

SCHEDULE 5 - STORM WATER MANAGEMENT

- 5.1. Storm Water Management General
 - 5.1.1. SD-1 illustrates the major water courses within the City of Langford. Existing major storm water control and/or treatment areas are shown. These areas are to be preserved unless professional storm water management studies indicate otherwise. The areas of the municipality where storm water infiltration and storm water detention (storage) are required for development are also shown on SD-1.
 - 5.1.2. For all subdivisions and developments in all areas of the City of Langford, drainage structures and features are required that will maintain the quality of site drainage water, minimize erosion and retain sediments.
 - 5.1.3. In the infiltration areas, the sandy and gravelly soils have high infiltration potential and surface drainage conveyance structures are limited, therefore the primary means of storm water discharge will be by infiltration.
 - 5.1.4. In the detention areas, storm water storage is required to control post development storm water release rates. Storm water storage may also be used in other (non-detention) areas as an alternative to upgrading downstream conveyance capacity if analysis shows capacity to be inadequate for the design flows. Except where infiltration is required and achievable, a municipal storm drain is required to serve each existing and newly created lot.
 - 5.1.5. Where parkland in excess of 0.25 ha has been dedicated to the City in conjunction with the proposed subdivision or development, storm water detention and treatment facilities may be located within the park, if in the opinion of the City Engineer the treatment and detention area will not detract from the aesthetics of the park and will not affect environmentally sensitive areas within the park and the usefulness to and safety of the public.
 - 5.1.6. If, in the opinion of the City Engineer, a community detention area for future developments within a specific storm drainage catchment area would be preferable to permanent on site storage facilities, then permanent storage and treatment areas on site may not be required. The developer shall provide land dedication or cash in lieu of this community detention area (by DCC or otherwise) and shall provide temporary facilities and the infrastructure to direct storm water to those future detention areas in accordance with this bylaw. Any lands required for the temporary facilities shall have a right-of-way in favour of the City of Langford for storm drainage which may expire when the community detention area is constructed.

- 5.1.7. For subdivisions and developments of areas greater than 1.0 hectare (ha) in size (Large Sites) a storm water management plan prepared by a Professional Engineer is required which will show:
 - 5.1.7.1 Scaled topographic site plan with existing cadastral and proposed development layout
 - 5.1.7.2 Drainage catchment areas showing contributory area to the site, onsite subcatchments, cumulative catchments and points of discharge.
 - 5.1.7.3 Predevelopment and post development flows.
 - 5.1.7.4 Internal drainage structures for conveyance, control and treatment.
 - 5.1.7.5 Existing and proposed offsite works.
 - 5.1.7.6 Erosion and sediment control works.
- 5.1.8. Within the areas where storm water detention is required, the Professional Engineer shall certify that for all events up to the estimated 200 year runoff event there will be no increase in water levels or rates of erosion at any point in the watershed as a result of the development compared to original site conditions, before the removal of natural vegetation.

5.2. Flood Plain Elevation Criteria

- 5.2.1. All structures intended for occupancy shall be designed with the underside of the floor system situated 600 mm (1000 mm adjacent to Millstream Creek, between the Trans Canada Highway and Treanor Ave.) above the 200 year peak flood elevation. (Reference: City of Langford Official Community Plan, Map 16, 200 Year Flood Plain.) Where adjacent flood elevations are not available the hydraulic profile shall be extended through hydraulic analysis to the development site, except where the site is clearly above the estimated flood elevations. All habitable structures shall also be protected from flooding by grading drainage away from the structure and providing overland flow routes through the site that are capable of safely conveying the 200 year runoff event. These routes, if not on roadways, shall be maintained in perpetuity and protected with rights of way in favour of the City.

5.3. Storm Drainage Systems Design Criteria

- 5.3.1. All minor systems, those designed and installed as part of the works and services for the subdivision or development, shall be designed for a 10 year peak flow rate. The site must allow for 200mm of ponding onsite to be directed to an overflow route either piped or overland.

