City of Prince Albert Design Standards

Design Basis, General Considerations, Stormwater Management, Water Distribution, Transportation, Post Lot Development Issues

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City of Prince Albert

TABLE OF CONTENTS

SECTION 1: DESIGN BASIS

The mission of the City of Prince Albert is to anticipate, encourage and prepare for growth and be responsive to the needs of our community. As well, the City will create infrastructure that supports growth while planning for continuous improvement.

1.0 PURPOSE

Design standards are an important part of accomplishing the mission of the City of Prince Albert. Standards are meant to provide a service for designers, giving clear direction and allow them to streamline the design, review and approval process. Design standards also demonstrate leadership by providing specifics with regard to the vision of building and maintaining a healthy, attractive and economically viable city. Finally, design standards assist the community by providing a common set of requirements based on the unique conditions encountered in Prince Albert.

The design standards are being issued to provide additional guidance to developers and their consultants. These standards will provide a consistent approach to development by clearly defining the expectations of the City of Prince Albert. The intent of the design standards is not to simply dictate what would be an acceptable design but to provide the design basis, which can be used to evaluate novel or innovative designs. Options and design guidelines will also be proposed in areas where strict standards are not required.

One goal of development is to provide a safe and enjoyable place for people to live and work. This must be done in a cost effective manner while considering environmental impacts as well as future maintenance and replacement costs. This is in fact the vision statement of the design standards that guides the development of the rest of this document.

The objectives of the design standards are:

i. To provide clear standards to designers regarding the design of infrastructure in the City of Prince Albert.

ii. To ensure that infrastructure built for the City of Prince Albert meets community quality of life expectations by being safe, functional, and aesthetically pleasing, while protecting the environment, and having reasonable life cycle costs.

1.1 DESIGN PRINCIPLES

The intent of providing overall design principles is to describe the desired outcomes. With a clear idea of the intent behind a standard, it becomes easier to interpret and apply in atypical situations. This also gives freedom to designers with regard to an innovative design, which is true to the overall intent of the standards but may not fit within all the specific requirements.

These basic design principles are a reflection of the community's quality of life expectations. Infrastructure is built to serve the community and it is the community that determines the service levels. The citizens should not be expected to adapt their lifestyle to fit within the municipal infrastructure but rather municipal infrastructure should be adapted to meet community expectations.

1.1.1 Safety

Public safety is the highest priority. Designers must consider safety as a high priority. This includes physical safety of the City's citizens as well as the safety of the City staff required to operate and maintain the facilities. Safety in this context also means the protection of health and property.

1.1.2 Functionality

The design elements must function reliably for their expected design life, providing a level of service on par with prevalent community expectations. The citizens of our community have come to expect a certain level of service and quality of life. New additions to the system must not negatively impact existing levels of service. The City of Prince Albert defines community expectation through the use of public forums, project committees and day-to-day interactions with the public.

1.1.3 Aesthetics

Extensive consultation with the public resulted in community values such as "small town atmosphere", cleanliness, parks, playgrounds and wide tree lined streets being articulated in the Official Community Plan. Aesthetics applies at the contact points between the physical infrastructure and the community, specifically to those areas and structures which will be seen and used by the public.

1.1.4 Environmental Protection

As stewards of the environment charged with creating a healthy city and protecting the natural endowments within our jurisdiction, the City of Prince Albert promotes any design measures which reduce or mitigate the impacts of development.

Some basic environmental principles can be defined to assist in decisions about infrastructure design and subdivision planning. Best practices in municipal servicing incorporate such principles. The City of Prince Albert promotes design choices and processes based on these principles. Design options should:

i. Enhance energy conservation and the efficient use of energy while decreasing emission that contributes to air pollution.

ii. Acknowledge the regional environmental conditions, park land ecosystem and prevailing west winds.

iii. Create and enhance opportunities for bio-diversity and maintenance of natural ecological function.

iv. Consider the effects of environmental hazards on development.

Stricter Environmental Protection standards are on the horizon for many aspects of development. These include such items as stormwater management and wind erosion protection. The citizens of our community have also identified environmental protection as an important priority. The City of Prince Albert wants to take a proactive approach to protecting the environment from adverse impacts of development and living.

1.1.5 Life Cycle Costs

The cost of maintaining and eventually replacing infrastructure ultimately becomes the responsibility of the City. Design of new infrastructure must take this factor into account in order to obtain the best possible balance between initial capital costs, future maintenance costs, ongoing replacement costs and the other design principles. Providing a well-thought-out design that considers the cost, ease and frequency of maintenance and then following up with quality construction are the main factors needed to achieve reasonable life cycle costs.

1.2 RELATED RESOURCES – PROVINCIAL AND FEDERAL REQUIREMENTS

The City of Prince Albert Design Standards supplements the existing standards, codes, guidelines and regulations regarding municipal infrastructure. These design standards provide additional detail for conditions unique to Prince Albert. Even though the requirements of the City of Prince Albert Design Standards have been met the developer is still responsible to comply with other appropriate regulations and obtain the required provincial and federal approvals.

1.2.1 Planning and Development

The City of Prince Albert follows the following Provincial Legislation for planning and development purposes:

i. *The Planning and Development Act.*

ii. *The Cities Act.*

1.2.2 Design Standards

These design standards refer in large extent to the most recent provincial and federal standards and guidelines referred throughout the document. All Water Distribution, Sanitary Sewer and Stormwater Management Systems must be designed so that they meet, as a minimum, the standards and design requirements set out in the latest editions of the Federal, Provincial and Municipal Bylaws.

This document takes its direction from the City of Prince Albert's Official Community Plan and the standards presented here naturally flow out of the community values and planning goals stated there. Developers are also referred to the following City of Prince Albert documents which provide additional information governing the subdivision development approval, construction and handover process:

i. 2014 City of Prince Albert Master Specifications, updated 2017.

ii. 2014 City of Prince Albert Standard Detail Drawings, updated 2017.

iii. 2015 City of Prince Albert Water Hydraulic System Analysis.

iv. 2016 City of Prince Albert Storm Hydraulic System Analysis.

v. 2017 City of Prince Albert Sewer Hydraulic System Analysis.

vi. 2017 City of Prince Albert Transportation Study.

SECTION 2: GENERAL CONSIDERATIONS

2.0 INTRODUCTION

This section covers general issues including infrastructure planning requirements, utility line assignments, developer fence locations, entry features, setbacks and other design issues not specifically noted in other chapters.

2.1 IN GENERAL

The overall design principles described in the introduction to these standards is the basis on which all construction is undertaken in the City of Prince Albert. These guiding principles are expanded below to provide more specific guidance related to the general issues described above.

2.2 LEVEL OF SERVICE OBJECTIVES

2.2.1 Utilities

The community at large expects building lots to have access to all utilities including shallow utilities consisting of electricity, telephone, cable and natural gas. This standard documents how location assignments are made in the road right of way and easements for each utility. This is done so that services can be provided in a consistent manner without the creation of unnecessary conflicts in facilitating the maintenance and repair of the services.

2.2.2 Safe Development Setback Line

The safe development setback line is established with the safety of the public and environmental considerations in mind. These setbacks provide that buildings are not built so near existing right of ways that they would be endangered by the public and protects environmentally sensitive areas and ecosystems. In determining where property lines are located in relation to the safe development setback line, the principle is that no additional restrictions should be placed on the adjacent lots.

2.2.3 Planning Requirements

These infrastructure planning requirements should be viewed as a supplement to the requirements and process administered by the Planning and Development Department. Contact the Planning and Development Department for detailed planning requirements for Master Plans, Development Plans and Subdivisions.

2.3 MASTER PLAN – INFRASTRUCTURE REQUIREMENTS

2.3.1 Stormwater – Master Plan Requirements

A Master Plan shall include the following information regarding stormwater management:

i. Definition of general catchment areas.

ii. Predevelopment peak flows, volumes and hydrographs, inflow and outflow points.

iii. Post development peak flows, volumes and hydrographs.

iv. Generalized storm pond locations and storage volumes.

v. Proposed location of connections to the downstream Major and Minor systems and proposed release characteristics at each location compared to pre-development characteristics.

vi. Description of the impacts of the proposed development on the downstream Major and Minor systems and a description of measures proposed to offset negative flooding, erosion and water quality impacts caused as a result of the development.

vii. A map or description of the Major system flow routes from the boundary of the development to the outlet. Outlets will usually be considered as the first water body or natural channel reached by stormwater runoff from the development.

viii. System performance for low intensity long duration storms will need to be reviewed. Particularly the performance of stormwater ponds. Examples of these events are to come from actual Environment Canada precipitation data for Prince Albert.

ix. Identification of offsite water system extensions are required to provide service to the development area complete with order of magnitude cost estimates and projected year of construction.

2.3.2 Sanitary Sewer – Master Plan Requirements

A Master Plan shall include the following information regarding the sanitary sewer system:

i. Generalized trunk layouts, particularly where they are not expected to follow roadway alignments.

ii. Land use and sewage generation rates.

iii. Expected peak flows and design flows.

iv. Impacts on the existing system and capacity of the existing system at connection locations.

v. Estimated sewer catchment boundaries at each connection point.

vi. Conceptual location and size of lift stations and force mains.

vii. Identification of offsite sanitary sewer system extensions required to provide service to the development area complete with order of magnitude cost estimates and projected year of construction.

This analysis may require a computer network analysis.

2.3.3 Water Distribution – Master Plan Requirements

A Master Plan shall include the following information regarding the water distribution system:

i. Land uses, expected peak demands, fire flow requirements.

ii. General pipe layouts.

iii. Impacts on the existing system and capacity of the system at connection points.

iv. Identification of offsite water system extensions required to provide service to the development area complete with order of magnitude cost estimates and projected year of construction.

This analysis may require a computer network analysis.

2.3.4 Transportation – Master Plan Requirements

A Master Plan shall include the following information regarding the transportation system:

i. Definition of general land use areas.

ii. Estimated trip generation data for the various land use areas.

iii. General locations of arterial and major collector roads and intersections.

iv. General location of pedestrian and bicycle corridors and circulation routes.

v. Impacts on the existing system and proposed measures to mitigate negative impacts on adjacent arterial roads.

vi. Impacts on the development from noise off arterial roads and proposed measures to mitigate noise.

vii. Schematic representation of proposed transit routes.

viii. Identification of offsite arterial road extensions required to provide access to the development area complete with order of magnitude cost estimates and projected year of construction.

Additional analysis may be required for high traffic generation land uses and areas with limited capacity for increased traffic volumes.

2.3.5 Parks And Open Space – Master Plan Requirements

A Master Plan shall include the following information regarding parks and open space:

i. General locations of parks and open space.

ii. Estimated percentage of reserve dedication by type zoning.

iii. Classification of municipal reserves.

2.4 DEVELOPMENT PLAN – INFRASTRUCTURE REQUIREMENTS

The Planning and Development Department is the focal point for the development plan process. All required development plan information should be submitted to Planning and Development for distribution.

For each development plan, Planning and Development will distribute to Public Works and Community Services for review and comment.

2.4.1 Stormwater – Development Plan Requirements

The following information regarding stormwater management shall be included with the supporting documentation submitted with the outline plan:

i. A description of any differences between the Area Master Plan and the proposed development plan with regard to the storm water management system.

ii. A conceptual overland drainage plan showing major system overland flow routes and trapped lows within the entire development and demonstrating continuity of flow from upstream developments through the proposed outline plan area.

iii. A conceptual servicing plan showing the routing of trunk lines and pond outlets.

iv. Description of how development phasing has been considered so that at no time are the identified peak release rates exceeded during the period from the start of development to the complete build out of the area. The description should include those trigger points, showing by area, when various stormwater management facilities become necessary.

v. Refined storm pond locations and volumes and a description of phasing strategies if required.

vi. Description of proposed sources of make-up water for wet pond facilities.

2.4.2 Sanitary Sewer – Development Plan Requirements

The following information regarding the sanitary sewer system shall be included with the supporting documentation submitted with the development plan:

i. A comparison between the Master Plan and the development plan noting the changes and their impacts.

ii. A conceptual servicing plan will be included with the information showing the location of sanitary sewers, lift stations and any other sanitary facilities.

iii. A description of development phasing, noting trigger points where sanitary sewer facilities or upgrades are required. The phasing should identify by area when each lift station is required.

2.4.3 Water Distribution – Development Plan Requirements

The following information regarding the water distribution system shall be included with the supporting documentation submitted with the development plan:

i. A comparison between the Master Plan and the development plan noting the changes and their impacts.

ii. A conceptual servicing plan will be included with the information showing the location of water mains and any other water distribution facilities.

iii. A description of development phasing, noting trigger points where water distribution facilities or upgrades are required in order to ensure defined levels of service are maintained.

2.4.4 Transportation – Development Plan Requirements

The following information regarding the transportation system shall be included with the supporting documentation submitted with the development plan:

i. Any differences between the Master Plan and the proposed development plan.

ii. Location of all roads and laneways within the development.

iii. Identification of roads as Arterial, Collector or Local.

iv. Intersections which will require signals and the development trigger points where they become necessary.

v. Location and conceptual plan of entryway features.

vi. Description of the impacts of the proposed development on the adjacent existing transportation system.

vii. Preliminary projected phasing and timing of the build out of the area, noting trigger points at which transportation facilities or upgrades are required.

2.4.5 Parks And Open Space – Development Plan Requirements

The following information regarding Parks and Open Space shall be included with the supporting documentation submitted with the development plan:

i. Location and boundaries of land dedicated as Municipal Reserve.

ii. The amount of land and percentage dedicated in the completed subdivision.

Detailed open space planning begins based on the approved development plan. A detailed landscape plan will be developed using a public input process that includes the developer and the City of Prince Albert. The detailed landscape plan shall be submitted to the Community Services Department for final approval.

2.4.6 Electric Distribution – Development Plan Requirements

A copy of the development plan showing the general layout of the street lights is required.

2.4.7 Construction Approval – Infrastructure Requirements

Prior to requesting a service agreement and submitting engineering drawings for construction approval, new phases of development must follow the appropriate process for subdivision.

Developers must also have a detailed landscape planning process for Municipal Reserve.

Developers must also have a detailed stormwater plan for the development.

2.4.8 Construction Approval Submission

Submissions for construction approval shall include the following:

i. A letter stating that these design standards have been followed and detailing any deviations from the standards along with a justification for the deviation.

ii. Engineering drawings of the subdivision stamped by a Professional Engineer registered to practice in the Province of Saskatchewan.

a. The engineering drawings shall follow the requirements under the City's Master Specifications and Standard Detail Drawings and be sufficiently detailed to construct the infrastructure required for the development.

b. The drawings shall also include any additional information requested by Public Works acting reasonably.

iii. Drawings and supporting documentation describing the stormwater system shall include the following information:

a. A description of how the area fits in with the rest of the development in terms of drainage, showing that peak release characteristics from the entire development are still below previously defined limits.

b. Any interim stormwater management measures required to maintain stormwater releases within requirements.

c. Any interim erosion control measures required to protect flow routes until build out is complete.

d. Estimated flow depths and velocities for critical locations such as storm pond inlets, outlets and overflows.

e. Extent, depth, volume and duration of ponding in both trapped lows and ponds.

f. A description of how the storage provided in ponds and trapped lows complies with the requirements of the outline plan.

iv. Drawings and supporting documentation describing the sanitary and water systems shall include the following information:

a. A description of how the area fits in with the rest of the development.

b. All pipe and appurtenances required for the utilities.

v. Drawings and supporting documentation describing the transportation system shall include the following information:

a. Location of all lot lines and identification of the ultimate number of dwelling units served at intersections and links or estimated trip generation data.

b. Any interim measures required to provide access to the area for regular traffic and/or emergency services until build out is complete.

c. Detailed irrigation and landscaping plans for entryways, boulevards and medians and any other area that will ultimately be maintained by City forces.

vi. The drawings shall include a grading plan showing any pre-existing conditions that may affect building construction such as fill in excess of 1.2 m deep, previously buried pipe or dugouts.

vii. The drawings shall include the proposed types and locations of all developer constructed facilities within or adjacent to roads, public right of

ways and easements. This particularly applies to fences, entryway features, trees, bushes, boulevard landscaping, and irrigation systems.

viii. Detailed landscape plans of all Municipal Reserves in the current phase as approved by Community Services or an indication that the minimal landscaping requirements under the service agreement will be followed.

ix. Drawings shall include proposed locations for the fire hydrants, Canada Post mail boxes and Saskatchewan Power Corporation street lights.

