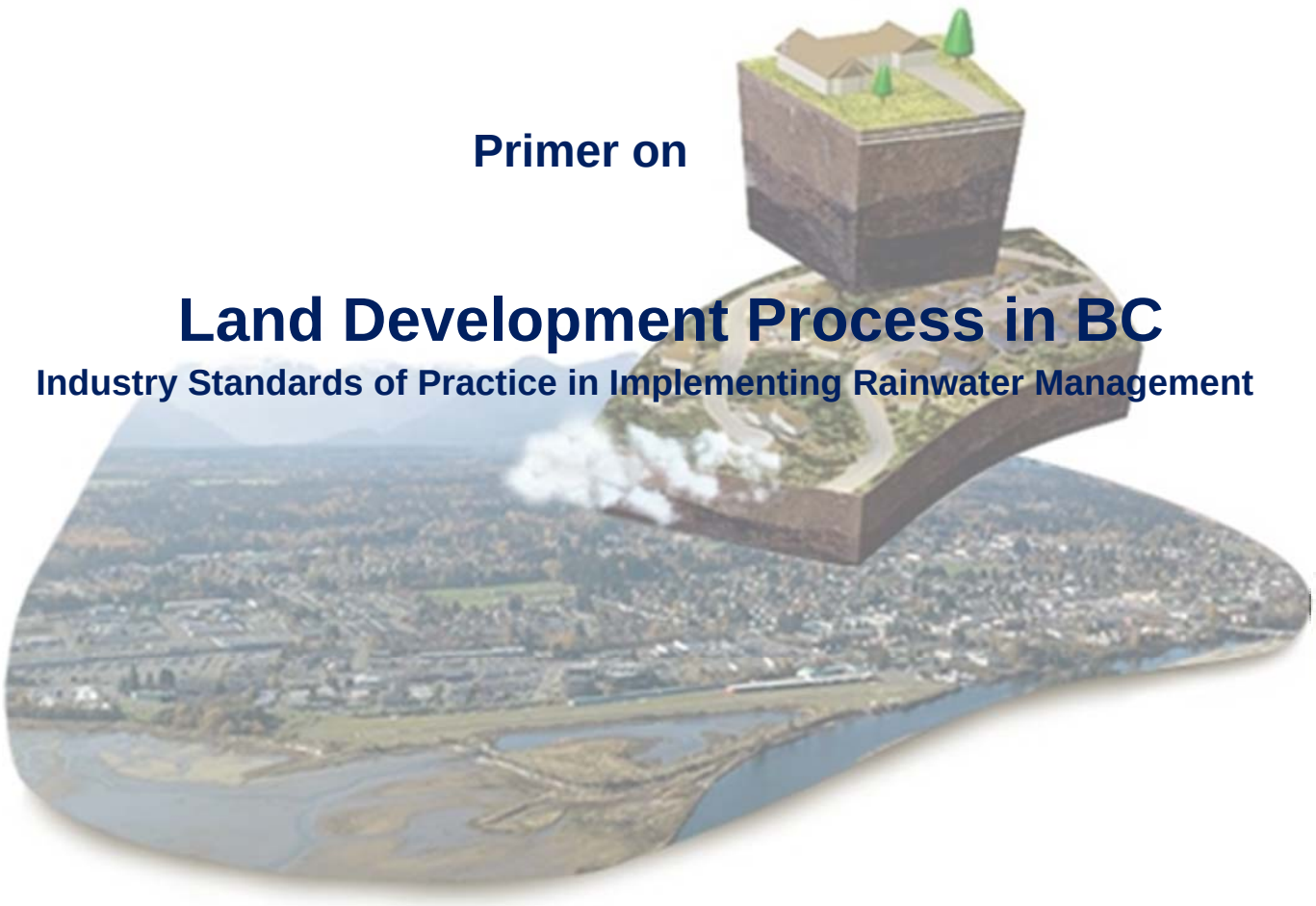
the partnership
for water sustainability in bc
IREI - Inter-Regional Education Initiative



## Primer on

# Land Development Process in BC

### Industry Standards of Practice in Implementing Rainwater Management

Integrating the Site with the
Watershed, Stream and Aquifer

**First Release for Comment:** September 2013

An initiative under the umbrella of the Water Sustainability Action Plan for British Columbia

# About This Primer

*Rainwater management must be a key consideration in urban development and redevelopment. Provincial direction is to mimic the natural Water Balance to protect stream and watershed health. This is the "designing with nature" strategy.*

*This Primer supports implementation of targets and actions listed in "Living Water Smart: British Columbia's Water Plan". The targets and actions establish expectations as to how land will be (re)developed:*

- *The focus of the Primer is on the steps in the Land Development Process. The Primer provides both context and general guidance. Table 1 presents a section-by-section synopsis of the Primer storyline.*
- *The Primer is a "bridging document" because it illustrates how to seamlessly integrate the legal and administrative parts of the Land Development Process through the designing with nature and rainwater management lens.*
- *Target audiences include local government staff, land developers and design professionals who are implementing rainwater management systems at the site, subdivision, neighbourhood or community scales.*

*While much attention is given to the technical and legal aspects, we are not aware of anyone who has addressed administration. At the heart of the Primer, then, is the discussion at the end of Section 6 about Administrative Process Requirements. This piece of the puzzle is the key to implementation of effective rainwater management systems on private property.*

*The Primer is the fourth in a series of guidance documents that form the basis for knowledge-transfer via the Georgia Basin Inter-Regional Education Initiative (IREI). The foundation document for the series is* **Stormwater Planning: A Guidebook for British Columbia**, *released in 2002.*

*The Primer will assist practitioners whose work addresses land subdivision concerns. The Partnership invites comments and suggestions on this first version of the Primer, which we will update in the future to reflect feedback.*

*Tim Pringle*
*President*
*Partnership for Water Sustainability in BC*
*September 2013*

# Table 1 – Synopsis of the Primer Storyline

**ABSTRACT:** The purpose of this Primer is to add depth to *Stormwater Planning: A Guidebook for British Columbia*. The Primer describes the Land Development Process, with a specific focus on the roles and responsibilities of those who are involved in implementing industry standards of practice. The Primer explains how local government can implement rainwater management systems that mimic the natural Water Balance. The Primer then identifies administrative options to achieve this desired outcome.

| | Section Title | Content Highlights |
|---|---|---|
| 1 | **Regulatory Context for Rainwater Management** | Introduces provincial expectations for rainwater management, and highlights the need to align roles and responsibilities in the land development setting in order to achieve desired outcomes at a watershed scale. |
| 2 | **Scope of Primer** | Explains that Land Development involves a series of distinct and separate process steps, with the rainwater management challenge being the need to bridge the gap between Land Subdivision and Building Construction. |
| 3 | **Land Subdivision Process Explained** | Describes the regulatory and approval processes that affect the standards for design and construction, and elaborates on these four topics: land use zoning, subdivision, bare land strata, and results of subdivision. |
| 4 | **Standard Consulting Roles Explained** | Elaborates on the three distinct steps in the Land Development Process (i.e. rezoning, subdivision, and design and construction); and explains why and how the roles of professionals are different during each step. |
| 5 | **Subdivision Design Standards & Drainage** | Provides detailed information on the regulatory requirements governing technical matters and business practices that form expectations and scope of work for all those involved in the Land Development Process. |
| 6 | **Implementing Rainwater Management** | Provides comprehensive guidance on how to achieve a balance of enforceable regulation that, through Bylaws and an Administrative Process, results in a bridge from Land Subdivision to Building Construction. |
| 7 | **Conclusions** | Extracts the highlights from each of Sections 2 through 6 in order to provide the reader with a concise and consolidated summary of what is important to remember. |
| 8 | **References** | Provides a starting point for interested readers to learn more about the Beyond the Guidebook Primer Series. |

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# 1. Regulatory Context for Rainwater Management

With release of *Stormwater Planning: A Guidebook for British Columbia* in 2002, BC was the first provincial or state government in North America to adopt the Water Balance Methodology. The methodology enables local governments to establish performance targets for land use. The goal is to protect watershed and stream health.