- 5.3.2. All minor systems associated with a commercial, industrial, multi family or institutional development as described by City of Langford Zoning Bylaw shall be designed for the 1:25 year storm.
 - 5.3.3. Previously undeveloped areas must create an overland route within the subdivision or development for the 1:200 year rainfall event to allow for the failure of the drainage system. This route must be physically protected and have a right-of-way in favour of the City.
 - 5.3.4. Where, in the opinion of the City Engineer, future development or subdivision shown in the Official Community Plan for the City is probable for the lands adjacent to the development or subdivision, storm sewers must be extended to the property boundary and terminated with a cleanout or a manhole. A right-of-way in favour of the City must be provided for this storm sewer on private property for access and maintenance.
 - 5.3.5. Storm drainage conveyance or disposal systems are required in the road right of way adjacent to the subdivision or development for all new and existing highways.
 - 5.3.6. If a vertical seepage pit is installed for in ground storm water disposal for the 1:25 year storm, the developer is not required to treat storm water with a oil separation device prior to disposal unless the disposal system is constructed in conjunction with required improvements for an auto repair or service facility, gas stations, or property zoned for industrial uses. Vertical seepage pits shall be designed in accordance with SD-7.
- 5.4. Tributary Area Schematic
- 5.4.1. Runoff calculation for subdivisions and development of Small Sites may be by the Rational Method. Analysis of upland and downstream catchments, up to a maximum of 10 ha, may also be calculated with the Rational Method. Calculations shall be submitted in tabular form in accordance with *SD-2* and certified by a Professional Engineer. For larger catchments reference shall be made to the Storm water Management Plan for pre-calculated values. The values shall be verified by the City prior to use by the developer's engineer. Original calculations for Large Sites and areas exceeding 10 ha shall be performed with a hydrograph method. Design parameters shall reflect BC west coast conditions.
 - 5.4.2. If in the opinion of the City Engineer conditions warrant, a tributary area plan shall accompany the runoff calculation and include:
 - 5.4.2.1 Scaled topographic site plan with existing cadastral and proposed development layout.
 - 5.4.2.2 Drainage catchment areas showing contributory areas to the site, on-site subcatchments for each inlet, manhole and outlet.

- 5.4.2.3 Locations of other drainage structures including silt traps, oil grit separators, and storage chambers.
- 5.4.2.4 Provision shall be made for servicing lands beyond (upstream) from the site by providing a point of access on a right of way and adequate conveyance capacity within the subdivision or development.
- 5.4.3 Rainfall intensity shall be taken from the intensity-duration-frequency (IDF) curves provided in *SD-3*. The minimum initial time of concentration shall be 10 minutes. For catchments which will remain undeveloped, the time of concentration shall be calculated using good engineering judgement.
- 5.4.4 Where soils will be exposed by land clearing, measures shall be taken to minimize potential erosion following the concepts illustrated in *SD-4*, including:
 - 5.4.4.1 Scheduling works for the period April through October inclusive, to the extent practical.
 - 5.4.4.2 Clearing the minimum possible land area.
 - 5.4.4.3 Clearing immediately before construction commences.
 - 5.4.4.4 Restricting vehicle access and providing a surfaced working area.
 - 5.4.4.5 Suspending construction activities during rainy periods and when soils are saturated.
- 5.4.5 All disturbed surfaces shall be protected against the loss of soils through the use of silt fencing as shown in *SD-5* to be located wherever surface drainage will leave the site as overland flow. Watercourses and ditches shall be protected by placing the silt fencing along the bank of the channel. Bare areas subject to erosion shall be covered by hand placed straw mulch.
- 5.4.6 Where disturbed catchment areas exceed 0.20 ha, a sediment basin as described in *SD-6*, shall be constructed. This requirement may be waived in rocky areas or if construction is completed in the April to October period and finished with a non-erodible surface. Erosion and sediment control measures shall be constructed before clearing and earthworks commence and remain in place until at least 80% of all building construction and landscaping are complete. Sediment traps may be converted to constructed wetlands at this time. Sediment traps shall be clear of sediments on September 30 each year and re-excavated any time the available storage has been reduced by one-third of the original volume.

- 5.4.7 Despite the requirements of this section it shall be the responsibility of the professional engineer to specify appropriate measures and ensure that sediment-laden water and any other deleterious substances do not leave the site or reach aquatic habitat areas.

Pipe Main Parameters

5.5.1 Specifications

Roughness coefficients	Concrete 0.013 PVC 0.013
Minimum diameter	200 mm
Minimum velocity	0.61 m/sec. (flowing full or half full)
Maximum velocity	6.1 m/sec

Above this maximum velocity, special consideration must be given by the Professional Engineer to incorporate pipe materials and construction methods, including pipe anchorage, scour protection and energy dissipation to the satisfaction of the City Engineer.

