Ventura County Watershed Planning Project
Watershed-based Planning Solutions for Ventura County

MEMO: Opportunities and Challenges for the Integrating Water and Land Use Comments on the Second Draft of the Ventura County Municipal Stormwater Permit October, 2007

Overview: The Los Angeles Regional Water Quality Control Board should be commended for trying to implement "an integrated approach to water quality and resources management." It is a challenge - as Aldo Leopold noted: *"Integration is easy on paper, but a lot more important and more difficult in the field than any of us foresaw."*

The second draft of Ventura County's Municipal Stormwater permit improves upon the first draft in terms of the emphasis it places on integration. In particular, there is improvement in the recognition that solutions must be coordinated across different scales. The first draft's focus on site-scale solutions was to the detriment of district and regional scale solutions, which many times yield far greater and far more cost-effective stormwater management than site-by-site practices. Though the 5% EIA provision still creates a site-level focus, the 2nd draft also refers to combinations of site, subregional and regional controls, which supports broader uses of "natural infrastructure" and creates opportunities for coordinated solutions that fit different types and sizes of development. The use of LID credits creates flexibility needed to link correct solutions to different development situations, and to address the most formidable problems. An integrated approach is also supported with the continuation and refinement of the Redevelopment Project Area Master Plan or RPAMPs.

For the final permit, these improvements can be built upon. Some challenges and opportunities are laid forth below, and are followed by suggestions for specific permit language. A separate memo with discussion and specific policy ideas related to the use infill and redevelopment is also included.

I. The Opportunities and Challenges

The second draft contains improvements with:

1) The emphasis on redevelopment as an environmental benefit remains.
2) The increased emphasis on flexibility, including the regional mitigation bank, redevelopment strategies and a new credit system for Low Impact Development.
3) A revised emphasis on combinations of BMPs, which will assist planners and engineers as they develop "treatment train" approached for infiltration and treatment. (page 53)
4) The emphasis on program integration
5) The attention to low impact designs for the entire landscape and the addition of scale as it applies to implementing low impact development. This will help Ventura County and its cities improve upon LID design and avoid the impacts associated with development that is "green" at the site scale, yet high impact due to its location in the watershed.
6) The continued inclusion of housing as an issue for watershed protection.

Challenges for resource-efficient planning in Ventura County and LGC members include:

1) The quantifiable recognition of mixed use and alternative transportation as it relates to lessening impacts to the watershed (in particular for stormwater runoff) at various scales. This is a nationwide challenge, which will be brought to the fore with this permit. The delineation of the RPAMPs will certainly shape the data collection, methodology and modeling needed.
2) While the permit gives recognition to the factors shaping an efficient development footprint for redevelopment, compact new development may still be at a disadvantage without express permit support (See Suggested language below).
3) The limitation of Effective Impervious Area (EIA) to less than 5% is a clear, strong, measure, however, there has been inadequate vetting of how it might affect site and community design once wider adoption takes place. Setting a "one size fits all" performance criteria has proven around the country to have negative consequences, in particular for small lots. The University of Maryland is documenting how otherwise smart policies have backfired with broad-brush approaches. In ultra urban areas, compliance with the Americans with Disability Act's requirements on pavement and access would exceed 5% for small lots.
4) Another issue is the relationship between Municipal Action Levels and the overall objectives of the permit, including support of LID. Though the Local Government Commission project is not engaging in MALs directly, some questions related to the implementation of other practices remain:
    a. Are MALs the most effective strategy for measuring compliance? Will the MALs support implementation of the permit requirements? Will their cost create a financial barrier to better planning and management given limited local government resources to "do it all?" Do MALs, an end-of-pipe approach to enforcement, fit with a new era of stormwater that aims to address stormwater issues at the source? Will meeting MALs rise to the top of priorities, even though other activities will, in the long run, provide better water resource and environmental protection?

    These are questions that are worth considering to ensure that the permit gives local governments the best opportunities to succeed in implementing more sustainable policies and development practices.

5) LGC is engaged in several activities related to aligning and integrating land use and water codes, performance standards and guidance. The following list represents a subset of the various plans, codes and standards dealing with how and where impervious cover is put in place, or similarly, where LID techniques face regulatory barriers:
    a. Zoning Codes
    b. Subdivision Regulations
    c. Parking Codes, in particular "Landscaping in Parking"
    d. Fire Protection District Standards on accepted materials
    e. California Building Code language on drainage
    f. Landscape Guidelines for Commercial Development, including irrigation rules
    g. Water Conservation and Plant Selection Guidelines
    h. Local Street Design Standards and Access standards (e.g. Driveways and Aprons)
    i. Building Codes related to Expansive Soils
    j. Design Guidelines for Parks and Open Space

k. Impact Fee structure
l. General Plan and Updates
m. CEQA guidelines for Initial assessments
n. Specific Area Plan documents
o. Redevelopment and Downtown Programs
p. Floodplain and Floodway development rules
q. Assessment Districts
r. Developer Agreements
s. TMDL Implementation Plans
t. Integrated Regional Watershed Management Plan

This list can also be viewed as the list of documents that each permittee or co-permittee must review and update.

