Integrated Stormwater & Stream Corridor Management

Balancing Challenges and Opportunities at the Community Level

Proactive local governments are replacing traditional strategies with integrated stormwater management and stream stewardship

ecosystem-based MANAGEMENT

In the 1960s, the prime protective drainage strategy was to pipe stormwater away from urban areas. In the '70s, local governments detained peak flows, while during the '80s they focused on reactive mitigation. In the early '90s, drainage professionals in the Puget Sound area began to link the cumulative impact of increased stormwater flow with fish habitat destruction. Now, proactive local governments are replacing traditional strategies with integrated stormwater management and stream stewardship.

These comprehensive science-based management approaches consider entire watersheds and their annual streamflow patterns, along with the destructive consequences of rainfall-runoff processes. They also encompass hydrological changes that result from the impervious surfaces that accompany urbanization.

To introduce this ecosystem-based approach, a community must embark on a three-step process that starts with *Master Drainage Planning* including key stakeholders and the public. The vision arising from this planning process will lead to the development of an *Integrated Stormwater Management Strategy*, and a subsequent *Master Drainage Plan* that is hydrotechnically sound, environmentally sensitive, and fiscally responsible in protecting property while sustaining natural systems and accommodating growth.

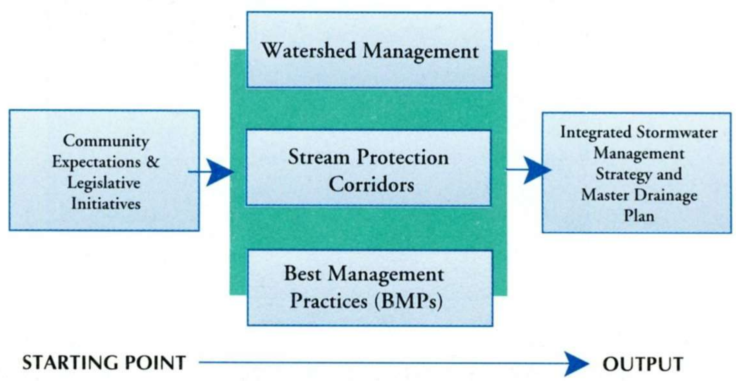
A 3-Step Approach to Ecosytem-Based Stormwater Management

For the process to be effective, the resulting Master Drainage Plan must also reflect an understanding of the relationships between watershed impervious percentage, watercourse stability, and aquatic abundance and diversity. Combined, these considerations will result in comprehensive strategies that are achievable, cost-effective, and supported by the public.

1 Embarking on a Master Drainage Planning Process

The fundamental question to answer during a Master Drainage Planning Process is, "How can the ecological values of our stream corridors and receiving waters be protected and enhanced by a Master Drainage Plan that also facilitates development and/or redevelopment?" Given this starting point, the following diagram conceptualizes the basic components of an ecosystem-based approach to stormwater management.

Master Drainage Planning Process



As shown in the illustration on pages 4 and 5, Master Drainage Planning (MDP) can be categorized in terms of one of six levels that reflect the evolution of stormwater management philosophy over the decades. The concept of MDP Levels illustrates the consequences for stream corridor ecology as a function of stormwater management objectives. Until quite recently, the approach in B.C. has been shaped by a Level 2 or 'detain peak flows' MDP philosophy that relied on hydrotechnical functions to protect property. Proactive communities are shifting to Level 3, where the emphasis is on reducing the percentages of impervious areas and building detention facilities to serve an environmental function.

2 Developing an Integrated Stormwater Management Strategy

The ultimate goal of Master Drainage Planning is to develop an Integrated Stormwater Management Strategy that considers all events comprising the annual runoff hydrograph and addresses the spectrum of runoff impacts. The purpose of the hydrotechnical components is to protect property from the dramatic impacts of extreme storms; the environmental component protects ecosystems from the insidious impacts of frequent storms.

continued from page 1

An ecosystem-based approach to integrated stormwater management is built on a hierarchical or cascading process involving provincial legislation (which provides local government with enabling tools), the municipality's Official Community Plan (which defines community goals and livability objectives), and integrated stormwater management practices (which protect both property and ecosystems). The following diagram illustrates how all factors are combined to create a long-term strategy for stream corridor protection.

