Introduction

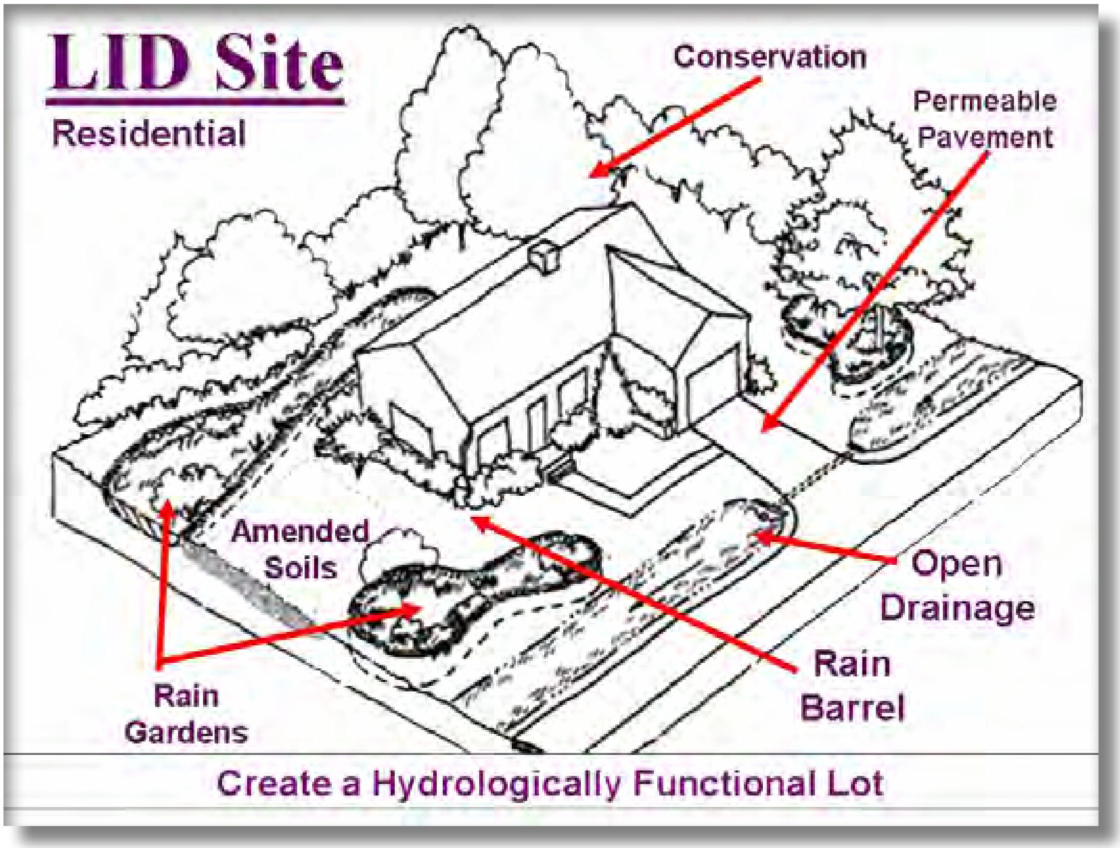
Chapter 3 Site Planning and Low Impact Development

3.0 Introduction

The City of Charleston requires that major residential, large commercial (>1 acre), and all subdivision permit applications have a detailed site plan prepared for review and comment. The permit application is based upon the overall plan for the proposed development.

The City highly recommends that a conceptual plan be prepared and submitted to the City for review in advance of preparing a formal permit application. The purpose of this conceptual review is to promote initial site planning that will minimize impacts to stormwater, create an opportunity for dialog between the City and the developer and identify limiting constraints early in a project. A conceptual plan and meeting is required for all projects exceeding three (3) acres.

This chapter discusses a general approach to site planning and ideas for innovative and Low Impact Development (LID) as illustrated in Figure 3-0.1. Use of LID is strongly recommended by the City to achieve the stormwater goals promoted in this manual. In addition to this document, the City Stormwater Department endorses review and use of the West Virginia Stormwater Management and Design Guidance Manual regarding additional LID approaches, principals, and Best Management Practices (BMP's).



Courtesy of haywood.edu

Figure 3-0.1
LID Site

3.1 Goals of the Site Planning Process

Developers should be mindful of the overall goals of the stormwater permitting process when preparing their site plan. Typically, design, permitting and construction of a new development can be faster, more cost efficient, and environmentally sustainable if the design meets the following goals:

- Minimize impervious areas.
- Stage disturbance and reseeding during construction phase.
- Avoid long and steep cut and fill slopes which promote erosion and minimize infiltration.
- Promote sheet flow of stormwater. Avoid concentrating flow with inlets and pipes where possible.
- Maximize greenspace, particularly areas planted with native vegetation.
- Improve existing stormwater issues with redevelopment.
- Protect water quality during and after construction.

3.2 Site Inventory and Site Analysis Process

The first task in the preparation of a site plan is to identify and inventory the site features that are present on the proposed site and immediately adjacent properties. For small projects this inventory would include items such as sidewalks, large trees, house location and size, driveway, parking spaces, drain inlets, etc. For larger projects this may also involve topographical, property boundaries, and site surveys that might extend off of the site.

3.2.1 Site Inventory

The general steps for site inventory and analysis are:

- Identify existing site features and designate what must be protected.
- Identify unique features (cliffs, springs, etc.).
- Identify limits of proposed improvements.
- Identify utility conflicts.
- Identify proposed slopes, drains and other features that will affect stormwater flow.
- Identify final discharge point of stormwater and downstream property that could potentially be affected by the discharge.
- Identify site access for construction equipment.
- Identify site access for end users of the project.

3.2.2 Site Analysis and Conceptual Site Plan

Typically, a conceptual site plan of the proposed improvements is prepared after the site analysis is complete to express the general intent of the proposed improvements.

A conceptual site plan is not necessary for City review, unless the project is three (3) acres in size or larger. However, discussing plans in advance with the City Stormwater, Engineering, and the CSB staff can avoid costly delays in permitting and minimize unanticipated construction costs.

3.2.3 Final Site Plan

Final site plans should clearly illustrate the proposed development or improvements. The City understands that private residents and small businesses often do not have experience in preparing these plans or the ability to hire someone to do it for them. As such, the City may allow hand sketches for Categories B and C (less than one [1] acre) projects as illustrated in Figure 3-2.1, page 3-4.

