CITY OF KELOWNA

BYLAW NO. 8847

Amendment No. 8 to "Subdivision, Development and Servicing Bylaw No. 7900"

The Municipal Council of the City of Kelowna, in open meeting assembled, enacts as follows:

1. THAT "Subdivision, Development and Servicing Bylaw No. 7900" be amended as follows:

   (a) Replace the **Schedules** list in the **Index** with the new **Schedules** list attached to this bylaw.

   (b) Replace **Schedule 1 – Works & Services Requirements** with the new **Schedule 1 – Works & Services Requirements** attached to this bylaw.

   (c) Amend **Schedule 4 – Design Standards** by:

      (i) Replacing Part 1 Water with a new Part 1 Water attached to this bylaw;
      (ii) Replacing Part 2 Sanitary Sewer with the new Part 2 Sanitary Sewer attached to this bylaw;
      (iii) Replacing Part 3 Drainage with the new Part 3 Drainage attached to this bylaw;
      (iv) Replacing Part 4 Highway with the new Part 4 Highway attached to this bylaw; and
      (v) Replacing Part 5 Electrical with the new Part 5 Electrical attached to this bylaw.

   (d) Amend **Schedule 5 – Construction Specifications** by:

      (i) Replacing the Title page with the Title Page attached to this bylaw;
      (ii) Replacing Subsection 1 - Construction Specifications with the new Subsection 1 – Construction Specifications attached to this bylaw;
      (iii) Adding the new Section S02223 – Excavation, Trenching and Backfilling attached to this bylaw;
      (iv) Adding the new Section S02224 – Roadway Excavation, Embankment and Compaction attached to this bylaw;
      (v) Replacing Section S02226 with the new Section S02226 – Aggregates and Granular Materials attached to this bylaw;
      (vi) Replacing Section S02512 with the new Section S02512 – Hot Mix, Asphalt, Concrete Paving attached to this bylaw;
      (vi) Replacing Section S02666 with the new Section S02666 - Waterworks attached to this bylaw;
      (vii) Replacing Section S02731 with the new Section S02731 – Sanitary Sewer attached to this bylaw;
      (viii) Replacing Appendix A with the new Appendix A - Water Main Testing and Tie-in Procedure attached to this bylaw;
      (ix) Replacing Subsection 2 – Drawing Index with the new Subsection 2 – Drawing Index attached to this bylaw;
      (x) Deleting Standard Drawing SS-C4 – Concrete Curb – Barrier Curb with Gutter dated November 2, 1998.
      (xi) Adding Standard Drawing SS-G5 – Pavement Restoration dated October 12, 2001 attached to this bylaw;
      (xii) Adding Standard Drawing SS-S55 – Flow Control Chamber (with Sediment & Grease Trap) dated May 8, 2002 attached to this bylaw;

(xiii) Adding Standard Drawing SS-S56 – IDF Curves dated May 8, 2002 attached to this bylaw;
(xiv) Adding Standard Drawing SS-S57 – RipRap Design Chart dated May 8, 2002 attached to this bylaw;
(xv) Adding Standard Drawing SS-W6 – Air Valve Assembly dated May 31, 2001 attached to this bylaw;
(xvi) Adding Standard Drawing SS-W8a – 50mm Blow-Off (for mains 100mm & Smaller) dated February 26, 2001 attached to this bylaw;
(xvii) Adding Standard Drawing SS-W8b – 100mm Blow-Off (for mains 150mm & Larger) dated November 2, 2001 attached to this bylaw;
(xviii) Adding Standard Drawing SS-C6 – Concrete Median Curb and Interim Curbs dated October 16, 2001 attached to this bylaw;
(xix) Adding Standard Drawing SS-C7 – Driveway Crossing for Barrier Curbs dated November 26, 2001 attached to this bylaw;
(xx) Adding Standard Drawing SS-C50 – Concrete Island Ramp dated October 16, 2001 attached to this bylaw;
(xxi) Replacing Standard Drawing SS-G4 – Utility Trench dated November 2, 1998 with the new Standard Drawing SS-G4 – Utility Trench dated May 9, 2002 attached to this bylaw;
(xxii) Replacing Standard Drawing SS-W2 – Water Service Connection dated November 2, 1998 with the new Standard Drawing SS-W2 – Water Service Connection dated November 14, 2001 attached to this bylaw;
(xxiii) Replacing Standard Drawing SS-W4 – Hydrant dated November 2, 19988 with the new Standard Drawing SS- W4 – Hydrant dated November 17, 2000 attached to this bylaw;
(xxiv) Replacing Standard Drawing SS-W51 – Joint Restraint Detail (Pipe Crossing Conflict) dated November 2, 1998 with the new Standard Drawing SS-W51 – U-Bend Detail (Pipe Crossing Conflict) dated September 27, 2001 attached to this bylaw;
(xxv) Replacing Standard Drawing SS-R4 – Class 2 Local (15 m R.O.W.) dated November 2, 1998 with the new Standard Drawing SS-R4 – Local-Class 2 (15m) dated April 8, 2002 attached to this bylaw;
(xxvi) Replacing Standard Drawing SS-R7 – Collector- Class 2 (20m) dated November 2, 1998 with the new Standard Drawing SS-R7 Collector-Class 2 (18m) dated April 8, 2002 attached to this bylaw;
(xxvii) Replacing Standard Drawing SS-R8 – Arterial – Class 1 Parkway dated November 2, 1998 with the new Standard Drawing SS-R8 – Arterial – Class 1 Parkway, 4(6) Lanes (35m) dated April 8, 2002 attached to this bylaw;
(xxviii) Replacing Standard Drawing SS-R17 – Local Residential Cul-De-Sac (15m) dated November 2, 1998 with the new Standard Drawing - SS-R17 – Local Residential Cul-De-Sac (15m) dated May 8, 2002 attached to this bylaw; and
(xxix) Replacing Standard Drawing SS-R27 – Street Name and Stop Sign Standard dated November 2, 1998 with the new Standard Drawing SS-R27 - Street Name and Stop Sign Standard dated Apr 2002 attached to this bylaw.

2. AND THAT wherever references to the *Municipal Act* appear throughout the bylaw, these references be updated to reflect the appropriate sections of the *Local Government Act*.

3. This bylaw shall come into full force and effect as and from the date of adoption.

4. This bylaw shall be cited as "Bylaw No. 8847, being Amendment No. 8 to "Subdivision, Development and Servicing Bylaw No. 7900".

Read a first, second and third time by the Municipal Council this 29th day of July, 2002

Adopted by the Municipal Council of the City of Kelowna this

Mayor

City Clerk

SCHEDULES

1. Works and Services Requirements
2. Servicing Agreement
3. Quality Control and Assurance
4. City of Kelowna Design Standards
5. City of Kelowna Construction Standards (Supplemental Standards to MMCD "GOLD" Book)
6. Master Municipal Construction Documents (MMCD) – 2000 Gold Book Edition (3 Volumes) – Published and Available from "The Master Municipal Construction Documents Association"

SCHEDULE 1

OF BYLAW 7900

CITY OF KELOWNA

WORKS & SERVICES REQUIREMENTS

WORKS & SERVICES REQUIREMENTS

KEY SHEET

ABBREVIATION	REQUIREMENT
WTR	Community water system. In subdivisions which are to be provided with a community water system, each Parcel within the proposed subdivision, or Parcel being Developed, must be supplied by a water distribution system, including service connections, and with adequate fire flow and protection, which is designed in accordance with the standards prescribed in the Design Standards Water Section.
WELL	Where a community water system is not available a proven water supply located on each parcel is permitted.
SWR	Community sanitary sewer system.
SWRSEP	Sanitary sewer collection and disposal or Sanitary sewage effluent ground disposal in accordance with Part 2, Section 5.2 (o)(viii) of this bylaw.
DITCH	Drainage collection and disposal system by open ditches and culverts.
STM	Closed drainage collection and disposal system (i.e. a system other than open ditches).
SL	Street lighting throughout the subdivision.
SLI	Street lighting at street intersections only.
OH	Overhead electrical and communication wiring.
UG	Underground electrical and communication wiring.
W	Communication and electrical wiring to conform to the highest standard of existing adjacent facilities.

WORKS & SERVICES REQUIREMENTS

	UTILITIES (REFER TO KEY SHEET)					STREET REQUIREMENTS (REFER TO STANDARD DRAWINGS)				
						ROAD	ROAD CLASSIFICATION			
ZONE[4]	WATER	SEWER	DRAIN	WIRING	LIGHTING	CHARACTER	LOCAL[1]	COLLECTOR[1] [2]		ARTERIAL[1]
								NO BIKE LANE	WITH BIKE LANE	
A1	WELL	SWRSEP	DITCH	OH	SLI	RURAL	SS–R3/R4	SS – R7	SS – R6	
RR1	WTR	SWRSEP	DITCH	OH	SLI	RURAL	SS–R3/R4	SS – R7	SS – R6	
RR2	WTR	SWR	DITCH	OH	SLI	RURAL	SS–R3/R4	SS – R7	SS – R6	
RR3	WTR	SWR	STM	UG	SL	URBAN	SS–R3/R4	SS – R7	SS – R6	IN ACCORDANCE
RU1	WTR	SWR	STM	UG	SL	URBAN	SS–R3/R4	SS – R7	SS – R6	WITH 'MAJOR
RU2	WTR	SWR	STM	UG	SL	URBAN	SS–R3/R4	SS – R7	SS – R6	
RU3	WTR	SWR	STM	UG	SL	URBAN	SS–R3/R4	SS – R7	SS – R6	ROAD
RU4	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R7	SS – R6	
RU5	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R7	SS – R6	NETWORK
RU6	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R7	SS – R6	
										PLAN'
RM1	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R7	SS – R6	
RM2	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R7	SS – R6	CLASSIFICATION
RM3	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R7	SS – R6	
RM4	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R7	SS – R6	
RM5	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R7	SS – R6	
RM6	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R7	SS – R6	
RM7	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R7	SS – R6	
C1	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R5	SS – R6	
C2	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R5	SS – R6	
C3	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R5	SS – R6	
C4	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R5	SS – R6	
C5	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R5	SS – R6	
C6	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R5	SS – R6	

	UTILITIES (REFER TO KEY SHEET)					STREET REQUIREMENTS (REFER TO STANDARD DRAWINGS)				
						ROAD	ROAD CLASSIFICATION			
ZONE[4]	WATER	SEWER	DRAIN	WIRING	LIGHTING	CHARACTER	LOCAL[1]	COLLECTOR[1] [2]		ARTERIAL[1]
								NO BIKE LANE	WITH BIKE LANE	
C7	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R5	SS – R6	
C8	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R5	SS – R6	
C9	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R5	SS – R6	
C10	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R5	SS – R6	
I1	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R5	SS – R6	IN ACCORDANCE
I2	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R5	SS – R6	
I3	WTR	SWRSEP	DITCH	OH	SLI	RURAL	N/A	SS – R5	SS – R6	WITH 'MAJOR
I4	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R5	SS – R6	
I5	WELL	SWRSEP	DITCH	OH	SLI	RURAL	N/A	SS – R5	SS – R6	ROAD
P1	WTR	SWR	STM	UG	SL	RURAL	N/A	SS – R5	SS – R6	NETWORK
P2	WTR	SWR	STM	UG	SL	RURAL	N/A	SS – R7	SS – R6	PLAN'
P3	WELL	SWRSEP	STM	W	SLI	RURAL	N/A	SS – R7	SS – R6	
P4	WELL	SWRSEP	STM	W	SL	RURAL	N/A	SS – R7	SS – R6	CLASSIFICATION
W1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
W2	AS REQUIRED BASED ON DEVELOPMENT PROPOSAL					AS REQUIRED BASED ON DEVELOPMENT PROPOSAL				
CD[3]	WTR	SWR	STM	UG	SL	URBAN	AS SPECIFIED IN EQUIVALENT ZONE		SS – R6	
CD12	WTR	SWR	STM	UG	SL	URBAN	N/A	SS – R5	SS – R6	

Notes: (1) Sidewalks: Urban Local: No sidewalk required.
Urban Collectors: Class 1, sidewalk on both sides, Class 2, sidewalk on one side.
Urban Arterial: Sidewalk on both sides.
Rural Roads: No sidewalks required.
Note: (a) Sidewalks are required on any road fronting a school or major recreational facilities.
(b) The City Engineer may require only one sidewalk on short crescents & cul-de-sacs in industrial zones with urban infrastructure

(2) Where the collector road is on a bikeway route, as defined by the City's Bikeway Network Plan the road requirement will be based on Drawing Standard SS – R6.

(3) Comprehensive Development Zones listed in Section 17 of the Zoning Bylaw, except the CD12 – Airport zone.

(4) The zones identified in this table are the zones designated in the Zoning Bylaw. 'Properties with an 's' as part of the zoning designation shall comply with the works and services requirements of the parent zone (e.g. RU1s shall comply with the requirements of the RU1 zone.) Similarly properties with a 'b' or 'h' as part of the zoning designation shall comply with the works and services requirements of the parent zone (e.g. RU6b shall comply with the requirements of the RU6 zone and RU1h shall comply with the requirements of the RU1 zone).

(5) Relocation of Urban Infrastructure: Where existing urban infrastructure is scheduled to be relocated at a future date as part of the City's 20-Year Transportation Plan; and if adequate infrastructure exists at the time of a redevelopment of property, then the developer will not be required to put up the letter of credit, cash-in-lieu, or bond for the cost of relocation. Instead the costs will be incorporated in the 20-Year Servicing Plan and related DCC charges.

DESIGN STANDARDS

1. WATER

1. Water

1.1 Water Distribution System

The system must be designed to provide day-to-day domestic requirements and also must provide adequate flows for fire protection.

Design Computations for water distribution systems will be based on the Hazen-William's formula, with the following 'C' values:

Pipe Material	C Value
PVC	130
Ductile, Concrete Cyl., Steel	120

The maximum allowable design velocity shall not exceed the following:

Pump Supply, Reservoir and Trunk Mains	2.0 m/sec.
Distribution Lines	
- At Peak Hour Flow	2.0 m/sec.
- Fire Flow Conditions	4.0 m/sec.

1.2 Per Capita Demand

The following design criteria must be used for most applications. Where, in the opinion of the City Engineer, the flow characteristics of the Development or of the Improvement District are substantially different, the criteria may be modified.

Average daily flow	900 litres/capita/day
Peak daily flow	2400 litres/capita/day
Peak hour flow	4000 litres/capita/day
Design population density:	
Single Family	3.0 people/dwelling
Multi-Family	2.0 people/dwelling

1.3 Fire Flow Demand

Fire flows must be designed in accordance with the criteria outlined in "Water Supply for Public Fire Protection - A Guide to Recommended Practice 1995" published by Fire Underwriters Survey.

The following minimum fire flows must be met for the noted zones under peak daily flow conditions:

Zone	Required Fire Flow
Single & Two Dwelling Housing	60 litres/sec
Modular/Mobile Home	60 litres/sec
Three & Four Plex Housing	90 litres/sec
Apartments and Row Housing	150 litres/sec
Commercial	150 litres/sec
Institutional	150 litres/sec
Industrial	225 litres/sec

1.4 Water Pressure

The water system must be designed to provide domestic water at the probable building main floor elevation on each Parcel as follows:

Maximum static pressure	827 Kpa (120 psi)
Minimum static pressure	275 Kpa (40 psi)
Minimum system pressure at peak hour	250 Kpa (36 psi)
Minimum system pressure at fire flow conditions	140 Kpa (20 psi)

Where, in the opinion of the City Engineer, the criteria of the Improvement District is substantially different, the criteria in this section may be modified.

1.5 Hydraulic Network Considerations

(a) Where there is an existing hydraulic network in place, the City will provide any available information for assistance in designing the network.

(b) Depending on the complexity and extent of the proposed distribution system, the City may require a hydraulic analysis design showing flows and pressures.

(c) The maximum desirable length of any permanent non-interconnected water main is 150 m. All mains exceeding 150 m, unless it is a temporary situation, must be looped, except with the approval of the City Engineer.

(d) Where the water system network is weak, installation of supplementary mains may be required and may necessitate the provision of rights-of-way in favour of the City.

(e) In residential areas, water mains servicing fire hydrants must be 150 mm diameter or larger. Water mains 100 mm in diameter may be permitted for domestic service on dead-end roads where no further extension is planned. Wherever practical, water mains must be looped. Dead-end mains must not be promoted.

In commercial/industrial/institutional areas, the minimum water main size allowed, shall be 200 mm diameter.

Where, in the opinion of the City Engineer, the criteria of the Improvement District is substantially different, the criteria in this section may be modified.

1.6 Minimum Depth of Cover

The cover over any water main must not be less than 1.5m. In the case where this can not be achieved due to a conflict where a u-bend cannot be utilized, and with approval from the City Engineer or Improvement District, rigid insulation may be used to provide protection to the water main from freezing, as per the DOW CHEMICAL CANADA Utility Line Insulation guidelines.

1.7 Minimum Grade

Water mains must be designed with a rising grade wherever possible, to minimize high points in the main. Where a high point is unavoidable, either a hydrant, service or air release valve should be installed at that point.

Where the slope of water main exceeds 15%, the design must provide for proper anchorage of the pipe in accordance with MMCD Drawing No. G8.

1.8 Minimum Clearance

At all locations, there must be a minimum lineal horizontal clearance of 1 meter between the water main and other existing or proposed underground services or open ditches, except sanitary sewers and storm drains. A minimum horizontal clearance of 3 meters must be maintained between the water main and sanitary sewer or storm drain, or where this is not possible, in accordance with Ministry of Health requirements.

Where it is necessary for the water main to cross under other underground services, the crossing must be made at an angle greater than 20 degrees horizontal. The vertical clearance between pipes at the crossing point must be in accordance with Ministry of Health requirements.

The drawings must indicate whether the water main passes over or under other underground services which it is crossing.

1.9 Valving

In general, valves must be located as follows:

(a) In intersections, in a cluster at the pipe intersection or at the projected property lines, to avoid conflicts with curbs and sidewalks:

  (i) 3 valves at "X" intersection
  (ii) 2 valves at "T" intersection
  (iii) Or as directed by the City Engineer or Improvement District, in order to allow for the isolation of specific sections of the main.

(b) Not more than 200 m apart for single family residential. All property zoned other than single family residential require special designs.
(c) In locations and at a frequency so that not more than two hydrants are out of service when a section of the main is turned off.
(d) An exclusive isolation valve for each hydrant.

Valves must be the same diameter as the main up to 300 mm diameter. Gate valves must be used up to and including 300 mm diameter.

Butterfly valves with gear operators will be allowed in mains larger than 300 mm.

1.10 Hydrants

The Consulting Engineer must consider the existing and intended use in the area, and ensure that adequate spacing is provided in accordance with the Standard Hydrant Distribution table in the F.U.S. Guidelines. Fire hydrants must be located so that the spacing is never greater than 200 meters in single family residential areas and 100 meters in higher density residential, commercial, industrial, and institutional areas.

In mid-block locations, fire hydrants must be located at the property lines. The design and proposed locations of fire hydrants must not conflict with existing or proposed street lights, power poles, etc., and must have a minimum 1.0 m clearance from any objects on the sides or back. Attempts must be made to avoid locating hydrants on sidewalks. Where this is not possible, a minimum distance of 1.2 m must be maintained between the front of the pumper port and the back of curb, in accordance with the Transportation Association of Canada Manual for Canadian Roads. If possible, consideration must also be given to try and satisfy minimum distance to main entrance or simese connection requirements per section 325 of the Provincial Building Code.

On Arterial Highways with, or designated to be constructed with, a raised median, fire hydrants shall be installed on both sides of the Highway with each side treated exclusively for spacing requirements.

1.11 Air Valves

The general application of the three types of air valves must be:

(a) air/vacuum valves for filling or discharging mains and preventing negative pressures.
(b) air release valves for small air release during normal operation.
(c) combination valves for combination of air/vacuum and air release valves.

Air valves are not required on water mains 200 mm diameter and smaller, except under special needs as determined by the professional engineer retained by the owner to design the Works or as required by the City Engineer.

Combination air valves must be installed at the summit of all mains 250 mm diameter and larger, except where the difference in grade between the summit and valley is less than 600 mm.

1.12 Blow-Offs

Blow-offs are required at the terminal ends of all water mains whether permanent or temporary, in order to achieve scouring velocities resulting in proper flushing.

Every 100mm watermain that terminates with out looping must come with a 50mm blow-off assembly as per standard drawing SS-W8a. All watermains that are 150mm and larger with a terminating end must come with a 100mm blow assembly as per standard drawing SS-W8b.

Where practical, and with the approval of the City Engineer and/or Improvement District, hydrants may also be used in a secondary role as a blow-off.

1.13 Thrust Blocking

Concrete thrust blocking and/or adequate joint restraining devices must be provided at bends, tees, wyes, reducers, plugs, caps, valves, hydrants and blow-offs.

Bends at 5 degrees do not require thrust blocking and/or adequate joint restraining devices.

The restraining device system must take into account potential future excavations of the road in the vicinity of the water main.

Provide the City Engineer of the Improvement District, when required, with engineered calculations for the thrust block design, based on fitting type, water pressure and soil conditions.

1.14 Chamber Drainage/Venting

Chambers or manholes containing valves, blow-offs, meters, or other appurtenances are to allow adequate room for maintenance, including head room and side room. The access opening must be suitable for removing valves and equipment. The chamber is to be provided with a drain to a storm drain or ditch (rock pits may be considered subject to adequate soil conditions) to prevent flooding of the chamber. Adequate venting is to be provided.

1.15 Service Connections

In general, 19mm diameter service connections may be tapped directly into mains 150mm diameter and greater; and 25mm diameter service connections may be tapped directly into mains 200mm diameter and greater, except in the use of PVC water mains where all service connections must be made with service saddles in conformance with Policy 266 (Approved Products List) of this bylaw. 38mm and 50mm diameter service connections must be made using service saddles.

Where possible, multiple corporation stops must have a minimum spacing of 1.0m. Where this cannot be met, the corporation stops must be staggered vertically and not less than 300mm apart. No tappings must be made at an angle greater than 30 degrees, or less than 10 degrees above the horizontal centreline plane of the pipe. Where it is necessary to install service connections at less than 1.0m centres in a 100mm diameter main, such lengths of pipe must, in all cases, be ductile iron.

The curb stop at the end of each service pipe must be located 500mm from the property line, on the road right-of-way, and at the centre of each lot. Where such locations will conflict with other services, the location may be revised with the approval of the City Engineer.

Services and curb stops must have a minimum cover of 1.5m and curt stops must be no deeper than 2.0m.

1.16 Pipe Alignment

Water mains must be normally designed to follow a straight alignment between intersections, at offsets parallel to the road centreline.

Water mains must be located within the road right-of-way as indicated in the applicable Standard Drawings of the typical cross-section for that road. Typically a water main should be placed on the south or west side of the road except on side hill streets, where the main must, where possible, be located on the cut side of the centreline of the street.

Water mains must be located such that each lot to be served has at least one side fronting thereon. The water main must be extended to the most convenient existing water main that will provide an adequate supply of water.

Where required, curved alignments may be accepted by means of pipe joint deflection, and in special cases by means of pipe barrel bending where no service connections are anticipated, and subject to City Engineer or Improvement District approval. Pipe alignment to be at a parallel offset with an established road right-of-way or property line, with a radius of curvature not less than 60m or 1.5 times the minimum radius of curvature recommended by the pipe manufacturer, whichever is the greater. The design drawings must indicate where short lengths or field belled pipe lengths are required on curves.

1.17 Water System Location/Corridors

When the utility is required to cross private land(s), the right-of-way must be sufficient to repair or replace the utility line without the use of caging or shoring, and be a minimum of 4.5 m wide.

When a utility is located within a right-of-way, and manholes, valve chambers, or other appurtenances which require maintenance are located within the right-of-way, the owner may be

required to provide for a constructed road access from a municipal road for maintenance vehicles. The maintenance access must be adequate to support the maintenance vehicles for which the access is intended.

1.18 Reservoirs

(a) Pre-Design Requirements - The Consulting Engineer retained by the owner to design the Works must obtain approval from the City that the siting of the reservoir is acceptable.
Prior to commencing detailed design, the Consulting Engineer must submit a pre-design report that addresses the design considerations of this criterion. Approval of the pre-design concept must be obtained prior to the Consulting Engineer commencing detailed design.

(b) Reservoir Capacity must be not less than the greater of the following:

1. One day average annual consumption for the service area.
2. The sum of the peak hourly demand flow rate sustained for 6 hours plus the fire flow required to meet Fire Underwriters Survey Guidelines for the specified period of time, less the pump station capacity with the largest capacity pump out of service.

(c) Reservoir design must incorporate the following features:

1. Reservoirs must be designed in accordance with the American Concrete Institute's Manual on environmental Engineering Concrete Structures - ACI 350R – Current Version
2. 2 cells, each containing one-half of total required volume and capable of being drained and filled independently
3. Reservoir to be below ground , unless specifically approved otherwise
4. Each cell is to have an access opening in the roof for cleaning and maintenance minimum dimension 900 mm x 900 mm to be located so that the overflow pipe is clearly visible inside the reservoir, when viewed from the hatch
5. At all access hatches, a survey mark inlaid inside showing the geodetic elevation is to be provided
6. Access hatch(s) to have the following:
   - aluminum 1/4" tread plate
   - perimeter drain
   - perimeter sealing gasket
   - slam lock with aluminum removable sealing plug and opening tool
   - flush lift handle
   - gas spring assist cylinder
   - 90 degree hard open arm
   - flush fitting padlock tang
7. The hatch must be reinforced for 1,465 kg/m² (300 lbs./sq.ft.)
8. All fasteners for the hatch to be made of 316 stainless steel
9. Ventilation pipes or openings sized to handle appropriate intake and exhausting volumes of air for filling and drawing the reservoir
10. Reservoir floor to slope to drain sump
11. Drain sump to be a minimum of 1000mm X 1000mm X 400mm, invert of drain pipe to be flush with sump floor , grating to be installed over sump

12. Sub-drain under floor to collect and drain any leakage (may be connected to overflow pipe provided suitable measures are incorporated to prevent surcharging) (13) overflow drain to be provided and sized to transmit the maximum pump discharge with all pumps running.
13. A stainless steel interior wall ladder is required from roof access to floor. All ladders to meet WCB regulations, supply attachment points for fall arrest equipment.
14. Where public access could be gained to reservoir, install appropriate fall prevention railings
15. Re-chlorination may be required. The Consulting Engineer retained by the owner to design the Works is to review this need based on demand forecasts
16. All pipework within the reservoir to be PVC or fiberglass except overflow which may be steel or cast iron coated to AWWA standards.
17. All metal parts within the reservoir including bolts, nuts, screws, anchors, ladders etc. to be stainless steel
18. Reservoir inlet pipe to terminate with a diffuser positioned opposite the reservoir outlet and a distance of 3/4 the length of the reservoir from the outlet . Diffuser to cover ¾ the wall length. (Refer to standard drawing)
19. Ports in diffuser pipe to be engineered to produce circulation within the reservoir during fill cycle.
20. Diffuser to incorporate removable end caps.
21. Backup high and low level control balls for each cell set at 40% and 95% levels, (not to contain lead or mercury)
22. The reservoir must be cleaned and disinfected to AWWA and City of Kelowna requirements.
23. Gated black chain link perimeter fencing may be required to address safety issues
24. Landscaping acceptable to the City is to be provided including irrigation.
25. Manuals to be supplied as per “Manuals” section

(d) Reservoir Valve Chamber

Reservoir to incorporate valve chamber containing:

1. All valves associated with the reservoir.
2. Entrance at grade large enough to permit safe removal of largest single piece of equipment
3. Lifting beams and hoists where necessary to enable removal of equipment or components
4. Floor drains
5. Separate inlet and outlet piping including check valves to separate inlet and outlet flows.
6. All inlet and outlet piping to incorporate a ¾ inch sampling port with isolating ball valve
7. A ¾ inch schedule 80 PVC sample line with isolating ball valve for each cell terminating in the middle of a cell wall at the 50% level and extending 25% towards the center of the reservoir.
8. A 2” stainless steel schedule 80 pipe with isolating ball valve extending into each cell for connection of cleaning hoses.
9. A ¾ inch stainless steel pipe with isolating ball valve extending into each cell connected to a pressure transmitter for level sensing
10. Minimum 30 amp, 120 VAC electrical service
11. Heat, light and ventilation to meet WCB requirements
12. All control wiring junction boxes
13. A PLC control system to current Pump Operations standards.
14. Chlorine residual analyzer

15. Interior and exterior of all steel piping to be coated to AWWA standards
    inlet piping – Mid Blue
    outlet piping – Dark Green
    Drain piping – Gull Grey
    All other piping – Mid Blue
    Check valves to show direction of flow with white painted arrows
16. -PLC controlled modulating inlet valve where more than one reservoir serves a single zone.