2.5 ENVIRONMENTAL CONSIDERATIONS

As stewards of the environment charged with creating a healthy city and protecting the natural endowments within our jurisdiction, the City of Prince Albert promotes any design measures which reduce or mitigate the impacts of development.

Environmental principles of design are discussed in Section 1.1 Design Principles. For the environmental principles to be effectively translated into action they must be considered at all stages of the planning and design process.

2.6 TECHNICAL STANDARDS

2.6.1 General Conditions

i. Utilities Located in Lanes:

Generally, utilities are not to be located in lanes. In those cases where a utility located in a lane is considered advantageous the Director of Public Works will consider it on a case by case basis. In those cases where a utility in a lane is being extended from a previous phase of development the utility shall only continue along the lane to the first available location where it can be brought to the front of lots.

ii. Standard Line Assignments:

The standard line assignment and depth zone for the various deep and shallow utilities can be found in the current edition of the City of Prince Albert Master Specification and Standard Detail Drawings.

2.6.2 Fences, Entryways and Other Features

i. Permanent structures built by the developer and located in or adjacent to the road right of way should be located so they do not conflict with the standard line assignments.

ii. Detailed plans describing the make up of landscaping, fences and entry features to be handed over to the City of Prince Albert must be submitted for approval when requesting a service agreement. Features and landscaping, which require minimal maintenance or are easily maintained by existing City equipment, are preferred.

iii. The developer shall provide access to the flanking boulevards from adjacent properties to minimize the amount of boulevard to be handed over to the City for maintenance. Standard practice within Prince Albert is that

the adjacent property owner is responsible for maintenance of the adjacent boulevards and associated landscaping.

SECTION 3: STORMWATER MANAGEMENT

3.0 INTRODUCTION

This section covers the design of Stormwater Management facilities including, but not limited to, conveyance systems, storage systems, and treatment.

3.1 GENERAL

The overall design principles described in the introduction to these standards are the basis on which all construction is undertaken in the City of Prince Albert. Often a combination of principles will come into play when designing a particular component of the system.

The purpose of stormwater management is to handle precipitation so it does not become an inconvenience or present a hazard to the community while also reducing impacts on the environment. Current practice is to use a system of underground pipes, overland flow routes as well as wet and dry stormwater detention facilities.

Prince Albert would like to take a proactive role in promoting measures to reduce the impacts on the environment due to development. In this respect these guidelines may be more restrictive than the requirements of Saskatchewan Ministry of Environment.

The system must be designed to provide access to components for maintenance. Overland conveyance routes should be designed to limit the potential for erosion. Outfalls and other structures must be as low maintenance as possible.

Stormwater facilities should be designed to be neat and tidy with a minimal amount of maintenance. Wherever possible, stormwater facilities such as wet or dry ponds or major system conveyance should be integrated into a multi-use facility. In combined open space/stormwater facilities the area's primary purpose will be as community green space with the stormwater purpose as a secondary role. The pond's shape, slopes, inlets and outlets must be designed with safety and aesthetics in mind.

New systems must be designed without exceeding peak flow capacities of the older systems to which they connect; this applies to both overland flow routes and well as underground components of the system.

The designer must take into consideration safety concerns in the design of storm management facilities because rain and runoff events can be sudden and unexpected.

The following safety factors should be considered in the design of stormwater management facilities:

i. Depth, speed and extent of overland flow and ponding
ii. Preventing access to the piped portion of the system
iii. Ability to escape from ditches and ponds
iv. Preventing the formation of slipping hazards
v. Access for emergency service vehicles
vi. Prevention of flooding and erosion damage

3.1.1 Level of Service Objectives

Level of service for Stormwater Management Systems has traditionally been defined using the return period of the design storms used to size the system. This is described in terms of the Major and Minor systems. The Minor system handles small frequent runoff events and currently consists mainly of underground pipes. The Major system handles any runoff which cannot be taken by the Minor system and usually consists of overland flow from large infrequent events.

i. The Minor (underground) portion of the system shall be designed with capacity for a one in five (1 in 5) year storm. The piped system shall convey flows from 1 in 5 year storm. Ponding in trapped lows shall not occur for storms up to and including the 1 in 5 year event. Ponding and overland flow must be confined to public property and right of ways. Section 3.2 provides minor system design guidelines.

ii. The Major system, storm ponds and overland flow within new developments shall safely handle a one in one hundred (1 in 100) year event without causing flooding of private property or erosion damage. Ponding and overland flow shall be confined to public property and right of ways and be limited to no more than 300 mm deep as measured at the gutter of the streets for the 1 in 100 year event. Once collected, stormwater shall remain on public property. Section 3.3 provides Major system design guidelines.

iii. Peak post development flow rates shall not exceed pre-development flows resulting from the 1 in 5 year event. Where downstream constraints exist, post development flow rates may be restricted to less than the 1 in 5 year pre-development flow. The allowable release rate shall be maintained for all design storms up to and including the 1 in 100 year event.

iv. New developments must include measures to improve stormwater quality. Erosion and sediment control must be in place as permanent features of development. These include grassed swales and runways to trap silt and ponds designed with dimensions and detention times promoting settling. Higher priority will be placed on environmental considerations along the river banks and adjacent to environmental reserves. The City has already taken steps to improve stormwater quality by implementing a street cleaning program, placing limitations on pesticide use, instituting a doggie bag program and requiring catch basin sumps.

3.1.2 Regulations

The following list is the regulations which have provisions that pertain to stormwater management applicable within the City of Prince Albert:

i. Storm Sewer Bylaw;

ii. Connections Bylaw;

iii. Standard Construction Specifications and Drawings, Roadways, Water, and Sewer, City of Prince Albert;

iv. Stormwater Guidelines, Water Security Agency;

v. The Occupational Health and Safety Act, Province of Saskatchewan;

vi. The Plumbing and Drainage Regulations, Province of Saskatchewan;

vii. National Building Code;

viii. PVC Pipe: Design and Installation, (M23), American Water Works Association (AWWA); and

ix. PE Pipe: Design and Installation, (M55), AWWA.

Designers are encouraged to contact the Provincial and Federal governments with regard to regulations which may apply but are not listed here.

3.1.3 Stormwater Planning Requirements

See Section 2.4 for Infrastructure Planning Requirements.

3.1.4 Environmental Considerations and Best Management Practice

See Section 2.5 for Environmental Considerations.

3.1.5 Erosion Control and Sedimentation

i. Erosion protection shall be adequately provided on all permanent surfaces and channels in the development area to resist the 1 in 100 year event.

ii. Concentrated flows over the top of the riverbank, down unprotected slopes or into unprotected ditches and swales will not be permitted. Sheet flow must occur along the entire top of bank and adequate erosion controls must be implemented to prevent rill erosion and gully formation. In conjunction with erosion protection, slope drains may be used to collect flows and safely convey them to the bottom of the slope.

iii. Catch basins shall be provided with a sump to improve sedimentation.

3.1.6 Reducing Hazardous Chemicals, Petroleum Products, Pesticides and Herbicides

i. Stormwater containment and treatment will be required for developments proposing to use hazardous materials on site. It is recommended that developers contact the Director of Public Works at the concept stage when considering these types of facilities.

ii. Stormceptors or other oil and grit separators should be considered for any development with large parking areas or where there is a risk of a petroleum product spill.

iii. Stormceptors or an approved alternate oil and grit separator will be required at all sites containing gas stations. The device shall be installed inside the car washers, repair shops, etc.

iv. Please refer to Community Services Parks and Open Space Standard with regards to planting designs and methods that are naturally pest and weed resistant.

3.1.7 Stormwater Quality Best Management Practices

The City of Prince Albert strongly recommends the use of any measures taken in the design which improve stormwater quality, reduce peak flows and reduce runoff volumes. The following items are suggested for consideration in new developments:

i. Grass swales and runways should be incorporated into pond inlets and green strip conveyance paths. Flow spreaders to encourage sheet flows across grassed areas are highly desirable. Flows across vegetation have been shown to be effective in improving stormwater quality and in reducing volumes.

ii. Appropriately sized trash racks and properly designed transitions from paved to grass areas, which will limit the transport of materials off the street into the piped portion of the system.

iii. Constructed wetlands which mimic natural processes for treating stormwater should be considered a viable alternative to either dry ponds or wet pond features. Constructed wetlands and similar features would be especially appropriate for use in developments adjacent to the river valley provided that safe set back requirements are followed.

iv. Wet and dry ponds with larger length to width ratios are preferred because of their increased sedimentation efficiencies. Target length to width ratios are greater than 5 to 1. Increased flow path lengths can be achieved through the use of interior berms and baffles. Minimum accepted ratio is 3 to 1.

v. Where possible detention times of 24 to 48 hours should be used for ponds to allow greater time for sedimentation.

vi. Sediment fore bays are encouraged at pond entrances. Fore bay designs should include consideration of access for maintenance and sediment removal.

3.2 ESTIMATION OF PEAK FLOWS, RUNOFF VOLUMES AND HYDROGRAPHS

3.2.1 General Rules of Thumb

In order to provide a quick design and review of stormwater management systems the City has created the following rules of thumb:

i. Major overland flow – 200L/sec/Ha

ii. Minor system flow – 90L/sec/Ha

iii. Wet Pond Storage – 1000m^3/Ha for 0 release rate situations

iv. Pond size is to be a minimum of 1Ha of normal water level area but larger is preferred

The City will not require any computer model simulation unless these values are unattainable.

3.2.2 Computer Model Simulation

Computer simulation will be required to assess the impacts of added development on the stormwater system and to assist in designing detention facilities for optimal release rates and timing. The City establishes allowable release rates based on previously submitted stormwater management reports. Where designers can show that capacity is available in the downstream system larger release rates may be allowed. Digital format to be compactable with the City hydraulic model.

3.2.2.1 Design Storms

The following storms shall be used to evaluate the stormwater management system behavior:

i. One in two year 1 hour duration storm

ii. One in five year 1 hour duration storm

iii. One in one hundred year 12 hour duration storm

Additional storm of varying duration and return periods should be used to adequately design stormwater management systems. Though not a requirement it is suggested that historic long-term precipitation data and data from historical storms be used to evaluate the performance of stormwater management designs.

3.2.2.2 Natural Conditions

Natural conditions refer to the state of the land in the development area prior to its alteration by people. The impacts of the proposed development on peak flows and volumes shall be evaluated based on the following baseline conditions. The following table describes the general parameters to be used for the estimation of runoff characteristic resulting from natural conditions. These values represent typical conditions for Prince Albert and are provided as guidelines. Where a designer has more accurate information or actual values, they should be used.

3.2.2.3 Rational Method

The imperviousness for the existing neighbourhoods was measured using aerial photographs. For catchments composed of only single-family residential lots, typical impervious values were determined and applied throughout the study area, as shown in Table 3.2.2.3(a). For catchments that contained a mixture of land uses (e.g. multi-family residential, commercial, schools, parks), the imperviousness was calculated manually. Standard impervious values were used for the future development areas, as shown in Table 3.2.2.3(b).

Table 3.2.2.3(a): Imperviousness Values Single Family Residential Lots

Land-Use	*Percent Impervious*	*Runoff Coefficient*
Grassed	0%	0.10
Full Lot	30%	0.34
Front Half of Lot	40%	0.42
Back Half of Lot	20%	0.26
Streets	100%	0.90

Table 3.2.2.3(b): Land-Use Runoff Coefficents	
Land-Use	*Runoff Coefficent*
Residential	0.60
Multi-Residential	0.80
Commercial	0.80
Park	0.30
Farmland	0.20
Wet pond	1.00
School	0.30
Light Industrial	0.65
Heavy Industrial	0.75

3.2.2.4 Rainfall Intensity – Frequency - Duration

The effective Runoff Coefficient (*Ceff*) used in the Rational Method is related to the percent impervious value (*%Imp*). It may be calculated as a weighted average using the Runoff Coefficients for an impervious area (e.g. pavement) and a pervious area (e.g. grassed):

$$Ceff = \frac{\%Imp\ (Cimp) + (100 - \%Imp)(Cperv)}{100}$$

- C*imp* is the Runoff Coefficient for an impervious area (0.90)
- C*perv* is the Runoff Coefficient for a pervious area (0.10)

Subcatchment width was calculated based on the area and shape of the catchment. Subcatchment slope was set as the slope of the dominant flow path (2% for residential lots).

Design storms were derived from Intensity-Duration-Frequency (IDF) data collected by Environment Canada at the Prince Albert Airport (Glass Field) for the period of 1960 to 2001. Equations to fit the IDF curves were developed and were of the form:

$$i = \frac{a}{(t + b)^c}$$

- i is the average intensity (mm/h)
- t is time (minutes)
- a, b, c are coefficients to fit the equation to the IDF data

The coefficients for the 2, 5, 25, 50, and 100 year design storms are shown below in Table 3.2.2.4. From the IDF equations, rainfall hyetographs were generated for the following design storms: 2 year 1 hour, 100 year 1 hour (Chicago distribution) and 100 year 12 hour and 100 year 24 hour (Huff II

distribution). The rainfall data was imported into XPSWMM as a tipping bucket gauge with the interval of the bucket tip set to the time step of the design storm.

Table 3.2.2.4: IDF Coefficients			
	a	***b***	***c***
2 year	416.79	3.2	0.766
5 year	577.06	2.7	0.769
25 year	785.39	2.1	0.762
50 year	881.85	2.0	0.763
100 year	986.97	2.0	0.766

The hydraulic system was modelled in XPSWMM as a node and link system where the nodes represent manholes or ponds and the links represent pipes (or the drainage channel).

For further information on rainfall intensity duration frequency data for the City of Prince Albert visit the Environment Canada website.

3.3 MINOR SYSTEM

The Minor system shall be designed to accommodate the 1 in 5 year event. The Rational Method shall be used to determine design flows. Computer modelling shall be used to confirm design. The Minor system shall be evaluated to confirm that runoff during design events will be conveyed to adequate receiving waters without surcharging the pipe system. The release rate from a new neighbourhood shall not exceed the capacity of the downstream system, or as set by the Public Works Department.

3.3.1 Gravity Flow

Gravity storm mains shall be sized for full flow during the total design peak flow. The Manning Equation shall be used for the design and modelling of gravity sewers.