The final site plan must present a logical and feasible approach for the permanent management of stormwater from the project. Peak flow management, volume reduction, and stormwater quality must all be considered as discussed in Section 2.3.4, particularly on projects exceeding one (1) acre. A site plan must be submitted for (major) projects classified in Categories C, D, and E as illustrated in Figures 3-2.2, page 3-5. Figure 3-2.3, page 3-6, and Figure 3-2.4, page 3-7.

In an effort to meet the requirements of the new stormwater regulations, site planning must evolve to accommodate new requirements. The following sections of this chapter discuss the integrated site design approach and ideas for Low Impact Development (LID).

Permittees should implement multiple aspects of LID into their stormwater management approach where possible. Every aspect of LID is not applicable for every site. Generally, demonstration that LID has been considered will be required to meet the intent of the stormwater management requirements.

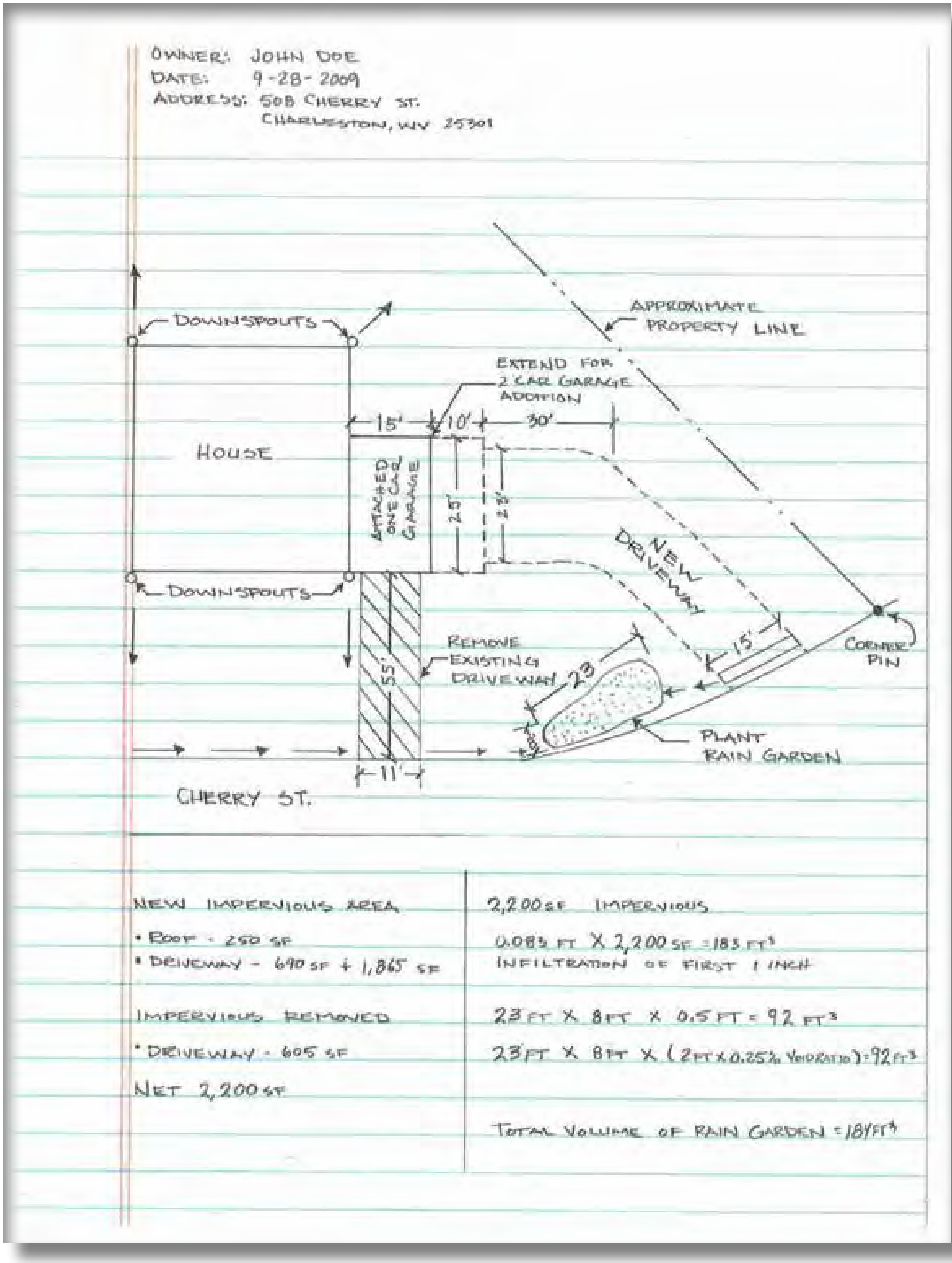
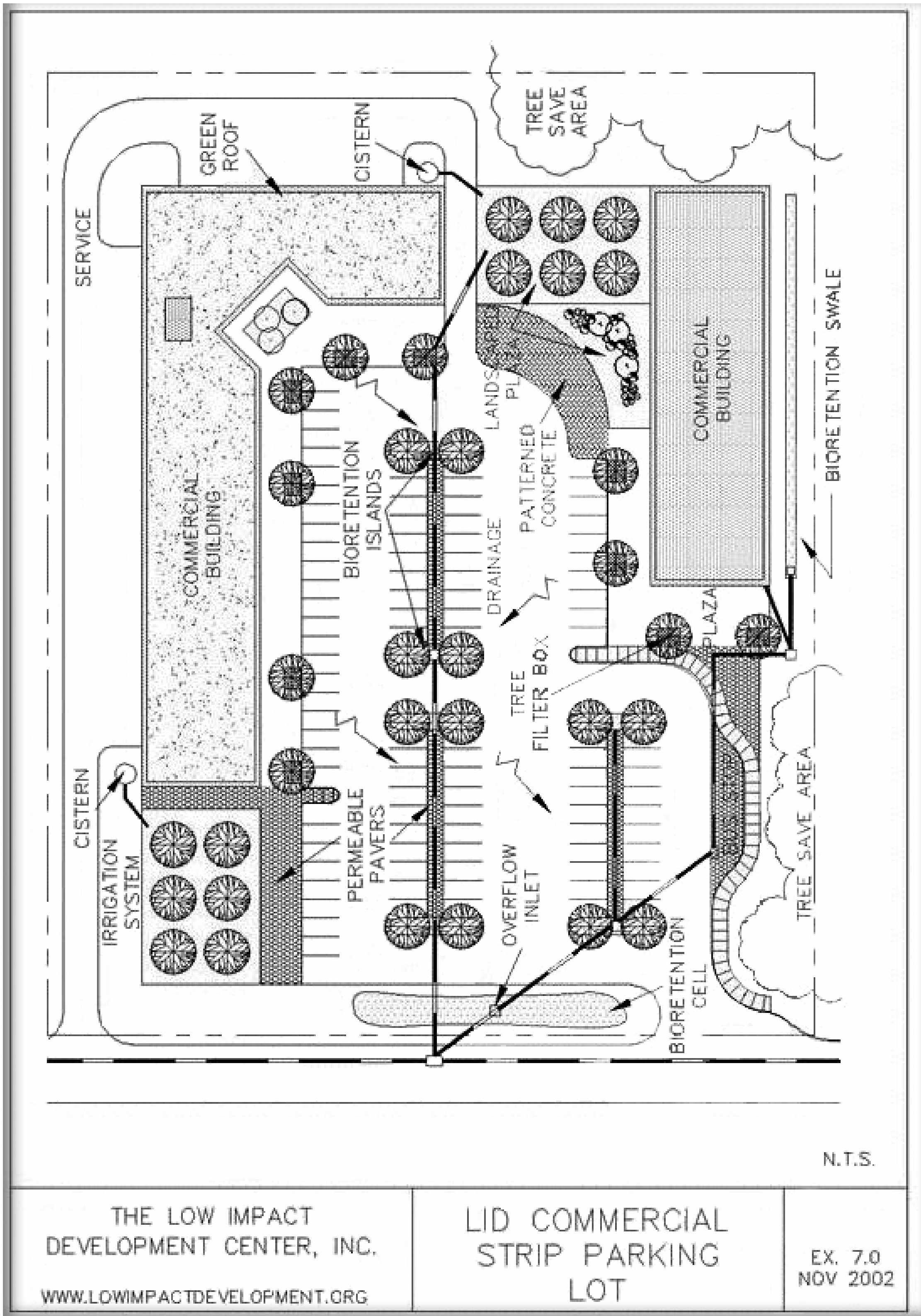


