City of Ellisville

One Weis Avenue
Ellisville, MO 63011
(636) 227-9660 FAX: (636) 227-9486

APPLICATION FOR SITE PLAN REVIEW

(please type or print)

ALL APPLICABLE SECTIONS OF APPLICATION MUST BE COMPLETE.
APPLICATION MUST BE CONSISTENT WITH SUBMITTED MATERIALS.
PLANS MUST BE FOLDED TO APPROXIMATELY 8 ½ x 11 or 8 ½ x 14 IN SIZE. A $50.00 APPLICATION FEE MUST ACCOMPANY THIS APPLICATION

Property Address:_____

Applicant:_____

PART A: SITE DEVELOPMENT

Briefly describe the intended project and use: _____

Is the intended use: Permitted _____Conditionally Permitted: _____ Part of a Planned Development: _____

Total Square Footage of Site: _____Total Square Footage of Building(s): _____

Ratio of Total Square Footage of Building(s) to Total Square Footage of Site: _____

Building Lot Coverage: _____ Total Impervious Lot Coverage:_____

Setbacks: Required: _____Provided: _____

Buffer Landscape: Required: _____Provided:_____

Parking Lot Landscape: Required: _____ Provided: _____

Fence: Required: _____ Location: _____ Type/Material: _____Height: _____

Wall (Screen/Sound): Required: _____ Location: _____ Type/Material: _____Height: _____

Public Art or Benefit Provided: _____ Describe: _____

Briefly describe the disposal of Trash, Delivery and Loading for Operation (Location and Hours):

_____

Architectural review is required for any exterior renovation or façade changes. If any of these items are part of the project, complete an Architectural Review Board Application.

PART B: PERFORMANCE STANDARDS

All land, buildings and uses must comply with the following performance standards. Other project or use specific factors may be regulated to protect the public health, welfare and safety as well as to protect the character of the neighborhood.

Vibration. Will the use be so operated that the maximum ground vibration generated is not perceptible without instruments at any point on the lot line of the lot on which the use is located, excluding vehicular traffic unrelated to the subject use?_____

Noise. Will the use be so operated that the maximum volume of sound or noise generated does not exceed seventy (70) decibels at any point on the lot line of the lot on which the use is located?_____

Odor. Will the use be so operated that no offensive or objectionable odor is perceptible at any point on the lot line of the lot on which the use is located?_____

Smoke. Will the use be so operated that no smoke from any source shall be emitted of a greater density than the density described as No. 1 on the Ringelmann Chart as published by the United States Bureau of Mines?

_____

Toxic gases. Will the use be so operated that there is no emission of toxic, noxious or corrosive fumes or gases? Emission of dirt, dust, fly ash and other forms of particulate matter. Emission of dirt, dust, fly ash and other forms of particulate matter shall not exceed eighty-five hundredths (85/100) pounds per one thousand (1,000) pounds of gases of which amount not to exceed five-tenths (5/10) pounds per one thousand (1,000) pounds of gases shall be of such size as to be retained on a three hundred twenty-five (325) mesh U.S. Standard Sieve. In the case of emission of fly ash or dust from a stationary furnace or combustion, device these standards shall apply to a condition of fifty (50) percent excess air on the stack at full load, which standards shall be varied in proportion to the deviation of the percentage of excess air from fifty (50) percent. Will the project comply with this standard?_____

Air pollution. Every form of objectionable odors, smoke, toxic gases, particulate matter such as dirt, dust, fly ash, must be restricted to specific low levels of emissions as set forth in Ord. No. 3347 of St. Louis County Code titled; Air Pollution Control Code, Chapter 612, as amended from time to time. Will the project/use comply with this standard?_____

Radiation. Every amount of radioactive emissions must be restricted to that considered safe by the Federal Radiation Board Standards, as amended from time to time. Will the use/project comply with this standard?_____

Operations, heat and glare. Every operation producing intense glare or heat must be enclosed so that they are imperceptible at any lot line without instruments. Will the project/use comply with this standard?_____

Additional Standards applicable to all new restaurants and fast food restaurants, and upon change of ownership of existing restaurants and fast food restaurants, with the exception of Bar B Que Restaurants as defined in Section 30-18: (Ord. #2288, Sect. 2, 11-18-99)

Grease extraction efficiency: Exhaust system shall have grease extraction efficiency of at least 90% as tested by an approved agency. Will the use/project comply with this standard?_____

Maintenance: Equipment shall be maintained at intervals as recommended by the manufacturer and property maintenance performed in accordance with manufacturer's instructions. Will the use/project comply with this standard?_____

Cleaning: Hoods, grease removal devices, fans, ducts and other appurtenances shall be cleaned to bare metal at frequent intervals prior to surfaces becoming heavily contaminated with grease or oily sludge. Will the use/project comply with this

standard?_____

PART C: STORM WATER QUALITY PROTECTION STANDARDS:
All development and redevelopment must comply with storm water quality protection standards. To the maximum extent feasible, the development plan should preserve and/or protect existing natural resource areas that facilitate pollutant removal and reduce runoff.

1. Can land disturbance be minimized?_____
2. Can additional greenspace be preserved? _____
3. Can proposed development be located in already developed areas? _____
4. Can stormwater be captured and infiltrated into the ground? _____
5. Can stormwater be captured and reused for irrigation or décor? _____
6. Could permeable surface materials be used to promote infiltration and limit runoff? _____
7. Can land disturbance be restricted to less sensitive areas? _____
8. Is the development located outside the 100 year flood plain? _____
9. Is the development located outside the stream bank setback buffer? _____
10. Does the development warrant engineering channel protection controls (because of size or stream bank erosion problems)? _____
11. Does the development plan avoid sensitive areas? _____
12. Does the site development plan utilize stormwater credits? _____
13. Does the site development plan show structural BMPs? What is the acreage of drainage to the BMP? Will the BMP be above or below ground? _____
14. Who will be responsible for maintaining storm water controls? Are the structural BMP shown on the plan appropriate for the entity or person responsible for maintenance? _____
15. Is over 1 acre of impervious area being added? _____
16. Is the development tributary to any existing basins that need to be upgraded? _____

PART D: ENVIRONMENTAL STATEMENT

Will the proposed request will not adversely impact the environment?:_____

Has a Phase I Assessment or Phase II Environmental Report/Study been prepared in association with this request? _____(Yes or No) If yes, please submit a copy of the report/study with this application.

By filing this application you acknowledge and are aware that the City may require a partial or comprehensive environmental assessment, impact analysis, or report, in conformity with Chapter 415, Environmental Report of the Land Use Regulations, at any time during the application or approval process.

PART E: CHECKLIST

_____ Existing and proposed (1) Site Plan, (2) Landscaping Plan and (3) Natural Resources Plan. Scale may be 1"= 20'-0".

_____ Five full size copies of plans must be submitted initially for staff review. Additional plan sets will be required later to forward to the Planning and Zoning Commission and/or City Council.

_____ Boundary Map showing all boundaries, existing setbacks and other physical features.

_____ Location map showing north arrow.

_____ Zoning district, subdivision name, lot number, dimensions and area, and zoning of adjacent parcels where different than site.

_____ Dimensions of existing and proposed roadway pavements, sidewalks and right-of-way width for streets abutting the site. The proposed ingress and egress to the site including adjacent streets.

_____ Location and identification of all easements (existing and proposed).

_____ Off-street parking spaces, required and proposed, including the number, size, and location of those designated for the handicapped. Depict loading areas.

_____ Topographical survey showing all topography and drainage. Existing and proposed contour lines or elevations based on mean sea level datum at intervals of five (5) feet or less. Plan must depict any changes to topography and the natural flow of drainage. Note type, size and location of storm water drainage facilities and sanitary sewage treatment.

_____ Approximate location of any storm water retention or detention facilities, sink holes and springs, silt berms, and other siltation control facilities.

_____ Location, dimension, and character of all proposed infrastructure improvements.

_____ Plans showing all existing and proposed utilities.

_____ Type, location, height, shielding and degree of brightness of all exterior lighting.

_____ Proposed use of the building and its construction type and distance from adjacent property lines. Overall dimensions of all buildings and the gross floor area of each building.

_____ At least two (2) section profiles through the site showing preliminary building form, existing natural grade and proposed final grade.

_____ Landscaping plan must show existing to remain, existing to be removed and proposed new landscaping. Note name, size and number of trees, shrubs and other plant material. Include plans for preserving existing trees and replacing removed trees.

_____ Natural Resources Plan must show all existing resources; Show all wetlands, major waterways, 100 and 500 year flood plains, stream buffer, areas prone to flooding, stream erosion areas, sinkholes, springs, seeps, other karst features, areas with shallow depth to bedrock, existing topography, identify areas with slopes greater than 20%, show site soil type, areas with erodible soil, gullies, swales, ditches, ponds, existing detention basins, show forests and prairie areas, existing impervious areas and utilities and stormwater “credit areas.”

_____ Provide an existing and proposed BMP area drainage map.

_____ Location and screening of trash and recycling containers.

_____ Location and screening of HVAC equipment.

_____ Location of proposed amenities.

_____ Location and size of existing and proposed freestanding signs.

_____ The seal, signed and dated, of the licensed person who prepared the drawing or under whose immediate personal supervision the drawing has been prepared.

_____ All amendments should be “clouded” and note referenced.

SITE DESIGN GUIDANCE

TOOLS FOR INCORPORATING POST-CONSTRUCTION STORMWATER QUALITY PROTECTION INTO CONCEPT PLANS AND LAND DISTURBANCE PERMITTING

Revision 1 - April 17, 2009

The Metropolitan St. Louis Sewer District, Developed in Conjunction with the St. Louis Municipalities Phase II Storm Water Steering Committee

Table of Contents

1. Introduction 4

2. Evaluation of Existing Conditions 6

3. Evaluation of Concept Plans 10

4. Integration with MSD Stormwater Quality Review 18

5. Conclusion 21

Tables

- Table 1 Existing Natural Resource Considerations 7
- Table 2 Site Development Goals, Questions, and Methods 11
- Table 3 Post-Construction Structural BMPs and Allowed 14

Figures

- Figure 1 Generic Stormwater Site Design Approval Process 19

Appendices

- Appendix A Example Maps
- Appendix B Typical BMP Layouts and Sections

1 Introduction

The effect of intense urbanization on natural watercourses is well documented: as urbanization (and impervious area) increases, the diversity and quality of aquatic life that exists within urban streams decreases. The sources of impairment (for example, roadway runoff, fertilizer runoff, creek bank erosion, litter, etc.) to these streams are collectively referred to as non-point source pollution (NPS). The Clean Water Act Phase II Stormwater Regulations were promulgated to provide appropriate stormwater management of NPS pollution in urbanized areas, and these regulations apply to the watersheds located within the Metropolitan St. Louis Sewer District (MSD). The Missouri Department of Natural Resources (DNR), through the Small MS4 Permit (Permit), sets requirements for stormwater management within the separate sewer portion of the MSD in St. Louis County. The St. Louis County Phase II Stormwater Management Plan (Plan) sets forth specific activities and schedules that the MSD, St. Louis County, and its fifty-nine municipal co-permittees must do to satisfy the Permit requirements.