    The modulating inlet valve shall:

    I. have non-contact 0 - 100% valve position indicator with 4-20 ma. output
    II. be hydraulically operated with pressure tank (minimum 40 psi) sized to operate valve for 3 cycles during power failure
    III. be complete with a hydraulically operated diaphragm actuated globe or angle
    IV. pattern valve of 'powertrol type'
    V. pilot system to be protected by single continuous flow 100 micron filter.

Where, in the opinion of the City Engineer, the criteria of the Improvement District is substantially different, the criteria in this section may be modified.

1.19 Pump Stations

Pump stations, where required, must be designed to suit the particular circumstances and otherwise comply with this bylaw. In general, pump stations must be designed to meet maximum daily demands with the largest pump out of service with balanced storage on line. If balancing storage is not on line, pump station capacity must meet peak hour demand with the largest pump out of service, and stand-by power must be provided to allow the greater of maximum day demand plus fire flow or peak hour demand during a power outage.

(a) Pre-Design Requirements - The Consulting Engineer retained by the owner to design the Works must obtain approval from the City that siting of the pump station is acceptable.
Prior to commencing detailed design, the Consulting Engineer must submit a pre-design report that addresses the design considerations of this criterion. Approval of the pre-design concerns must be obtained prior to the Consulting Engineer commencing detailed design.

(b) Pump station design must incorporate the following features:

1. reinforced concrete, blockwork or brick construction, aesthetically pleasing;
2. access doorways sized so that the largest single piece of equipment may be safely removed and replaced. Lifting hooks or rails with pulley blocks as required
3. adequate HVAC with filtered air inlet
4. housekeeping pads for MCC’s
5. electric motors to be premium efficiency
6. motors to have thermal protection
7. motors 100 hp and above to have analogue vibration recording and protection
8. all pilot, air relief discharge to be piped to floor drains to avoid standing water
9. air release valves
10. hydraulically operated pump control valves with isolation valves
11. flow meter
12. spring return check valves
13. high pressure and surge relief valves with isolation valves

14. suction and discharge pressure gauges for each pump with isolation valves
15. mechanical pump seals
16. lockable roof hatches for motor and pump removal
17. water quality sampling ports
18. off road vehicle parking
19. landscaping to City Parks department specifications
20. interior and exterior of pipework to be coated to AWWA standards
    exterior colors to be:
    inlet piping – Mid Blue
    outlet piping – Mid Blue
    Drain piping – Gull Grey
    All other piping – Mid Blue
21. pump system to be PLC controlled and connected to City of Kelowna Pump Operations SCADA system
22. control system to include but not limited to:
    (a) Security switches
    (b) Discharge and suction pressure transmitters
    (c) Temperature sensor
    (d) Uninterruptable power supply
    (e) Radio or hard wire modem
    (f) External antenna
    (g) Operator interface panel
    (h) Power meter without outputs to PLC
    (i) Phase loss protection
    (j) 5 spare fuses for all fuseholders
    (k) Current copy of PLC and MMI program to be left in control enclosure (see Pump Operations department for current standards)
23. Motors to be 600volt, 3 phase
24. Hour meters and ammeters for each pump
25. Power factor correction if required by Power Authority
26. MCC, breaker boxes, receptacles to be labelled
27. Station to be cleaned and dust free
28. Noise attenuation
29. Manuals to be provided as per “Manuals” section

Where, in the opinion of the City Engineer, the criteria of the Improvement District is substantially different, the criteria in this section may be modified.

1.20 Pressure Reducing Stations (As per standard drawings)

Minimum chamber size: 4 X 2 X 2 meters
Minimum 30 amp, 120 VAC service

1. Forced air ventilation, heat and light
2. External kiosk and antenna
3. Parallel pressure reducing valves
4. Air release valves
5. Water quality sample points
6. Sump drain to storm
7. Hatch as per reservoir section
8. Off road vehicle parking
9. Manuals as per “manual” section
10. landscaping acceptable to the City of Kelowna Parks Department

11. PLC control to City of Kelowna SCADA system, including:
    (a) security switches
    (b) discharge and suction pressure transmitters
    (c) temperature sensor
    (d) flowmeter
    (e) uninterruptable power supply
    (f) radio or hard wire modem
    (g) external antenna
    (h) operator interface panel

Where, in the opinion of the City Engineer, the criteria of the Improvement District is substantially different, the criteria in this section may be modified.

1.21 Manuals

Supply (3) copies of operating and maintenance manuals:

Bind contents in a three-ring, hard covered, plastic jacketed binder, name of facility to be embossed onto binder cover and spine.

Each section shall be separated from the preceding section with a plasticized cardboard divider with a tab denoting contents of the section

Contents to include:
    (a) Title sheet, labelled “Operation and Maintenance Instructions”, and containing project name and date
    (b) List of contents
    (c) Reviewed shop drawings of all equipment
    (d) Equipment list showing all model and serial numbers
    (e) All equipment manufacturers manuals
    (f) As-built drawings of all mechanical, electrical, control and alarm installations
    (g) Full description of system operation including: design points, designed pump and system curves, ultimate capacity, area served and any relevant design criteria relevant to the operation of the system.
    (h) Full description of entire mechanical, electrical and alarm system operation
    (i) Names, addresses and telephone numbers of all major sub-contractors and suppliers
    (j) Commissioning report showing pressures, flows, current draw for all possible operating conditions

Where, in the opinion of the City Engineer, the criteria of the Improvement District is substantially different, the criteria in this section may be modified.

1.22 Facility Access

Paved vehicular access must be provided to all reservoirs and pump stations. The minimum standard must be as for an emergency access road as shown in the standard drawings, with curbing and drainage provisions as may be required.

Where, in the opinion of the City Engineer, the criteria of the Improvement District is substantially different, the criteria in this section may be modified.

DESIGN STANDARDS

2. SANITARY SEWER

2. Sanitary Sewer

2.1 Sanitary Sewer

Sanitary sewer systems must be designed in accordance with the requirements noted in this Schedule.

2.2 Design Flows

The sanitary sewer system must be designed based on the following criteria:

(a) Domestic Flow Rate = 300 litres/capita/day, except when used for the analysis of older areas (pre-1960), when a value of 420 l/c/d shall be used.

(b) Infiltration rates for:

Pipes not in water table	=	5,000 l/ha/d
Pipes in water table	=	8,000 l/ha/d

(c) General Zoning Densities:

	People/Gross Ha.	**People/Unit**
Single Family	24-30	3
Multi-family Low	65	2
Multi-family Medium	(3 storey) 120	2
Multi-family High	(4-12 storey) 320-960	2
Mobile Home	40	2
Industrial	50	-
Institutional	50	-
Commercial	75	-

(d) A peaking factor must be applied to the average flow, with this factor being modified to suit the areas served as follows:

$$\text{Peaking Factor} = f \times \left(1 + \frac{14}{4 + \sqrt{P}} \right)$$

where: P = Population in Thousands
f = Reduction factor, applied as follows:
- New residential areas = 0.75
- Old residential areas = 0.85
- Commercial and Industrial area = 1.00

(e) Peak design flows must be determined by applying the peaking factor to the average daily flow, and then adding the infiltration (I & I) flows.

(f) Pipes shall be designed so that sewers flow 2/3 full for pipes 250 mm diameter and less, or 3/4 full for pipes greater than 250 mm diameter.

2.3 Pipe Flow Formulas

Gravity Sewers: Manning's formula must be used.

The roughness coefficients must be:
Concrete = 0.013
PVC = 0.011

Force Main Sewers: Hazen-Williams formula must be used.

Friction coefficients must be the same as specified in the Water Design Standards (D.1.1.).

2.4 Manholes

Manholes are required at:

- all changes in grade
- all changes in direction
- all changes in pipe sizes
- all intersecting sewers
- all terminal sections

- downstream end of curvilinear sewers

Manholes must be placed where future extensions are anticipated and must be spaced no greater than 150 m apart.

Sanitary manhole rim elevations in off road areas must be designed to be:

(a) above the adjacent storm manhole rim elevation

(b) above the surrounding ground so that infiltration from ponding will not occur.

2.5 Hydraulic Losses Across Manholes

The following criteria must be used:

(a) The springline of the downstream pipe must not be higher than the springline of the upstream pipe.

(b) Minimum drop in invert levels across manholes:

(i) Straight run - no extra drop required other than slope of pipe
(ii) Deflections up to 45º - 25 mm drop
(iii) Deflections 45º to 90º - 50 mm drop

(c) Drop manholes and outside ramps must be installed in accordance with standard drawings.

(d) Inside ramps will be permitted up to 450 mm from invert to channel bed.

(e) The maximum deflection angle created in a junction is 90^{O}.

2.6 Temporary Clean-Outs

Temporary clean-outs may be provided at terminal sections of a main provided that:

(a) future extension of the main is proposed or anticipated.

(b) the length of sewer to the downstream manhole does not exceed 45.0 m.

(c) the depth of the pipe does not exceed 2.0 m at the terminal point.

(d) clean-outs are not be considered a permanent structure.

2.7 Minimum Pipe Diameter

The minimum permitted size of pipe is:

- For residential lands - 200 mm diameter.
- For commercial and industrial - 250 mm diameter.

Terminal pipe section, upstream of the last intersection of mains, and where no further extension is planned, must be:

- For residential lands - 150 mm diameter with min 1.0% grade
- For commercial and industrial - 200 mm diameter with min. 0.60% grade

2.8 Velocities

The minimum velocity must be 0.6 m/sec. There is no maximum velocity, however, consideration must be given to scour problems and the dynamic loading on manholes where flow exceeds 3.0 m/sec. Anchoring must be incorporated where the grade(s) of the sewer are 15% or greater in accordance with MMCD Drawing No. G8.

2.9 Minimum Grade

The grade of any sewer is governed by the minimum velocity required of 0.6 m/sec. If the calculated design flow is not expected to produce a velocity of at least 0.6 m/sec., then the minimum grade shall be calculated on the basis of the pipe flowing 35% full at a theoretical velocity of 0.6 m/sec. However, the last section of a main that will not be extended in the future, must have a minimum grade of 1.0% where 150 mm diameter pipe is proposed.

2.10 Depth and Cover

The minimum depth of the sewer main (from the surface of the road or ground to the top of pipe) must be suitable to service the basement(s) of adjacent properties as required in the "Service Connection" section. This depth is normally 2.0 m, but mains may have to be installed to depths of 4.5 m to provide gravity services.

The absolute minimum cover over a pipe must be 1.0 m (measured from the surface to the top of pipe).

The depth of the sewer must be sufficient to provide ‘gravity flow’ service connections to both sides of the Roadway and must allow for future extension(s) to properly service all of the upstream tributary lands for ultimate Development.

The maximum dept of mains and services for typical installations is 4.5 metres of cover, which shall not be exceeded without authorization to do so from the City Engineer.

2.11 Curvilinear Sewers

Where permitted, horizontal and vertical curves will require a constant offset and/or must be uniform throughout the curve. The radius of the curve must not be less than 1.5 times the pipe manufacturer’s recommended minimum radius. The design velocity must exceed 0.91 m/sec., and the curve midpoint and two 1/4 points are to be located by survey and shown on the as-constructed drawings with an elevation and offset of the invert at each point.

2.12 Sewer Location/Corridors

Sanitary sewers are to be located within the roadway as shown in the applicable standard road cross-section drawings. Servicing from the roadway is required unless the main would need to be in excess of 5m depth of cover to provide a gravity service, and in that case the City will allow a design based on sewer pumps for basement levels provided that the main floor of the building is serviced by gravity.

Rear yard sewers are discouraged and must be approved by the City Engineer.

When the utility is required to cross private land(s), the right-of-way must be a minimum of 4.5 m wide for a single pipe. The width must be suitable to accommodate excavations based on WCB regulations for side slopes (normally 0.75H:1.00V). Where water mains are provided, adequate clearance from other utilities is required in accordance with Ministry of Health regulations and the right-of-way width must allow for this.

A cross-section of the proposed trench(es) must be shown, indicating the minimum safe elevation of adjacent building footings based on a safe angle of repose from the limits of the (0.75H:1.00V) excavation. The trench section must be based on WCB regulations for side slopes (0.75H:1.00V).

When a utility is located within a statutory right-of-way, and manholes, valve chambers, or other appurtenances which require maintenance are located within the right-of-way, the owner may be required to provide a constructed road access from a Municipal road for maintenance vehicles. The maintenance access must be adequate to support the maintenance vehicles for which the access is intended. Maintenance access must be level (from side to side) and a minimum width so that open excavation to WCB standards can be achieved within the level surface, and in no case shall be less than 3m wide. The maximum grade of the maintenance access is 12%.

2.13 Service Connections

(a) Service connections must be provided to each lot fronting the main. Service connections shall not be extended at an angle that exceeds 45° from perpendicular to the main, and in no case shall a service connection be placed so that it extends in front of any property other than the one being serviced.

(b) Lots are allowed one service connection per property. In special circumstances where the servicing of all buildings on existing Industrial or Commercial properties is not feasible, two services may be permitted if authorized by the City Engineer.

(c) Connections to new mains must be made using standard wye fittings; connections to existing mains must be made using wye saddles or, where approved by the City Engineer, inserta-tees may be used. All services must enter the main at a point just below the springline.

(d) The standard size for single family residential service connections must be 100 mm, for which the minimum grade from the main to the property line must be 2.0%.

(e) The minimum depth of a service at the property line must be 1.5 m provided that gravity service to the Minimum Building Elevation (as defined in the Drainage Standards) is available.

(f) Where rear yard sewers are necessary, due to steep topography, the minimum cover must be 1.0 m provided that gravity service, to the Minimum Building Elevation is available.

(g) Service connections may be permitted into manholes provided that:

  (i) the connection is not in an adverse direction to the flow in the sewer main;

  (ii) the connection enters the manhole so the service crown is no lower than the sewer main crown.

(k) Inspection Chambers (I.C.'s) are required for all service connections, except when the sewer main is in a right-of-way and the service is less than 2.5m long and ties into a manhole.

(l) Control manholes are required for all industrial and light industrial connections. Control manholes will be required for commercial connections at the discretion of the City Engineer. (See Standard Drawings.)

(m) Service connections must be installed at the lower (downstream) portion of the lot for larger lots or Parcels of land. In urban Developments, connections must be as noted on the Standard Drawings.

(n) The maximum length of any service connection is 30m, unless authorized by the City Engineer.

2.14 Sanitary Lift Stations

The use of sanitary pump stations is to be discouraged. Any proposed use of lift stations must receive prior approval from the City Engineer. Sanitary lift stations should normally be located within a right-of-way outside the required road dedication.

This criteria covers both dry well and submersible sewage lift stations. Larger capacity sewage lift stations or lift stations with special design or siting requirements may require additional assessment and review of criteria.

(a) Pre-Design Requirements

The Consulting Engineer retained by the Owner to design the Works and Services must attempt to minimize the number of sewage lift stations and thoroughly consider other options to avoid lift stations wherever practical and must obtain approval from the City Engineer prior to siting the lift station.

Prior to commencing detailed design of a lift station, the Consulting Engineer must submit a pre-design report that addresses the design considerations of this criteria. Approval of the pre-design concepts must be obtained prior to the Consulting Engineer commencing detailed design.

(b) Location and Layout

The location and layout of a lift station must include an assessment of the following basic design considerations:

- The lift station must be designed to handle the ultimate flows of the designated catchment.
- Type of station and impact on neighbours.
- Construction dewatering requirements.
- Access for construction.
- Access for maintenance.
- Aesthetics, noise, odour control and landscaping requirements.
- Security against vandalism and theft.
- Flood elevations. Station uplift design must be based on maximum load level.
- Proximity of receiving sewers, water mains, and adequate power supply.
- Minimizing energy requirements.

- Standby power and its compatibility.
- Soils. Sub-surface investigations must be undertaken prior to site approval.
- Convenience of operation and maintenance.
- Safety for operators and public.
- Capital costs and operation and maintenance costs.

(c) Design Criteria

(1) Pumps must be:
- capable of passing solids up to 75 mm in size
- equipped with hour meters
- easily removed for maintenance
- operate with a motor running at 1750 RPM's
- operate on a 347/600 volt electrical source (pump motors 5 h.p. and greater are to be 600 volt 3 phase type)
- able to operate alternately and independently of each other
- able to meet maximum flow condition with one pump in failure mode
- designed so that each motor does not cycle more than 4 times in one hour under normal operating conditions. For example, in a duplex pump station that is designed to alternate the pump starts, each motor can have a maximum of 4 starts in an hour which could result in a total of 8 motor starts per hour for this station.

(2) Motor cables, power cables, etc., must be continuous from within the pump station to within the kiosk unless an adequate exterior pull pit and junction box is installed.

(3) Levels to be controlled by ultrasonic level transmitter with emergency high and low level balls.

(4) All auxiliary equipment and control panels must be mounted in a suitable kiosk adjacent to the station. The kiosk must be located a minimum of 3.0 m from the station lid.

(5) The control kiosk must be designed to contain all control and telemetry equipment on the front panel and all power equipment on the rear panel.

(6) Check valves must be ball lift check valves.

(7) All stations require an explosion-proof exhaust fan which can be activated by manual switch, and which meets WCB requirements for ventilation in a confined space.

(8) The entrances to all stations must be waterproof and be provided with a suitable lock. The access must be a minimum 900 mm x 900 mm in size. The access hatch shall have:

- an aluminium ¼" tread plate
- a perimeter drain
- a perimeter sealing gasket
- a slam lock with an aluminium removable sealing plug and opening tool
- a flush lift handle
- a gas spring assist cylinder
- a 90 degree hold open arm

- a flush fitting padlock tang

The hatch must be reinforced for 1465 kgs/m² (300 lbs./sq.ft.). All fasteners to be made of 316 stainless steel.

The entrance must be above ground level where feasible but, in no case, more than 300 mm above the ground.

(9) Access into the stations must be by an aluminium ladder. The location of the ladder must not interfere with the removal and installation of the pumps, etc. The ladder must be designed to extend and lock at least 600 mm above the station entrance. A platform is to be provided above the high water level float to permit wet well access. The platform is to be a fibreglass grating. The access, ladder and platform meet WCB standards.

(10) All wiring must be explosion-proof, Class 1, Division 2, and electrical design and installation is subject to the acceptance of the Provincial Safety Inspector. Metal stations must be protected by impressed current cathodic protection.

(11) All stations must provide an automatic generator for standby power in case of power failure. Provision for a telemetry system must be included for connection into the Municipality's Telemetry System. For small lift stations with an ultimate capacity less than 100 units, emergency storage may be considered in place of standby power; emergency storage is to be based on 8 hours of average day flows.

(12) All equipment must be CSA approved and have at least a one year guarantee for parts and labour. The Consulting Engineer is to provide to the Municipality three sets of Operating and Maintenance Manuals. All pumps must be factory tested prior to installation.

(13) A gate valve is required on the influent line and on each pump discharge. The valves must be outside the station and be complete with square operating nut and nelson box.

(14) If a lift station is authorized, by the City Engineer, to be constructed in an area that may be subject to vehicle loads, the roof and cover of the pump station should be designed to withstand a loading of H-20 (Highways Standard).

(15) Provision(s) must be made for standby pumping from an external source. An adaptor flange ("Kamlock") complete with a quick coupling and lockable cap will be required.

(16) The area around the station and all associated equipment or building must be asphalted. The size of the area to be determined by the requirements for maintenance.

(17) The surfaces of all steel components and fibreglass stations must receive at least two coats of two component white epoxy enamel. All concrete stations must be designed and constructed to prevent Sulphide attack and include epoxy coated rebar, and the concrete surface must be coated with at least 2 coats of blue epoxy and then an additional 2 coats of white epoxy.

(18) The wet well bottom must be benched to direct all solids into the pump suction. The influent line must be located tangent to the wet well to encourage scouring of the wet well.

(19) The station shall be complete with a Uninterruptable Power Supply (UPS) to serve all alarms and controls.

(20) The pump control panel must incorporate an operator interface (Panelmate or equivalent), and the panel must be complete with a lamp test button.

(21) Separate starter enclosures must be provided for each pump.

(22) PLC control to be based on City of Kelowna standards.

(23) Station communication to be provided via radio transmission compliant with the City's telemetry system, and an antenna must be installed on a suitable mast or pole to ensure reliable transmission.

(24) An hour meter must be built into the panel for each pump.

(25) An amp meter must be provided for each pump.

(26) Minimum storage between the high level alarm and the start of overflow under the more critical of:

- Minimum 1 hour in wet well at average wet weather flow.
- Minimum 1 hour in wet well and influent pipes at peak wet weather flow.

(27) Station to have a magnetic flow meter.

(28) Station to allow removal of pumps using hoist truck with 1.8 m (6') boom.

(29) Where vandalism or safety is a concern, perimeter fencing is to be provided. The fence must be made of black chain link.

(30) Landscaping acceptable to the City, is to be provided including irrigation.

(31) Noise control may be required when criteria in Section 2.16 is exceeded.

(32) Odour control may be required when criteria in Section 2.17 is exceeded.

(33) Minimum barrel size must be 2440 mm (8') in diameter.

2.15 Force Main

In conjunction with sanitary pumping facilities, the following criteria must be noted in the design of force main systems: Design computations for force mains must be made using a 'C' factor of 120 (for PVC pipe) and then re-calculating the system curve using a 'C' factor of 145 to ensure adequate motor horsepower and pump characteristics.

Velocity

(a) At the lowest pump delivery rate anticipated to occur at least once per day, a minimum cleansing velocity of 1.0 m/sec should be maintained. Maximum velocity should not exceed 3.5 m/s.

Air Relief Valve

(b) An automatic air relief valve must be placed at high points in the force main to prevent air locking.

Termination

(c) Force mains should enter the gravity sewer system at a point not more than 600 mm above the flow line of the receiving manhole. An inside drop pipe must be incorporated. If the receiving manhole design does not allow this, then a manhole drop structure in accordance with the standard drawings, is required.

Size

(d) The minimum size for force mains is 100 mm diameter.

Materials

(e) With the exception of valves, the material selected for force mains must meet the standards specified for water mains and in accordance with Schedule 5 and must adapt to local conditions, such as character of industrial wastes, soil characteristics, exceptionally heavy external loadings, abrasion and similar problems.

Valves used on force mains shall be lubricated plug valves sufficient for long term use in a corrosive environment.

Loads and Transient Pressures

(f) All force mains must be designed to prevent damage from superimposed loads, or from water hammer or column separation phenomena.

Corrosion and Odour

(g) Corrosion and Odour controls may be required.

2.16 Noise Control Criteria

Noise levels for facilities must not exceed 65 dB at property line or 20 m away whichever is closer.

2.17 Corrosion and Odour Criteria

(a) Dissolved sulphide maximum limit at any point in the system is to be 0.5 mg/l.

(b) Odour Criteria:

- at 10 m from any gravity main, force main, manhole and lift station or other sewer facility (summer conditions, winds between 2-10 km/h), 1.0 odour units.
- where sewer facilities are close to houses, parks or walkways, 0.0 odour units.

(c) Analysis for odour and sulphides may be required.

2.18 On-site Sewage Disposal (Septic) Requirements

Where permitted, site conditions and on-site sewage disposal systems shall meet the following criteria:

(a) The native soil in the area intended for the septic field must percolate at a rate less than or equal to 30 minutes/inch (30 min./25 mm),

(b) There must be a minimum depth of 1.2 m of permeable native soil in the area intended for the absorption field,

(c) The field area consists of the primary septic field area and a reserve field area. The intended field area must be located on a slope less than (flatter than) or equal to 30%, and

(d) The intended field area must be located to provide a minimum of 15 m setback from any cut, embankment slopes or retaining walls.

Where a lot is allowed to be Subdivided or Developed with a septic disposal field, and the topography or condition of the lot limits the Useable area of the lot, the Public Health Officer may, at their discretion, require the Owner to register a Restrictive Covenant for the field areas. The Covenant for single family residential properties shall be registered for the field area and a reserve field area, both of which shall be sized to accommodate the effluent from a minimum of a four-bedroom dwelling and accommodate all setback requirements to protect the field areas by prohibiting such actions such as excavations, filling and any surface construction.

Where the proposed parcel or parcels are allowed to be subdivided or Developed with a septic disposal field, and are in an Environmental Control Area or Natural Environmental/Hazardous Conditions Area, the Owner must engage a qualified Engineer to conduct a comprehensive suitability analysis for permanent on-site disposal, for the projected cumulative development in the area.

DESIGN STANDARDS
3. DRAINAGE

3. Drainage

3.1 Run-Off Analysis

This section describes the methods acceptable to the City of Kelowna for use in the determination of the rate and amount of stormwater run-off for the design of storm drainage conveyance and storage facilities.

Hydrologic aspects of urban drainage (peak flows, volume and durations) directly affect the success of the design. Errors in analysis may result in under designing of facilities, oversizing them and incurring unnecessary expenditures, or both. In the interest of the public good, a conservative approach to all designs is warranted.

The hydrologic criteria needed to calculate basin runoff are rainfall, soil types, vegetation and ground cover, extent of development and land slope and shape. It is expected that the design consultant will use criteria that is justifiable for the location of the development.

Application of computer simulation models is recommended for all analysis and detailed design, however, the rational method may be used for pre-design analysis and for detailed design of minor systems with contributing areas less than 10 ha.

Rational Method

The Rational Method may be used for pre-design system analysis and for detailed design of minor system components with contributing areas less than 10 ha. The Rational Method shall not be used for the design of major system components or storage facilities.

The Rational Formula is expressed as:

$$Q = CIA/360$$

where; Q = peak runoff, m^3/s

C = runoff coefficient
A = area, hectares
I = rainfall intensity, mm/hr

Runoff Coefficient, (C).

C values should be established based on the proposed land uses, proposed developments and hydrogeological information. Calculations and justification for the determination of C values are to accompany development submissions. Developers and consultants are encouraged to look for ways to reduce the amount of Effective Impervious Area within their developments to reduce the amount of runoff generated and the costs associated with stormwater infrastructure. “Default” C values, as shown on Table 1 can also be used.

In a case of applying the Rational Method to a mixed land use in a drainage area, a weighted average C value should be used and can be calculated from the following formula:

$$C_{avg} = \Sigma \frac{A_i C_i}{A}$$

where; A_i is the area with the same type of land use correlated to run-off coefficient R_i, and A is the sum total of all areas, A_i.

Rainfall Intensity, (I).

The value of the design rainfall intensity (I) for the Rational Formula is selected from the appropriate Intensity Duration Frequency (IDF) curve, with a duration chosen to coincide with the Time of Concentration. The Time of Concentration is the time required for run-off flow to become established and reach the design location from the furthest point within the contributing basin.

Time of concentration is the sum of two components, the “inlet time” and the “travel time”.

The inlet time is the overland flow time for run-off to enter the conveyance system. It varies with size of the catchment area and surface imperviousness. In developed urban areas where paved surfaces drain directly to catch basins, an inlet time of 10 minutes shall be utilized for assessment of 5 year and smaller design storms. Inlet times for higher intensity design storm events are as follows:

Event	Inlet Time (min.)
5	10
10	9
25	8
50	7
100	5

For inlet times in rural areas, the overland flow time must be calculated using appropriate formulas.

The travel time is the length of time required for flow to travel within the conveyance system from the point of inflow to the location being analyzed.

Rainfall

Standard Drawing SS-S56 shows the rainfall intensity-duration-frequency (IDF) curve for the City of Kelowna which was developed from the Atmospheric Environment Service recording station located at the Kelowna International Airport. The IDF curve in tabular format up to one hour duration is show on Table 2. Design Storm Hyetographs are shown on Table 3.

Computer Simulation of Run-off

All minor storm drainage components draining areas larger than 10 ha. and all major storm drainage systems and storage facilities must be designed using computer modelling techniques. The selection and the proper application of computer models is the responsibility of the Developer and the Consultant. It is necessary to utilize computer models which have the capability to generate hydrographs and which can route these hydrographs through a network of open channels, conduits and storage facilities showing volumes, hydraulic grade lines, the ability to simulate the minor and major system and their interrelation and the ability to simulate submerged and/or surcharged conditions.