The choice of pipe material and manufacture is limited to concrete, PVC or ribbed pipe in accordance with the following table.

Less than 380mm diameter	PVC or concrete
380 mm to 610mm diameter	Ribbed or concrete
Greater than 610mm and all driveway culverts	Concrete

- 5.5.2 Pipes may be laid to the minimum vertical and/or horizontal radius of 60 metres or as recommended by the manufacturer, providing the design velocity (full pipe) is increased to 0.914 m/s for the curved section.
- 5.5.3 Mains shall have at least 1.0m cover and be deep enough to provide drainage to 0.6m below the existing or proposed basement floor elevation of each property being serviced based on a 2.0% grade from the main obvert.
- 5.5.4 When a stormwater pipe is installed such that it crosses below an existing asbestos cement (alc) watermain, the existing watermain material shall be replaced with ductile iron pipe for a distance of at least two (2) metres beyond each edge of the trench of the service crossing the watermain.

5.5 Manholes

- 5.6.1 Manhole structures shall be in accordance with MMCD S1 and S2.

- 5.6.2 Manholes shall be provided at all changes in grade, pipe size, horizontal alignment (for non-curvilinear sewers) and at the upper end of mains not to be extended in the future. Only one curve, horizontal and/or vertical, is permitted between manholes. In addition to the foregoing, additional manholes shall be constructed so that the maximum distance between manholes is as follows:

Pipe size (mm Ø)	Maximum Distance (m)
375 and smaller	125
450 and 750	155
900 and larger	185

- 5.6.3 Cleanout structures may be used at the upper terminus where the main will not be extended and the end of the present construction is within 45m of an existing manhole. Cleanout structures shall be constructed in accordance with drawing SS-S6.
- 5.6.4 Outside drop manholes will be permitted, if in the opinion of the City Engineer, the circumstances preclude the use of normal manholes. These shall be constructed wherever the change in invert elevations though the manhole are greater than 600mm. Elevations changes greater than 600mm shall be by way of an outside drop only. Allowance shall be made in the design for the effect of the resulting turbulence on the hydraulic capacity of the system.
- 5.6.5 The relative elevations entering and leaving a manhole must not reduce the hydraulic capacity of the system.
- 5.6.6 Allowances for energy losses or changes in velocity are to be determined in accordance with sound hydraulic principals.
- 5.6.7 The City Engineer may approve situations involving a large pipe flowing into a smaller pipe at steeper grade.
- 5.6.8 Stubs shall be placed in manholes to allow for future connections. The length of the stubs shall be 600mm maximum from the outside of the manhole. The end shall be securely capped to the satisfaction of the City Engineer. Grades shall be suitable for future extension of the system.
- 5.6.9 Manhole benching shall be a steel trowel finish with a constant grade from the inlet(s) to the outlet. The benching inside radius shall be no less than three times the branch diameter. Pre-benched manholes are permitted.
- 5.6.10 All channels shall be constructed to permit use of a pan and tilt camera having dimensions of 600mm x 150mm diameter.

- 5.6.11 The obvert of pipes entering a manhole shall not be lower than 50mm above the obvert of the outlet pipe. The internal channel in the manhole shall have an elevation difference of 5% from the inlet to the outlet.
- 5.6.12 Manhole and cleanout lids are to be set to match existing or planned grades both longitudinally and transversely. If the highway grade is greater than 6%, manhole castings shall be encased in a concrete surround poured to 150mm below the rim.
- 5.6.13 All manhole barrel and sections shall be installed with rubber gaskets and mastic and shall be grouted inside with rapid set non-shrink grout. If, in the opinion of the City Engineer the water table may be high enough to affect the manhole, fibreglass bases in a concrete liner may be required.
- 5.6.14 Inlet and outlet pipes shall be grouted inside the manhole with rapid set non-shrink grout.

