management practices to target specific pollutants.

U-12. Require source controls on

- New and redevelopment site plans for commercial/industrial facilities
- Commercial/industrial facilities through development of a
  - Stormwater Pollution Prevention Plan (SWPPP) where required for regulated industrial categories
  - Similar stormwater pollution prevention plans that might be required by local authorities
- Municipal facilities or other designated Municipal Separate Storm Sewer System (MS4s) permittees through development of Pollution

Prevention/Good Housekeeping programs such as the Stormwater Phase II Minimum Control Measures.

U-13. Develop and implement ongoing outreach programs aimed at behavior change to prevent pollution and control it at its source. Methods for impact and effectiveness evaluation should be incorporated into these outreach and education programs.

U-14. Implement programs for disconnection of directly connected impervious areas, such as residential downspout disconnection programs.

U-15. Conduct inspections of commercial/industrial facilities to provide compliance assistance or to ensure implementation of controls.

Runoff Treatment

U-16. Identify the POCs to help target the type of treatment approaches that are most appropriate.

U-17. Select treatment practices based on applicability to the POCs

- Use practices to reduce runoff volume as the preferred and most reliable approach to reducing pollutant loading to receiving waters
- Use treatment practices as needed if reduction of runoff is not feasible
- Base the selection of treatment practice on
  - Treatment effectiveness for the POC to ensure discharge quality
  - Long-term maintenance considerations to ensure continued adequate maintenance and recognition of life-cycle costs
  - Site limitations to ensure appropriateness of practice to the site
  - Aesthetics and safety to ensure public acceptance

Turf Management Implementation Measures

Turf Landscape Planning and Design

U-18. Where turf use is *essential* and appropriate, turf areas should be designed to maintain or restore the natural hydrologic functions of the site and promote sheet flow, disconnection of impervious areas, infiltration, and evapotranspiration.

Turf Management

U-19. Use management approaches and practices to reduce runoff of pollutant loadings into surface and ground waters.

U-20. Manage turf to reduce runoff by increasing the infiltrative and water retention capacity of the landscape to appropriate levels to prevent pollutant discharges and erosion.

U-21. Manage applications of nutrients to minimize runoff of nutrients into surface and ground waters and to promote healthy turf

- Where appropriate, consider modifications to operations, procedures, contract specifications and other relevant purchasing orders, and facility management guidance to reduce or eliminate the use of fertilizers containing P

U-22. Manage turf and other vegetated areas to maximize sediment and nutrient retention.

U-23. Reduce total turf area that is maintained under high-input management programs that is not essential for heavy use situations, e.g., sports fields and heavily trafficked areas.

U-24. Convert *nonessential*, high-input turf to low-input or lower maintenance turf or vegetated areas that require little or no inputs and provide equal or improved protection of water quality.

U-25. Use turf species that reduce the need for chemical maintenance and watering, and encourage infiltration through deep root development.

U-26. Conduct a facility or municipal wide assessment of the landscaped area within the facility property or jurisdiction. This assessment should include

- A map of the jurisdiction or facility, including the identification of all turf and other landscape areas
- An inventory or calculation of the total turf and other landscape area in acres or hectares using GIS techniques or other methods
- An evaluation to determine essential and nonessential turf areas
- Identification and delineation of all high-input, low-input, and no-input turf areas
- An evaluation of turf management activities and inputs, preferably by turf category or significant turf area within the facility or jurisdiction
- An assessment of landscape cover type benefits such as pollution load reductions and resource savings, e.g., water and energy that are provided by each landscape cover type
- An assessment of landscape cover type health, infiltrative and pollutant loading capacity and opportunities to increase soil health to promote the infiltrative capacity of turf and landscape areas
- An assessment of surface water and groundwater loadings related to high-input, low-input, and no-input turf area

U-27. Develop a management plan that contains

- An analysis of options to reduce or eliminate *nonessential* turf or convert *essential* turf to low-input turf that performs optimally from a water resource protection perspective

- An analysis of turf areas to identify opportunities to maximize water quality benefits of landscapes in regard to runoff, in-stream flows, infiltration, groundwater recharge and sediment, nutrient and pathogen loadings
- A landscaping approach that integrates turf management within the context of natural resource and habitat plans
- Stated goals and objectives regarding the reduction of turf related inputs (water, fertilizers, pesticides, fossil fuels) and maximizing water resource benefits on a facility- or municipality-wide basis
- An analysis of options to reduce potable water use by using cultural practices, hardy cultivars, or recycled water or harvested runoff
- An identification of areas where soil amendments can be used to enhance soil health and the infiltration capacity of the soils
- Areas of turf that could be used to manage runoff
- Areas of turf that could be replaced by lower maintenance cultivars or other grasses such as switch grass
- A training program for landscaping personnel
- An implementation schedule
- An annual landscaping inventory and progress report

U-28. Develop and implement ongoing public education and outreach programs Bay-friendly lawn, landscape, and turf management. Programs should target behavior change and promote the adoption of water quality friendly practices by increasing awareness, promoting appropriate behaviors and actions, providing training and incentives. Impact and effectiveness evaluation should be incorporated into such outreach and education programs.

