Recommendation Memo

December 15, 2003

From: Timothy S. McSheffery

RE: Modification of Stormwater Regulations and Development Practices

Traditional stormwater regulations and land development practices control the rate of stormwater discharge on a site-by-site (individual property) basis, regardless of its geographic position. This approach to stormwater does little to address volume and quality of water released or decreases in site-specific infiltration rates. In short, it does not adequately mitigate the negative stormwater impacts caused by land development.

Two alternative methods of stormwater regulation and development practice have been proposed for the Market Street Residential project, aspiring to the following goals:

a. Protection of water quality by promoting infiltration versus runoff.
b. Reducing long term erosion impacts on stream channels.
c. Reduction in the lowering of regional water tables.
d. Protection of municipal drinking water sources.

Alternative 1: adds a step to the site development process where the soil within future residential area yard areas is amended to increase stormwater infiltration rates.

Alternative 2: a modification of standard land development and construction practices that would protect the soil within future residential yard areas from compaction and grading operations.

My recommendation at this time would be for alternative two. Although it requires greater changes in the development process, it is better suited as a long term solution. Both alternatives have the ability to accomplish some of the long term goals. Both alternatives also roughly balance their short term monetized costs and benefits. However, alternative 2 solves the problem of increased stormwater runoff created by soil compaction by not creating the problem in the first place.

Introduction:

Land development standards for stormwater management have remained unchanged for a majority of the U.S. since the 1950's. Traditional management techniques, still common today, assume that controlling the rate of stormwater discharge on a site-by-site (individual property) basis, regardless of its geographic position, is adequate mitigation of the negative stormwater impacts caused by development. This approach to stormwater does little to address volume and quality of water released as well as decreases in site-specific infiltration rates. These practices are the root of stormwater policy in the majority of municipal ordinances across the country. The delayed and incremental impacts of this policy include increased flooding, flooding in areas previously not considered flood prone, a decrease in water quality, increased erosion and degradation of natural streams and drainage ways and a reduction in aquatic biodiversity (Saari, 1999). While these impacts have increased in severity over time, stormwater policy has not adapted at the same rate. This type of policy has remained in place due in part to following factors:

1. The scientific community has historically not had the political backing to effect changes to existing stormwater policy on a significant scale.
2. Historically, stormwater has been the domain of Civil Engineers via design, oversight and approval powers and these powers have been protected through state and local legislation.
3. There have been few financial or legislative incentives for practitioners (Engineers, Land Developers, and Municipalities) to modify existing policies and methods.

The findings of a comparative study of pre and post-development precipitation distribution helps to frame the problem by presenting the changes in surface runoff and soil recharge (infiltration).

Precipitation Pre-development	Precipitation Post-development
40% Evaporation 10% Surface Runoff 45-50% Soil Recharge	30% Evaporation 55% Surface Runoff 15% Soil Recharge

(Souza, 2000)

Within the last decade, new schools of thought regarding stormwater control, management and design have emerged (Scheuler and Holland, 2000). Scattered research by individuals with diverse engineering, scientific and design backgrounds has been coming together to reveal a new wealth of methods to mitigate the damages caused by half a century of a static approach to stormwater and land development issues. Institution of a new stormwater policy for land development that permits a lower net increase in stormwater *volume* released, via increased on-site infiltration, would be beneficial in many ways:

a. Protection of water quality by promoting infiltration versus runoff.
b. Reducing long term erosion impacts on stream channels.
c. Reducing occurrences of “combined sewer overflow” in older urbanized areas.
d. Reduction in the lowering of regional water tables.
e. Protection of municipal drinking water sources.

Analysis:

For the purposes of this analysis a proposed development site in the Village of New Albany, Ohio will be referenced. The subject property, Market Street Residential (MSR), is 18 acres and is currently zoned R-4 residential. If developed under this classification the property will have approximately ten acres of residential yard area. The analysis will focus on alternative approaches to stormwater infiltration rates within these ten acres. (Fig. 1)

Baseline Conditions

Baseline Conditions can be measured using the proposed Development Plan for the MSR property. The plan adheres to existing stormwater regulations that require that "the peak rate of runoff from the critical storm occurring over the development shall not exceed the peak rate of runoff from a one-year storm occurring over the same area under predevelopment conditions" (VNA, 2001, Pg. 142). This requires that stormwater be stored on the developed property and released at the predevelopment runoff rate. Traditional development practices employ mass grading and earthwork of future lawn areas. This process, carried out by large machinery, compacts the soil and decreases the stormwater infiltration capability of the soil. Typical land development practices for residential home construction usually begin by stripping the topsoil from the site and stockpiling it for later use. The subsoil is then left exposed until the end of construction, leaving it vulnerable to further compaction and structure degradation (Hamilton and Waddington, 1999). Summing the impacts of soil compaction and the addition of impervious surfaces (roof tops, roads, driveways and sidewalks), the stormwater runoff rate for the MSR site will increase from 10.5 cubic feet per second (CFS) pre-development to 27.5 CFS post-development. However, the regulations quoted above require that the post-development "critical storm" rate, 47.3 CFS, less the pre-development 10.5 CFS, be stored. (McSheffery, 2003). (Fig. 2) The collection and storage of this volume of water requires costly and intrusive storm sewers and detention basins. Although the baseline policy does protect the immediate area from periodic flooding, it creates new long-term problems including, but not limited to, surface water temperature increase, higher contaminant loading, aquatic habitat degradation and stream bank erosion (Scheuler and Holland, 2000).