NPS Pollution, St. Louis County, MO

This document has been prepared to assist in implementing the Permit and Plan requirements related to Post-Construction Storm Water Management in New Development and Redevelopment. These requirements apply to all new development and redevelopment projects that disturb greater than or equal to one acre, including (but not limited to) municipal roadway projects, residential infill and redevelopment projects, commercial and industrial development and redevelopment projects, and new residential subdivisions. While this topic's description implies measures that should be taken at project completion, its implementation begins in the project planning process, before project clearing and grading (i.e., land disturbance). The Permit states that water quality impacts must be prevented or minimized by mimicking pre-construction runoff conditions on new development projects to the maximum extent practicable, emphasizing practices that provide infiltration. Policies and ordinances must be implemented to protect sensitive areas, maintain green space, buffer water bodies, minimize impervious surfaces, and minimize disturbance of soils and vegetation. The Permit further requires that "The permittee shall assess site characteristics at the beginning of the construction design phase to ensure adequate planning for storm water program compliance". Thus, appropriate planning for mitigation of stormwater impacts <u>must</u> begin at the start of the project planning stage.

A significant complicating factor in meeting this requirement is that MSD, who is responsible for implementing the stormwater facility design requirements, is not typically involved in the early planning stages of a development or redevelopment project. Municipal planners and other officials are more typically in contact with developers in the early stages of a land development project. Additionally, MSD does not issue land disturbance permits, which are issued by municipalities or St. Louis County. As a result, municipal/county plan review officials are the "first line" of watershed protection. However, post-construction stormwater quality and treatment considerations have not traditionally been part of the planning or land disturbance permit approval process. Thus, training and education

on stormwater management techniques that will meet the Permit and Plan are needed. This guidance is written for municipal/county plan review officials who will review development project concept plans and/or stormwater pollution prevention plans (SWPPPs) at sites located with the MSD. This guidance is consistent with Plan goals of

- Providing "…educational materials on Best Management Practices (BMPs) and promote the use of non-structural credits and the benefits of site storm water management planning prior to land disturbance" and
- "Provid(ing) storm water management BMP guidelines to public works and planning and zoning reviewers to assist in the concept review of plans."

While upfront stormwater planning is a requirement of the Permit, our Permit does not provide methodology for completing this requirement. This document presents "tools" and processes that plan review officials can use to evaluate whether development plans address Permit requirements and Plan goals for upfront stormwater planning. The tool develops a series of questions and actions that could be taken to meet Permit and Plan requirements. Not all of these questions and actions will be applicable to every project. Municipal/county plan reviewers even have the option of replacing this methodology with another one that accomplishes the same upfront stormwater planning objectives. The test is, when evaluated as a whole,

1. Does the project planning effort adequately document existing site conditions and identify important natural resource considerations?
2. Does the project plan provide features that minimize runoff and pollutant loading and mimic pre-construction runoff conditions (for new development projects) to the maximum extent practicable?

Although emphasis has been placed in this introduction on the regulatory requirements, the goal of this document is to better serve our communities through better site development design. The public is served when new development and redevelopment projects implement practices that help avoid public hazards like flooding and NPS pollution and that protect important natural resources not fully appreciated until they are gone.

2 Evaluation of Existing Conditions

Purpose:

Documenting a site's existing conditions is the first step in protecting natural resources. The primary purpose of evaluating existing conditions is to generate information that should be used as a basis for laying out the development and implementing strategies for protecting environmentally sensitive areas. Some of these areas may be protected by federal, state, and/or local regulations as well.

Tool:

Table 1, Existing Natural Resource Considerations, presents a list of natural resources, key questions, and actions that should be taken by the developer to document a site's existing resources. The plan reviewer should use the questions as a "springboard" of initial questions to be discussed. Additional probing will likely result from answers to the questions listed in Table 1, and documentation of these additional questions is also important since a legal review of these issues could ensue.

In the evaluation of existing conditions, the "actions" should be focused on delineating the location and extent of areas that warrant protection. The next step, concept planning, addresses specific "actions" that may be taken to protect natural resources and to mitigate the impacts.

Key Terms:

The following key terms define the natural resources and other technical terms evaluated in Table 1.

Existing topography: mapping of the existing (pre-development) land surface elevations, water bodies, geology, and other features that describe a piece of property. Steep areas are generally unstable and can result in extensive runoff caused by stormwater runoff.

Flood plain: the area adjacent to a stream of body of water that is susceptible to flooding. The edge of a flood plain is defined by a water level for a given recurrence interval (i.e., probability of flooding), such as "100-year flood plain". Development in the flood plain is at higher risk of flood damage, and reducing the floodwater storage volume in the flood plain will impact flood levels in other areas.

Floodway: the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the 100-year flood without cumulatively increasing the water surface elevation. [See 44 CFR 59.1]

Karst: areas where the dissolution of limestone or other soluble rocks has produced cliffs, sinkholes, caves, underground streams, and other similar features. Karst areas may be direct "conduits" of stormwater "injection" to groundwater or streams. Increasing the rate and amount of urban stormwater to karst features also increases the rate of limestone dissolution, which can exacerbate erosion problems. NPS pollution in urban runoff to karst areas can quickly contaminate groundwater wells and impact public health.

Ponds: a small, still body of water. Lakes and reservoirs, including natural lakes and any impoundments created by the construction of a dam across any waterway or watershed, are considered Waters of the State. [See 10 CSR 20-7] Ponds (wet or dry) that were engineered and constructed for the purpose of flood detention or stormwater treatment are generally not considered Waters of the State.

Table 1: Existing Natural Resource Considerations

Natural Resource	Questions	Actions
Wetlands	Are wetlands on site? Are Army COE and/or MDNR permits needed (e.g., 404/401 permits)?	Show all wetlands on map. Obtain COE/MDNR permits &/or documentation before plan approval.
Streams and Floodplains	Are major waterways on the site? Are Army COE and/or MDNR permits needed? Is the site located within the 100 or 500-year flood plain? Is the municipal or county stream buffer (setback) shown? Is the site in a flooding or erosion prone area?	Show major waterways. Obtain COE/MDNR permits &/or documentation before plan approval. Show 100 and 500-year flood plains on map. Show stream buffer. Show areas prone to flooding. Show stream bank erosion areas.
Karst	Are sinkholes, springs, or seeps located on the site? What is the depth to bedrock?	Show sinkholes, springs, seeps, and other karst features. Show areas with shallow depth to bedrock.
Existing Topography	What is the existing topography? Are there areas with slopes steeper than 20 percent? What are the site's soil types? What is the existing stormwater drainage area and flow path?	Show existing topography, identify areas with slopes greater than 20 percent. Show site soil type. Show areas with erodible soils. Show gullies, swales, ditches, etc.
Ponds	Are there existing ponds on or adjacent to the property? Does the pond provide recreational benefits? Does the pond provide flood detention benefits? What is the condition of existing ponds (i.e., depth of sediment in pond, bank erosion, invasive plants)?	Show all ponds on map, including any existing detention basins.
Vegetated Cover	Is the site forested? Are grassy/prairie areas on the site?	Show forest and prairie areas. Show large trees (>12" dia).
Existing Property Use	What is the site's current use? What buildings, structures, and other impervious surfaces are present? Are there utilities through the site?	Show existing impervious areas and utilities.
Surrounding Property Use	What is the surrounding property use?	Show property boundary and surrounding property uses.

Property use: evaluating the existing property use is important in understanding the impact from the proposed development or the project site. Evaluation of surrounding property use is important in evaluating its impact on the development site.

Soil type (or hydrologic soil group): a term used to estimate the stormwater runoff potential. The USDA (NRCS) classifies soils as “A”, “B”, “C”, or “D” soils based on the soil’s potential for runoff. “A” soils have the lowest runoff potential (i.e., highest infiltration rate), while “D” soils have the highest runoff potential (i.e., lowest infiltration rate). Understanding what soil types exist before grading begins and leaving “A” and “B” soils undisturbed can reduce urban stormwater impacts by infiltrating stormwater runoff into the soil. Soil type information is easily retrieved through the web at http://websoilsurvey.nrcs.usda.gov.

Stream: a body of moving water in a natural channel, such as a creek or river. Regulated streams are those that are considered Waters of the State. Streams are considered regulated wetlands and are subject to State and Federal law, as well as local stream buffer ordinances that require areas next to the stream to remain undisturbed in natural condition.

Stream Buffer: a natural area boundary between a development and stream that helps protect water quality by filtering pollution and infiltrating stormwater runoff. Stream buffers also help alleviate stream bank erosion and provide room for the normal lateral movement of the stream channel.

Vegetated Cover: vegetation can heavily influence the runoff potential from a site. Wooded sites, sites with heavy brush, and sites planted in warm-season native grasses have the lowest runoff potential. Large trees help stabilize sites, reduce runoff, and reduce thermal warming of waters. Preserving areas with quality vegetated cover, and replanting buffer areas with deep-rooted trees and native plants are techniques that minimize site development runoff. Turf grass (i.e., bluegrass, fescue, etc.) has a shallow root structure and, accordingly, a higher runoff potential.

Wetland: wetlands occur at the transition zone between land and water. For regulatory purposes under the Clean Water Act, the term wetlands means "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.” [See 40 CFR 230.3 (t).] Wetlands are protected from disturbance under the Clean Water Act. The Army Corps of Engineers and DNR issue permits for any work impacting a wetland.

Ramona Lake, Berkeley, MO

Waters of the State: All rivers, streams, lakes, and other bodies of surface and subsurface water lying within or forming a part of the boundaries of the state which are not entirely confined and located completely upon lands owned, leased, or otherwise controlled by a single person or by two or more persons jointly or as tenants in common and includes waters of the United States lying within the state. [See 10 CSR 20-7] This term is important because the small MS4 Permit authorizes discharges to waters of the state (i.e., the Permit applies to and protects waters of the State). Waters of the state should not be used as BMPs, but rather be protected by BMPs.

Deliverables:

At a minimum, the developer should provide the reviewer an Existing Site Resources Map of the site that documents the location of any of the features listed in Table 1. A table or legend stating what features are (and are not) of concern on the site would be helpful. Presenting this information on a separate large size sheet (preferably on 24” x 36” paper) will assist the reviewer in evaluating the site’s information. An example Existing Site Resources Map is provided in Appendix A.