3 Implementing a Master Drainage Plan

An MDP is an integral component of a local government's land-use development and growth management strategy because upstream activities have downstream consequences. Hence, an MDP is shaped by five objectives:

- To classify watercourses based on fisheries values;
- To route urban runoff from uplands areas through low-lands areas;
- To alleviate existing drainage, erosion, and flooding concerns;
- To protect major streamside resources, including riparian and aquatic habitat; and
- To remediate existing and/or potential water quality problem areas.

MDP deliverables comprise three products:

- a complete inventory of the physical system;
- a plan to protect the resources, resolve identified problems, and accommodate growth; and
- a management program that includes monitoring, education, maintenance activities, and financing sources.

These products should be developed in partnership with the community to engender public support for the master plan. Developing and implementing a customized plan to suit local government concerns, needs, means, and priorities requires systematic consensus-building to guarantee political commitment.

Regional Research Regarding Fish and Urbanization– Management Implications for Local Water Resources

by William Derry

Under the direction of the Center for Urban Water Resources at the University of Washington, a significant body of research has been completed regarding the impacts of urbanization on streams, fish, and wetlands. This research involved several graduate students and faculty, and has been described by Karr, Horner, May et al.

The research initially studied 31 sites on 19 lowland streams in the Pubet Sound Basin; additional sites and streams have now been added. The streams and sites represent a range of development intensities from nearly undisturbed watershed conditions to watersheds that are almost completely developed in residential and commercial land uses in urban areas. Watershed, stream, and riparian conditions were documented.

Research Findings

For each watershed, detailed continuous simulation hydrologic models were prepared and calibrated to rainfall and runoff data. Physical stream habitat conditions, water quality, sediment composition, sediment contamination, fish

continued on page 3

SPONSORSHIP

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British Columbia Ministry of the Environment, Lands and Parks

City of Nanaimo

Habitat Conservation Trust Fund

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continued from page 2
populations, and benthic organisms were measured and documented for each site. Stream conditions were compared to watershed conditions. **The findings clearly demonstrated that the most important impacts of urbanization on streams, in order of importance, are:**

- **changes in hydrology;**
- **changes in riparian corridor;**
- **changes in physical habitat within the stream, and**
- **water quality.**

In any given watershed or at any given site, any of these factors can limit biologic health. Recent work by Karr and Morley (unpublished) demonstrates the importance of healthy riparian corridors. In side-by-side watershed comparisons, the presence or absence of riparian forest greatly affects the stream's biologic integrity in otherwise similar watersheds with similar total impervious area. A healthy, forested riparian corridor can partially compensate for impervious surfaces. In contrast, a cleared riparian corridor results in a damaged stream even in a watershed with low impervious area.

Another significant finding is that the density of road networks also provides an excellent way to closely track total impervious area as an indicator of impacts. This is because of the drainage system pattern associated with nearly all roads. Drainage ditches collect surface and shallow groundwater and transport it immediately to streams. Resulting changes in stream-system hydrology are similar to the effect of increased impervious surface.

Building a Knowledge Base

Do we know everything that's important? No. Do we know enough to do better? Yes. What we know the most about is how to protect the living systems of streams and rivers that constitute the best salmon habitat. We know less about how to develop the landscape to maintain that habitat and ecosystem health. And we know very little about how to restore damaged water systems in urbanized watersheds within the context of political and financial realities. Any proposed actions to restore urban watersheds, therefore, must be tempered with realistic expectations and balanced with sufficient investments.