3.2 MINOR SYSTEM DESIGN

An urbanized area will have two separate and distinct drainage systems, whether these systems are planned and designed or not. The "minor system" includes street gutters, catch basin inlets and the network of underground pipes and facilities associated with the collection, conveyance and water quality treatment of minor, or frequently occurring rainfall events.

Service Level

The storm mains shall be designed for free-flow conditions for the 1:5 year storm (the rainfall that has a 20% probability of occurrence in any given year). The interception capacity of the system of street gutters and catch basins must be compatible with the design capacity of the storm mains.

Streets, Gutters and Ditches

Urban Cross-Sections

The flooding depths for a 1:5 year storm, which will be permitted on streets, while the streets are acting as part of the minor drainage system, are as follows:

- There shall be no curb overtopping.
- Maximum depth of ponding at sag locations or inlets will be 150 mm.
- On local roads, the flow may spread to the crown except where curb over-topping will occur.
- On collector roads, the flow spread must leave one lane or a road surface equivalent free of water to ensure access for emergency vehicles (fire, ambulance).
- On arterial roads, the flow spread must leave one lane in each direction free of water.

Flow across urban road intersections shall not be permitted for storms with a return frequency of 5 years or less.

Rural Cross-Sections

Rural roads, gravel or paved, shall be constructed with swales or ditches that ensure adequate road subgrade drainage (in compliance with standard road design). Where ditching for minor drainage is provided, ditch design shall consider the following:

- Rip-rap as necessary to eliminate incising and erosion.
- Freeboard of 0.3 m.
- Free surface elevations permitting agricultural tile drainage where required.
- Stable side slopes.
- Road subgrade.

Catch Basins

To ensure that the capture or inlet capacity matches the storm main capacity, the spacing of catch basins on streets may be varied; however, they shall generally meet the following criteria:

– Spacing

  - Road grades less or equal to 3%, space 150 m maximum or 675 m^2 of paved area.
  - Road grades greater than 3%, space 100 m maximum or 450 m^2 of total area.

- Space catch basins to ensure no overflows to driveways, boulevards, sidewalks, or private property.
- Space at intersection so as not to interfere with cross walks.
- Side inlet catch basins are required for all curbed roads.

All catch basin leads are to be a minimum diameter of 200 mm and sized to convey the design inlet capacity.

All catch basin leads are to discharge into a manhole.

Storm Mains

Capacity

Hydraulic capacity shall be calculated using Manning's formula. A roughness coefficient of 0.013 shall be used for concrete and 0.011 shall be used for smooth plastic pipe.

Velocity

Minimum velocity shall be 0.75 m/s at the design flow rate.

Minimum Sizes

250 mmϕ

Location, Alignment and Grade

Storm mains must be located within the road right-of-way as noted in the applicable Standard Drawing Typical Cross-Section for that road.

When the storm main is required to cross private land(s), the right-of-way must be a minimum of 4.5 m wide, however, the width must be suitable to accommodate excavations based on WCB regulations for side slopes.

When a storm main is located within a statutory right-of-way and appurtenances which require maintenance are located within the right-of-way, the landowner/developer must ensure that maintenance access is available. For large structures or structures requiring an enhanced maintenance level such as oil/sediment chambers, control structures and pond inlet/outlet chambers, an access route adequate to support the maintenance vehicles is to be provided. The surface of the route may be gravel, pavers or asphalt depending on the location and the context of the site.

Depth of Cover

Provide 1.2 m in travelled areas and 1.0 m otherwise. However, these minimum's are to be used only when conflicts with other utilities will not occur and all upstream catchment areas are serviceable by gravity.

For Catch basin leads 0.9 m minimum cover shall be used. If 0.9 m is not available, design to protect from freezing and traffic loads, design calculations must be provided.

Curvilinear Mains

If horizontal or vertical curves are used to maintain a constant offset, the radius of the curve is to be no less than 1.5 times the recommended manufacturer's minimum radius of curvature. The design velocity must exceed 0.91 m/sec. and the curve midpoint and two quarter points are to be located by survey and shown on the as-constructed drawings with an elevation and offset of the invert at each point.

Manholes

Storm manhole spacing is to be related to pipe main size as follows:

250 and 300 mm diameter - 135 m maximum spacing;
over 300 mm to 600 mm diameter - 120 m maximum spacing, and
over 600 mm diameter - 100 m maximum spacing.

Manholes are required at:

- all grade or alignment changes (except curved sections)
- pipe size changes
- all intersecting mains
- all upstream ends of mains
- upstream and downstream end of all curvilinear mains unless a constant offset is maintained from the curb
- all catch basin connections
- outfalls to the major system (i.e. creeks, channels, lake) in order to isolate the upstream main to facilitate cleaning. The manhole is to be located as close as possible to the point of discharge.

Manhole sizing shall be in accordance with City of Kelowna supplemental "Standard Detail Drawing SS-S1a".

To ensure manhole construction will not cause a loss in hydraulic capacity, the design gradient shall be continuous through the manhole; otherwise, where the inlet is not at 180^{o} to the outlet, a minimum drop of 30 mm shall be provided;

Ground Water Recharge Systems

To promote interception of pollutants and reduction in downstream impacts, ground water recharge systems must be utilized to the maximum extent possible as determined by a qualified professional experienced in this field.

Mains may be sized according to the required capacity taking 50% or the groundwater recharge capability into consideration. The groundwater recharge component must be calculated and justified by a qualified hydrogeologist/engineer experienced in this field. Minimum sizes of mains must still be utilized.

Storm Services

Minimum diameter of storm services shall be 100 mm.

Minimum Grades for storm sewer services shall be 2%.

Storm services to properties shall not be permitted from storm drains located in rights-of-way unless a clean-out is provided and the nature of the development will permit access to the right-of-way for inspection, maintenance and repair, as necessary.

Roof Leaders

Roof drainage leaders are to be connected to the storm service connection only where geotechnical requirements dictate the need. The evaluation of this requirement is to be included in the scope of the Hydrogeotechnical Study. Otherwise, roof leaders are to be directed to a splash pad for dispersal to the ground. Roof leaders shall not be directed onto driveways which drain directly onto city right-of-way or areas draining directly onto neighboring properties.

Foundation Perimeter Drains

Perimeter drains for buildings are required as per the British Columbia Building Code.

Foundation perimeter drains shall be connected by gravity via a storm service to the storm main provided that the elevation of the basement/crawlspace floor is at least 600 mm above the elevation of the storm main obvert, 600 mm above the anticipated or known high ground water table, or 600 mm above the 100 year hydraulic grade line within the main at that point, whichever is higher.

When the above provisions regarding the elevation of the storm main obvert or 100 year hydraulic grade line for gravity connection of foundation perimeter drains cannot be met, a backflow prevention device and sump pump system inside the building discharging to the storm main via a storm service shall be installed. A backwater or check valve and a siphon break must be installed in the sump pump discharge line to prevent backflow into the basement. Discharge may be to the surface or a soak away pit, if geotechnical conditions permit.

As an alternative, the perimeter drains may be connected to a "Foundation Drainage Pipe". The "Foundation Drainage Pipe" is a small diameter pipe installed within the road right-of-way with connections from foundation perimeter drains only. This system will eliminate the potential of long term pumping due to fluctuations in groundwater table. Its point of discharge to the storm system shall be far enough downstream so that the basement floors it protects are 600 mm above the 1:100 year hydraulic grade line at the discharge point. In general, the design criteria will follow that as laid out in this document, however, minimum size is reduced to 150 mm.

Where hydrogeotechnical studies justify their use, dry wells or ground infiltration systems may be used as the storm water disposal method for connection of perimeter drains. These systems are to be designed and supervised by a Geotechnical Engineer.

Water Quality Treatment

Water quality treatment is required for frequently occurring events. All flows up to 50% of the 2-year (1 hour duration) post-development flow must be routed through some form of water quality treatment facility utilizing “best management practices” to remove suspended solids and floatables. The facility can be an in-ground structure which passes flow through or an above ground facility such as a treatment wetland. Wetlands can be incorporated into larger stormwater management facilities for the attenuation of large events. Allowable discharge criteria are identified in the City of Kelowna Sanitary Sewer/Storm Drain Regulation Bylaw number 6618-90.

Any form of water quality treatment must be designed to allow for future maintenance activities associated with the removal of the collected material and access to incoming and/or outgoing piping.

Lot Grading/Swales and Driveways

Lot grading shall be carried out in accordance with the BC Building Code, City Policy 265 and the following:

1. Swales shall have a minimum slope of 1 percent. Swales shall be lined with turf on a minimum 100mm topsoil or lined with a non-erodable hard surface. All such swales serving two or more parcels of property shall be designed to accommodate the anticipated flows and the right of way shall be sized accordingly (3.0 m minimum).

2. To ensure flooding is avoided, carports or garages attached to residential buildings shall not be constructed with their floor level below the adjacent curb of City street or crown of pavement of City street, unless:

   - the drainage of the driveway serving the carport or garage is connected by gravity to a City storm sewer meeting the connection criteria, or

   - is above the 100 year floodline, or

   - the runoff water from the driveway may flow past the carport/garage without accumulating and entering. Properties utilizing this method must have an Engineer seal the design. All other relevant criteria of this document must also be met.

3.3 MAJOR SYSTEM DESIGN

Storm runoff generated by less frequent, higher intensity rainstorms may exceed the capacity of the minor system. Runoff from these events will pond in depressions and follow whatever overflow route is available. This network of ponding and overland flows is called the "major system". If the major system is properly planned, it can alleviate the potential inconvenience and property damage caused by large rainfall events.

MAJOR SYSTEM

The major system includes all drainage infrastructure which convey, detain, divert and intercept the 100 year design storm runoff. In general, all components of the major system must be designed to accommodate the flows generated by the upstream contributing area. The following section describes the major system provisions and technical requirements for use in planning and design of the major drainage system.

The depth of flooding permitted for the major event is as follows:

- For all classes of roads, the depth shall not exceed 0.3 m.

- One lane, or a 3.5 m width at the crown shall be free from flooding.

- Flooding is not permitted on private property

To meet the criteria for major storm runoff, sags or low points in roads or subdivisions must be designed with a safe overland outlet flow route.

Outfalls

Ministry of Environment approval is required on all storm water outfalls to natural watercourses or waterbodies.

Outfalls into lakes are to be constructed to have minimum bury according to the following:

- soft bottom, 0.6 metres to allow for seasonal sand erosion and deposition
- rock bottom, criteria to be confirmed by Coast Guard
- exposed pipes must be a minimum of 2.4 metres deep during lake "low water" to allow safe passage of deep keel vessels

Lake outfalls require approval from the Canadian Coast Guard.

Control Structures

Control structures, such as the one shown on Standard Drawing SS-S55 shall be used to provide consistent control for design storm flows of different return periods. These can be modified to include multi-stage inlets. For example, three orifices located vertically on a control structure are normally designed such that the lower, smaller orifice restricts frequent storms and the larger upper orifices control less frequent larger storms. Safe overflow must still be available above the highest orifice.

Considerations shall be given for the design of smaller sediment trap basins at the points of discharge to the detention/retention facilities. Normally, basin inlets shall be designed to provide sediment containment. Build up of sediment shall not restrict inflows and suitable designs shall be provided to allow ease of sediment removals.

Culvert and Bridge Capacity

The following service levels are to be used for design:

Road Class	Design Flood Frequency Bridges, Culverts
Arterial and Collector	1:200 year flood
Local	1:100 year storm plus provision for overflow if on major channel

Culverts over 30 m in length and/or 300 mm and larger in diameter shall be constructed with headwalls and endwalls. The headwall shall be constructed with a free swinging, weighted grating. To protect against entry, the City may require a locking mechanism which limits the range of movement of the grating.

Down Slope Cul-de-Sacs

Major flood routes must be provided on down slope cul-de-sacs.

Ground Recharge Systems

Ground recharge systems are not normally considered for major flood routing. However, given the soil conditions in the Kelowna area, geotechnical investigations may support the retention and ground infiltration of major events in some areas. Further details are provided in Section 4.

Ditch and Swale Construction

Velocity of flow in ditches and/or swales is not to exceed the limits given below for the various types of materials used as the conveyance surface.

Lining Materials	Maximum Permissible Velocity m/s
Fine sand	0.45
Fine gravel	0.75
Stiff clay	1.00

For velocities higher than the above maximums, the Rip Rap Design Chart Standard Drawing SS-S57 is to be used.

3.4 STORMWATER STORAGE

This section identifies the general design parameters and requirements that must be considered by development proponents in the planning and design of stormwater storage facilities.

Peak Flow Control

Control on peak flow rates and volumes in the City are necessary:

1. To minimize impacts on watercourses and downstream developments from flow increases which will result from land development, and

2. To maintain or lessen flows in watercourses so that creek channels and existing structures, such as bridges and culverts, will continue to operate without being flooded or damaged.

In consideration of the above, the City has the following objectives and requirements:

(a) Impact and expenditures to existing downstream users shall not be increased.

(b) Increases in peak storm flows and volumes to the watercourses and receiving waters shall be limited.

(c) The number of storage facilities shall be minimized. (Permanent detention will not be permitted under private ownership, unless incorporated on-site within a private development).

(d) Permanent storage facilities are to be owned and maintained by the City.

(e) Where land developments occur in advance of permanent detention facilities, the City may consider temporary storage facilities on an individual basis. Maintenance charges and responsibility for temporary storage facilities will be borne by the developer.

(f) Storage facilities may be surface or underground. Rooftop or parking lot storage may be considered, where appropriate.

(g) Private property owners are to indemnify the City from liability arising out of private facilities.

BASIS FOR DETAILED DESIGN

Level of Service

Developments near the lake and/or downstream of the Mill Creek diversion are required to provide water quality treatment for flows up to 50% of the 2 year event. Flows generated from rainfall events greater than this can be discharged directly to a receiving body of water provided the required minor and major systems exist and approval from the City of Kelowna and the Ministry of Environment is obtained.

Developments within other areas of the City of Kelowna are required to provide water quality treatment for flows up to 50% of the 2 year event and to provide storage up to the 100 year (plus 10% volumetric safety factor) event with a maximum outlet rate based upon the 5 year pre-development rate generated by the catchment area. The release rate is to be based upon

the post-development outlet hydrograph mirroring the pre-development runoff hydrograph up to the 5 year level. Release rates not based on this criteria may be allowed by the City of Kelowna based on downstream conveyance system protection, stream protection, flood protection or water quality.

An overflow shall be provided to route any excess water to the designated one hundred year flood route. Such an overflow can be in the form of a spillway or may be incorporated in the flow control structure through oversizing of downstream pipes, provision of overflow pipes or such other arrangement as the designer may devise.

Geotechnical Considerations

Special geotechnical investigations to address issues related to the design of all stormwater management lakes and dry ponds are to be undertaken as part of the planning and design studies, and are a prerequisite to the final design of such facilities.

Wherever possible, the stormwater storage facility shall be excavated in natural, stable ground. Should topography dictate that a berm be constructed along one or more sides of the basin, the berm shall be designed by a qualified professional engineer registered to practice in the Province of British Columbia and with relevant training and experience.

Staged Construction - Standards for Interim Facilities

When stormwater management storage facilities are to be implemented in stages, the standards applicable to the design and construction of the interim facilities are to be generally in accordance with the standards set out herein for permanent facilities of that type. (e.g. Where an interim dry pond facility is proposed as a preliminary stage in the implementation of a stormwater lake, it shall be designed and constructed in accordance with the criteria and standards applicable to a permanent dry pond.)

DESIGN REQUIREMENTS COMMON TO STORMWATER MANAGEMENT STORAGE FACILITIES

Land Dedication

Generally, the area of land covered by water when the basin is at the 5-year water level will be dedicated to the City. This dedication will also apply to all accesses to inlets/outlets, any structures and maintenance access routes to the facility.

Land that is adjacent to a basin which is subject to flooding as per the design standard established, but which is part of a privately owned developed parcel, will be required to carry rights-of-way, to allow for encroachment of water onto the affected land. The right-of-way documents shall be prepared by the development proponent, naming the City as grantee.

A restrictive covenant will be placed on lots abutting the facility to control lot development so as not to compromise design requirements at the HWL. This is to ensure an adequate freeboard is maintained.

Maintenance Access Requirements

An all-weather access for maintenance vehicles must be provided to all facility works. A vehicle access route shall also be provided to the edge of all SWM lakes suitable to carry maintenance vehicles and for use as a boat launch point. The access surface shall be a minimum of 4.5 m wide, shall extend into the lake beyond the lake edge at normal water depth to a point where the normal water depth is 1.0 m, and shall be accessible from and extend to a public road. Sharp bends are to be avoided, and it shall have a straight run of 12 m or more leading to the lake edge (to permit a straight run in for launching of boats).

Emergency Overflow Provisions

The feasibility of an emergency overflow spillway is to be evaluated for each storage facility design and, where feasible, such provisions are to be incorporated in the facility design. The consultant is to identify the probable frequency of operation of the emergency spillway. Where provision of an emergency spillway or overflow route is found to be unfeasible, the design is to include an analysis of the impact of overtopping of the storage facility and the probable frequency of occurrence of overtopping. The functional requirements of the spillway, and the impact analysis for the absence of one, are to consider the possible consequences of blockage of the system outlet or overloading due to consecutive runoff events, such that the storage capacity of the facility may be partially or completely unavailable at the beginning of a runoff event.

Landscaping Requirements

Landscaping plans for areas bounding the facility shall be submitted as part of the Engineering Drawings. Landscaping of all proposed public lands included for purposes of the facility and of all proposed rights-of-way on proposed private property up to the design high water level, is to be part of the lake construction requirement and be dependant on the location and the context of the facility. The requirement for landscaping may be irrigated turf, constructed to the satisfaction of the Parks Department.

Sediment Removal Provisions

The facility design shall incorporate the ability for sediment capture and efficient removal for the control of solids which may be washed to the facility.

Maintenance and Service Manual

As part of the responsibility for design of a stormwater management storage facility the development proponent shall prepare and provide a maintenance and service manual for the facility.

Six complete copies of the manual are to be provided to the City of Kelowna prior to the time when the operation responsibility of the facility is transferred to the City of Kelowna, which will generally be at the time of substantial completion. The manual shall include complete equipment manufacturer's operation, maintenance, service and repair instructions, and complete parts lists for any mechanized or electrical equipment incorporated in the design.

The manual is to include, at a minimum, the following information:

(a) A copy of the approved Engineering Drawings relating to the Stormwater Storage Facility and appurtenances, updated to "As-Constructed".

(b) Schematic diagrams of the inlet and outlet arrangements, connections to and arrangement of upstream and downstream systems, including all controls, shutoff valves, bypasses, overflows, and any other operation or control features.

(c) Location plans for all operating devices and controls, access points and routes, planned overflow routes, or likely point of overlapping in the case of exceedance of the design containment volume.

(d) Stage Discharge Curves with clear relationships of the stages relative to surrounding features.

Signage for Safety

The design for SWM Facilities shall include the installation of signage to warn of anticipated water level fluctuations, with demarcation of maximum water levels to be expected for design conditions. Warning signs will be provided and installed by the development proponent.

Engineering Drawing Requirements

The engineering drawings for any SWM Facility are to include the following information, in addition to the physical dimensions:

(a) Stage-Volume and Stage-Area Curves;
(b) elevations at Normal Water Level (NWL), 5 Year Level and High Water Level (HWL);
(c) volumes at NWL, 5 year Level and HWL;
(d) freeboard elevation;
(e) notation indicating the lowest allowable building elevation for lots abutting the lake;
(f) contributing basin size (ha);
(g) measurements to locate submerged inlet(s), outlet(s) and sediment traps referenced to identifiable, permanent features which are not submerged at NWL.

DESIGN DETAILS FOR STORMWATER MANAGEMENT LAKES (WET PONDS)

Side Slopes

Areas normally or infrequently covered by water, from the design high water level down to a point 1.0 m below the normal water level shall have a maximum slope of 5 (horizontal) to 1 (vertical).

A slope of 3 (horizontal) to 1 (vertical) may be required from the 1.0 m depth point (below normal water level) to the pond bottom. The requirement for maximized slopes below water is an attempt to discourage the growth of unwanted vegetation.

In the case of constructed wetlands, benched areas above and below the NWL to encourage growth of aquatic and riparian plants is desirable.

Lake Bottom Material

For areas where the groundwater table is below the NWL, the lake bottom and side slopes are to be composed of impervious material with a suitably low permeability (e.g. with a permeability coefficient in the order of 1×10^{-6} cm/s).

For areas where the groundwater table is expected to be near or above the NWL, the lake bottom may be of a pervious material as dictated by geotechnical considerations.

Circulation Requirements

Narrow or dead bay areas where floating debris may accumulate are to be avoided. Inlets and outlets should be located with consideration of the need to maximize detention time and circulation within the lake water body.

The length of the wet pond relative to the width should not be less than 3:1 or greater than 6:1 so as to promote natural water circulation and avoid water quality deterioration associated with stagnant reaches within the facility.

Outflow Control Works

The outlet from a stormwater management storage system must incorporate appropriate means for control of outflow. In addition, the outlet works must include provisions for operational flexibility, and to address unintentional blockage of the outlet and the possible need to either stop outflow or increase the rate of outflow.

Drawdown Provisions

The means should be provided to permit discharge from storage facilities at the maximum rate of flow which the downstream system can accommodate after storm runoff peak flows have passed and the flows from other contributing areas have decreased or ended. The rate of discharge to be provided for drawdown purposes is to be sufficient to restore availability of storage capacity of facilities sufficiently to accommodate subsequent runoff events within a reasonable time frame. To achieve this purpose, drawdown of facilities is to be possible at rates to satisfy the following relationship of available volume to the time from commencing drawdown with the facility at the design high level.

Time After Commencing Drawdown From Full Level	Available Volume Required Below Design Full Level
24 hours	Volume equivalent of 1 in 10 year run-off
72 hours	100% of total storage volume

Submergence of Inlets and Outlets

Inlets and outlets are to be fully submerged, with the crown of the pipe at least 0.5 m below normal water level. Inlet and outlet pipe inverts are to be a minimum 0.1 m above the lake bottom.

Provision for Free Outfall from Inlets to Lakes

The invert elevation at the first manhole upstream from the lake in a minor system shall be at or above the normal water level of the lake to avoid deposition of sediments in the inlet pipe. To avoid backwater effects on the upstream sewers leading to the lake, the obvert of the inlet sewer at the first manhole upstream from the lake shall be at or above the lake level for the 1 in 5 year storm. A drop structure upstream from the lake will generally be required to achieve this. “Inlet” and “outlet” control calculations are required to verify the mode of operation of the lake inlets.

Provisions for Lowering the Lake Level

The provision of the means to drain the lake completely by gravity drainage is desirable. The incorporation of this provision with the outlet control bypass should be considered. Where a gravity drain is not feasible, provisions are to be made in association with the outlet works or otherwise, so that mobile pumping equipment may be installed and used to drain the lake.

Lake Edge Treatment

Edge treatment or shore protection is required and shall be compatible with the adjacent land use. The treatment used shall meet criteria for low maintenance, safety, and ease of access to the waters edge.

The edge treatment is to cover ground surfaces exposed or covered by water during a lake level fluctuation to 0.3 m below or above the normal water elevation, and shall be adequate to

prevent erosion of the lake edge due to wave action. The typical acceptable edge treatment shall be, but is not limited to, a 250 mm deep layer of well graded washed rock with a 75 mm minimum size or vegetated strip consisting of hardy materials suitable for this application.

The proposal of variations to the edge treatment minimum is encouraged. The final selection of edge treatment being subject to the approval of the City.

DESIGN STANDARDS FOR DRY PONDS

Outflow Control Works

The outlet from a stormwater management storage system must incorporate appropriate means for control of outflow. In addition, the outlet works must include provisions for operational flexibility, and to address unintentional blockage of the outlet and the possible need to either stop outflow or increase the rate of outflow.

Drawdown Provisions

The means should be provided to permit discharge from storage facilities at the maximum rate of flow which the downstream system can accommodate after storm runoff peak flows have passed and the flows from other contributing areas have decreased or ended. The rate of discharge to be provided for drawdown purposes is to be sufficient to restore availability of storage capacity of facilities sufficiently to accommodate subsequent runoff events within a reasonable time frame. To achieve this purpose, drawdown of facilities is to be possible at rates to satisfy the following relationship of available volume to the time from commencing drawdown with the facility at the design high level.

Time After Commencing Drawdown From Full Level	Available Volume Required Below Design Full Level
24 hours	Volume equivalent of 1 in 10 year run-off
72 hours	100% of total storage volume

Frequency of Operation

All dry ponds shall be designed to temporarily detain excess runoff and thereby reduce the peak outflow rates to the connected downstream system. They shall not detain runoff for storms with post-development return periods of less than 2 years except where special provisions are made to facilitate clean up (i.e. paved bottom areas, etc.).

Depth of Ponding

The maximum live storage limit in a dry pond is 3.0 m, as measured from the invert elevation of the outlet pipe.

Dry Pond Bottom Grading and Drainage

The dry pond shall be graded to properly drain all areas after its operation. The dry pond bottom shall have a slope of 1.0% or greater. Sub-surface drains or similar means may be required where it is anticipated that these slopes will not properly drain the dry pond bottom, or where dictated by multiple use or other special considerations.

Side Slopes

25% of the side slopes subject to inundation upon filling of the dry pond shall have a maximum slope of 5 (horizontal) to 1 (vertical). An alternate method of egress (eg stairs) may be required in steep areas.

Safety Provisions at Inlets and Outlets

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 0.15 m shall be used for gratings.

Grated outlet structures are to be designed with a hydraulic capacity of at least twice the required capacity to allow for possible plugging. Further, the arrangement of the structures and the location of the grating shall be such that the velocity of the flow passing through the grating will not exceed 1.0 m/s. Appropriate fencing and guard-rails are to be provided to restrict access and reduce the hazard presented by the structure headwalls and wingwalls.

Other Considerations

An on-stream dry pond may be constructed upstream of a road crossing as long as geotechnical evaluations conclude that construction is appropriate. Facilities must be constructed to allow overtopping without causing undue erosion or damage. All facilities on fish bearing streams shall be designed to pass fish.

DESIGN STANDARDS FOR INFILTRATION BASINS

Outlet Design

Infiltration basins do not have a formal outlet structure. As such, the storage volume must be based upon the complete runoff generated by the 1:100 year storm with no provision for outlet during the event, plus a 50% safety factor.

Depth of Ponding

The maximum live storage limit in a basin is 3.0 m.

Side Slopes

Side slopes subject to inundation upon filling of the basin shall have a maximum slope of 5 (horizontal) to 1 (vertical).

Safety Provisions at Inlets

All inlet structures associated with infiltration basins 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 0.15 m shall be used for gratings.

Appropriate fencing and guard-rails are to be provided to restrict access and reduce the hazard presented by the structure headwalls and wingwalls.

Other Considerations

(a) A detailed hydrogeological investigation must be conducted to support the proposed infiltration basin. The investigation must assess impacts to upstream and downstream properties and identify measures to alleviate impacts, if necessary.

(b) To address the issue of sediment plugging during development in the catchment area, the basin is to be constructed to 90% of its ultimate depth and volume. When development in the catchment reaches 90%, the infiltration basin is to be completed.

3.5 EROSION AND SEDIMENTATION CONTROL

All proposed projects must provide erosion and sedimentation controls to prevent the displacement of soil and the transport of sediment from the project site resulting from land-disturbing activities. To prevent the displacement of soil and the sediment transport during land-disturbing activities, Erosion and Sedimentation Control (ESC) measures are required and shall be performed as described below. Both temporary and permanent erosion and sedimentation controls shall be implemented.

The objective of erosion and sedimentation control is to prevent the displacement of soil and the transport of sediment to streams, wetlands, lakes, drainage systems, and adjacent properties. Erosion on construction sites can result in excessive sediment transport to adjacent properties and to surface waters. Sediment transport can result in adverse impacts such as flooding due to obstructed drainage systems, smothering of aquatic habitat and the creation of algal blooms in lakes, among others.

ESC

The following ESC documents detail methods of control:

- Best Management Practices for Erosion & Sediment Control – Upland Works, City of Kelowna (1998)
- Land Development Guidelines for the Protection of Aquatic Habitat, Department of Fisheries and Oceans and the BC Ministry of Environment (1992)

In general, erosion and sedimentation controls shall address the following:

Clearing Limits: Prior to any site clearing or grading, areas to remain undisturbed during project construction shall be delineated and marked on-site by flagging or other method. At a minimum, clearing limit delineation shall be installed at the edges of all sensitive area buffers.