## The Goal: Mimic Natural Water Balance and Protect Water Quality

Protection of watershed and stream health ultimately involves maintaining the natural proportion of rainwater entering streams via three pathways: surface flow, interflow, and groundwater flow. This desired outcome is described as "mimicking the natural Water Balance."

Achieving this outcome following land development depends on a clear delineation and common understanding of expectations, roles and responsibilities of those involved in the Land Development Process. This requires a seamless progression from Rezoning through to Land Subdivision and Building Construction.

***Context:*** This Primer adds depth to the Guidebook. The focus is on how local government can implement rainwater management systems that mimic the natural Water Balance. The Primer:

- Addresses the existing disconnect between the Land Subdivision and Building Construction steps in the Land Development Process; and
- Is written as a "bridging document" in order to illustrate how to seamlessly integrate the legal and administrative parts of the Land Development Process.

The Primer identifies administrative options and provides general guidance for aligning roles and responsibilities in the land development setting.

## Move from Awareness to Action

"There is a knowledge vacuum in BC and this has resulted in a gap between awareness of what needs to be done, and the capability of local government staffs and others to implement standards of practice that will ultimately achieve the goal of mimicking the natural Water Balance following development" states Jim Dumont, Engineering Applications Authority for the *Partnership for Water Sustainability in BC*.

"The land development sector is experiencing the consequences of the demographic shift that is occurring society-wide. There is staff turnover; and long-term experience and wisdom is not being passed on to the next generation. Increasingly, it seems that few administrative staff and even fewer members of the general public really understand the land development process."

"Before we can even begin to look at solutions we need to recognize the knowledge vacuum and provide information to fill it. When there is a knowledge base, then solutions are much easier to implement. To fill this educational need, the goal of the Land Development Primer is to provide practitioners with an understanding of the legal and administrative framework for land development."

***Beyond the Guidebook:*** Launched in 2007, "Beyond the Guidebook" is an ongoing initiative. Implementation is under the umbrella of the *Water Sustainability Action Plan for BC*, with delivery led by the Partnership for Water Sustainability.

This Primer is the fourth guidance document in the "Beyond the Guidebook Primer Series" (refer to Section 8 for details). The Partnership's purpose in developing the Primers is to inform and educate infrastructure, land use and environmental professionals about core concepts related to implementing actions at the site scale that will achieve desired outcomes at the watershed scale.

# 2. Scope of this Primer

The target audiences for this Primer include local government staff, land developers and design professionals who are implementing rainwater management systems at the site, subdivision, neighbourhood or community scales.

Other audiences would also find the Primer informative because the Primer provides a broad understanding of 'what you need to know' about how to align roles and responsibilities to implement rainwater management infrastructure.

## Educational Objectives

The scope of the Primer is to provide both context and general guidance because rainwater management is a key consideration in urban development and redevelopment projects.

In BC, there is a strong awareness of the connection between rainwater management and watershed health and protection. Accordingly, development projects commonly use rainwater practices that reduce or eliminate rainwater runoff in order to protect streams and habitats.

***Understand the Land Development Process:*** This Primer describes the Land Development Process, with a specific focus on the roles and responsibilities of those who are involved in implementing industry standards of practice.

This background information is necessary to understand how these processes and roles may need to be altered to allow new development standards that provide for rainwater management and environmental mitigation.

Much attention is given to the technical and legal parts of the Land Development Process. This Primer fills a gap by addressing the administrative part of the process.

## Land Development Process has Distinct and Separate Steps

The Land Development Process is comprised of a series of distinct and separate steps. The people and their roles change significantly as the process moves from the first step of land use rezoning through the creation of the subdivision and finally to constructing the dwellings on individual sites for occupation and use.

It is the change of the roles and responsibilities that occurs during the process of land development that needs to be understood in order to implement rainwater management systems that successfully mimic the Water Balance.

A new set of processes is required to allow successful implementation. This need is the focus of this Primer.

***Bridge from Land Subdivision to Building Construction:*** Inclusion of rainwater management can be a complex regulatory issue in light of how land development occurs and the responsibilities of the individuals and firms which are a part of the process.

The Land Development Process requires a balance of enforceable regulation provided through Bylaws and an Administrative process that would allow a bridge to be formed between the Subdivision and Building Construction steps of land development.

***Role of the Approving Officer:*** This Primer touches lightly on the role of the Approving Officer because the Primer is mainly concerned with the nature of the Land Development Process, whether it be rural or urban / suburban. A key distinction is the part that the Ministry of Transportation and Infrastructure (MOTI) plays in electoral areas of regional districts vis-à-vis subdivision approval.

## About the Primer Storyline

To achieve the educational objectives, the balance of the Primer is organized in five sections: Sections 3 and 4 provide context; Sections 5 and 6 provide guidance; and Section 7 consolidates what is important to know.

Section 8 summarizes the Beyond the Guidebook Primer Series, and illustrates the Water Balance.

***Land Subdivision Process Explained:*** Section 3 describes the regulatory and approval processes that affect the standards for design and construction, and elaborates on these four topics: land use zoning, subdivision, bare land strata, and results of subdivision.

Section 3 notes that the differences between urban and rural subdivisions relate to the regulatory and approval processes that affect the standards for design and construction.

***Standard Consulting Roles Defined:*** Section 4 elaborates on the three distinct steps in the Land Development Process (i.e. rezoning, subdivision, and design and construction); and explains why and how the roles of professionals are different during each step.

The roles of Developer, Development Planner and Development Engineer are discussed. A key message in Section 4 is that individuals and firms have very defined and also limited roles and responsibilities.

Together, Sections 3 and 4 provide a concise overview of the administrative part of the Land Development Process. This provides the background and intellectual foundation for the "how to implement rainwater management" guidance that follows in Sections 5 and 6.

***Subdivision Design Standards and Drainage:*** Section 5 provides detailed information on the regulatory requirements governing technical matters and business practices that form expectations and scope of work for all those involved in the Land Development Process.

The focus of Section 5 is on drainage within subdivisions. To fill an information gap, Section 5 introduces examples of rainwater management systems that have been implemented in BC. The reader is advised to read Section 5 in conjunction with other guidance documents in the "Beyond the Guidebook Primer Series".

***Implementing Rainwater Management:*** Section 6 provides comprehensive guidance on how to achieve a balance of enforceable regulation that, through Bylaws and an Administrative Process, results in a bridge from Land Subdivision to Building Construction.

Section 6 introduces three approaches to infrastructure implementation:

- Within Public Rights-Of-Way
- On Private Property
- Distributed

Section 6 then elaborates on the Distributed option on the basis that it is the most likely to be adopted by a typical local government. By definition, Distributed means that rainwater management infrastructure would be located on both public and private lands.

Section 6 is the heart of the Primer content because the discussion of Administrative Process Requirements delves into the "how-to-do-it" details of changes that will enable local governments, developers and design professionals to move from awareness to action more easily.

# 3. Land Subdivision Process Explained

This section describes the process of land development and the industry standards of practice for either rural or urban subdivisions in British Columbia. Information about the process is presented under four topic headings:

- Land Use Zoning
- Subdivision
- Bare Land Strata
- Results of Subdivision

The development of rural subdivisions is similar but different than land development within urban or areas. The differences relate to the regulatory and approval processes that affect the standards for design and construction.

## An Overview of the Process

Subdividing is a complex process involving many overlapping interests and regulatory requirements. In British Columbia, a person may divide his or her property into a number of separate parcels and register them in the Land Title & Survey Authority.

