EXECUTIVE SUMMARY

Blackberry Creek Watershed Alternative Futures Analysis

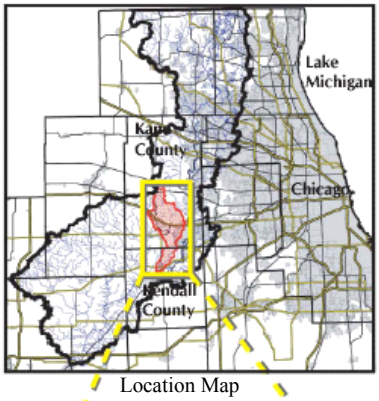
A Watershed Project Sponsored By:

Introduction and Purpose

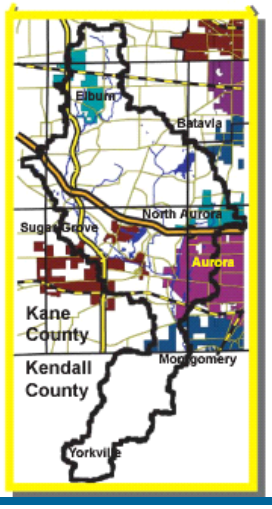
In July 1996 a major rainfall event struck northeastern Illinois. One of the most heavily impacted areas was the Blackberry Creek Watershed. The flooding and associated damage prompted formation of the Blackberry Creek Watershed Resource Planning Committee. This committee, with the assistance of numerous municipal, county, regional, state, and federal agencies, as well as private consultants, developed the Blackberry Creek Watershed Management Plan. This plan was completed in 1999 and adopted by most of the municipalities and Kane and Kendall Counties. A significant focus of the Plan's recommendations was prevention of problems as the watershed develops. In addition to increased flooding, "stakeholders" were concerned about degradation of the overall health of Blackberry Creek and the watershed's wetlands. Water quality, biological integrity, and streambank erosion were specific areas of concern.

Due to the existence of the Watershed Management Plan as well as expected growth in central Kane County, USEPA and IDNR funded an alternative futures analysis for the Blackberry Creek Watershed. The purpose of this project was to identify alternative visions for the future of the watershed and to evaluate their implications. Armed with this information, the municipalities and counties will be able to make informed decisions related to site design practices and future land uses. Kane County will be considering this information as it develops its 2030 Land Resource Management Plan and as it coordinates with municipalities on the development of stormwater management strategies.

Flooding in Blackberry Creek Watershed, July 1996



Location Map



Project Components

During scoping of this project, it was recognized that protection of the watershed's aquatic resources from both direct and indirect impacts will be essential during its transition from a largely rural watershed to a mixed rural and urban watershed. To that end, there was both a land use focus to protect the streams and wetlands from direct modifications, and a site design focus to prevent degradation of watershed hydrology and water quality upon which streams and wetlands depend. The primary components of the project were:

1. Develop model site design templates on a hypothetical 40 acre parcel for a range of land uses (commercial, three densities of residential, agriculture, as well as streams and wetlands). The focus of the urban templates was to illustrate conservation based stormwater and site design principles to preserve natural hydrologic mechanisms, minimizing changes in hydrology and water quality caused by land development. In addition to the conservation version of each template, a "conventional" version was developed. The conventional version of each template was based on current practice for site design and stormwater management that collects, conveys, and detains stormwater rather than distributes, infiltrates and retains stormwater. The stream and wetland templates illustrate management of these resources in ways that protect and improve their natural capacity to mitigate the effects of intensive land use change.