$Q = (A*R^{2/3}*S^{1/2})/n$ Where: Q = Flow (m^3/s)

A = Cross-sectional area of pipe (m^2)

R = Hydraulic radius (area/wetted perimeter) (m)

S = Slope of hydraulic grade line (m/m)

n = Manning coefficient = 0.013 for all approved materials in straight alignment (s/m 1/3)

3.3.2 Velocity

Guidelines for Storm Works Design, a mean velocity of 0.61 m/s shall be maintained during average flow conditions to provide self-cleansing flow. The maximum velocity shall be 3.0 m/s to reduce the risk of undue turbulence and scour.

3.3.3 Size

The minimum size of gravity storm main pipe shall be 250 mm diameter.

3.3.4 Slope

Storm mains shall be laid in a straight alignment between manholes at the following minimum grades:

Sewer Size (mm)	Minimum Slope (%)
250	0.40
300	0.28
375	0.22
450	0.15
525	0.12
600 and greater	0.10
675 and larger	0.0812

3.3.5 Trapped Lows (Minor System Storage)

i. New developments shall be designed to limit the number of trapped lows required. The additional storage provided by trapped lows is marginal and the additional maintenance required by the use of Inlet Control Devices makes trapped lows undesirable.

ii. Trapped lows shall be designed so no significant ponding occurs for events up to the 1 in 5 year event. The maximum depth of ponding in trapped lows shall be 300 mm as measured from the gutter for the 1 in 100 year event. Detailed design drawings shall show the extent of flooded area at trapped lows during a 1 in 100 year rainfall event.

iii. Ponding in trapped lows shall be contained within the road right-of-way or public property.

iv. Overland flow routes out of trapped lows must conform to the requirements of Section 3.3.1.

v. Trapped lows shall not be located so they inundate sanitary manholes. Where sanitary manholes must be located within trapped lows, special provisions to limit stormwater inflow to the sanitary sewer must be taken and approved by the Public Works Department.

vi. Trapped lows shall be surveyed and the actual extents, spill elevations and catch basin elevations confirmed on the as-built drawings.

3.3.6 Piped System and Gutters

i. The minimum grade on gutters or paved surfaces shall be 0.6%. Greater grades are preferred on curved gutters and curb returns.

ii. Minimum grade of lanes shall be 1.5% for a minimum distance of 5 m from the back of concrete along the lane. The minimum grade of lanes shall be 0.6% at other locations.

iii. The surface of the asphalt in the lane shall be at least 12 mm higher than the concrete where the asphalt meets the back of concrete.

iv. Maximum depth of flow in gutters for the 1 in 5 year event shall be the lesser of 150 mm or the height of the sidewalk top above the gutter.

v. In the design of pipes a roughness coefficient equivalent to The Manning Equation of 0.013 shall be used to account for the degradation of the pipe over time.

vi. The piped system shall be designed so that no surcharging occurs during the 1 in 5 year event.

vii. The minimum size of storm drainage piping shall be 250 mm diameter.

viii. Minimum depth of pipe cover shall be 1.9 m.

ix. Frontage piping shall be of adequate depth to receive connections from adjacent properties.

x. Maximum distance between catch basins shall be 150 m.

xi. Maximum distance between manholes shall be 150 m.

xii. For back of lot easement grading is Standard Detail Drawing 00-06-01.

xiii. For minimum lot grading is Standard Detail Drawing 00-06-02.

xiv. For lot grading of split drainage back to front or walk out basements is Standard Detail Drawing 00-06-03.

3.3.7 Catch Basins

i. Catch basins which discharge directly to the piped system without passing through a downstream detention facility are required to accommodate peak runoff for the 1 in 5 year event.

ii. For combined manhole and catch basins see Standard Detail Drawing 00-01-06.

iii. For standard catch basins see Standard Detail Drawing 00-01-07.

iv. Catch basins shall not be located in the expected wheel path of vehicles.

v. Catch basins shall not be located in front of driveways, wheelchair ramps or in entryways.

vi. Catch basins shall be built with a 450 mm deep sedimentation sump.

vii. Catch basins in lanes are discouraged where possible lanes shall drain to a street. Where required, catch basins located in lanes shall be constructed with 10 m of weeping tile installed below the granular base course down the centerline of the lane each direction from the catch basin.

viii. Catch basin leads to be installed with a minimum 2.00% grade.

3.3.8 Connections to Existing Piped Systems

i. The designer is required to show that the system downstream from the development has adequate capacity to accommodate changes in peak flows and volumes resulting from the development. The City will provide conservative estimates of downstream system capacities upon request.

ii. In areas where the stormwater system capacity is less than required for the 1 in 5 year return period, peak flows off the development/redevelopment must not be increased above predevelopment levels. Flows from the development must be retained on site and released so that the length and severity of surcharging in the downstream system is not increased.

iii. All individual lot developments greater than 2500 m² shall provide a stormwater management plan for review and approval, and shall require a private underground storm sewer service connection.

iv.

Table 3.3.8(a): Surface Run Off Coefficients	
Asphalt	0.95
Building	0.95
Concrete	0.95
Gravel	0.85
Grass	0.15

Table 3.3.8(b): Service Connection Manhole Requirement Chart

Storm Service-Service Connection Size (mm)

Main Size (mm)	200	250	300	375
200	Yes	N/A	N/A	See Below
250	Yes	Yes	N/A	See Below
300	No	Yes	Yes	See Below
375	Yes	Yes	Yes	See Below
450	See Below			

Each service larger than 375 mm will require review and approval by the Director of Public Works.

3.3.9 Manholes

Manholes shall be located at the upstream end of each line, at changes in size or alignment, at all junctions, and at all catch basin connections.

The minimum manhole diameter shall be 1.2 m. For pipes at depths greater than 5.5 m special manholes are required with safety platforms at intermediate levels. The lowest platform should typically be above the incoming flow. For standard manhole see Standard Detail Drawings 00-01-03, 00-01-04 and 00-01-05.

3.4 MAJOR SYSTEM

The Major system shall be designed to accommodate the 1 in 100 year 24 hour design event. Computer modelling shall be used to confirm that any flooding during design events shall be restricted to public areas. The grading of streets and the layout of the Major drainage system shall be assessed relative to the following guidelines during the design event. The maximum depth of ponding on the road shall be 0.30 m for all roadways. A depth of 0.45 m shall be considered if adequate justifications can be provided. In this case, the approval of the Public Works Department must be obtained. Continuity of the overland flow routes between adjacent developments shall be maintained.

3.4.1 Overland Flow

i. New developments shall have a continuous route for overland flow from the point of precipitation to a suitable outlet. Continuity of overland flow routes between adjacent developments shall be maintained. The overland flow route will handle runoff from storms that exceed the 1 in 5 year event.

ii. The route must be adequate to contain the 1 in 100 year event without causing flooding of private property or erosion damage to existing facilities. Flow and ponding shall be contained within public property and right-of-ways.

iii. Where private property is used to convey runoff from multiple lots:

   a. The means of conveyance shall be designed appropriately.

   b. The full width of flow under the design 1 in 100 year rainfall event shall be protected by an easement.

iv. Overland flow routes once they have reached public property must remain on public property. Providing an escape route for a trapped low via an easement between private residences will not be allowed. Overland flow routes of this type are only allowed along roadways, walkways, and other public properties such as Municipal Reserves.

v. The combined conveyance capacity of public right-of-ways downstream of a trapped low shall be equal to or great than the combined conveyance capacity of public right-of-ways upstream.

vi. Overland flow routes depth and velocity relationships will be determined for critical locations. Critical locations are those points where maximum flow rates are encountered, where high velocity flow is expected, where overland flow may present a danger to the public and locations where there is particular risk of significant erosion or flooding damage.

vii. Depth and velocity will be calculated using The Manning Equation for open channel flow or an approved alternative method.

viii. The following table provides safe flow velocity – depth relationships. Overland flows shall not exceed these limits for storms up to the 1 in 100

year event. In locations where these limits cannot be met measures must be taken to ensure public safety by limiting access and posting appropriate warning signs. Exceptions to these defined limits will be evaluated on a case-by-case basis. Note that Table 3.4.1 provides safety limits only and does not address erosion resistance requirements.

Table 3.4.1: Maximum Combination of Gutter Flow Depth and Velocity

Water velocity (m/s)	Maximum Permissible Depth (m)
0.50	0.80
1.00	0.32
2.00	0.21
3.00	0.09

3.4.2 Use of Roadways as Overland Conveyance

i. Local roadways may be used as part of the Major system conveyance route, provided that the requirements of Section 3.3.1 are adhered to for the 1 in 100 year event.

ii. Maximum depth of flow or ponding on local roads shall be 300 mm at the gutter of the road in a 1 in 100 year event.

iii. Collector roadways may be used as part of the Major system conveyance route, provided that the requirements of Section 3.3.1 are adhered to for the 1 in 100 year event.

iv. Depth of crossing flow or of ponding in trapped lows in Collector roads shall not exceed the lesser of 300 mm at the gutter of the road or 100 mm at the crown of the road in a 1 in 100 year event.

v. Collector roadways should have at least one lane which is not inundated parallel with the direction of flow.

vi. The travel lanes of Arterial roadways shall not be used as part of the Major system. The Public Works Department, on a case-by-case basis, will consider exceptions where it is especially difficult or expensive to prevent flows from entering the Arterial road right of way. In cases where Arterial roads must be used, the designer shall show that flow or ponding along the roadway will not adversely impact the operation of the Arterial road.

vii. Special permission must be obtained in order to use easements as part of the major overland flow route system.

3.4.3 Dry Ponds

i. Estimation of required storage volumes, peak flows and drainage times shall be done using an approved computer model.

ii. The pond shall provide sufficient storage so that operation of the emergency overflow does not occur during 1 in 100 year events.

iii. The dry pond shall be graded to properly drain all areas after its operation. The pond bottom shall have a minimum slope of 2.0% (Please refer to Community Services Parks and Open Space Standards for details).

iv. Ponds should be designed with organic shapes and undulating edges to provide visual relief. Rectangular ponds or dugout like ponds should be avoided.

v. The maximum 1 in 100 year high water level shall be 0.45 m below the floor elevation of the building on properties having a common property line with the pond.

vi. An emergency overflow shall be provided on all ponds. The path from the pond overflow to an approved outlet must be identified. Safe depth/velocity relationships cannot be exceeded and adequate erosion protection shall be provided for the emergency overflow and the overland flow routes within the development when operating with peak flows estimated for the 1 in 100 year event.

vii. All inlet and outlet structures associated with dry ponds shall have grates provided over their openings to restrict access and prevent entry into sewers by children or other persons. A maximum clear bar spacing of 100 mm shall be used for gratings.

viii. Grated outlet structures are to be designed with a hydraulic capacity of at least twice the required capacity to allow for possible plugging.

ix. Velocity of flow through gratings on inlets to pipes shall not exceed 1.0 m/s for maximum expected flows during the 1 in 100 year event.

x. Appropriate means of limiting access to outlets and reducing the danger of falls from headwalls and wing walls shall be taken.

xi. Where possible, dry ponds should be incorporated into parks and open space.

xii. In the design of combined park/dry pond facilities the park usage of the area shall take precedence over dry pond requirements.

xiii. Dry ponds located in parks shall include special needs access and egress points having slopes of less than 1 vertical to 12 horizontal.

3.4.4 Wet Ponds – Physical Characteristics

i. Estimation of required storage volumes, peak flows and drainage times shall be made using an approved computer model.

ii. The pond shall provide sufficient active storage so that operation of the emergency overflow does not occur during 1 in 100 year events.

iii. A minimum horizontal distance of 5 m shall be maintained from any property line to the high water level. 10 m will be required if a pathway is to be installed between HWL and the property line.

iv. A silt trap or forebay shall be provided at the inlet of each pond.

v. Access to the pond shall be provided to accommodate expected maintenance traffic including a boat ramp to facilitate maintenance for floating or submerged facilities.

vi. The lake bottom and side slopes shall be composed of an impervious material up to the 1 in 100 year level.

vii. The maximum 1 in 100 year water level shall be 0.45 m below the floor elevation of buildings on properties having a common property line with the pond.

viii. The lowest adjacent manhole invert shall be at or above the normal water level elevation.

ix. The pipe crown at the lowest manhole upstream of the pond shall be above the high water level during a 1 in 5 year storm event to limit back water effects.

3.4.5 Wet Ponds – Water Quality

3.4.5.1 Performance Objectives

Aesthetics: Maintain water clarity, colour and prevent odor and keep the pond looking and smelling clean.

3.4.5.2 Nutrient Control: (remove nutrients, litter/debris)

i. Suspended solids – 85% reduction of 75 micron particles and larger by weight.

ii. Total phosphorus and nitrogen – the pond shall incorporate proven strategies showing removals of these nutrients.

iii. Litter – the pond shall incorporate strategies that facilitate the trapping and subsequent collection of litter.

3.4.5.3 Design Considerations

i. Ponds shall be designed with sufficient area, dimensions, and flow characteristics to minimize aquatic weeds and maintain acceptable water quality. Inlets, outlets, pond shape, internal baffles and aquatic benching will be arranged to prevent stagnant areas and promote circulation. No dead bay areas shall be permitted. A wedge-shaped pond with the Major inflows on the narrow end can prevent short-circuiting and stagnation.

ii. Wet ponds should be designed with a length to width ratio of at least 3:1 to promote sedimentation. If the length to width ratio is lower the flow path through the pond should be maximized.

iii. Extents of Aquatic Benches: All ponds will include aquatic benches either:

a. As a continuous ring 2- 4 m in width around the perimeter of the permanent pool; or

b. Arranged in bands across the flow path covering a minimum of 20% of the open water area as measured at the normal water level. This type of aquatic benching will

be arranged as wetland zones at the inlet and outlets from the pond; or

c. RIP RAP: Where a vegetated aquatic bench is not provided for shoreline protection rip rap must be used. Rip rap is to be a minimum of 200 mm diameter stones to minimize loss as a result of rip rap being thrown into the lake.

3.4.5.4 Aquatic Bench Configuration:

i. The aquatic benches will have a maximum depth of 450 mm below the normal water line.

ii. Organic soils at least 150 mm in depth will be used as a planting bed on aquatic benches. Organic soils can serve as a sink for pollutants and generally have high water holding capacities.

iii. Vegetation will be seeded or planted to initiate the growth of aquatic plants. Robust, non-invasive, perennial plants that establish quickly are ideal. The designer should select species that are tolerant of a range of depths, inundation periods, etc. Monoculture planting should be avoided due to the risk from pests and disease.

3.4.5.5 Circulation / Turn Over

i. A source of water is to be provided to all ponds as a make-up water supply and to allow flushing / refreshing of the pond permanent pool during low precipitation and high temperature periods.

ii. A pond aeration and circulation system is to be provided for all ponds.

3.4.5.6 Landscaping

i. Park-like facilities adjacent to wet pond facilities shall comply with Community Services Parks and Open Space Standards.