II. Specific Language Suggestions for further improving the permit

The suggestions below refer to specific permit language. The intent is to support comprehensive and coordinated strategies for integrating water and land planning in a manner that is aligned with the planning context of Ventura County, achieves multiple-benefits and promotes sustainable development practices. Page numbers are provided to refer Regional Board staff to the correct location and bold text is used to highlight specific changes.

RPAMPs PG 59

(c) A Permittee or a coalition of Permittees may apply to the Regional Water Board for approval of a Redevelopment Project Area Master Plan (RPAMP) for **development** projects within Redevelopment Project Areas, in consideration **of: 1) the fact that development in certain locations, patterns, and intensities provide higher environmental performance than others; 2) the potential watershed benefits of infill and redevelopment that are typically not recognized in conventional site-level stormwater models; and 3) the importance of balancing water quality protection with the needs for adequate housing, population growth, public transportation and management, land recycling, and urban revitalization.** (d) For the RPAMP to be considered, a technical **"Urban Design Strategies" (UDS) panel will be developed to review and approve criteria for a proposed RPAMP** prior to its submittal to the Regional Water Board, for conformity with the balancing of interests identified in (b), including water quality. The Regional Water Board Executive Officer may then consider the RPAMP for approval, or elect to submit it to the Regional Water Board for consideration. **The UDS panel can be developed with the assistance of the Local Government Commission or an equivalent state or regional planning agency or organization.** (e) The RPAMP, on approval, may substitute in part or wholly for on-site post-construction and hydromodification requirements. (f) Redevelopment Project Areas include the following:
(1) City Center areas.
(2) Historic District areas.
(3) Brownfield areas.
(4) Infill Development areas.
(5) Urban Transit Villages.
(6) Mixed Use Project Areas.
(7) Any other redevelopment area so designated by the Regional Water Board.

Under I Purpose on PG 49

(a) Minimize the percentage of impervious surfaces on land developments to support the percolation and infiltration of storm water into the ground**, and support preventative land development practices that conserve ecologically valuable areas, reduce overall amounts of impervious surface cover, and help to direct development away from ecologically valuable areas an into already disturbed areas.**

(e) Prioritize the selection of BMPs suites to remove storm water pollutants, reduce storm water runoff volume, and beneficially reuse storm water to support an integrated approach to protecting water quality and managing water resources in the following order of preference:
(1) Low Impact Development Strategies (see the following section E.III.2).
(2) Integrated Water Resources Management Strategies.
(3) Multi-benefit Landscape Feature BMPs.
(4) Modular/ Proprietary Treatment Control BMPs.
(5) Coordinated Community Design strategies for efficient land use.

PG 52

(b) The Permittees shall develop a LID Technical Guidance Section to the Ventura County Water Guidance Manual for Storm Water Quality Control Measures no later than (365 days from the Order's adoption date) for use by land planners and developers. The LID Technical Guidance Section shall include objectives and specifications for integration of LID strategies in the areas of:
(1) Site Assessment.
(2) Site Planning and Layout.
(3) Vegetative Protection, Revegetation, and Maintenance.
(4) Techniques to Minimize Land Disturbance.
(5) Techniques to Implement LID Measures at Various Scales
(6) Integrated Water Resources Management Practices.
(7) LID Design and Flow Modeling Guidance.
(8) Hydrologic Analysis.
(9) LID Credits.
(10) Techniques to Promote Efficient Land Use.

(c) The Permittees shall facilitate implementation of LID by providing key industry, regulatory, and other stakeholders with information regarding LID objectives and specifications contained in the LID Technical Guidance Section through a training program. The LID training program will include the following: (1) LID targeted sessions and materials for builders, design professionals, regulators, resource agencies, and stakeholders. (2) A combination of awareness on national efforts and local experience gained through LID pilot projects and demonstration projects. (3) Materials and data from LID pilot projects and demonstration projects including case studies. (4) Guidance on how to integrate LID requirements into the local regulatory program(s) and requirements. (5) Availability of the LID Technical Guidance regarding integration of LID measures at various project scales. (6) Guidance on the relationship among LID strategies, Source Control BMPs, Treatment Control BMPs, Hydromodification Control requirements, ***and community design strategies.***

The Local Government Commission greatly appreciates the opportunity to work with the Los Angeles Regional Water Quality Control Board and local stakeholders in Ventura County to align water and land use in a manner that achieves comprehensive and coordinated planning and management solutions.

Ventura County Watershed Planning Project
Watershed-based Planning Solutions for Ventura County

MEMO: Policy Ideas for Infill and Redevelopment in the Ventura Draft Permit
August, 2007

Background

The Local Government Commission (LGC) has been working with local agencies, the Regional Board, and other stakeholders to develop strategies that align local land use planning and stormwater management in Ventura County. The draft stormwater permit has been a focal point of the effort so far. The draft permit supports LID, which is a great step forward, but still faces the challenge of supporting good urban and community design principles that are essential to reducing per-capita imperviousness and conserving ecologically valuable areas by concentrating future growth. LGC has convened three meetings to discuss these issues and potential solutions. LGC issued a whitepaper discussing opportunities for supporting "smart growth" planning principles in the permit.