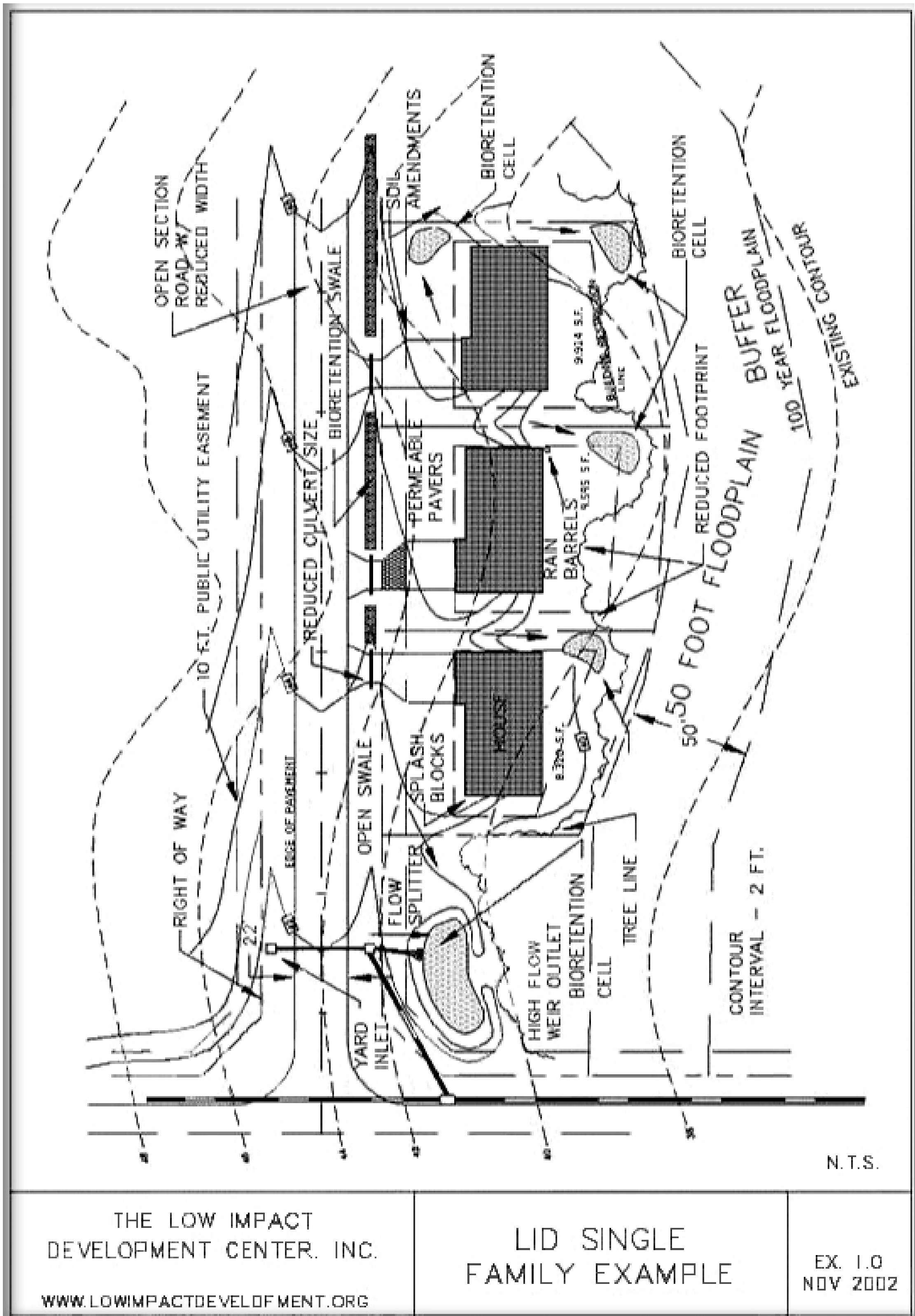
Figure 3-2.1
Example Detailed Site Plan for Residential Development (Hand Sketched)
Above is an example of a simple residential improvement project site that exceeds 2,000 sf of disturbance.
Example calculations are written below the sketch.