The presence of some features will require additional assessment beyond the Existing Site Resources Map. A site visit and digital photographs of the features are also helpful. Additionally, a project which impacts wetlands or waters of the U.S. or State (jurisdictional waters) will likely be accompanied by an additional assessment of the feature as required for Army Corps of Engineers and/or Missouri Department of Natural Resources under the Clean Water Act section 404/401 permitting requirements. The plan reviewer should request and review this information, as it may be helpful to them as well in determining the location, extent, and quality of these features.

3 Evaluation of Concept Plans

Purpose:

Once the Existing Site Resources Map is presented, the next step is locating the proposed buildings and other impervious features (e.g., parking lots, roadways, sidewalks, etc.) and managing the stormwater runoff from these areas. To the maximum extent practicable, the development plan should preserve and/or protect existing natural resource areas that facilitate pollutant removal and reduce runoff.

With today's construction technology, the tendency is to completely disturb and grade a site based on the future use of that property, but without regard to a site's existing natural resources or potential for minimizing stormwater runoff. While this approach facilitates the speed of development, frequently it is at odds with conservation of natural features and soil characteristics (e.g., soil permeability) that mitigate development impacts and have longer-term community and water quality benefits. Additionally, many have approached compliance with "MSD's water quality requirements" in a similar way to traditional flood detention, in that an engineered structural BMP is installed near the low point of the site. This mindset needs to be replaced with one that also includes practices that minimize the volume of runoff, because treatment alone does not meet the Permit intent's for mimicking pre-construction runoff or implementing water quality strategies to the maximum extent practicable.

Tool:

Table 2, Site Development Goals, Questions, and Methods, presents an approach to site design that plan reviewers can look for, and designers and developers can take, to minimize impacts to the environment from stormwater. While specific solutions will be tailored on a site-by-site basis, the major concepts that these solutions embody (in order of preference) include:

- Limiting disturbance and preserving existing pervious areas (i.e., green space) and sensitive areas such as flood plains and stream buffers.
- Reducing the amount of impervious area (rooftops, parking lots, sidewalks, roads, etc.).
- Disconnecting impervious areas stormwater from the storm sewer system via overland flow to vegetated buffers and other "green" infrastructure techniques that promote infiltration.
- Using pervious surface materials, such as permeable paver blocks, porous asphalt, porous concrete, and green roofs.
- Installing engineered systems that treat stormwater runoff and/or reduce peak stormwater runoff rates using techniques that employ vegetation and infiltration. Underground structural techniques should be used as a last resort.

A significant portion of MSD is already developed. Strategies for managing stormwater quality at redevelopment sites are sometimes more limited because of existing utilities, space restrictions, and other factors. MSD provides greater flexibility for meeting water quality requirements to smaller (<5 acre) redevelopment projects. Additionally, MSD wants to encourage redevelopment of existing impervious areas and infill development as a component of regional stormwater management. (Redeveloping a parking lot, commercial district, or already degraded site allows a community to enjoy the benefits of growth and improved water quality without further increasing net runoff.) However, MSD anticipate that larger redevelopment projects will have an opportunity to employ techniques

Table 2: Site Development Goals, Questions, and Methods		
Goal	**Questions**	**Methods (To the Maximum Extent Practicable)**
Minimize Stormwater Generation	Can land disturbance be minimized? Can additional green space be preserved? Can proposed development be located in already developed areas?	Limit clearing, grading, and earth disturbance. Use clustered development with open space designs. Use narrower, shorter streets, right-of-way, and sidewalks. Allow smaller radii for cul-de-sacs. Reduce parking space requirements. Preserve and protect forested areas, especially areas with large trees. Show tree preservation areas on plans. Allow for shared driveways and parking areas. Provide incentives for site redevelopment.
	Can stormwater safely flow overland to buffer areas (i.e., avoid piping)?	Grade to allow stormwater to sheet flow into buffer or conservation easement areas. Limit use of curb and gutter streets. Use grass channels for street drainage and stormwater conveyance. Allow roof downspouts to flow overland into vegetated cover.
	Can stormwater be captured and infiltrated into the ground?	Rainwater infiltration systems. Examples include rain gardens, dry wells, and other landscape infiltration methods. Emphasize managing stormwater at the point of generation.
	Can stormwater be captured and reused for irrigation or décor?	Rainwater harvesting systems. Examples include rain barrels, cisterns, shallow ponds, and underground chambers. Emphasize managing stormwater at the point of generation.
	Could permeable surface materials be used to promote infiltration and limit runoff?	Use permeable pavements in low traffic areas. Use green roofs. Direct rooftop runoff to pervious surfaces, such as amended soils.
Minimize Erosion of Site Soils	Can land disturbance be restricted to less sensitive areas? Is the development located outside the 100-year flood plain?	Land disturbance SWPPP requirements apply. Avoid grading areas with steep slopes and erodible soils. Limit disturbance areas within the 100-year floodplain.
Minimize Stream Bank Erosion	Is the development located outside the stream bank setback buffer?	Development should not encroach municipality's stream bank buffer. **Show stream buffer on preliminary plan.**
	Does the development warrant engineering channel protection controls (because of development size or stream bank erosion problems)?	MSD rules and regulations require channel protection detention for the 1-year 24-hour rainfall event. **Show detention basin on preliminary plan.** Locate outside limits of 100-year floodplain. If feasible, stabilize the stream bank using other engineered methods.

Minimize Impact to Environmentally Sensitive Areas	Does the development plan avoid sensitive areas?	**Untreated stormwater should not discharge into sinkholes, wetlands, fishing ponds, and other sensitive areas.** Provide a buffer around sensitive areas. Preserve the existing stormwater flow path.
Adequately Treat Stormwater Before Discharge	Does the site development plan utilize stormwater credits? Does the development plan show structural BMPs? What is the acreage of drainage to the BMP? Will the BMP be above or below ground?	**Show locations of any (non-structural) "credit" areas and show locations of any structural stormwater BMPs on preliminary plan.** Locate structural BMPs outside the 100-year flood plain. Provide a BMP drainage area map. Only certain wet ponds and wetlands may be used for drainage areas larger than 10 acres. Encourage stormwater credits, managing stormwater at the point of generation, and aboveground stormwater BMPs. "Regional BMPs" and underground BMPs should be avoided when possible. As a rule of thumb, the development should provide 35% minimum green space for a structural BMP(s).
Stormwater Controls Shall Be Maintainable and Enforceable	Who will be responsible for maintaining stormwater controls? Are the structural BMP shown on the plan appropriate for the entity or person responsible for maintenance?	The property owner or subdivision association will maintain BMPs. Underground BMPs, large surface filters, and other maintenance intensive BMPs should be avoided on residential developments.
Minimize Downstream Flooding	Is over 1 acre of impervious area being added? Is the development tributary to any existing basins that need to be upgraded?	A stormwater detention basin will be needed. Show location on plan. Developments feeding basins that do not currently meet MSD flood detention requirements will need to be upgraded. Frequently this requires enlargement of the existing basin.

(Bold items reflect project requirements.)

that both minimize stormwater generation and treat stormwater pollution. For example, larger redevelopment and new development projects may employ alternative surfaces (e.g., porous pavement) that reduce stormwater runoff, as well as decentralized technologies that infiltrate and treat stormwater runoff at the source. At smaller redevelopment projects, these alternative surfaces and technologies may not be practical due to space constraints, utility conflicts, traffic flow, cost, or other factors.

A common misconception is that a traditional "dry" flood detention basin meets MSD water quality requirements. Dry basins may be used in conjunction with water quality BMPs for flood control, but by themselves they do not provide effective stormwater quality management. Additionally, while constructed wet ponds and wetlands provide effective water quality management, developments may not use existing features that are considered "waters of the State" as a BMP. This includes wetlands, lakes, and ponds located on public property (e.g., park land), as well as the streams that feed them (including intermittent streams).

MSD recognizes that some of the methods that can be used to mitigate stormwater impact may be in conflict with other development requirements (e.g., reducing cul-de-sac radii, reducing parking spaces, use of narrower streets and sidewalks, alternative pervious materials, etc.). Municipal/ county/state officials and MSD must identify impediments to these practices, determine what flexibility is available, and modify rules as appropriate. St. Louis area local governments are increasingly supportive of green infrastructure and have an incentive to be supportive as a Phase II co-permittee. Until all barriers and conflicts are removed, co-permittees are encouraged to allow greener stormwater management solutions and allow exemptions to conflicting requirements where it makes sense.

The property owner must maintain stormwater treatment devices, and they will be periodically inspected by MSD to ensure proper maintenance is occurring. (A maintenance plan is recorded with the property and is transferable with property ownership.) Failure of the property owner to maintain their BMPs is a violation of MSD ordinance and the site maintenance agreement. **Therefore, whatever BMPs are selected, they need to be maintainable by the end user of the property.** It is important to recognize that all designed systems will require maintenance, and as a rule, the more "engineered" the solution, the more frequent and expensive maintenance will be. There are economic tradeoffs: while establishing buffer areas and managing stormwater using non-structural BMPs may reduce the amount of land available for development, maintenance costs and headaches on future property owners are reduced. However, only using non-structural BMPs may make some developments cost prohibitive due to land value, and some commercial users will have the resources needed to maintain the engineered structural BMPs. The best solution is the one that balances future maintenance costs, given the resources of the user, with the cost of development. Underground vaults, filters, and manufactured separation devices (which are maintenance intensive) are not appropriate for residential development. Except for approved hydrodynamic separation devices installed by municipalities in roadway right-of-way, MSD will not maintain stormwater treatment devices.

Post-Construction Non-Structural BMPs:

Non-structural BMPs are development strategies that minimize the impact of land development on natural resources. Many of the "methods" in Table 2 are non-structural techniques that can be used to treat, as well as reduce, site runoff. In the Maryland Stormwater Manual, some non-structural techniques are grouped together as a "credit" that satisfies MSD water quality requirements (as a stand-alone practice) or reduces the volume or rate of water that must be managed as part of the stormwater management plan. These credits include

- Natural area conservation
- Disconnection of rooftop runoff

- Disconnection of non-rooftop runoff
- Sheet flow to buffers
- Open (grass) channel use (for roadways), and
- Environmental sensitive development (i.e., low-impact development).

In most cases, non-structural practices must be combined with structural practices to meet stormwater requirements. Nationally and at MSD, non-structural practices are increasingly recognized as a critical and economical feature of stormwater management.

