



Engineering Design Standards

Prepared and Administered by
Engineering Services

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FOREWORD

These Engineering Design Standards outline the design and construction standards applicable to subdivision development activity within Parkland County.

This manual is intended to provide information and guidance to Developers, Engineering Consultants and Utility companies regarding the standards governing the design, preparation of plans, specifications, construction standards and supervision for municipal improvements in Parkland County. These standards are to be regarded as the “minimum” allowable levels to which the improvements proposed are to be built.

These standards do not cover the detailed design or construction of shallow utilities, such as power, street lighting, gas, telephone and cablevision services, but do include general requirements, alignments and the need for co-ordination with the various utility companies.

Although these standards are generally not applicable to the subdivision approval process, it is strongly recommended that they be considered during the subdivision planning and conceptual design phases to minimize the potential for unforeseen difficulties during detailed design and/or construction of the improvements required.

All proposed developments shall be designed and constructed in accordance with the standards outlined herein. Where approval has been granted for variations from the standards or for improvements not covered by the standards, good planning and engineering practices shall be followed to maintain the integrity of the development. Whenever the standards may be at variance with the provisions of the Development Agreement, the Development Agreement shall govern.

1.1 GENERAL

The following design standards sections apply to any and/or all of the respective services:

Section 1:	General Conditions
Section 2:	Engineering Plans and Drawings
Section 3:	Water Distribution Systems
Section 4:	Sanitary Sewer Systems
Section 5:	Service Connections
Section 6:	Storm Drainage Systems
Section 7:	Roadway Systems
Section 8:	Miscellaneous Requirements
Section 9:	Landscape Requirements
Section 10:	Standard Detail Drawings

The standards outlined here are intended to be the minimum requirements for the construction and delivery of civil engineered infrastructures in Parkland County. It is the Developer's responsibility to develop subdivisions that meet or exceed the standards following with good engineering practices, specific site condition requirements, and as may be required by the General Manager of Infrastructure Services, Policies and; local, provincial and federal Codes, Acts and Regulations.

In addition to these Engineering Design Standards, the developer and Developer's Engineer must be familiar with Parkland County following planning documents prior to undertaking the design of a specific subdivision or project:

- 1.1.1** The Municipal Development Plan puts forward general policies and guidelines with respect to land development within the Parkland County.
- 1.1.2** The Area Structure Plans represent the next level of planning. However, not all works and development fall under an existing area structure plan.
- 1.1.3** The Land Use Bylaw puts forward a list of permitted and discretionary uses for each land use district in addition to defining numerous design parameters.

1.2 DEFINITIONS

In these standards, the following words shall have the meaning here after assigned to them:

1.2.1 Applicant

A person or entity who has applied for approval of a Proposed Subdivision or Development Permit, for servicing an existing parcel of land, whether as the owner or an agent for the owner of the land included therein.

1.2.2 Construction Completion Certificate (CCC)

A certificate authenticated by the Developer's Engineer that certifies that the construction and installation of identified local improvements have been completed in accordance with the Engineering Design Standards, Plans and Specifications approved by the County and that all deficiencies have been resolved to the satisfaction of the County.

1.2.3 Contractor

A person, persons, or corporation whom shall undertake the construction of Municipal Improvements on behalf of the Developer.

1.2.4 County

Municipal district or rural municipality within the Province of Alberta governed by elected councils with the mandate to administer rural areas that can include farmlands, resource areas and unincorporated hamlets and rural subdivisions.

1.2.5 Developer

A person or entity who has executed a Development Agreement with the County; in which the Developer has undertaken to develop those lands described by a tentative plan of subdivision, with such development to be in compliance with the Parkland County Engineering Design Standards as set out here and the Development Agreement.

1.2.6 Developer's Engineer

A qualified Professional Licensee (Engineering) - P.L.(Eng.), Professional Technologist (Engineering) - P.Tech.(Eng) or a Professional Engineer – P.Eng. who is licensed to practice engineering in the Province of Alberta with membership with ASET or APEGA. The Developer's Engineer is appointed and engaged by the Developer to be responsible for the design and preparation of drawings and specifications, and for provision of engineering supervision during the construction of the Municipal Improvements for the subdivision development area.

1.2.7 Final Acceptance Certificate (FAC)

A certificate authenticated by the Developer's Engineer that certifies that the construction and installation of identified local improvements have been completed in accordance with the Engineering Design Standards, Plans and Specifications accepted by the County and that all deficiencies and maintenance work have been resolved to the satisfaction of the County.

1.2.8 General Manager

Parkland County employee designated by the title General Manager of Infrastructure Services, or his designated representative.