5.7 Service Connections

- 5.7.1 Storm sewer service connections of adequate size, but not less than 100mm Ø shall be provided from a main to the property line of each new or existing parcel, which forms part of the development or which fronts a highway or other right-of-way in which the sewer is to be constructed and shall be constructed in accordance with MMCD S7.
- 5.7.2 All service connections shall be provided with an inspection chamber at the property line or at service the right-of-way boundary in accordance with drawing SS-S9.
- 5.7.3 All service connections shall terminate a distance inside the property line equal to the depth at the property line for new parcels unless otherwise approved by the City Engineer and at property line for existing parcels at a location agreed upon by the owner. All stubs must have a 1% minimum gradient from the inspection chamber into private property in accordance with the Building Code and 2% minimum from the sewer main to the inspection chamber, in accordance with the MMCD Documents.
- 5.7.4 Where deep sewers exist, the service stub shall be terminated within 1.0 vertical meters of the minimum basement floor elevation and marked with a 2x4 stake. The service connection shall have a long radius sweep and be installed at no more than 45 degrees from the vertical.
- 5.7.5 Duplex lots shall have a 200mm^Ø service connection with two 100mm^Ø stubs and two inspection chambers or may terminate at a 100x100x100 duplex inspection chamber. The storm drain duplex inspection chamber shall have a grit sump.
- 5.7.6 Wherever possible, adjoining lots shall be serviced with one 150mm^Ø service connection with one 200mm^Ø stub and one inspection chamber

for each lot, or may terminate at a 150x100x100 duplex inspection chamber.

- 5.7.7 All service connection locations shall be located with a 40mm x 90mm stake painted green complete with a green insulated wire from a nail on the stake to the service connection cap and the depth to invert marked.

5.8 Inspection Chambers

- 5.8.1 All inspection chamber (IC) lids and collars shall be installed in accordance with drawing SS S9. The lid cams shall be securely tightened to ensure that they are not subject to vandalism or misuse. Cast iron IC lids may be substituted for the plastic covers in existing asphalt or concrete driveways.
- 5.8.2 All inspection chambers shall have a cast iron chamber cover and concrete surround in accordance with drawing SS S9.
- 5.8.3 Any inspection chamber set in a slope greater than 3% shall have a cast iron chamber cover and concrete surround in accordance with SS S9.
- 5.8.4 Wherever a inspection chamber is covered by a cast iron chamber cover, the clearance between the cast iron lid and the plastic lid shall be a minimum of 75mm.
- 5.8.5 Inspection chambers shall be supplied and installed without plugs.
- 5.8.6 The inspection chamber lid shall be fastened to the riser pipe with a stainless steel machine bolt as provided by the manufacturer.
- 5.8.7 Where property line is within 1 meter of the backside of a sidewalk or curb the inspection chamber shall be installed using cast iron inspection chamber cover specified in drawing SS S9, in a cast in place concrete apron protruding from the sidewalk or curb toward the property. This apron shall be constructed to the same engineering specifications as the sidewalk and shall provide a minimum of 200mm of concrete from the edge of the cast iron lid to the edge of the apron. An expansion joint at the sidewalk or curb to apron interface shall be provided.
- 5.8.8 Inspection chambers shall be a minimum of one meter apart from centre to centre when installed, unless, in the opinion of the City Engineer the clustering of services would be beneficial to site servicing and layout, in which case the sewer and drain connections may be installed on one adjoining property line.

5.9 Testing

- 5.9.1 CCTV videos and reports are to be accompanied with half size drawings. Air test and CCTV videos are required prior to hot-mix asphalt concrete paving.

- 5.9.2 If in the opinion of the City Engineer conditions warrant, the storm drainage system must be flushed and re-videoed prior to the 1 year warranty inspection.

5.10 Catch Basins

- 5.10.1 Catch basins are detailed as per drawing SS S11 shall be provided as required to collect from a maximum area of 400 square metres of road, at the beginning of curb returns to which water flows and at low points. Leads will be a minimum 150 mm diameter. Rim elevations shall be 30 mm below finished pavement grade.

5.11 Inlet Structures

- 5.11.1 Storm sewer inlet structures shall be provided when the following conditions are encountered:

5.11.1.1 Type I inlet (MMCD drawing No. S13) used where a ditch carries storm water into the storm system of the proposed subdivision or development.

5.11.1.2 Lawn basin (MMCD drawing No. S12) in local low spots where storm water is unable to reach the storm system by a ditch.

- 5.11.2 Headwalls other than those described in sections 5.11.1 a and b of this bylaw must be mortared rock or precast concrete. Sandbag inlet headwalls are not permitted.

- 5.11.3 Inlet and outlet structures shall be mortared rock or precast concrete unless otherwise approved by the City Engineer.

5.12 Outfall Structures

- 5.12.1 Inlet and outlet structures shall be mortared rock or precast concrete unless otherwise approved by the City Engineer.

- 5.12.2 Cast in place reinforced concrete outfall structures shall be provided at all watercourses. In all cases energy dissipation shall be provided to reduce maximum outlet flow velocity to 1.0 m/s.