Post-Construction Structural BMPs:

In all new development and redevelopment, MSD rules and regulations require the use of BMPs to treat a water quality volume of runoff from 1.14 inches of rainfall. MSD regulations specify and allow certain structural BMP's for use. The structural BMPs allowed for stormwater quality control are divided into six general categories as shown in Table 3. Typical BMP layouts and sections are provided in Appendix B. The full scope of BMP selection, design, and construction is beyond this document and the goal of conceptual plan review. However, concept plan reviewers may find this table of BMP categories helpful in evaluating whether a proposed BMP, at least by name, is allowable and whether adequate space has been allocated in the design. For more specific guidance on structural BMPs, MSD relies upon Chapters 3 and 4 of the Maryland Department of the Environment's (MDE), April 2000, "Stormwater Design Manual, Vol. I and Vol. II." The "Maryland Manual" outlines the selection, design and construction of various structural BMPs. (At present, there is not a national or Missouri state design manual for these devices. The Maryland Manual is a comprehensive BMP design manual, and its principles can be adapted to the St. Louis region.)

Table 3. Post-Construction Structural BMPs Allowed within MSD

Stormwater Ponds	***Stormwater Filtering System***
• Micropool Extended-Detention (ED) Ponds	• Surface Sand Filters
• Wet Ponds	• Underground Sand Filters
• Wet ED Ponds	• Perimeter Sand Filters
• Multiple Pond System	• Organic Filters
• "Pocket Ponds"	• Pocket Sand Filters
Stormwater Wetlands	• Bioretention
• Shallow Wetland	• Proprietary Cartridge Devices
• ED Shallow Wetland	***Open Channel Systems***
• Pond/Wetland System	• Dry Swale
• "Pocket Wetland"	• Wet Swale
Stormwater Infiltration	***Hydrodynamic Separator Devices***
• Infiltration Trench	• MSD Approved Devices[1]
• Infiltration Basin	***Alternative Surface Materials***[2]
	• Green Roof
	• Permeable Pavement

[1]Hydrodynamic Separator Devices are manufactured by a variety of vendors. A list of approved devices and vendors is available through the MSD website, www.stlmsd.com.
[2] Alternative surfaces reduce the impervious area, reduce the volume of runoff requiring treatment, and provides some pre-treatment benefit; but are not recognized as "stand-alone" treatment BMPs. They may be a component of a BMP that does provide treatment (i.e., infiltration or filtration).

Many of the post-construction structural BMPs incorporate plants that add functional and landscape value to the BMP. MSD references the "Landscape Guide for Stormwater Best Management Practice Design, St. Louis, Missouri" for recommendations on selecting plant species and on planting methods used in BMPs. (This guide can be accessed through the MSD website, www.stlmsd.com.)

Surface Sand Filter, St. Louis County, MO

Key Terms:

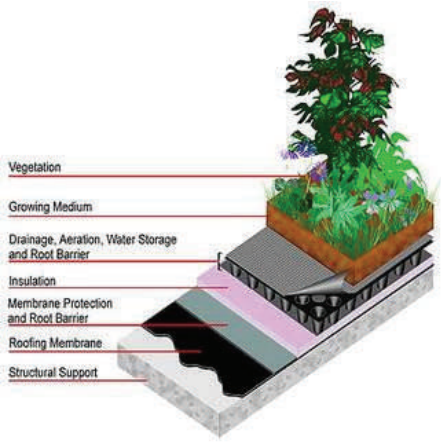
Amended soils: soil that has been improved by practices that preserve site topsoil, reduced soil compaction, and/or blended with organic and/or inorganic materials that reduce soil runoff capacity.

BMP drainage area map: a topographical map that shows the drainage areas that feed individual BMPs or credit areas. The BMP drainage area map also provides limits of disturbance, improvements, and a table showing the water quality volumes required and provided in BMPs.

Disconnection of runoff: Credit focused on reducing the water quality volume by disconnecting impervious areas (rooftops, parking lots, etc.) from the sewer and directing them to pervious areas where stormwater can either infiltrate into the soil or filter over it. The credit is usually obtained by grading the site to promote overland flow or by providing bioretention/rain garden areas on single-family residential lots.

Engineered channel protection: to protect natural channels from erosion and consequent pollution, MSD rules and regulations require some developments to provide extended detention of the one-year, 24-hour storm event. A detention pond or underground chamber is generally needed to meet channel protection requirements.

Environmentally Sensitive Development (or Low-Impact Development (LID)): mimicking a site's predevelopment hydrology by using decentralized "micro-scale" techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source. These micro-scale techniques include rainwater harvesting (e.g., rain barrels), dry wells, small rain gardens, bioswales, and other small-scale techniques that reduce runoff.



Typical section of a green roof

Grass channel credit: Credit that is given when open grass channels are used in lieu of curb and gutter and when designed to reduce the volume of runoff during smaller storms.

Green roof: also referred to as vegetated roofs, roof gardens, or eco-roofs, green roofs replace conventional roof materials with a protective (water barrier), planting media, and vegetation. The planting media and vegetation assists in attenuation of stormwater impacts.

Hydrodynamic Separator (HDS) Devices: A pre-fabricated stormwater treatment structure utilizing settling and vortex separation to remove coarse sediment and trash from storm runoff. HDS devices are only allowed as "stand-alone" treatment devices for highway runoff and small redevelopment

sites. They may also be used for pre-treatment to filters, ponds, or other types of structural BMPs.

Infiltration basin (or trench): BMPs that capture and temporarily store the water quality volume while allowing infiltration into the soil over a defined period. Infiltration basins should be limited to tributary areas smaller than 10 acres, and infiltration trenches should be limited to areas smaller than 5 acres. Infiltration techniques should be located in areas with A or B soil types. These techniques should not be located where seepage could damage adjoining or downstream property.

Maintenance agreement: a recorded agreement between MSD and the owner of the property where the BMP is located. The agreement requires the property owner to maintain the stormwater facilities and provides a means for MSD to rehabilitate these facilities and place a lien on the property, if necessary.

Natural Area Conservation: Credit focused on conserving natural areas, thereby retaining the pre-development and water quality characteristics. This strategy reduces the water quality volume that must be managed by placing conservation areas in permanent protection through a conservation easement, reserve area, or other means that preserves the pervious area in its natural state.

Permeable Pavement During Rainfall

Open channel systems: BMPs that are designed to capture and treat the water quality volume within swales formed by check dams or other means of shallow ponding. They are typically limited to roadways and low-density residential projects with drainages areas 5 acres or less.

Permeable pavement: pavement that is porous, allowing stormwater to infiltrate into the subbase (gravel) and soil below it. Permeable pavements are effective for reducing imperviousness in parking lots, driveways, sidewalks, and areas with low traffic load. Permeable pavement areas are also exempt from MSD's stormwater service fee.

Rain Garden: a rain garden, or bioretention area, is a type of filtering system where stormwater is allowed to temporarily pond in a planted shallow depression. Rain gardens are planted with native vegetation that can tolerate periods of inundation and remove pollution in stormwater. (Rain garden is a "buzzword" that is sometimes inaccurately used to describe many filtering systems. They may or may not meet MSD Rules and Regulations, based on whether they meet the applicable filter system design.)

Redevelopment site: within MSD, a site (i.e., total property area) is considered a redevelopment site if at least 20% of the existing site was impervious coverage as of January 15, 2000.

Regional stormwater treatment: post-construction structural BMPs that serve multiple properties, property owners, and sub-watersheds. While regional BMPs focus maintenance in large, centralized, treatment cells, by themselves they do not encourage methods that reduce runoff at the source and can complicate maintenance responsibilities.

Sheet flow: flow over plane surfaces (e.g., a rooftop or roadway) that typically occur in the headwaters of the watershed. As the volume of water in sheetflow increases, it concentrates and begins to

(quickly) flow in channels. By maintaining sheet flow conditions in buffers, the length of time stormwater is allowed to infiltrate increases.

Sheet Flow to Buffer: Credit that reduces the water quality volume when a natural buffer or a forested area effectively treats stormwater runoff. Effective treatment is achieved when pervious and impervious area runoff is discharged to a grass or forested buffer through overland sheet flow.

Stormwater filtering systems: BMPs that capture and temporarily store the water quality volume and then pass it through a bed of sand, organic matter, soil, or other media. Filtered water is then collected and returned to the conveyance system (or allowed to infiltrate). Examples of stormwater filters include sand filters, bioretention (rain gardens), and manufactured filter devices. Due to clogging, experience suggests the drainage area to underground filters should be limited to a couple acres; aboveground surface sand filters may serve up to 10 acres. The filtering medium may need to be removed and replaced in the future, as sediments build up over the filter and ponding times increase.

Stormwater ponds: BMPs that have a permanent pool of water, or combination of extended detention or shallow wetland with a permanent pool, equivalent to the water quality volume. Stormwater ponds remove solids by settling. The shallow bench around stormwater ponds is planted with aquatic plants that further remove pollution. To ensure the pond remains "charged" with water, stormwater ponds should be limited to sites with a drainage area of 10 acres or greater.

Rain Garden in St. Louis County, MO

Stormwater wetlands: BMPs that create shallow wetland areas to treat urban stormwater and often incorporate small permanent pools of water and or extended detention storage to contain the full water quality volume. Stormwater wetlands should be limited to sites with a drainage area of 25 acres or greater.

Water Quality Volume (WQ_v): the storage needed to capture and treat the runoff from 90 percent of the recorded daily rainfall events. [See 4.080.02 of MSD's Rules and Regulations].

Deliverables:

The Concept Plan submittal should include a Site Development Plan (preferably on 24" x 36" paper) and narrative to support the design. The narrative should describe how natural resources will be preserved and protected, and explain how stormwater quality and flood protection requirements will be achieved. At a minimum, the concept should include the following:

- Location of site natural resources.
- Proposed limits of clearing and grading.
- Location of proposed impervious areas (buildings, roadways, parking, and sidewalks).
- Location of existing and proposed utilities.
- Locations of proposed buffer areas and BMPs.

4 Integration with MSD Stormwater Quality Review

As alluded to earlier, a challenge to meeting better site designs for stormwater management is coordination between municipal/county plan reviewers and MSD plan reviewers. Complicating this further, the process by which municipalities and/or St. Louis county review preliminary development plans and land disturbance plans varies. For an overview, Figure 1 presents a general process of how the preliminary and detailed plan development pieces "fit" together. While each municipality and St. Louis County can use a different process for assessing site plans, the elements of the process (establishing existing site conditions, identifying natural resources that warrant protection, establishing a preliminary layout that illustrates post-construction buffers and BMPs, etc.) should be common.

The municipality and/or St. Louis County would review the initial steps in the development review process: establishing site conditions and presenting a preliminary development plan. For projects that need "rezoning", the initial stormwater planning steps should occur before or during the rezoning process. In many cases, it will make sense to incorporate key components (e.g., protection buffers and "credit" areas) as conditions of rezoning. If rezoning is not required, the planning authority should coordinate with MSD to ensure stream buffers and non-structural BMPs are reserved in the recorded maintenance agreement.