We also know that salmon need estuarine, near-shore marine, and ocean habitats, but those issues are beyond the scope of this article. The larger concern is the impacts of urbanization on salmon in the regional landscape. Urbanization starts with forest clearing and low-density development beyond cities and continues with increasing intensities of land use. Therefore, the recommended solutions also extend beyond city boundaries.

Developing Guidelines

Based on our current knowledge of the science of watershed management, certain guidelines can be identified. Goals must be established in each watershed and across the region based on the value of stream resources, the character of the land use in the watershed, and community values. We must understand the current condition of the watershed's salmon-supporting habitat, what is possible in terms of protection and restoration, and what our long-term commitment is to protecting healthy areas and restoring what has been damaged.

Most importantly, watersheds that currently support wild salmon populations or that have the potential to support them must be protected. In these watersheds, constraints to aggregate development across the watershed include:

- maintaining effective impervious surfaces close to zero;
- infiltrating or reusing runoff from developed areas;
- retaining significant forest cover across the watershed, for which numerical hydrologic modeling suggests that 60% to 70% is a minimum amount; and
- maintaining broad buffers of undisturbed native vegetation for a substantial majority of the overall length of the riparian corridor.

These criteria are not interchangeable; all are necessary. Yet these constraints likely conflict with density requirements for urban areas and, in general, probably cannot be achieved inside urban areas. Most such watersheds in urban areas no longer meet these criteria. If development is to continue in watersheds supporting wild salmon, we need to develop so that small and even moderate-sized storms produce no runoff, even from paved areas. To meet this goal, we must gain additional experience in achieving better infiltration or reuse of stormwater. 'Zero-discharge development' is relatively easy for residential land use with appropriate soils. For the more prevalent areas with soil limitations, however, additional experience is needed to ensure success.

For watersheds entirely within urban areas, watershed management goals must be established by the community through a watershed planning process that supports the presence of a healthy, living, natural system, even if salmon use is limited. Urban streams do have tremendous value; they may support rich aquatic biological communities, including benthic invertebrates and fish. They provide open space, aesthetic and educational benefits, and an enhanced sense of local community. In already-urbanized areas, accomplishing this alternative set of goals requires an effective management program that:

- addresses the hydrological impacts of development;
- protects riparian corridors;
- restores physical habitat; and
- improves water quality.

Our current state of knowledge indicates that biological health tends to decline inexorably as urbanization increases, despite our best efforts to avoid degradation. Cities with highly-productive wild salmon populations may need to consider maintaining rural densities in certain watersheds if they seek to maintain those populations.

In Closing . . .

The underlying premise of this article, and the motivation for many individuals working in this field is that self-sustaining populations of wild salmon are a regional resource that must be protected. To achieve this level of protection, it is essential we preserve the remaining healthy aquatic ecosystems and the processes that create them. Yet the potential for true restoration of this resource in urban watersheds is limited. This inescapable condition requires that alternative and feasible restoration goals and investments be selected for such watersheds. These should be local decisions based on community values, but urban areas must also protect water quality, control erosion, and limit the flooding potential of areas farther downstream. Their citizens must also participate financially in a regional approach to preserving the best remaining freshwater salmon habitat wherever it is found. Without this commitment, there is little possibility of long-term success.

BIOGRAPHY

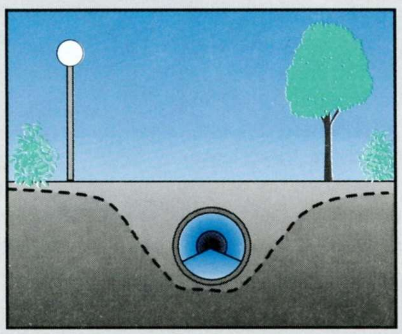
Bill Derry, senior consultant with CH2M Hill Inc. in Seattle, has more than 25 years experience in utility management and the development of research and regulatory programs involving surface and stormwater. He has collaborated with CH2M's Kim Stephens to provide workshops for B.C. municipalities promoting an ecosystem approach to stormwater management.