1.2.9 Municipal Improvements

Underground and surface structures including, but not necessarily limited to water mains, sewer systems, storm drainage systems, roadways, walkways, park areas, shallow utilities, signage, fencing, street lighting, and other improvements as required by the County, all of which shall become the property of the County to operate and maintain.

1.2.10 Warranty Period

A minimum one year for all works including complete road structure from the time commencing with the execution of a Construction Completion Certificate and ending with the execution of a Final Acceptance Certificate.

1.3 ENGINEERING DESIGN

1.3.1 These Standards apply to the preparation and submission of engineering drawings for municipal services in both residential and industrial developments and include without being limited to the following:

- Water distribution systems, fire protection systems, and lot service connections.
- Sanitary sewage systems and lot service connections.
- Storm collection systems and related appurtenances, lot grading, and lot service connections.
- Facilities including sewage lift stations and storm water management facilities.
- Roadways, sidewalks, curb and gutter, and lane improvements.
- Shallow utilities (i.e. gas, power, lighting, telephone and cable T.V.).
- Landscaping requirements, including hard and soft elements and walkway systems.

1.3.2 The Developer shall retain the services of a qualified Developer's Engineer, registered and licensed to practice in the Province of Alberta, who shall be responsible for the design and preparation of drawings and specifications for all Municipal Improvements to be constructed within and/or related to the proposed development area. All required Municipal Improvements shall be designed in accordance with accepted engineering practices and shall meet or exceed the Parkland County Engineering Design Standards as set out here.

1.3.3 It shall be the responsibility of the Developer's Engineer to establish the location and alignment of all existing and proposed Municipal Improvements including coordination with the shallow utilities. Unless approved otherwise by the General Manager, the location of all underground utilities shall generally conform to the Utilities Layout as illustrated in the Standard Detail Drawings.

Refer to Standard Detail Drawings No. 7.1 to 7.7.

1.3.4 The Developer's Engineer shall be responsible for carrying out all surveys and investigations necessary to prepare the design. It shall further be the responsibility of the Developer's Engineer to identify the need for any easements or additional rights-of-way that may be required within or outside of the development area. Where such easements or rights-of-way are required, the plans and related documents shall be prepared by a qualified licensed Alberta Land Surveyor at the Developer's expense.

1.3.5 While the Developer's Engineer may arrange to have certain portions of the work carried out by other qualified persons, he shall remain responsible for the coordination of the work and the certification of its quality and accuracy.

1.4 GEOTECHNICAL REPORT

- 1.4.1** As part of the Subdivision Application, the Developer shall submit a geotechnical engineering report, prepared by a qualified Professional Geotechnical Engineer, which identifies and evaluates the subsurface ground characteristics of the subdivision development area.
- 1.4.2** If the source of water supply is groundwater, testing to establish quantity and quality of groundwater shall be conducted.
- 1.4.3** If sewage disposal system is an in-ground system, soil percolation tests shall be conducted.
- 1.4.4** Such report shall identify soil types and conditions including frost susceptibility, soil stability, water table elevations, sulfates, etc., as well as any potential difficulties that could be encountered during the construction of the Municipal Improvements.
- 1.4.5** Recommendations for setbacks, foundations, road structure and pavement design, trenching and bedding for utilities, storm drainage/storage facilities, weeping tile discharge (foundation drains), compaction requirements, and any special construction requirements should be made.
- 1.4.6** At the requirement of the General Manager, additional geotechnical information (a report) may be requested outlining recommended design and construction requirements and techniques that may have to be followed to satisfactorily develop the subdivision, particularly as related to water and sewer main construction and roadway structures.

1.5 SUBMISSION OF ENGINEERING DESIGN

- 1.5.1** Two (2) complete sets of plans and specifications and one PDF copy of the proposed subdivision area shall be submitted to the General Manager for review. A print of the approved tentative plan(s) of subdivision shall be included as well as the design calculations for water distribution analysis as specified in Section 3, sanitary and storm sewer capacity and pipe loading as specified in Sections 4 and 6.
- 1.5.2** Engineering drawings, diagrams, and reports must be sealed by a Developer's Engineer registered in the Province of Alberta. Landscape plans are to be submitted with the Engineering Drawings and be signed by the Landscape Consultant, who is a member in good standing of the Alberta Association of Landscape Architects.
- 1.5.3** Other information that may be required to be submitted during the approval process:
- design calculations;
 - a copy of required approvals from Alberta Environment and Sustainable Resource Development;
 - approvals from all other regulatory authorities;
 - tender documents and specifications;
 - traffic impact analysis; and
 - construction drawings and contract documents.