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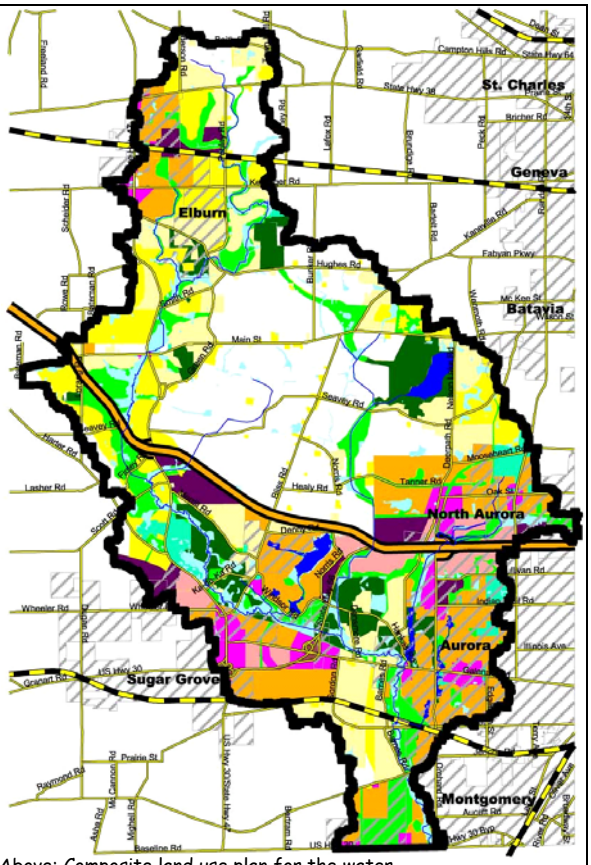
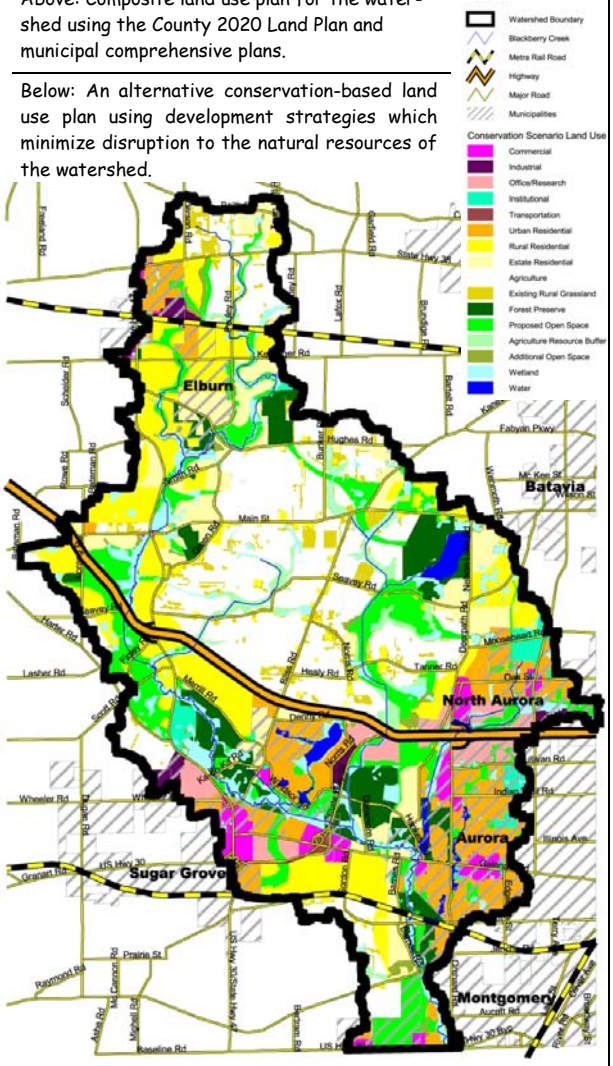
Project Components (Continued from Page 1)

2. Develop a conservation based watershed land use scenario that provides direct protection of stream and wetland resources from land disturbances. The conservation land use scenario is then contrasted with existing watershed land uses (existing conditions) and future watershed land uses based on current plans (current proposed land use plans). The conservation scenario does not significantly change the overall character of current land use plans, but demonstrates how the "green infrastructure" of streams, wetlands, floodplains, and natural drainage of the watershed can be integrated into those plans.
3. Evaluate hydrologic impact of the parcel-sized land use templates and watershed scenarios. Continuous simulation hydrologic modeling was used to determine the hydrologic response of each of the templates and to compare the response of the conventional and conservation versions of each of the templates. The value of the conservation-based templates was also evaluated at the watershed scale by comparing results at a number of evaluation points in the watershed for each of the three scenarios. The hydrologic response was characterized using a number of evaluation metrics to assess the implications of the results in terms of biological health, protection of aquatic habitat, and impacts on flooding and streambank erosion.



Above: Composite land use plan for the watershed using the County 2020 Land Plan and municipal comprehensive plans.

Below: An alternative conservation-based land use plan using development strategies which minimize disruption to the natural resources of the watershed.



Alternative Futures Evaluation

Evidence from other watersheds around the region and the Country has shown that as a watershed urbanizes, a number of changes in hydrology occur. In addition to an increase in the magnitude and frequency of flooding, a reduction in low flows between storm events also occurs. The reduced stability of hydrology associated with more frequent flood events can destroy streams and habitats through streambank erosion and deposition, and through shifts in vegetation resulting from greater water level fluctuation. The lower low flows stress aquatic insects and other organisms that live in the bottom of streams and serve as food for fish and other life on the food chain.