This memo aims to ***clarify the stormwater benefits of infill and redevelopment,*** and ***presents three policy ideas*** for establishing a regulatory framework to support and provide credit for compact community design principles or "Smart Growth" in the Ventura Countywide Stormwater permit. These three elements would be mutually supportive and could be initiated in part, through the current Ventura County Regional Watershed-based Planning project. They include:

1. Refining the RPAMP concept to create a community or district scale planning system that provides regulatory support for infill and redevelopment as stormwater BMPs, and relieves the administrative burdens of the current RPAMP program;
2. Establishment of "credit system" to support urban design practices that reduce watershed level imperviousness of new development;
3. Establishment of an expert "Urban Design Strategies" advisory panel that will oversee the development of an effective credit system and help to establish criteria for the RPAMP or whatever other "district-level" planning system is created to support urban design strategies like infill and redevelopment as stormwater BMPs.

Clarifying Infill and Redevelopment as Stormwater BMPs

Infill and redevelopment are among the most effective ways to reduce development impacts at a watershed-level. To understand the benefits, however, requires moving away from the "percent removal" standard for measuring the performance of best practices, to one that also looks at the prevention of excess runoff and its impacts in the first place. Moreover, preventing impacts will lessen the need to develop extensive maintenance plans, since the benefits are, literally, built-in and self-sustaining.

Redevelopment prevents generation of "new" impervious cover by making use of areas that are already developed. Infill focuses growth into already developed areas, reducing "sprawl" and

creating a more compact development footprint. This also reduces per capita imperviousness and prevents conversion of natural land cover on the urban fringe and in ecologically-sensitive areas. Both strategies help to concentrate the impacts of development into areas that are less valuable from a watershed or ecological view.

Specific benefits are drawn-out below:

1. Infill and redevelopment occur within already developed areas, which relieves development pressure on undeveloped or "greenfield" sites that offer ecological services.
2. Infill and redevelopment tend to occur within areas already served by infrastructure. The benefits accrue when existing roads and other service infrastructure can be used instead of being created. Moreover, infill and redevelopment enhance the local tax base, which increases funding for infrastructure repair, upgrade and water quality/quantity retrofit.
3. Infill and redevelopment are typically part of a more compact development format. Older cities and suburbs were planned and developed at a time when parking standards, setbacks and streets were geared more to pedestrian access. This, in turn, brought uses closer together. While compact development tends to be highly impervious at the site level, compact districts can reduce the overall development footprint within the watershed.
4. Infill and redevelopment on small lots are served by a much smaller complement of public infrastructure. This reduction in frontage (and thus roadway) is often overlooked, in particular for analyses that only look at on-site imperviousness. For modern five-lane arterial roads, each 10-foot increment in parcel frontage is served by almost 600 square feet of pavement needed to reach the next lot.
5. Further benefits arise from infill and redevelopment in compact districts when automobile trips are substituted by walk trips. Air deposition of exhaust components are reduced, as are metals deposited by brakes and tire wear.
6. Infill and redevelopment projects tend to have higher densities. Instead of one-story buildings, many urban projects are two to three stories high (or higher in commercial core districts), though they may cover the entire site with building footprint, parking and pedestrian access. The draft permit's focus on the footprint (effective impervious surface) overlooks the watershed benefit of placing additional stories of development demand under one roof (instead of several roofs).
7. Infill and redevelopment offer the opportunity to retrofit vacant lots, many of which are 100% effective impervious surface.

Challenges for Recognizing the Benefits of Redevelopment and Infill within the Permit

Not unlike many other permitting authorities, the LAWQRB faces several challenges in recognizing the benefits of infill and redevelopment. The challenges can be grouped as follows:

1. Infill and redevelopment projects do not all start at the same level of interest or funding. While many redevelopers will recognize the value of LID and begin to assimilate the cost of new BMPs with the cost of existing landscaping or building systems, there are many vacant or abandoned properties that are not drawing investment even under current rules. Observers have noted that the stringency of the new permits may be poised to drive development to greenfields. However, land owners and developers may also choose to rehabilitate their building rather than redevelop. In these cases, there will be no

mechanism for mitigation since trigger levels of land disturbance are not met. Note this also means that other benefits accruing from redevelopment will not materialize as well, such as introduction of use mix, shared parking, housing, an enhanced tax base and so on.

2. As noted above, conventional stormwater management and engineering focuses on "percent removal" of pollutants or volume reduction on individual sites. These conventions have made their way into permitting and regulatory language, as well as guidance on BMP selection. Very little research or models exist to incorporate preventative stormwater Impacts.
3. Infill development may occur on pervious parcels, so some watershed value may be lost. However, the function lost on a smaller footprint is far less than having the same development demand satisfied under typical greenfields zoning.
4. Redevelopment in built-out watersheds is likely to be the main path (under permits that are triggered by disturbance of 5,000 square feet or larger) to retrofitting properties. Exempting redevelopment thus eliminates this main path to improving the impacts of stormwater.

