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The Downstream Economic Benefits from storm Water Management: a Comparison of Conservation and Conventional Development

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THE DOWNSTREAM ECONOMIC BENEFITS FROM STORM WATER MANAGEMENT: A COMPARISON OF CONSERVATION AND CONVENTIONAL DEVELOPMENT

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This paper evaluates the downstream hydrologic and economic impacts of conservation development strategies that promote greater on-site storage of storm water runoff. Conservation development provides the same gross density of conventional residential and commercial development, but through techniques such as clustering, permits more land to be used for such functions as storm water management. Storm water management strategies employed typically include wetlands, vegetated swales, and porous paving among others.

We apply benefits transfer techniques to quantify the downstream economic consequences of urban development strategies related to storm water runoff. This information is important in quantifying benefit-cost tradeoffs associated with storm water management policies and design standards for new development. Estimates of the downstream costs can inform developers about the value of preventive measures and help public officials determine the appropriate balance between those preventive measures and downstream mitigation.

Storm water management can produce the following types of downstream benefits:

1. Reduced frequency, area, and impact of flooding
2. Less costly public drainage infrastructure
3. Reduced erosion and sedimentation
4. Increased low flows
5. Improved water quality
6. Improved in-stream biological integrity
7. Improved stream aesthetics
8. Increased ground water recharge

With the exception of ground water recharge, these effects are concentrated in stream corridors and riparian zones. This paper outlines how each type of impact can be valued economically. From the available literature, with due regard for the difficulty of assigning complex values to specific causal factors, we extract estimates of their respective economic values.

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Flood mitigation and water quality protection are the most important services. For residential properties, the economic value of those services is on the order of one to five percent of market value depending on the difference that retention makes to downstream flood exposure. For water quality improvements, the increases range up to 15 percent of market value for waterside residences where clarity of the water quality is greatly improved. The increases are much less for improvements that are less visible, properties that are not developed, and properties not adjacent to the watercourse. The best estimate of total benefits to property owners is three to five percent of property value on average for all properties in the flood plain. The public sector realizes additional benefits through smaller bridges, culverts, and other drainage infrastructure and through increased aquifer recharge. Cities and industries may avoid costly upgrades to waste water treatment facilities if low flows increase. It is difficult to generalize about the economic value of the latter effects.

We take the next step toward usefulness by applying the benefits transfer methodology to a specific case study in a suburban Chicago watershed. The case study emphasizes the effects of flood risk reduction on property values, and the costs of storm water drainage infrastructure. The estimates are at a first level of approximation, based on generally available data. We use widely accepted simulation models to compare alternative development scenarios. For the case study, reduced downstream flooding with the employment of conservation design practices generates from $3,949 to $47,033 per hectare ($1,795 to $21,379 per acre) in downstream property value benefits over all affected areas. For comparison purposes, flood-damage estimation methods generate an average of $10,638 to $28,778 per hectare ($4,337 to $11,732 per acre) present value reduction in damages for the 0.01 probability flood event alone. The two methods yield conservative, but mutually reinforcing estimates. For infrastructure benefits, considering only downstream road culverts, the use of conservation design practices upstream avoids $3.3 million to $4.5 million in costs of culvert replacement or upgrades

The results indicate that implementation of upstream conservation design practices should have substantial off-site benefits in addition to any on-site economic benefits. Using very conservative benefit estimation methods, our case study reveals downstream flood mitigation benefits and infrastructure savings ranging from $744 to $1,684 per upstream developed hectare ($301 and $681/ developed acre). Clearly, downstream economic impacts should be included in any evaluation of on-site practices.