BMP 5.6.1: Minimize Total Disturbed Area - Grading

Without changing the building program, you can reduce site grading, removal of existing vegetation (clearing and grubbing) and total soil disturbance. This eliminates the need for re-establishment of a new maintained landscape for the site and lot-by-lot, by modifying the proposed road system and other relevant infrastructure as well as the building location and elevations to better fit the existing topography.

Key Design Elements

- Identify and avoid special value and environmentally sensitive areas
- Minimize overall disturbance at the site
- Minimize disturbance at the individual lot level
- Maximize soil restoration to restore permabilities
- Minimize construction-traffic locations
- Minimize stockpiling and storage areas

Potential Applications

Residential: Yes
Commercial: Yes
Ultra Urban: Limited
Industrial: Yes
Retrofit: Limited
Highway/Road: Limited

Stormwater Functions

Volume Reduction: High
Recharge: High
Peak Rate Control: High
Water Quality: High

Water Quality Functions

TSS: 40%
TP: 0%
NO3: 0%

Description

This Non-Structural BMP assumes that the special value and sensitive resource areas have been identified on a given development parcel and have been protected, and that clustering and area wide concentration of uses also have been considered and included in the site design. All of these BMPs serve to reduce site grading and to minimize disturbance/minimize maintenance. This BMP specifically focuses on how to minimize the grading and overall site disturbance required to build the desired program while maximizing conservation of existing site vegetation.

Reduction of site disturbance by grading can be accomplished in several ways. The requirements of grading for roadway alignment (curvature) and roadway slope (grade) frequently increase site disturbance throughout a land development site and on individual lots. Most land development plans are formulated in 2-dimensional plan, based on the potential zoned density, and seldom consider the constraints presented by topographic variation (slope) on the site. The layout and design of internal roadways on a land development site with significant topographic variation (slope) can result in extensive earthwork and vegetation removal (i.e., grading). Far less grading and a far less disruptive site design can be accomplished if the site design is made to better conform with the existing topography and land surface, where road alignments strive to follow existing contours as much as possible, varying the grade and alignment criteria as necessary to comply with safety limits.

Site design criteria have evolved in municipalities to make sure that developments meet safety standards (sight distance, winter icing, and so forth) as well as certain quality or appearance standards. A common perception among municipal officials is that little deviation should be allowed in order to maintain the integrity of the community. In fact, roadway design criteria should be made flexible in order to better fit a given parcel and achieve a more “fluid” roadway alignment. The avoidance of sensitive site features, such as important woodlands, may be facilitated through flexible roadway layout. Additionally, rigorous parcel criteria (front footage, property setbacks, etc.) often add to this “plane geometry” burden. Although the rectilinear grid layout is the most efficient in terms of maximizing the number of potential lots created at a development site, the end result is a “cookie cutter” pattern normally found in residential sites and the “strip” development found in most highway commercial districts, all of which are apt to translate into significant resource loss.

Figure 5.6-1 Residential Area with Disturbance Minimized

From the perspective of a single lot, the municipally-required conventional lot layout geometry can also impose added earthwork and grading that could be avoided. Lot frontage criteria, yard criteria, and driveway criteria force the placement of a structure in the center of every lot, often pushed well back from the roadway. Substantial terracing of the lot with added grading and vegetation removal is required in many cases. Although the intent of these municipal requirements is to provide privacy and spacing between units, the end result is often totally cleared, totally graded lots, which can be visually monotonous. Configuring lots in a rectilinear shape may optimize the number of units but municipalities should require that the site design in total should be made to fit the land as much as possible.