- 1.5.4** All proposed roadways and streets shall be named on the drawings with the names, where applicable, as approved by the County. In addition, all lots shall be numbered consistent with the rural addressing system employed by the County.
- 1.5.5** The design drawings, specifications, and relevant data shall be reviewed by the General Manager who shall return one (1) marked up set to the Developer's Engineer, within three (3) weeks of the date of receipt, identifying any required revisions.
- 1.5.6** The Developer's Engineer shall incorporate the required revisions and submit four (4) sets of the Contract Documents to the General Manager for final review and acceptance prior to be authorized to construct.
- 1.5.7** Two (2) sets of the Contract Documents, stamped "Reviewed and Accepted", will be returned to the Developer's Engineer within two (2) weeks of the date of their receipt once the drawings are deemed acceptable. The General Manager's review and acceptance of the Contract Documents acknowledge compliance to the County's Engineering Design Standards; it is not meant to remove the professional obligations of the Developer's Engineer design authentication.
- 1.5.8** No work shall commence until the subdivision is approved, the Development Agreement has been executed, and the General Manager's review of the drawings and plans has been completed.

1.6 EROSION AND SEDIMENT CONTROL MEASURES

- 1.6.1** In accordance with the Alberta Soil Conservation Act, every landholder shall take appropriate measure to prevent soil loss or deterioration from taking place. Furthermore, the landholder must stop the loss or deterioration from continuing.
- 1.6.2** All new development and redevelopment that include land disturbing activities such as clearing, grading, filling, and excavation will require an Erosion and Sediment Control (ESC) plan and Best Management Plan (BMP).
- 1.6.3** The objective is to control erosion and prevent sediment from leaving the site. The ESC plan should provide for the interception and treatment of all potential silt-laden runoff that could occur during clearing, grading, construction, and site stabilization.
- 1.6.4** The site plan for an ESC plan shall be prepared by the Developer's Engineer and include the following: location of clearing limits and easements, setbacks, water quality sensitive areas and their buffers, locations and descriptions of all erosion and sediment control measures for each phase of construction, and cross-sections of fill or excavations.
- 1.6.5** All ESC shall be in place prior to any site material disturbance.

1.7 ENGINEERING SUPERVISION

- 1.7.1** For the construction of Municipal Improvements, the Developer's Engineer shall be responsible for:

- Inspecting and approving of all materials to be used;
- Carrying out all necessary construction survey layout to ensure the finished construction conforms to the lines and grades shown on the approved plans;
- Carrying out all necessary construction supervision to ensure all construction is carried out to meet the requirements to the approved plans and specifications and any supplementary standards required by the County;
- Communicating with the County on proposed changes to the accepted drawings;
- Recording of all “as-built” information;
- Authenticating changes to the accepted drawings; and
- Authenticating the record drawings.

1.7.2 A complete set of all approved drawings and specifications shall be maintained at the construction site at all times.

1.7.3 In addition to the supervision carried out by the Developer’s Engineer, the General Manager may periodically inspect the work to ensure conformance with the standards. The General Manager may also assist in the coordination of subdivision works with any other related municipal works.

1.7.4 The General Manager shall bring the use of any unacceptable materials, or practices, in particular matters related to safety, to the attention of the Developer’s Engineer or Contractors. If remedial action is not taken to the satisfaction of the General Manager, he may stop the work until such time as the required corrective action has been taken.

1.7.5 If the Developer’s Engineer wishes to make any changes to the design prior to or during the execution of the work, he shall first submit a marked print (drawing) showing the proposed revision(s) to the General Manager. If acceptance is granted for the revision, the original drawing shall be immediately revised and new prints issued.

1.8 TESTING

1.8.1 It shall be the responsibility of the Developer’s Engineer to ensure that testing of all materials called for in the specifications are carried out by an accredited testing firm. Copies of all test results and testing summary signed by the Developer’s Engineer shall be forwarded to the General Manager without delay. The cost of all testing shall be borne by the Developer.

1.8.2 Underground Municipal Improvements shall not be permitted to operate or be operated as part of the existing municipal systems until the respective subdivision services have been inspected, tested, and accepted in writing by the General Manager.