Retain existing vegetation, as much as possible.

Cover Measures: Temporary and permanent cover measures shall be provided when necessary to protect disturbed areas as detailed in the ESC Documents. Temporary cover shall be installed if an area is to remain unworked for more than seven days, unless otherwise determined by the City. Any area to remain unworked for more than 30 days shall be seeded or sodded, unless the City determines that winter weather makes vegetation establishment infeasible. Slopes and stockpiles 3H:1V or steeper and with more than 3 metres of vertical relief shall be covered if they are to remain unworked for more than 12 hours. The intent of these measures is to have as much area as possible covered during any period of precipitation.

Perimeter Protection: Perimeter protection to contain sediment from sheet flow shall be provided downslope of all disturbed areas when necessary as detailed in the ESC Documents. Such protection shall be installed prior to upslope grading. Perimeter protection includes the use of vegetated strips, as well as more conventional constructed measures such as silt fences.

Traffic Area Stabilization: Unsurfaced entrances, roads, and parking areas used by construction traffic shall be stabilized to minimize erosion and tracking of sediment offsite as detailed in the ESC Documents.

Sediment Retention: Surface water collected from disturbed areas of the site shall be routed through a sediment pond or trap prior to release from the site as detailed in the ESC Documents, except areas at the perimeter of the site small enough to be treated solely with perimeter protection. Sediment retention facilities shall be installed prior to grading of any contributing area.

Surface Water Controls: Surface water controls shall be installed to intercept and convey all surface water from disturbed areas to a sediment pond or trap and discharge it downslope of any disturbed areas as detailed in the ESC Documents, except areas at the perimeter of the site small enough to be treated solely with perimeter protection. Significant sources of upslope surface water that drain onto disturbed areas shall be intercepted and conveyed to a stabilized discharge point downslope of the disturbed areas.

Implementation requirements

ESC Plan

All proposed projects must submit a plan for providing ESC measures as specified in City Policy 265. All ESC measures shall conform to the details and specifications in the ESC documents unless an alternative is approved by the City.

Construction within Sensitive Areas and Buffers

Any construction that will result in disturbed areas on or within a stream or associated buffer, within a wetland or associated buffer, or within 15 metres of a lake shall be subject to the Best Management Practices for Erosion & Sediment Control – In-stream Works (1998). These provisions include phasing the project whenever possible so that construction in these areas is limited to the dry season.

Maintenance

All ESC measures shall be maintained as per the Erosion and Sedimentation Control Plans. The consulting engineer shall be responsible for maintenance and review of ESC and for compliance with all conditions relating to ESC.

Final Stabilization

Prior to obtaining total performance, the site shall be stabilized and the structural ESC measures (such as silt fences and sediment traps) shall be removed and drainage facilities cleaned as specified.

TABLE 1

Rational Method "C" Coefficients for Design

Description of Area		Minor Storm	Major Storm
Commercial		0.85	0.90
Residential	Single-Family areas	0.40	0.50
	Multi-units, detached	0.50	0.60
	Multi-units, attached	0.60	0.70
Apartments		0.75	0.80
Industrial		0.75	0.80
Parks		0.20	0.25
Natural Areas		*	*
Streets	Asphaltic	0.85	0.95
	Concrete	0.85	0.95
Drives and walks		0.80	0.90
Roofs		0.80	0.90

* - to be determined by site specific conditions

TABLE 2
IDF CURVE VALUES for 1 HOUR STORM

Kelowna Airport						
	2 yr	**5 yr**	**10 yr**	**25 yr**	**50 yr**	**100 yr**
a=	8.5	11.3	13.1	15.5	17.2	18.9
b=	0.675	0.704	0.716	0.728	0.735	0.740

STORM INTENSITY (mm/hr)

	STORM					
T (min)	2	5	10	25	50	100
5						119
6						104
7					83	93
8				67	76	84
9			51	62	69	77
10	28	40	47	57	64	71
11	27	37	44	53	60	66
12	25	35	41	50	56	62
13	24	33	39	47	53	59
14	23	31	37	45	50	55
15	22	30	35	43	48	53
16	21	29	34	41	45	50
17	20	27	32	39	43	48
18	19	26	31	37	42	46
19	18	25	30	36	40	44
20	18	24	29	34	39	43
21	17	24	28	33	37	41
22	17	23	27	32	36	40
23	16	22	26	31	35	38
24	16	22	25	30	34	37
25	15	21	25	29	33	36
26	15	20	24	28	32	35
27	15	20	23	28	31	34
28	14	19	23	27	30	33
29	14	19	22	26	29	32
30	14	18	22	26	29	32
35	12	17	19	23	26	28
40	11	15	18	21	23	26
45	10	14	16	19	21	23
50	10	13	15	18	20	22
55	9	12	14	17	18	20
60	9	11	13	16	17	19

Based on 1997 Airport IDF values

TABLE 3

HYETOGRAPHS

	Rainfall Depths						
	Duration	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
1.00	60	8.5	11.3	13.1	15.5	17.2	18.9
3.00	180	12.1	15.6	17.9	20.9	23.0	25.1
6.00	360	15.2	19.2	21.8	25.2	27.7	30.1
12.00	720	19.1	23.6	26.5	30.5	33.2	36.1
24.00	1440	23.9	28.9	32.3	36.8	39.9	43.2

Kelowna Airport						
	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
a=	8.5	11.3	13.1	15.5	17.2	18.9
c=	0.675	0.704	0.716	0.728	0.735	0.740

Time	t<= 6 hr Dist	t> 6 hr Dist	2 year					5 year					10 year				
			1 hr	3 hr	6 hr	12 hr	24 hr	1 hr	3 hr	6 hr	12 hr	24 hr	1 hr	3 hr	6 hr	12 hr	24 hr
0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.08	0.08	0.08	0.7	1.0	1.2	1.5	1.9	0.9	1.3	1.5	1.9	2.3	1.0	1.4	1.7	2.1	2.6
0.17	0.10	0.09	0.9	1.2	1.5	1.7	2.1	1.1	1.6	1.9	2.1	2.6	1.3	1.8	2.2	2.4	2.9
0.25	0.19	0.10	1.6	2.3	2.9	1.9	2.4	2.1	3.0	3.6	2.4	2.9	2.5	3.4	4.1	2.7	3.2
0.33	0.20	0.10	1.7	2.4	3.0	1.9	2.4	2.3	3.1	3.8	2.4	2.9	2.6	3.6	4.4	2.7	3.2
0.42	0.09	0.10	0.8	1.1	1.4	1.9	2.4	1.0	1.4	1.7	2.4	2.9	1.2	1.6	2.0	2.7	3.2
0.50	0.08	0.11	0.7	1.0	1.2	2.1	2.6	0.9	1.3	1.5	2.6	3.2	1.0	1.4	1.7	2.9	3.6
0.58	0.07	0.11	0.6	0.9	1.1	2.1	2.6	0.8	1.1	1.3	2.6	3.2	0.9	1.3	1.5	2.9	3.6
0.67	0.06	0.11	0.5	0.7	0.9	2.1	2.6	0.7	0.9	1.2	2.6	3.2	0.8	1.1	1.3	2.9	3.6
0.75	0.05	0.08	0.4	0.6	0.8	1.5	1.9	0.6	0.8	1.0	1.9	2.3	0.7	0.9	1.1	2.1	2.6
0.83	0.04	0.07	0.3	0.5	0.6	1.3	1.7	0.5	0.6	0.8	1.7	2.0	0.5	0.7	0.9	1.9	2.3
0.92	0.03	0.03	0.3	0.4	0.5	0.6	0.7	0.3	0.5	0.6	0.7	0.9	0.4	0.5	0.7	0.8	1.0
1.00	0.01	0.02	0.1	0.1	0.2	0.4	0.5	0.1	0.2	0.2	0.5	0.6	0.1	0.2	0.2	0.5	0.6

Time	t<= 6 hr Dist	t> 6 hr Dist	25 year					50 year					100 year				
			1 hr	3 hr	6 hr	12 hr	24 hr	1 hr	3 hr	6 hr	12 hr	24 hr	1 hr	3 hr	6 hr	12 hr	24 hr
0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.08	0.08	0.08	1.2	1.7	2.0	2.4	2.9	1.4	1.8	2.2	2.7	3.2	1.5	2.0	2.4	2.9	3.5
0.17	0.10	0.09	1.6	2.1	2.5	2.7	3.3	1.7	2.3	2.8	3.0	3.6	1.9	2.5	3.0	3.2	3.9
0.25	0.19	0.10	2.9	4.0	4.8	3.0	3.7	3.3	4.4	5.3	3.3	4.0	3.6	4.8	5.7	3.6	4.3
0.33	0.20	0.10	3.1	4.2	5.0	3.0	3.7	3.4	4.6	5.5	3.3	4.0	3.8	5.0	6.0	3.6	4.3
0.42	0.09	0.10	1.4	1.9	2.3	3.0	3.7	1.5	2.1	2.5	3.3	4.0	1.7	2.3	2.7	3.6	4.3
0.50	0.08	0.11	1.2	1.7	2.0	3.4	4.0	1.4	1.8	2.2	3.7	4.4	1.5	2.0	2.4	4.0	4.8
0.58	0.07	0.11	1.1	1.5	1.8	3.4	4.0	1.2	1.6	1.9	3.7	4.4	1.3	1.8	2.1	4.0	4.8
0.67	0.06	0.11	0.9	1.3	1.5	3.4	4.0	1.0	1.4	1.7	3.7	4.4	1.1	1.5	1.8	4.0	4.8
0.75	0.05	0.08	0.8	1.0	1.3	2.4	2.9	0.9	1.2	1.4	2.7	3.2	0.9	1.3	1.5	2.9	3.5
0.83	0.04	0.07	0.6	0.8	1.0	2.1	2.6	0.7	0.9	1.1	2.3	2.8	0.8	1.0	1.2	2.5	3.0
0.92	0.03	0.03	0.5	0.6	0.8	0.9	1.1	0.5	0.7	0.8	1.0	1.2	0.6	0.8	0.9	1.1	1.3
1.00	0.01	0.02	0.2	0.2	0.3	0.6	0.7	0.2	0.2	0.3	0.7	0.8	0.2	0.3	0.3	0.7	0.9

DESIGN STANDARDS

4. HIGHWAY

LIST OF TABLES

4. Highway

4.1 General

Developments may require Frontage Roads, double Frontage lots, deep lots with rear service Lanes, or such other treatment as may be necessary in the public interest for the adequate protection of residential properties and to afford separation of through and local traffic.

In reviewing engineering plans, the Approving Officer or Building Inspector must consider the sufficiency and suitability of the proposed Road system, the arrangement, width, grade and location of all Roads in relation to existing and planned Roads, to topographical features, to public convenience and safety, and to the proposed uses of the land to be served by such Roads.

The arrangement of Highways in a Subdivision must either:

(a) provide for the continuation or appropriate projection of existing Roads in surrounding areas; or

(b) where topographic or other conditions make continuation or projection of existing Roads impractical, provide an adequate and suitable Highway system having regard to the uses of the land to be served.

The dimensions, locations and standard of all Roads in a proposed Subdivision must conform substantially to any applicable community plan.

Local residential Roads must be aligned so that their use by through traffic will be discouraged.

Cul-de-sac Roads, designed to be permanent, must be provided at the closed end with an area designed to permit safe and adequate space for the turning of motor vehicles.

Walkways must be provided where they are deemed desirable to provide access through the Subdivision to schools, playgrounds, shopping centres, transit, beaches and other community facilities or for proper circulation of pedestrian traffic.

Jogs in Highway alignment at intersections may be allowed provided that the distance between centre lines is sufficient to maintain traffic safety.

Intersections are to be designed and located within a range of angles between 70º and 110º.

In the design of all street intersections, including those with lanes and walkways, the Consulting Engineer must give consideration to providing adequate sight and stopping distances for conflicting traffic streams involving pedestrians, bicycles and/or vehicles. The City of Kelowna Traffic Regulation Bylaw No. 8120 prohibits sight obstruction greater than 1 m in height within 8 m of intersections.

If reversed curves are required in a Highway alignment, the City Engineer may require that they be separated by means of tangents of sufficient length.

Where angular deflections occur in a Highway alignment, the City Engineer may require that the angle be replaced by a curve of suitable radius.

Road name signs and traffic signs required as a result of constructing or improving Roads must be provided by the City of Kelowna at the expense of the Owner.

Transit bays must be provided where required by the City Engineer.

4.2 Road Classification

The roadway classification applicable to the Road under consideration will be determined from Table 1. Where topographical or other conditions make continuation or projection of an existing street impractical, the City Engineer will review the Developer's proposal and may approve the alternative.

NOTE: All vertical and horizontal alignment elements will be designed utilizing information from Tables 1 and 2 and in accordance with:

1. Transportation Association of Canada - Geometric Design Guide for Canadian Roads, 1999 Edition

TABLE 1 – ROADWAY CLASSIFICATION

Road Class/R.O.W. Improvements	Road Allowance Width (min.)	Surface Width (min.)	Curb Type	Standard (Dwg. No.)
LANES				
Residential and Emergency and Private Access Roads	6.0	6.0	N/A	SS-R2
Commercial	7.6	7.6	N/A	SS-R2
LOCAL STREET				
Class -1, 2 Lane - ULU	18	10.3	Rollover	SS-R3
- RLU	18	7.0	N/A	SS-R3
Class -2, 2 Lane - ULU	15	9.1	Rollover	SS-R4
- RLU	15	7.0	N/A	SS-R4
COLLECTOR STREETS				
Class -1, 2 Lane - UCU -	20	13.1	Barrier	SS-R5
- RCU -	20	10.0	N/A	
Class -1, 2 Lane - UCU - with Bike Lanes	22	14.5	Barrier	SS-R6
- RCU - with Bike Lanes	22	10.0	N/A	
Class -2, 2 Lane - UCU -	18	11.3	Rollover	SS-R7
- RCU -	18	10.0	N/A	
ARTERIAL STREETS				
Class -1, 4 (6) Lane - UAD - Parkway	35	21.5	Barrier	SS-R8
Class -1, 4 Lane (Ult.) - UAD - Parkway	30	21.5	Barrier	SS-R9
Class -1, 2 Lane (Stage I) - UAD - Parkway	30	21.5	Barrier	
Class -1, 2(4) Lane - RAD -	30	20.6	N/A	SS-R10
Class -2, 4 Lane - UAD - Residential	30	20.9	Barrier	SS-R11
Class -2, 3 Lane (one way) - UAU - Residential	20	12.3	Barrier	SS-R12
Class -2, 2 Lane - RAU - Residential	20	10.3	N/A	SS-R13
Class -3, 4 Lane - UAU - TwnCntre	28	20.9	Barrier	SS-R14
Class -3, 3 Lane (one way) - UAU - TwnCntre	25	17.7	Barrier	SS-R15

Note the following definitions:

ULU - Urban/Local/Undivided
RLU - Rural/Local/Undivided
UCU - Urban/Collector/Undivided
RAU - Rural/Arterial/Undivided
RCU - Rural/Collector/Undivided
UAU - Urban/Arterial/Undivided
UAD - Urban/Arterial/Divided
RAD - Rural/Arterial/Divided

Surface Width - on urban section, this measures from back of curb to back of curb
- on rural section, it measures from the edge of asphalt to edge of asphalt.

4.3 Vertical Alignment

The vertical alignment of roads must be set so the grades of driveway to adjacent properties will conform to MMCD Drawing C7. Where it is impractical to meet this criteria, the City Engineer may approve the use of private access roads.

The minimum and maximum road centreline grades allowed on various classes of roads must be as per Table 2.

TABLE 2

GEOMETRIC STANDARDS

Facility Classification	Design Speed (km/h) (min.)	% Super. Elevation (max.)	Radius (metres) (min.)	% Grade		K-Value (min.)			Sight Distance (min.)	
				Min.	Max.	Crest	Sag		Stopping (metres)	Decision (metres)
							No Illum.	Illum.		
Walkway				1.0	15					
Emergency Access	30			1.0	15					
Driveway Single Fam.				1.0	15					
Driveway Multi-Fam.	30			1.0	12					
Rear Laneway	40	*I.C.	18	1.0	12	4	7	4	45	
See Notes Below					(10)					110 - 160
Local Roadway	50	*N.C.	100	0.5	12	7	11	6	65	
See Notes Below					(10)					140 - 190
Collector Roadway	50	6	115	0.5	10	7	11	6	65	
See Notes Below		(4)	(500)		(8)					140 - 190
Arterial Roadway	70	6	190	0.5	8	22	25	15	110	
See Notes Below		(4)	(1,000)		(6)					200 - 270

Notes: 6% super-elevation only permitted on collector roads in segments without intersecting roads or private access.

Notes: Through roads at an intersection are governed by the numbers shown in brackets, with the reduced grades on each side of the intersection for a distance equivalent to the "stopping sight distance".

*Inverted Crowns (I.C.) and Normal Crowns (N.C.) shall be built with 2% crossfall.

At road intersections, the minor road and/or cul-de-sac must be constructed with an approach grade of not greater than 3% for a distance of not less than 15 m from the adjacent edge of asphalt of the major road.

The draining grade around the outside curb of a cul-de-sac must be not less than 0.50% and not greater than 5.00%. Longitudinal gradients of cul-de-sac bulbs shall not exceed 5.00%.

When a cul-de-sac is at the bottom of a hill, the longitudinal gradient of the first 50m of roadway uphill from the cul-de-sac bulb shall not exceed 5.00%. The maximum longitudinal gradient for the rest of the hill shall not exceed 8.00%.

When a cul-de-sac is at the top of a hill, the longitudinal gradient for the roadway downhill from the cul-de-sac must not exceed 12.00%.

All changes in gradient over 1.00% on arterial and collector Roads and over 2.00% on all other road classifications must be connected by vertical curves. Vertical curves must be designed in accordance with the latest edition of the Geometric Design Guide for Canadian Roads as published by the Transportation Association of Canada.

Standard cross slopes (normal crown) must be 2.00% on all road classifications unless specified otherwise by the City Engineer. Design road elevations must give due consideration to flood-proofing requirements of adjacent properties. Full road crossfall (reverse crown) may be considered in special circumstances, as a means of more closely matching property grade adversity on either side of the highway.

The length of a transition from a normal cross-sectioned road to a section of road where there is super-elevation or crossfall must, in no case, be less than 70 m for a 50 kmh designed road or 110 m for a 70 kmh designed road. In selecting the length of the transition, care and consideration must be given to draining all of the pavement. Typically, if no horizontal spiral curve is used, 60% of the super-elevation is introduced prior to the beginning of the curve, and the balance is developed in the curve.

Gutter elevations on curb returns and cul-de-sacs must be shown on the drawings at the beginning, one-quarter points and end of curb returns and at 7.50 m intervals around cul-de-sacs.

4.4 Horizontal Alignment

The horizontal centreline alignment of the road will be located on the centreline of the right-of-way, unless approved otherwise by the City Engineer. Typical locations of works and utilities in Roads are shown on Standard Drawings.

Centreline chainage stations must be fully referenced and dimensioned from property lines.

Minimum radius of curve and maximum super-elevation normally allowed are shown in Table 2 (Geometric Standards). The Minimum radius of curb return at intersections must be 7.50 m. Transitions in road widths, tapers, etc., must be formed with smooth curves and tangents, including no less than 30:1 for 50 km/h design speeds and preferably 40:1 tapers.

A horizontal curve must be fully described showing internal angle, radius, tangent length and arc.

Curb returns located on roads within industrial and commercial districts may require a larger radius to facilitate truck traffic and bus traffic, and will be as specified by the City Engineer.

When a new road with curbs intersects an existing road without curbs, only half the curb returns must be constructed unless the road design for the uncurbed road is available and will allow construction of the full curb returns. Full curb returns must be constructed at the intersection of two curbed roads.

A turn-around or a second point of access is required on roads longer than 100 m. The maximum length of a permanent cul-de-sac shall be 200 m. Where it is part of a temporary and/or staged development, this maximum length may be 400 m. Cul-de-sac lengths greater than 200 m may be considered by the Approving Officer.

4.5 Road Cross-Section

The standard Road cross-section shall be as detailed in Table 1.

Note that the objectives of the standard road cross-sections as detailed in Table 1 and the Standard Drawings are the clear and intended goals on all roadways within the City of Kelowna. It is recognized, however, that ambient conditions may require variance from these standards in existing and substantially “built-up” areas, where provisions to accommodate the required roadway modification may not have been anticipated. A variance to these standards may be considered by the City Engineer.

4.6 Curb and Gutter, Sidewalks and Bike Lanes

The standards for curbs, gutters, sidewalks and bike lanes shall be as detailed in Table 1 and in the MMCD standard drawings and City of Kelowna supplemental drawings to the MMCD.

Each property shall only have one (1) driveway access per road frontage. Upon demonstrated need and approval from the City Engineer, more than one (1) driveway access may be granted to service stations, major commercial and other developments. Where a lot abuts a lane or road of different classification, the driveway shall be located to access the lane or road of the lower classification.

Residential driveway access onto an arterial or Class 1 collector road, is not permitted unless alternate access is impossible. Wherever physically possible, alternate local road or lane access shall be dedicated to preclude residential driveways accessing directly onto major roads.

Residential driveway accesses serving corner lots shall be a minimum of 7 m from the lot corner nearest the intersection. All residential driveway accesses shall have a minimum width of 4 m and a maximum width of 6 m.

Driveway accesses to commercial and industrial corner lots shall be a minimum of 15 m from the property line of the adjoining road. The maximum width of a driveway to a commercial or industrial property having only one access shall be 11 m. The maximum width of each driveway to a commercial or industrial property having more than one access shall be 9 m.

At the discretion of the City Engineer, access to large parking areas shall be by curb returns rather than a driveway letdown. The City Engineer may require deceleration and acceleration lanes for access off major roads for safety reasons and to minimize disruption to traffic flows. Design of such access shall follow the recommendations in the Ministry of Transportation & Highways, Highway Engineering Branch "Design Manual".

Wheelchair ramps must be provided at all intersections as an integral part of the sidewalk.

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4.7 Appurtenances

All proposed traffic islands, retaining walls, guard-rails, and permanent barricades must be designed in keeping with good engineering practices.

Traffic control devices shall be designed and installed in accordance with applicable and current City of Kelowna requirements.

For all utility poles and tie-downs which require re-locating prior to road construction, the utility must confirm the feasibility of their re-location prior to design completion.

4.8 Pavement Structure

4.8.1 Subgrade Preparation

Subgrade preparation shall be considered integral for construction of new roads.

Frost Susceptible Soils (ML): The susceptibility of soils to frost heave is commonly classified using the US Corp of Army Engineers four categories, as shown in Table 15.2 of the "Canadian Foundation Engineering Manual", 3rd edition, 1992. All geotechnical reports shall address the frost susceptibility of the subgrade soil.

Swelling Soils (CH): Pockets of soils known to change volume with variation of moisture content are known to exist in several locations within the limits of the City of Kelowna. These soils are typically identified as high plastic clays (CH) using the Unified Soil Classification System and Atterberg Limits index test (ASTM D4318). Where these soils are encountered as subgrade, special subgrade preparation considerations are required, as outlined below.

Scarification should render the subgrade to cohesive pieces of a maximum size of 20 mm to allow adequate moisture conditioning of the soil. The soil should be moisture conditioned to achieve a homogeneous moisture content between 0 and 3% over optimum. Following moisture conditioning, the subgrade soil should be compacted to a minimum of 95% of Modified Proctor density, as determined by ASTM D1557. The subgrade should be covered with granular sub-base as soon as practical to minimize the variation of the moisture content in the subgrade. The contractor should be aware that additional moisture condition and compaction may be required, at the contractor's expense, should the moisture content be allowed to vary significantly from optimum prior to placing the sub-base.

4.8.2 New Pavement Design

Designers of pavement structures shall consider four primary factors in undertaking a specific design. These are:

Subgrade support quality (geotechnical report)
Design life (20 years)
Traffic loading (expressed in ESALs)
Climate

New pavement structures shall be designed in accordance with the methodologies presented in "AASHTO Guide for Design of Pavement Structures", 1993. The pavement structure shall be designed for a twenty (20) year design life.

The AASHTO design method is based on a Structural Number (SN) for the entire pavement structure (i.e. hot mix asphalt, granular base and granular sub-base). The method incorporates the subgrade strength expressed as the Subgrade Resilient Modulus (Mr), and design loading (ESALs). Each component of the pavement structure is assigned a layer coefficient.

Subgrade strength is frequently characterized utilizing the California Bearing Ratio (CBR) test procedure (ASTM D1883). This test should be performed on soaked subgrade soil specimens compacted to 95% of Modified Proctor density as determined by ASTM D1557. The Resilient Modulus may be approximated from the soaked CBR test values using the following relationships:

Mr (MPa) = 10.3 CBR, or
Mr (psi) = 1500 CBR

The soaked CBR properties of subgrade soil should be determined at a frequency of at least one test per every 150 lineal metres, or a portion there of, and for each major soil type encountered. Where more than one test is required, the tests should be evenly spaced.

The required SN for the pavement structure is the sum of the product of the layer coefficient, the component thickness, and a drainage coefficient for each component:

eq'n (1) $SN = a_{ac}D_{ac} + a_bD_bM_b + a_{sb}D_{sb}M_{sb}$

where:

SN	=	Structural Number for pavement structure
a_{ac}	=	layer coefficient for hot mix asphalt (0.4)
a_b	=	layer coefficient for granular base (0.14)
a_{sb}	=	layer coefficient for granular sub-base (0.10)
D_{ac}	=	Thickness of hot mix asphalt (mm)
D_b	=	Thickness of granular base (mm)
D_{sb}	=	Thickness of granular sub-base (mm)
M_b & M_{sb}	=	layer drainage coefficient (1.0 for Kelowna)

Road classifications, design traffic values and minimum depths of hot mix asphalt and granular base components of the total pavement structure are defined in Table 3.

Table 3
Minimum Asphalt & Granular Base Depth vs Design Traffic

Road Classification	Design Traffic (ESALs) [1]	Minimum Depth of Hot Mix Asphalt	Minimum Depth of Granular Base
Walkways	n/a	50	75
Local, Lanes & Access Roads	2.8×10^4 (28,000)	50	75
Collector	2.8×10^5 (280,000)	100	75
Arterial [2]	1.0×10^6 (1,000,000)	100	75

Notes:

(1) See Part 1 – Chapter 1 of AASHTO for definition of an Equivalent Single Axle Load (ESAL).
(2) Special design reviews may be requested by the City Engineer.

Standard pavement structures, including required SN values, are provided on Table 4 for three strengths of subgrade. The standard pavement structures incorporate the minimum depths of hot mix asphalt and granular base shown in Table 3.

Table 4
Standard Pavement Structures

Street Classification	Structure Component	Thickness in mm for Soaked CBR [1] of		
		3[4] ≤ CBR<5	5 ≤ CBR<10	CBR ≥ 10
Walkways	Asphalt - Surface Course	50	50	50
	Granular Base	75	75	75
	Granular Sub-base [3]	150	150	150
	Required SN Value	n/a	n/a	n/a
Local, Lanes & Access Roads	Asphalt - Surface Course	50	50	50
	Granular Base	75	75	110 [2]
	Granular Sub-base [3]	275	165	0
	Required SN Value	58	47	35
Collector	Asphalt - Surface Course	40	40	40
	Asphalt - Base Course	60	60	60
	Granular Base	75	75	100 [2]
	Granular Sub-base	335	185 [3]	0
	Required SN Value	84	69	53
Arterial	Asphalt - Surface Course	40	40	40
	Asphalt - Base Course	60	60	60
	Granular Base	75	75	75
	Granular Sub-base	535	355	155 [3]
	Required SN Value	104	86	66

Notes:

(1) Soaked CBR value shall be at 95% of Modified Proctor maximum dry density and optimum moisture content, as determined by ASTM D1557.

(2) Placement of equivalent sub-base layer is not practical and shall be replaced with additional granular base.

(3) Maximum aggregate size of sub-base material to be no more than 50% of total depth of sub-base.