5.13 Treatment Options

- 5.13.1 Stormwater detention (storage) may be combined with a constructed wetland or oil/grit separator chamber or provided in a separate detention facility such as a pond or underground chamber. The 2 year event shall be controlled to prevent watercourse and aquatic habitat impacts. The 10 year event shall be controlled to protect downstream conveyance capacity. The required live storage volumes and corresponding release rates are tabulated below. Where both 2 year and 10 year control is required, the combined storage requirement is also provided.

- 5.13.1.1 Proprietary systems including enhanced manholes, swirl concentrators and deflection screen technologies may be used providing the Professional Engineer can clearly demonstrate that the proposed system will treat storm water to the same criteria as 5.14.3 and the proposed system is certified for performance by the Professional Engineer for the specific site.
- 5.13.1.2 Infiltration systems shall incorporate appropriate pre-treatment systems (for example an oil/grit separator) to protect contamination of the disposal area.
- 5.13.2 Where in-ground disposal is permitted, vertical seepage pits shall be provided and installed in accordance with drawing SD-7. Seepage pits shall be protected by a catch basin.
- 5.13.3 Drainage water quality improvements for all subdivisions and land developments shall be achieved preferably with a constructed wetland as shown in SD-8 and to the satisfaction of the City Engineer. With outlet control and sufficient live storage, the wetland may also serve as a detention pond. The permanent water surface area (as defined by the outlet culvert invert) shall be a minimum of 1% of the contributory catchment area. The constructed wetland shall have a normal outlet capacity for the peak 10 year design flow and an emergency overflow capacity for the 200 year peak design flow that is routed in such a way that it does not flood downstream property or subject it to erosion. Constructed wetlands should have maintenance vehicle access.

Where constructed wetlands are not used, proprietary systems with filtration media may be approved if certified performance and a specification for the site are submitted for approval by the City Engineer.

For Small Sites, or small catchments within Large Sites that cannot be directed to a constructed wetland, the following alternative storm water treatment techniques may be used:

SD-9	Grass Swale
SD-10	Filter Strip
SD-11	Oil/Grit Separator Chamber with External High Flow Bypass
SD-12	Oil/Grit Separator - Type 1
SD-13	Oil/Grit Separator - Type 2
	Permeable Pavement, in accordance with product specifications

These treatment facilities shall be designed on the basis of the post development peak "6-month" event which is deemed to be 60% of the 2-year peak flow. Oil/grit separator chambers may be proprietary or non-proprietary. Design criteria for non-proprietary separators are included on the standard drawings. These concepts are expected to remove approximately 90% of the sediment particles larger than 100 microns (0.1 mm).

5.13.4 For these subdivisions and developments the designer is encouraged to use combinations of engineered wetlands and ponds to conform to the water quality and runoff rate requirements.

Site Soils		2 year	10 year	2 and 10 year combined
Rocky <500 mm of soil	Live storage (m ³ /ha catchment without native vegetation)	100	120	180
	Controlled release rate (L/s/ha total catchment)	10	20	10 and 20
Soils >500 mm of silts and clays	Live storage (m ³ /ha catchment without native vegetation)	110	135	200
	Controlled release rate (L/s/ha total catchment)	8	16	8 and 16
Soils >500 mm of sands and gravels	Live storage (m ³ /ha catchment without native vegetation)	125	150	2 and 10 year combined 225
	Controlled release rate (L/s/ha total catchment)	5	10	5 and 10

5.13.5 The following facilities may be used alone or in combination to achieve the desired detention and treatment.

5.13.5.1 SD-14 shows a typical flow control manhole for use at stormwater detention facilities where only the two year event is being controlled.

5.13.5.2 SD-15 shows a combined detention and oil/grit separator.

5.13.5.3 SD-16 illustrates a detention facility that will serve a 0.5 to 1.0 ha site that will have no remaining native vegetation and is rocky with 15% slopes and must provide detention for both the 2 year (watercourse protection) and 10 year (storm drain capacity protection) events.

5.13.6 Stormwater storage volumes may be reduced if used in combination with an infiltration system designed in accordance with good engineering practice. The reduction in the storage requirement shall be proportional to the percentage of peak 2 year event post development discharge that is infiltrated to ground. Stormwater storage may be eliminated if the peak 2 year event post development discharge downstream from an infiltration system does not exceed the release rate tabulated above.