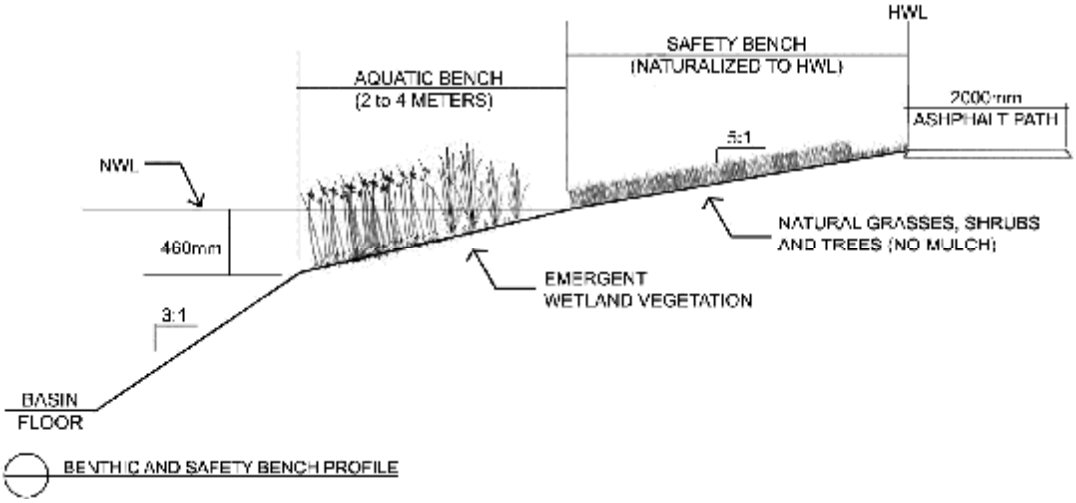
ii. Ponds should be designed with organic shapes and undulating edges to provide visual relief and integrate them into the park and open space. Rectangular ponds or dugout-like ponds should be avoided.

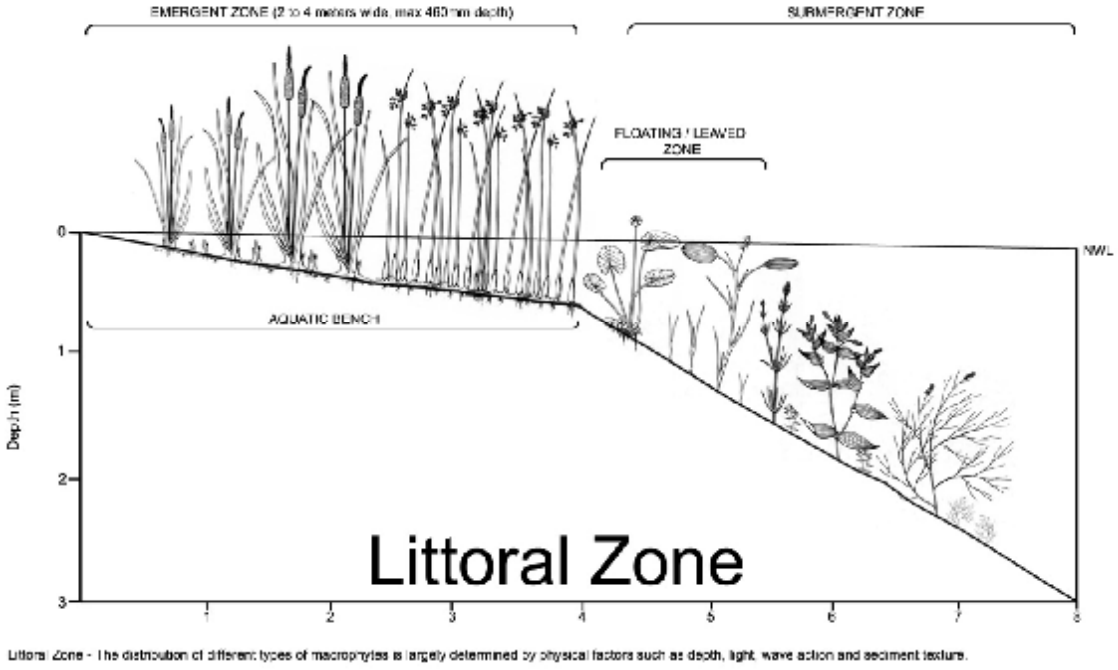
iii. Irrigation systems will not be installed below the High Water Level. Naturalized (native) vegetation is acceptable plant material between the HWL and NWL. All plant material below the HWL will require minimal maintenance.

iv. A physical division will be installed between the unmanicured vegetation below the High Water Level and manicured vegetation above it. This division can take the form of an asphalt pathway or moving strip.

v. When the irrigated areas in the vicinity of a wet pond exceed 2.5 ha the pond may become the park water supply and will require an irrigation pump house.

vi. If the lake is to be considered as a source for irrigation water then water quality must be modeled to ensure public safety.





Littoral Zone - The distribution of different types of macrophytes is largely determined by physical factors such as depth, light, wave action and sediment texture.

3.4.5.7 Storm Pumping Stations

See 5.4.6 Sewage Pumping Stations for details.

3.5 SERVICE CONNECTIONS

Effluent from sanitary sewers or surface drainage from industrial, agricultural or commercial operations that may be contaminated shall not be discharged to the storm sewer.

Connections from roof leaders shall not be made to the storm sewer system. Roof drainage from residential housing units, apartments, commercial and industrial buildings shall discharge to grassed or pervious areas except where building density makes this impractical (Central Business District).

Weeping tile connections to the storm sewer system through surface drainage shall be provided for in all new construction through sump pumps. Water from discharge pipes must end at least 2 m away from any sidewalk, road, park, alley, lane or surface drainage facility. The 2 m buffer zone allows some of the runoff to absorb into the ground before it enters the storm system. It also helps prevent icing on sidewalks and lanes in winter.

3.5.1 Site Drainage and Storm Sewer Service Restrictions

All developments are required to provide a detailed site grading drawing identifying storm drainage patterns, on site detention, storm sewers, manholes and catch basins.

Where a storm sewer exists adjacent to a property and the site is larger than 2500 m² in size, the installation of on-site catch basins and connection to the City's storm sewer system are generally required.

If the site is between 2500 m² and 5000 m² and more than 50% of the site is landscaped, on site catch basins and storm sewer connection requirements may not be required at the discretion of the Public Works Department.

Calculations for storm sewer and detention sizing must be provided for sites larger than 5000 m².

Under no condition shall a private property direct its drainage to another property unless it is a designated drainage route.

3.5.2 Storm Service Design Criteria

The storm service size is to be determined based on the following, depending on the capacity of the downstream storm sewer system.

3.5.3 Redevelopment Areas

Where a new service is being connected to an existing main, the allowable capacity for the development will be based on the following formula:

$$\text{Allowable Capacity} = \frac{\text{Development area X Capacity of Main}}{\text{Upstream Catchments Area}}$$

The calculated capacity of the service will likely be less than a 1 in 5 year storm discharge, but the allowable discharge shall not be greater than the 1 in 5 year discharges calculated for new development areas.

3.5.4 New Development Area

Where the new service is being connected to an existing main in a recently developed area of the City service, the allowable capacity of the development will be determined using the 1 in 5 year rainfall IDF curve and the appropriate run off coefficient.

All new building foundations shall drain to a sump discharging to the storm sewer system through surface drainage.

Foundation drains shall not be connected to the sanitary sewer system.

Storm service connections shall comply with the National Plumbing Code.

Properties zoned for non-residential land uses and for multi-family residential (excluding lots less than 2500 m^2) must retain runoff volumes of the 1 in 5 year return period on site. The excess runoff control may take the form of a parking lot, rooftop, or underground storage, as well as wet or dry ponds. The Public Works Department shall approve runoff control designs.

Sump pump outlets and roof leaders shall discharge flows no closer than 1.0 m from property line, any sidewalk, road, park, alley, lane or surface drainage facility. Where possible, drainage across property lines shall be spread to encourage sheet flow and reduce concentrated erosive flows.

3.5.4.1 Length of Run

Surface water should not be permitted to run a distance greater than 150 m in streets or 200 m in lanes and swales without interception by a catch basin.

3.5.4.2 Back of Lot Drainage

The following will apply to back of lot drainage in lane less subdivisions:

For back to back lots and lots backing onto a park, a concrete swale is to be constructed along the rear property lines within a City easement to direct the drainage to a street. Concrete swales are to be constructed with continuous grade lines with a minimum 0.5% slope to convey rear lot drainage to a catch basin located in a street or utility right of way.

The swale shall be on the opposite side of the property line from the Crown Utilities easements.

SECTION 4: WATER DISTRIBUTION

4.0 INTRODUCTION

This section will cover the design of Water Distribution facilities including, but not limited to, distribution piping, valves, fire fighting facilities, reservoir and pumping facilities.

4.1 GENERAL

The overall design principles described in the Introduction to these standards is the basis on which all construction is undertaken in the City of Prince Albert. These guiding principles are expanded below to provide more specific guidance related to Potable Water Distribution Standards. Often a combination of principles will come into play when designing a component of the system.

The design of water distribution systems must take extreme care with respect to safety. Any threat to the delivery or quality of City of Prince Albert water is unacceptable. The following fundamental factors are to be considered when designing potable water distribution facilities:

i. Provision of high quality drinking water at all times.

ii. Minimized interruption in service delivery.

iii. Provision of adequate fire protection.

Additional safety considerations may be required based on specific conditions.

4.1.1 Level of Service Objectives

Level of service requirements have been defined based on a 2015 Hydraulic Systems Analysis. The City of Prince Albert has adopted this set level of service requirements and as such they will form a basis for these principles of functionality.

The minimum acceptable pressure delivered to each Prince Albert service connection is to be no less than 275 kPa (40 psi) during peak hour demand, and 310 kPa (45 psi) at maximum day demand. The maximum delivered pressure will not exceed 620 kPa (90 psi).

All extensions of the City of Prince Albert water distribution system will be designed and evaluated such that all customers, both existing and new, will not experience any lower level of service.

4.1.2 Applicable Regulations, Guidelines and Resources

The following documentation is the regulations, which have provisions that pertain to water distribution systems:

- *Water Services Bylaw, City of Prince Albert;*
- *Connection Bylaw, City of Prince Albert;*
- *Standard Construction Specifications and Drawings, Roadways, Water, and Sewer, City of Prince Albert;*
- *Water Works Design Standard, Water Security Agency;*

- *National Building Code;*
- *Distribution System Requirements for Fire Protection, (M31), American Water Works Association (AWWA);*
- *Concrete Pressure Pipe, (M9), AWWA;*
- *Steel Water Pipe: A Guide for Design and Installation, (M11), AWWA;*
- *PVC Pipe: Design and Installation, (M23), AWWA; and*
- *PE Pipe: Design and Installation, (M55), AWWA Master Specification.*

Designers are encouraged to contact the Provincial and Federal Governments with regard to regulations which may apply but are not listed here.

4.1.3 Water Distribution Planning Requirements

See Section 2.4.3 for Water Distribution – Development Plan Requirements.

4.1.4 Environmental Considerations

See Section 2.5 for Environmental Considerations.

4.2 DESIGN FLOWS

4.2.1 Hydraulic Network Analysis

In general, a hydraulic network analysis is required for any new development that has not been analyzed previously, or for any development that significantly alters the servicing scheme such as when an existing hydraulic network analysis is no longer applicable.

The developer will submit a report showing that the system will meet level of service requirements at the final development concept and also through interim development stages. A digital plan of the system compatible to the City of Prince Albert Hydraulic Model will be required.

4.2.2 Design Parameters

The following parameters shall be used in the design or evaluation of the water distribution system:

4.2.2.1 Hazen-Williams Coefficient (C)

i. Polyvinyl Chloride (PVC)	140
ii. Asbestos Cement (AC)	130
iii. Ductile Iron (DI) or Cast Iron (CI)	80 to 100

4.2.2.2 Distribution Main Sizes

The minimum size of Distribution Mains shall be as follows:

i. Residential = 200 mm diameter

ii. Industrial = 200 mm diameter

Where two hydrants are to be installed on an unlooped Distribution Main the minimum size of the main shall be 200 mm diameter.

In general, water mains 400 mm and larger will be designated “Trunk Water Mains”.

4.2.2.3 Consumption Rates

Residential per capita consumption rates:

i. Average Day Demand: 400 litres per capita per day.

ii. Maximum Day Demand: 715 litres per capita per day.

iii. Peak Hour Demand: 1070 litres per capita per day.

4.2.2.4 Non-Residential Consumption Rates:

For non-residential developments, the minimum water consumption rate shall be equal to 0.15 litres per second per hectare. The applied peaking factor shall be $PF = 10Q^{-0.45}$ to a maximum of 25 and a minimum of 2.5 where Q is in litres per second. In addition, water demand for large developments should be evaluated based on site specific service requirements as well as fire flow requirements.

4.2.2.5 Design Population

The design population shall be the ultimate population in the area under consideration based on the approved Zoning Bylaw requirements.

4.2.2.6 Fire Flow Requirements

Residential Low Density	60 l/s
Residential Med Density	60 l/s
Residential High Density	120 l/s
Commercial, Local, Highway	120 l/s
Commercial Shopping, Downtown	120 l/s
Industrial Light	180 l/s
Industrial Heavy	180 l/s

The minimum fire flow used for developments larger than a single family (ie: commercial, apartment) should also be in accordance with the fire flow requirements set out by the architect.

4.2.2.7 Pressure

i. Minimum residual line pressure under maximum day plus fire flow conditions shall be 140 kPa (20 psi) at ground level of any point in the system. Minimum residual line pressure under peak hour flow conditions shall be 275 kPa (40 psi).

ii. Minor pressure losses through valves and fittings must be accounted for.

4.2.2.8 Velocity

Main line flow velocities should not exceed 1.5 m/s during peak hour flow conditions and 2.5 m/s during maximum day plus fire flow conditions. The design must address low demand conditions which could affect chlorine residuals in the system.

4.3 WATER SYSTEM COMPONENTS

4.3.1 Water Mains

4.3.1.1 Water Main Location

i. Line assignments for water mains installed in a street or avenue may be found in the City of Prince Albert Construction Specifications.

ii. A minimum horizontal distance of 1.8 m must be maintained between a water main and any gas main, power cable, telephone cable, duct line or new tree installation.

iii. Where power cables, telephone cables, television cables, or duct lines cross a water main, they shall be at a minimum distance of 1.0 m from any valve, hydrant or curb stop.

iv. Where a water main is installed in a utility lot or easement it shall be located on an alignment 1.5 m from a property line.

v. Where a catch basin is installed at a street intersection, a minimum clearance of 1.5 m shall be maintained from the water main and 3.0 m from water services.

vi. Water mains must not be designed to be located under significant structures such as retaining walls, planters, etc.

4.3.1.2 Depth

i. Minimum depth of cover to the top of uninsulated pipe shall be 3.0 m.

ii. Maximum depth of cover to top of pipe shall be 4.0 m.

4.3.1.3 Sizing

i. Sizing of water mains will be determined by hydraulic network analysis as set out in Section 4.2 Design Flows.

ii. The minimum size for water mains will be 200 mm except in cul-de-sacs which do not require hydrants for fire protection. In this case the main will be no smaller than 150 mm and be designed with flushing points to provide adequate flushing velocities.

4.3.1.4 Looping

i. The number of services allowed at the end of a phase without looping will be 70, provided that they will be looped as per the final build out of the development plan.

ii. The number of services allowed at the end of a phase without looping on a permanent basis is 35.

4.3.1.5 Dead Ends

Dead ends will be avoided wherever possible. Where looping is not possible, flushing points will be included in the design.

4.3.1.6 Hydrostatic Leakage Testing

All new water mains after backfilling is completed shall be pressure tested before being put into service in accordance with the latest edition of AWWA Standard C651-05 for Test Pressure.

4.3.1.7 Water Main Disinfection

All new water mains shall be disinfected and flushed before being put into service in accordance with the latest edition of AWWA Standard C651 for Disinfecting Water Mains.