Municipal criteria that impose road geometry are usually contained within the subdivision and land development ordinance (SALDO), while densities, lot and yard setbacks, and minimum frontages are usually contained in the zoning ordinance. Variations in these land development standards should be

accepted by the local government where appropriate, which should modify their respective ordinances. Municipalities should consider being more flexible without compromising public safety in terms of:

- Road vertical alignment criteria (maximum grade or slope).
- Road horizontal alignment criteria (maximum curvature)
- Road frontage criteria (lot dimensions)
- Building setback criteria (yards dimensions)

Related Non-Structural BMPs, such as road width dimensions, parking ratios, impervious surface reduction, chemical maintenance of newly created landscapes, and others are discussed as separate BMPs in this Chapter, though are all substantially interrelated.

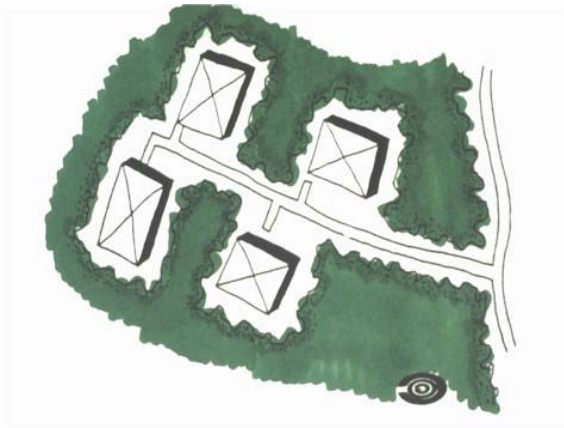

Figure 5.6-2 Minimally Disturbed Development

Detailed Stormwater Functions

Volume Reduction Calculations: Minimizing Total Disturbed Area can reduce the volume of runoff in several ways. Reducing disturbance and maintaining a natural cover can significantly reduce the anticipated volume of runoff through increased infiltration and increased evapotranspiration. This practice will be self-crediting in site stormwater calculations through lower runoff coefficients and/or higher infiltration rates. Minimizing Total Disturbed Area can reduce anticipated runoff volumes because undisturbed areas of existing vegetation allow more infiltration to occur, especially during smaller storm events. Furthermore, employing strategies that direct non-erosive sheet flow onto naturally vegetated areas can allow considerable infiltration to occur and can be coupled with level spreading devices (see Chapter 6) and possibly other BMPs to more actively manage stormwater that cannot be avoided. In other words, Minimizing Total Disturbed Area/Maintained Area through Reduced Site Grading (Designing with the Land) not only prevents increased stormwater generation (a volume and peak issue), but also offers an opportunity for managing stormwater generation that cannot be avoided. See Chapter 8 for volume reduction calculation methodologies.

Peak Rate Mitigation Calculations: Minimizing Total Disturbed Area/Maintained Area through Reduced Site Grading (Designing with the Land) can reduce the peak rate of runoff in several ways. Reducing disturbance and maintaining a natural cover can significantly reduce the runoff rate. This will be self-crediting in site stormwater calculations through lower runoff coefficients, higher infiltration rates, and longer times of travel. Minimizing Total Disturbed Area/Maintained Area through Reduced Site Grading (Designing with the Land) can lower discharge rates significantly by slowing runoff and increasing on-site storage.

Water Quality Improvement: Minimizing Total Disturbed Area can improve water quality preventively by reducing construction phase sediment-laden runoff. Water quality benefits also by maximizing preservation of existing vegetation at a site (e.g., meadow, woodlands) where post-construction maintenance including application of fertilizers and pesticides/herbicides is avoided. Given the high rates of chemical application which have been documented at newly created maintained areas for both residential and non-residential land uses, eliminating the opportunity for chemical application is important for water quality – perhaps the most effective management technique. In terms of water quality mitigative functions, Minimizing Total Disturbed Area provides filtration and infiltration opportunities, assuming that undisturbed areas are being used to manage

stormwater generated elsewhere on the development site, as well as thermal mitigation. See Chapter 8 for Water Quality Improvement methodologies.