Before such a subdivision plan can be registered, however, the Land Title Act, Strata Property Act, Real Estate Development Marketing Act and Local Government Act of British Columbia require an official known as an Approving Officer to approve the plan.

Every subdivision must be approved by an Approving Officer appointed under the Land Title Act. For rural subdivisions (i.e. those in unincorporated areas), the Approving Officer is situated in the MOTI district offices. For urban areas (i.e. areas within a municipality – where the municipality is incorporated as a city, town, village or district municipality), the Approving Officer is a municipal staff member.

***For Land Subdivision within Regional Districts:*** It is important here to note that MOTI defines developments under their jurisdiction to be rural subdivisions and that the rules and regulations may be quite different from those found in an urban (municipal) setting.

Property owners, builders and professionals must recognize the different processes and standards that may apply to subdivisions in a rural setting.

Additional information can be found in the MOT Subdivision Application Guide and the Bylaws of individual Regional Districts.

Due to past name changes, MOTI may also be referred to as either the Ministry of Transportation (MOT) or the Ministry of Transportation and Highways (MOTH).

***For Land Subdivision within Urban Areas:*** The rules and design standards are established by the City, Town, Village or District Municipality within the framework of the Local Government Act.

***Steps in the Land Subdivision Process:*** The creation of a development involves a series of steps with reviews and due process. In simple terms the steps of the process include:

1. Land Use Rezoning (where the development involves changes to existing zoning bylaws);
2. Subdivision and creation of individual properties that includes design and installation of necessary utilities and public access; and
3. Design and construction within the boundary of the resulting individual properties.

In the following pages, this Primer elaborates on each step to provide the reader with a basic understanding of the land development process.

## Land Use Rezoning

A part of the rezoning process includes a comprehensive review of many technical issues. The local government must be satisfied that the public will be served by allowing a change in the land use zoning.

***For Rural Subdivisions:*** In the case of an electoral area in a Regional District, some of the issues to be addressed might include:

- Source of potable water and adequacy of the source;
- Sewage disposal methods and their adequacy;
- Ownership of the land;
- Review by MOTI of technical issues;
- Review by Regional District and MOTI staff to verify that public safety concerns have been addressed, primarily the natural hazards that would include avalanche, flooding, erosion, landslip, wildfire, rock fall, and debris torrent. Regional District Staff may request a review by the Ministry of Environment of these matters.

The rezoning process would address such issues as the serviceability and access to the properties that would be created by a subsequent subdivision. Simply put the review would provide assurance that there would be sufficient potable water, a way of disposing of sewage, ready public access to the properties and that no significant natural hazards existed or would be created that would endanger the public or adjacent properties.

The rezoning process would not result in a subdivision or the authorization to construct a development on the proposed parcels. The process of subdivision would be initiated in accordance with existing zoning or enactment of the rezoning.

***For Urban Subdivisions:*** The role of MOTI in an urban subdivision is provided by City, Town, Village or District Municipality staff.

## Subdivision

The process of subdivision involves a much greater level of engineering detail than the rezoning process which deals primarily with land use, density of use and the siting of buildings and structures. The design and installation of utility servicing for each of the subsequent individual properties is a requirement of the subdivision process.

Professionals are engaged to prepare the subdivision plan, detailed design of the utility servicing and grading plans for the subdivision. The designs are submitted to the Approving Officer who will assure that each of the properties is suitable for its designated use.

There would be verification that individual parcels have an adequate supply of potable water, ways to dispose of sewage, are not subject to flooding or other natural hazards, and each has a point of adequate public access.

A number of investigations to be undertaken by qualified professionals would include: Geotechnical; Archaeological; Environmental; Hydrological; and Soils.

Review of the detailed designs would be undertaken as described below:

- **In rural areas:** By MOTI and any agency that MOTI may choose to include in the review process. Only when the MOTI Approving Officer is assured that the designs meet all of the requirements for subdivision would an approval be issued.
- **In urban areas:** City, Town, Village or District Municipality staff would review the designs and provide assurance that all of the requirements for subdivision have been met before an approval would be issued.

Prior to registration of a Plan of Subdivision, the owner of the subdivision is responsible for providing for each property:

- road and drainage works;
- utilities;
- survey; and
- covenants and other legal documents

## Results of Land Subdivision

The fee simple subdivision process results in a number of individual properties or lots that have a public road access and necessary utilities installed to the property line. The properties have all of the services required to allow the land to be used in accordance with the Land Use Zoning.

It is important to acknowledge that at the end of the subdivision process there are no buildings located on the properties and that access and utilities have been installed to the property line of each lot and that the lots are individual properties registered under plan in accordance with the Land Title Act.

Subsequently the individual lots can then be sold to new owners who can apply to the local government for a building permit to construct within the bounds of the lot.

The ultimate connection of the buildings to the utility servicing would be very simple and occur under the Plumbing Code Provisions for sewer and water services as part of the process that would include design and construction of the building.

Typically, owners or persons supervising building construction would engage contractors to make plumbing service connections.

Where parcels are not serviced by offsite sources of water, nor are storm or sanitary sewer services are provided, health authority requirements would apply.

## Bare Land Strata

An alternative to fee simple lot developments, which involve the creation of individual self-standing parcels, is the creation of a Bare Land Strata. These have gained favor in recent years due to cost and affordability.

The utility servicing within the Strata Lot is owned and maintained by the Strata. As a consequence, the standards for the utilities can be lesser than those required by a local government. Hence, there is a reduction in cost to the Strata Unit purchaser.

Following the subdivision process, a Strata Lot is bare and does not contain buildings, utilities or roads. Utility services and road access would only have been provided to the boundary of the Strata Lot.

Starting with the bare parcel, a Bare Land Strata Lot is further subdivided into multiple units and common elements within the process governed by the Property Strata Act. Each of the units would remain part of the larger Strata Lot in accordance to the Strata Property Act. This subdivision necessitates extending the utility services along with road and surface drainage within common elements to the future privately held residential units within the Strata Lot.

The access and utilities are designed and constructed as an extension from the property line of the Strata Lot to the boundary of the individual Strata units. Common elements contain utility services and road access needed for each unit.

The Strata units at this time would be bare and without buildings. The units can be sold and unit owners would have a right to use common elements. Each individual unit would ultimately contain a building or family dwelling(s).

# 4. Standard Consulting Roles Explained

The role of professionals is specific to the regulatory and approval requirements of each step of the land development process.

The steps in the land development process include Rezoning, Subdivision, and On-lot Design and Construction.

The public and others not involved in land development are often unaware of these distinct steps in the process and very limited roles for the individuals and firms that are a part of the land development industry.

## During Zoning

Applying existing or rezoning requires the property owner to engage planning, engineering and design professionals who gather information of sufficient scope and detail to provide the review agencies with the confidence that the land can ultimately be used in a manner that fits the proposed land use zoning.

The level of detail is restricted to a level sufficient to address any identified and outstanding issues but is not of sufficient detail to be used for construction.

***Role of Developer:*** The owner or developer may act as their own representative in the process by coordinating the professionals and submissions to the review agencies.

A more traditional approach would have the owner delegate responsibility to a Planner who would act as the point of contact between the review agencies and the other professionals. The engineers would be responsible for their work and in supplying reports and documents to the Planner for submission to the review agencies.

***Role of Planner:*** The role and responsibilities of a Planner involves submission of the rezoning application and liaison with review agencies to address any identified issues. The rezoning of the development area to allow for a more diverse development with a different mixture of building and ownership types than was allowed prior to the rezoning application.

The Planning component provides the framework for the land use changes and the support for revision of Municipal Bylaws.

***Engineering Aspects:*** A part of the rezoning process involves a conceptual approach to address engineering aspects and may include specialist sub-consultants, geotechnical engineers, municipal engineers and others to document and to provide solutions accordance with the development requirements of the local government.