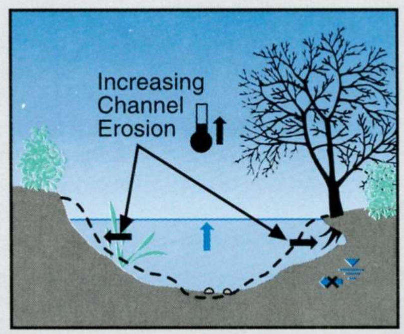
ALTERNATIVE VISIONS FOR LONG-TERM ENV

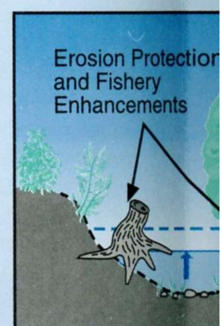
Conceptual Framework for Selection o

PLANNING LEVEL	1	2	3
GOAL OF MASTER DRAINAGE PLAN	**Protect Property** (1970's approach)	**Mitigate Major Storms** ('70's & '80's approach)	**Preser Aquatic H** (1990's app
Guiding Philosophy	To provide basic drainage servicing for peak flow conveyance and discharge to the nearest receiving water	To provide detention storage for major events to maintain peak discharge rates at pre-development levels	To implement BMPs that velopment effects by at l existing conditions in str there is no further loss o and abundance
Strategic Objectives	• Construct efficient drainage network to protect property and minimize inconvenience • Focus on peak flows and drainage risk • Analyse major/minor flow paths	Those for Level 1, plus • Protect creek corridors from development • Attenuate peak flows for major events only	Those for Level 2, plus • Maintain the effective imp pre-development levels • Improve stormwater qualit • Consider protective measu high natural resource valu

Condition of Stream Corridors







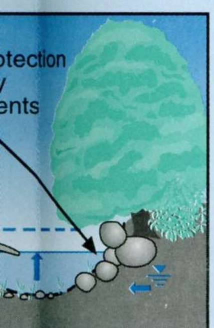
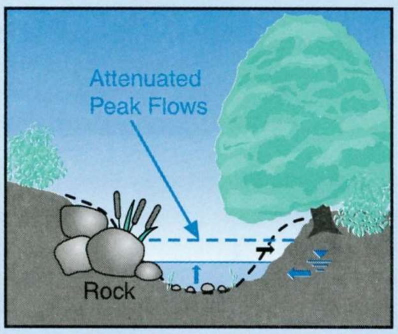
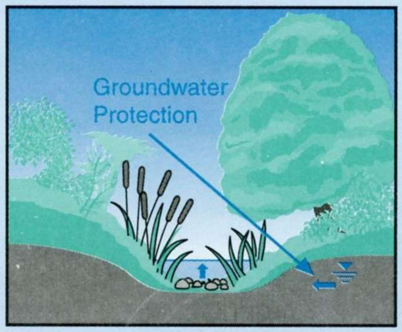
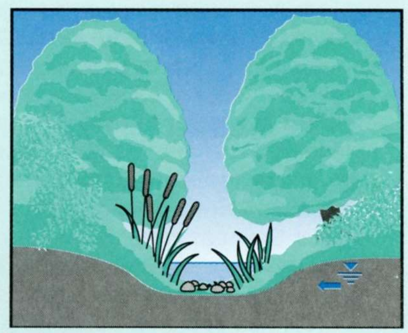
	1	2	3
Biodiversity and Abundance	**ELIMINATED** ◀	**DECREASED** ◀	**NO FUR LOS**
Hydrotechnical Management Practices	• Standard storm sewer design • Standard culvert design	Those for Level 1, plus: • Leave strips • Project detention ponds • Community detention ponds • Amour eroding creek sections	Those for Level 2, plus: • Source infiltration and attenua • First level source quality contr • Creek bypasses • Retrofit existing ponds for frec and settling • Selected practices from the ne opportunities exist
Environmental & Social Management Practices		• Minimal public information	Those for Level 2, plus: • Selected practices from th where opportunities exist • Public education
Impact on Aquatic Habitat	• Increased peak flow for all events • Lower base flows • Greater erosion and sediment loads • Pollution • Water temperature rises	• Insidious erosion during frequent events • Water temperature may rise further • Loss of riparian habitat in armoured areas • Damage from frequent events reduced to natural levels • Possible reduction in peak flows for frequent events	• Prevents worsening of cre redevelopment • Protects and enhances ha areas of the creek system temperature, pollutant, ar regimes)