4.3.2 Fire Hydrants

Fire Hydrants shall be located:

i. Minimum of 1.0 m from property line.

ii. Where structures (i.e. fence, hard landscaping) are erected along property line the offset distance must be a minimum of 1.0 m.

iii. Where a fire hydrant is installed at a corner of an intersection, it shall be installed at the beginning of the curve of the curb return.

iv. In cul-de-sacs that are 90 m or less in length, the fire hydrant shall be installed on the intersecting street at or near the intersection of the cul-de-sac. Where the water main in the cul-de-sac is a dead end a flushing point must be included in the design.

v. Fire hydrant spacing shall be measured along the centerline of the streets.

4.3.3 Residential Hydrant Spacing

i. The maximum allowable spacing between fire hydrants shall be 180 m.

ii. The maximum allowable spacing between the back of homes in a cul-de-sac and a hydrant outside of the cul-de-sac shall be 150 m.

iii. Institutional, Commercial, High Density Residential Hydrant Spacing the maximum spacing between fire hydrants shall be 90 m, or as required by the Public Works Department.

4.3.4 Valves

The location and spacing of valves in the water system should be such that when in operation:

i. No more than two fire hydrants may be taken out of service by a water main shutdown.

ii. No more than four valves are required to affect a shutdown.

iii. No more than 35 single-family lots may be taken out of service by a water main shutdown.

iv. Valves will be designed at a maximum of 150 m apart on water mains defined as under 400 mm diameter.

v. Valves will be designed at a maximum of 600 m apart on water transmission mains, defined as 400 mm diameter or larger.

vi. Mainline valves at intersections of water mains shall be located on the projection of property lines.

vii. There shall be two valves at each tee and three valves at each cross.

viii. Hydrant valves shall be installed at a minimum distance of 1.0 m from the water main and 1.0 m from the hydrant.

ix. There shall be a minimum horizontal separation of 1.5 m between a catch basin lead and a valve. Deflection of a catch basin lead in order to avoid a hydrant lead is acceptable.

4.4 WATER SERVICES

The scope of work as described in this section refers to the portion from the main stop at the distribution main to the curb stop. The curb stop shall be 300 mm from the property line on the City side and greater than 3.0 m from any structure foundation.

New water services will be 25 mm minimum diameter to provide capacity for residential sprinklers.

The Developer must comply with the requirements of the City of Prince Albert Master Specifications, Standard Detail Drawings and the National Plumbing Code.

In general:

i. Each building shall have separate connection.

ii. Duplex buildings shall have separate connection to the main.

iii. Multi-family units shall have shared one service connection connected to the main.

All water services, from property line to main, are to be shown on the service connection note Standard Detail Drawing 00-01-10; 00-01-16 and 00-01-20.

4.4.1 Park Irrigation Services

Connection may be made to the water distribution system for irrigation water as per typical irrigation connection 50 mm Service Standard Detail Drawing 00-01-09.

4.4.2 Private Water Distribution Systems

Water distribution systems must comply with these standards where they service a private development. To protect the quality and safety of water supplied by the City of Prince Albert, these standards apply to any potable water distribution system from the main, in the City right-of-way, to the property line.

4.4.3 Water Main Design Criteria

i.	Minimum depth of pipe cover	3.0 m
ii.	Maximum depth of pipe cover	4.0 m

iii.	Minimum pipe size of main	200 mm
iv.	Maximum distance between valves	150 m
v.	Maximum distance between hydrants	150 m

SECTION 5: SANITARY SEWER

5.0 INTRODUCTION

This section will cover the design of Wastewater Collection System including, but not limited to, underground collection mains, manholes, service connections and pumping facilities.

5.1 GENERAL

The overall design principles described in the introduction to these standards is the basis on which all construction is undertaken in the City of Prince Albert. These guiding principles are expanded below to provide more specific guidance related to the City of Prince Albert Wastewater Collection System. Often a combination of principles will come into play when designing a particular component of the system.

The design of sanitary sewer extensions must take public health and safety into account. Facilities that may put public safety or health at risk due to flooding, environmental overflows, or create unsafe access points are not acceptable.

5.1.1 Level of Service Objectives

Level of service requirements have been defined based on a 2015 Hydraulic System Analysis. The City of Prince Albert has adopted this set level of service requirements and, as such, they will form a basis for these principles of functionality. The following level of service objectives have been set:

i. Provide sewage collection adequate to meet the dry weather demand of the proposed development with appropriate allowances made for wet weather inflows based on current sanitary sewer construction practices.

ii. Provide sanitary sewer capacity so that surcharging does not occur for design dry weather peak flows and so 99.5% of homes are protected from sewer back-up during peak wet weather flow events.

iii. No additional or new homes will be added to the “at risk” list as a result of any new development. “At risk” is defined as locations where surcharging of the sanitary sewer occurs to a level less than 2 m below the manhole rim for the design wet weather event.

iv. Limit wet weather inflows to less than 5% of the total volume of rainfall in the system during wet weather periods.

5.1.2 Applicable Regulations, Guidelines and Resources

The following documentations are the regulations which have provisions that pertain to sanitary sewer systems include:

- *Sanitary Sewer Bylaw, City of Prince Albert;*
- *Connections Bylaw, City of Prince Albert;*
- *Standard Construction Specifications and Drawings, Roadways, Water, and Sewer, City of Prince Albert;*
- *Sewage Works Design Standard, Water Security Agency;*

- *National Plumbing Code;*
- *PVC Pipe: Design and Installation (M23), American Water Works Association (AWWA); and*
- *PE Pipe: Design and Installation, (M55), AWWA.*

5.1.3 Sanitary Sewer Planning Requirements

See Section 2.4 Development Plan - Infrastructure Requirements.

5.1.4 Environmental Considerations

See Section 2.5 for Environmental Considerations.

5.2 SEWAGE GENERATION RATES

5.2.1 Hydraulic Network Analysis

In general, a network wide hydraulic analysis is required for any new development that has not been analyzed previously, or for any development that significantly alters the servicing scheme such that an existing hydraulic network analysis is no longer applicable. An analysis is required, in particular, where sewage generation rates have been altered in a way that will affect existing customers.

All force mains and gravity sewer mains 200 mm in diameter or larger shall be modeled. Transient analysis is required for all force mains. Runs shall include, at a minimum, a simulation of peak flows including allowances for Infiltration and Inflow (I&I) and Wet Weather Flow (WWF) (where applicable).

The developer will submit a report showing that the system will meet level of service requirements at the final development concept and also through interim stages of development. A digital plan of the system compatible to the City of Prince Albert Hydraulic Model will be required.

5.2.2 Sewage Generation Rates

The rates given below shall be used to calculate design flows:

5.2.2.1 Sewage Dry Weather Flows

Residential	360	L/capita/d
Commercial	20	m^3/ha/d
Institutional	20	m^3/ha/d
Recreational	10	m^3/ha/d
Industrial (light and medium)	30	m^3/ha/d
Industrial (heavy)	process specific	

5.2.2.2 Residential Density

Highest Observed New Developments	40	persons per hectare	
(Average Density) Recommended	30	persons per hectare	
	Area Structure Plan Forecast		

5.2.2.3 Peaking Factor

Harmon's Peaking (field correlated)	$\frac{14}{4+\sqrt{p}}+1$

5.2.2.4 Sewage Wet Weather Flows

Residential (new developments)	(in addition to Dry Weather Flows)	
Residential (older developments)	400	L/capita/d
Commercial		
Institutional	1600	L/capita/d
Recreational		
Industrial	7.5	m^3/ha/d
	7.5	m^3/ha/d
	2.5	m^3/ha/d
	7.5 m^3/ha/d	

5.2.2.5 Infiltration and Inflow Allowance

In areas where the ground water table is at a depth of 3 m or less below the surface, a groundwater infiltration allowance shall be accounted for as follows:

Residential	135	L/capita/d
Industrial	2.25	m^3/ha/d
Commercial	2.25	m^3/ha/d
Institutional	2.25	m^3/ha/d
Recreational	2.25 m^3/ha/d	

5.2.2.6 Weeping Tile Flow Allowance

Connection of foundation drains of any buildings to the sanitary sewer collection system is no longer permitted; therefore, there is no weeping tile allowance for new developments.

5.2.3 Industrial Sewage Generation

In circumstances where industrial sewage generation rates are being made without process specific information, the Public Works Department should be consulted regarding the capacity to be provided.

5.3 GRAVITY FLOW

Gravity sewer mains shall be sized for full flow during the total design peak flow. The Manning Equation shall be used for the design and modelling of gravity sewers.

Q = $(A*R^{2/3}*S^{1/2})/n$ Where: Q = Flow (m^3/s)
A = Cross-sectional area of pipe (m^2)
R = Hydraulic radius (area/wetted perimeter) (m)
S = Slope of hydraulic grade line (m/m)

n = Manning coefficient = 0.013 for all approved materials in straight alignment (s/m 1/3)

5.3.1 Velocity

Sewage Works Design Standard, a mean velocity of 0.6 m/s shall be maintained during average flow conditions to provide self-cleansing flow. The maximum velocity shall be 3.0 m/s to reduce the risk of undue turbulence and scour.

5.3.2 Size

The minimum size of gravity sanitary sewer pipe shall be 200 mm diameter. Mains with diameters equal to or greater than 375 mm shall be deemed to be trunk sewers.

5.3.3 Slope

Sanitary mains shall be laid in a straight alignment between manholes at the following minimum grades:

Sewer Size (mm)	Minimum Slope (%)
200	0.40
250	0.28
300	0.22
375	0.15
450	0.12
525	0.10
600 and greater	0.08

5.4 SANITARY SYSTEM COMPONENTS

This section covers standards for the design of pipes, manholes, and sewage pump stations.

5.4.1 PIPES

The sewer collection system shall consist of the following three types of sewage mains:

5.4.1.1 Sanitary Collection Main

All sanitary collection mains with a minimum size of 200 mm mainly used for the collection of sewage from the neighbourhood. Service connections are allowed.

5.4.1.2 Trunk Sanitary Main

All trunk sanitary mains with a minimum size of 375 mm mainly used for the collection of sewage from the collection mains. Service connections are not allowed.

5.4.1.3 Forcemains

Mainly used for transmitting sewage from lift stations to gravity pipes.

5.4.2 Sizing

Pipes shall be sized to accommodate the peak design flows for the proposed contributing area and, if applicable, to reasonably accommodate extensions to adjacent future development areas as described in the sector plan for each development area.

5.4.3 Depth

All sewers shall be designed so that the top of the main is at the minimum depth 2.75 m, unless otherwise approved by the Director of Public Works. Where existing conditions dictate that the depth of buries be less than 2.75 m, the main/service is to be insulated. The maximum depth of cover shall not exceed 5.5 m in cases where sanitary and/or storm service connections are to be installed. In situations where depth of cover exceeds 5.5 m, the consultant shall redesign the sanitary sewer system and/or the site grading to reduce the depth of cover to less than 5.5 m.

5.4.4 Clearance

Sewer mains shall pass under adjacent water mains. The minimum vertical clearance from the bottom of one pipe to the top of the next lowest pipe shall be 150 mm. The minimum horizontal clearance between the outer walls of adjacent pipes shall be 300 mm.

5.4.5 Manholes

Manholes shall be installed at the end of each line, at all changes in sewer size, grade, or alignment, at all junctions, and at intervals of no greater than 150 m along the length of the sewer. To maintain a continuous energy gradient through manholes, the obvert (crown) elevation of the lowest upstream pipe shall be equal to, or higher than, the obvert of the downstream pipe. Wherever possible, sanitary sewer manholes shall not be located within trapped lows. Where it is unavoidable, the manhole shall be fitted with a watertight seal.

Manhole bases may be cast-in-place or pre-cast complete with flow channel, benching, and pipe stubs. See City Standard Design Drawings 00-01-03, 00-01-04, and 00-01-05.

5.4.6 Sewage Pump Stations

Extension of sanitary servicing by means other than gravity flow sewers shall be considered only in cases where insurmountable constraints cannot be resolved, dictating a requirement for a wastewater pumping station. The use of a sewage pump station shall require the submission of a *Sewage Pump Station Design Report* and the approval of the Public Works Department. This report should include pump curves and system curves.

5.4.6.1 Architectural

i. Exterior block shall be 390 x 190 x 90 concrete block, #248 Red as manufactured by Expocrete

ii. Roofing shall be 24 gauge, standing seam, complete with eavestroughs, HSS downspouts, perforated metal soffits. All prefinished metal shall be Bone White in colour.

iii. Building shall be constructed with minimum 3600 mm ceiling height.

iv. Roof shall be hip roof design with engineered trusses.

v. Substructure and foundations shall be cast in place reinforced concrete.

vi. Structure shall include an integrated wet well suitable cut off from the building and mechanical components, and a drywell to house all necessary mechanical components.

5.4.6.2 Structural

i. All access into the substructure shall use stairwell design, meeting Occupation Health and Safety standards and regulations.

ii. Station shall be equipped with necessary provisions for lifting and pump removal using electric hoist(s).

5.4.6.3 Mechanical

i. Station shall have duplex pump arrangement, each pump of adequate capacity to meet peak flow rates and full pump redundancy. Pumps shall be Flygt submersible sewage pumps.

ii. All mechanical components shall consist of 316 stainless steel.

iii. Station shall be equipped with all necessary valves to easily isolate and remove one pump from service while maintaining operation of the station.

iv. Station shall be equipped with domestic water service.

v. Adequate ventilation shall be provided to meet all regulations.

5.4.6.4 Electrical and Controls

i. Electrical distribution shall be combined into a single motor control center.

ii. Voltage and power supply to the facility shall be 600V, 3 phase.

iii. Programmable logic controller shall be fully programmable, shall be equipped with a touchscreen HMI, and shall be equipped with a redundant level monitoring system also capable of operating the pumps.

iv. All functions of the station shall be integrated into and monitored by the City's SCADA system.

v. Level monitoring shall be a fully redundant system consisting of a pressure transducer and ultrasonic transducer, with a high level float.

vi. Station shall be equipped with an emergency standby generator, natural gas fueled, domestic (city) water cooled, and shall be capable of powering the station under all operating conditions. Generator shall automatically startup in the event of a power outage, and return to standby conditions once utility has ben restored.

5.5 SANITARY SEWER SERVICES

Residential sanitary sewer services shall be no less than 100 mm in diameter and have a slope from the main to the property line of a minimum of 2%. Services of a size larger than those indicated will be required where, in the opinion of the Director of Public Works, the lengths of service pipe or other conditions warrant these.

In general, note:

i. Each building shall have separate connection.

ii. Duplex buildings shall have separate connection to the main.

iii. Multi-family units shall have shared one service connection connected to the main.

iv. Sanitary service connections shall comply with the National Plumbing Code.

All sanitary services, from property line to main, are to be shown on the service connection. Note: see Standard Detail Drawing 00-01-20.

Table 5.5:

Service Connection Manhole Requirement Chart – Sanitary Sewer

Main Size (mm)	Service Connection Size (mm)					
	100	150	200	250	300	375
150	No	Yes	Yes	N/A	N/A	See below
200	No	Yes	Yes	Yes	N/A	See below
250	No	No	Yes	Yes	Yes	See below
300	No	No	No	Yes	Yes	See below
375	No	No	No	Yes	Yes	See below
400	See Below					

Each service larger than 375 mm will require review and approval by the Director of Public Works.

SECTION 6: TRANSPORTATION

6.0 INTRODUCTION

This section covers the design of the transportation system including, but not limited to, roadways, lanes, sidewalks and pathways located within road right of way.

6.1 GENERAL

Current practice is to use a system of arterial roadways, collector roadways, local roadways, sidewalks and pathways to move people and goods.