Site Scale Modeling Results

The hydrologic modeling performed for this project indicates that all hydrologic measures are improved under the conservation templates relative to the conventional templates of the same land use. The "flashiness" of the stream is decreased, low flows are maintained, and the magnitude of floods is decreased. As expected, the modeling also indicates that the conventional versions of the urban templates generally have less stable hydrology than an assumed existing condition of cropland. However, the conservation version of all the templates, including commercial, should be able to improve many measures of hydrologic conditions relative to conventional agriculture.

(Evaluation discussion continued on Page 6)

Recommended Best Management Practices for Development Planning and Stormwater Management

The following Best Management Practices were incorporated into the Blackberry Creek Watershed Alternative Futures Project as essential components for each Conservation Template and the watershed analysis for the Conservation Scenario.

Planning/Zoning BMPs

Conservation Development

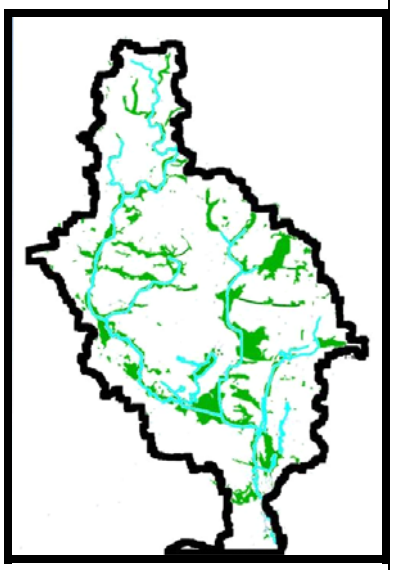
Site planning and design approaches that preserve existing natural areas, enhance habitat, utilize naturalized drainage and detention measures for stormwater management, conserve energy, and improve transportation efficiency.

Impervious Area Reduction

Impervious area reduction can be achieved in a number of ways, including use of narrower streets, shorter streets in lower density residential neighborhoods, creative driveway design, shared parking facilities, and designing roads, walkways, and trails for multiple uses as an integrated system.

Open Space/Natural Greenway

Designation of linear open spaces and/or natural areas as greenways, in order to preserve and connect significant natural features and accommodate aesthetic, recreational and/or alternative transportation uses. Floodplains, wetlands, and woodlands protected from encroachment by new development.



Conceptual Greenway Plan for the watershed to preserve floodplains, isolated wetlands, etc.

Stormwater BMPs

Bioswales

Filtration and infiltration systems planted with grasses and forbs, and designed to filter, retain and evapotranspire stormwater. Vegetation enhances filtration, cooling and cleansing of water to improve water quality and prevent sealing of subsoils. Bioswales typically include an infiltration trench below the vegetated swale to provide temporary storage to increase the volume of runoff water infiltrated.

Filter Strips/Level Spreaders

Filter strips are an area of dense, preferably native, vegetative cover used to filter and absorb runoff. Level spreaders are often used in conjunction with filter strips and laid on the contour to distribute runoff over filter strip areas. Filter strips/ level spreaders can be used within stream and wetland buffers to de-concentrate stormwater prior to discharge to streams and wetlands.

Green Roofs

Vegetated roof system designed to capture, temporarily store, and evapotranspire rainwater on the top of roofs. Green roofs are generally planted with drought and wind tolerant native vegetation. Green roofs can be designed as simple, lightweight systems primarily providing stormwater benefits or as more elaborate rooftop gardens providing outdoor space and stormwater benefits.

Naturalized Detention

Naturalized detention basins are used to temporarily store runoff and release it at a rate allowed by ordinances. Native wetland and prairie vegetation improve water quality and habitat benefits. Naturalized detention basins can be designed as either shallow marsh systems with little or no open water or as open water ponds with a wetland fringe and prairie side slopes.

Porous Pavement

Permeable or perforated paving materials with spaces that allow for the infiltration of rainwater and the transmission of water through an aggregate base to the subsoils. Runoff is temporarily stored in the base for infiltration into the sub-soils and/or slow release to a bioswale or stormwater system.

Porous Pavement adjacent to a government building

Rain Barrels/Cisterns

A vessel used to capture and temporarily store rainwater for various uses, including landscape irrigation, reuse for gray-water purposes, etc..