Site Inventory and Site Analysis Process



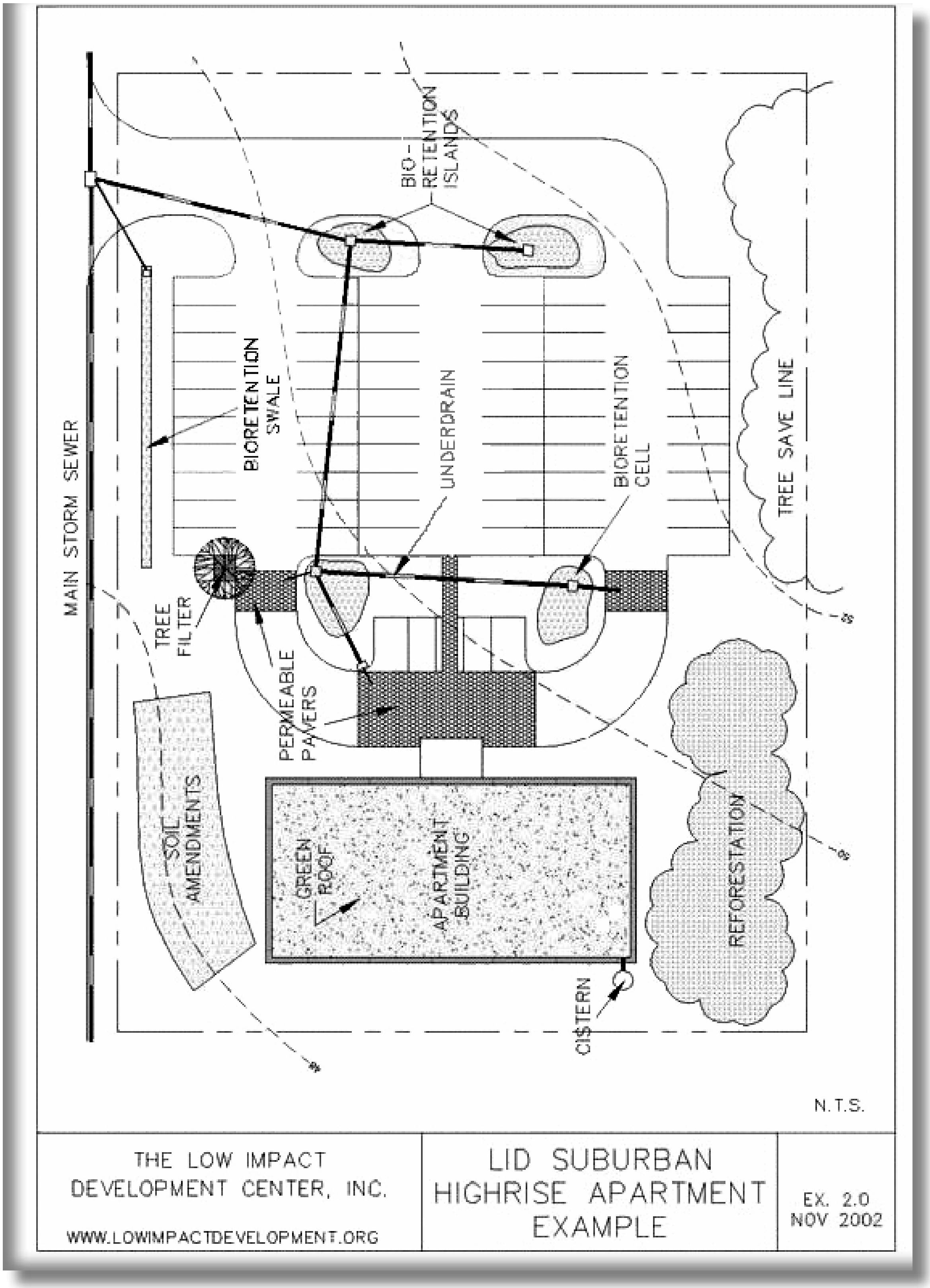
*Courtesy of Lowimpactdevelopment.org

Figure 3-2.2
Example Site Plan Commercial Development



*Courtesy of Lowimpactdevelopment.org

Figure 3-2.3
Example Site Plan for Single Family Residence



*Courtesy of Lowimpactdevelopment.org

Site Inventory and Site Analysis Process

Figure 3-2.4
Example Site Plan for LID Suburban Apartment

3.3 Introduction to Low Impact Development (LID)

The primary goal of LID is to reduce damage and pollution impacts to streams, rivers, wetlands, and large bodies of water by reducing post-development runoff and promoting infiltration of stormwater on-site. Implementation of LID practices is beneficial at all levels of site design, whether it be new development, urban retrofits, or revitalization projects. These practices are most beneficial when implemented early in the design phase, beginning with a site assessment to analyze natural hydrology.

Proposed BMPs consume more site area than traditional stormwater controls of the past several decades (i.e. catch basins, pipes, etc.). The objective of this chapter is to present alternative drainage/infiltration practices that promote on-site treatment and quality control of stormwater. Every site will present unique challenges that usually require a combination of controls to achieve pollutant removal as well as controlling stormwater peak runoff rate.

Ultimately, LID addresses many of the environmental practices that are essential to “Smart Growth” strategies, which include conservation of open green space. If LID techniques are considered in the planning stages of a project, site development will more closely mimic a watershed’s natural hydrologic function (discussed in Chapter 1) and as a result reduce stormwater quantity and pollutants.

LID is not necessarily complicated, as shown in Figure 3-3.1, it can be simple changes, such as the removal of curbs from street edges allowing flow to parallel vegetated channels.

Courtesy of Philadelphia Stormwater Manual V 2.0

Figure 3-3.1
LID Street Design

3.4 Integrated Site Design

Managing stormwater properly begins with a holistic site planning approach at the beginning of every project. The planning process encompasses many design techniques that shape the proposed site, such as preserving natural vegetation, reducing the development footprint, utilizing natural features for stormwater management, and managing impervious surfaces. Figure 3-4.1 is an overview of an example design process that includes existing site conservation utilizing sheet flow off the parking lot (instead of piping) to direct stormwater into infiltration basins.