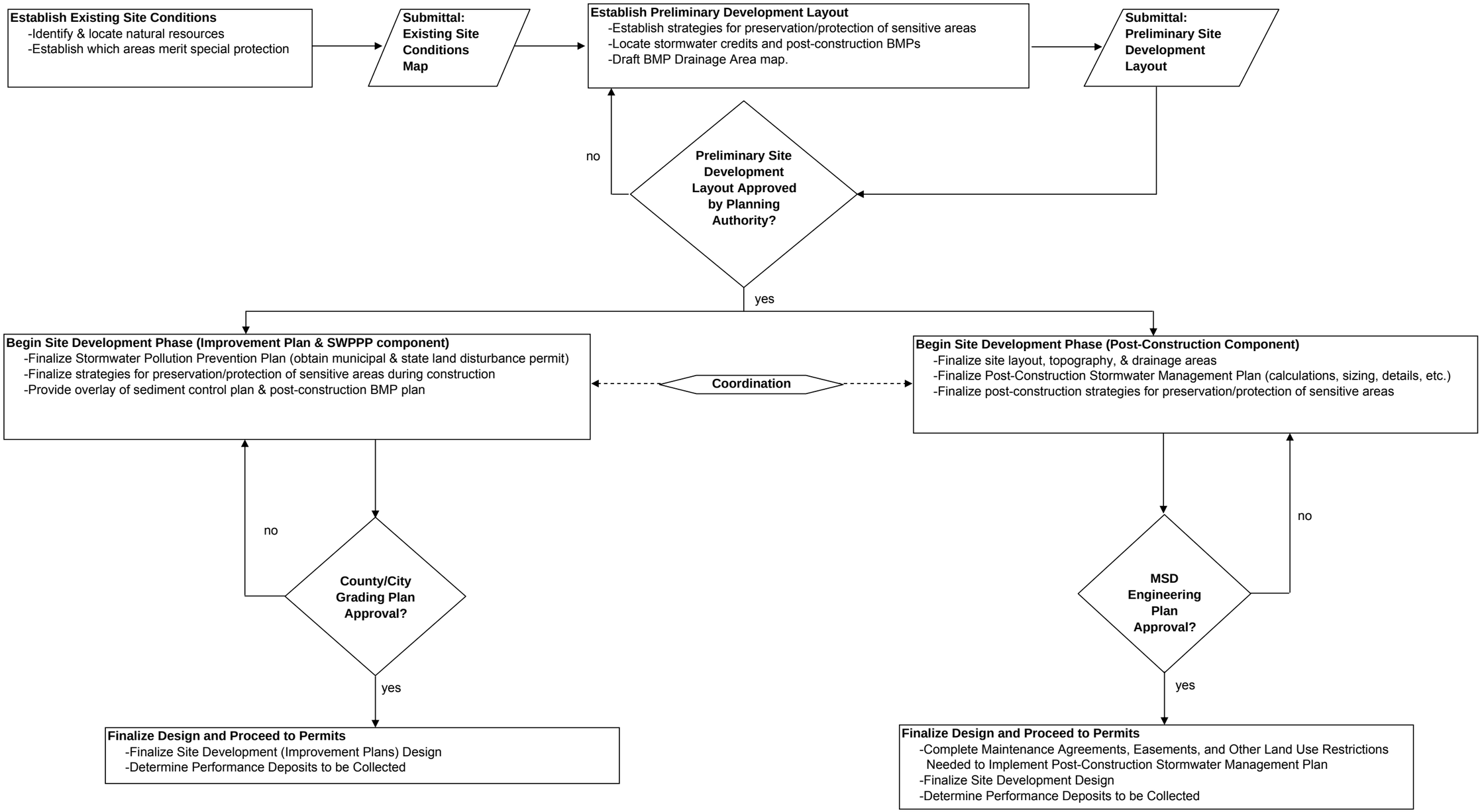
The more detailed site development phase begins after the planning authority approves the preliminary plan. The resource protection component of the approved preliminary plan will need to be coordinated between the SWPPP authority (St. Louis County or municipality) and post-construction permit authority (MSD). The SWPPP authority will address the actions to be taken to protect resources from runoff during construction activities. MSD will permit the actions need to protect resources after construction activities are complete.

SWPPP reviewers should note the relationship between construction and post-construction BMPs. Construction BMPs in a SWPPP are designed to minimize impacts during the active construction phase, and they do not always translate into BMPs applicable for post-construction. Post-construction BMPs must treat long-term runoff from the newly constructed or redeveloped site. In some cases, construction and post-construction BMPs can be located in the same area. (For example, a sediment control basin may be converted into a wet pond and flood detention basin.) However, at the majority of sites, construction and post-construction sites will be located on different parts of the site. This is needed to preserve the soil structure necessary for BMPs that rely upon infiltration (such as infiltration basins). Also, post-construction BMPs (such as filters, bioretention/rain gardens, dry swales, and infiltration areas) must be installed after contributing drainage areas are stabilized in order to prevent them from clogging with construction sediment.

Surface Sand Filter Clogged with Construction Site Sediment, Berkeley, MO

MSD plan review engineers will review the post-construction stormwater management plan. This will include review of plans showing how stormwater will be conveyed and treated (and detained), the BMP drainage area map, maintenance plans, calculations,

Figure 1. Generic Stormwater Site Design Approval Process



BMP sizing, and other details. MSD and the owner of the property(s) where the BMP(s) is located will enter into a maintenance agreement, and the agreement will be recorded with the property(s). MSD will also collect a BMP construction deposit and field-inspect the post-construction BMPs.

It is not the task of the planning and zoning or SWPPP permitting staff to review detailed post-construction stormwater management plans and calculations. These reviewers need only to be focused on ensuring

- that post-construction stormwater management is a component of preliminary design and
- that the development approach considers sensitive areas, buffer areas, and methods that reduce (as well as treat) stormwater runoff.

It is very difficult to provide “rules of thumb” and general guidance on stormwater management design, given the site-specific nature of design and the range of BMP options available. In some cases, specific questions about post-construction stormwater management should be addressed to MSD, and assistance is available on three levels. First, MSD plan review engineers are available through the MSD permit office (314-768-6272) to answer general questions. Second, where a site specific and/or more defined scope of stormwater management requirements is requested, MSD can provide a (paid) conceptual review. The conceptual review provides a quicker “desktop” review of the development plan and comments on the overall direction of stormwater management, but does not typically address project details and calculations. **Plan approvals are not provided in conceptual review.** Where a detailed project review and plan approval is needed, the developer and engineer should apply for a formal plan review. It is important to note that the developer/engineer can submit plans to MSD for formal plan review at any point in the process (including preliminary site layout).

5 Conclusion

Stormwater quality in our community will best be managed when all of us coordinate our stormwater management strategies. Stormwater management should be focused on minimizing and treating stormwater runoff. One development or redevelopment project, alone, is unlikely to improve regional stormwater quality. Rather, meaningful results will only be achieved after many redevelopment and development projects that incorporate good stormwater management practices and years operation. MSD looks forward to working with our co-permittees and stakeholders on improving water quality. Questions about stormwater management plans and approaches may be directed to these MSD managers.

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JSHOSK@stlmsd.com

Internet Resources:

http://www.stlmsd.com/MSD/PgmsProjs/planreview/Search. MSD plan review information, including links to rules and regulations, proprietary devices, and the Landscaping Guide.

http://www.stlmsd.com/MSD/PgmsProjs/PhaseII. MSD Phase II information website, a clearinghouse on many stormwater related items.

http://www.dnr.mo.gov/env/wpp/stormwater/sw-local-gov-programs.htm. Phase II stormwater requirements and resources Information for local governments from Missouri DNR.

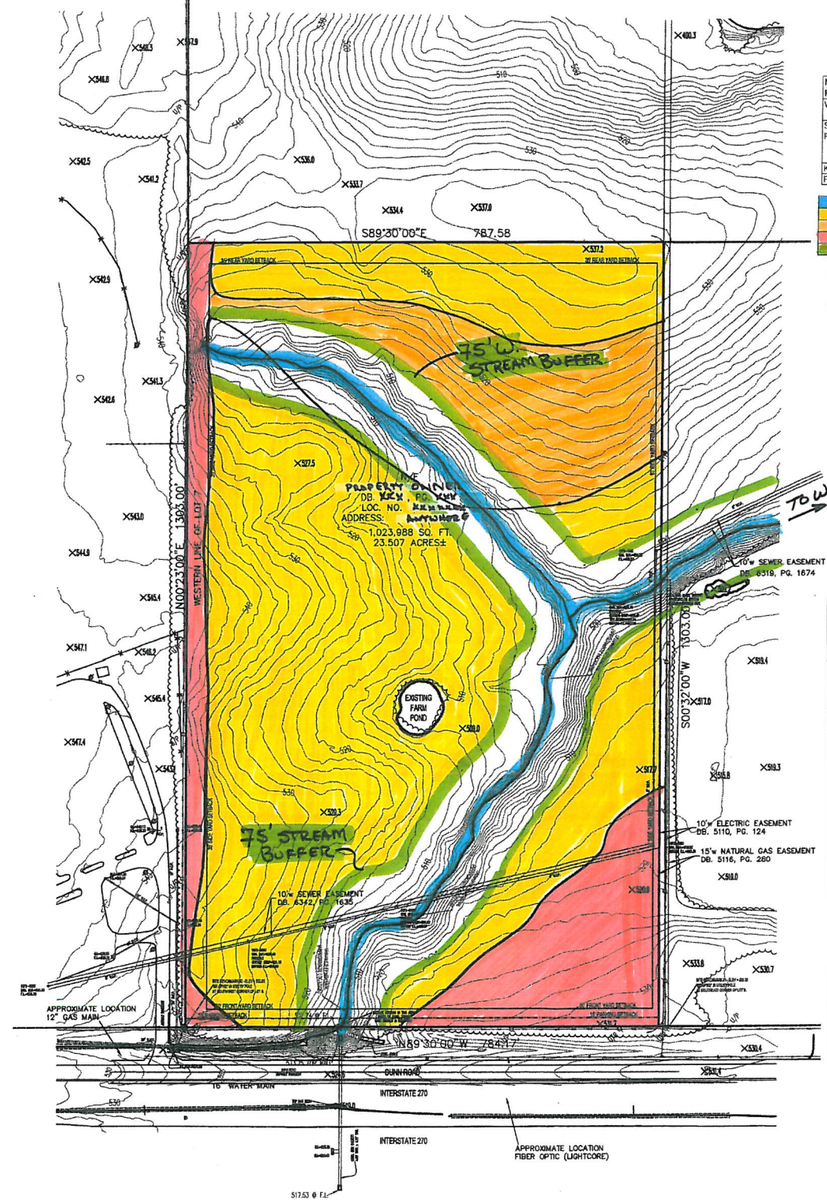
http://www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/stormwater_design/index.asp. The Maryland Stormwater Design Manual may be downloaded from this website.

http://websoilsurvey.nrcs.usda.gov/app/. Web soil survey application from the USDA-NRCS.

http://www.cwp.org/. The Center for Watershed Protection is a non-profit organization that develops watershed protection strategies, researches their effectiveness, and publishes guidance to watershed managers across the U.S.