Design Considerations

During the initial conceptual design phase of a land development project, the applicant's design engineer should provide the following information, ideally through development of a Minimum Disturbance/Minimum Maintenance Plan:

1. Identify and Avoid Special Value/Sensitive Areas (see BMP 5.4.1)

Figure 5.6-3 Woodlands Protected through Minimum Disturbance Practices

Delineate and avoid environmentally sensitive areas (e.g., Primary and Secondary Conservation areas, as defined in BMP 5.4.1); delineation of Woodlands, broadly defined to include areas of immature and mixed tree growth, is especially important; configure the development program on the balance of the parcel (i.e., Development Areas as discussed in BMP 5.4.1).

2. Minimize Disturbance at Site

Modify road alignments (grades, curvatures, etc.), lots, and building locations to minimize grading, earthwork, overall site disturbance, as necessary to maintain safety standards. Minimal disturbance design shall allow the layout to best fit the land form without significant earthwork. The limit of grading and disturbance should be designated on the plan documentation submitted to the municipality for review/approval, and should be physically designated at the site during construction by flagging, fencing, or other methods.

3. Minimize Disturbance at Lot

Limit lot grading to roadways and building footprints. Municipalities should establish Minimum Disturbance/Minimum Maintenance Buffers, designed to be rigorous but reasonable in terms of current feasible site construction practices. These standards may need to vary with the type of development being proposed and the context of that development (the required disturbance zone around a low density single-family home can be expected to be less than disturbance necessary for a large commercial structure), given the necessity for use of different types of construction equipment and the realities of different site conditions. For example, the U.S. Green Building Council's Leadership in Energy & Environmental Design Reference Guide (Version 2.0 June 2001) specifies the following:

"…limit site disturbance including earthwork and clearing of vegetation to **40 feet** beyond the building perimeter, **5 feet** beyond the primary roadway curbs, walkways, and main utility branch trenches, and **25 feet** beyond pervious paving areas that require additional staging areas in order to limit compaction in the paved area…"

Municipalities in New Jersey's Pinelands Preservation Zone for years have supported ordinances where limits are more restrictive than the LEED footages (e.g., clearing around single-family homes is reduced to 25 feet). Again, such requirements can be made to be flexible with special site factors and conditions. The limit of grading and disturbance should be designated on the plan documentation submitted to the municipality for review/approval, and should be physically designated at the lot during construction by flagging, fencing or other marking techniques.