The following are LID site design techniques that are recommended for proposed development and are applicable to the Charleston region.

Conservation of Natural Features and Resources (Section 3.4.1)

- Preserve Undisturbed Natural Areas
- Preserve and Protect or Reconstruct Riparian Buffers (Vegetation Bordering Streams)
- Avoid Floodplains

Low Impact Site Design Techniques (Section 3.4.2)

- Fit Design to the Terrain
- Reduce Limits of Clearing and Grading
- Cluster Development

Reduction of Impervious Cover/Impervious Cover Management (Section 3.4.3)

- Use Fewer or Alternative Cul-de-sacs
- Create Parking Lot Stormwater "Islands"
- Minimize Impervious Area (including rooftop and pavement areas)
- Disconnect Impervious Cover

Utilization of Natural Features for Stormwater Management (Section 3.4.4)

- Use Buffers and Undisturbed Areas
- Use Natural Drainageways instead of Storm Sewers
- Use Vegetated Swales instead of Curb and Gutter
- Maximize Tree Canopy over Impervious Cover
- Alter the Time of Concentration

*Courtesy of Philadelphia Stormwater Manual V 2.0

Figure 3-4.1
Integrated Site Design

3.4.1 Conservation of Natural Features and Resources

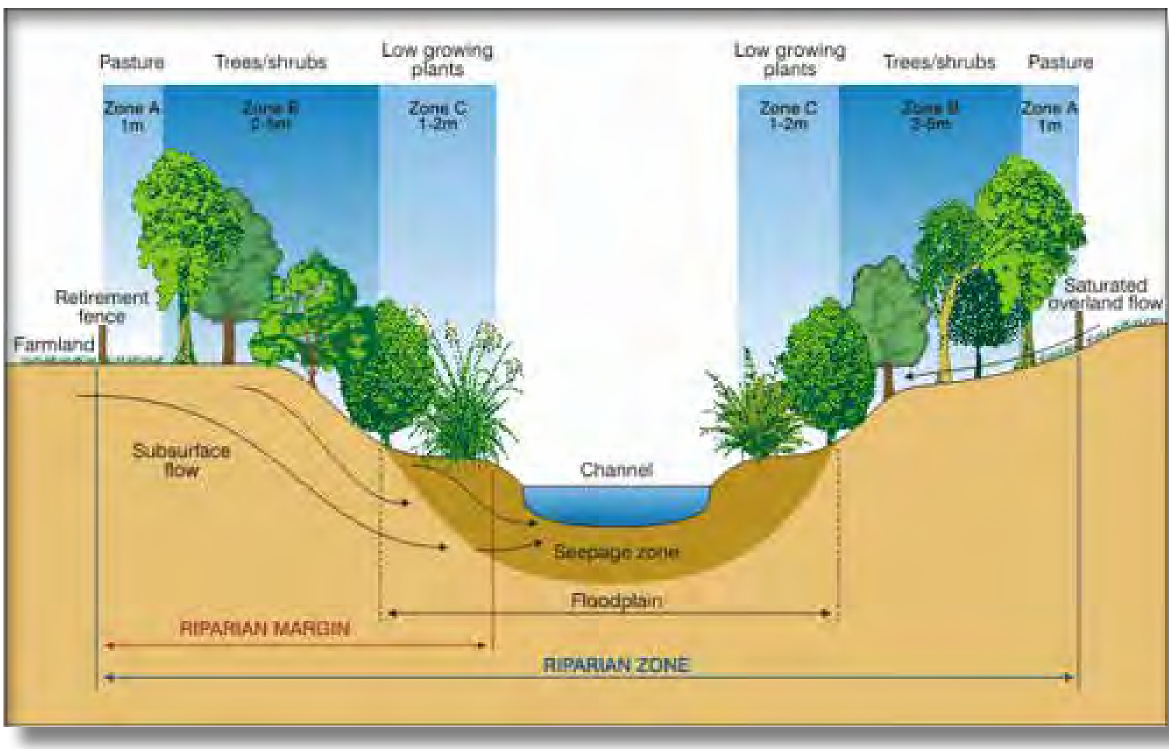
The first step in LID is the conservation of the site's natural features and resources.

- Preservation of natural areas with significant hydrologic functions including forested areas, riparian areas and soils with a high potential for infiltration.
- Preserve native ground cover and riparian buffers that naturally minimize runoff.
- Avoid impacts to established or existing natural floodplains.

A. Preserve Undisturbed Natural Areas: Preserving natural conservation areas, such as undisturbed forested and vegetated areas, natural drainageways, stream corridors and wetlands on a development site helps to preserve the original hydrology of the site and aids in reducing stormwater runoff and pollutants. Undisturbed vegetated areas also stabilize soils, provide for filtering and infiltration, and increase evapotranspiration.

Natural conservation areas should be delineated before any site design, clearing or construction begins. When done before the conceptual plan phase, the planned conservation areas can be used to guide the layout of the site.

B. Preserve and Protect or Reconstruct Riparian Buffers: A riparian buffer, illustrated in Figure 3-4.2, is a special type of natural conservation area along a stream, wetland or shoreline where development is restricted or prohibited. The primary function of buffers is to protect and physically separate the stream from future disturbance or encroachment. If properly designed, a buffer can provide stormwater management, can act as a right-of-way during floods, and can sustain the integrity of stream ecosystems and habitats.