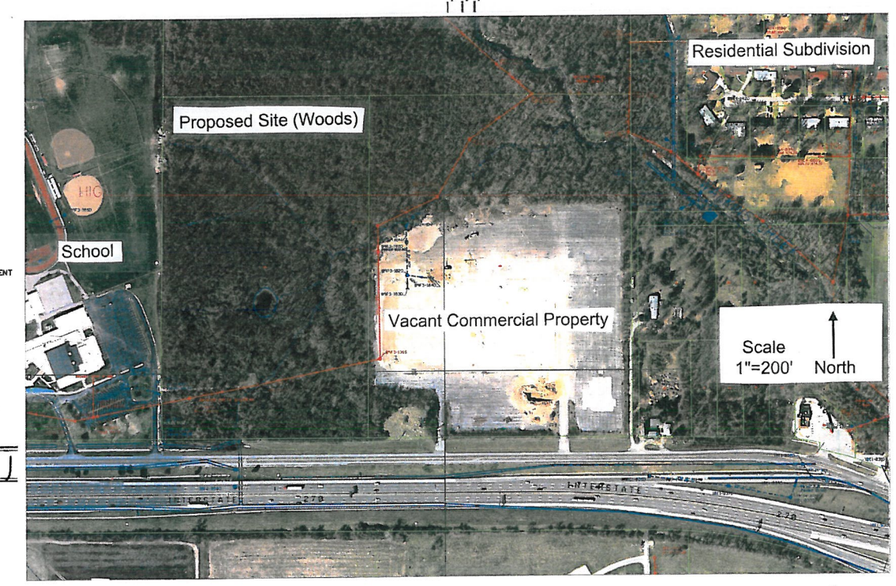
Appendix A

Example Site Resources Map
Example Concept Plan for Stormwater Management
Example BMP Drainage Area Map



Natural Resource	Presence?	Additional Information
Wetlands	Yes	COE/MDNR 404/401 are required for any work in wetlands.
Streams and Floodplains	Yes	Watkins Creek tributaries flow through site. Site is located outside of 100-year floodplain. Stream buffer requirements apply.
Karst	No	Not identified during site walk.
Ponds	Yes	"Farm pond" is not waters of the State.

- Regulated Waters of State or Nation
- Hydrologic Group B Soils
- Hydrologic Group C Soils
- Hydrologic Group D Soils
- 75' Wide Stream Buffer



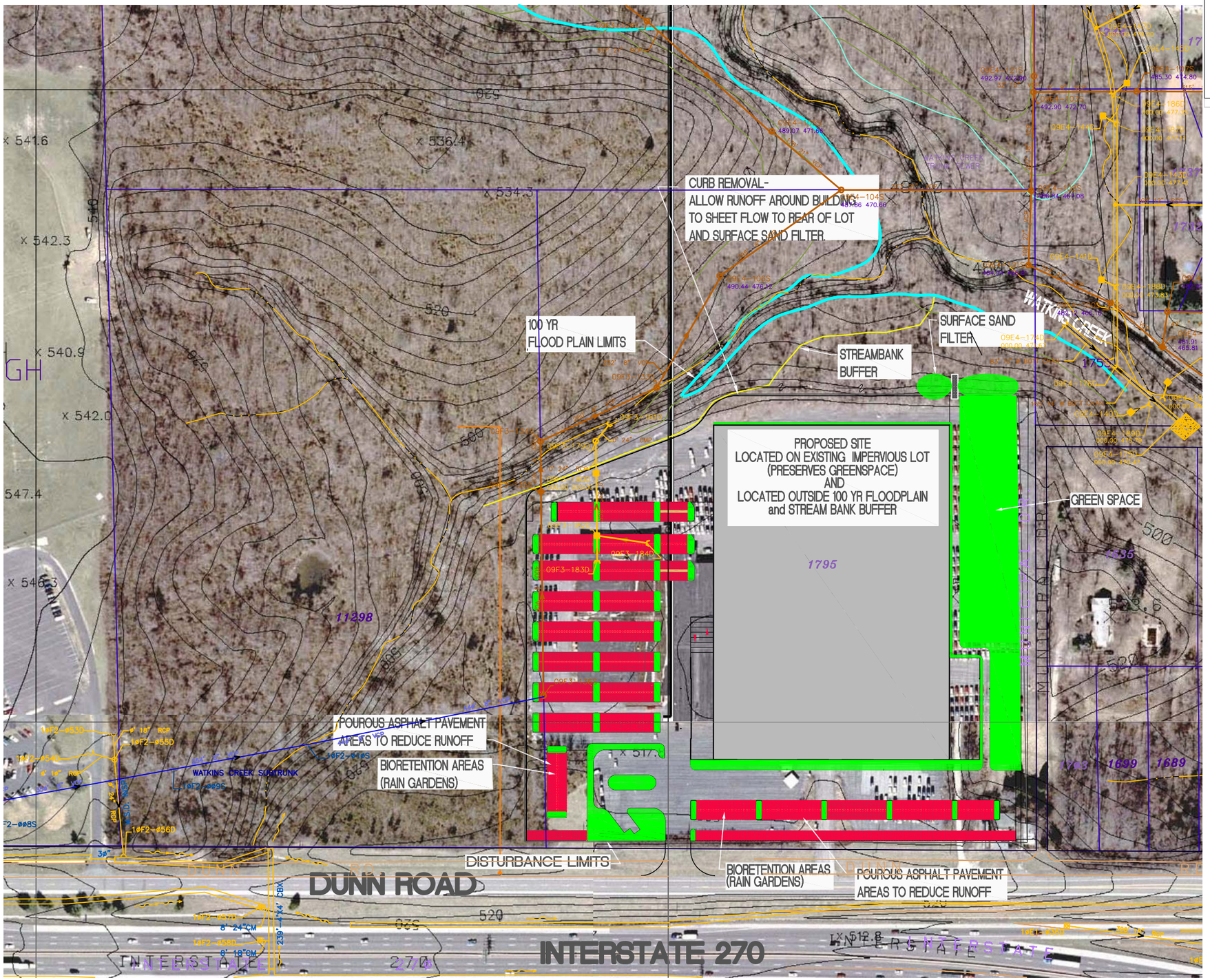
Example
Existing Site Resources Map

Scale: 1" = 100'

Total Disturbance Acreage: 18.6 Ac
Total Existing Imperviousness: 17.1 Ac
Total Proposed Site Imperviousness: 13.5 Ac
Only surface BMPs will be used and more pervious area is created. No flood or channel protection detention is required.
Post-construction stormwater quality management is required.

Stormwater BMP/Credit Summary Table

Basin	Description of Area	BMP Type	Drainage Area (Acres)	Imperviousness	WQv (Cu. Ft.)
A	Roof, roadway, and green space	Surface Sand Filter	9.04	76%	27,000
B	Parking areas	Bioretention	9.56	70%	27,000
		Total	18.6	73%	54,000



N

SCALE: 1"=100'
0 50 100

THE PROFESSIONAL WHOSE SIGNATURE AND PERSONAL SEAL APPEAR HEREON, ASSUMES RESPONSIBILITY ONLY FOR WHAT APPEARS ON THIS PAGE, AND DISCLAIMS (PURSUANT TO SECTION 327.411 RSMO) ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS, OR OTHER DOCUMENTS OR INSTRUMENTS NOT SEALED BY THE UNDERSIGNED PROFESSIONAL RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS PAGE REFERS.

REV.	DATE	DESCRIPTION	BY

Engineer Seal

METROPOLITAN
ST. LOUIS SEWER DISTRICT

EXAMPLE STORMWATER
MANAGEMENT CONCEPT PLAN

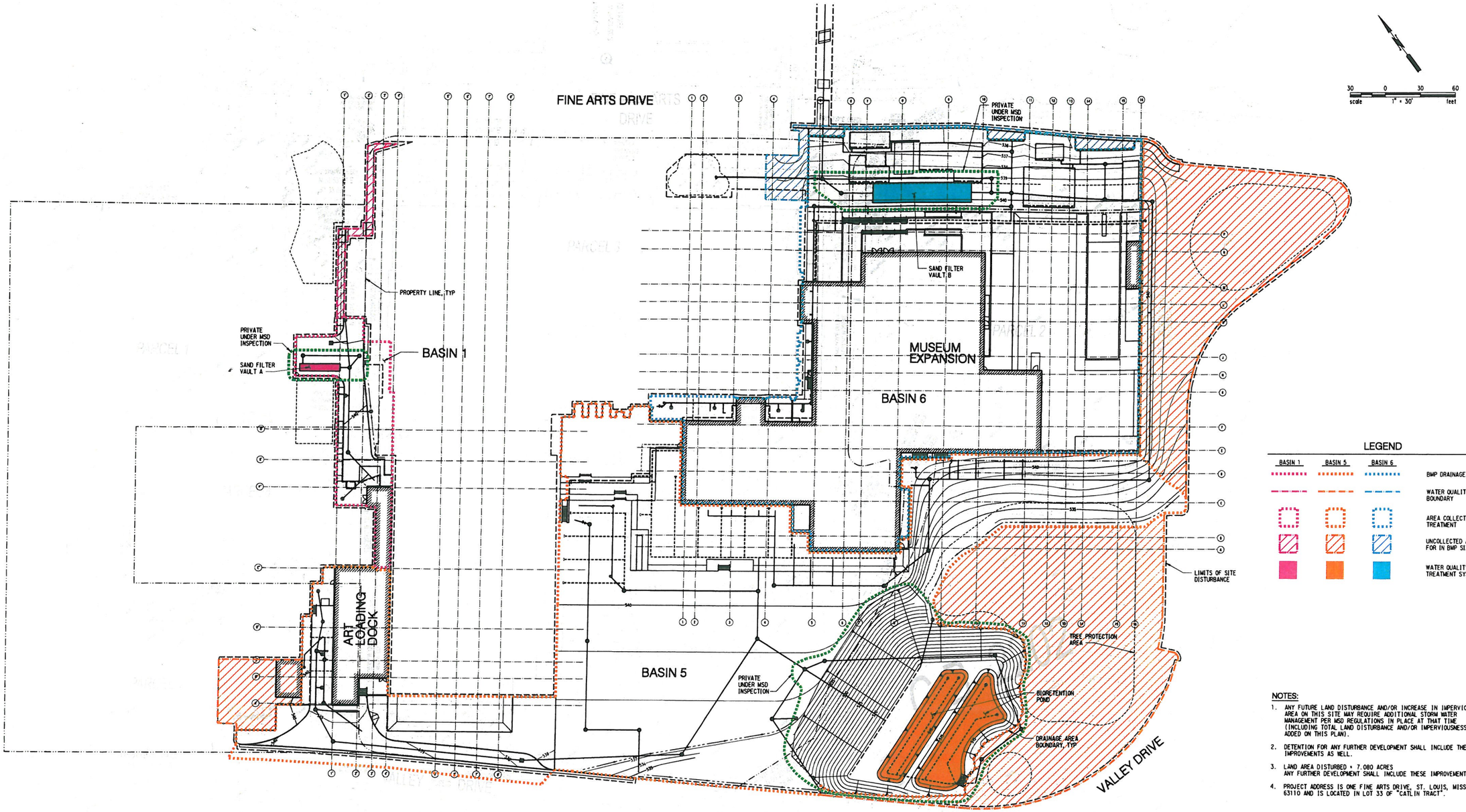
Designed A.A.A.
Drawn A.A.A.
Checked
Date AUG., 2008
Sheet No 1 of 1