Three Policy Ideas for Addressing these Challenges and Opportunities in the Permit

1) Making RPAMPs Work

Redevelopment Project Area Master Plans (RPAMPs) are one proposed mechanism forwarded to support redevelopment and more compact development. RPAMPs present a unique opportunity to define, assess and demonstrate the stormwater benefits of a coordinated redevelopment district. Perhaps the most powerful feature of RPAMPs is that they level the post-construction playing field between greenfields and redevelopment areas. How? Large greenfields projects are considered a "Common Development Plan." As such a developer has many options to meet the performance criteria even if individual parcels do not. While many redevelopment projects are part of a common plan, they do not enjoy the same flexibility during site design. The RPAMP serves the useful tool of creating drainage options for older commercial areas. However, municipalities have indicated that the RPAMP is likely to be unmanageable as currently conceived. One solution is to develop an expert panel to establish design / performance criteria for the RPAMPs and to determine the best ways to implement the RPAMPs. Preliminary language to carry the "advisory panel" concept forward was included in the 2nd Draft of the Permit. Further discussion of an "Urban Design Strategies" advisory panel is included in a separate section below. Suggested revisions to the current permit language are included there as well in the separate Memo providing specific comments on the 2nd draft of the permit.

According to the permit, the RPAMP "may substitute *in part* or wholly for on-site post-construction requirements." To cut down on administrative barriers and streamline the process of developing and approving RPAMPs an "advisory panel" could be developed that would be responsible for establishing criteria for RPAMPs, policy indicators for compliance, and approving a standard system (perhaps a sliding scale, point or rating program) that would determine the level of exemption for a given project within an RPAMP (e.g. must meet 50% EIA requirement, or the project is entirely exempt, etc.). In the short term, acknowledgement of "imperviousness avoided" or assessment of imperviousness per unit can guide discussion about measuring stormwater benefits of smart growth strategies.

One of the more complicated tasks will be to judge when a redevelopment district serves "in part" or "wholly" as a substitution for on-site post-construction requirements and what defines the gradations in between. LGC has initiated discussion between stakeholders, developed a conceptual "sliding scale" and begun analysis of several "smart growth" or "sustainable development" rating systems with the hope of developing a tool for assessing the watershed, stormwater, and community benefits associated with distinct but linked urban design strategies like use mix, redevelopment, and affordable housing.

One option is to make use of existing "policy infrastructure" by using well-developed specific or district plans in the Ventura region as a basis for future RPAMPs.

2) Smart Growth Credit Program

There is no counterpart of "RPAMP" for new development, even though the same interplay is needed to produce compact districts that consume less land per new project, specific plan area, and/or master planned communities.

Recognizing the environmental benefits associated with Smart Growth development, and the potential challenges of implementing a 5% EIA standard for areas of higher density, a credit program can be established for review and approval by an Urban Design Advisory Panel. The goals of the program would be to prevent dispersed development patterns so as to minimize land disturbance and consumption, as well as to minimize watershed-level imperviousness through an rating system that allocates points for implementing certain development strategies. This program can build on a number of sustainable planning and design rating systems including LEED ND, which places significant emphasis on the location and form of development.

3) Urban Design Strategies (UDS) Advisory Panel

Developing comprehensive and coordinated planning and design solutions is a challenge. In LGC project meetings it was indicated that RPAMPs would be too much of an administrative burden for either Regional Board staff or Local Government staff to develop for them to be used, and that expertise was needed to help establish standard performance criteria and overall guidelines for the development and implementation of RPAMPs. Regional Board staff offered the idea of developing an expert panel through the current LGC project to alleviate the administrative burden and provide needed expertise. Recognizing the unique planning context of Ventura County, LGC proposes that an expert advisory panel be developed to serve throughout the term of the permit so as to:

1. Oversee development of an effective credit system for alternative compliance;
2. Oversee development of criteria for RPAMP areas; and
3. Work with local governments to identify plans or policies to build upon for developing RPAMPs;
4. Review and approve individual RPAMP plans.

It is essential that any alternative compliance or "non-traditional" stormwater strategies be viewed as effective and compliant with the requirements of the permit. The Urban Design Strategies advisory panel would provide needed oversight to ensure that urban / community design plans that support smart growth principles would be effective in meeting local and

regional water management goals. The current LGC process offers a venue to initiate development of rating criteria and discuss the composition of the RPAMP advisory panel.

Recommended revisions to RPAMP language:
RPAMPs PG 59

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(7) Any other redevelopment area so designated by the Regional Water Board.

The Future of Stormwater Management: Coordinating Site to Regional Solutions
Truly sustainable development must not only mitigate, but also prevent impacts through comprehensive and coordinated planning and management. Ventura County is not the only place seeking to coordinate efficient land use and sustainable site design.