***For Rural Areas:*** Review of the engineering aspects of the subject properties is undertaken by the Regional District, MOTI and other agencies such as the Health Authority and MOE.

Each review agency has a specific expertise and responsibility in the process and can only support or approve the rezoning based upon the information available to them. Each agency will request clarification or additional information during their review they find additional information is required.

***For Urban Areas:*** Review of the engineering aspects of the subject properties is undertaken by the municipal staff.

The City, Town, or Village can only approve the rezoning based upon the information available to them. Staff will request clarification or additional information during their review if additional information is required.

## During Land Subdivision

The subdivision process results in the creation of individual land parcels that may include residential lots, industrial, commercial, institutional, parks, environmental reserves and municipal Rights-Of-Way in accordance with the zoning bylaw and any related bylaws.

The professionals involved will prepare legal documents for registration under the Land Titles Act requirements, undertake investigations, and complete detailed designs for review agency for approval.

***Role of Development Engineer:*** It is typical industry practice for an owner to engage a Development Engineer.

The Development Engineer would typically provide consulting services in Civil and Municipal Engineering. For areas outside their scope of practice they would seek expert advice from other specialized sub-consultants, for instance on geotechnical hazards, on behalf of the owner / developer.

The subdivision plan typically is the responsibility of the Planner who would engage the services of a Land Surveyor to register the Plan of Subdivision.

The Development Engineer is responsible for the design of the utility servicing, and obtaining regulatory approvals. The design of utilities fall under the direct responsibility of the Development Engineer, and include roadways, water, sewage, and drainage.

The Development Engineer is responsible for coordinating sub-consultants. The coordination role has specific limitations in this context and an explanation of that role is required herein.

***For Rural Areas:*** Review of the utilities involves MOT, Regional District and the Health Authority and the relevant regulations are listed below:

- Roadways and associated drainage must comply with the Guidelines for subdivision roads that can be found in Chapter 1400 of the MOT BC Supplement to TAC Geometric Design Guide.
- Requirements for geotechnical design are found in the MOT Geotechnical Design Specifications for Subdivisions publication.
- Ministry of Transportation staff draws on the expertise of the regional Health Authorities when evaluating the property's capacity for providing safe drinking water and adequate sewerage. The Health Authority has approving authority for water systems and for sewer systems; and in the case of on-site sewage disposal, it may make recommendations, but the Approving Officer makes the decision to accept or reject the proposal.

***For Urban Areas:*** Review of the utilities involves municipal staff and the relevant regulations are listed below:

- Roadways and associated drainage must comply with the municipal bylaws of the City, Town, Village or District Municipality.
- Requirements for geotechnical design would be found in the municipal bylaws of the City Town, Village or District Municipality.
- Municipal staff can draw on the expertise of the regional Health Authorities when evaluating the property's capacity for providing safe drinking water and adequate sewerage where municipal systems are not in place. The Health Authority may make recommendations to the Approving Officer regarding the subdivision application. The Approving Officer makes the decision to accept or reject the subdivision application.

***Construction Phase:*** Following approval of the designs, construction proceeds. The Owner would typically engage the Development Engineer to monitor and administer the construction of the utility servicing required to satisfy the legal requirement for subdivision.

The Development Engineering professional provides sufficient field reviews to be confident that the constructed utility servicing and roads is in general conformance with the design.

The installed utilities for the subdivision stop at the property line. Extension onto the individual lots is not part of the subdivision process.

The subdivision process results in a number of individual properties or lots that have a public road access and utilities installed to the property line. All the services required to allow the lots to be used in accordance with the Land Use Zoning.

It is important to acknowledge that at the end of the subdivision process there are no buildings located on the properties and that access and utilities have been installed to the property line of each lot and that the lots are individual properties registered under plan in accordance with the Land Title Act.

At this point, the developer can then sell or dedicate each part of the subdivision. The lots go to new owners for building construction while Rights-Of-Way and other dedications are transferred to the local government.

## During On-Lot Development

The new owners of the new properties would follow the Building Permit Process of the local government to construct the buildings on the properties, to connect the utility services from the property line to the buildings, and undertake any landscaping necessary within the limits of the lot.

Extension of services onto the lots would only occur during the Building Permit process and at the time of building construction on the individual lots.

***Requirements for Professional Services:*** The Development Engineer is not required to be involved in the building permit and construction process for typical residential construction. The exception would lie in the further development of a Bare Land Strata Lot. In the case of Strata Lots it is typical that there are new Strata owners, which would typically hire new professionals to provide services for development within a Strata Lot.

A Civil Engineer would only become involved through a contract with the owner or the Responsible Professional, as defined by the appropriate sections of the British Columbia Building Code (BCBC).

There is no requirement under the Section 9 Exceptions of the BCBC for a Civil Engineer to be involved in the Building Permit process for design and construction of single family or duplex buildings on the individual units of a Strata Lot.

If a responsible professional was required for design and construction outside of the building envelope, then the Owner or their Architect would use the BCBC requirements and definitions to establish their potential scope of work and the need for other specialist professionals.

Further subdivision of a Strata Lot will require a Civil Engineer who would be responsible for the design and obtaining approval of the utility and road access extension onto the Strata Lot to the boundary of the individual Strata Units.

Normally the Civil Engineer would provide sufficient field reviews to be confident that the constructed utility servicing and roads are in general conformance with the design.

The information obtained during the field reviews would be used to prepare the record drawings for future use by the Strata.

The installed utilities for the Strata Lot stop at the boundary of the Strata Units and would not be extended onto the individual units. At this moment in time there would be no building or utilities on the individual Strata Units.

***Application for Building Permit:*** The final step in developing the individual Strata unit would be for the owner to apply to the local government for a building permit.

The ultimate connection of the buildings to the utility servicing would be very simple and occur as part of the building permit process that would include design and construction of the building under the Plumbing Code provisions for sewer and water services.

Plumbing service connections would be undertaken by contractors under the direct control of the owner or persons supervising building construction.

# 5. Subdivision Design Standards & Drainage

Industry standards for subdivision design have evolved over time and encompass both the regulatory requirements governing technical matters and the business practices that form expectations and scope of work for all those involved. The reader is reminded that:

- For rural subdivisions, the standard of practice encompasses the approval processes and requirements as stated in Legislation as well as the guidelines for a rural subdivision prescribed by MOTI, the water supply and sewage disposal regulations of the Health Authority, and bylaws of a Regional District.
- For urban subdivisions in Cities, Towns, Villages or District Municipalities, the standard of practice encompasses the approval processes and requirements as stated in legislation and municipal bylaws as well as the guidelines for water supply and sewage disposal regulations of the Health Authority if municipal utilities are not available.
- A Strata Lot development includes the internal subdivision and servicing occurred subsequent to the creation of the Subdivision. The Strata owns the internal roads and utility servicing which are located within the common element to the boundary of each Strata unit. The subdivision of the Strata Lot would have resulted in bare units with Strata owned utilities and road access to the boundary of each unit.

The focus of this section is on drainage within subdivisions. In general, the discussion may be applicable to either rural or urban subdivisions, unless otherwise noted.

## Subdivision Surface Drainage

The standard for rural subdivisions is to provide surface drainage routes within public Rights-Of-Way. There are no requirements to utilize storm sewer pipes, except where roads and lot access must cross a surface ditch.

The standard of practice in rural subdivisions is to provide surface drainage through roadside ditches.

The standard for urban subdivisions is to provide surface drainage routes within municipal Rights-Of-Way with the use of storm sewer pipes. There are instances where a city, town, or village may allow, or require surface drainage through roadside ditches.

Most urban municipal design criteria includes the use of a dual drainage system where the pipes would convey frequent small storms and an overland system would safely convey large flood events.