COMMUNITY VISION — **NO LONGER ACCEPTABLE**

Affordability Thresho

NVIRONMENTAL STREAM CORRIDOR HEALTH

n of Master Drainage Plan (MDP) Level

3	4	5	6
eserve ic Habitat approach)	**Improve Aquatic Habitat**	**Restore Aquatic Habitat**	**Restore Entire Watershed**
IPs that mitigate rede- s by at least maintaining ns in stream corridors so r loss of biodiversity	To implement BMPs that compensate for redevelopment effects by improving stream corridor conditions so that biodiversity and abundance is enhanced	To implement BMPs in conjunction with the restoration of habitat in stream corridors so that biodiversity and abundance is increased	To implement BMPs and return stream corridors to a pristine condition so that biodiversity and abundance is fully restored
lus ctive impervious area at levels ter quality ve measures for areas of rce value	Those for Level 3, plus: • Reduce the effective impervious area from pre-development levels • Attenuate peak flows for frequent events • Provide primary treatment of stormwater	Those for Level 4, plus: • Severely restrict the effective impervious area after redevelopment • Provide enhanced treatment of stormwater	Those for Level 5, plus: • Reduce the effective impervious area to zero after redevelopment • Eliminate stormwater pollution
			
FURTHER LOSS	**ENHANCED**	**INCREASED**	**FULLY RESTORED**
us: d attenuation techniques lity controls ds for frequent event attenuation m the next 2 levels where	Those for Level 3, plus • Community infiltration facilities • Primary treatment (settling ponds) • Modified/additional detention ponds • Baseflow augmentation	Those for Level 4, plus: • Secondary and tertiary treatment (biological & filtration) • Real-time stormwater flow control • Combined sewers • Pervious pavement	Those for Level 5, plus: • Technologies not yet developed
plus from the next two levels es exist	Those for Level 3, plus: • Limit human activity in some areas • Promote public volunteer enhancement (stream surveys, trash removal, placement of habitat structure, and revegetation) • Reduce existing impervious surfaces	Those for Level 4, plus: • Severely restrict human activity in creek corridors • Promote native vegetation buffers along water bodies • Enforce strict source controls - banning phosphorous detergents, eliminating copper zinc in automotive products, restricting fertilizer types and applications	
g of creek conditions due to nces habitat in selected system (more natural flow, tant, and sediment	• Allows more natural flow, temperature, pollutant, and sediment regimes • Supports hatchery fish stock and possibly some wild populations	• Allows reasonably natural flow, temperature, pollutant, and sediment regimes • Supports the full life cycle of some limited wild fish stocks	• Supports the full cycle of all fish stocks that naturally occurred prior to initial settlement and development

RETROFIT STREAM STEWARDSHIP — **NOT ACHIEVABLE**

reshold? (Community willingness to pay)

Implementing Ecosystem-Based Stormwater Management in B.C.

by Kim A. Stephens

The 21st century is less than a year away. And with the new millennium will come the implementation of a new approach to stormwater management in B.C. The holistic philosophy underpinning this 'new approach' has taken root in a number of communities throughout the province over the past two years. Cities such as Kelowna, North Vancouver, Nanaimo, Surrey, and Burnaby have embraced an environmental approach to Master Drainage Planning to help achieve their OCP visions for sustainable environments. In the next few years, we should begin to see more fruits of the pioneering efforts of those promoting a paradigm-shift in the way we view stormwater management.