(4) Where the top 1 m of subgrade has a soaked CBR value of less than 3, then the subgrade strength should be supplemented with an additional thickness of granular sub-base material in order to achieve a soaked CBR value of 3 or greater. The thickness of the supplemental sub-base and the corresponding composite CBR value for the top 1 m of composite subgrade can be determined by the following formula:

$$\text{CBR Composite} = ((t_{ssb} \times CBR_{ssb}^{0.33} + (100-t_{ssb}) \times CBR_{sg}^{0.33})/100)^3$$

Where CBR Composite is 3 or greater.
t_{ssb} = thickness of supplemental sub-base (cm).
CBR_{ssb} = CBR value of supplemental sub-base.
CBR_{sg} = CBR value of subgrade soil.

Design pavement structure to be placed on a prepared subgrade or adequately compacted fill embankment. Refer to Section 4.8.1 and 02226 of the MMCD.

Granular base and granular sub-base to have a minimum soaked CBR value of 80 and 20, respectively (refer to City Supplemental S02226).

For design purposes, the maximum subgrade soaked CBR value shall not exceed 10.

Required physical properties for granular base and granular sub-base are given in Schedule 5, Section S02226.

Staged construction may be considered by the City Engineer when a road is to be constructed and to be widened at a later date.

Table 4 provides standard pavement structures for roads constructed on only three strengths of subgrade. Alternate pavement structures may be designed based on the SN determined using Figure 1. For example, for a Collector Road with soaked subgrade CBR value of 4, then the corresponding pavement structure requires a SN of 75. Using eq'n (1), and the specified layer coefficients, a suitable pavement structure alternative may be determined as shown on Table 5:

Table 5
Example Pavement Structure

Pavement Structure Component	Thickness, D (mm)	Layer Coefficient, a	SN
Hot Mix Asphalt	100	0.40	40
Granular Base	100	0.14	14
Granular Sub-base	210	0.10	21
Total SN			75

Note that the minimum depths of hot mix asphalt and granular base shown on Table 3, and the required SN have been met.

The curves shown on Figure 1 are derived from the methodologies presented in AASHTO. A description of all variables used to derive the curves is presented in the MoT Technical Circular T - 9/95, "Pavement Design Standards".

AASHTO Structural Number (SN) Values
for Kelowna Street Classifications
as a Function of Soaked Subgrade CBR Value

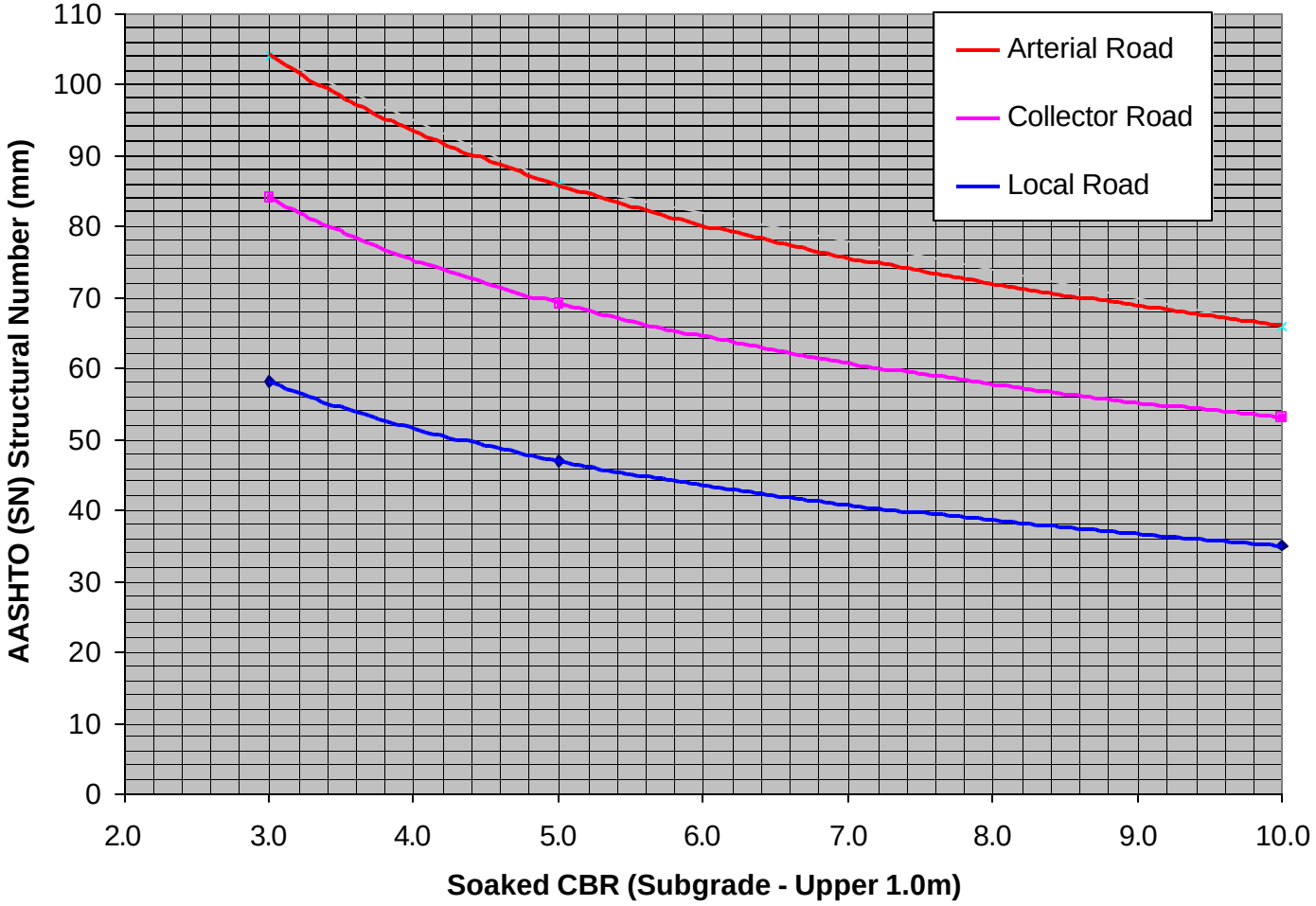


FIGURE 1

4.8.3 Design of Overlays for Existing Pavements

Overlay designs for existing pavements are to be performed in accordance with "Technical Publication No. 12" published by the Roads & Transportation Association of Canada. The design criteria for overlays are based on limiting Benkelman Beam deflections as follows in Table 6:

Table 6
Benkelman Beam Criteria for Overlays

Road Classification	Maximum Deflection (mm)
Arterial Roads	1.00
Collector Roads	1.25
All Other Road Classifications	1.50

Notes: (1) The design Benkelman Beam rebound ($x + 2\sigma$) should be determined on the basis of at least 10 uniformly spaced readings per two-lane kilometre (one half in each lane).

(2) The summary rebound statistic for a pavement section should be seasonally adjusted to the spring peak rebound value.

DESIGN STANDARDS

5. ELECTRICAL, STREET LIGHTING AND COMMUNICATION WIRING

5.1 General

The electrical systems must be installed at the Owner's expense, in accordance with the requirements of the appropriate utility company.

Where overhead distribution is permitted, pole and anchor locations must be approved by both the City Engineer and the appropriate utility company. Care must be taken to avoid aerial trespass.

Plans and agreements for rights of way for anchors, pad-mounted transformers, etc., must be provided and registered at the expense of the Owner.

5.1.1 Rules and Regulations

Equipment, installation, wiring methods, and materials used must be in accordance with the Rules and Regulations for the Installation and maintenance of Electrical Equipment as issued by the Ministry of Transportation & Highways, Province of British Columbia. Work must also be in accordance with all applicable Municipal codes and regulations, Provincial statutes or regulations in effect at the site.

5.1.2 Conduits

Conduits must be installed, as nearly as possible, at a constant depth and on the alignment shown on the Standard Drawings. Conduits under existing paved roads, driveways, or sidewalks must be installed by tunnelling unless the City Engineer gives his express written consent for open trenching prior to the commencement of the work.

5.2 Electrical

Electrical systems must be provided to serve each lot within the Subdivision. The location of all facilities and structures must be in accordance with the engineering drawings as approved by the City Engineer, and must be clearly indicated on the plans.

5.3 Street Lighting

5.3.1 Design Levels

(a) **Level of Illumination:** The "Maintained illuminance Uniformity Levels" as recommended by the Illumination Engineering Society (IES) shall be as follows:

TABLE 1

Road Classification	Area Classification	Average Maintained Illuminance in Lux	Illuminance Uniformity Ratio
Arterial	Commercial	17	3 to 1
	Intermediate	13	
	Residential	9	
Collector	Commercial	12	4 to 1
	Intermediate	9	
	Residential	6	
Local	Commercial	9	6 to 1
	Intermediate	7	
	Residential	4	

(b) **Roadway Classification:**

Arterial: A Roadway that serves as a continuous route primarily for inter community through traffic.

Collector: A Roadway that performs the dual function for traffic of land access and traffic movement between arterial and local roads.

Local: A Roadway that provides direct land access and is not intended to carry through traffic.

(c) **Area Classification:**

Commercial: All areas that are zoned as Commercial. Examples are Roadways adjacent to shopping centres, central business districts, Village town centres, Motels and Hotels.

Intermediate: Areas that are zoned as High Density Multi-Family, Local Commercial, Industrial, and Public. Transportation area between commercial and residential areas of up to 500 m in length.

Residential: Areas that are zoned as Rural-Residential, and Single Family Residential to Medium Density Multi-Family Residential.

Notes: Lux is defined as illuminance and is expressed in lumens per square metres. Foot Candles has been the previous measurement term. For conversion purposes 1 Lux = .09 Foot Candle.

5.3.2 Pole Locations

In general, the layout for pole installation must be as follows:

(a) Divided Arterial Roadways:

- Four (4) Lane road width< 22 m staggered spacing.
- Six (6) Lane road width > 22 m. Treat each three Lane portion of divided Roadway as two separate roads. One sided or staggered spacing.

(b) Undivided Arterial Roadways two (2) to four (4) Lanes. Staggered spacing.

(c) Collector Roadways - staggered spacing.

(d) Local Roadways - staggered or one sided spacing.

Poles must be located within 0.6 m of the property corners where possible and must not conflict with driveways and underground utilities. Pole layout must be based from the intersections.

5.4 Communication Wiring

The owner must make arrangements with the appropriate communication and cable T.V. company for installation of services in accordance with the requirements of these utilities.

Underground Telephone and Cable TV, where installed, must be sufficiently complete prior to construction of sidewalks, curbs and gutters and Street paving, to avoid damage to these improvements.

5.5 Overhead/Underground Requirements

The City's requirements for allowing overhead or underground wires is as follows:

a) In all Town Center and Village Center areas as identified by the Official Community Plan all wires shall be buried and installed in conduits.
b) All streets and highways that are created as a result of new development shall have all wires buried underground.
c) Outside of these areas where existing overhead wires parallel the existing road the developer shall have the option to bury or to leave overhead the wires.
d) On roadways identified in the City's 20 Year Servicing Plan for upgrade and urbanization, all service wires crossing the roadway must be buried.

SCHEDULE 5

OF BYLAW 7900

CITY OF KELOWNA

CONSTRUCTION STANDARDS

(SUPPLEMENTAL STANDARDS TO MMCD "GOLD" BOOK)

1. CONSTRUCTION SPECIFICATIONS
2. STANDARD DRAWINGS

1. CONSTRUCTION SPECIFICATIONS

CITY OF KELOWNA SUPPLEMENTAL TO THE MASTER MUNICIPAL SPECIFICATIONS

This document is the City of Kelowna Supplement to the Master Municipal Specifications, 2000 Gold Book Edition, and is to be applied in conjunction with the Master Municipal Specifications, which otherwise apply to all Works and Services constructed within the City of Kelowna.

The provisions of this Kelowna Supplement to the Master Municipal Specifications, supplement or supersede the provisions of the Master Municipal Specifications.

Where the provisions of the Kelowna Supplement are in conflict with the Master Municipal Specification the provisions of the Kelowna Supplement take precedence.

Section and article numbers in the Kelowna Supplement coincide with those of the Master Municipal Specifications.

INDEX

3.6 Surface Restoration

Delete: Section 7.5

Add:

7.5.1 All asphalt shall be saw cut 500 mm wider and longer than the surface dimensions of the actual trench excavation. This saw cut must extend cleanly through the existing asphalt to the base material prior to asphalt removal. See Drawing SSG5.

7.5.2 If the thickness of the existing asphalt is greater than 75 mm, grind it to a depth of 40 mm and a width of 200 mm along the saw cut edge. This can be done just prior to the final asphalt restoration.

7.5.3 Where the edge of the saw cut or milled asphalt, whichever is wider, extends into the travel lane, it should be extended to the mid point of that lane. Where the edge extends past the mid point of the travel lane, it should be extended to the far edge of that travel lane.

7.5.4 Where the edge of the saw cut or milled asphalt, whichever is wider, is less than 1.5 m from the lip of gutter or edge of paved shoulder, it should be extended to the lip of gutter or edge of paved shoulder.

7.5.5 When an area of existing asphalt between two transverse trenches is less than one third (1/3) of the total area of the proposed paving of the two trenches plus the area between them (based on the shortest trench), the existing asphalt shall be removed and the area paved in conjunction with the paving of the two trenches.

7.5.6 Regardless of 7.5.5, if the longitudinal distance between two trenches is less than three (3) meters it shall be removed and the area paved in conjunction with the paving of the two trenches.

7.5.7 Longitudinal trenches must be paved with a paving machine.

7.5.8 Hot-mix paving shall meet the thickness of the existing pavement or that shown on the design drawings, whichever is greater. If the thickness of the hot-mix paving is 75 mm or less, it shall be placed in one lift. If the thickness of the hot-mix paving is greater than 75 mm it shall be placed in two lifts as shown on Drawing SS-G5.

7.5.9 Vertical faces and the surface of the bottom lift of asphalt must be painted with bituminous material prior to hot mix paving.

3.3 Inspection of Native Surface

Add 3.3.2

Top 150 mm of Native Surface to be scarified, moisture conditioned to optimum moisture content and compacted to a minimum of 95% of Modified Proctor density in compliance with ASTM D1557, before placing of embankment or sub-base material.

2.1 Materials – General

.1 Delete and replace with: "Notwithstanding the provisions of 2.1 of Section 02226 the physical properties of the materials for granular sub-base and crushed granular base course shall be as set out herein:

Physical Property	Test Designation	Granular Sub-base	Granular Base
$MgSO_4$ Loss % Course Ag (Max) Fine Ag (Max)	ASTM/C88	 20 25	 20 25
Sand Equiv. % (Min)	ASTM/D2419	25	35
Plasticity Index % (Max)	ASTM/D4318	6.0	6.0
Crushed Particles (one face) % (Min)	MoT I-11 (A)		60
California Bearing Ratio (Soaked) % (Min)	ASTM/D1883	20	80

"

2.7 Granular Pipe Bedding and Surround Material

.2 Delete and replace with: "Pit run sand as specified in Section 02226 (2.4) may also be used unless otherwise specified by the Contract Administrator".

.3 Add: "Other permissible materials: Only where shown on Contract Drawings or directed by the Contract Administrator shall drain rock or approved materials be used for bedding and pipe surround".

2.8 Select Granular Sub-base

.1 Delete and replace with: "Notwithstanding the provisions of 2.8 of Section 02226 of the Master Municipal Specification the Granular Sub-base must conform to the following gradations:

Sieve Size (mm)	Percent Passing
150	100
100	85-100
50	65-100
19	40-100
4.75	20-70
0.150	0-20
0.075	0-8

"

.2 Add: "Maximum aggregate particle size to be no more than 50% of total thickness of sub-base layer".

2.10 Granular Base

.1 Delete and replace with: “Notwithstanding the provisions of 2.10 of Section 02226 of the Master Municipal Specification the crushed granular base course must conform to the following gradations:

Sieve Size (mm)	Percent Passing
25	100
19	80-100
9.5	60-90
4.75	35-70
2.36	25-50
1.18	15-35
0.300	5-20
0.075	2-8

”

2.11 Recycled Aggregate Material

.1 Delete and replace with: “Aggregates containing recycled material may be utilized if approved by the Contract Administrator. In addition to meeting all other conditions of this specification, recycled material should not reduce the quality of construction achievable with quarried materials. Recycled material should consist only of crushed portland cement concrete and asphalt pavement. Other construction and demolition materials such as bricks, plaster, etc. are not acceptable".

.2 Add: Material retained on the 4.75 mm sieve to be not more than 20% recycled material. Minimum size of processed recycled material is to be retained on the 4.75 mm sieve.

.3 Add: Recycled material and granular sub-base material is to be mechanically blended to produce a homogeneous mixture prior to delivery to site. Blending on site will not be permitted.

.4 Add: Acceptable recycled material to be used in sub-base material only.

)

2.0 PRODUCTS

2.1 Materials

2.1.1 Delete and replace with: “Asphalt cement: to CGSB-16-3-M90, Grade 80-100, Class A.”

2.1.3.2 Delete and replace with: “Gradations to be within limits specified when tested to ASTM C136 and ASTM C117.”

Table 2.1.3.2
Hot Mix Asphalt Aggregate Gradation Specification

Sieve Designation	Percent Passing	
	Lower Course	Surface Course
25 mm	100	-
19 mm	80-100	100
12.5 mm	-	84-95
9.5 mm	50-84	73-90
4.75 mm	25-55	50-75
2.36 mm	20-45	35-57
1.18 mm	15-35	25-45
0.600 mm	-	18-34
0.300 mm	5-20	10-26
0.150 mm	-	6-17
0.075 mm	3-7	3-7

2.1.3.6 Delete and replace with: “Sand Equivalent: to ASTM D2419. Min 50 (New Arterial). Min 40 (All other street classifications).”

2.1.3.10 Delete and replace with: “Lightweight particles: to ASTM C123. Maximum % by mass less than 1.95 relative density:

.1 Surface course: 1.0
.2 Lower course: 1.5”

2.1.3.11 Delete and replace with: "Flat and elongated particles: (with length to thickness ratio greater that 5): Maximum % by mass:

.1 Coarse aggregate, surface course: 10
.2 Coarse aggregate, lower course: 10"

2.1.3.12 Delete and replace with: "Crushed Particles (fraction retained on 4.75 mm sieve), 2 faces, % minimum:

New arterial streets: 85
All other street classifications: 70"

2.2 Mix Design

2.2.1 Delete and replace with: "The Contractor, at their cost, must retain an independent testing consultant to perform trial mix designs and to submit the job mix formula. The trial mix design must be performed in accordance with ASTM D1559 (75 blows per face) and must include five (5) separate trial values of asphalt content. Contractor must pay for trial mix designs and submissions."

2.2.2 Delete and replace with: "Mixes for construction of asphalt base course may contain up to 20% of RAP, provided that the properties of RAP material are considered in the trail mix design. Submissions for RAP mixes must contain all data relevant to RAP utilized in the mix design."

2.2.3 Delete and replace with: "Include the following data with the trial mix design submission:

.1 Aggregate bulk specific gravity and water absorption.
.2 Sand equivalent values.
.3 Asphalt cement properties including mixing and compaction temperatures, based on temperature viscosity properties of asphalt cement.
.4 Aggregate gradations and blending proportions.
.5 Maximum theoretical density of trial mixes.
.6 Asphalt absorption values.
.7 Mix physical requirements to meet Table 2.2.3.
.8 Do not change job-mix without prior approval to Contract Administrator. Should change in material source be proposed, new job-mix formula to be submitted to Contract Administrator for review and approval.

Table 2.2.3
Specified Physical Requirements of Hot Mix Asphalt

Property	Mix Type	
	Lower Course (1)	Surface Course
Stability @ 60°C, kN (min)	8.0	9.0
Flow Index, 0.25 mm units	8-14	8-14
Voids in Mineral Aggregate % (min)	12.0	14.0
Air Voids, % (2)	3-6	3-5
Index of Retained Stability after Immersion in Water for 24 hrs @ 60°C, % (min)	75	85

Notes: (1) If lower course mix is used in staged construction, i.e. exposed for at least one winter, specified properties for surface course mix must apply.
(2) Percent air voids in compacted trial mixes must be determined in accordance with ASTM D3203, with asphalt cement absorbed into the aggregate compensated for in the calculation.

3.0 EXECUTION

3.1 Plant and Mixing Requirements

3.1.1.3 Delete and replace with: “Before mixing, dry aggregates to a moisture content not greater than 1% by mass or to a lesser moisture content if required to meet mix design requirements.”

3.1.1.9 Where RAP is to be incorporated into mix:

3.1.1.9.3 Delete and replace with: “RAP must not be fed through the aggregate dryer system.”

3.1.1.11 Mixing Time:

3.1.1.11.3 Add: “Mixing period and temperature to produce a uniform mixture in which particulates are thoroughly coated, and moisture content of material as it leaves mixer to be less than 0.2%.”

3.1.4 Mixing Tolerances:

3.1.4.1 Delete and replace with: “Permissible variation in aggregate gradation from job mix (percent of total mass):

.1	4.75 mm and larger	± 4.5
.2	2.36 and 1.18 mm	± 4.0
.3	0.600 mm	± 3.5
.4	0.300 mm	± 2.5
.5	0.150 mm	± 1.5
.6	0.075 mm	± 1.0”

3.2 Equipment

3.2.1 Delete and replace with: "Pavers must be capable of placing a standard mat width not less than 3 m and must be capable of paving wider widths in 150 mm and 300 mm increments by means of equipment supplied by the manufacturer of the equipment. The screed must include a tamping bar or strike-off device.

Control of the screed must be by automatic sensing devices. Longitudinal control must be by a sensor that follows a string-line, ski or other reference. The grade sensor must be movable and mounts provided so that grade control can be established on either side of the paver. A slope control sensor must be provided to maintain the proper transverse slope of the screed."

3.6 Compaction

.2 General:

3.6.2.1 Delete and replace with: "Provide sufficient compaction equipment to ensure that the compaction rate meets or exceeds the placement rate and to ensure that specified density is achieved before the temperature of the mat falls below 100°C."

3.7 Joints

.1 General:

3.7.1.4 Add: "When placing final pavement layer against concrete curbing, compacted pavement must meet the gutter at the same elevation or a maximum of 10 mm above and along the entire lip of the gutter."

4.0 COMPLIANCE WITH SPECIFICATIONS AND PAYMENT ADJUSTMENT FOR NON-COMPLIANCE

4.1 Hot Mix Asphalt Concrete

.1 A Marshall analysis will performed from a sample obtained at the paving site on a frequency of one analysis per day, with at least one analysis required per project or 700 tonnes of asphalt.

.2 When analysis identifies non-conformance with specified properties, the Contractor must immediately initiate remedial measures, and submit, at its expense, evidence that compliance exists with the approved mix design. Failure to do so will result in suspension of plant mixing operations.

4.2 Aggregate Gradation

.1 When the aggregate fails to comply with tolerances set forth in Section 3.1.4.1 of this specification, the Engineer will initiate the following action:

.1 When two (2) consecutive gradation analyses identify non-compliance with the specified tolerances, the contractor must be served notice and a third test will be initiated.

.2 If continued non-compliance is indicated from the third test, the Contractor must suspend production. It must not commence construction again until it has demonstrated that corrective action has been taken and that the aggregate gradation is within the specified tolerance limits.

4.3 Asphalt Cement

.1 Payment adjustment for non-compliance with the tolerance specified:

Asphalt Content Deviation from Design %	Payment Adjustment Factor
0.30 OR LESS	0.00
0.31 TO 0.40	0.20
0.41 TO 0.50	0.75
0.50 OR GREATER	Remove and replace

.2 Adjustment for asphalt cement content non-compliance to the amount payable for Hot Mix Asphalt Paving equals the unit bid price times the payment adjustment factor times the quantity to which the factor is to be applied, i.e.:

$$A_c = P\,(F_c)\,(Q_n)$$

where:

A_c = Adjustment for asphalt cement content non-compliance

P = unit bid price

F_c = Payment Adjustment Factor for Asphalt Cement Content non-compliance

Q_n = Asphalt measured for payment which was produced during the production period to which a test applies

4.4 Pavement Thickness

.1 Pavement of any type found to be deficient in thickness by more than 10 mm must be removed and replaced by pavement, of specified thickness, at the contractor's expense.

.2 Pavement of any type found to be deficient by less than 10 percent of its specified compacted thickness will not be subject to payment adjustment for thickness non-compliance.

.3 Pavement of any type found to be deficient in thickness by more than 10 percent of its specified thickness but not more than 10 mm shall give rise to an adjustment in the amount to be paid to the Contractor. The adjustment shall be subtracted from the amount otherwise payable to the

Contractor, and the amount of the adjustment will be paid to the City. The adjustment shall be calculated as follows:

$$A_t = \frac{T_d}{T_s} \times P \times Q_t$$

where:

- A_t = Adjustment for thickness deficiency
- T_d = Deficiency in thickness measured in mm and being greater than 10% of specified thickness but not greater than 10 mm.
- T_s = Specified thickness in mm.
- Q_t = Asphalt measured for payment lying within a unit of work area defined in 5.2.2, where the thickness deficiency has been identified.
- P = Unit Bid Price.

NOTE: No allowance will be made for the tolerance provided for in Section 4.4.2.

The adjusted price will be applied to all asphalt measured for payment which lies within a unit of work area defined in 5.2.2 where the thickness deficiency had been identified, or to such lesser area as may be defined in accordance with the provisions of 5.2.2.

4.5 Density

.1 The minimum specified density for acceptance, without payment adjustment, must be 97% of the 75 blow Marshall density as most recently determined by the appointed testing agency.

.2 Payment adjustment for density non-compliance will be as follows:

DENSITY (% OF 75 BLOW MARSHALL)	PAYMENT ADJUSTMENT FACTOR
97 and greater	0.0
95.0 to 96.9	As per Density Payment Adjustment Factor Chart (see Standard Drawing SS-R24)
Less than 95.0	No Payment (subject to removal and replacement after review by the Engineer)

Adjustment for density specification non-compliance shall be determined as follows:

$$A_D = P\ (F_D)\ (Q_{nD})$$

where:

- A_D = Adjustment for density non-compliance
- P = Unit Bid Price for Hot Mix Asphalt Cement paving
- F_D = Payment Adjustment Factor for density non-compliance
- Q_{nD} = Asphalt measured for payment within a unit of test area as defined in 5.3.

4.6 Adjusted Payments

.1 The total adjustment arising from pavement deficiencies identified in the foregoing shall be determined as follows:

$A_r = A_c + A_t + A_D$

where:

A_r = Total Adjustment
A_c = Adjustment for asphalt cement content non-compliance
A_t = Adjustment for thickness deficiency
A_D = Adjustment for density non-compliance

The total adjustment (A_r) shall be paid to the City.

5.0 TESTING FREQUENCY AND PROCEDURES

5.1 Aggregate Gradation and Asphalt Cement Content

One test per production period as defined in Section 4.1.1. Asphalt content shall be determined in accordance with ASTM D2172 or D6307. Gradation analysis of extracted aggregate shall be performed in accordance with ASTM C136 and C117.

5.2 Thickness

The actual pavement thickness, for each unit of work area, will be determined on the basis of the average thickness of three (3) cores. The cores shall be spaced at intervals of 150 m of paved lane width or less. If the deficiency of any individual core exceeds 10 mm, three (3) additional cores may be extracted in proximity to the location of the core of excessive deficiency, to identify the extremities of the pavement area to be removed and replaced. The contractor will initiate and pay for such additional coring.

A unit of work area is defined as1,500 m^2 or fraction thereof, representing pavement placed in an individual placement day.

Sampling and testing for thickness determination shall be in accordance with ASTM D3549.

5.3 Density

Density of compacted pavement shall be determined on the basis of tests on core samples taken at a maximum interval of 150 m of paved lane width. A test area shall be that area lying between longitudinal joints and between transverse lines located midway between test cores or between such transverse lines and the beginning or end of placement.

With prior approval of the City Engineer, the in situ density of a compacted layer of pavement may also be determined by nuclear methods in accordance with ASTM D 2950. Spacing of tests shall be as stated above, and tests shall be taken in the vicinity of the core samples extracted for testing of the thickness of the pavement layer. In a situation where the in situ density of the lift does not meet specification, according to D 2950, then the density of the extracted cores shall be determined and will take precedent

)

over the in situ density. Where the specified compaction has not been met, as confirmed by the direct measurement of the core, then an additional three cores shall be taken in the immediate area and the average of the three cores shall be used.

2.1 General

.2 A list of approved waterworks products is provided by the City, see Council Policy 266.

2.2 Mainline Pipe, Joints and Fittings

.1 Ductile Iron Pipe

.3 Add "Wrap: Ductile iron pipe to be installed with a polyethylene encasement conforming to AWWA C104, unless the Consulting Engineer has arranged suitable testing of the soil conditions to satisfy the City Engineer that there is no risk of accelerated corrosion".

