INTEGRATED STORMWATER MANAGEMENT

High rates and volumes of stormwater discharge, due largely to urban growth and country residential developments, are affecting the health of Nose Creek, West Nose Creek and their tributaries. Typical land development practices can generate 5 to 100 times more runoff compared to predevelopment conditions (City of Calgary 2005). Increased stormwater flows are caused by greater impervious coverage, grading and compaction of subsoils, draining or infilling of depressional or wetland areas, deforestation and elimination of native vegetation. The increased stormwater runoff causes channel erosion, higher pollutant loads, deterioration of receiving stream water quality and adverse impacts on aquatic species. Figure 3.1 illustrates the impacts of typical urbanization on the hydrograph of a receiving stream.

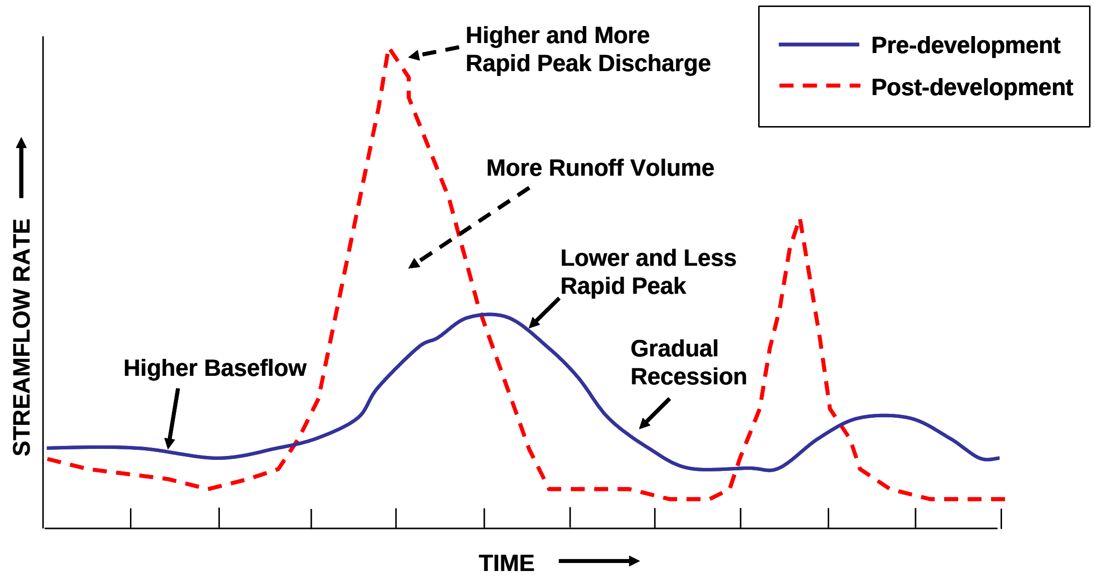

Figure 3.1. Changes to stream flow following urban or country-residential development.

Stormwater practices vary for urban developments in the Nose Creek watershed within the City of Calgary. Storm systems that were built prior to the late 1980s were based on conventional designs where stormwater was conveyed directly to the creeks. Many storm systems constructed since the 1980s have incorporated flow attenuation technology, including treatment capability to remove total suspended solids (TSS) and other pollutants. Although stormwater retention facilities are constructed within new developments to provide peak flow attenuation and sediment removal, these facilities do not reduce total stormwater volume or promote the preservation of natural hydrologic processes in the watershed.

The US EPA (2004) has identified five performance levels for various stormwater control strategies (Table 3.1). Most of the Level 2 targets (i.e. flood control, peak discharge control and suspended solids removal) are being achieved for new urban and country-residential developments in the City of Airdrie, City of Calgary and the M.D. of Rocky View. Older developments, at this time, do not meet these standards. No municipality has met the volume control recommendation in Level 2. Stormwater volumes and quality improve as higher performance Levels are achieved. Level 3 performance includes water quality considerations and Level 4 introduces groundwater recharge and channel protection. The target for integrated stormwater management in the Nose Creek watershed would be to achieve Performance Level 5, the highest level defined, using a staged approach to implementation.

Table 3.1. Best Management Practice Performance Levels vs. Control Strategies, Criteria and Standards. Adopted from US EPA 2004.

	PERFORMANCE LEVELS				
CONTROL STRATEGIES	**1 NPDES Phase 1**	**2 Specified Pollutant Removal**	**3 Water Quality Control**	**4 Multiple Parameter**	**5 Ecological Sustainability**
Flood Control	X	X	X	X	X
Peak Discharge Control	X	X	X	X	X
SS Removal		X	X	X	X
Volume Control		X	X	X	X
Water Quality Management			X	X	X
Groundwater Recharge				X	X
Channel Protection				X	X
Thermal Impacts Control				X	X
Credits				X	X
Pollution Prevention				X	X
Distributed Controls					X
Multi-functional Controls					X

Current Performance Standard
Future Performance Target

Recently the City of Calgary completed the West Nose Creek Stream Corridor Assessment (WER 2003), which included a hydrologic and hydraulic analysis of stormwater impacts on stream morphology. It was demonstrated that the urbanization of the West Nose Creek watershed led to an artificial increase in catchment area by a factor of 5 to 6, resulting in widening and deepening of the channel in the lower reaches. In addition, peak flows and base flows increased as a result of urbanization. This is contrary to common thought in that base flows are often assumed to decrease because of reduced infiltration in urban areas. These observations are an example of the unique hydrology in the Calgary area where pre-development runoff was extremely small, especially for the smaller, frequent events. The combination of large impervious areas, compacted soils and the introduction of artificial precipitation resulting from lawn watering or input from leaking water mains, has led to an exponential increase in runoff compared to pre-development conditions (WER 2002).