## On-Lot Surface Drainage

The universally accepted method of providing surface drainage for a lot is to simply slope the surface elevations of the landscaping so that any surface water flows away from the building toward the property boundary. The standard slope used is a minimum of 2%, which is also 1 foot or metre drop for every 50 feet or metres of horizontal distance. The design of on-lot surface drainage systems is not included in the design requirements for rural subdivisions.

Prevention of surface runoff toward or along a building must be avoided to prevent damage to the building. The building features of footprint, location, elevation, and landscaping must work together to direct the surface runoff away from the building.

Industry standard practice places the responsibility for locating the building unit services with the building designer. Industry standard practice provides landscaping that slopes away from buildings to prevent surface water from encroaching and causing damages.

Provision of this lot landscaping feature begins with the subdivision design which allows the landscape design to be successfully completed at the time of building design.

Factors to be considered by the owner and building designer during the building and landscape design include:

- Level of landscaping against the building,
- Building cladding to suite landscape grading and levels,
- Elevation of footings for frost protection,
- Elevation of adjacent buildings and landscaping, and
- Directing surface runoff away from the building.

Finally, the contractor must build the landscape that provides all of the features envisioned by the building designer. Without a formal landscape design the landscape contractor should follow industry standard by providing surface grades that would direct surface runoff away from the building.

## On-Lot Sub-Surface Drainage

The practice of installing sub-surface drainage has evolved as a method of preventing damage to buildings resulting from the effects of high groundwater levels.

Many municipalities allow construction of buildings without footing drains if the groundwater levels can be expected to remain below the elevation of the building foundation.

Where groundwater levels are well below the foundation, provision of a piped drainage system to dispose of groundwater would not typically be required in a rural development.

If groundwater levels are expected to be near the building foundations, the most common methods of preventing damage to buildings is to provide a pipe drain that will discharge to the surface on a steeply sloping property or to a municipal pipe system on flatter terrain.

A second widely accepted method is to install a sump pump with a discharge to the ground surface where the landscaping would allow water to flow away from the building.

In all cases where sub-surface drains are installed they are not intended for nor are they designed to prevent damage caused by the ingress of surface runoff into the ground in the immediate vicinity of a building.

Sub-surface drainage systems can be easily overwhelmed if there is a direct connection to the surface to allow runoff to enter them.

Direct connections will result if the surface landscaping slopes toward the building and surface water is allowed to contact the walls of the foundation and percolate downward between the foundation wall and the soil backfill.

## Rainwater Management Systems

The purpose of *Rainwater Management Systems* is to mitigate environmental damages resulting from land development. Many municipalities and the MOTI do not have design standards for the necessary rainwater management infrastructure.

To fill an information gap, the purpose of this section to describe some systems that have been implemented, recognizing that there is a much wider range of possible configurations and designs which can be provided. Only the imagination of the designer and practical considerations will limit the number of viable rainwater management system designs.

***Examples of Rainwater Management Systems:*** As previously noted, the potential shape and appearance of the retention systems is limited only by the imagination of the designer and constraints of a site and regulatory concerns. Several retention systems are shown in **Figures 4-1** through **4-4.**

**Figure 4-1** shows a conventional street rain garden with landscaping and surface treatment. These conventional systems include a list of plants which are selected for this application and generally to minimize future maintenance.

Some municipalities will include maintenance as part of their responsibility and cost while others view these facilities as a benefit to the property and expect the adjacent property owner to be responsible for maintenance costs for the vegetation to the edge of the roadway pavement structure.

**Figure 4-2** shows an approach which would provide the storage, release, and infiltration area in a location that would not disrupt the surface, and not increase the maintenance costs of landscaping.

These systems are more typical in an urban area that in a rural subdivision. The systems are located completely underground and within municipal street Rights-Of-Way. In this instance the removable plugs would eliminate discharges into the system during construction and would be replaced with flow restrictions to control the rate of base flow discharge from detained storage.

**Figure 4-3** shows an underground system that can be located on private property. Both the installation and final finished product are illustrated. While this is a larger unit suitable for a large property, smaller versions can be constructed for single family lots.

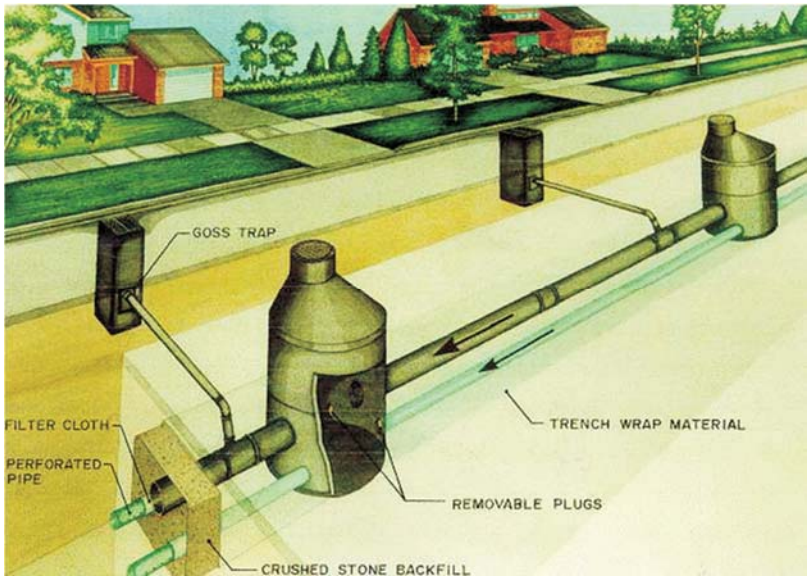
A feature of many of the products available for this type of installation is a surface H-20 load rating which would allow trucks to cross the systems without causing damage. These could then be located beneath parking lots or other landscape features without affecting the use and occupation of the surface landscape outside of the building footprint.

**Figure 4-4** shows a retrofit solution for an existing parking lot. In the photo sequence, the material is shown being installed along with the finished product. These are relatively inexpensive facilities for a retrofit situation and could dramatically reduce the disruption and cost of surface restoration over other system configurations.

***Implementation:*** As can be seen in **Figures 4-1** through **4-4**, and system descriptions, there are a great many methods and alternative infrastructure design that can be used to assist in achieving the watershed targets.

**Street Rain Garden**

Figure 4-1




**Underground Street Rain Garden**

Figure 4-2

**Underground On-Lot Rain Garden**

Figure 4-3

**Parking Lot Underground Rain Garden**

Figure 4-4

# 6. Implementing Rainwater Management

Implementing affordable and effective rainwater management systems in conjunction with land development is a good and environmentally sound decision in any local government jurisdiction. The aesthetics and livability of neighbourhoods and communities can be enhanced while allowing development and protecting the environment.

Inclusion of rainwater management can be a complex regulatory issue, however, in light of how land development occurs and the responsibilities of the individuals and firms which are a part of the process.

Thus, the Land Development Process would require a balance of enforceable regulation provided through Bylaws and an Administrative process that would allow a bridge to be formed between the two steps of the Land Development process which are comprised of Subdivision and Building Construction.

### Introduction of Three Approaches to Infrastructure Implementation

Three different approaches to locating rainwater infrastructure have been adopted by local governments. The approaches encompass location within Rights-Of-Way or other dedicated lands, on private property, or distributed on all properties. A description of each type of location follows:

1. **Within Public Rights-Of-Way**: All rainwater management infrastructure would be located only within the lands controlled by the local government, including Rights-Of-Way and dedications.

   In this instance the local government would be responsible for all infrastructure and would have access for all future monitoring and maintenance.

   This would create a design problem because reduced space would then be available within road Rights-Of-Way for other infrastructure. Wider Rights-Of-Way may be needed to provide the additional land necessary to accommodate rainwater management infrastructure.

2. **On Private Property**: All rainwater management infrastructure would be located only on private property. This approach relieves the local government of future costs and places the maintenance responsibilities onto the property owners.