Evolution of Drainage Planning Philosophy

In the early 1970s, there was a major breakthrough in contemporary drainage planning philosophy. Drainage engineers realized that upstream activities have downstream impacts. Concerns over watercourse stability and capacity prompted the requirement for stormwater detention facilities in new subdivisions. This represented a departure from past practice, as the historical approach to urban drainage design was simply to collect stormwater runoff in a system of buried pipes and remove it from the drainage basin as rapidly as possible.

More than two decades after the initial breakthrough in drainage planning, society's concern for the environment has resulted in another turning point in the evolution of drainage planning philosophy. As we approach the millennium, there is growing recognition that local goverments should develop Integrated Stormwater Management Strategies and subsequent Master Drainage Plans that protect property and allow economic land use, while sustaining natural systems. We often call this 'stream stewardship'.

This new approach builds on Washington State research and experience (see page 2). It is described as an 'ecosystem-based approach' because it views ecosystem components and functions in a broad context integrating environmental, economic, and social concerns. It is also described as 'integrated stormwater and stream corridor management'.

Integrated Stormwater and Stream Corridor Management

Changes in land use outside a designated stream corridor can result in a progressive loss of biodiversity and abundance within the corridor. This underscores the importance of a holistic approach that emphasizes protecting receiving waters through the application of affordable and effective BMPs (Best Management Practices) in the surrounding watershed. To select appropriate BMPs, you must first identify resources to be protected, threats to those resources, and alternative BMPs.

By definition, integrated stormwater management considers all rainfall events that comprise the annual runoff hydrograph, and comprises two distinct components – the hydrotechnical component, which includes dramatic flood impacts associated with infrequent large storms, and the environmental (or enhanced hydrotechnical) component, which addresses the insidious impacts of frequent small storms on stream-corridor ecology.

Factors Limiting the Ecological Values of Urban Streams

Studies of urban streams by the Center for Urban Water Resources Management at the University of Washington have determined that changes in hydrology, disturbance of the riparian corridor, disturbance of aquatic habitat, and deterioration of water quality are primary factors affecting the ecological values of urban streams. Understanding these factors (and their inter-relationships) enables the development of guiding principles for an ecosystem-based approach to stormwater and stream corridor management. These factors provide a 'roadmap' for crystallizing scenarios that correspond to various levels of environmental protection, specific objectives to achieve the results, measurable criteria to test achievement, and actions needed to achieve the desired results.

Significantly, changes in hydrology are paramount because the consequences of those changes progressively manifest themselves in the disturbance of riparian and aquatic habitat, and in the deterioration of water quality. Furthermore, changes in hydrology correlate directly with the percentage of impervious surface area.

Achieving the goal of sustaining aquatic systems, therefore, means implementing measures that maintain or even reduce the TIA (Total Impervious Area) below a threshold level. These measures could comprise a combination of on-site stormwater detention, on-site impervious area reduction, flow diversion around high-value creek reaches, and regional detention.

Developing an Integrated Stormwater Management Strategy

Developing and implementing a holistic Integrated Stormwater Management Strategy that addresses all four limiting factors – changes in hydrology, disturbance of the riparian corridor, disturbance of aquatic habitat, and deterioration of water quality – requires a thorough understanding of the above-mentioned concepts and the consequences for stream corridor ecology as illustrated on pages 4 and 5. In addition to capturing the evolution of drainage planning over the decades, the levels outlined in this MDP tool represent a significant advancement in stormwater management as they provide a framework for defining strategic objectives and identifying the BMPs needed to achieve them.

An ecosystem-based strategy integrates component plans for flood risk management and environmental risk management. The purpose of the former is to protect property by ensuring that the 'design flood' can be contained by creek channels and passed by culverts, whereas the latter protects stream corridor ecosystems from being degraded by the insidious consequences of frequently-occurring small storms.