An effective stormwater management plan for the Nose Creek Watershed requires a diversified approach that considers flow volume reduction, base-flow augmentation in rural areas (groundwater recharge and infiltration), water quality control and ecological protection (coulee ecosystems) rather than simply controlling site specific peak flow. In British Columbia, an integrated approach to stormwater management was adopted that incorporates principles of runoff volume controls at the source and flood risk management (Figure 3.1). Stormwater management cannot be considered in isolation as it has been in the past, but must be conducted at the watershed scale and in association with other watershed activities.

Runoff Volume Control Target

Urbanization increases impervious surfaces, reduces infiltration and causes greater runoff and higher peak discharges compared to natural environments. To lessen the impact, a minimum volume of runoff should be captured on site. The minimum runoff capture volume is the volume of stormwater that in post-development conditions will not be released to Nose or West Nose Creek. Instead it is captured on site and reused, infiltrated or evaporated. The minimum capture volume reflects the need for groundwater recharge, water quality improvement and flood and channel protection.

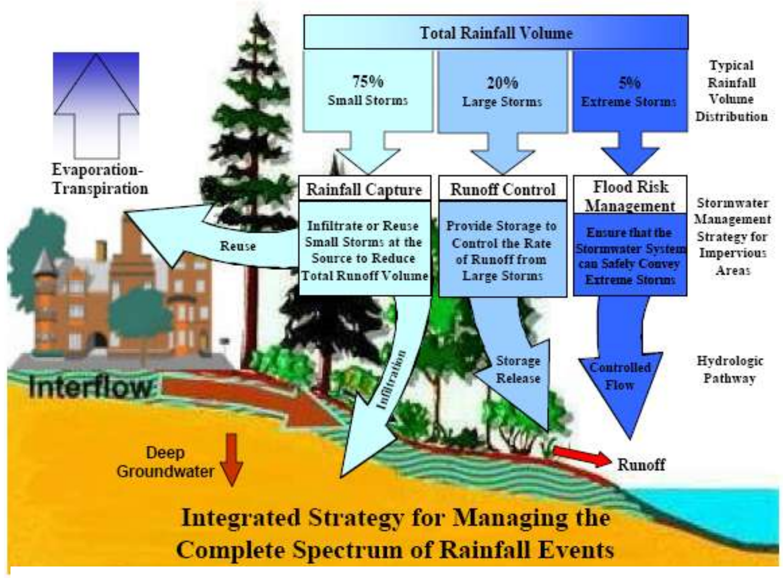

Figure 3.1. Diagram showing sustainable stormwater management practices. Source: Stormwater Planning – A Guidebook for British Columbia (BC Environment 2002).

Contaminants tend to accumulate on impervious surfaces between rainfall events. Consequently, concentrations in runoff tend to be highest at the beginning of a storm event. Capturing the rainfall from these smaller, more frequent events detains stormwater and promotes sedimentation of contaminants. The amount of stormwater runoff from any given storm that should be captured and treated in order to remove a majority of stormwater pollutants on an average annual basis is called the Water Quality Volume (WQV). The US EPA (2004) reported that most pollutants are washed into streams during smaller storms that account for 90% of the annual rainfall events, such as those generated by 13 to 25 mm (½ to 1 inch) of rainfall.

Maximum Allowable Release Rates

As part of the Instream Flow Needs Study, an assessment of predevelopment unit area flow rates was completed (WER 2005). Results indicate that the maximum post-development peak flow rates (in L/s/ha) for Nose Creek that would maintain the natural flow regime and preserve the integrity of the creek are less than the current 2.6 L/s/ha for a 1:100 year condition.

Low Impact Development

Low-impact development strategies and stormwater runoff volume control practices should be incorporated into old and new developments to minimize impacts from urbanization. A development is considered 'low impact' when the post-development runoff conditions mimic the pre-development rates and volumes for smaller storm events and severe, infrequent events. This is typically achieved through reduction in the level of imperviousness and integration of best management practices (BMPs) in subdivision design, including "green infrastructure" features, and stormwater reuse. In some cases, precipitation captured at the source can be returned to the original, natural hydrologic pathways through infiltration and evapotranspiration.

Properly sized and designed structural BMPs used to satisfy runoff volume control recommendations may also simultaneously serve as water quality treatment BMPs (e.g. bioretention areas, cisterns and rain barrels). The use of BMPs can simultaneously contribute to runoff volume control and attainment of water quality volume objectives (Appendix E).