The overall design principles described in the introduction to these standards are the basis on which all construction is undertaken in the City. Often a combination of principles will come into play when designing a particular component of the system.

The designer must consider safety in the design of transportation facilities. At a minimum, the following safety factors shall be considered in the design of the transportation system:

i. Number and types of vehicles using the roadway.
ii. Accessibility of an area for Emergency Services.
iii. Spacing, type, intersecting angle and location of intersections and crosswalks.
iv. Sight distance (decision, stopping, intersection, etc.).
v. Level of access from adjacent properties.
vi. Traffic calming requirements.
vii. Playground and school zone locations.
viii. Pedestrian facilities.
ix. Intersection offsets.
x. Intersection control (uncontrolled, yield, stop, roundabout or traffic signal).
xi. Median treatment.
xii. Traffic control device warrants.
xiii. Requirements identified by *The Traffic Safety Act, Saskatchewan*.

Designers shall consider how the transportation system interacts with other components of the City's infrastructure. In particular, this applies to major overland flow routes forming part of the Storm Water Management System (see Section 3).

6.2 LEVEL OF SERVICE OBJECTIVES

The objective of the transportation system is to allow movement of people and goods into, out of, and within the City while maintaining quality of life.

In considering the layout of streets; safety and convenience are overarching principles. Design of local roadways shall focus on providing safe access to adjacent properties while minimizing speed and potential for transient traffic use.

When considering the impact of development of adjacent areas on existing arterial and collector roadways more traditional definitions of level of service will be used. The City in these cases considers level of service "D" and a "Volume to Capacity" ratio of 0.80 to be acceptable operating conditions during peak traffic periods. Improvements are identified / required when the level of service reaches the "D/E" transition.

In addition to providing a minimum level of service for traffic flow, roadways and other surface improvements in the road right of way shall be designed to provide a useful life of 20 years with a minimal maintenance program.

6.3 APPLICABLE REGULATIONS, GUIDELINES AND RESOURCES

The following legislation provides information related to the design of transportation systems:

- *The Traffic Bylaw, City of Prince Albert;*
- *Standard Construction Specifications and Drawings, Roadways, Water, and Sewer, City of Prince Albert;*
- *Transportation Impact Analysis for Site Development, Institute of Transportation Engineers (ITE);*
- *Promoting Sustainable Transportation Through Site Design, ITE;*
- *Geometric Design Guide for Canadian Roads, Transportation Association of Canada (TAC);*
- *Canadian Guide to Neighbourhood Traffic Calming, TAC;*
- *Manual of Uniform Traffic Control Devices for Canada, TAC;*
- *The Traffic Safety Act, Saskatchewan;*
- *2017 City of Prince Albert Transportation Study.*

6.4 TRANSPORTATION REQUIREMENTS

6.4.1 Traffic Impact Assessments

A Traffic Impact Assessment (TIA) shall be completed for all new development or redevelopment that generates 100 additional trips during a peak hour period and/or is expected to create operational difficulties associated with the safe and efficient movement of traffic, pedestrians, bicycles and transit vehicles.

A TIA shall be required even if there are less than 100 peak hour trips when one or more of the following conditions are anticipated or present:

i. The development/redevelopment is located in an area of high roadway congestion and/or a high expected rate of population or employment growth.

ii. The development is located within or adjacent to a residential community that has over-spill of parking issues and may have a residential parking permit program in place.

iii. The development is located in an area with existing parking issues.

iv. The development, its access or type of operation is not envisaged by local land use or transportation plans.

v. The development or redevelopment proposal requires amendment of the applicable official plan(s).

vi. As part of the proposed development, a new traffic signal is proposed to be installed on the arterial road network.

vii. If the development/redevelopment has the potential to create unacceptable adverse operational and safety impacts on the road network. Examples include the following:

- Inadequate horizontal or vertical sight distances at access points;
- The proximity of the proposed access points to other existing driveways or intersections;
- Lack of existing left or right turn lane(s) on the adjacent roadway at the proposed access point(s);
- The vehicular traffic generated by the development/redevelopment would result in volume/capacity ratios at an adjacent intersection becoming critical (i.e. greater than 0.80 overall or Level of Service D).

The onus is on the proponent/consultant to demonstrate that a traffic impact assessment is not required.

6.4.2 Qualifications to Conduct a Traffic Impact Assessment

i. When the scale of the development/redevelopment warrants a TIA, it is the proponent's responsibility to retain a qualified transportation engineering consultant experienced in transportation planning and traffic engineering.

ii. The consultant's representative, the engineer responsible for the traffic impact assessment, shall be a member of the Institute of Transportation Engineers and registered as a Professional Engineer in the Province of Saskatchewan. The report must be dated and signed accordingly. The signing engineer is verifying that appropriate assumptions, procedures and calculations have been undertaken during the process of completing the traffic impact assessment and that they are the individual who is taking corporate/professional responsibility for the work.

6.4.3 Traffic Impact Assessment Guidelines

The following guidelines provide additional information on TIAs:

i. Transportation Impact Analysis for Site Development, Institute of Transportation Engineers.

ii. Transportation and Land Development, Institute of Transportation Engineers.

iii. Access Management Manual, Transportation Research Board.

iv. Trip Generation, Institute of Transportation Engineers.

v. Saskatchewan Ministry of Highways and Infrastructure.

6.4.4 Requirements for a Traffic Impact Assessment

Specific requirements for the completion of a TIA are provided by the Public Works Department on a case by case basis and generally include, but are not limited to:

i. Identification of intersections to be included in the TIA.

ii. Proposed development layout.

iii. Development horizons (existing, interim, 10 year, 20 year, full build out, etc. horizons to be determined based on development size, complexity and proposed staging).

iv. Confirmation of trip generation rates prior to analysis.

v. Review of trip distribution assumptions prior to analysis (internal & external to site).

vi. Review of trip assignment prior to analysis (internal & external to site).

vii. On site circulation.

viii. On site parking layout.

ix. Access.

x. Pedestrian requirements.

xi. Adjacent on-street parking.

xii. Transit requirements.

xiii. Safety review.

xiv. Traffic Signal Warrants (most recent available from TAC).

xv. Synchro analysis of intersections (City of Prince Albert factors).

xvi. Prince Albert Transportation Planning Study.

Results of the TIA shall identify improvements in the transportation network required to support the proposed development. Improvements required within 10 years of development completion are the responsibility of the developer. Improvements identified at a time period greater than 10 years after development completion will be used by the City for future network planning. Clarification – if a development is expected to take 25 years to complete, the developer is responsible for all transportation requirements within the development area and connecting the development area until the development is complete.

6.4.5 Traffic Impact Assessment Categories

TIAs can be separated into three categories:

i. Urbanization Plans and Area Master Plans - These TIAs focus on the impact the new development area will have on the existing transportation network and the connection points to the existing/future external transportation network.

ii. Development Plans - At this level the TIA will review the internal road network of the proposed development area and also refine the requirements for the access points.

iii. Specific Development Projects - These TIAs look specifically at an individual development site or sites that may be associated with rezoning or development permit applications.

Additional information is provided in Section 2 General Considerations.

6.4.6 Environmental Considerations and Best Management Practices

As stewards of the environment, charged with creating a healthy city and protecting the natural endowments within our jurisdiction, the City promotes any design measures, which reduce or mitigate the impacts of development.

In particular design features and construction methods which contribute to improved stormwater and air quality are strongly encouraged. Specifically related to transportation design and planning are measures which promote pedestrian and bicycle traffic and encourage the use of public transit.

6.5 TRANSIT REQUIREMENTS

The City of Prince Albert is committed to Transit Orientated Developments (TOD). To accomplish this goal all developments shall locate moderate to higher density developments within an easy walk of a major transit stop, generally with a mix of residential, employment and shopping opportunities designed for pedestrians without excluding the auto. Major senior facilities shall be located adjacent to roadways with transit routes.

6.5.1 General

Transit routes shall not be located on local roadways. They should be located on any of the following:

i. Arterial (accommodated with pull outs);

ii. Major Collector;

iii. Minor Collector; or

iv. Industrial Collector roadways.

6.5.2 Walk Distances

Transit services shall be considered where the location exceeds the following distance from a transit route:

i. 400 m walking distance for residential areas (an area may be excluded from consideration if 90% of all residences in the built up area are currently served).

ii. 250 m walking distance to all medium and high density residential buildings.

iii. 250 m walking distance to institutional facilities including major educational, medical and recreational services.

iv. 200 m walking distance to major seniors' residences and seniors' activity centres.

v. 750 m to industrial land uses.

6.5.3 Bus Stops

Bus stops shall not be located less than 250 m apart (multiple stops at a single location may be considered), spaced to achieve the walking distance standards and located to maximize safety considerations.

Stops and the area around them shall be accessible to people with disabilities, including wheelchairs and other mobility aids. Pads shall be installed at all stops and curb cuts at each corner.

6.6 MINIMUM REQUIREMENTS FOR ROADWAY PAVEMENT

The following table outlines the minimum materials required for the pavement structures of roadways for the City of Prince Albert:

MINIMUM REQUIREMENTS FOR ROADWAY PAVEMENT STRUCTURES (MM)							
Material	**Maximum Aggregate Size (mm)**	**Arterial**	**Collector**	**Industrial**	**Residential**	**Lane**	**Pathways**
Asphalt Surface	16	150	100	100	80	50	50
Granular Base Course	19	375	250	250	225	150	200
Geo Textile	N/A	Yes	Yes	Yes	Yes	N/A	N/A

Specific roadway pavement structures are detailed in the Master Specifications and Standard Detail Drawings.

6.7 ENTRYWAYS, BOULEVARD, AND MEDIAN LANDSCAPING

i. Landscaping of boulevards and road right-of-ways shall be done in compliance with Community Services Parks and Open Space Standard, the latest version of the City Master Specifications, and the latest version of the Standard Detail Drawings. Landscaping plans will be subject to the approval of the Public Works and Community Services Departments.

ii. Landscaping features shall be low maintenance and cost effective to maintain with existing City maintenance equipment and personal.

iii. Trees planted in boulevards adjacent to collector roads shall be of a species with an elevated canopy to reduce line of sight conflicts and of a species approved by the Community Services Department.

6.8 SIDEWALKS, PATHWAYS, AND CROSSWALKS

i. Subdivisions shall be incorporated into the City's regional pathway and park system by providing adequate pedestrian linkages internally and to adjacent neighborhoods.

ii. Innovative community planning which promotes pedestrian traffic for both work and pleasure is encouraged. Some characteristics which promote pedestrian traffic, include: short trip distances; wide, well lit pathways; and safe road crossings.

iii. Crosswalks shall be located at intersections only. Pathway and park entrances intersecting roads at mid-block shall require approval in writing from the Public Works and Community Services Departments.

iv. A minimum of 50 mm of gravel shall be provided under all sidewalks where medium to high plastic soils are present as per the City's existing standard. The Public Works Department will on a case by case basis consider not having gravel if a detailed geotechnical report indicates:

- Soils are not medium to high plastic;
- Soils are not having high swelling properties; and
- There will be no long term performance issues without gravel for each specific location.

6.9 STREET AND TRAFFIC CONTROL SIGNS

i. The Street Naming Committee names streets according to prevailing City conventions when the lands are subdivided and titles created.

ii. Costs of preparing and installing street and traffic control signs are included in the charges calculated and paid as part of the Service Agreement. The Public Works Department determines the requirement for traffic control devices. The Planning and Development Department determines the requirements for approved street names and civic addresses.

iii. Any other identifying signage must comply with the Corporate Identity Guidelines (color, font, text size and type of name).

iv. Street Naming Conventions

a. Arterials

i. Avenues – north and south

ii. Streets – east and west

b. Collectors
    i. Boulevard
    ii. Parkway
    iii. Road
c. Residential
    i. Drive
    ii. Crescent
    iii. Gate
    iv. Lane
    v. Terrace
    vi. Way
d. Cul Du Sacs
    i. Bay – regular
    ii. Court – with island
    iii. Cove – with turn
    iv. Place – with median

6.10.1 ARTERIAL ROADWAYS

Design

TRAFFIC VOLUME (vehicles per day)	NUMBER OF LANES	RIGHT-OF-WAY REQUIREMENT	MINIMUM INTERSECTION SPACING (Property Lines)
10,000 to 25,000	2 to 6 (see Geometric note)	30 m	200 m uncontrolled 400 m controlled

FUNCTION

- To distribute traffic in commercial areas, between residential communities and as community entry roadways
- To serve secondary traffic generators such as commercial centres, recreational facilities, schools and traffic from neighbourhood to neighbourhood within the community
- May be used as a transit route.

CONDITIONS

- Direct access to abutting commercial properties shall be based on intersection spacing requirements
- Residential frontage is not permitted on an Arterial
- Arterial may intersect with Residential roadways, Minor Collectors, Major Collectors, or Arterial roadways
- Developers shall complete a Traffic Impact Assessment prior to approval of commercial driveway access to an Arterial
- When an Arterial intersects with an Arterial, all turns driveway access from adjacent properties shall not be allowed within a minimum distance of 100 m from the edge of the Arterial right of way
- Right in right out driveway access to adjacent property will be considered by Public Works pending completion of a Traffic Impact Assessment by the applicant
- Intersection spacing on Arterial shall not be less than 200 m property line to property line unless agreed to in writing by Public Works.

FEATURES	
Posted Speed (kph)	50 to 60
Parking	No
Sidewalk	Yes (*see Note 8*)
Traffic Signals	As Warranted
Pedestrian Crossing	At Grade Ramps required
Bikeway	TBD
Transit Route	Yes
Truck Route	Yes
Sound Attenuation	As warranted
Pavement Markings	Yes

NOTES

1. Basic right of way requirement is 30.0 m. Additional right of way shall be required for trees in boulevard and/or median
2. Divided roadway
3. All intersections shall be as near as possible to 90 degrees
4. Arterial roadways shall not end in a cul-de-sac
5. Arterial roadways shall be configured in loops and/or intersect with other Collector or Arterial roadways at a minimum of two locations
6. Modification of the Arterial standard will be considered by Public Works on a case-by-case basis
7. If the roadway is adjacent to low density residential development, one storey single family residential dwellings must back onto the Arterial unless sufficient noise attenuation is provided by the developer
8. Separate sidewalk, curb and gutter shall be provided on one side and regional pathway on one side
9. Play grounds shall be placed a sufficient distance from a collector to eliminate the need for a playground zone
10. If left turn bays will not be developed at the intersection the median width must be reduced
11. Manholes shall not be placed in pathways

Reference Drawings	00-04-03 00-04-06

6.10.2 ARTERIAL ROADWAYS

Geometric

CLASSIFICATION	DESIGN SPEED	DESIGN VEHICLE
Urban Collector Divided (UCD 60) Urban Collector Divided (UCD-70)	60 – 70 kph	Residential - WB-17 Commercial - WB-20 (1.0 m buffer with a minimum of 0.3 m each side of vehicle)

HORIZONTAL ALIGNMENT	
Minimum Stopping Sight Distance	**Minimum Radius of Curvature**
(see TAC)	(see TAC)
Median Left Turn Bay	
• Left turn bay storage lengths as per 6.12.1 Intersection Design • (see TAC)	
VERTICAL ALIGNMENT	
Maximum & Minimum Grades	
• Max 6%, Min 0.6%	
Grade at Intersections	
• (see TAC)	
Vertical Curves & Super Elevation	
• Vertical curve lengths in meters should not be less than speed in kilometers per hour • Use 0.04 or 0.06 super elevation tables	
PAVEMENT STRUCTURE	**REFERENCE DRAWINGS**
	City of Prince Albert Standard Detail Drawings

6.11.1 MAJOR AND MINOR COLLECTOR

Design

TRAFFIC VOLUME (vehicles per day)	NUMBER OF LANES	RIGHT-OF-WAY REQUIREMENT	MINIMUM INTERSECTION SPACING (Property Lines)
2,000 to 10,000	2 to 4	24.0 m	100 m

FUNCTION

- To collect and distribute traffic within residential communities
- To provide access to the adjacent residential lots within the subdivision
- To serve secondary traffic generators such as neighbourhood commercial centres, recreational facilities, schools and traffic from neighbourhood to neighbourhood within the community
- To serve as a transit route.