Rain Barrel installed on the side of a residence

Rainwater Gardens

A landscaped garden designed to retain, detain, infiltrate, and evapotranspire stormwater runoff from individual lots and roofs.

Rain Garden in front of a residence

Vegetated Swales

Vegetated stormwater features that convey, retain, infiltrate and cleanse stormwater. Native vegetation enhances filtration and retention of stormwater.

Vegetated Swale along roadside

Native Landscaping

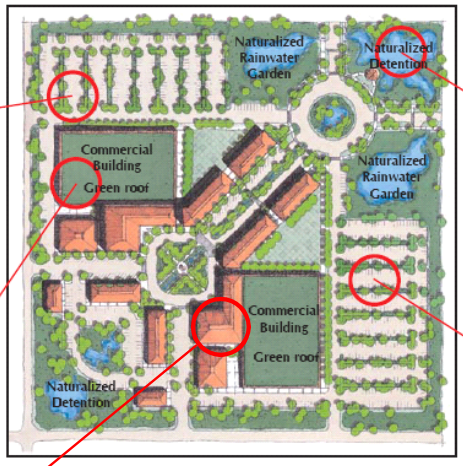
Native vegetation used in either large restoration or smaller gardening projects. Native vegetation refers to plants that were indigenous to a location prior to European settlement. Native landscaping can serve a variety of purposes including wildlife habitat and stormwater infiltration, filtering, and evapotranspiration.

Native Landscaping around a sin-gle family home

TEMPLATES USED IN WATERSHED AND PARCEL SCALE EVALUATIONS

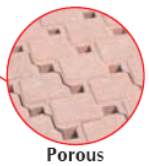
Bioswale

Green Roof



Conservation Commercial/ Industrial Template

Naturalized Detention



Porous Pavement

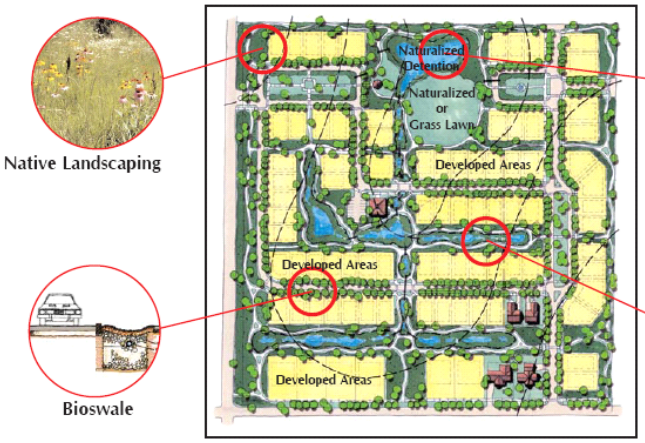
Conventional Commercial / Industrial Template

Conventional Design Features:

- Centralized detention
- Curb & gutter
- Large asphalt parking lot
- Extensive storm sewer network
- Single use development (i.e. retail, etc.)

Mixed uses within Development (i.e. offices, retail, restaurants, etc.)

TEMPLATES USED IN WATERSHED AND PARCEL SCALE EVALUATIONS

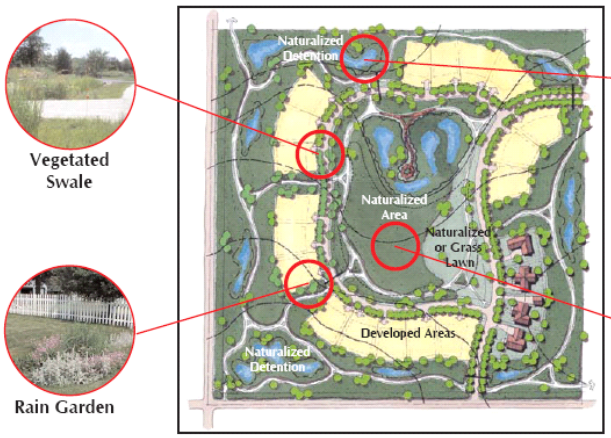


Conservation Moderate Density Residential Template

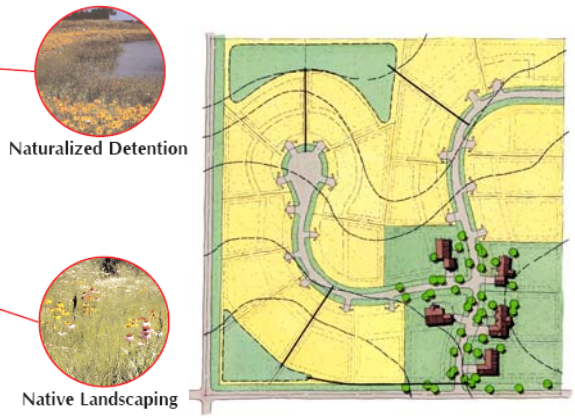
Conventional Moderate Density Residential Template