Policy Alternatives

There are stormwater / land development policy alternatives and modifications available to the municipality that would solve many of their long term problems related to stormwater runoff. The alternatives discussed here attempt to balance the value of increased infiltration rates within residential yard areas with the costs of revised policy.

Alternative One – Post Construction Amendment of Soil in Yard Areas

This alternative would be implemented after all construction had been completed and would be required of the land developer via an amendment of the stormwater ordinance. It would consist of adding the following steps to the standard site preparation activities: 1. The subsoil surface of all yard areas would be scarified (tilled) to a depth of 12 to 18 inches. 2. A blend of stockpiled topsoil, organic compost and sand would be spread over the yard areas to a depth of 2 inches. 3. Soil surface would be fine tilled to a depth of 6 inches and the surface smoothed in preparation for seeding.

The costs of this alternative would be immediate and include soil tilling, acquisition of compost and sand material, blending of the soil materials and the final fine tilling. The stockpiled topsoil would already be available on site. Additionally, there may be costs to the municipality through required changes in ordinances and specialized knowledge needed for enforcement.

The benefits of soil amendment would be both long and short-term:

(Short-term being during project construction, long-term being from project completion forward in time)

- Reduces the need for additional costly stormwater infrastructure to be paid for the developer (short term).
- Protection of water quality by promoting infiltration versus runoff. Reduces the risk of enforcement actions from Ohio EPA (long term).
- Reducing long term erosion impacts on stream channels thus reducing maintenance required by the municipality to reinforce stream banks and repair existing infrastructure (long term).
- Reduction in the lowering of regional water tables which keeps water supply consistent for those residents neighboring the village who rely on wells (long term).
- Protection of municipal drinking water sources downstream, thus reducing the possibility of litigation against the municipality (long term).
- Reduces flood potential, protecting municipal and private interests (long term).

Alternative 1 Assumptions:

1. Amendment materials are available within a reasonable distance from the site.
2. Market values for compost and sand material remain stable.
3. Local housing market remains stable or expands.

Alternative 1 Costs:

- Total Amendment Operation Cost to Developer = $150,000
- Costs to Municipality via Specialized Knowledge Needed for Construction and Material Inspection = $10,000 to $20,000

Alternative 1 Benefits:

- Reduction in storm sewer pipe size required throughout project = $6000
- Reduced excavation of detention basins due to reduced runoff volumes = $189,000
- Long Term Benefits Listed Above.

Alternative Two – Modified Construction Methods / Avoid Compaction of Yard Areas

Alternative two would be based on the municipality providing developers with the option of employing alternative site grading and development techniques in-lieu of tax breaks or streamlined plan approval. The goal of this alternative is to reduce the amount of soil compaction of future yard areas during construction. This would require the developer to:

1. Design a plan layout that works with existing stormwater drainage patterns, removing the need for mass clearing and grading operations.
2. Guarantee construction access is limited throughout site, primarily in future yard areas, to reduce the rate of soil compaction.

Both of the previous requirements would add cost to the developer as it would be a change to the standard approach to site design, although it would not require new materials or machinery. The costs would be incurred because the developer's economic model for purchase, zoning, design and construction of property is typically standardized. If there are any significant changes anywhere in the standardized process, then their model must be completely changed.

The benefits of Alternative two are much the same as Alternative one plus a reduction in mass grading and excavation costs. An additional benefit would be the health of adjacent vegetated and forested areas. With less modification of the quality and flow of ground water (via less soil compaction), the existing vegetation will suffer lower stress caused by the adjacent construction.

Alternative 2 Assumptions:

1. Machinery is available that can "tread lightly" enough as to not inadvertently compact the existing soils.
2. Site construction traffic can be adequately monitored and controlled.

3. Infiltration rate of native soils is two to four times higher when not compacted by construction activities.
4. Local housing market remains stable or expands.

Alternative 2 Costs

- Cost to Developer of Changing Site Design Approach (Additional Consultant Fees) = $100,000 to $150,000
- Cost to Developer of Modified Development/construction Procedures (Time and Specialized Knowledge) = $500,000
- Possible Loss of Site Development Density (Number of Homes per Acre) = $50,000 to $300,000

Alternative 2 Benefits

- Reduction in grading and clearing operations required throughout project = $600,000
- Reduced excavation of detention basins due to reduced runoff volumes = $189,000
- Reduction in storm sewer pipe size required throughout project = $6000
- Tax break for property over a specified time period.
- Improved Health of Adjacent Forested/Undeveloped Areas.
- Long Term Benefits Described for Alternative 1.

Recommendations:

My recommendation at this time would be for **alternative 2**. Although it requires greater changes in the development process, it is better suited as a long term solution. If successful, it may be able to provide an example of alternative methods to the land development community. Both alternatives would have a positive net effect compared to the baseline and the short term monetized costs and benefits of each seem to balance. However, alternative 2 is superior because it solves the problem of increased stormwater runoff created by soil compaction by not creating the problem in the first place.

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