.14 Tapping Sleeves for Branch Connections 75 mm and Larger

.2 Delete.
.3 Delete.

2.3 Valves and Valve Boxes

.2 Mainline Gate Valves

.7 Delete.

.3 Mainline Butterfly Valves

Replace with: "Mainline butterfly valves: may only be installed on mains greater than 300 mm, to AWWA C504 Class 150B.

2.5 Service Connection Pipe, Joints and Fittings

.1 Replace with "Pipe diameter 19 mm to 50 mm to be Type K annealed copper, to ASTM B88M, and pipe diameter 25 mm to 50 mm may be Pressure Class 160 Polyethylene tubing, certified to CSA B137.1.

2.6 Hydrants

.2 Colour
Replace with: "All hydrants are to be painted in accordance with the standard drawings."

.6 Replace with: “For hydrants not in service, place an orange bag over the entire hydrant, secured at the bottom with tape and labelled in black “Not In Service”. Remove bag once the water main has been accepted by the Contract Administrator, City Engineer or Improvement District.

3.6 Pipe Installation

Add to beginning of this section:

"Unless approved by the City Engineer or Improvement District, all pipe to be delivered from manufacturer with weather proof plugs/bagging to prevent contamination while being delivered and during storage. Pipe to remain this way until placed into trench and installed.

.6 Remove "Joint deflection not permitted for PVC pipe."

3.17 Flushing, Testing and Disinfection

.2 Add "Upon satisfactory completion of the testing and disinfection, and prior to allowing the main to be used for active service, the Contract Administrator shall provide the City Engineer with written certification that the flushing, testing and disinfection has been performed in accordance with AWWA, MMCD, and City of Kelowna requirements, and has been substantiated with Total and Fecal Coliform results of zero colonies per 100 ml. Use Form 6, Request for Water Main Tie-In and refer to Schedule 5 of the Construction Specifications, Appendix 'A' of the City of Kelowna Subdivision and Servicing Manual.

3.20 Disinfection, General

.2 Replace with "Disinfect and flush pipes and appurtenances in accordance with section 3.21, AWWA C651 and the City of Kelowna Water Main Testing and Tie-In procedure (Appendix 'A' Construction Specifications)".

.3 Add "Disinfect and flush water reservoirs and appurtenances in accordance with AWWA C652".

3.6 Pipe Installation

.6 Pipes on curved alignments:

.1 Delete "and ribbed profile PVC plastic pipe".

3.8 Connection to Existing Mainline Pipes

.4 Delete.

3.12 Leakage Testing - General

.1 Delete "Specified tests may include one or more of the following:" and replace with "Specified test must include at a minimum, either test .1 - Water exfiltration test, or test .2 - Low pressure air test. Additional tests may be specified in the Supplementary Specification or be required as directed by the Contract Administrator".

3.18 Video Inspection

.1 Replace this section with "Contract Administrator shall ensure that a video inspection of sewers is conducted and that it is performed in accordance with the City of Kelowna requirements".

3.20 Connection to Existing Mains

.1 Replace with "Connections to existing sewer systems will be made by the City of Kelowna, and the cost of which will be borne by the Contractor. Make all necessary arrangements with Contract Administrator to schedule work to prevent delays".

.2 Delete.

Water Main Testing and Tie-in Procedure

Prior to the completion of a tie-in of a newly constructed water main to the City of Kelowna Water System, the following procedures and tests must be performed, recorded and presented for acceptance:

Note: New water main and all appurtenances connected to it, to remain physically separated from existing water system during testing and flushing, and to remain separated until all test results have been reviewed and accepted by the City of Kelowna Water Utility. Testing against a valve is not permitted.

1. Pipe must be clean of any residual debris, foreign material, silt, etc. by means of flushing. For flushing procedures, refer to MMCD 02666, 3.18 and AWWA C651.
2. Leakage and pressure testing to be performed in accordance with MMCD 02666, 3.19 as well as AWWA C600 & M41 for ductile iron pipe, and C605 & M23 for PVC pipe.
3. Disinfection of water main to be in accordance with AWWA C651, MMCD 02666 3.21. Results from this procedure must include actual concentration levels at 0 & 24 hours and must be from both ends of the pipe.
4. Flush water main to tanker truck or holding facility and Dechlorinate the disinfection solution using thiosulfate. Confirm that the solution has been neutralized prior to disposing to an approved location.
5. Test water main in accordance with AWWA C651 to confirm that no bacteria exists. Testing to include two consecutive sets of samples at least 24 hours apart, taken at both ends of the pipe, including all branches and at intervals in between as specified in AWWA 651. Tests required for the samples are; Total Coliform, Fecal Coliform, Background Bacteria, and a Chlorine Residual.

The Consultant or Contract Administrator to include the following results to the City of Kelowna Water Utility with the “Request for Water Main Tie-in” form, as prescribed by the City of Kelowna.

1. Copies of all test results including those from other companies that performed any of the tests.
2. A sketch or copy of a drawing showing the sections tested and the location of the tie-in(s).
3. A copy of the video showing the inside of the newly constructed water main.

Please note that water used for flushing and filling to be from an approved hydrant or from a City of Kelowna filling station. Ensure that adequate flushing of hydrant and hydrant lead takes place prior to using water. All water drawn from the City Water System to be done with approved backflow protection.

For information on procedures and testing, refer to the appropriate documents applicable as described above, or as listed below:

- Contract Documents
- Master Municipal Specifications (MMCD)
- City of Kelowna Subdivision & Servicing Bylaw
- City of Kelowna Water Regulation Bylaw
- AWWA standards
- Guidelines for Canadian Drinking Water Quality

CITY OF KELOWNA STANDARD DRAWINGS INDEX AND CROSS-REFERENCE TO MMCD

MMCD Standard Drawings		City of Kelowna Standard Drawings		
Dwg.	Title	Comment	Dwg.	Title
	GENERAL DETAILS			
G1	General Legend for Contract Drawings	Deleted		*(Per City A-size Drawing Block)*
G2	Legend for Materials	MMCD	G2	Legend for Materials
G3	Legend for Street Light and Traffic Signal Drawings	Deleted		*(Future Amendment – Refer to Utility)*
G4	Utility Trench	Replaced	SS-G4	Utility Trench
G5	Pavement Restoration	Replaced	SS-G5	Pavement Restoration
G6	Concrete Encasement for Water Main/ Sewer Separation	MMCD	G6	Concrete Encasement for Water Main/Sewer Separation
G7	Concrete Protection for Underground Utilities	MMCD	G7	Concrete Protection for Underground Utilities
G8	Pipe Anchor Blocks	MMCD	G8	Pipe Anchor Blocks
	STORM AND SANITARY SEWERS			
S1	Standard and Sump Manholes	Replaced	SS-S1a SS-S1b	Manholes Manhole Frame and Cover
S2	Standard Manhole Connection Details	Replaced	SS-S1a	Manholes
S3	Manhole Connection Details – Drop and Ramp Type	MMCD	S3	Manhole Connection Details – Drop and Ramp Type
S4	Inside Drop Manhole	MMCD	S4	Inside Drop Manhole
S5	Precast Riser Manhole	MMCD	S5	Precast Riser Manhole
S6	Sewer Clean-Out	Replaced	SS-S6	Clean-Out Detail (Temporary)
S7	Sanitary Sewer Service Connection	MMCD	S7	Sanitary Sewer Service Connection
S8	Storm Sewer Service Connection	MMCD	S8	Storm Sewer Service Connection
S9	Inspection Chamber for 100 to 200 Sanitary Sewer Connection	MMCD	S9	Inspection Chamber for 100 to 200 Sanitary Sewer Connection
S10	Inspection Chamber for 250 to 375 Storm Sewer Connection	MMCD	S10	Inspection Chamber for 250 to 375 Storm Sewer Connection

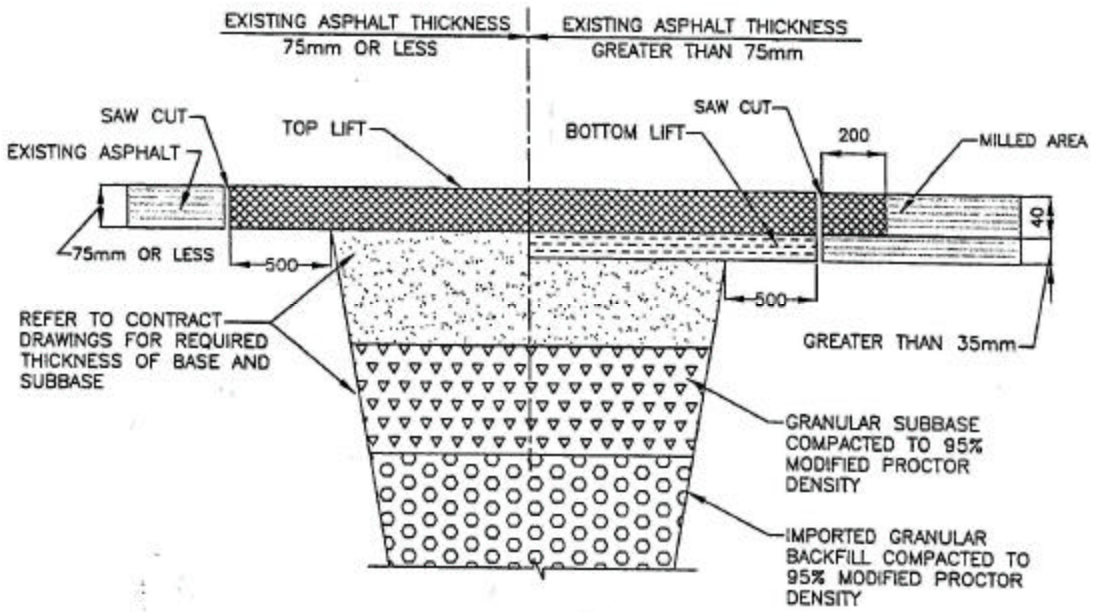
MMCD Standard Drawings		City of Kelowna Standard Drawings		
Dwg.	Title	Comment	Dwg.	Title
S11	Top Inlet Catch Basin	Replaced	SS-S11a SS-S11b SS-S11c	Catch Basin 900 mm diameter Catch Basin Castings Combined Side and Gutter Inlet Catch Basin – Top Slabs
S12	Lawn Drains	MMCD	S12	Lawn Drains
S13	Storm Sewer Inlet with Safety Grillage	MMCD	S13	Storm Sewer Inlet with Safety Grillage
S14	Concrete Block Endwall	MMCD	S14	Concrete Block Endwall
S15	Driveway Culvert with Concrete Block Endwalls	MMCD	S15	Driveway Culvert with Concrete Block Endwalls
		Added	SS-S50	Manhole Requirement for Services
		Added	SS-S51	Drainage Drywell
		Added	SS-S52	Drainage Drywell Installation
		Added	SS-S53	Pipe Perforation and Bedding Detail for Ground Water Recharge
		Added	SS-S54	Catch Basin Trapping Hood
		Added	SS-S55	Flow Control Chamber (with sediment grease trap)
		Added	SS-S56	IDF Curves
		Added	SS-S57	RipRap Design Chart
	WATERWORKS			
W1	Typical Thrust Block Arrangements	MMCD	W1	Typical Thrust Block Arrangements
W2a	Water Service Connection	Replaced	SS-W2	Water Service Connection
W2b	Water Service Connection	Replaced	SS-W2	Water Service Connection
W2c	Meter Installation for 19mm & 25mm Service Connections	Deleted		
W2d	Meter Installation for 38mm & 50mm Service Connections	Deleted		
W3	Gate Valve Installation	MMCD	W3	Gate Valve Installation
W4	Fire Hydrant Installation	Replaced	SS-W4	Hydrant
W5	Test Point Installation	MMCD	W5	Test Point Installation
W6	Air Valve Assemblies – 25 and 50 mm Valves	Replaced	SS-W6	Air Valve Assembly
W7	Air Valve Assembly – 100 mm Valve	Delete		
W8	Blow-Off for Water Main	Replaced	SS-W8a SS-W8b	Blow-Off (for mains 100mm & smaller) 100mm Blow-Off (for mains 150mm & larger)
W9	Blow – Down Chamber	MMCD	W9	Blow – Down Chamber
W10	Waterworks Chamber Drain	MMCD	W10	Waterworks Chamber Drain
		Added	SS-W50	Irrigation Service
		Added	SS-W51	U-Bend Detail (Pipe Crossing Conflict)

MMCD Standard Drawings		City of Kelowna Standard Drawings		
Dwg.	Title	Comment	Dwg.	Title
	CONCRETE AND MISCELLANEOUS DETAILS			
C1	Concrete Sidewalk, Infill and Barrier Curb	MMCD	C1	Concrete Sidewalk, Infill and Barrier Curb
C2	Concrete Sidewalk and Barrier Curb	MMCD	C2	Concrete Sidewalk and Barrier Curb
C3	Concrete Sidewalk and Roll-Over Curb	MMCD	C3	Concrete Sidewalk and Roll-Over Curb
C4	Concrete Curbs – Narrow Base	MMCD	C4	Concrete Curbs – Narrow Base
C5	Concrete Curbs – Wide Base	MMCD	C5	Concrete Curbs – Wide Base
C6	Concrete Median Curb and Interim Curbs	Replaced	SS-C6	Concrete Median Curb and Interim Curbs
C7	Driveway Crossing for Barrier Curbs	Replaced	SS-C7	Driveway Crossing for Barrier Curbs
C8	Wheelchair Ramp for Sidewalk, Infill and Barrier Curbs	MMCD	C8	Wheelchair Ramp for Sidewalk, Infill and Barrier Curbs
C9	Wheelchair Ramp for Sidewalk and Barrier Curbs	MMCD	C9	Wheelchair Ramp for Sidewalk and Barrier Curbs
C10	Concrete Walkway	Replaced	SS-R28	Walkway Gate
C11	Bicycle Baffle	Replaced	SS-R28	Walkway Gate
C12	Removable Restriction Post	Replaced	SS-R28	Walkway Gate
C13	Chain Link Fence for Walkway	MMCD	C13	Chain Link Fence for Walkway
C14	Handrail on Concrete Retaining Wall	MMCD	C14	Handrail on Concrete Retaining Wall
			SS-C50	Concrete Island Ramp
	ROAD WORKS			
R1	Paved Shoulders	MMCD	R1	Paved Shoulders
		Added	SS-R2	Lanes and Emergency and Private Access Roads
		Added	SS-R3	Local – Class 1 (18 m)
		Added	SS-R4	Local – Class 2 (15 m)
		Added	SS-R5	Collector – Class 1 (20 m)
		Added	SS-R6	Collector – Class 1 with Bike Lanes (22 m)
		Added	SS-R7	Collector – Class 2 (18 m)

MMCD Standard Drawings		City of Kelowna Standard Drawings		
Dwg.	Title	Comment	Dwg.	Title
	ROAD WORKS (Cont'd)			
		Added	SS-R8	Arterial – Class 1 Parkway, 4(6) Lanes (35 m)
		Added	SS-R9	Arterial – Class 1 Parkway, 2(4) Lanes (30 m)
		Added	SS-R10	Arterial – Class 1 Rural, 2(4) Lanes (30 m)
		Added	SS-R11	Arterial – Class 2 Residential, 4 Lanes (30 m)
		Added	SS-R12	Arterial – Class 2 Residential, One Way – 3 lanes (20 m)
		Added	SS-R13	Arterial – Class 2 Rural, 2 lane (20 m)
		Added	SS-R14	Arterial – Class 3 Town Centre 4 Lane (28 m)
		Added	SS-R15	Arterial – Class 3 Town Centre, One Way – 3 lanes (25 m)
		Added	SS-R16	Arterial – Class 3 – 2 lane (28 m)
		Added	SS-R17	Local Residential Cul-de-sac (15 m)
		Added	SS-R20	Left Turn Lane (Raised Median)
		Added	SS-R21	Left Turn Lane (Painted) and Two-Way Left Turn Lane
		Added	SS-R22	Curbed Driveway Widths
		Added	SS-R23	Concrete Drainage Swale Across Asphalt
		Added	SS-R24	Density Payment Adjustment Chart
		Added	SS-R25	Noise Mitigation Criteria
		Added	SS-R26	Hydrants and Poles Near Ditches
		Added	SS-R27	Street Name and Stop Sign Standard
		Added	SS-R28	Walkway Gate
		Added	SS-H1	Arterial Condition –A (Village Parkway)
		Added	SS-H2	Arterial Condition B (With 0.8 km Walking Distance of Village
		Added	SS-H3	Arterial Condition C (Greater than 0.8 km Walking Distance of Village)
		Added	SS-H4	Village Collector Condition A (Retail/M.F. Fronting)
		Added	SS-H5	Village Collector Condition B (No Retail Fronting)
		Added	SS-H6	Collection Condition A (Development Both Sides)
		Added	SS-H7	Collector Condition B (Development One Side)
		Added	SS-H8	Collector Condition C – (No Development Either Side)

MMCD Standard Drawings		City of Kelowna Standard Drawings		
Dwg.	Title	Comment	Dwg.	Title
	ROAD WORKS (Cont'd)			
		Added	SS-H9	Minor Collector Condition A
		Added	SS-H10	Minor Collector Condition B
		Added	SS-H11	Village Local – Residential
		Added	SS-H12	Local Condition A (Development Both Sides)
		Added	SS-H13	Local Condition B (Development One Side)
		Added	SS-H14	Local Condition C (No Development Either Side)
		Added	SS-H15	Public Lane
	ELECTRICAL AND TRAFFIC SIGNAL DETAILS			*(Future Amendment – Refer to Utility)*

STANDARD DETAIL DRAWINGS



CROSS SECTION

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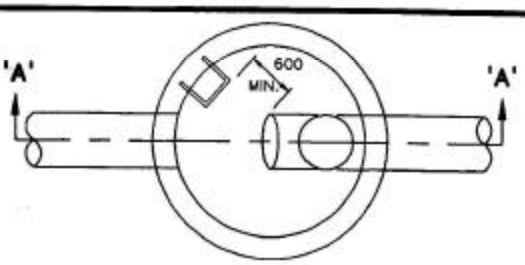
PAVEMENT RESTORATION

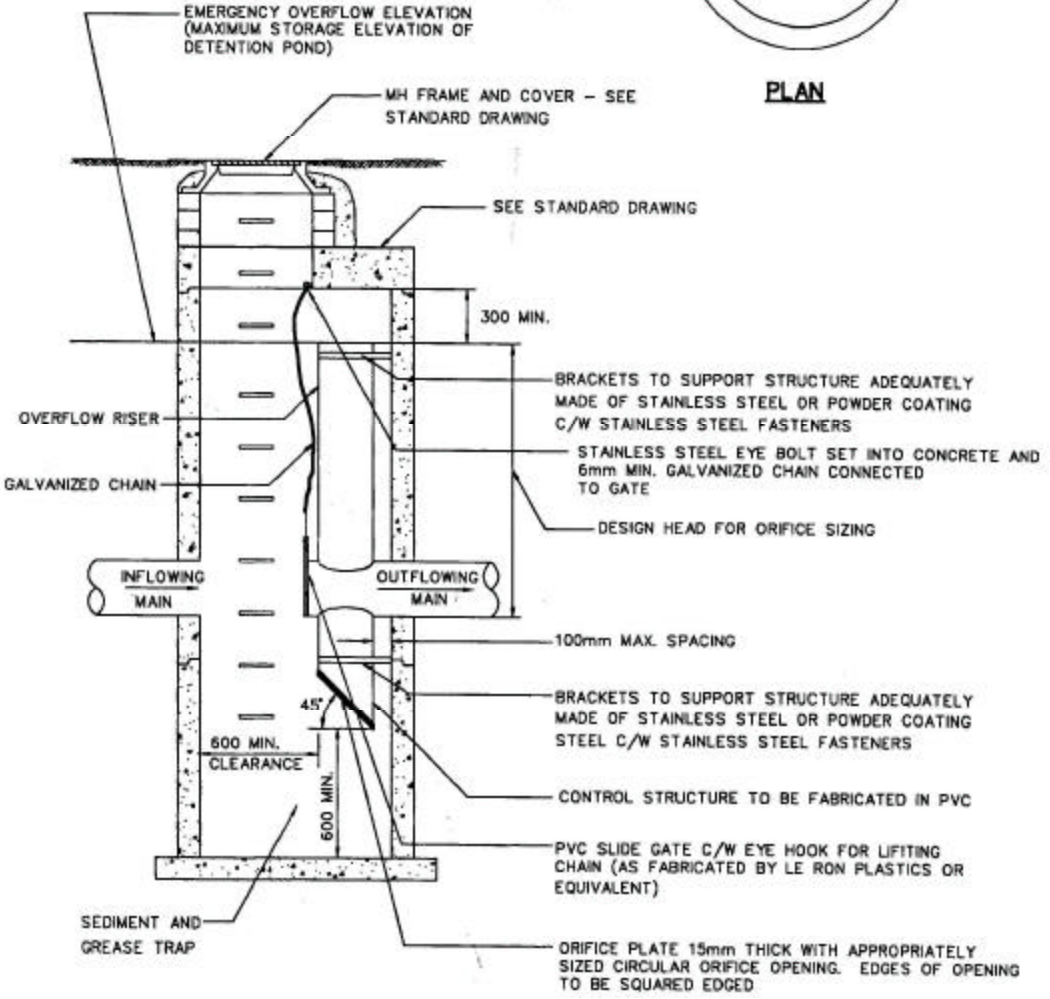
REV: JAN.29/01 DATE: OCT.12/01

SS-G5

STANDARD DETAIL DRAWINGS



PLAN



SECTION 'A – A'

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES.

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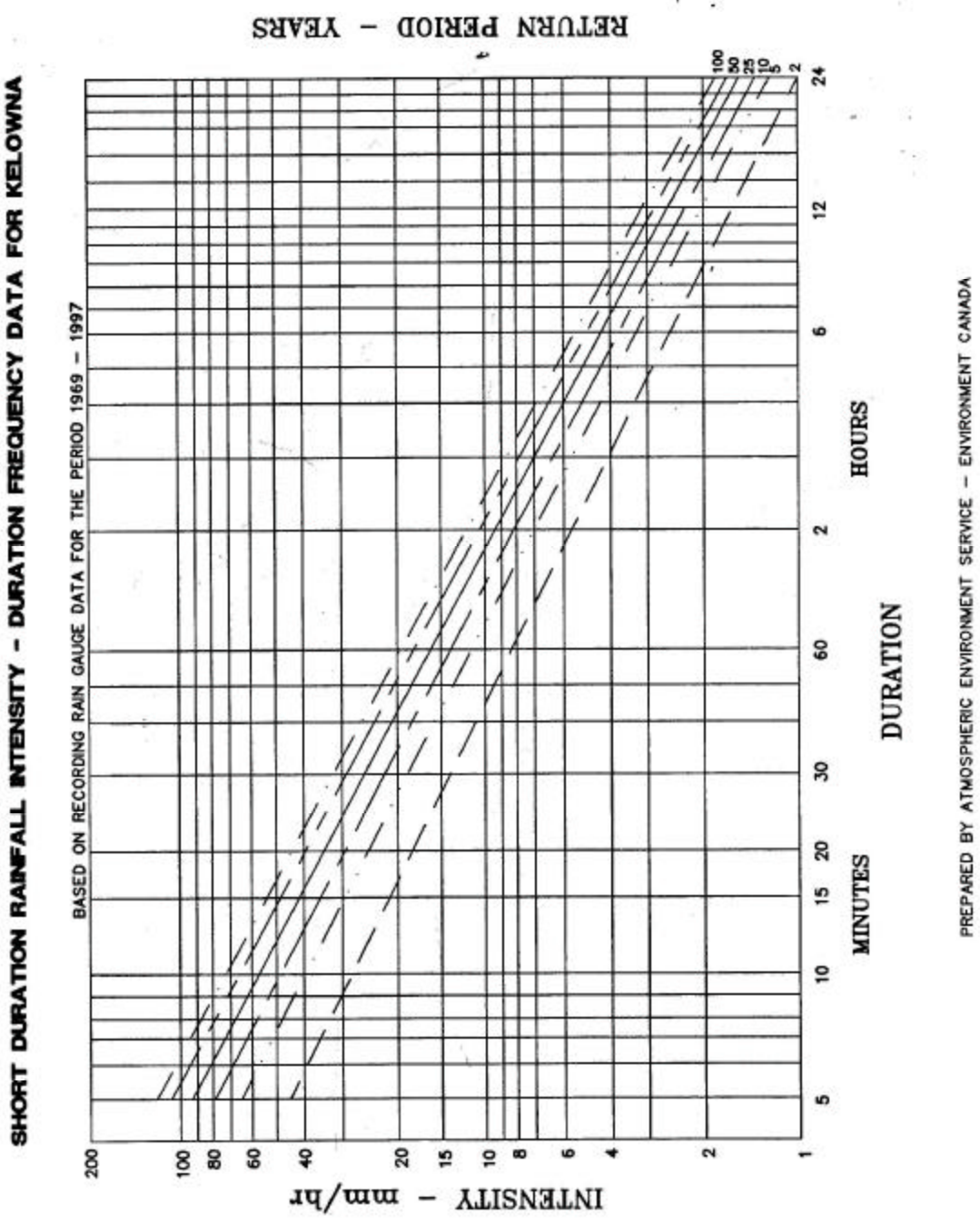
FLOW CONTROL CHAMBER (WITH SEDIMENT & GREASE TRAP)

DATE: MAY08/02

SS-S55

STANDARD DETAIL DRAWINGS



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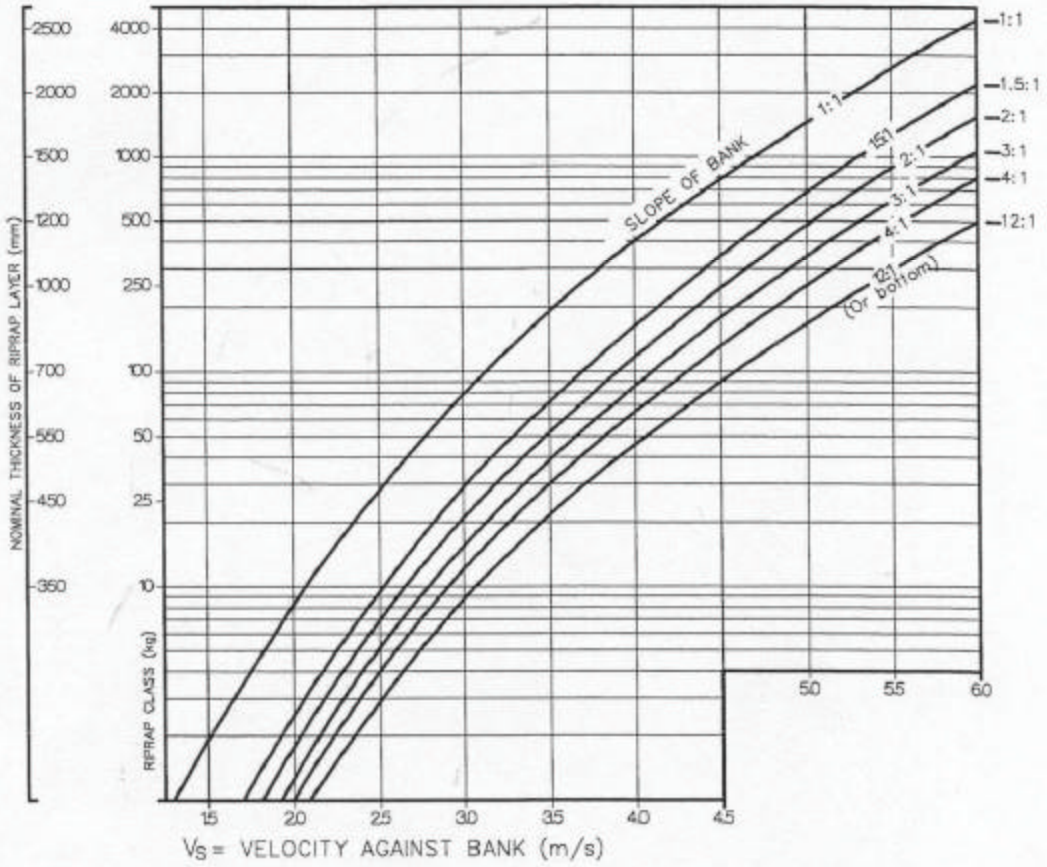
IDF CURVES

DATE: MAY08/02

SS-S56

STANDARD DETAIL DRAWINGS



SIZE OF ROCK AND THICKNESS OF PROTECTION BLANKET THAT WILL RESIST DISPLACEMENT FOR VARIOUS VELOCITIES AND BANKSIDE SLOPES.