   This decision has the potential to allow the local government to avoid any future responsibility while providing no way to monitor and demonstrate long term compliance with the goals and objectives of the local government.

   This approach would see the need to enlarge private systems to allow them to manage rainwater from the adjacent Rights-Of-Way and introduce the need for flow from public lands into private property.

3. **Distributed**: Rainwater management infrastructure would be designed and constructed for all of the lands within the local government jurisdiction both within those controlled by the local government and on private property.

   This approach would distribute the costs and responsibility for construction, operation, and maintenance while allowing the local government to control the design and approval of the infrastructure.

For the knowledge-sharing purposes of this section, it is presumed that the third approach is the most logical and reasonable to implement such that it would be the approach adopted by a typical local government.

***Integration with Land Development Process:*** As explained in Section 4, land development occurs in two steps in accordance with applicable zoning, namely: subdivision; and building construction

**Subdivision:** The subdivision process yields bare lots that have utility services and road access to their property boundaries. Design and construction of rainwater management systems in the municipal Rights-Of-Way and dedications can be undertaken as part of the subdivision process by providing municipal infrastructure.

Following subdivision with the creation of bare serviced lots the land developers and their respective consultants have completed their obligations and are released from further responsibilities.

**On-Lot Construction:** The on-lot building construction is the final step in overall process where the property owner applies to the local government for a building permit to construct a dwelling or building on private property and to connect to off-lot services.

Design and construction of on-lot rainwater management would occur following subdivision. The two most significant reasons for this sequence are described below.

The first reason is that subdivision creates serviced lots without any provision for on-lot construction. The latter must meet building code provisions, and municipal staff carry out inspections at specific points during construction.

The second reason is the need to establish the building location within the building envelope to allow sufficient clearance and to avoid conflicts between the location of the building and the various components of the rainwater management system.

At the present time we are not aware of provisions for rainwater management systems, other than rainwater harvesting, within either the Building or Plumbing Code.

## Municipal Rainwater Infrastructure

For the purposes of this Primer, it is presumed that systems for rainwater management would be located on both public and private lands pursuant to the Distributed Approach introduced earlier.

The municipal road Rights-Of-Way and other dedications would typically occupy approximately one third ($^1/_3$) of a developed watershed. In order to mimic the natural Water Balance for a watershed, it is critical that rainwater management systems be designed and constructed within these municipal lands to capture and infiltrate rainwater runoff, and thereby meet the watershed protection objectives of local governments.

The design and construction of rainwater infrastructure within municipal road Rights-Of-Way and other dedications can be made part of the subdivision process and the responsibilities would then fall to the developer and their respective consultants.

## On-Lot Rainwater Infrastructure

The lots and private property would typically occupy approximately two thirds ($^2/_3$) of a developed watershed. Construction and operation of on-lot systems for rainwater infiltration would be integral in the requirements of the watershed; and would be used to create an effective environmental mitigation program that would offset future impacts to aquatic and terrestrial habitat.

On-lot systems for rainwater infiltration would be constructed in new developments and in redeveloping areas. It is critical that the on-lot rainwater systems be designed and constructed in a way that actually achieves the watershed protection objectives of the local government. The primary item of concern is the actual implementation of on-lot systems.

The question of HOW to achieve the desired outcome is discussed next.

***Roles and Responsibilities:*** Components of on-lot systems comprise rainwater capture and infiltration systems plus enhanced topsoil for rainwater runoff volume reduction. Specific questions to be addressed include:

- Who would be responsible for constructing the infiltration facilities? Would it be the developer or the home builder?
- Who would ensure their installation conforms to design? Would it be the local government's building inspectors?

A number of construction sequences can be envisioned with responsibility being taken by a number of different individuals or firms. In the remainder of this Section 6, the discussion of the range of possibilities is organized under six topic headings as listed below:

- Installation by House Builder
- Installation by Developer
- Installation by Developer and With Restrictive Covenants
- Move Systems Off-Lot
- Enhanced Topsoil Installation
- Administrative Process Requirements

The selection of the overall design, construction and compliance process would require input and acceptance by a number of local government departments and developers of new subdivisions within the designated area.

**Construction Responsibility:** There are two separate issues regarding construction responsibility and they hinge upon the timing of construction of the on-lot rainwater management systems.

Typically construction of facilities would occur in a logical progression as individual site locations become available for unencumbered construction.

Site access and protection of systems from physical damage or uncontrolled runoff of silt-laden water would be the most significant issues facing the construction of the systems.

***Installation by House Builder:*** There is an inherent difficulty in providing a final design for each on-lot infiltration facility at the time of subdivision design.

When a subdivision is designed, municipal infrastructure requirements and locations of servicing ties to individual properties are established.

At that time in the subdivision design process, the individual building footprint for any given lot is unknown to the municipal design team and the Development Engineer.

Given the flexibility of locating the building footprint within the building envelope, it is not possible to assign a specific location for on-lot infiltration systems.

Hence, it would logically follow that the final layout of on-lot infiltration systems should be completed as part of the building design rather than as part of subdivision design (layout of lot boundaries, access, on- and off-site services).

Only at the time of building design would there be assurance that no conflicts would occur between the building footprint and on-lot infiltration system.

It may be possible for the local government to revise the building envelope, for instance through a development variance permit, to include an allowance for the on-lot infiltration system.

In that case, the design standards and criteria would presumably be established as an integral part of the watershed planning process.

**Building Department Responsibility:** As the design and construction of on-lot systems would logically fall to the property owner and building contractor, it would then be necessary for the local government Building Department inspection staff to review the rainwater management system designs and to undertake the necessary inspections during construction in a process that extends their responsibilities within the Building Permit process. This assumes that the local government has or will enact bylaws or established development permit requirements to enable these staff to inspect and approve the rainwater system.

***Installation by Developer:*** As an alternative to installation by the house builder, the land developer and Development Engineer could undertake the design and installation of the rainwater infiltration systems following the construction of the buildings.

However, this would create problems with scheduling and access to the properties along with building occupancy and the building inspection process of the local government.

While the scheduling of this alternative may appear to be attractive, there would be many conflicts that may make this unworkable.

**Establish a Legal Chain of Responsibility:** A variation of the above process would see the developer passing the responsibility for the design and construction of the physical works to the builder and/or owner as a part of the sales agreement.

This could be a seamless process that would be invisible to the local government which would have an agreement with, and bonding from, the Developer for the works.

A legal agreement between the developer and the builder / home owner would pass along the overall responsibility but the process would not relieve the developer of regulatory, covenant or other negotiated contractual obligations with the local government.

In this case the Development Engineer who undertook responsibility for the subdivision may undertake the design, inspection and certification of the installations. However, any qualified individual could take the responsibility for design, inspection and certification of the installations.

***Installation by Developer and with Restrictive Covenants:*** Alternatively, the land developer could undertake the design and installation of the rainwater management system prior to the building design being completed.

Under this alternative, encumbrances would be placed upon the subdivided lots in order to avoid damage to the systems and to provide separation between the systems and the building footprint.

In this situation, the Development Engineer for the subdivision would undertake the design, inspection and certification of the installations.

There would be a need for on-going inspections during building construction to verify whether there had been any damage to the systems or whether silt had been deposited in them.

A final inspection following landscaping and hook up would allow certification of installation by the Development Engineer.

**Extent of Local Government Responsibility:** This alternative process would only involve local government staff from the Building Department to verify the certification of rainwater management systems prior to issuing Occupancy Permits for the buildings.

While this alternative process would be attractive to a local government, there would be an ongoing involvement of the developer and legal agreements between the developer and the lot owner to allow access for both inspections and maintenance if it should be required.

***Move Systems Off-Lot:*** A fourth alternative would be to move the rainwater management systems for the lots to locations within the road Rights-Of-Way or other municipal land.