Conventional Design Features:

- Centralized detention (turf or rip rap shoreline)
- Curb & gutter on all streets
- Extensive storm sewer system
- No provisions for infiltration of runoff
- Little, if any preserved natural areas (floodplain, wetlands, woodlands, or prairie)



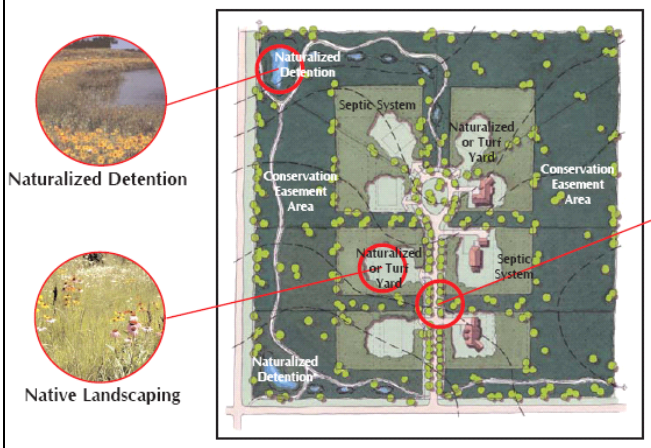
Conservation Rural Residential Template



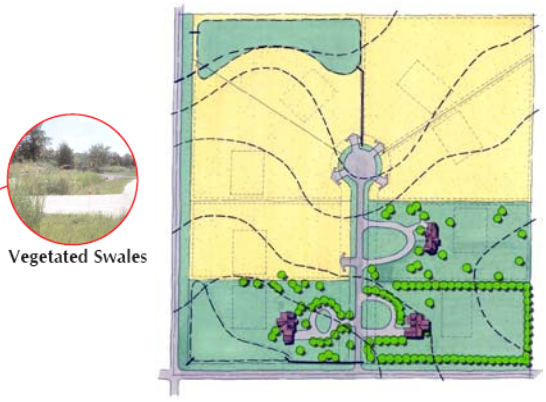
Conventional Rural Residential Template

Conventional Design Features:

- Centralized detention (turf or rip rap shoreline)
- Large turf lawns
- Mowed roadside swales
- Storm sewers from road to detention basin
- No provisions for infiltration of runoff
- Little, if any preserved natural areas (floodplain, wetlands, woodlands, or prairie)



Conservation Estate Residential Template



Conventional Estate Residential Template

Conventional Design Features:

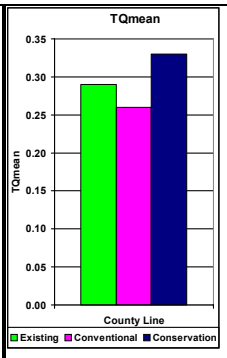
- Centralized detention (turf or rip rap shoreline)
- Large turf lawns
- Mowed roadside swales
- Storm sewer from road to detention basin
- No provisions for infiltration of runoff
- Little, if any preserved natural areas (floodplain, wetlands, woodlands, or prairie)

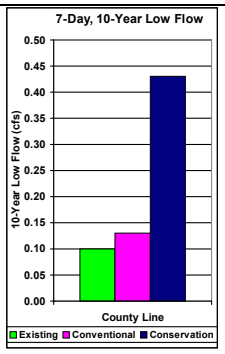
Watershed Scale Modeling Results (cont. from Page 2)

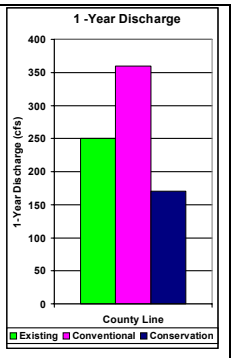
The watershed-scale scenario results are similar to the parcel-scale template results. The results show that hydrologic, physical, and biological conditions in the streams and wetlands of Blackberry Creek are likely to degrade as the watershed urbanizes based on current plans and conventional templates. Conversely, under the conservation scenario with conservation templates, hydrologic, physical, and biologic conditions have the potential to improve as conservation plans and developments are implemented. However, the results indicate that the negative impacts of conventional development and the positive impacts of conservation development are less pronounced than at the site (template) scale. This appears to be due to the mix of existing conventional and proposed conservation land uses in the conservation scenario as well as due to the moderating influence of floodplains and protected natural areas that occur in both conventional and conservation scenarios. Flooding, as measured by the 100-year flood flow, is expected to remain the same or even decrease even under the current proposed land use scenario with conventional templates due to Kane County's detention release rate standards. Under the conservation scenario with conservation templates, flooding could be expected to actually decrease. Although not a direct focus of this study, the results suggest that implementation of the conservation templates may also improve deep groundwater recharge, potentially improving the water supply for a growing population.