The US EPA is developing new General Permit language that recognizes that not all development has the same environmental impacts. The EPA's new language aims to facilitate incorporation of "green infrastructure" that can infiltrate, reuse, and evapotranspirate runoff, in a state and municipal stormwater management programs and also to recognize that *some development patterns have better environmental performance* (e.g., infill, redevelopment, and mixed use) than others (e.g. dispersed, separated uses, low density, auto-dependent) no matter how well they are designed at the site-level. This new language includes a point system that aims to recognize the environmental benefits that certain development types have over others. The new language will ensure that all developments address stormwater on-site, but that some types

of development, which start out at a higher level of environmental performance, (i.e. compact redevelopment that outperforms greenfield sprawl) can receive a reduction in the amount of runoff that must be managed on site. Points are allotted for land uses that have higher environmental performance than conventional development including infill, redevelopment, mixing uses, increased density and Transit Oriented Development (TOD).

The City of Grand Rapids is an example of a municipality that has established a credit system for rewarding demonstrated runoff reductions, water quality benefits, and environmental performance of compact community design practices. Grand Rapids began with that the fact that "a higher-density residential development will generate less runoff than a lower-density residential development with the same number of residences. Although the higher-density development will have a greater percentage of impervious area per acre of development, the total impervious area per residence actually will be less. Thus, each residence will generate less runoff, thereby having less of an impact on the community's water resources."[i] The approach shows an evolving understanding of impervious surfaces – that the overall amount of imperviousness associated with development is not the only concern, that the amount of imperviousness *per-unit or per-capita* is far more meaningful since communities are growing to accommodate numbers of people, jobs, and businesses. Recognizing that impervious surfaces were associated with certain amounts of growth, and that certain types of development and certain development patterns would could lead to more or less overall impervious cover, Grand Rapids developed a standard evaluation method to be used for granting a waiver or reduction in the city's stormwater regulations for higher-density development. A write-up of the Grand Rapids program is attached and an article in the October issue of *Stormwater* can be found here: www.gradingandexcavation.com/sw0710_evaluation.html

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[i] Lemoine, R., (2007) "An Evaluation of the Reduced Environmental Impact From Higher Density Development" October 2007 Issue of Stormwater Magazine

AN EVALUATION OF THE REDUCED ENVIRONMENTAL IMPACT FROM HIGH-DENSITY DEVELOPMENT

Intuitively, a high rise building will generate less rain water runoff than a single-story building of the same floor area. This is because the high rise will have less roof area (impervious area), resulting in less runoff. Less intuitive is the fact that a higher density residential development also will generate less runoff than a lower density residential development with the same number of residences. Although the higher density development will have a greater percentage of impervious area per acre of development, the total impervious area per residence actually will be less. Thus, each residence will generate less runoff, thereby having less of an impact upon the community's water resources. This fact has been documented by the United States Environmental Protection Agency (EPA) in a report (EPA publication 231-R-06-001) entitled "Protecting Water Resources with Higher-Density Development". Consistent with the City of Grand Rapids' desire to promote "Low Impact Development" and "Smart Growth" initiatives, city staff expanded upon the EPA report by evaluating the water resource impacts for higher densities and different types of development, with the intent of determining the appropriate density thresholds to define high density development, and to establish a standard evaluation method for granting a waiver or reduction in the City's stormwater regulations for high density developments.

Evaluation of Development Types and Densities

As in the EPA report, the City's runoff evaluation is based upon the runoff caused by impervious areas such as roofs, roads, driveways and sidewalks per unit of development, rather than simply looking at the percent of impervious area. Therefore, a residential development is evaluated on the average impervious area per residence, a parking facility development on the average impervious area (exposed impervious surface area) per parking space, and an office or commercial development on the average impervious area (roof area) per gross floor area. The impervious area for a higher density development is compared with the impervious area of a pre-defined, low-density development with an equal number of development units (residences, parking spaces, gross floor area). The runoff reduction is estimated by subtracting from one, the ratio of the site's actual impervious area (AI_{site}) divided by the impervious area (Ai_{LD}) of a low density development having the same number of units, and converted to a percentage.

Equation 1 $$\text{Percent Runoff Reduction} = (1 - Ai_{site} / Ai_{LD}) \times 100\%$$

Impact Reduction Goal

A previous evaluation of vegetated roof systems conducted by Grand Rapids city staff had determined that vegetated roof systems provided more than an eighty percent reduction in runoff when compared with a standard roof. The eighty percent runoff reduction justified granting a waiver of the stormwater management requirements, since the impact of a vegetated roof system closely resembled that of natural pervious areas. Therefore, it seems reasonable to use the same eighty percent (80%) runoff reduction as the threshold for the granting of a waiver for high density developments.

Residential Development

The chart shown as Figure 1 displays the runoff reductions from the EPA report and from Grand Rapids' extended analysis. The resulting curves are very similar for the densities evaluated in both of the analyses, the only difference being that Grand Rapids' analysis was extended to include much higher densities. The curves show a rapid rise in the percent of runoff reduction between the densities of one residence per acre and five residences per acre, followed by smaller runoff reductions indicated by a flattening of the curve as densities increase beyond five residences per acre. Although there were only three different densities evaluated in the EPA report, the same rapid rise and flattening of the curve is evident.