CONDITIONS

- Direct access shall be permitted to abutting residential and commercial properties
- Collectors shall intersect with Residential roadways, Minor Collectors, Major Collectors, or Arterial Roadways
- Lane intersections with Major Collector roadways are not preferred. (All efforts should be taken to eliminate the intersection)
- Adequate emergency services access shall be provided to all abutting properties
- When an existing Collector intersects with an Arterial, driveway access from adjacent properties shall not be allowed within a minimum distance of 30 m from the edge of the Arterial right of way
- Lane connections to Collector roadways will be treated as driveways until the lane generates more than 250 vehicles per day. (No less than 30 m from the nearest intersection measured from property line to property line)
- Intersection spacing on Collector roadways shall not be less than 100 m property line to property line unless agreed to in writing by Public Works
- The cross section of a collector asphalt carriageway shall be increased to 11 m at four way arterial intersections to allow development of two 3.5 m outbound lanes and one 4.0 m receiving lane.

FEATURES	
Posted Speed (kph)	50 to 60
Parking	Yes (see Note 4)
Sidewalk	Separate sidewalk, curb and gutter on both sides
Traffic Signals	As Warranted
Pedestrian Crossing	At Grade Ramps required
Bikeway	TBD
Transit Route	Yes
Truck Route	Yes
Sound Attenuation	No
Pavement Markings	At signalized intersections

NOTES

1. Undivided roadway
2. All intersections shall be as near as possible to 90 degrees
3. Intersection control by yield signs or stop signs as warranted
4. Parking permitted on both sides of roadway, but may be restricted on higher volume sections by Public Works on a case by case basis
5. Collector roadways shall not end in a cul-de-sac
6. Collector roadways shall be configured in loops and/or intersect with other Collector or Arterial roadways at a minimum of two locations
7. No front residential driveway access on Collectors with projected volumes exceeding 7000 vehicles per day
8. Collector roadways shall be configured to discourage transient traffic through residential neighbourhoods
9. Modification of the Collector standard shall be considered by Public Works on a case-by-case basis
10. Playground and School zones shall be minimized on Collector roadways.

Reference Drawings	00-04-02 00-04-06

6.11.2 MAJOR AND MINOR COLLECTOR

Geometric

CLASSIFICATION	DESIGN SPEED	DESIGN VEHICLE
Urban Collector Undivided (UCU 50) Urban Collector Undivided (UCU 60)	50 - 60 kph	Residential - WB-17 Commercial - WB-20 (1.0 m buffer with a minimum of 0.3 m each side of vehicle)

HORIZONTAL ALIGNMENT	
Minimum Stopping Sight Distance	**Minimum Radius of Curvature**
(see TAC)	(see TAC)

VERTICAL ALIGNMENT
Maximum & Minimum Grades
• Max 6%, Min 0.6%
Grade at Intersections
• (see TAC)
Vertical Curves & Super Elevation
• Vertical curve lengths in meters should not be less than speed in kilometers per hour • Use 0.04 or 0.06 superelevation tables

PAVEMENT STRUCTURE	REFERENCE DRAWINGS
	City of Prince Albert Standard Detail Drawings

6.12.1 INDUSTRIAL COLLECTOR

Design

TRAFFIC VOLUME (vehicles per day)	NUMBER OF LANES	RIGHT-OF-WAY REQUIREMENT	MINIMUM INTERSECTION SPACING (Property Lines)
N/A	2 to 4	18 to 24 m	120 m

FUNCTION

- To collect and distribute traffic within industrial areas
- To serve as a transit route.

CONDITIONS

- Direct access shall be permitted to abutting commercial and industrial properties
- Industrial Collectors shall intersect with Lanes, other Industrial Collectors, Minor Collectors, Major Collectors or Arterial roadways
- Adequate Emergency Services access shall be provided to all abutting properties
- When an Industrial Collector intersects with an Arterial, driveway access from adjacent properties shall not be allowed within a minimum distance of 60 m from the edge of the Arterial right of way
- Intersection spacing on Industrial Collector roadways shall not be less than 120 m unless agreed to in writing by Public Works
- Parking may be restricted to accommodate turning requirements for larger vehicles
- Parking may be restricted on higher volume Industrial Collectors.

FEATURES		NOTES
Posted Speed (kph)	50 to 60	1. Undivided roadway 2. All intersections shall be as near as possible to 90 degrees 3. Intersection control by yield signs or stop signs as warranted 4. Parking permitted on both sides of roadway, but may be restricted under special circumstances 5. Industrial Collector roadways shall not end in a cul-de-sac 6. Industrial Collector roadways shall be configured in loops and/or intersect with other Industrial Collector or Arterial roadways at a minimum of two locations 7. Modification of the Industrial Collector standard shall be considered by Public Works on a case-by-case basis
Parking	Yes (see Note 4)	
Sidewalk	Both Sides	
Traffic Signals	As Warranted	
Pedestrian Crossing	At Grade Ramps required	
Bikeway	TBD	
Transit Route	Yes	
Truck Route	Yes	
Sound Attenuation	No	
Pavement Markings	At signalized intersections	**Reference Drawings** 00-04-01, 00-04-02, 00-04-06

6.12.2 INDUSTRIAL COLLECTOR

Geometric

CLASSIFICATION	DESIGN SPEED	DESIGN VEHICLE
Urban Collector Undivided (UCU-60) Urban Collector Undivided (UCU-70)	60 – 70 kph	WB-20 or larger dependent on projected land use (1.0 m buffer with a minimum of 0.3 m each side of vehicle)

HORIZONTAL ALIGNMENT	
Minimum Stopping Sight Distance	**Minimum Radius of Curvature**
(see TAC)	(see TAC)

VERTICAL ALIGNMENT
Maximum & Minimum Grades
• Max 6%, Min 0.6%
Grade at Intersections
• (see TAC)
Vertical Curves & Super Elevation
• Vertical curve lengths in meters should not be less than speed in kilometers per hour • Use 0.04 or 0.06 super elevation tables

PAVEMENT STRUCTURE	REFERENCE DRAWINGS
	City of Prince Albert Standard Detail Drawings

6.13.1 RESIDENTIAL

Design

TRAFFIC VOLUME (vehicles per day)	NUMBER OF LANES	RIGHT-OF-WAY REQUIREMENT	MINIMUM INTERSECTION SPACING (Property Lines)
< 2000	2	18 m	40 m

FUNCTION

- To provide access to adjacent residential lots
- To convey local residential traffic to Collector roadways
- Local roadways include cul-de-sacs and P loops.

CONDITIONS

- Direct access shall be permitted to abutting residential properties
- Access shall not be permitted to commercial properties from Local roadways
- Residential roadways shall intersect with Lanes, Residential roadways, Minor Collectors, or Major Collectors
- Adequate Emergency Services access shall be provided to all dwelling units
- No dwelling shall be located more than 200 m as measured along the centreline of the roadway from a roadway intersection that provides the only access to the dwelling. This includes cul-de-sacs and multiple branch cul-de-sacs
- The length of road making up a P loop as measured along the centreline of the roadway shall not exceed 350 m
- P loop links shall be no shorter than 60 m as measured along the property line of the adjacent lots

FEATURES	
Posted Speed (kph)	40
Parking	Yes (see note 4)
Sidewalk	Both sides
Traffic Signals	No
Pedestrian Crossing	At Grade Ramps required
Bikeway	TBD
Transit Route	No
Truck Route	No
Sound Attenuation	No
Pavement Markings	No

NOTES

1. Undivided roadway
2. All intersections shall be as near as possible to 90 degrees
3. Intersection control by right-of-way rule, yield signs or stop signs
4. Parking permitted on both sides of roadway, but may be restricted under special circumstances
5. Parking in cul-de-sacs may be restricted for Emergency Services vehicle and solid waste vehicle access
6. P loops serving more than 100 dwelling units shall have the asphalt surface widened to 12 m (18.0 m R.O.W.) as measured from face of curb to face of curb to the first intersection in the P loop
7. A Local roadway with traffic volumes in excess of 1000 vehicles per day shall have the asphalt surface widened to 12 m (18.0 m R.O.W.) , as measured from face of curb to face of curb. Transitions will occur at intersections
8. Divided entrance roads shall be considered as a single entrance and shall be allowed only on the basis of providing a low maintenance entryway feature to the subdivision
9. Traffic calming shall be considered on Local roadways with potential for transient traffic
10. Modification of the local standard shall be considered by Public Works on a case-by-case basis.

Reference Drawings	
	00-04-01 00-04-04 00-04-05 00-04-06

6.13.2 RESIDENTIAL

Geometric

CLASSIFICATION	DESIGN SPEED	DESIGN VEHICLE
Urban Local Undivided (ULU-50)	50 kph	WB-17 (1.0 m buffer may be required with a minimum of 0.3 m each side of vehicle)

HORIZONTAL ALIGNMENT	
Minimum Stopping Sight Distance	**Minimum Radius of Curvature**
(see TAC)	(see TAC)

VERTICAL ALIGNMENT
Maximum & Minimum Grades
• Max 6%, Min 0.6%
Grade at Intersections
• (see TAC)
Vertical Curves & Super Elevation
• (see TAC)

PAVEMENT STRUCTURE	REFERENCE DRAWINGS
	City of Prince Albert Standard Detail Drawings

6.14.1 LANES

Design

TRAFFIC VOLUME (vehicles per day)	NUMBER OF LANES	RIGHT-OF-WAY REQUIREMENT	MINIMUM INTERSECTION SPACING (Property Lines)
N/A	N/A	6.0 m	30 m

FUNCTION

- To provide rear access to the adjacent lots within the subdivision
- To provide opportunity for loading and unloading in commercial districts.

CONDITIONS

- Direct access is permitted to abutting properties
- Lanes shall intersect with other Lanes, Residential roadways, Industrial Collectors and Minor Collectors
- Lane intersections with Major Collector roadways are not preferred. (All efforts should be taken to eliminate the intersection)
- Lane design shall accommodate Emergency Services access to abutting properties
- The distance along the centreline of a lane from a property to the nearest roadway shall not exceed 300 m
- Intersection spacing on Lanes shall not be less than 30 m unless agreed to in writing by Public Works
- Lane connections to higher classification roadways will be treated as driveways until the traffic generates more than 250 vehicles per day. (No less then 30 m from the nearest intersection measured from property line to property line). Lane intersections with higher classification roadways shall meet the intersection spacing requirements of the higher classification roadway.
- Accommodation of pedestrian facilities in a Lane require additional Lane width and permanent delineation of the pedestrian facility
- Pedestrian crossing points in Lanes shall include an offset pedestrian gate
- Dead end lanes shall provide a turnaround sufficient to accommodate emergency services vehicles and garbage trucks.

FEATURES	
Posted Speed (kph)	20
Parking	No
Sidewalk	No
Traffic Signals	No
Pedestrian Crossing	At Grade
Bikeway	No
Transit Route	No
Truck Route	No
Sound Attenuation	No
Pavement Markings	No

NOTES

1. All intersections shall be as near as possible to 90 degrees
2. Only T intersections are permitted in lanes
3. Intersection control between two lanes is by right-of-way rule
4. Where lanes intersect one another a sufficient fillet shall be provided to allow fire trucks and garbage trucks to turn in a single operation (contact Fire for appropriate vehicle size)
5. Lane design shall minimize opportunity for transient vehicle use (shortcutting)
6. All new Lanes shall be paved in accordance with the standard for paved lanes in the current version of the Engineering Standards.

Reference Drawings	00-04-07

6.14.2 LANES

Geometric

CONSTRUCTION TYPE	
HORIZONTAL ALIGNMENT	
Radius of Curvature	
• Based on design vehicle	
RIGHT-OF-WAY	
LENGTH	
GRADE	
• Max 6%, Min 0.6% • Last 5 m of lane at 1.5%	
PAVEMENT STRUCTURE	**REFERENCE DRAWING**
	City of Prince Albert Standard Detail Drawings

6.15.1 INTERSECTION

Design

DESCRIPTION

An intersection is formed when two or more roadway segments converge at a point. Intersection design is a complex engineering function which considers multimodal use of the road right of way, safety considerations, sight distances, traffic control devices, channelization, pavement markings, turning movement capacity/demand, drainage, etc.

FUNCTION

- Intersection requirements are design dependent based on classification of intersecting roadways and traffic demand.

CONDITIONS

- Left turn bay storage length shall be a minimum of 60 m and right turn bay shall be a minimum of 30 m on Collector and Arterial roadways
- Storage bay length shall be determined from Trafficware Synchro analysis of 95% queue length for a future 10 year horizon Synchro analysis when storage bay is defined by pavement markings
- Storage bay length shall be determined from Trafficware Synchro analysis of 95% queue length for a future 20 year horizon Synchro analysis when storage bay is defined by permanent curbing
- Intersection designs shall consider the appropriate design vehicles for the roadway classification and the accessible land uses
- For residential approaches the design vehicle shall be a WB-17
- For commercial/industrial approaches the design vehicle shall be a WB-20
- Alternate design vehicles shall be considered by Public Works on a case by case basis
- A 1.0 m buffer, with a minimum of 0.3 m each side of vehicle, shall be provided for the wheel path of the design vehicle relative to the edge of asphalt for all turning movements unless agreed to in writing by Public Works
- A 1.0 m buffer, with a minimum of 0.3 m on each side of vehicle, shall be provided for the swept path of the design vehicle relative to signs, poles, etc. placed on islands, medians and boulevards, for all turning movements unless agreed to in writing by Public Works.

FEATURES	
Posted Speed (kph)	Based on approach classification
Parking	No
Sidewalk	Match Roadway
Traffic Signals	As Warranted
Pedestrian Crossing	Yes
Bikeway	TBD
Transit Route	Match Roadway
Truck Route	Match Roadway
Sound Attenuation	No
Pavement Markings	As warranted

NOTES

1. The design of intersections shall include an evaluation of sight distance on all approaches for all relevant vehicle types expected to use the intersection
2. Sight lines shall be identified prior to landscape design
3. Opposing and alternating intersection approaches may have different design speeds and posted speed limits based on the approach classification
4. Additional travel lanes should be initiated or terminated at an intersection
5. Minimum intersection spacing identified in the design standards is relative to the property lines at the edge of the right of way. The centerline spacing is greater than the identified minimum intersection spacing
6. All intersections shall be as near as possible to 90 degrees.