Conclusions

The analysis outlined in the report suggests that with proper planning and site design, Blackberry Creek and wetlands can be protected from many of the negative impacts often associated with watershed urbanization. The evaluation results for the conservation templates and scenarios are conditioned upon full implementation of the stormwater management practices outlined in the conservation templates and not just the general land use plan. Although substitution of native prairie and wetland landscaping for turf will improve hydrology, that design modification alone will not achieve the benefits identified here. It is essential that a distributed stormwater management approach that utilizes created prairie and wetland systems to filter and retain stormwater runoff be implemented if the benefits outlined here are to be achieved. Two future conditions watershed scenarios were evaluated as part of this project, although there are many other possible scenarios that could be conceived for the watershed as the County and municipalities proceed with development of 2030 land use plans. The scenario models in this study could readily be adapted to evaluate other potential scenarios and factor water resource implications into the land use decision-making process.







TQmean

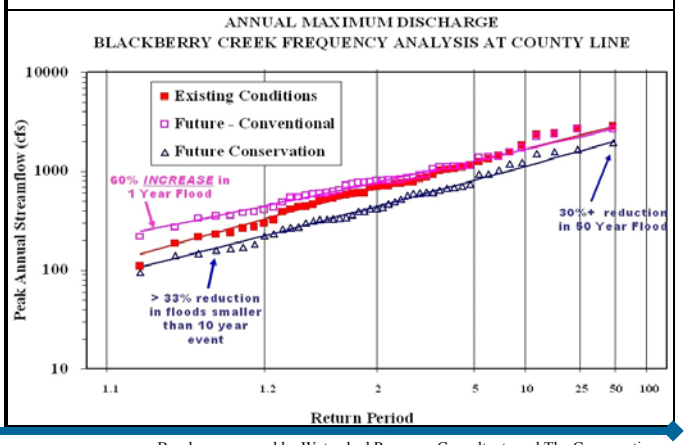
TQmean is defined as the proportion of time that the flow rate is above the average rate of the stream. The higher the TQmean value, the more stable and less "flashy" the streamflow. For gaged streams in northern Illinois, values of TQmean range from 0.19 to 0.41, indicating that flows greater than the average rate occurred from 19% to 41% of the time. The higher TQmean values were typically associated with more rural streams. As expected, the study shows that TQmean values under the conventional development scenario will be reduced, indicating that Blackberry Creek, will be subjected to shorter duration but higher intensity high flow periods, which is detrimental to the stream's habitat and ultimately its ecosystem health. Modeling of the parcel-scale templates indicates that this impact will be even more severe for the headwater tributaries of Blackberry Creek.

1-2 Year Discharge Rate

These are smaller floods that occur, on average, once every 1 to 2 years. Floods in this range have been shown to be the most significant factor in determining channel size. Thus, increases in these "channel forming" flows will lead to increases in streambank erosion and destruction of aquatic habitat. The study indicates that although the Kane County Stormwater Ordinance provides effective control for eliminating increases in the 100-year discharge after development, it is much less effective at controlling these smaller, more frequent flood flows that determine channel stability. Increases in the 1-2 year flood event were predicted to increase by more than 60% if conventional development practices are followed. Conversely, employing conservation development practices could REDUCE 1-2 year flood discharges from existing conditions by about 30%.

7-Day, 10-Year Low Flow

This is the 7-day duration low flow rate that occurs, on average, once every ten years and has a 10% chance of occurring in any one year. It is an indicator of the stream's ability to maintain baseflows during drought periods, which is vital to sustaining healthy populations of aquatic organisms. The study indicates little change in low flow rates from existing to future conventional conditions. In contrast, using conservation development techniques, the base flow could be expected to increase significantly, 100%-400% in most reaches and therefore the stream should be able to support more diverse aquatic communities at smaller watershed areas. This is a direct result of the distributed stormwater management system used in the conservation development templates that maximize stormwater retention and infiltration.



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