Within the road Right-Of-Way there is a limited amount of space that is unassigned. In urban areas, for example, the space beneath sidewalks is available for these systems.

This configuration would not replace the street infiltration systems; rather, it would replace the on-lot systems.

The construction of these systems could then be undertaken at the time of the subdivision construction of the roadway immediately.

The final connection of these systems would be done as part of the final landscaping of the lots and could be controlled by either the local government or the Developer.

In this case the Development Engineer who undertook responsibility for the subdivision would undertake the design, inspection and certification of the installations.

With the facilities located within road Rights-Of-Way, the local government would be acquiring the responsibility for maintenance and operation of the systems.

**Concept for a Neighbourhood System:** A variation of this alternative would see a consolidated rainwater management system located centrally in the lower reaches of the neighbourhood or watershed.

This system, if contemplated, would occupy a land area which must be identified within the Official Community Plan and would need to be examined on a conceptual basis prior to adoption to verify that this concept would satisfy the objectives of the local government for watershed preservation.

***Enhanced Topsoil Installation:*** The second component of a rainwater management system is the enhanced topsoil that would be applied to all disturbed pervious surfaces in the development area.

Pervious surfaces requiring topsoil would include municipal Rights-Of-Way, parks and private properties created as part of the subdivision process.

The local government objective for topsoil placement would be to have all installations comply with subdivision design specifications.

As with the installation of other on-lot rainwater management systems, the most logical time to place the topsoil would be following the construction of buildings.

This timing corresponds to standard practice in use today. To meet the design specifications, a formal grading check should be made at two milestones: the first when the subgrade has been prepared prior to placement of the topsoil; and the second following its placement but prior to seeding or sodding.

**Responsibilities of a Building Contractor:** Traditionally the building contractor is responsible for installation of the topsoil and vegetation on each lot. This has expanded somewhat to include the boulevard areas because of the disruptions caused during the building construction, which follows street construction which is part of creating the subdivision.

In many instances, finishing the swales specified in the municipal designs has been added to the builder's responsibility.

There would be a need to verify that the final grades are achieved and that the specified depth of topsoil is installed for both the lot and the boulevard.

***Administrative Process Requirements:*** The two basic situations are described below to illustrate necessary administrative modifications to the Building Process to ensure and assure quality control when rainwater management systems are implemented.

**Within Rights-Of-Way:** Implementing rainwater management infrastructure within road Rights-Of-Way and other dedicated lands is relatively easy.

It requires that defined goals and design standards be established by the local government. This infrastructure would then be designed and constructed as part of the subdivision portion of the land development process, or later as part of reconstruction by the local government.

**On Private Property:** Implementing rainwater management infrastructure on private property is a goal of many, and this creates challenges requiring innovation in the administrative processes. When there are no design standards or goals in place, these must be established.

The next consideration is assigning the responsibility for the design, construction monitoring, and certification of the infrastructure.

The Building Permit process is the only current method of administering and verifying compliance on a private property.

As discussed previously in this Section 6, it would be possible for the local government to assign responsibility for implementation of rainwater management to the Building Department and Building Inspectors, provided that the local government enacted bylaws or permit approval requirements as a basis for guiding design and construction and subsequent approvals

Building Inspectors would then require training in rainwater management design and the standard details which would be constructed.

The additional training and increased number of Building Inspections would likely increase the staffing levels within the local government.

While this might appear to be an easy solution, experience shows that there can be a great deal of reluctance on the part of Building Department staff to embrace this change, especially where standards are not precise or there is a need for a relatively high degree of on-site adaptation.

As a result of the identified difficulties, alternative approaches have been utilized by various jurisdictions. These include involving the subdivision developer and their professional consultants.

Keeping the developer involved in the subdivision process requires legal contracts and agreements between the developer and the lot purchaser that are not currently required.

There would be a need for coordination between the developer, their consultants and the building contractor to allow for the design, construction and inspection of rainwater management systems.

It should be expected for developers to be reluctant to extend their responsibility beyond creation of the subdivision.

# 7. Conclusions

Land development in British Columbia follows a legislative and regulatory framework that allows property owners to build in accordance with existing zoning or to apply to the local government having jurisdiction for changes to land use and density of use through rezoning processes and then to subdivide the property in accordance with applicable zoning and other development related bylaws and requirements. This results in smaller lots that can be sold to others with the intent of constructing buildings upon the individual lots.

## Rezoning of Land

The rezoning process includes a comprehensive review of many technical issues. A local government must be satisfied that the public will be served by allowing a change in the land use zoning.

The rezoning process addresses such issues as the serviceability and access to the new properties. For rural and urban areas, the review provides assurance that there would be sufficient potable water, a way of disposing of sewage, ready public access to the properties and that no significant natural hazards exist that would endanger the public or properties.

The rezoning process does not directly result in a subdivision or the authorization to construct a development on the resulting parcels. The process of subdivision is initiated with reference to applicable zoning, which in the case of rezoning, the subdivision process would follow the approval of the rezoning application.

## Subdividing of Land

Subdividing is a complex process involving many overlapping interests and regulatory requirements. In British Columbia, a person may divide his or her property into smaller parcels and register them with the Land Title & Survey Authority.

Before such a subdivision plan can be registered, however, the Land Title Act, Strata Property Act, Real Estate Development Marketing Act and Local Government Act of British Columbia require an official known as an Approving Officer to approve the plan.

Every subdivision must be approved by an Approving Officer appointed under the Land Title Act.

The subdivision process yields bare lots that have utility services and road access to their property boundaries. Including rainwater management systems into the municipal Rights-Of-Way and dedications can be undertaken as part of the subdivision process in providing municipal infrastructure.

Following subdivision with the creation of bare serviced lots the land developers and their respective consultants have completed their obligations and are released from further responsibilities.

## On-Lot Construction

A vast majority of the newly created properties are sold to new owners who would then complete the development process.

The building construction is the final step in overall process where the property owner applies for a building permit to construct a dwelling.

Design and construction of on-lot rainwater management systems would occur following subdivision. The two most significant reasons for this sequence are described below.

The first reason is to establish the building location within the building envelope to allow sufficient clearance and to avoid conflicts between the location of the building and the various components of the rainwater management system.

The second reason is that subdivision creates serviced lots without any provision for on-lot construction. The latter must meet building code provisions, and municipal staff carry out inspections at specific points during construction.

## Implementing Rainwater Management

Implementing rainwater management systems is a good and environmentally sound decision in any local government. The aesthetics and livability of neighbourhoods and communities can be enhanced while allowing development and protecting the environment.

Inclusion of rainwater management can be a complex regulatory issue in light of how land development occurs and the responsibilities of the individuals and firms which are a part of the process.

The actual process of implementing rainwater management requires that the local government establish watershed targets, design guidelines and provide clarity on whether the infrastructure would be constructed within Rights-Of-Way, on private property or distributed.

The rainwater infrastructure constructed within Rights-Of-Way requires review and approval of the local government and MOTI in rural areas. The infrastructure could be constructed as part of the servicing of the subdivision and prior to the sale of individual lots.

Rainwater infrastructure which is to be constructed on private property would require design review and inspections by a suitably qualified professionals and / or building inspectors.

Alternatively a new administrative process of design, review, approval and acceptance may be created by the local government.

A modified process may include a qualified professional for design and certification. Inclusion of a qualified professional would necessitate modification of the Development Agreements and the legal relationships between the local government, the developer, the home builder and the engineering consultants that have been a standard part of the land development process to date.

Thus, the Land Development Process would require a balance of enforceable regulation provided through Bylaws and Administrative process that would allow a bridge to be formed between the two steps of the Land Development process which are comprised of Subdivision and Building Construction.