PRELIMINARY

Path: G:\Jay Hoskins\FE drawings\
Plotted on: 3/20/09 @ 10:40:46AM by RGWBB

3/09/2009

BASE MAP: 00-A-1 **00-A-1** MSD ALT #3



LEGEND

BASIN 1	BASIN 5	BASIN 6	
			BMP DRAINAGE BOUNDARY
			WATER QUALITY TREATMENT BOUNDARY
			AREA COLLECTED FOR TREATMENT
			UNCOLLECTED AREA ACCOUNTED FOR IN BMP SIZING
			WATER QUALITY TREATMENT SYSTEM

NOTES:

1. ANY FUTURE LAND DISTURBANCE AND/OR INCREASE IN IMPERVIOUS AREA ON THIS SITE MAY REQUIRE ADDITIONAL STORM WATER MANAGEMENT PER MSD REGULATIONS IN PLACE AT THAT TIME (INCLUDING TOTAL LAND DISTURBANCE AND/OR IMPERVIOUSNESS ADDED ON THIS PLAN).
2. DETENTION FOR ANY FURTHER DEVELOPMENT SHALL INCLUDE THESE IMPROVEMENTS AS WELL.
3. LAND AREA DISTURBED = 7.080 ACRES
   ANY FURTHER DEVELOPMENT SHALL INCLUDE THESE IMPROVEMENTS AS WELL.
4. PROJECT ADDRESS IS ONE FINE ARTS DRIVE, ST. LOUIS, MISSOURI, 63110 AND IS LOCATED IN LOT 33 OF "CATLIN TRACT".

BMP/STORMWATER CREDIT SUMMARY TABLE

BASIN	REQUIRED TREATMENT AREA (ACRES)	COLLECTED AREA (ACRES)	DESCRIPTION	BMP	STORMWATER CREDIT	WQv REDUCTION TYPE (1 OF 3 TYPES)	WQv REQUIRED (CU FT) 75% of WQv	WQv PROVIDED (CU FT)
1	0.20	0.21	NORTHWEST	SAND FILTER	--	--	540	540
5	4.24	2.96	SOUTH	BIORETENTION POND	--	--	2368	8026
6	2.29	2.22	NORTHEAST	SAND FILTER	--	--	5524	5524
	TOTAL 6.73	TOTAL 5.39						

ARCHITECT OF RECORD: DESIGN ARCHITECT: CIVIL + STRUCTURAL ENGINEER: MEP/FP ENGINEER: MEP/FP ENGINEER OF RECORD: ENVELOPE CONSULTANT:

PROFESSIONAL SEAL:

STATE OF MISSOURI
TODD A. GARDNER
NUMBER PE-2004017480
PROFESSIONAL ENGINEER

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REVISION HISTORY:

no.	description	date	no.	description	date

PROJECT:

MSD BASEMAP 19H3 & 19H4

SHEET TITLE: BMP DRAINAGE MAP

SHEET NUMBER: MSD-2

MKA 88222.00

CONSTRUCTION DOCUMENTS

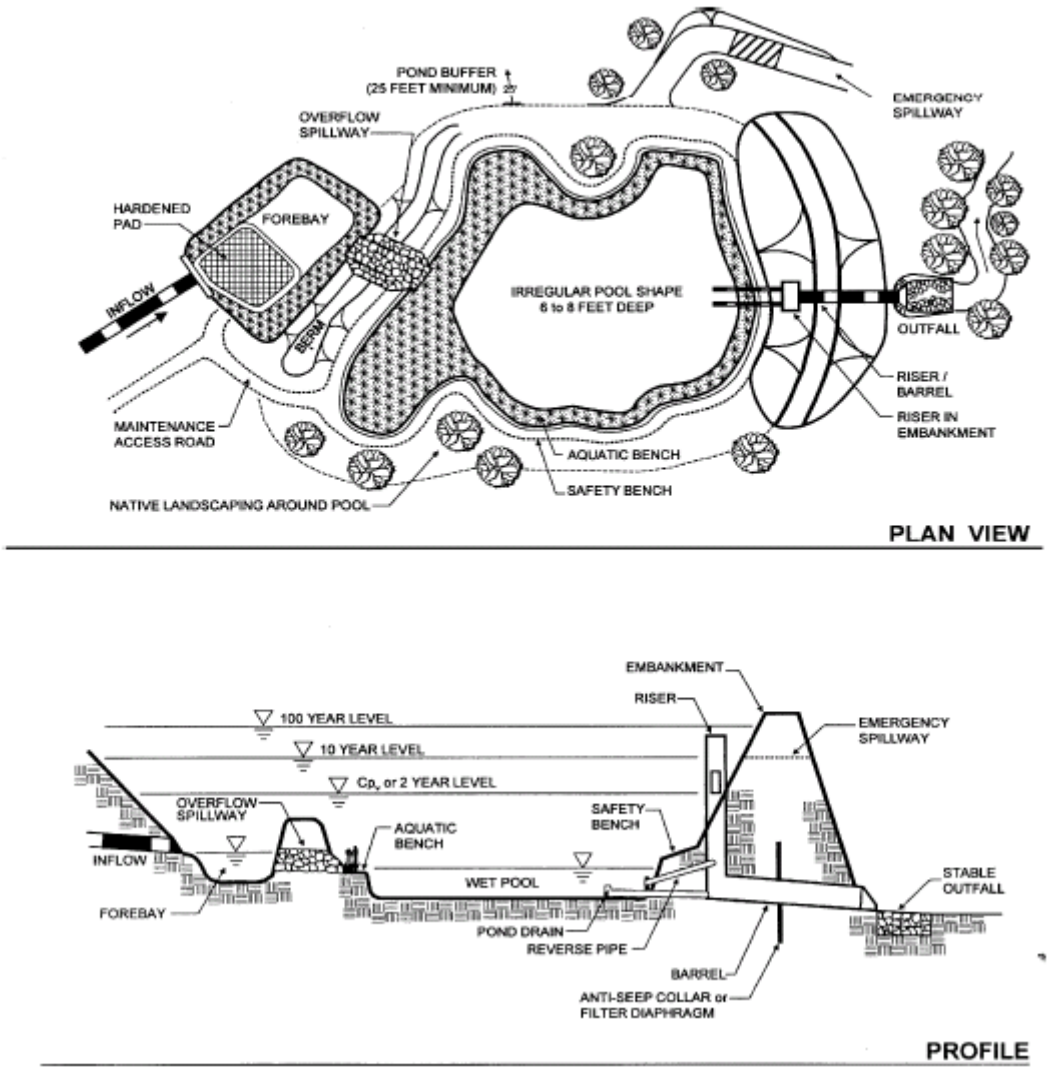
DRAWN BY: RBG CHECKED BY: DAG ISSUE DATE: PERMIT - 19 JUNE 2020