The EPA report effectively demonstrates that higher density developments will result in less impact on the overall watershed. However, the density of one residence per acre for the base low density residential development does not seem appropriate when applied to urbanized communities for consideration of waiving the stormwater management requirements. Generally, urbanized communities have very few residential areas with densities less than five residences per acre. And, given the dramatic difference in runoff impact (150 percent) for developments of one residence per acre verses five residences per acre, the definition of a low density residential development is five residences per acre for this analysis, rather than one residence per acre as defined in the EPA report.

Typically, a residential development with five residences per acre will have an average of 4700 square feet of impervious area per residence. The impervious area includes roof, patio, sidewalk, and driveway. Figure 2 shows the relative percent of runoff reduction for higher densities compared with an equivalent low density residential development of five residences per acre with the same number of residences. The eighty percent (80%) runoff reduction for residential developments is obtained at a density of thirty-eight (38) residences per acre.

Parking Facility Development

The configuration for low density parking facilities was defined as a one acre surface parking lot with a ten foot vegetation buffer on three sides, two parking spaces on each side of a single twenty foot wide drive aisle and a driveway at each end. The parking spaces were assumed to be nine feet wide by twenty feet long. The low density parking facility has an optimum density of 134 parking spaces per acre with a total impervious area of 36,850 square feet, resulting in a unit density of 275 square feet of impervious area per parking space. The higher density parking facilities were defined as being a one acre multi-level parking facility. A "rule of thumb", which was provided by Mark DeClercq of Walker Parking Consultants, for estimating parking deck area needed to accommodate a given number parking spaces is 350 square feet of deck area per parking space. Assuming a parcel size of one acre, the parking spaces per level was calculated by taking 43,560 square feet per acre and dividing by 350 square feet per parking space, which yields 124 spaces per parking level. Since only the upper level of a multi-level parking facility receives rainfall, the runoff will remain constant regardless of the number of parking levels. Therefore, while the number of parking spaces increases with each additional parking level, there is less runoff per parking space. The chart labeled Figure 3 shows the relative percentage of runoff reduction compared with an surface parking lot with the same number of parking spaces. The eighty percent runoff reduction occurs when there are six levels of parking, which translates into a density of 744 parking spaces per acre of land area used by the facility.

Commercial and Office Development

The configuration for the low density commercial/office development was defined as a single story commercial or office building. The runoff was estimated for the building area being 100% impervious. Since a building's density is related to the floor space, the ratio of floor space area divided by the building roof area was used as the indicator for density. The eighty percent (80%) threshold is reached by buildings with a gross floor area five times greater than the building roof area, or in other words, by buildings that are at least five stories in height. Figure 4 is a chart showing the relative percentage of runoff reduction compared to a single story building of equal floor space.

Mixed Use Development

Most high density developments involve a mix of uses. Such developments typically have retail use at street level, parking decks in the back and beneath the development, office spaces on the second and possibly third levels, and residential use on the remaining upper floors. Therefore, an empirical method is needed for evaluating the runoff impact reduction for such mixed use developments.

The evaluation is based on the average impervious area per unit of the pre-defined low density development unit, which is shown in the following table.

Low Density Development Type	Average Impervious Area	Development Unit
Residential	4700 square feet	Residence
Parking Lot	275 square feet	Park-Loading Space
Office - Commercial	1 square foot	Gross Floor Area

The equivalent low density impervious area (Ai_{LD}) for each use type is estimated by taking the number of proposed development units (i.e. residences, parking spaces, or gross floor area) and multiplying by the "Typical Impervious Area" for each development unit. The equivalent low density impervious area (Ai_{LD}) for a residential development is calculated by multiplying the number of proposed residences by 4700 square feet per residence. The (Ai_{LD}) for a parking facility is calculated by multiplying the number of proposed parking spaces by 275 square feet per parking space. And, the (Ai_{LD}) for all other uses such as office, retail and hotel is simply the proposed gross floor area. The development's total equivalent low density impervious area (Ai_{LD}) for the mixed uses is the sum of the (Ai_{LD}) for each of the different uses. The percent runoff reduction is then estimated using Equation 1 (above), incorporating the development's actual site impervious area (Ai_{site}) (less any vegetated roof areas) and the development's total equivalent low density impervious area (Ai_{LD}).

The goal for granting a waiver from the stormwater management requirements is for at least an 80% reduction in runoff relative to an equivalent low density development. The attached spreadsheet table (Figure 5) shows the calculations for two proposed mixed-use developments in Grand Rapids, the Gallery Project and the 240 Ionia Condominiums, which were evaluated for the granting of a waiver.