Reference Drawings	00-04-05 00-04-11

6.15.2 INTERSECTION

Geometric

CLASSIFICATION	DESIGN SPEED	DESIGN VEHICLE
Adjoining Road Classification		Residential - WB-17 Commercial - WB-20 (1.0 m buffer required with a minimum of 0.3 m each side of vehicle)

HORIZONTAL ALIGNMENT

Minimum Stopping Sight Distance	Minimum Radius of Curvature
(see TAC)	(see TAC)

Median Left Turn Bay

- Arterial, Collector
- (see TAC)

VERTICAL ALIGNMENT

Maximum & Minimum Grades

Grade at Intersections

- (see TAC)

Vertical Curves & Super Elevation

- Vertical curve lengths in meters should not be less than speed in kilometers per hour
- emax = 0.04 or less

MINIMUM PROPERTY LINE CORNER CUTS (m)

	Arterial	Collector	Industrial	Residential	Lane
Arterial	10	10	10	N/A	N/A
Major Collector	8	5	5	5	5
Minor Collector	8	5	5	5	5
Industrial Collector	8	5	5	5	5
Residential	N/A	5	5	5	5
Lane	N/A	*Evaluate to provide sight distance**			5

PAVEMENT STRUCTURE	REFERENCE DRAWINGS
	City of Prince Albert Standard Detail Drawings

* Sight distance shall be considered for vehicle-vehicle and vehicle-pedestrian interaction.

6.16.1 ROUNDABOUT

Design

DESCRIPTION

An intersection with three or more approach legs in which the traffic streams merge and then diverge on a one-way roadway surrounding a central island. Traffic on this roadway travels counter-clockwise, and has the right-of-way over traffic entering the circulatory roadway.

Roundabout design is an iterative process that requires achieving an optimal balance between capacity and safety. The process of optimization is iterative and requires a thorough knowledge of site constraints and operating criteria. Even a minor change in geometry can have a substantial impact on safety and operational performance. In addition, designers should keep firmly in mind that the geometric elements are not independent on one another. How all the geometric elements of a roundabout interact is clearly more important than their individual impacts.

GUIDELINES

- Designers should consider "Roundabouts: A Different Type of Management Approach", Quebec Ministry of Transportation as the reference of choice for roundabout design in Prince Albert
- Projection of the centre line of each approach shall be to the left of the centre of the roundabout. Projection to the right of centre is NOT acceptable
- Approach legs should be evenly spaced around the Roundabout
- The speed differential between entering and circulating movements shall be less than 20 kph
- Manholes located within the landscaped portion of the Roundabout shall be accessible
- The curb height for a mountable truck apron shall be 75 mm
- Single lane entry and exit widths to include sufficient width for design vehicles plus 1.0 m buffer. To reduce speed the design should consider mountable areas for larger design vehicles.

FEATURES		**NOTES**
Posted Speed (kph)	Advisory speed may be posted	1. No raised landscaping planters 2. The slope of the central island should not exceed 6:1 3. Stopping sight distance and intersection sight distance must be established prior to landscape design 4. Landscape should block sight lines through the centre of the roundabout 5. Zebra striped crosswalks to be placed 6.0 m in advance of the yield line for single lane approaches 6. Bicycle traffic to access pedestrian crossing via up-ramps in advance of roundabout and multi-use sidewalk/path 7. Continuous involvement of Public Works is required during Roundabout design 8. Right turn bypass lanes should be used to increase capacity where high right turn volumes occur. Design shall consider safety requirements for pedestrians and bicyclists 9. Public Works may require a professional engineer's stamp on roundabout designs.
Parking	No	
Sidewalk	Match Roadway	
Traffic Signals	No	
Pedestrian Crossing	(see Note 5)	
Bikeway	(see Note 6)	
Transit Route	Match Roadway	
Truck Route	Match Roadway	
Sound Attenuation	No	
Pavement Markings	Permanent	**Reference Drawings**

6.16.2 ROUNDABOUT

Geometric

CLASSIFICATION	DESIGN SPEED	DESIGN VEHICLE
Adjoining Road Classification		Residential - WB-17 Commercial - WB-20 (1.0 m buffer required with a minimum of 0.3 m each side of vehicle) SU-9 & Bus to circulate without apron

HORIZONTAL ALIGNMENT	
Minimum Stopping Sight Distance	**Minimum Radius of Curvature**
(see TAC & Reference)	(see Reference)

Note

- Reference – "Roundabouts: A Different Type of Management Approach", Quebec Ministry of Transportation

VERTICAL ALIGNMENT
Vertical design should indicate the maximum longitudinal grades at the circle (<4%), crossfall and the need for pavement elevation plans in X and Y coordinates.

PAVEMENT STRUCTURE	REFERENCE DRAWINGS
	City of Prince Albert Standard Detail Drawings

6.17.1 RIGHT-IN RIGHT-OUT

Design

DESCRIPTION

A Right-in Right-out intersection provides vehicle access to and from one direction of travel on the adjacent roadway. Delineation at the Right-in Right-out, and in some cases a median in the centre of the adjacent roadway, prevent left turns and through movements.

Right-in Right-out intersections may be permitted as secondary access points to commercial developments; however, they may also be used to connect two public roadways when the roadway classification restricts full access due to intersection spacing constraints and/or safety issues.

GUIDELINES

- Right-in Right-out designs shall consider the appropriate design vehicles for the roadway classification and the accessible land uses
- The intersection spacing for a Right-in Right-out access shall be 50% of the corresponding roadway classifications intersection spacing. (e.g. Arterial RI/RO spacing of 50 m)
- A Traffic Impact Assessment addressing safety and operational considerations shall be required for a commercial Right-in Right-out access to an Arterial Collector unless this condition is waived in writing by Public Works.

FEATURES	
Posted Speed (kph)	N/A
Parking	No
Sidewalk	(See Note 2)
Traffic Signals	No
Pedestrian Crossing	(See Note 2)
Bikeway	N/A
Transit Route	Yes
Truck Route	Yes
Sound Attenuation	No
Pavement Markings	Yes

NOTES

1. Geometric design to meet or exceed minimum requirements of adjacent roadway classification
2. Pathway / pedestrian facility crossings at Right-in Right-out accesses shall be delineated such that it is clearly apparent to drivers that they are crossing a pathway / pedestrian facility where the pathway user / pedestrian has the right of way. The pathway / pedestrian facility crossing shall be provided as (a) a concrete sidewalk; (b) a raised asphalt crossing; or (c) permanent pavement markings in a zebra stripe or piano bar pattern. Signage identifying the location of the pathway / pedestrian facility shall be provided.
3. Sight lines shall be identified prior to landscape design.

Reference Drawings	00-04-12 00-04-13

6.17.2 RIGHT-IN RIGHT-OUT

Geometric

CLASSIFICATION	DESIGN SPEED	DESIGN VEHICLE
Adjoining Road Classification		Residential - WB-17 Commercial - WB-20 (1.0 m buffer required with a minimum of 0.3 m each side of vehicle)

HORIZONTAL ALIGNMENT	
Minimum Stopping Sight Distance	**Minimum Radius of Curvature**
(see TAC)	(see TAC)

VERTICAL ALIGNMENT
Maximum & Minimum Grades
• Max 6%, Min 0.6%
Grade at Intersections
• (see TAC)
Vertical Curves & Super Elevation
• Vertical curve lengths in meters should not be less than speed in kilometers per hour • emax = 0.04 or less

PAVEMENT STRUCTURE	REFERENCE DRAWINGS
	City of Prince Albert Standard Detail Drawings

6.18.1 PAVEMENT MARKINGS

Design

DESCRIPTION

Pavement markings include longitudinal, transverse, symbol and word pavement markings.

Pavement markings provide information to drivers. There are, however, limitations to the use of pavement markings including obstruction by snow cover, limited visibility when wet, and reduced visibility with wear.

The design of pavement markings must conform to the Manual of Uniform Traffic Control Devices for Canada.

The following table identifies marking material for all pavement markings on all roadway classification. Roadway design and engineering judgment will determine actual use of pavement markings and/or marking materials.

MATERIAL

	Arterial	**Collector**	**Residential**
Lane Lines	Paint	Paint	N/A
Edge Lines	Paint	Paint	N/A
Centre Lines	Paint	Paint	N/A
Crosswalks	Inlaid	Inlaid	Inlaid
Stop Bars	Inlaid	Inlaid	Inlaid
Continuity Lines	Paint	Paint	N/A
Guide Lines	N/A	N/A	N/A
Arrows	N/A	N/A	N/A

NOTES

1. Surface applied pavement markings include plastic (hot or cold applied), epoxy, Methyl Methacrylate (MMA), and hot tape.
2. Paint may be upgraded to Surface and applied in high volume areas.
3. All approaches of Collector roadways to Arterials will be treated with the same level of pavement marking as the higher classification roadway. Roadway design and engineering judgment will determine length of pavement markings required.

6.19.1 ERRATA

Design

DESCRIPTION

The Errata page presently identifies items identified by Public Works that have not found a permanent location elsewhere in the Design Standards document.

ERRATA

1. Adequate clear zone distance shall be provided between the edge of travel lanes and roadside obstructions. This includes separation for light standards, signs, landscaping, fences, etc
2. Stopping sight distance, decision sight distance and intersection sight distance shall be considered in all design
3. Driveway locations shall meet City of Prince Albert design standard and Bylaw requirements
4. Throat lengths for Arterial and Collector roadways shall meet or exceed the throat lengths identified for specific land uses in the TAC Geometric Design Guide for Canadian Roads unless this condition is waived in writing by Public Works
5. Roadways shall terminate in a temporary or permanent cul-de-sac. If a temporary cul-de-sac is provided until such time that the roadway is completed it shall be maintained by the developer to a level suitable for public use
6. Temporary construction access shall not attract shortcutting traffic to the construction access. Signage is required for all temporary construction access and the developer is responsible for construction and maintenance
7. As built drawings are required prior to Final Acceptance Certificate
8. Coordinate tree locations with street lights to minimize future tree trimming requirements
9. Sidewalk and pathway grades should not exceed a maximum of 5%.
10. A portion of roadway shall not have a change of gradient more than 1 in 12.5 over a maximum distance of 15 m
11. Handicap accessible ramps shall be provided for each individual crossing and shall be directed into the crosswalk location. The ramps shall not be located such that pedestrians are directed into the middle of the intersection.

SECTION 7: POST LOT DEVELOPMENT ISSUES

7.0 INTRODUCTION

This section covers issues related to utility infrastructure constructed or installed after lot servicing takes place. This includes lot grading and sump pumps. This information is provided for information only, since the land developer may or may not be the owner, home builder or the landscaper of each lot after sale of the said lot.

7.1 GENERAL

The overall design principles described in the introduction to these standards are the basis on which all construction is undertaken in the City of Prince Albert. Often a combination of principles will come into play when designing a particular component of the system.

7.2 LEVEL OF SERVICE OBJECTIVES

Lot grading and drainage control within the City of Prince Albert has evolved from the following needs:

i. To reduce the amount of stormwater inflow entering the Wastewater Collection System via foundation drains.

ii. To ensure functional surface drainage to protect private property from flooding caused by stormwater runoff.

7.3 LOT GRADING AND DRAINAGE DESIGN CRITERIA

i. Lot grading design is based upon the Overall Major (Overland) Drainage System Grading Plan prepared for a development area at the preliminary planning stage and in conjunction with the Stormwater Management Plan for the area.

ii. The minimum Finish Grade Elevation at the building(s), for all lots adjacent to trapped lows is to be a minimum of 300 mm above the 1:100 year ponding elevation for the trapped low.

iii. Split-drainage is the recommended drainage arrangement for lots in the City of Prince Albert.

iv. Lots can be dished out to a maximum of 0.5 m below the highest finished lot grade elevation. The City would prefer the subgrade outside the building envelope drain away from the center of the lot.

v. Fixed grade control must be provided at the back of each lot. The grade control may take the following forms:

   a) The finished lane for lots backing onto lanes.

   b) The finished grade on the Lot Grading Plan for lots draining front to back, or having split drainage, except where the lots back onto a linear open space.

   c) The finished grade on the Lot Grading Plan for lots draining back to front.

vi. Positive swale drainage must be provided between lots draining from front to back, and from back to front. The swale may be in the form of sod (grassed), asphalt, concrete, or other approved material.

vii. Design elevations must be provided at the following critical boundary locations on each lot:

a) All lot corners.

b) Any point along the property line where a grade change occurs.

c) For easement grading see Standard Detail Drawing 00-06-01.

d) For typical lot grading see Standard Detail Drawing 00-06-02.

e) For split drainage, back to front or walk out basements see Standard Detail Drawing 00-06-03.

f) Reverse driveways are not permitted unless the runoff can be directed away from the structure and off the property in a controlled fashion.

7.4 LOT GRADING CONTROL

i. Lot Grading Control Procedures have been developed by the City of Prince Albert in an attempt to control the vertical elevation, and proper lot grading, for buildings constructed in subdivisions.

ii. Developers will be responsible for Lot Grade Control on lots serviced after January 1, 2016. The City will assign a portion of the Developers Letter of Credit (or an alternate form of credit acceptable to the City) as required by the subdivision Service Agreement as a performance bond for Lot Grade Control.

iii. The Developer may obtain a security deposit from the builder or home buyer to ensure Lot Grading is completed as per design.

iv. The Developer's Project Engineer provides the lot grading design to the City for approval. The Developer's Contractor then rough-grades the subdivision and constructs the underground utilities and surface features. After construction is complete, the Project Engineer then confirms any changes to the lot grading design, and submits any changes to the City for approval.

v. The Developer provides the approved Lot Grading Design information to builders, home designers, and legal surveyors. The builders, home designers, and legal surveyors then prepare house and plot plans for submission to the Developer or his/her representative for approval. The builder will then submit the house and plot plans, along with the Service Connection Note Drawing 00-01-20, to the Planning and Development Department for approval.

vi. All plot plans are required to have a completed Service Connection Note. It is the responsibility of the builder to ensure that the building is constructed and the lot graded according to the specified elevations. It is the responsibility of the developer to ensure the purchaser of the lot is fully aware of the specified elevations.

7.5 DOWNSPOUT DISCHARGE

i. It is recommended that downspouts discharge to a splash pad, or a surface of concrete or other impervious materials, that is positively graded to convey the runoff a minimum of 1.2 m horizontally away from the building and adjacent properties.

ii. Splash pads are to be securely anchored to the foundation wall at the design finish grade elevation.

iii. Except for commercial buildings, industrial buildings and multi-family apartments containing more than 6 units, downspouts and roof leaders shall not be connected directly to the storm sewer system but shall discharge to the surface of the ground and flow overland before entering the stormwater system. Downspouts may not be connected to the Wastewater Collection (Sanitary Sewer) system by any means.

7.6 FOUNDATION DRAINAGE

7.6.1 Foundation Drainage (Weeping Tile) Requirements

The bottom of every exterior foundation wall shall be drained as per the Building and Plumbing Codes.

7.6.2 Discharge of Foundation Drainage Water

i. All buildings are required to drain foundation water into a sump, which in turn discharges the water through surface to such sewers designated as storm sewers or foundation drainage collectors.

ii. Sumps discharging through surface to storm sewers or foundation drainage collectors shall be pumped to the main by a pressure service connection as per detail drawing Sump with Pumped discharge to Storm Sewer or Foundation Drain Collector, Standard Detail Drawing 00-01-11.

iii. Properties zoned for non-residential land uses and for medium and high density multi-family residential (excluding lots less than 2500 m^2) must retain runoff volumes of the 1 in 5 year return period on site. The excess runoff control may take the form of parking lot, rooftop, or underground storage, as well as wet or dry ponds. The Department of Public Works shall approve runoff control designs.

iv. Sump pump outlets and roof leaders shall discharge flows no closer than 1.0 m from the property line, sidewalk, road, park, alley or surface drainage facility. Where possible, drainage across property lines shall be spread to encourage sheet flow and reduce concentrated erosive flows.