Implementation Measures for Forestry

F-1. Perform advance planning for *timber harvesting* and *forest road systems* that includes the following elements, where appropriate:

- Identify the harvest area and road layout and areas to be avoided during harvest and road construction (for example, waterbodies, wetlands, protected species locations and habitat, and highly erosive soils). Avoid locating roads, landings, and skid trails on steep grades and in streamside management areas (SMAs). Use electronic and paper topographic and soil maps and a handheld global positioning system unit to facilitate marking the features, and mark them in a highly visible manner before the harvest.
- Consider all water quality-related factors when planning the harvest and road system. Factors to consider include soil moisture conditions when the harvest and heaviest traffic will occur, BMPs for erosion control during and after the harvest, and existing water quality conditions in all potentially affected waterbodies.
- Design roads to withstand the anticipated amount of traffic during the anticipated season of harvest such that ruts will not form and the effectiveness of road surface drainage features will not otherwise be compromised.
- Design road drainage structures to discharge runoff in small quantities to off-road areas that are not hydrologically connected to surface waters.
- Design the road layout to minimize the number of stream crossings.
- For fish-bearing streams, design stream crossings to permit fish passage.

F-2. Establish and maintain an SMA along all (perennial and ephemeral) waterbodies. Avoid all activity inside SMAs along all waterbodies. SMAs should be wide enough to provide a preharvest level of shade to surface waters, detain and capture water and sediment runoff from the harvest site and roads, and a sustainable source of large woody debris for in-stream channel structure and aquatic habitat.

F-3. Guard against the production of sediment when installing stream crossings. Maintain permanent stream crossings and associated fills and approaches to reduce the likelihood (a) that stream overflow will divert onto roads and (b) that fill erosion will occur if the drainage structures become obstructed.

F-4. Protect surface waters from slash and debris material from roadway clearing.

F-5. Expedite the revegetation of disturbed soils on unstable cuts and fills. Use temporary structures such as straw bales, silt fences, mulching, or other appropriate practices until an area is adequately stabilized.

F-6. Conduct maintenance practices, when conditions warrant, including cleaning and replacing deteriorated structures and erosion controls, grading or seeding road surfaces, and, in extreme cases, slope stabilization or removing road fills where necessary to maintain structural integrity.

F-7. Evaluate the future need for a road and close roads (including temporary spur roads and seasonal roads) that will not be needed. Road closure should include stabilizing closed roads and drainage channels against failure during storms, ensuring that runoff from a closed road will be directed away from the roadway, removing drainage crossings and culverts if there is a reasonable risk of plugging, and removing all temporary stream crossings.

F-8. Install landing drainage structures to avoid sedimentation to the extent practicable. Disperse landing drainage over stable side slopes. Protect landing surfaces used during wet periods. Locate landings outside SMAs.

F-9. Conduct harvest and construct landings away from steep slopes to reduce the likelihood of slope failures.

F-10. Protect stream channels and significant ephemeral drainages from logging debris and slash material.

F-11. Protect surface waters during site preparation by

- Selecting a method of site preparation and regeneration that is suitable for the site conditions.
- Conducting mechanical tree planting, ground-disturbing site preparation activities, and bedding on the contour of sloping terrain and outside SMAs and ephemeral drainages.
- Protecting surface waters from logging debris and slash material, including locating windrows far enough from drainages and SMAs to limit the entry of material into surface waters during high-runoff conditions.
- Suspending operations during wet periods if equipment begins to cause excessive soil disturbance that will increase erosion. Conduct bedding operations in high-water-table areas during dry periods of the year.

F-12. Prescribed and wildland fire should not cause excessive erosion or sedimentation because of the combined effect of partial or full removal of canopy and removal of ground fuels and the litter layer, to the extent practicable.

F-13. All bladed firelines, for prescribed fire and wildfire, should be stabilized with water bars or other appropriate techniques if needed to control excessive sedimentation or erosion of the fireline.