Ensuring that the integrated strategy is realistic and supported by the community requires an understanding of what may be achievable in terms of environmental protection. This is where the Washington State experience takes on real significance.

BIOGRAPHY **Kim Stephens, vice-president of CH2M Gore & Storrie Ltd. in Canada, first introduced the concept of an 'environmental approach' to master drainage planning to B.C. in 1991. Since then, he's continued to refine this approach. Over the past two years, he and Bill Derry (of CH2M in Seattle) have stimulated and influenced discussion in B.C. regarding an ecosystem-based approach to stormwater management. Together they have guided a number of municipalities away from the 'big pipe' approach.**

7

Green Infrastructure for Smarter Urban Landscapes

by Patrick Condon

We suggest that what the cell is to the body, the site is to the region. Individually-developed sites and the infrastructure needed to serve them consume the bulk of our urban landscapes. Solutions to urban problems, therefore, must begin and end at those individual sites. This is particularly true for water quality.

Using Charrettes to Design Sustainable Urban Landscapes

Planners, architects, and landscape architects use design charrettes to address urban design issues of social and civic importance in creative yet feasible ways.
A charrette is a design activity where participants are assigned a complicated design project and are expected to bring it as close to completion as possible in a short time. There are three types of charrettes: 1) those that test new public policies or design ideas on real sites, 2) those that respond to requests for help from neighbourhood groups or government agencies, and 3) those that initiate unsolicited proposals for a glaring problem or opportunity presented by a specific site.

Last September, for example, a UBC charrette combined all three types to test government policies on an underdeveloped site at the request of the City of Surrey. Four competing teams of students, led by design professionals, developed different design solutions for a new town site. The resulting designs conformed with proactive local, provincial, and national policies that are emerging to promote sustainable development. Because UBC's charrette program requirements are closely linked to existing laws and policies (e.g. the *Growth Management Strategies Act*), they don't express an abstract ideal, but rather illustrate how a community built in conformance with these policies should look.

Design Principles for Sustainable Communities

Design charrettes have helped us identify planning and design principles for sustainable communities. Ideally, there should be:

- five-minute walking distance to transit and commercial services;
- different dwelling types in the same neighbourhood and even on the same street;
- detached dwellings that present a friendly face to the street;
- car storage and services handled at the rear of the dwellings on lane;
- an interconnected street system;
- narrow streets with lighter construction; and
- natural drainage systems where surface drainage infiltrates back into the soil.

Specific to drainage, we have a two-thousand year tradition of engineering our storm drain systems to shed rather than absorb water. The consequences of this are disastrous, both ecologically and economically. UBC and BC Hydro research supports the following engineering standards to reverse this trend:

- reduced road width;
- curbless streets;
- graded sites to absorb rather than shed water;
- grass swales for stormwater conveyance rather than subsurface storm drains;
- crushed stone parking strips and rear lanes to increase permeability;
- retention of natural streams to serve as destinations for stormwater and as a recreational and habitat resource; and
- the use of community facilities such as ball parks as the 'kidneys' of the community where non-point source pollution would naturally be sequestered in the soil prior to discharge into the stream.

Other recommendations for sustainable communities are to:

- design neighbourhoods with a gross density of 13 or more dwelling units per acre;
- preserve all natural water courses and, in some cases, create new ones;
- locate bicycle and pedestrian paths along streams;
- provide electric services from poles located in lanes;
- provide narrow building lots, but allow one to three units on each lot;
- provide outdoor space for each unit; and
- provide an interconnected street system so every trip is via the shortest practical route.

Community Benefits

If these principles are adhered to, a community can expect to experience the following social, economic, and ecological benefits:

- more efficient land use;
- a 35 to 40 percent reduction in the cost of a typical dwelling unit;
- a 75 percent reduction in per-dwelling-unit cost for neighbourhood streets and utilities;
- economically-viable neighbourhoods and transit systems;
- preserved access to natural systems for all residents;
- a 30 to 50 percent reduction in per-capita production of greenhouse gases; and
- increased protection of habitats and water quality.