# 8. References

To date, the Partnership for Water Sustainability has released three guidance documents in the Beyond the Guidebook Primer Series (see page 26 for URLs). The first two were released in November 2011 and the third in May 2012. Other Primers in the Series are listed below:

- **Primer on Rainwater Management in an Urban Watershed Context:** Provides engineers and non-engineers with a common understanding of how a science-based approach to rainwater management has evolved since the mid-1990s.
- **Primer on Urban Watershed Modelling to Inform Local Government Decision Processes:** Provides engineers and non-engineers with guidance in three areas: setting performance targets, defining levels-of-service, and application of screening / scenario tools.
- **Primer on Integrated Rainwater and Groundwater Management for Lands on Vancouver Island and Beyond:** Provides engineers and non-engineers with a common understanding of the links between rainfall, groundwater movement and surface flows in sustaining aquatic life.
- **Primer on Underground Rainwater Discharge – Facility Siting and Design Practices for Protection of Groundwater Resources** (*to be released in October 2013*)**:** Provides technical guidance regarding application of the Water Balance Methodology to design of rainwater infiltration and groundwater recharge systems.

The core concepts presented in these companion documents provide an educational foundation for rainwater management in a watershed context.

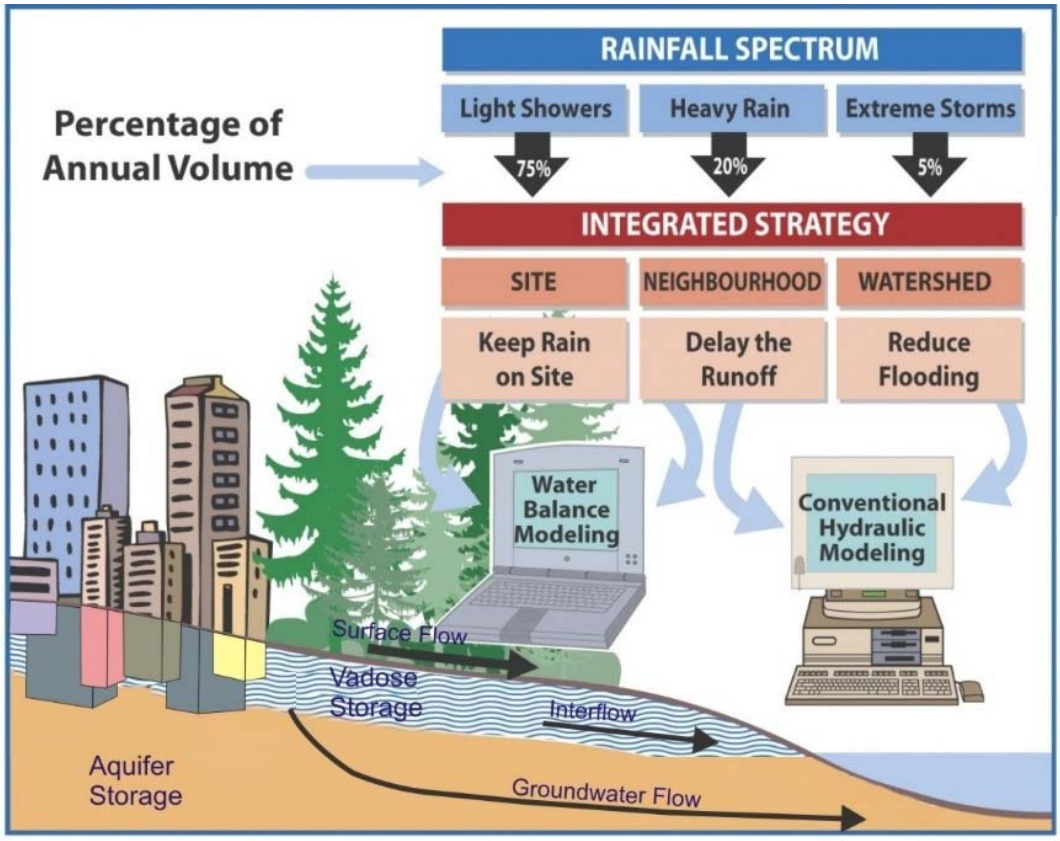
***Water Balance Methodology:*** "A decade ago, looking at rainfall differently led the Province to initiate a change in the way rainwater is managed. In 2002, introduction of the Water Balance Methodology was a catalyst to trigger actions on the ground that would maintain or restore the natural Water Balance. The initial priority was to reduce surface runoff volume," states Peter Law, Chair of the Guidebook Steering Committee. Formerly with the Ministry of Environment, he is a founding Director of the Partnership.

"Then, in 2007, the Beyond the Guidebook initiative enhanced the Water Balance Methodology to address the relationships between volume of rainwater captured and held on site, release to interflow, and resulting flow rates in streams."

"Now, Beyond the Guidebook has addressed the relationship between volume of rainwater captured and groundwater recharge. Application of the Water Balance Methodology enables local governments to establish a set of watershed-specific and integrated Performance Targets."

***Integration with Land Development Process:*** Adapted from the Guidebook, Figure 8-1 illustrates the integrated strategy that is the centrepiece of the Water Balance Methodology. An integrated design for land development, rainwater management and groundwater recharge would balance the annual volume necessary for interflow storage with the annual volumes necessary to: sustain the duration of interflow; and allow infiltration to groundwater.

Achieving this Water Balance outcome depends on a clear delineation and common understanding of expectations, roles and responsibilities of those involved to ensure a seamless progression from Rezoning through to Land Subdivision and Building Construction.




**Source:** *Stormwater Planning: A Guidebook for British Columbia*, 2002

Figure 8-1

## Integrated Strategy for Managing the Rainfall Spectrum & Mimicking the Natural Water Balance

Explanatory Notes – Key Messages:

Definitions: '*Aquifer Storage' refers to the saturated zone below the groundwater table where all pore spaces in the soil are filled with (ground)water. 'Vadose Storage' refers to the unsaturated zone above the groundwater table where void spaces are filled with air AND water.*

Urban development reduces the 'vadose storage' and interflow. Therefore, to mimic the natural water balance of the site, development projects should strive to retain or restore these processes by means of green infrastructure solutions.

Basements and underground structures will lower groundwater levels to the footing level. The ground above this then becomes part of the vadose zone and can be used for vadose storage. When designed properly, this zone can form part of the green infrastructure solution.

### How Does Water Reach a Stream?

Surface Runoff - *from minutes to hours*

Shallow Groundwater - *from days to years*

Deep Groundwater - *from years to decades and longer*

## *Provincial Guidance Documents:*

Stormwater Planning: A Guidebook for British Columbia (2002)
http://www.env.gov.bc.ca/epd/mun-waste/waste-liquid/stormwater/index.htm

Beyond the Guidebook: Context for Rainwater Management and Green Infrastructure in British Columbia (2007)
http://www.waterbucket.ca/rm/sites/wbcrm/documents/media/37.pdf

## *Beyond the Guidebook Primer Series:*

Primer on Rainwater Management in an Urban Watershed Context (2011)
http://www.waterbucket.ca/rm/sites/wbcrm/documents/media/239.pdf

*Provides engineers and non-engineers with a common understanding of how a science-based approach to rainwater management has evolved since the mid-1990s.*

Primer on Urban Watershed Modelling to Inform Local Government Decision Processes (2011)
http://www.waterbucket.ca/rm/sites/wbcrm/documents/media/243.pdf

*Provides engineers and non-engineers with guidance in three areas: setting performance targets, defining levels-of-service, application of screening / scenario tools.*

Primer on Integrated Rainwater and Groundwater Management for Lands on Vancouver Island and Beyond (2012), http://waterbucket.ca/wp-content/uploads/2012/05/3_Primer-on-Integrated-Rainwater-Groundwater-Management-for-Lands-on-Vancouver-Island_April-2012.pdf

*Provides engineers and non-engineers with a common understanding of the links between rainfall, groundwater movement and surface flows in sustaining aquatic life.*