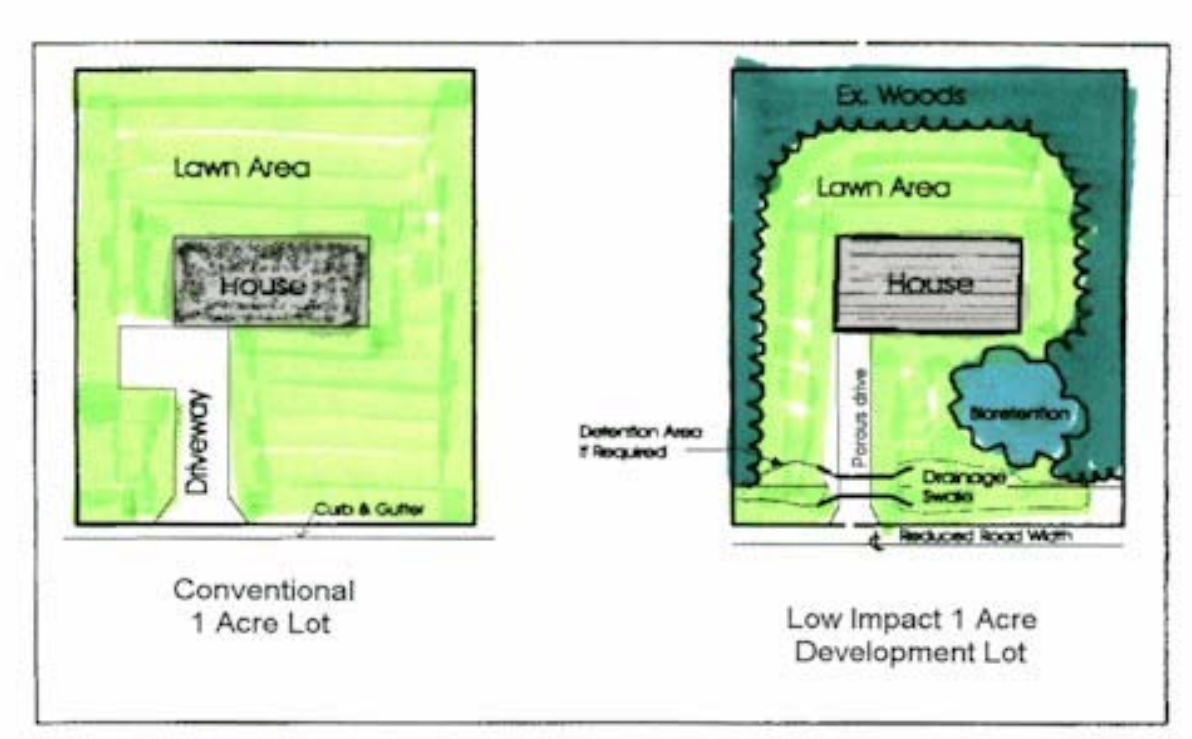

Figure 5.6-4 Convential Development Versus Low Impact Development

4. Maximize Soil Restoration

Where construction activity does require grading and filling and where compaction of soil can be expected, this disturbance should be limited. Soil treatments/amendments should be considered for such disturbed areas to restore permeability. If the bulk density is not reduced following fill, these areas will be considered semi-impervious after development and runoff volumes calculated accordingly.

5. Minimize Construction Traffic Areas

Areas where temporary construction traffic is allowed should be clearly delineated and limited. These areas should be restored as pervious areas following development through a required soil restoration program.

6. Minimize Stockpiling and Storage Areas

All areas used for materials storage during construction should be clearly delineated with the surface maintained, and subject to a soil restoration program following development. For low-density developments, the common practice of topsoil stripping might be unnecessary and should be minimized, if not avoided.

Construction Issues

Most of the measures discussed above are part of the initial concept site plan and site design process. Only those measures that restore disturbed site soils are related to the construction and post-construction phase, and may be considered as avoidance of impacts.

Cost Issues

Cost avoidance as a result of reduced grading and earthwork should benefit the developer. This BMP is considered to be self-crediting, given the benefits resulting from reduced costs. Cost issues include reduced grading and related earthwork (see Site Clearing and Strip Topsoil and Stockpile below), as well as reduced costs involved with site preparation, fine grading, and stabilization.

Calculation of reduced costs is difficult due to the extreme variation in site factors that will affect costs (amount of grading, cutting/filling, haul distances for required trucking, and so forth). Some relevant costs factors are as follows (as based on R.S. Means, *Site Work & Landscape Cost Data*, 2002):

Site Clearing

Cut & chip light trees to 6" diameter	$2,900/acre
Grub stumps and remove	$1,400/acre
Cut & chip light trees to 24" diameter	$9,700/acre
Grub stumps and remove	$5,600/acre

Strip Topsoil and Stockpile

Ranges from $0.52 to $1.78 / cy because of Dozer horse power, and ranges from ideal to adverse conditions
Assuming 8" of topsoil, the price per sq. yd. is $0.12 – $0.40
Assuming 8" of topsoil, the price per acre is $560 – $1,936

Site Preparation, Fine Grading, Seeding

Fine grading w/ seeding $2.33 /sq. yd.
Fine grading w/ seeding $11,277 /acre

In sum, total costs appear to approximate $20,000 per acre and could certainly exceed that figure in more challenging sites. Reducing graded and disturbed acreage clearly translates into substantial cost reductions.

Stormwater Management Calculations

No calculations are applicable for this BMP.

Specifications

The modification of road geometry is a site-specific issue, but in general any criteria that will result in significant earthwork should be reconsidered and evaluated.