Notes:

1. Adapted from report of Sub-committee on slope protection, Am. Soc. Civil Engineers Proc. June 1948.
2. Density of stone assumed at 2,640 kg/m .
3. Enter graph at known velocity to intersection with desired slope curve. Move horizontally to required riprap class and thickness.
4. V_M = mean stream velocity.
5. For parallel flow along tangent bank; $V_S = 2/3\ V_M$
6. For impinging flow against curved bank; $V_S = 4/3\ V_M$
7. For direct impingement on the bank; $V_S = 2_M V$
8. The riprap class No. is the mass (kg) of the 50% rock size (i.e., at least half of the riprap must be heavier than its class mass).
9. Do not interpolate between riprap classes. Use the next highest class.

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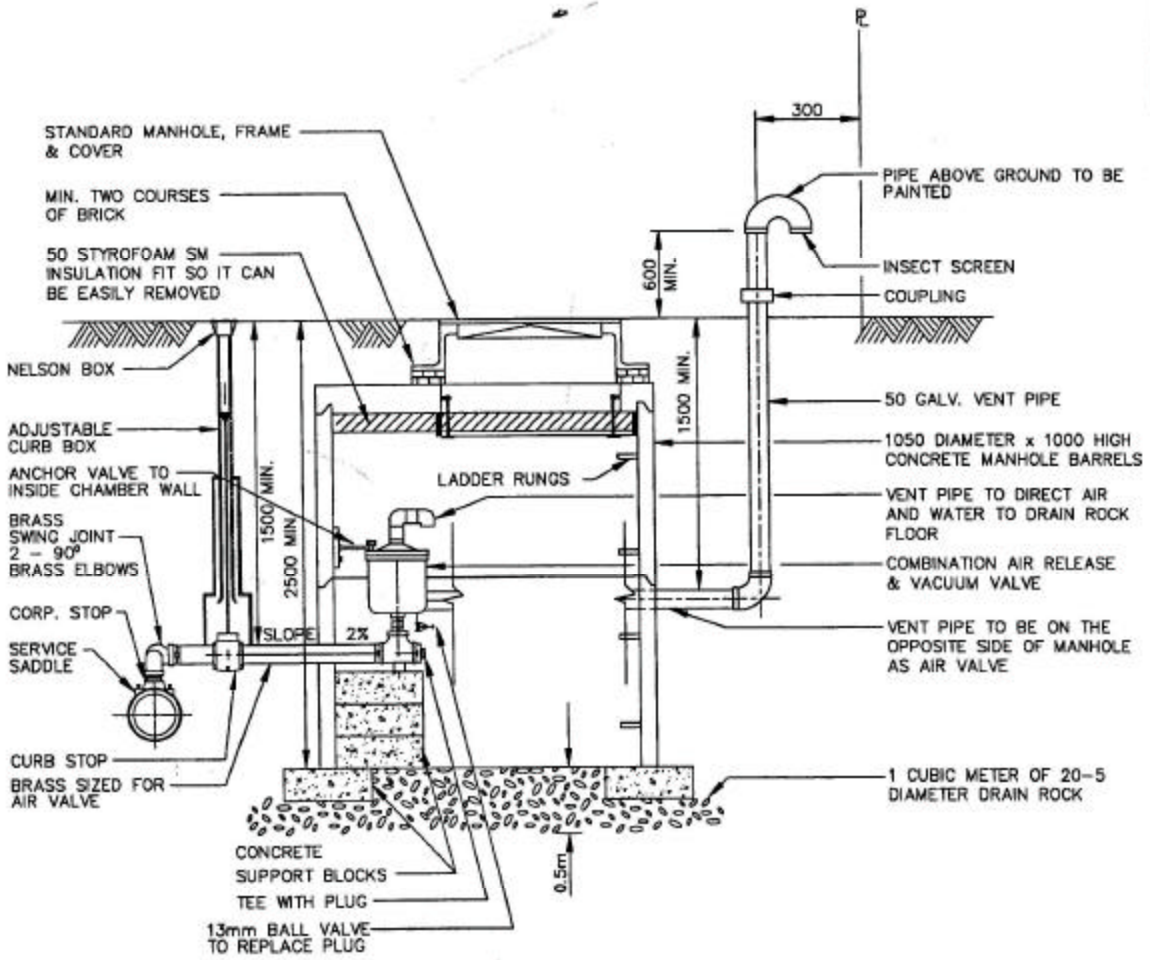
RIPRAP DESIGN CHART

DATE: MAY08/02

SS-S57

STANDARD DETAIL DRAWINGS



NOTES:

1. AIR VALVE ASSEMBLY IS FOR 25 OR 50 AIR VALVES.
1. ALL DIMENSIONS IN MILLIMETERS.

AIR VALVE ASSEMBLY

REV: MAY 31/01

SS-W6

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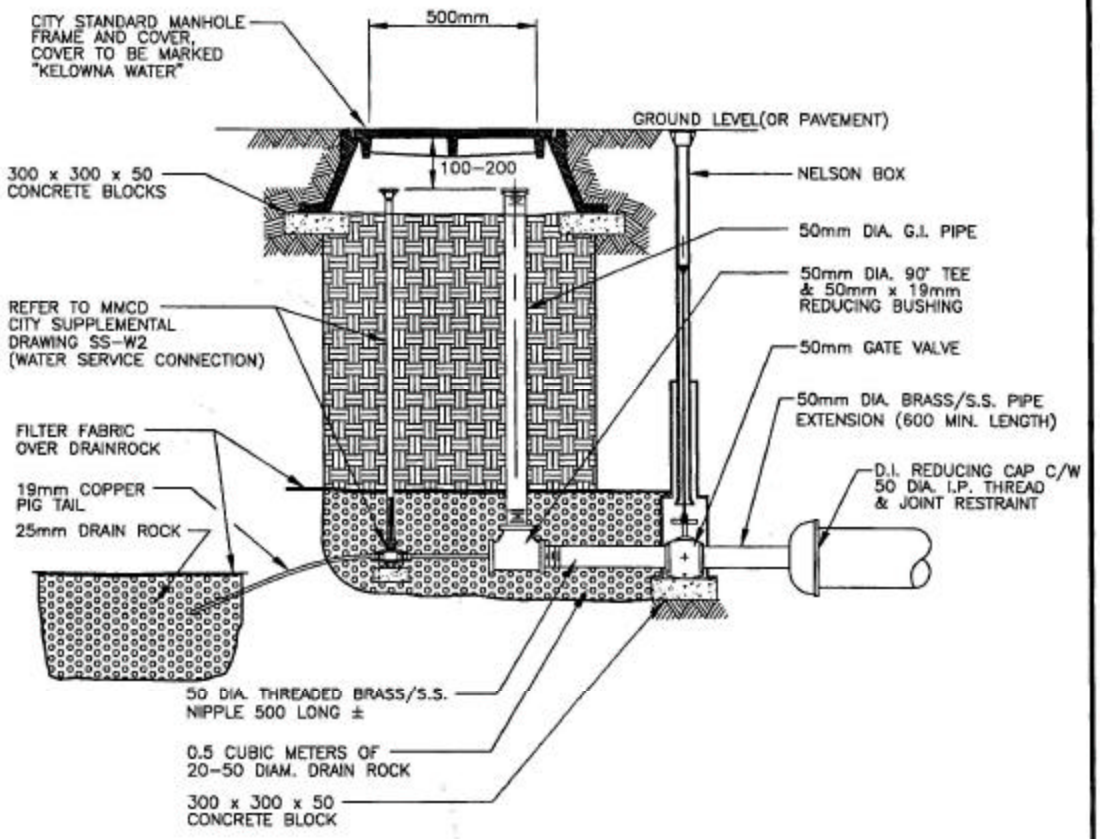
STANDARD DETAIL DRAWINGS



NOTES:

1. SIZE BLOW-OFF ASSEMBLY TO ACHIEVE SPECIFIED MAIN FLUSHING VELOCITY.

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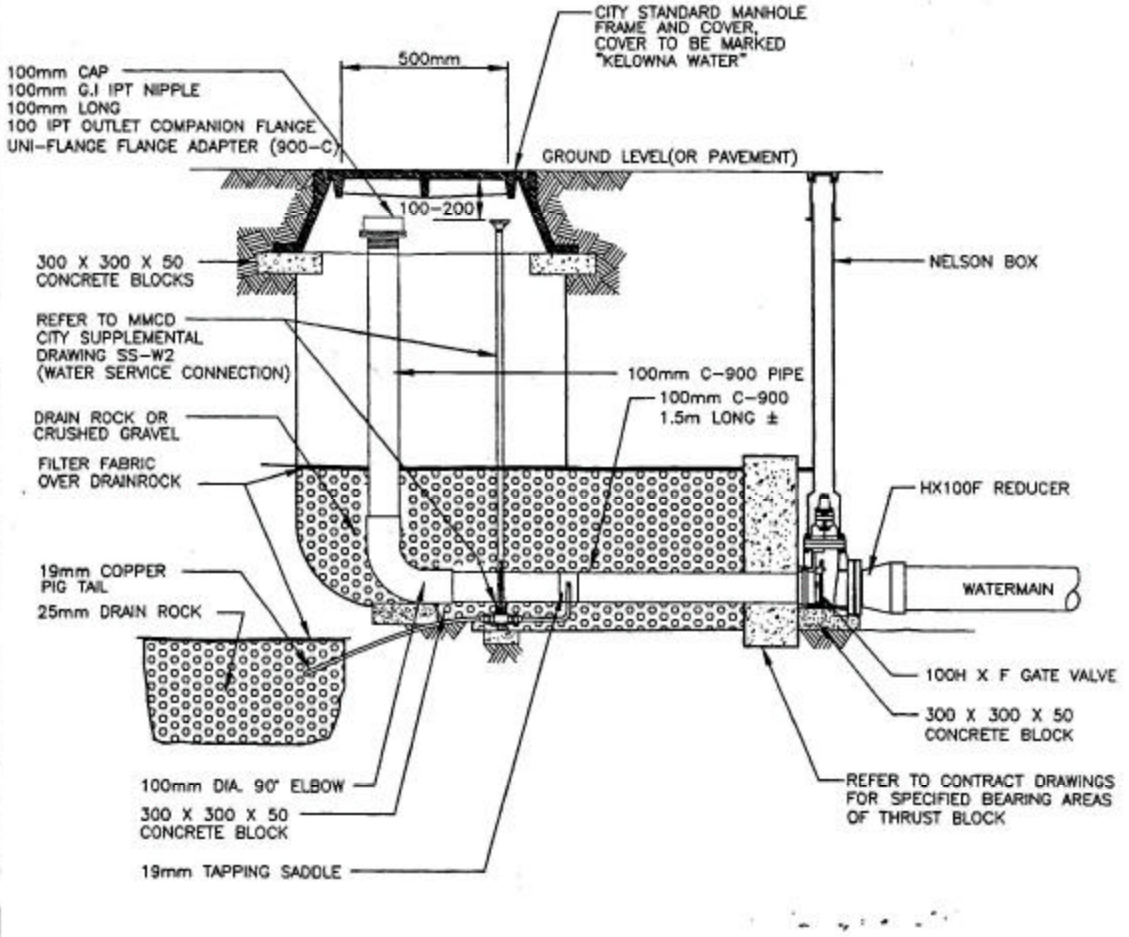
50mm BLOW-OFF

(FOR MAINS 100mm & SMALLER)

REV: FEB.26/01

SS-W8a

STANDARD DETAIL DRAWINGS



NOTES:

1. JOINT RESTRAINT BETWEEN WATERMAIN AND TOP OF 100MM PVC RISER.
2. ALL JOINT RESTRAINERS TO BE APPROVED AS PER POLICY 266 IN THE CITY OF KELOWNA SUBDIVISION AND SERVICING BYLAW.
3. ALL JOINTS TO BE RESTRAINED AS PER MMCD 02666, 2.2.13 AND THE CITY OF KELOWNA SUBDIVISION AND SERVICING BYLAW SCHEDULE 4 WATER, SECTION 1.13, AND/OR AS SPECIFIED IN THE CONTRACT DOCUMENTS OR DRAWINGS.

100mm BLOW-OFF

(FOR MAINS 150mm & LARGER)

REV: NOV. 02/01

SS-W8b

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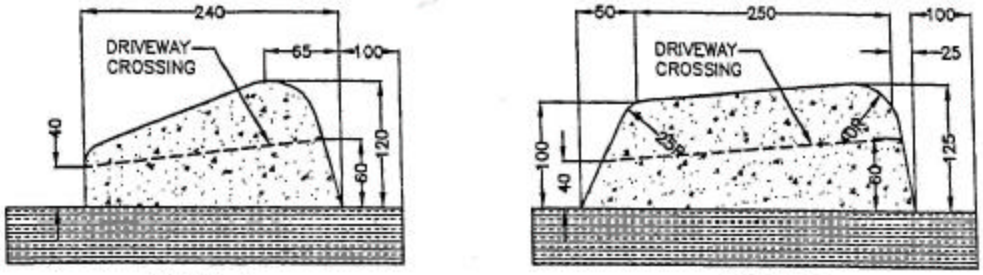
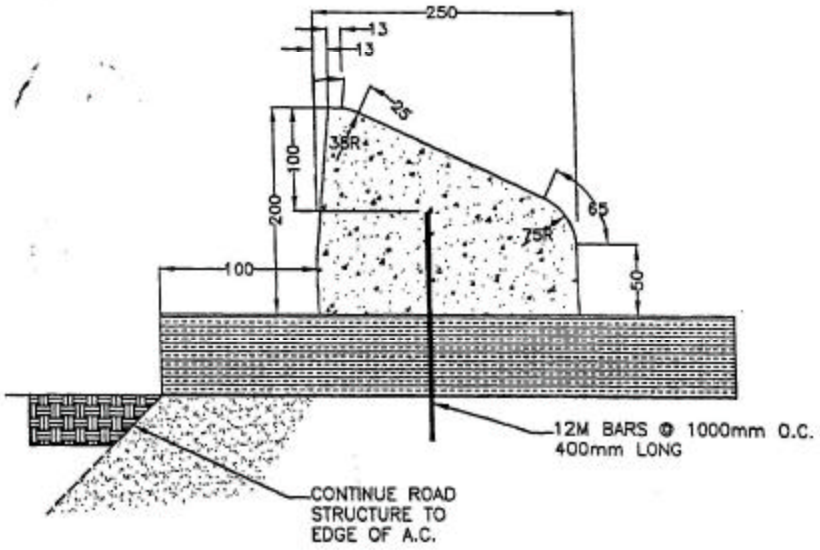
STANDARD DETAIL DRAWINGS



STYLE 1 STYLE 2

INTERIM CURBS



MEDIAN CURB

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED

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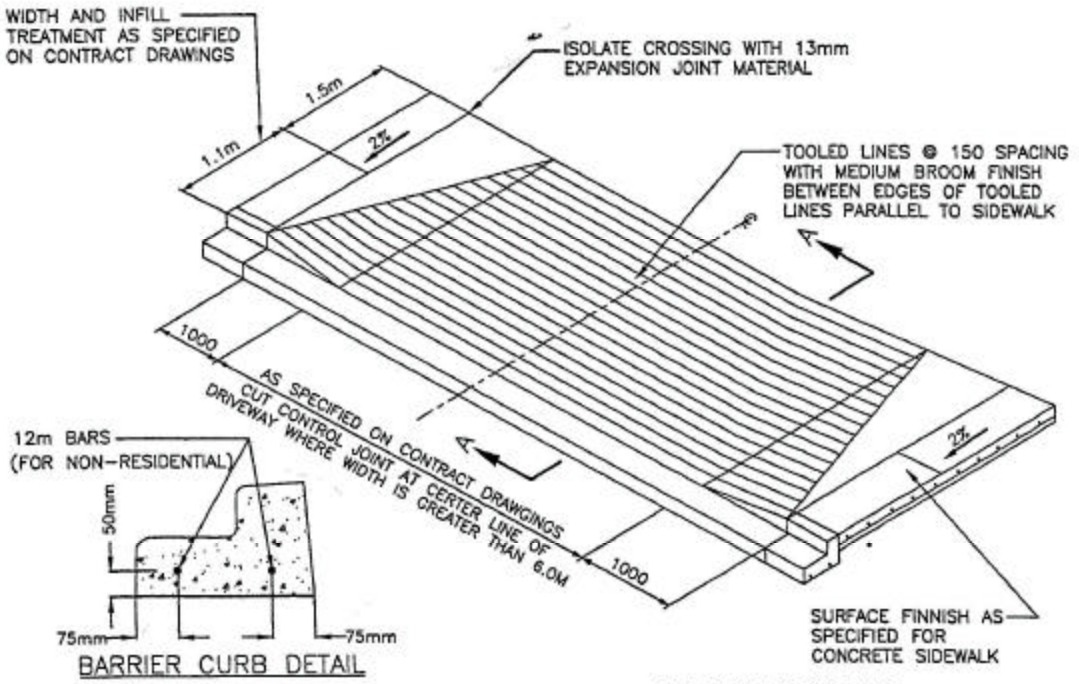
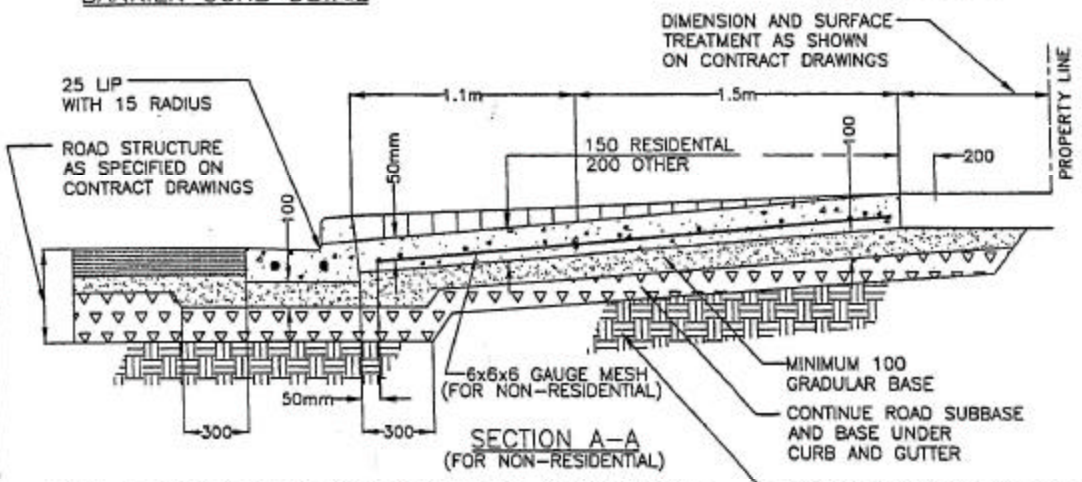
CONTRETE MEDIAN CURB AND INTERIM CURBS	SS-C6
DATE: OCT.16/01	

STANDARD DETAIL DRAWINGS



BARRIER CURB DETAIL



SECTION A–A
(FOR NON-RESIDENTIAL)

NOTE: 1. DRIVEWAYS ORIENTATED AT 90° TO CURB, UNLESS SPECIFIED OTHERWISE ON CONTRACT DRAWINGS
2. REFER TO CONTRACT DRAWINGS AND SECTION 02523 FOR DETAILED SPECIFICATIONS.

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED

H:\WU\DRAFTING\STD-DWGS\MCD\SS-C7

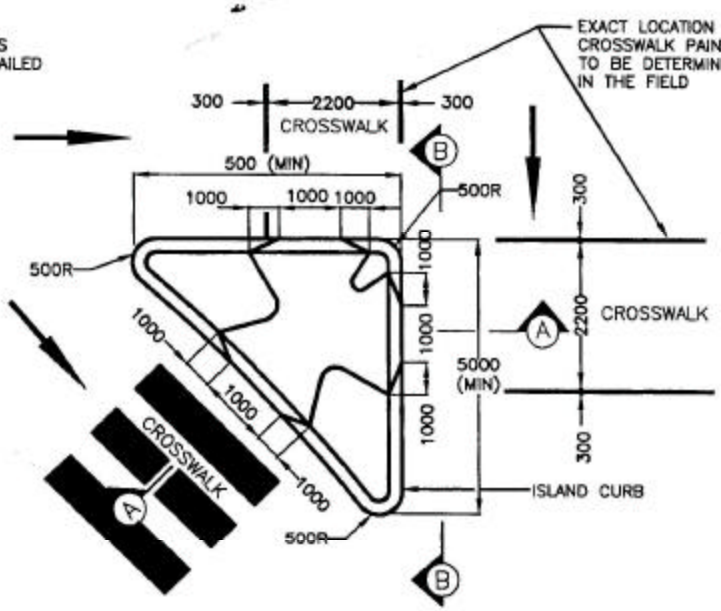
DRIVEWAY CROSSING FOR BARRIER CURBS

DATE: NOV.26/01

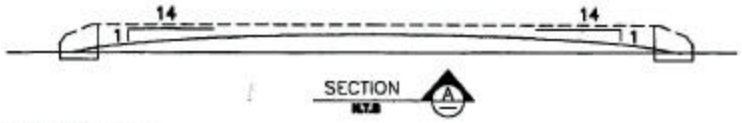
SS-C7

STANDARD DETAIL DRAWINGS

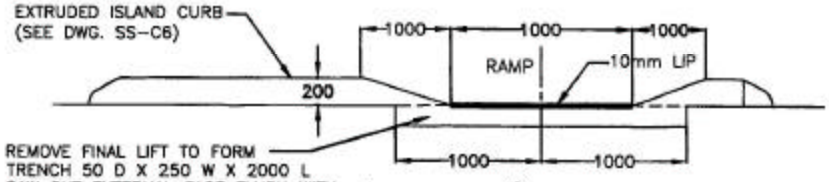
NOTE:
REFER TO CONTRACT DRAWINGS AND SECTION 02523 FOR DETAILED SPECIFICATIONS.



PLAN

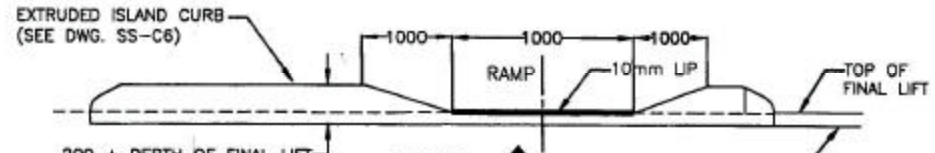


SECTION A



SECTION B

AFTER FINAL LIFT



SECTION B

BEFORE FINAL LIFT

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS OTHERWISE NOTED

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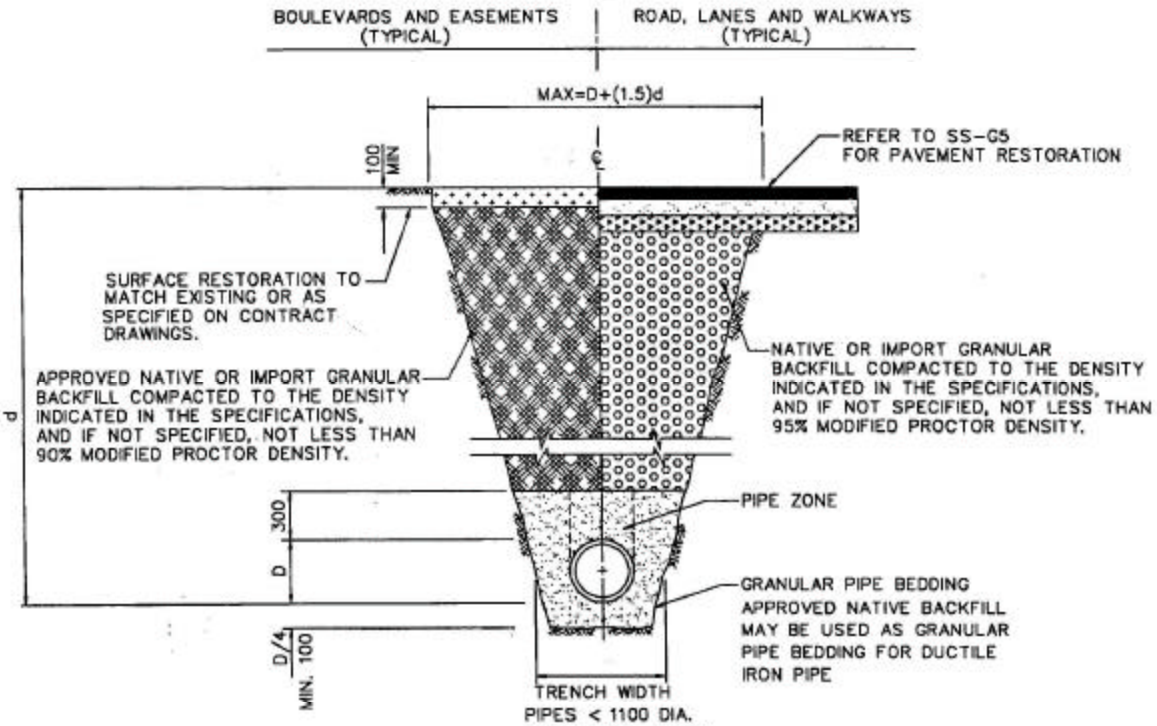
CONTRETE ISLAND RAMP

DATE: OCT.16/01

SS-C50

STANDARD DETAIL DRAWINGS



NOTE:
1. TRENCHING TO COMPLY WITH ALL REQUIREMENTS OF THE WORKERS COMPENSATION BOARD.
2. REFER TO CONTRACT DRAWINGS AND SECTION 02223 FOR DETAILED SPECIFICATIONS.

MAY 09/02

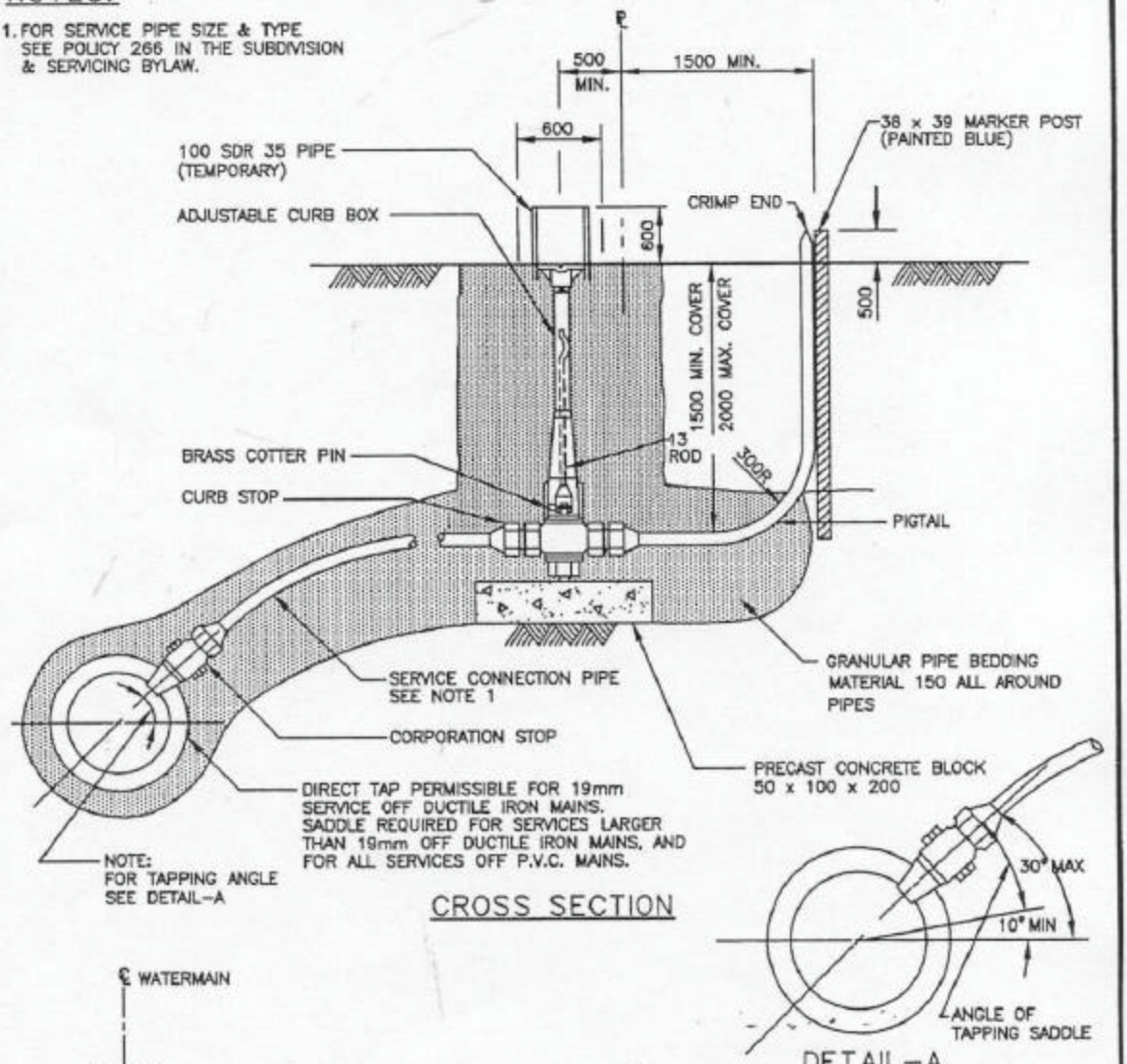
UTILITY TRENCH

SS-G4

STANDARD DETAIL DRAWINGS

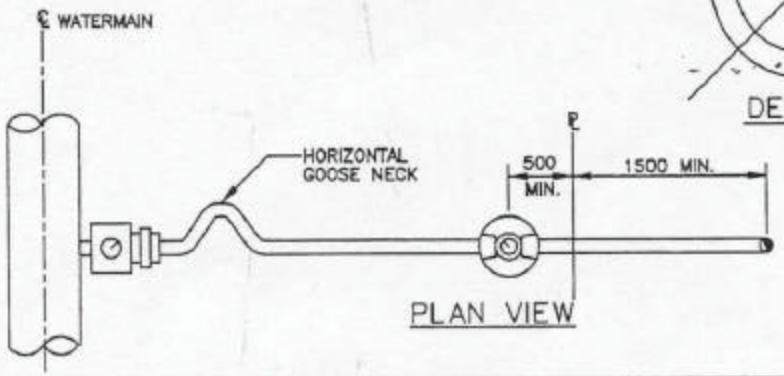
NOTES:

1. FOR SERVICE PIPE SIZE & TYPE SEE POLICY 266 IN THE SUBDIVISION & SERVICING BYLAW.



CROSS SECTION

DETAIL-A
N.T.S.