Conclusion

The granting of a waiver from certain stormwater management requirements for high density developments makes good sense from an overall watershed perspective. High density developments provide more spaces for living, working and commerce while reducing the total disturbed land area, requiring fewer streets, and minimizing the overall volume of runoff discharged into the surface waters of the watershed. In spite of these environmental benefits for the watershed, the increased peak discharge from high density development into local and downstream drainage systems must be considered. If the local and downstream drainage systems can accommodate that discharge, as is the case for the Grand Rapids downtown area, than a waiver can be granted. However, if the local and downstream drainage system cannot accommodate that discharge, public officials need to consider improvements to the drainage system (including offsite detention) to accommodate the granting of such a waiver. Therefore, although high density development should be fostered as a watershed "best management practice", consideration must be given to the capacity of the local and downstream drainage systems to accommodate and manage the peak discharges, before a waiver or reduction in the stormwater management requirements is granted.

Prologue

Currently, the City of Grand Rapids has granted waivers for two high density developments. These two developments, involving a total of 1.2 acres of re-development, avoided the creation of over fourteen acres of impervious area elsewhere in the watershed. This more than ten-fold reduction was due, in large part, to the City's policy that deliberately recognizes the value of high density development and rewards such development by reducing or waiving certain stormwater requirements. Combined with other "low impact development" policies and practices like promoting the Green Building Council's LEED certification, vegetated roof covers, porous paving, rain gardens, and runoff capture & reuse, the City of Grand Rapids is quickly redeveloping into a community with a healthy environment in which to live, work and play.