*Courtesy of Taranaki Regional Council

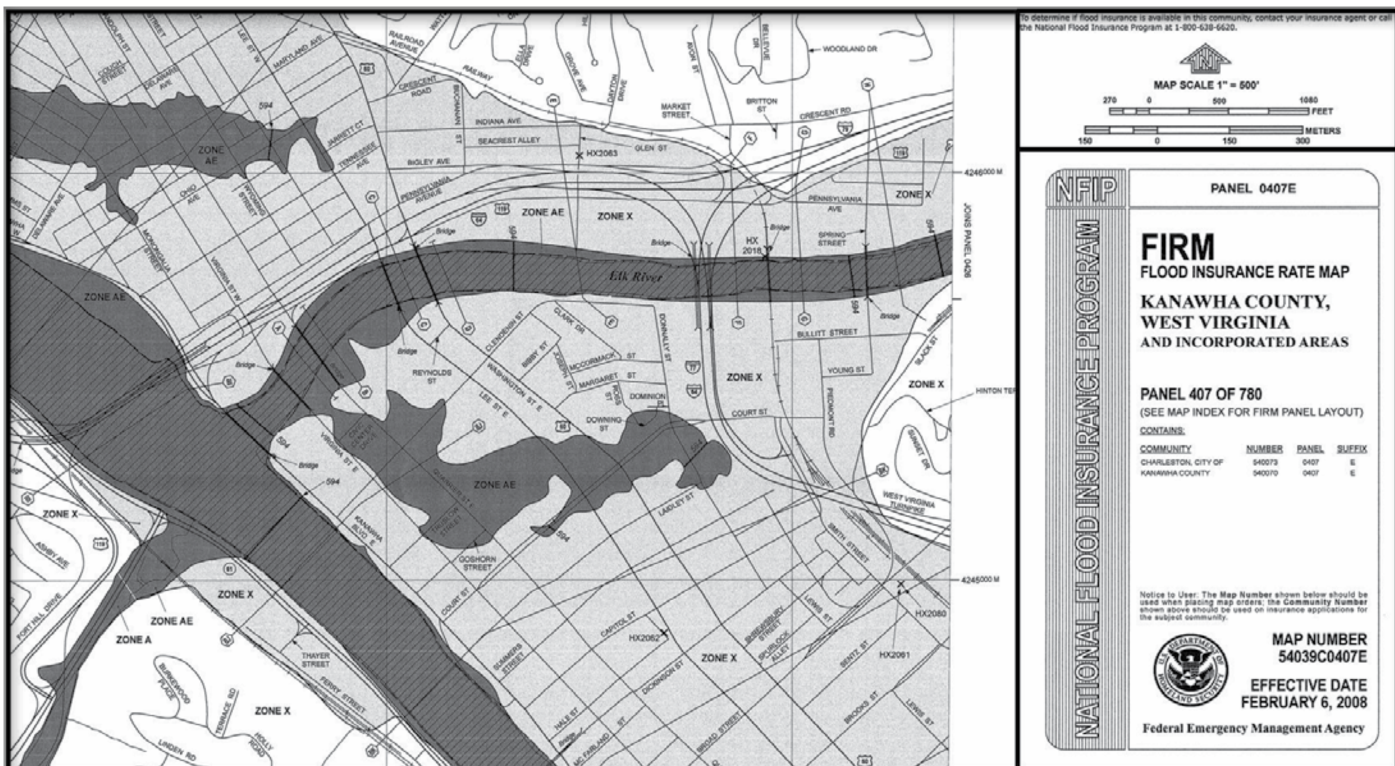
Figure 3-4.2
Typical Riparian Zone Cross-Section

Further, replacement or reconstruction of a former riparian buffer can be utilized to help stabilize and rejuvenate detrimentally impacted streams.

A riparian buffer can be of fixed or variable width, but should be continuous and not interrupted by impervious areas that would allow stormwater to concentrate and flow into the stream without first flowing through the buffer.

Ideally, riparian buffers should be sized to include the 100-year floodplain as well as steep banks and wetlands. The buffer depth needed for proper performance will depend on the size of the stream and the surrounding conditions, but a minimum 25-foot undisturbed vegetative buffer is needed for even the smallest perennial streams, and a 50-foot or larger undisturbed buffer is preferred.

C. **Avoid Floodplains:** Floodplain areas should be avoided on a development site. Ideally, the entire 100-year floodplain should be avoided for clearing or building activities, and should be preserved in a natural undisturbed state where possible. Floodplain protection is interconnected with riparian buffer preservation. Both of these stormwater site design practices preserve stream corridors in a natural state and allow for the protection of vegetation and habitat. Depending on the site topography, 100-year floodplain boundaries may lie inside or outside of a preserved riparian buffer corridor. Floodplain limits for communities can be obtained from the Federal Emergency Management Agency (FEMA) website. Firmettes of a particular area can be obtained, as shown in Figure 3-4.3. No work can be performed in the 100 floodplain without approval from the Charleston Planning Department.