PLAN VIEW

H:\WU\DRAFTING\STD-DWGS\MMCD\SS-W2

WATER SERVICE CONNECTION

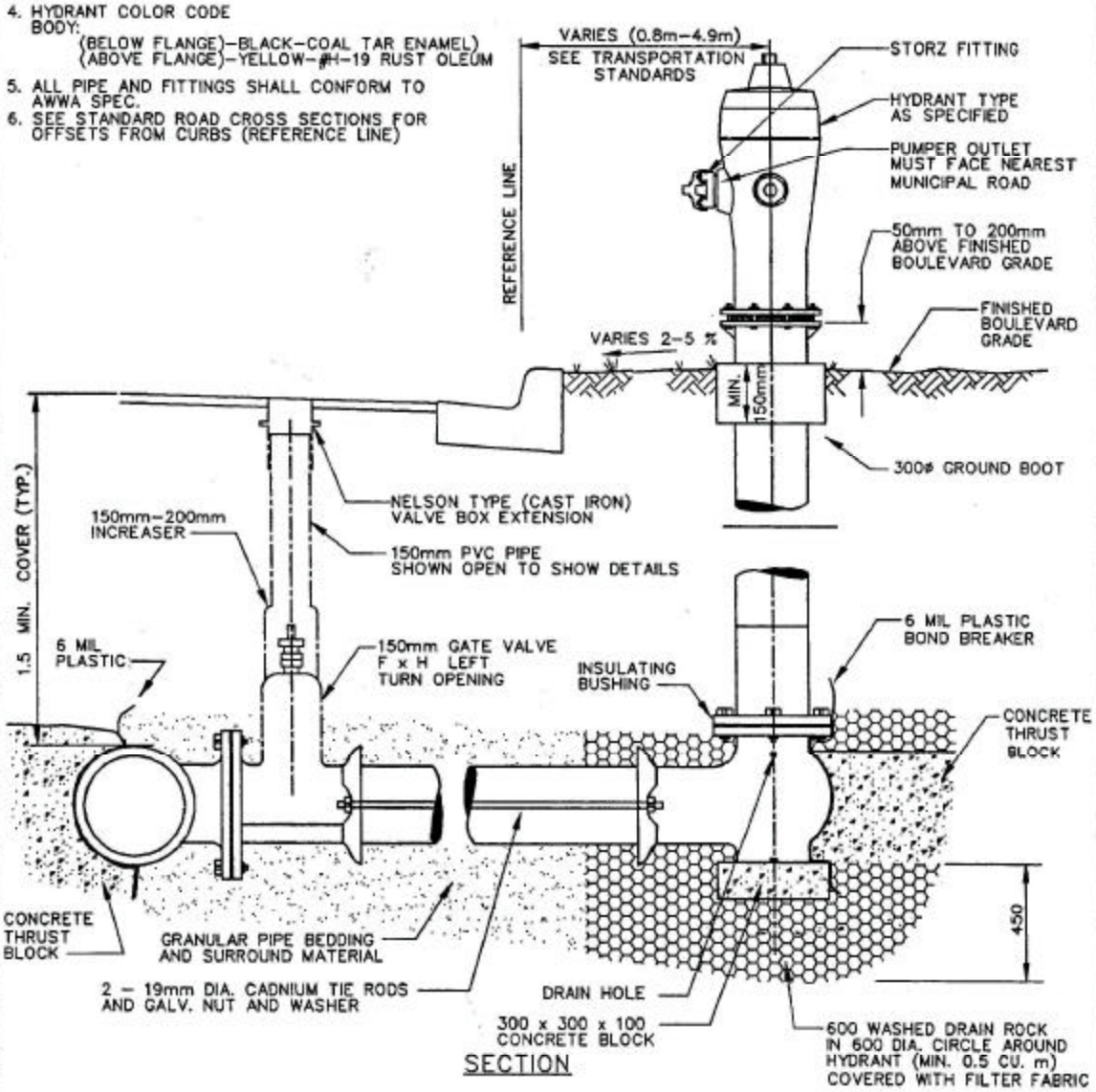
SS-W2

REV: JAN.29/01 DATE: NOV. 14/01

STANDARD DETAIL DRAWINGS

NOTES:

1. HYDRANTS – IN ACCORDANCE WITH APPROVED PRODUCTS LIST.
2. HYDRANTS SHALL HAVE 2 – 63.5mm OUTLETS B.C. STANDARD
   1 – 100mm PUMPER OUTLET WITH STORZ FITTING
3. ALL HYDRANTS TO HAVE 300ø GROUND BOOT
4. HYDRANT COLOR CODE
   BODY:
   (BELOW FLANGE)–BLACK–COAL TAR ENAMEL)
   (ABOVE FLANGE)–YELLOW–#H–19 RUST OLEUM
5. ALL PIPE AND FITTINGS SHALL CONFORM TO AWWA SPEC.
6. SEE STANDARD ROAD CROSS SECTIONS FOR OFFSETS FROM CURBS (REFERENCE LINE)



SECTION

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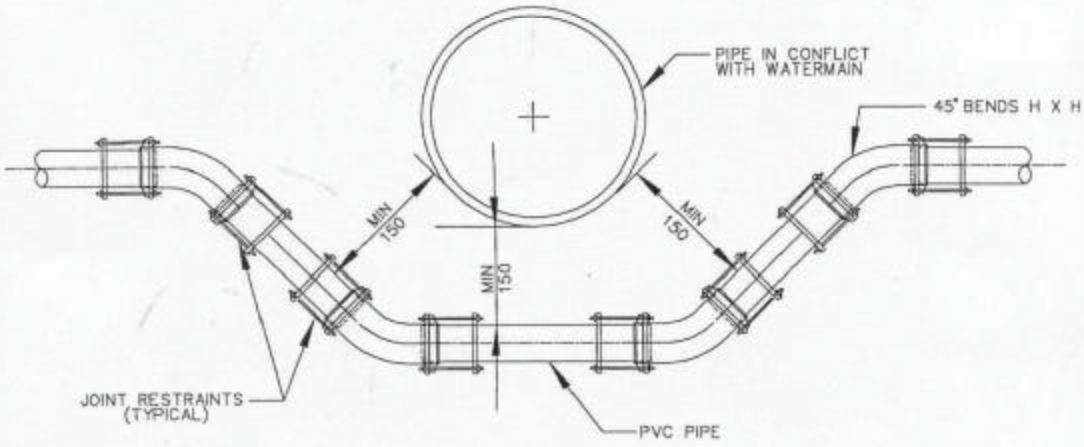
HYDRANT

NOV. 17/00

SS–W4

STANDARD DETAIL DRAWINGS



TYPICAL SECTION

NOTES:

1. ALL JOINT RESTRAINERS TO BE APPROVED AS PER POLICY 266 IN THE CITY OF KELOWNA SUBDIVISION AND SERVICING BYLAW.
2. ALL JOINTS TO BE RESTRAINED AS PER MMCD 02666, 2.2.13 AND THE CITY OF KELOWNA SUBDIVISION AND SERVICING BYLAW SCHEDULE 4 WATER, SECTION 1.13, AND/OR AS SPECIFIED IN THE CONTRACT DOCUMENTS OR DRAWINGS.

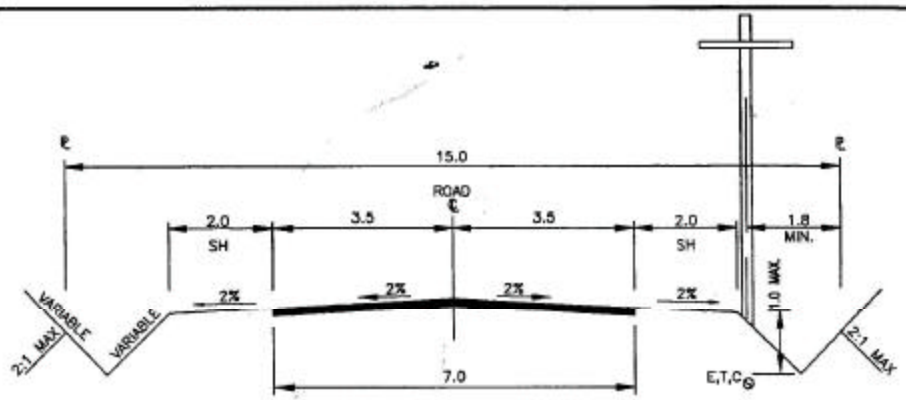
\WU\DRAFTING\STD-DWGS\MMCD-STD\SS-W51.dwg

U-BEND DETAIL
(PIPE CROSSING CONFLICT)

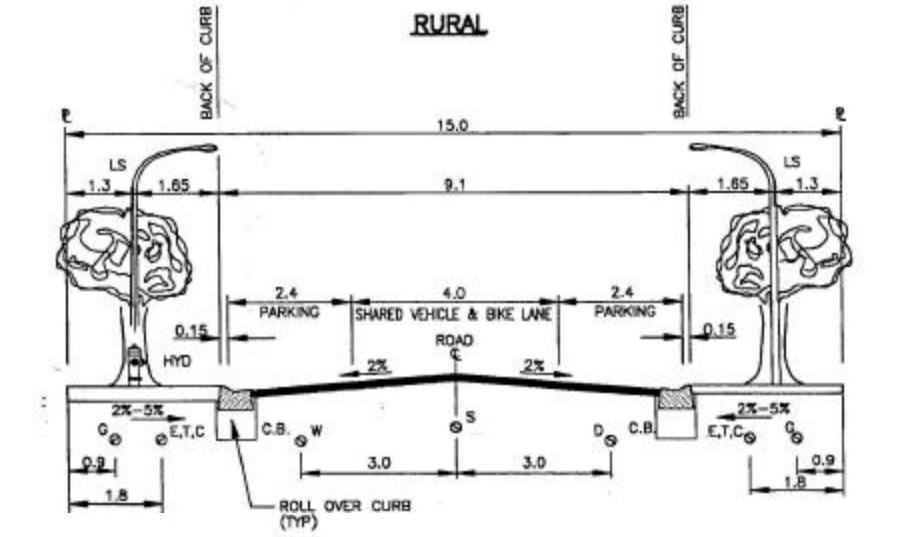
REV. SEPT. 27/01

SS-W51

STANDARD DETAIL DRAWINGS



RURAL



URBAN

LEGEND

T	–	TELEPHONE
G	–	GAS
E	–	ELECTRICAL (PRIMARY) / (SECONDARY)
C	–	CABLE T.V.
W	–	WATER
S	–	SANITARY SEWER
D	–	STORM DRAIN

MIN. DEPTH=760mm
MAX. DEPTH=1210mm

HYD	–	HYDRANT
℄	–	PROPERTY LINE
R/W	–	RIGHT OF WAY
SW	–	SIDEWALK
C.B.	–	CATCH BASIN
LS	–	LIGHT STANDARD
SH	–	SHOULDER

NOTES:

1. THE CITY ENGINEER MAY REQUIRE SPECIAL PROVISIONS FOR:
   a. CUT AND FILL SLOPES.
   b. DRAINAGE ON RURAL CROSS SECTION.
2. ALL UTILITIES SHALL BE INSTALLED TO ACCOMODATE ULTIMATE ROAD AND DRIVEWAY LOCATIONS WHERE POSSIBLE.

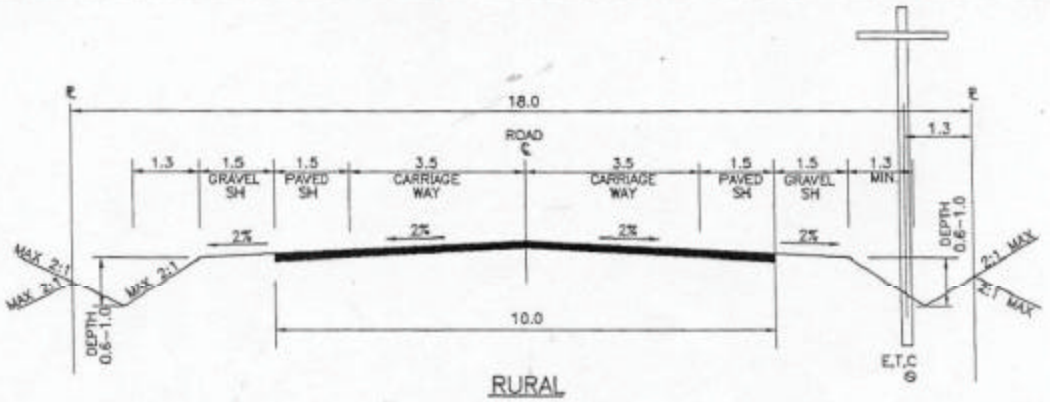
H:\WU\DRAFTING\STD-DWGS\MMCD\SS-R4

LOCAL–CLASS 2 (15M)

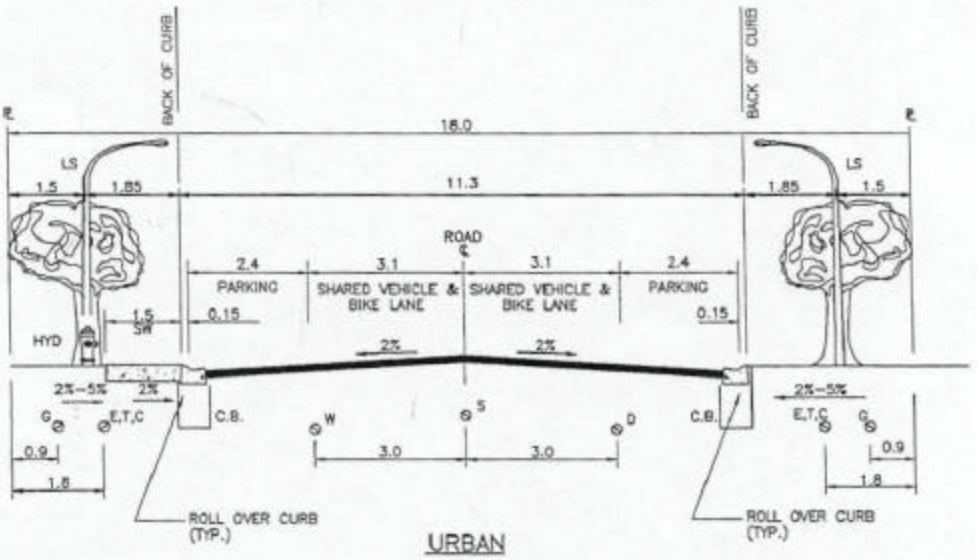
DATE: APRIL 08/02

SS–R4

STANDARD DETAIL DRAWINGS



RURAL



URBAN

LEGEND

T	–	TELEPHONE
G	–	GAS
E	–	ELECTRICAL (PRIMARY) (SECONDARY)
C	–	CABLE T.V.
W	–	WATER
S	–	SANITARY SEWER
D	–	STORM DRAIN

MIN. DEPTH=760mm
MAX. DEPTH=1210mm

HYD	–	HYDRANT
℄	–	PROPERTY LINE
R/W	–	RIGHT OF WAY
SW	–	SIDEWALK
C.B.	–	CATCH BASIN
LS	–	LIGHT STANDARD
SH	–	SHOULDER

NOTES:

1. THE CITY ENGINEER MAY REQUIRE SPECIAL PROVISIONS FOR:
   a. CUT AND FILL SLOPES.
   b. DRAINAGE ON RURAL CROSS SECTION.
2. ALL UTILITIES SHALL BE INSTALLED TO ACCOMMODATE ULTIMATE ROAD AND DRIVEWAY LOCATIONS WHERE POSSIBLE.

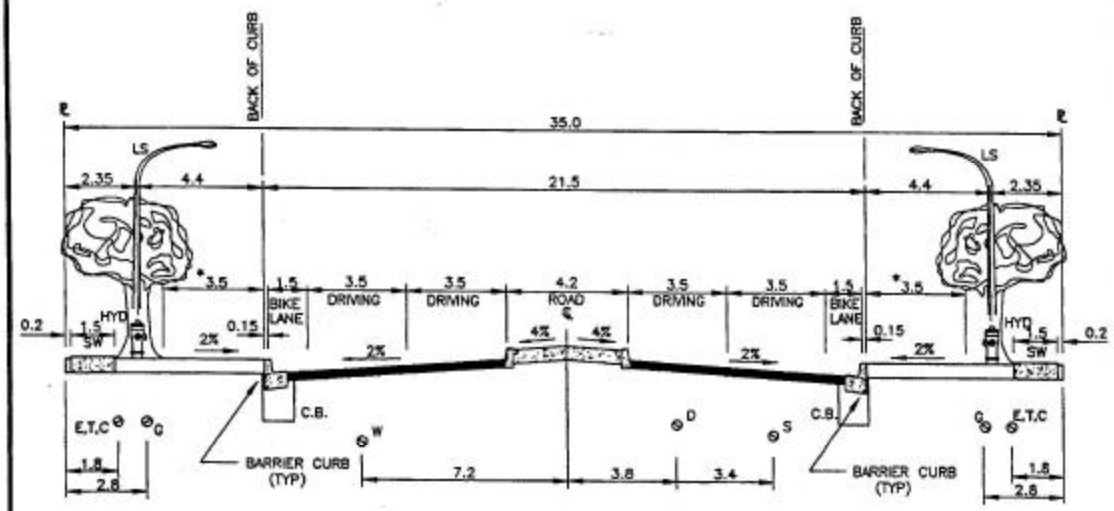
H:\WU\DRAFTING\STD-DWGS\MMCD\SS-R7

COLLECTOR-CLASS 2 (18m)

DATE: APRIL 08/02

SS-R7

STANDARD DETAIL DRAWINGS



* ALLOWANCE FOR FUTURE H.O.V. LANE

LEGEND

T	–	TELEPHONE
G	–	GAS
E	–	ELECTRICAL (PRIMARY) (SECONDARY)
C	–	CABLE T.V.
W	–	WATER
S	–	SANITARY SEWER
D	–	STORM DRAIN

MIN. DEPTH=760mm
MAX. DEPTH=1210mm

HYD	–	HYDRANT
℄	–	PROPERTY LINE
R/W	–	RIGHT OF WAY
SW	–	SIDEWALK
C.B.	–	CATCH BASIN
LS	–	LIGHT STANDARD

NOTES:

1. THE CITY ENGINEER MAY REQUIRE SPECIAL PROVISIONS FOR CUT AND FILL SLOPES.
2. ALL UTILITIES SHALL BE INSTALLED TO ACCOMMODATE ULTIMATE ROAD AND DRIVEWAY LOCATIONS WHERE POSSIBLE.

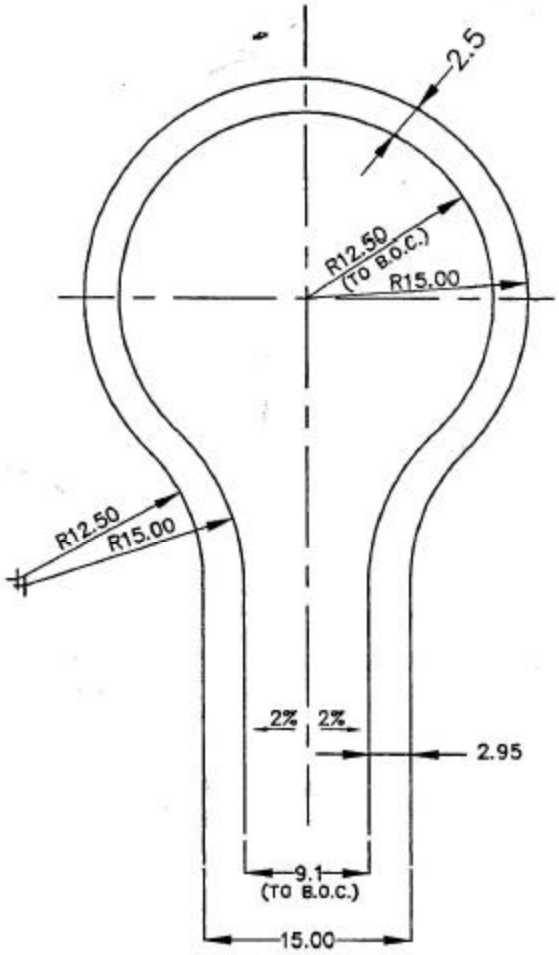
WU\DRAFTING\STD-DWGS\WMCD-STD\SS-R8

ARTERIAL–CLASS 1 PARKWAY, 4(6) LANES (35M)

DATE: APRIL 08/02

SS–R8

STANDARD DETAIL DRAWINGS



LEGEND

T	–	TELEPHONE
G	–	GAS
E	–	ELECTRICAL (PRIMARY) / (SECONDARY)
C	–	CABLE T.V.
W	–	WATER
S	–	SANITARY SEWER
D	–	STORM DRAIN
HYD	–	HYDRANT
P.L.	–	PROPERTY LINE
R/W	–	RIGHT OF WAY
SW	–	SIDEWALK
C.B.	–	CATCH BASIN
LS	–	LIGHT STANDARD

MIN. DEPTH=760mm
MAX. DEPTH=1210mm

NOTES:

1. THE CITY ENGINEER MAY REQUIRE SPECIAL PROVISIONS FOR CUT AND FILL SLOPES.
2. ALL UTILITIES SHALL BE INSTALLED TO ACCOMMODATE ULTIMATE ROAD AND DRIVEWAY LOCATIONS WHERE POSSIBLE.
3. CUL-DE-SAC TO HAVE LONGITUDIONAL DRAINAGE OF A MINIMUM 0.5%.

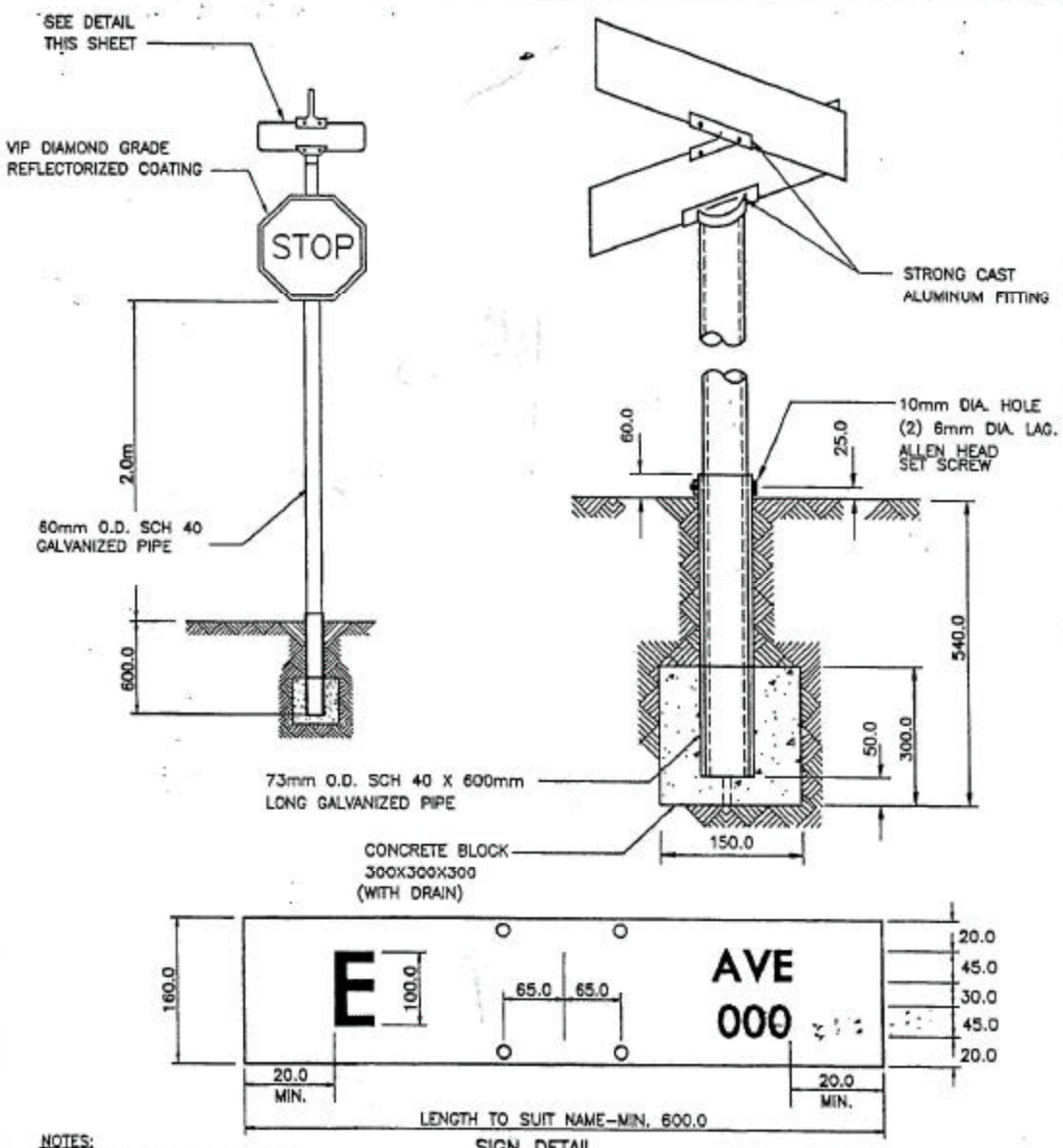
H:\WU\DRAFTING\STD-DWGS\WMCD\SS-R17

LOCAL – RESIDENTIAL CUL-DE-SAC (15m)

DATE: MAY08/02

SS-R17

STANDARD DETAIL DRAWINGS



SIGN DETAIL

NOTES:

1. STREET NAME SIGNS TO BE:
   a) WHITE REFLECTORIZED LETTERING ON BLUE BACKGROUND.
   b) LETTERING ON BOTH SIDES, HIGHWAY GOTHIC MEDIUM FONT.
   c) SIGNS ARE TO BE 5052-H32, .025(1/8") FLAT ALUMINUM
2. SIGNS TO CONFORM TO LATEST ISSUE OF UNIFORM TRAFFIC CONTROL DEVICES FOR CANADA.

APRIL/2002

STREET NAME AND STOP SIGN STANDARD

SS-R27