By Randel Lemoine, P.E.
City of Grand Rapids, Environmental Services

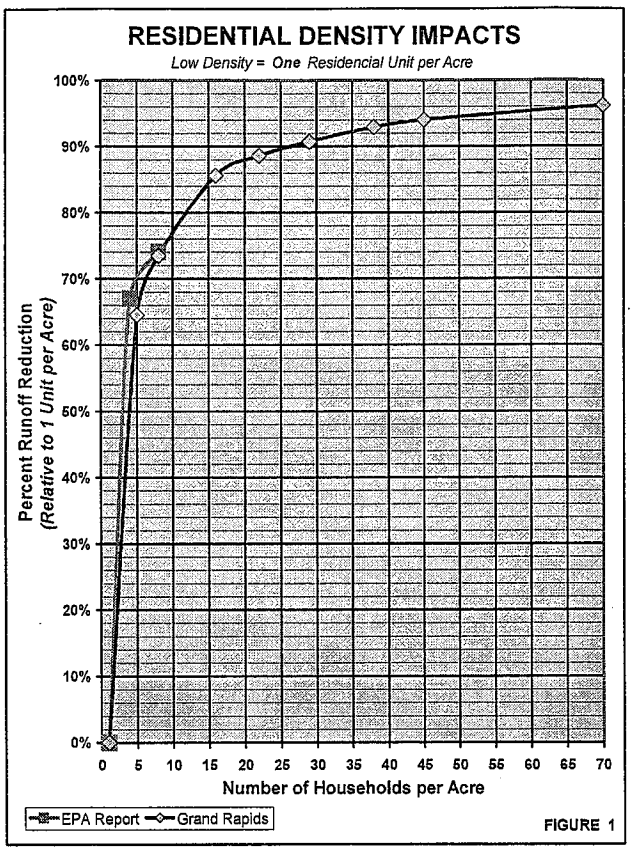

FIGURE 1

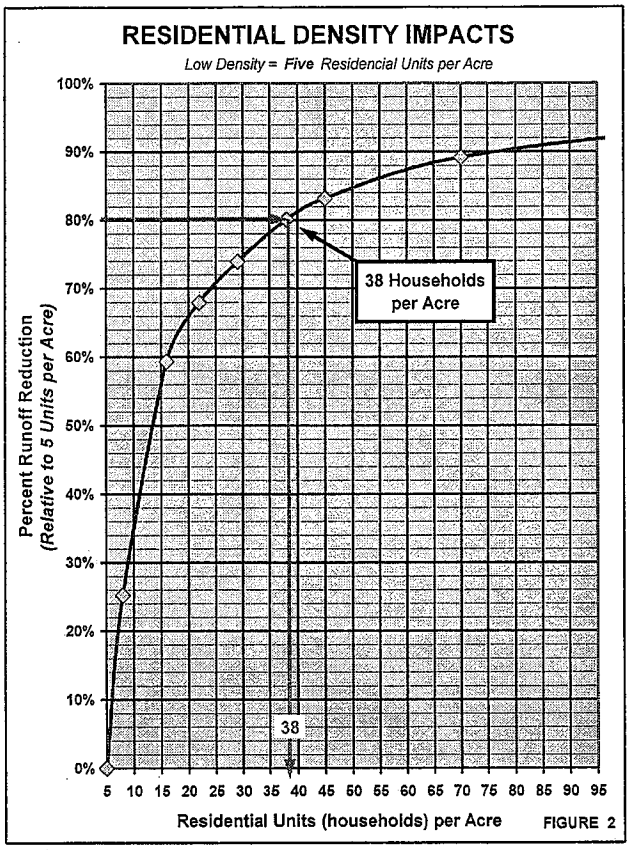

FIGURE 2

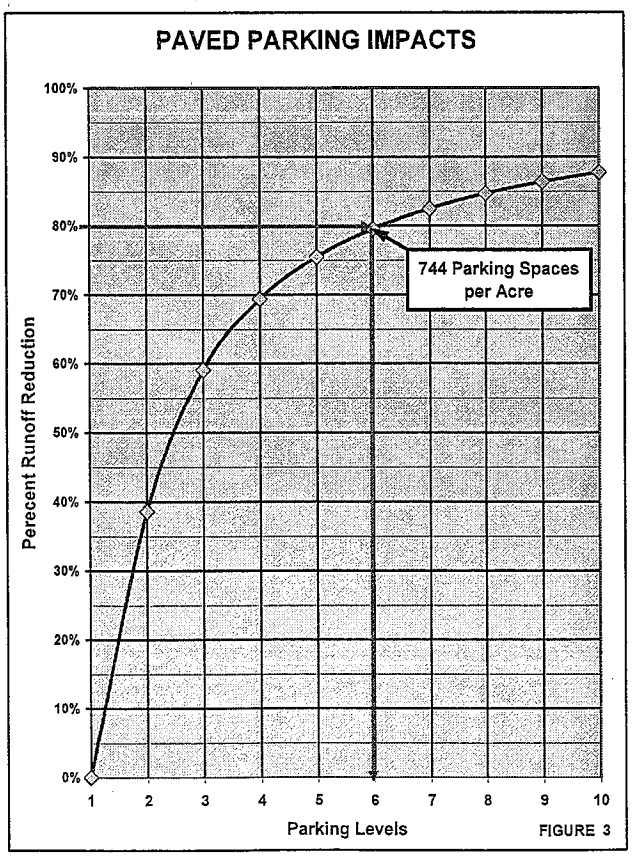

FIGURE 3

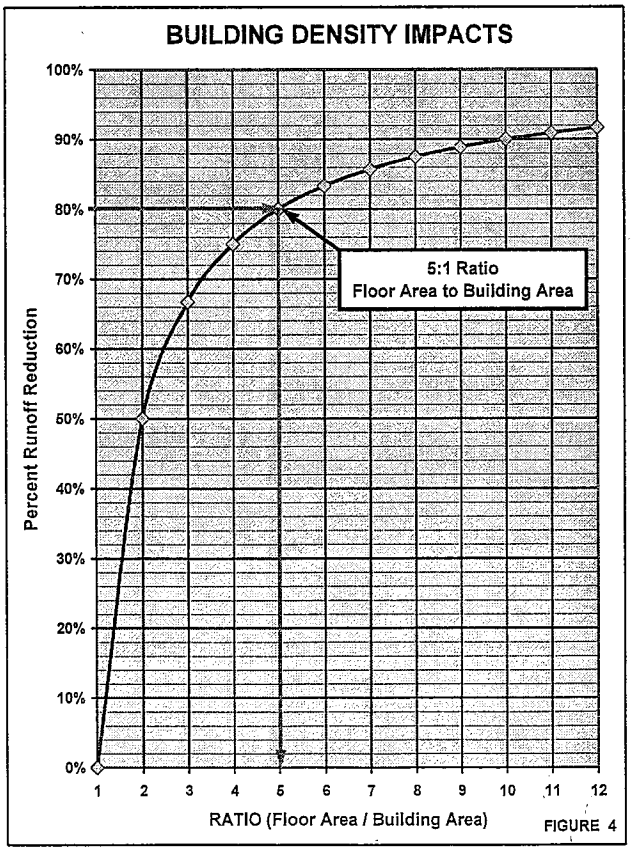

FIGURE 4

THE GALLERY PROJECT

Site Impervious Area		37,245 sf
Vegetative Roof Area		12,356 sf
Impervious Area (site area - vegie roof area) = Ai_{site}		**24,889 sf**
EQUIVALENT IMPERVIOUS AREA (low density)		
Residential	0 units	
Residential Usage Area =		
0 residences x 4700 sf/residences =		0 sf
Parking		
Public	152 spaces	
Hotel	113 spaces	
Total	265 spaces	
Parking Usage Area =		
265 spaces x 275 sf/space =		72,875 sf
Hotel Area		114,300 sf
Retail Area		14,342 sf
Cultural Retail		36,936 sf
Total Equivalent Impervious Area =		**238,453 sf**
Runoff Reduction		
$(1 - Ai_{site} / TIA) \times 100\% =$		**89.6% > 80%**

240 IONIA CONDOMINIUMS

Site Impervious Area		16,887 sf
Vegetative Roof Area		0 sf
Impervious Area (site area - vegie roof area) = Ai_{site}		**16,887 sf**
EQUIVALENT IMPERVIOUS AREA (low density)		
Residential	72 units	
Equivalent Residential Area		
72 units x 4700 sf/unit =		338,400 sf
Parking	72 spaces	29,843 sf
Equivalent Parking Area		
72 units x 275 sf/parking space =		19,800 sf
Retail Area		4,819 sf
Office Area		8,317 sf
Total Equivalent Impervious Area =		**371,336 sf**
Runoff Reduction		
$(1 - Ai_{site} / TIA) \times 100\% =$		**95.5% > 80%**

FIGURE 5