Appendix B

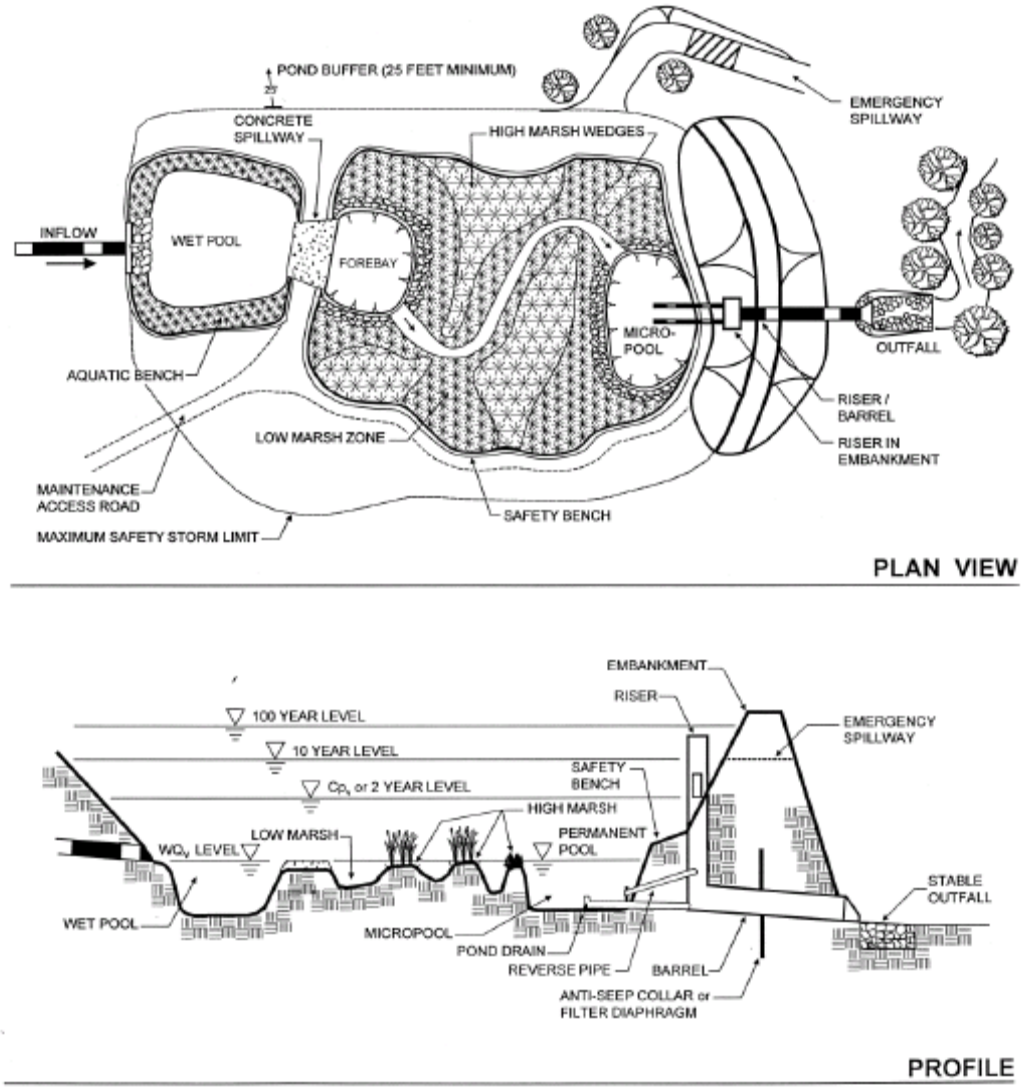
Typical BMP Layouts and Sections

Appendix – Examples of BMP Designs

P-2	Figure 3.2 Example of Wet Pond	P-2

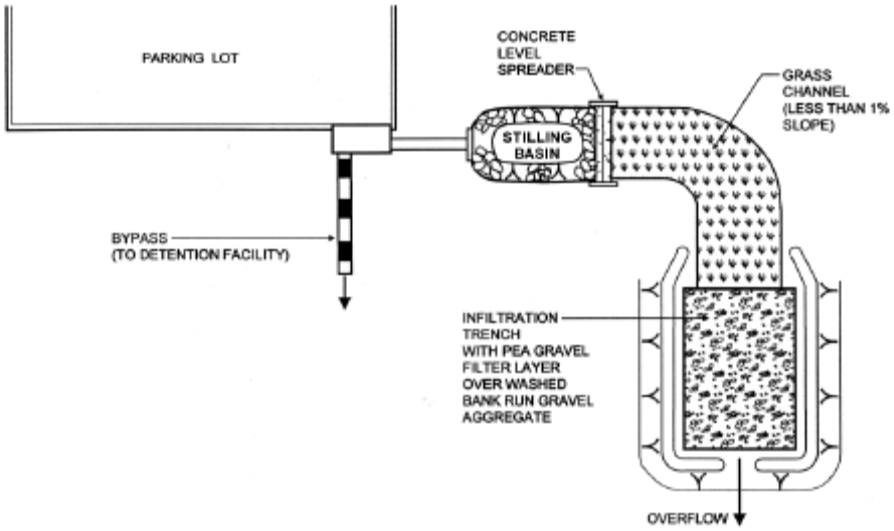


W-3	**Figure 3.8** Example of Pond/Wetland System	W-3

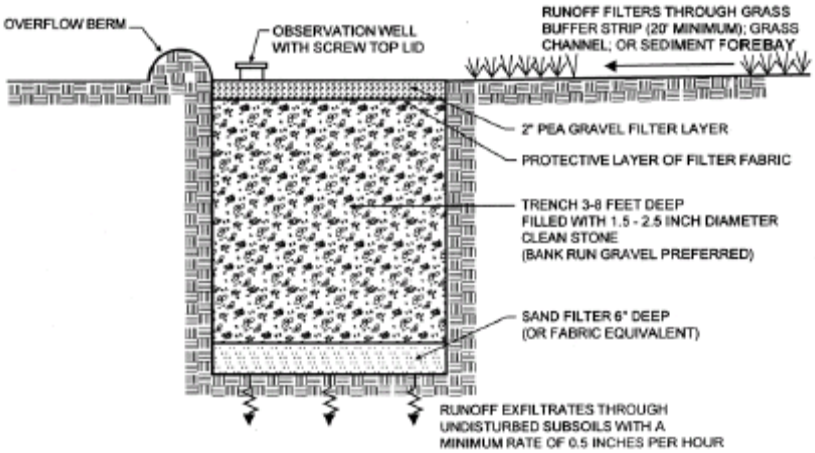


In this BMP, a deep permanent pool is placed before the shallow wetland.

I-1	**Figure 3.10** Example of Infiltration Trench	I-1

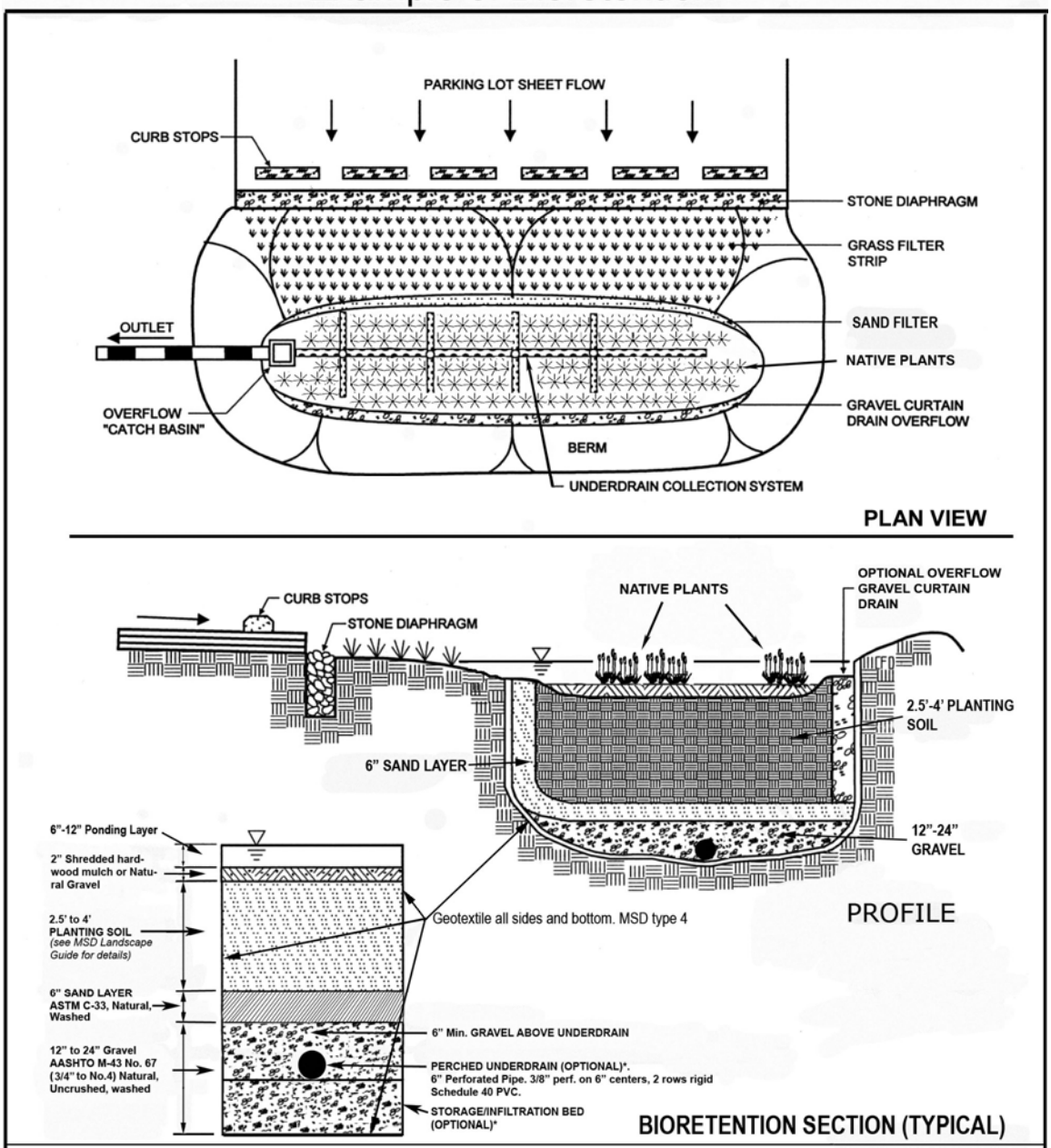


PLAN VIEW



PROFILE

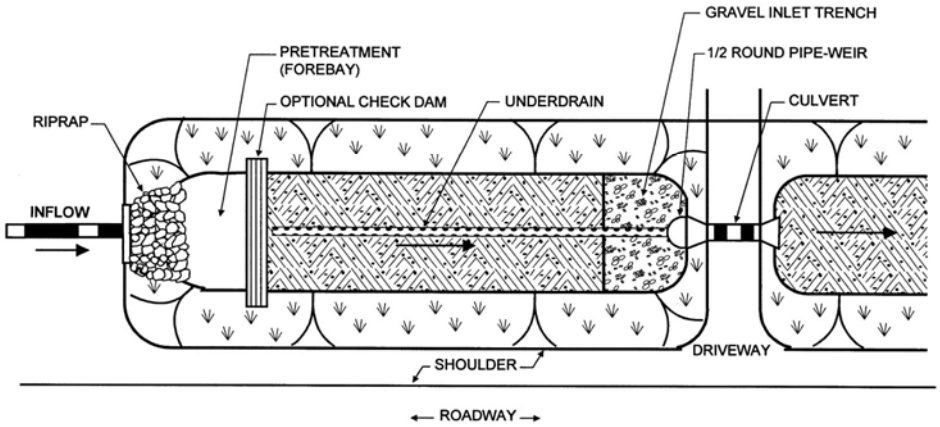
Example of Bioretention



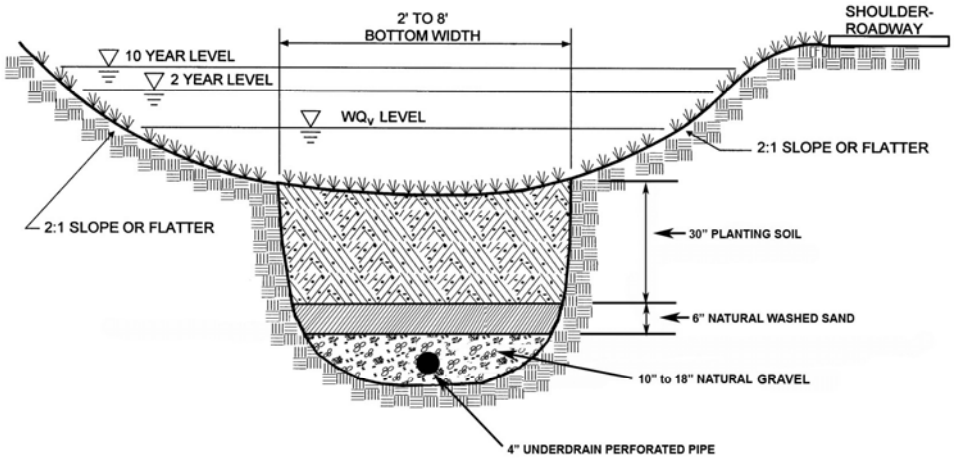
Bioretention combines open space with stormwater treatment.

* The need for a perched underdrain or infiltration basin should be evaluated based on infiltration capacity of exising soil.

Example of Dry Swale



PLAN VIEW



SECTION

Dry swales are used at low density residential projects or for very small impervious areas.