F-14. Consider the potential nonpoint source pollution consequences on watercourses of wildfire suppression and rehabilitation activities, while recognizing the safety and operational priorities of fighting wildfires.

F-15. Revegetate disturbed areas (using seeding or planting) promptly after completing the earth-disturbing activity. Local growing conditions will dictate the timing for establishing vegetative cover.

F-16. Use mixes of species and treatments developed and tailored for successful vegetation establishment for the region or area. Native species are generally preferred, although nonnative species can be acceptable as long as they are noninvasive.

F-17. Concentrate revegetation efforts initially on priority areas such as disturbed areas in SMAs or the steepest areas of disturbance (e.g., on roads, landings, or skid trails) near drainages.

F-18. Establish and identify buffer areas for surface waters. (This is especially important for aerial applications.) Conduct applications by skilled and, where required, licensed applicators according to the registered use, with special consideration given to effects on nearby surface waters. Carefully prescribe the type and amount of pesticides appropriate for the insect, fungus, or herbaceous species.

F-19. Before applying pesticides and fertilizers, inspect the mixing and loading process and the calibration of equipment, and identify the appropriate weather conditions, the spray area, and buffer areas for surface waters. Immediately report accidental spills of pesticides or fertilizers into surface waters to the appropriate state agency. Develop an effective spill contingency plan to contain spills.

F-20. Plan, operate, and manage normal, ongoing forestry activities (including harvesting; road design, construction, and maintenance; site preparation and regeneration; and chemical management) to adequately protect the aquatic functions of forested wetlands.

Implementation Measures for Riparian Area Management

R-1. Promote the restoration of the preexisting functions in damaged and destroyed riparian systems, especially in areas where the systems will serve a significant nonpoint source pollution-abatement function as well as the suite of valuable ecosystems services riparian buffers provide.

R-2. Protect from adverse effects riparian areas that are serving a significant nonpoint source pollution-abatement function and maintain this function while protecting the other existing functions of these riparian areas.

Implementation Measures for Decentralized Wastewater Treatment Systems

D-1. Specify the following risk-based, N-removal performance levels for all new and replacement individual and cluster systems:

- 20 milligrams per liter (mg/L) total nitrogen (TN) standard* for all new subdivisions and commercial and institutional developments and all system replacements throughout the Chesapeake Bay watershed.
- 10 mg/L TN standard* for all new developments and all system replacements in sensitive areas—i.e., between 200 and 1,000 feet of the ordinary high water mark of all surface waters, or between 200 and 500 feet of an open-channel MS4.
- 5 mg/L TN standard* for all new developments and system replacements in more sensitive areas—i.e., between 100 and 200 feet of the ordinary high water mark of all surface waters, or between 100 and 200 feet of an open-channel MS4.
- 100-foot setback from surface waters and open channel MS4s for all effluent dispersal system components.

** Effluent standards may be met by either system design or performance, as verified by third-party design review or field verification. Except in sandy or loamy sand soils, a 5 mg/L N reduction credit is given when using time-dosed, pressurized effluent dispersal within 1 foot of the ground surface and more than 1.5 feet above a limiting soil/bedrock condition.*

D-2. Ensure wastewater treatment performance effectiveness and cost efficiency by using cluster systems with advanced N-removal technology sufficient to meet the standards specified above for all newly developed communities and densely populated areas.

D-3. Sustain treatment system performance in perpetuity through management contracts with trained and certified operators for all advanced N-removal systems, and responsible management entity (RME) operation and maintenance (O&M) for all cluster and nonresidential systems. RMEs include sanitation districts, special districts, and other public or private entities with the technical, managerial, and financial capacity to assure long-term system performance.

D-4. Preserve long-term treatment system performance with management practices designed to protect system investments, by doing the following:

- Conducting GIS-based inventories of all individual and cluster (i.e., decentralized) wastewater systems in all areas that drain into the Chesapeake Bay or its tributaries. Inventory information includes system location (i.e., latitude/longitude), type, capacity, installation date, owner, and relevant information on complaints, service (including tank pump-out), repairs,

inspections, and dates. Inventory data is stored electronically in a format amenable for use in watershed studies, system impacts analyses, and supporting general management tasks. EPA offers *The Wastewater Information System Tool* (TWIST) (USEPA 2006) as a free resource for managing that information in a user-friendly database. Health departments, state agencies, RMEs and others can adapt, amend, or otherwise modify TWIST without restriction or obligation.