*Courtesy of FEMA

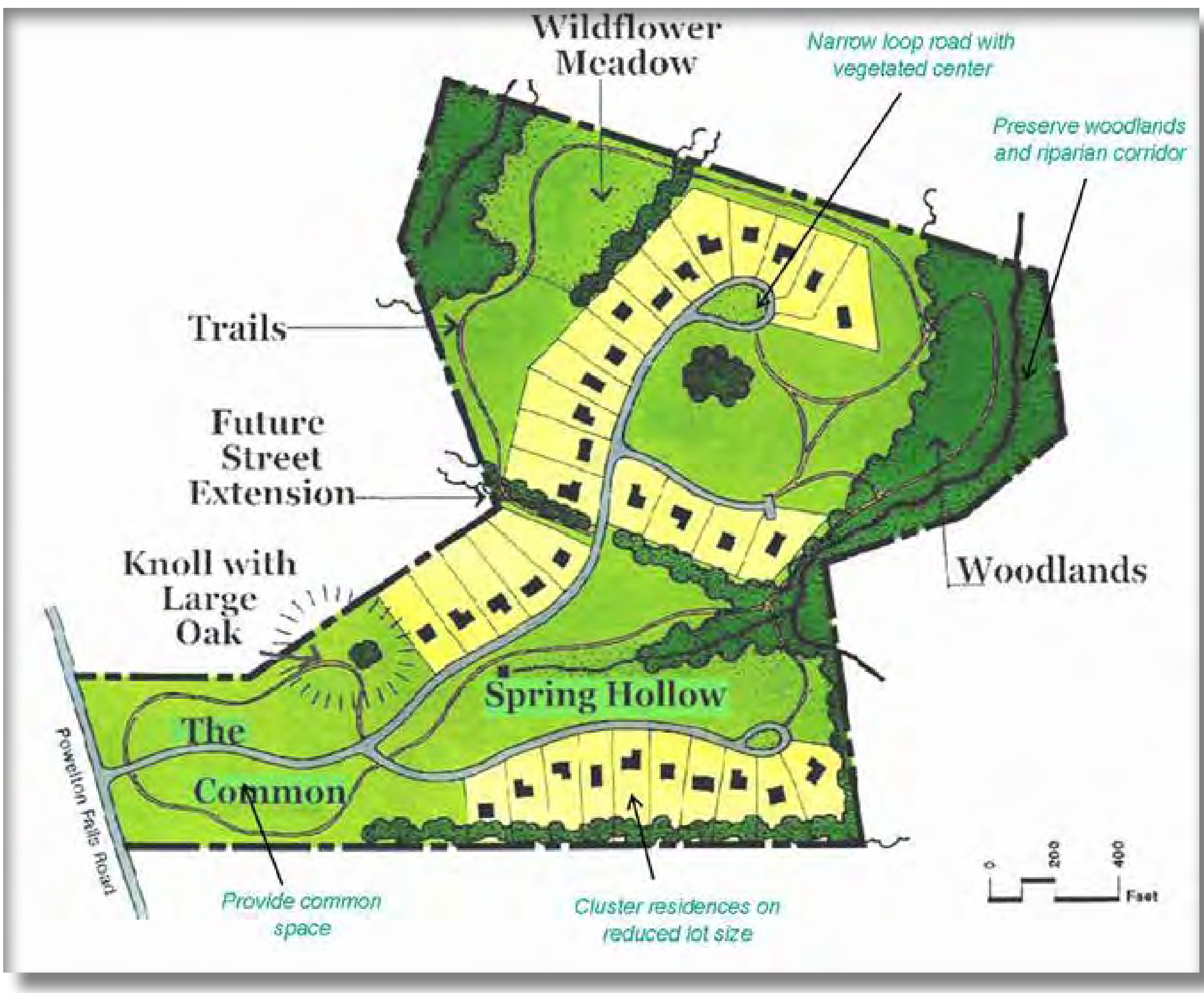
Figure 3-4.3
Typical FEMA Firmette

3.4.2 Low Impact Site Design Techniques

Low impact site design techniques, illustrated in Figure 3-4.4, promote maintenance of the natural water cycle. These techniques reduce runoff volume and pollutant loads, while maintaining existing groundwater recharge rates and other hydrologic functions. Key techniques include:

- Planning and design of the development to fit the natural topography of the site, limiting clearing and grading.
- Evaluating site conditions and constraints including soil types, geology, topography, slopes, drainage areas, wetlands and floodplains to maintain high groundwater recharge areas and provide runoff storage areas.
- Utilizing construction techniques will limit impervious areas and soil compaction.
- Utilizing cluster developments to keep substantial impacts in a contained area.

A. Fit Design to the Terrain: This technique helps to preserve the natural hydrology and drainageways on the site, as well as reducing the quantity of excavation and disturbance of vegetation and soils. Figure 3-4.4



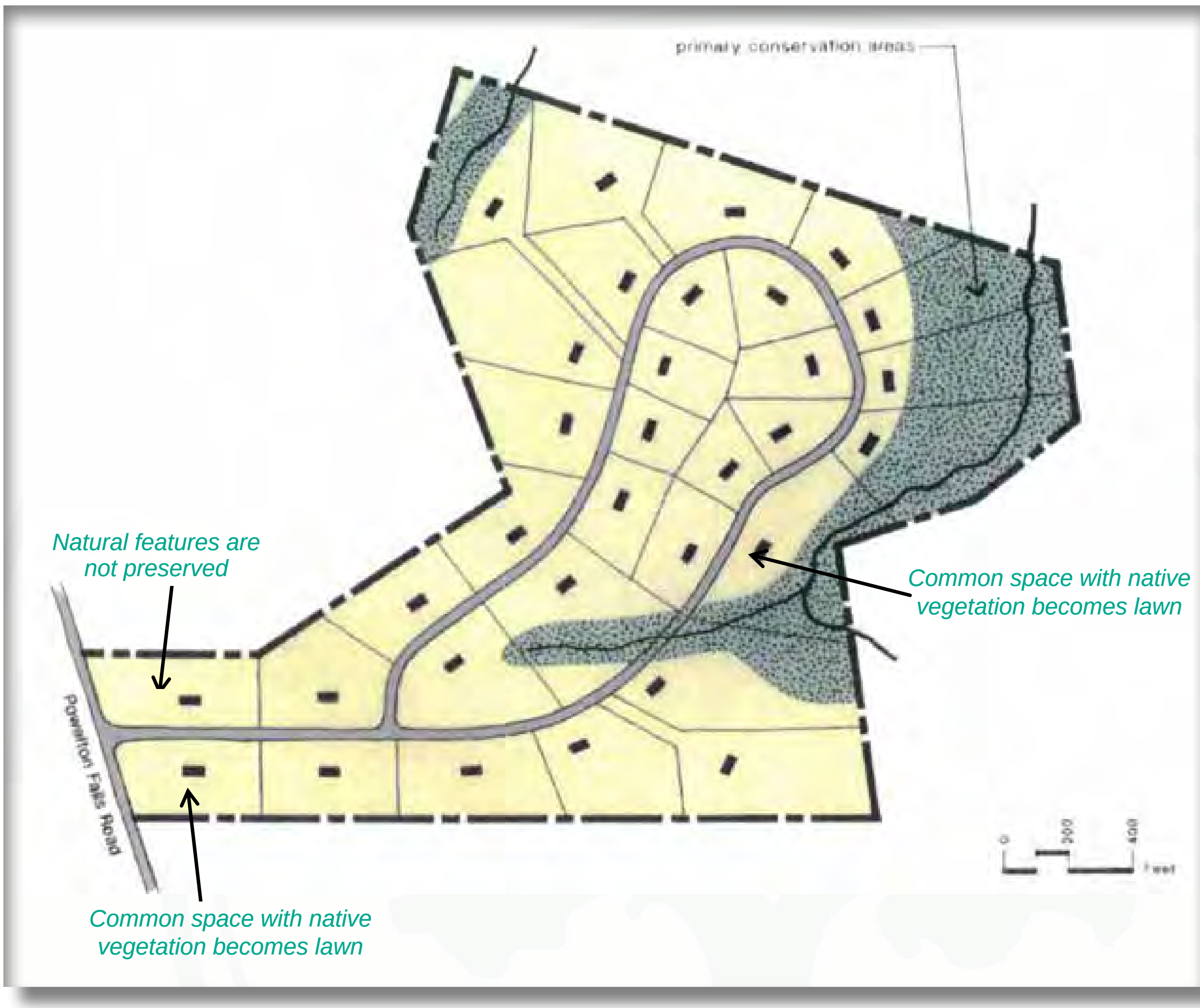
Courtesy of Philadelphia Stormwater Manual V 2.0

Figure 3-4.4
Example of a Low Impact Development Subdivision

illustrates the placement of roads and homes in a residential development that avoids stream impacts.