BIOGRAPHY

Patrick Condon, UBC's Chair of Landscape and Livable Environments, has been published widely and has lectured at many North American universities on topics ranging from sustainable community design to landscape space perception theory. As Chair, he has organized a series of design charrettes for sustainable urban landscapes, and developed alternative development standards for sustainable communities. Patrick is a partner in the firm of Moriarty/Condon Ltd.

Stormwater Management and the *Municipal Act*

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by Eric Karlsen

Experience tells us that legislation often follows practice, but in this case the *Municipal Act* enables local governments to address stormwater management much more comprehensively than current practice. The challenge ahead is to use this legislation to achieve comprehensive goals and objectives in appropriate and effective ways.

Key *Municipal Act* Planning, Regulation, and Development Approval Provisions Applicable to Stormwater Management

Prohibition of Pollution

Section 551 enables local governments to enact bylaws prohibiting water pollution and to impose penalties for contravening prohibitions.

Soil Deposit and Removal

Section 723 enables local governments to include erosion control and sediment retention requirements associated with soil removal and deposit. The *Soil Conservation Act* also gives local governments permitting authority for soil removal and the placing of fill (Section 2 (1)(b).

Regional Growth Strategy and Official Community Plan Goals

Section 849 (2) provides goal statements for:

- protecting environmentally-sensitive areas;
- maintaining the integrity of a secure and productive resource base, including agricultural and forest land reserves;
- reducing and preventing air, land, and water pollution; and
- protecting the quality and quantity of groundwater and surface water.

Environmental Policies

Section 879 enables official community plans to include "policies of the local government relating to the preservation, protection and enhancement of the natural environment, its ecosystems and biological diversity." Development approval information areas or circumstances (Section 879.1) enable the designation of areas or circumstances, or areas for which in specified circumstances, development approval information may be required.

Capital and Regulatory Programs

Section 884 states that capital (works) and regulatory (bylaw) programs of a local government "must be consistent with the relevant plan".

Zoning

Section 903 states that land uses which, for instance, generate NPS (non-point source) pollution, can be prohibited or regulated.

Drainage Control

Section 907 enables local governments to set maximum percentages of areas that can be covered by impermeable material and to make requirements for ongoing drainage management.

Landscaping

Section 909 enables local governments to set standards for and regulate the provision of landscaping for the purposes of preserving, protecting, or restoring and enhancing the natural environment (e.g. requiring streamside vegetation).

Farm Bylaws

As outlined in Section 917, farm bylaws are subject to the approval of the minister, who is responsible for the administration of the *Farm Practices* (Right to Farm) *Act*. A local government may make bylaws in relation to farming areas respecting farm operations.

Development Permit Areas

Development permit areas designated under Section 879 cannot be altered, subdivided, or built on without a development permit. The permit can contain conditions for the protection of the environment.

Subdivision Servicing Requirements

Section 938 enables a local government to "require that, within a subdivision" ... "a drainage collection or a drainage management system be provided, located and constructed in accordance with the standards established in the bylaw".

Applications

Local governments have extensive and very specific tools available to them. They also have the discretion to use them or not. With this in mind, the topic of 'applications' is perhaps best handled by asking the questions, "What do governments and others want to achieve with respect to stormwater and stream corridor management?", and "How can this 'set' of interests be integrated with other sets of interests?".

Legal counsel should be consulted on specific applications of legislation described in this summary.

BIOGRAPHY

Erik Karlsen – Director of Special Projects for the Ministry of Municipal Affairs' Growth Stategies Office – is currently involved in the development of streamside policy guidelines under the *Fish Protection Act*. Erik's experience in local government planning and a range of regional planning, community planning, and sustainability initiatives span 30 years.