- Requiring inspections for all systems on a schedule according to wastewater type, system size, complexity, location, and relative environmental risk. At a minimum, qualified inspectors inspect all systems at least once every 5 years and inspect existing systems within sensitive areas at least once every 3 years. Inspect advanced treatment systems, cluster systems, and those serving commercial, institutional, or industrial facilities at least semiannually and manage such systems under an O&M agreement or by an RME. Inspections are consistent with EPA management guidelines for individual and cluster systems. A service professional or other trained personnel conducts routine monitoring of all systems, and periodic effluent sampling for cluster and nonresidential systems, on the basis of system type, operating history, manufacturer's recommendations, and other relevant factors.
- Repairing or replacing all malfunctioning systems when discovered, with new or replacement technologies capable of meeting the N-removal standards specified above.
- Requiring reserve areas for installing a replacement soil dispersal system that is equal to at least 100 percent of the size of the original effluent dispersal area. Treatment systems using effluent time-dosing (i.e., not demand-dosing) to the soil can have reserve areas equal to at least 75 percent of the total required drainfield area. Systems with pressurized drip effluent dosing or shallow pressurized effluent dispersal and those with dual drainfields operated on active/rest cycles (i.e., alternating drainfields) can have reserve areas equal to at least 50 percent of the original required dispersal area.

D-5. Remove nitrate in subsurface effluent plumes that enter surface waters by using effective, low-cost technologies such as permeable reactive barriers (PRBs). PRBs are low-cost, pH-controlled trenches filled with sand and a degradable carbon source, such as sawdust, shredded newspaper, or wood chips, designed to intercept groundwater plumes and reduce the TN concentration via denitrification.

Implementation Measures for Hydromodification

H-1 The protection of streambanks and shorelines from erosion refers to the installation of structural or biological practices at or near the land water interface. The primary goals of this implementation measure are the following:

- Protect streambank and shoreline features with the potential to reduce nonpoint source pollution
- Protect streambanks and shorelines from erosion from uses of either the shorelands or adjacent surface waters

H-2 The control of upland sources of nonpoint source pollutants at dams and other hydromodification facilities, refers to the active implementation of pollutant control techniques and practices that minimize the source generation and reduce the transport of sediments and nutrients into the Chesapeake Bay and its watershed. This implementation measure is well described in the 2007 guidance document (formerly titled *Erosion and Sediment Control for Construction of New Dams and Maintenance of Existing Dams*). The goals of this implementation measure are

- Reduce the generation of sediment and nutrients during and after construction
- Retain eroded sediment and nutrients on-site
- Apply nutrients at rates necessary to establish and maintain vegetation without causing significant nutrient runoff to surface waters

H-3 The restoration of in-stream and riparian habitat function refers to the direct implementation of practices that address functions of the aquatic environment. Because the practices recommended as part of this implementation measure often do not address the causative factors behind habitat degradation, other implementation measures described in this chapter should be considered for implementation. This implementation measure is well described in the 2007 guidance document (titled *Protection of Surface Watery Quality and In-stream and Riparian Habitat*). The primary goal of this implementation measure is

- Provide for safe passage of fish and other aquatic species upstream or downstream of dams and other structures

H-4 Reduction of pollutant sources through operational and design management of dams refers to the design and management of dams so as to minimize the source generation and reduce the transport of sediments and nutrients into the Chesapeake Bay and its watershed. This implementation measure is well described in the 2007 guidance document (formerly titled *Erosion and Sediment Control for Construction of New Dams and Maintenance of Existing Dams*). The goals of this implementation measure are

- Reduce pollutant generation and impact on living resources through programmatic dam management
- Design structures to limit pollutant generation

H-5 The restoration of stream and shoreline physical characteristics is important to restoring predevelopment hydrology and reducing loading from larger and scouring flows. Degraded streams can themselves become a source of downstream pollution, such as when P-laden sediments are mobilized during high-flow events. In such cases, stream restoration can be a useful strategy to improve downstream water quality. However, it is important to keep in mind that the elevated flows causing sediment mobilization must also be addressed (see the Urban and Suburban chapter). Stream stabilization requires restoration of the stream's energy signature. The predevelopment hydrology of the watershed must be restored to regain the predevelopment character of the stream; however, in existing urban areas, that might be a longer-term goal. The primary goal of this implementation measure is to

- Restore stable relationship between watershed hydrology and stream and shoreline geometry. Where streambank or shoreline erosion is a nonpoint source pollution problem, streambanks and shorelines should be stabilized. Vegetative methods are strongly preferred unless structural methods are more effective, considering the severity of stream flow discharge, wave and wind erosion, offshore bathymetry, and the potential adverse effect on other streambanks, shorelines, and offshore areas.