Roadway patterns on a site should be chosen to provide access schemes which are compatible with the terrain. In rolling or hilly terrain, streets should be designed to follow natural contours to reduce clearing and grading. Street hierarchies with local streets branching from collectors in short loops and cul-de-sacs along ridgelines help to prevent the crossing of streams and drainageways. A traditional pattern of streets or “fluid” grids, which interrupt natural drainageways, and impacts the natural flow of stormwater (see Figure 3-4.5). These traditional layouts also impact riparian buffers with home sites and replace native vegetation with individual lawns. Natural features are also often removed.

Buildings and impervious surfaces should be kept off of steep slopes, away from natural drainageways, and out of floodplains and other lower lying areas. In addition, the major axis of buildings should be oriented parallel to existing contours.



Courtesy of Philadelphia Stormwater Manual V 2.0

Figure 3-4.5
Example of a Traditional Subdivision

B. Reduce Limits of Clearing and Grading: Minimal disturbance methods should be used to limit the amount of clearing and grading that takes place on a development site, preserving more of the native vegetation and natural hydrology of a site. These methods include:

- Establishing a limit of disturbance (LOD) based on maximum disturbance zone radii/lengths. These maximum distances should reflect reasonable construction techniques and equipment needs together with the physical constraints of the development site, such as slopes or soils. LOD distances may vary by type of development, size of lot or site, and by the specific development feature involved.
- Slope analysis is one technique that can be used to identify the most developable portions of a site. An example of slope analysis is illustrated in Figure 3-4.6. Slopes are analyzed, typically from 0-5%, 5%-10%, 10%-15%, and above 15% to determine where structures, roadways and stormwater management features may be suitably located.
- Using special procedures and equipment which reduce land disturbance.

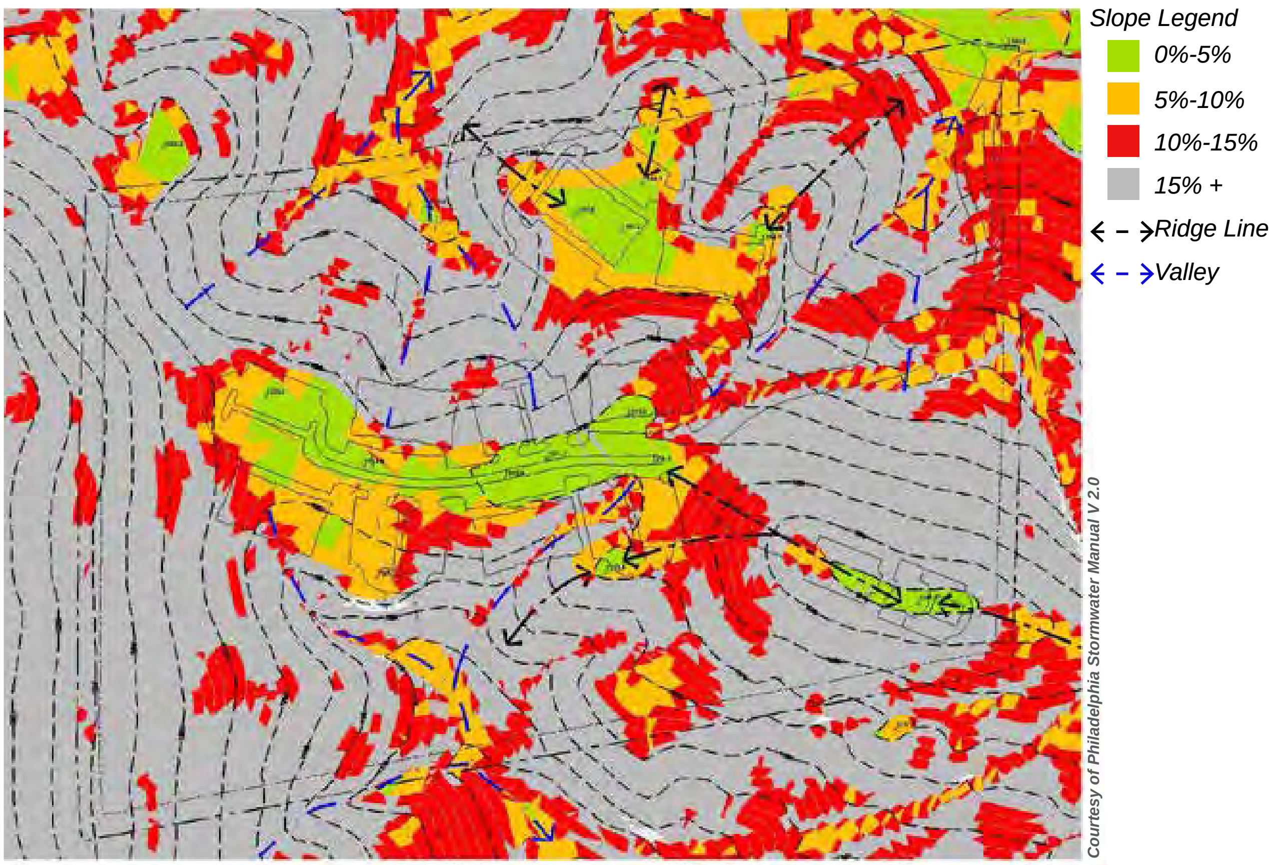


Figure 3-4.6
Slope Analysis

C. Cluster Development: Cluster development, also known as open space development, is a site design technique that concentrates structures and impervious surfaces in a compact area in one portion of the development site in exchange for providing open space and natural areas elsewhere on the site. Typically, smaller lots and/or nontraditional lot designs are used to cluster development and create more conservation areas on the property. Cluster developments allow the use of common driveways, less sidewalk and roadways, and more common space.