TABLE 1.1 – Test Frequency

Specification	Type of Test	Recommended Test Frequency	Remarks
Trenching, Backfilling and Compaction for Deep Utilities	Trench Longer than 15 m	2 density tests per 600 mm of depth for every 100 m of trench length	Testing will vary with location of project and consequences of trench settlement
Trenching, Backfilling & Compaction for Electrical Installation	Trench shorter than 15 m	3 density tests per trench	
Roadway Excavation, Backfill & Compaction	Grading/Fill Compaction	1 density test per 2000 sq. m.	
	Subgrade Preparation	1 density test per 1000 sq. m	
	Proof Rolling	Entire Project	
Aggregate: General	Source Sampling	1 sieve analysis per 1000 tonnes of asphalt aggregate	Required 2 weeks prior to commencing work
Granular Sub-base	Compaction	1 sieve analysis per 1000 tonnes of base and sub-base aggregate	
Granular Base	Source Sampling (aggregate)	1 density test per 1500 sq. m. of granular	
	Proof Rolling	Entire Project	
Stabilization: Lime	Source Sampling Test Area	400 sq. m. to establish and demonstrate work methods and timing.	Required 2 weeks prior to commencing work
	Proof Rolling	At completion of curing period	
Soil Cement	Source Sampling (aggregate) Mix Design	1 sieve analysis per 1000 tonnes	Required 2 weeks prior to commencing work. Area suspected to have inadequate thickness
	Thickness Test	1 core sample per 1000 sq. m in	
	Compaction Test	1 density test per 1000 sq. m in place	
	Strength Test	17-day compressive strength test per 1000 tonnes	
Topsoil	Topsoil Analysis On-site Sources	1 analysis report for each topsoil source	Required 4 weeks prior to commencing work
	Contractor Supplied	Contractor to supply 1 litre sample of each topsoil type for testing	
Asphaltic Concrete Paving	Mix Design Density/Thickness Test	3 cores per 1000 sq. m. of asphalt pavement	Required 2 weeks prior to commencing work
	Mix Proportions	1 Marshall core per 1000 tonnes mix, with a minimum of 1 test from each full day's production	
Hydrants	Pressure/Leakage Test * Flow Test	Minimum of one hydrant per development	Provide County at least 24 hours notice
Water Main	Hydrostatic/Leakage Test * Bacteria/Chlorine Test *	Test section not to exceed 365 m in length	Provide County at least 24 hours notice
Storm Sewer Sanitary Sewer	Television and Photographic Inspections	Upon completion of sewer installation, after backfilling	Performed by Contractor
Forcemains	Hydrostatic/Leakage Test *	Test section not exceed 365 m in length	Provide County at least 24 hours notice
Concrete Curbs & Gutters, Walks, Medians, Driveways & Swales General Concrete Slip Formed Concrete	Mix Design	1 per 60 cu. m for each class of concrete poured, min. 1 per day	Required 2 weeks prior to commencing work
	Slump Test and Air Content Test	1 per 60 cu. m for each class of concrete poured, min. 1 per day	Every truck until consistency is established
	Strength Test	1 per 60 cu. m for each class of concrete poured, min. 1 per day	Every truck until consistency is established

* Test to be witnessed by Parkland County

1.9 RECORD DRAWINGS

- 1.9.1** After satisfactory completion of the Municipal Improvements and as a condition of the execution of the Construction Completion Certificate (CCC), the Developer shall submit to the General Manager the following information:
- 1.9.1.1 Certification by the Developer's Engineer that all work has been completed in accordance with the plans and specifications, the Engineering Design Standards, and that all work and deficiencies have been completed.
 - 1.9.1.2 Within 120 days from the issuance of the CCC submit record drawings fully authenticated by a Developer's Engineer. This shall include one set of prints, and an electronic copy compatible with Parkland County CADD and GIS systems as outlined in the Parkland County Digital Plan Submission Standards and Procedures.
 - 1.9.1.3 Materials inspection certificates, asphalt mix designs, deflection testing, concrete strength tests, compaction tests, infiltration tests, exfiltration tests and video inspection tests.
 - 1.9.1.4 Operation and Maintenance Manuals, spare parts, and lubricants.
 - 1.9.1.5 Developer may request a construction completion inspection fifteen (15) working days following the release of the above mentioned deliverables for the execution of the Construction Completion Certificate.

1.10 MUNICIPAL ACCEPTANCE

- 1.10.1** Upon the satisfactory completion of the Municipal Improvements in the development and after all the identified deficiencies have been corrected, a Construction Completion Certificate (CCC), signed by the Developer's Engineer, shall be issued by the General Manager to the Developer, noting acceptance of the work and the duration of the maintenance period. The Developer shall be responsible, at his own expense, to remedy any defect, fault or deficiency in the completed work during the maintenance period, all in accordance with the terms and conditions of the Development Agreement.
- 1.10.2** Upon completion of the maintenance period and after a final inspection and correction of all deficiencies thereof, a Final Acceptance Certificate (FAC), signed by the Developer's Engineer, will be issued to the Developer.

1.11 VARIANCES TO ENGINEERING DESIGN STANDARDS

- 1.11.1** As represented in other areas of this guideline, the Standards developed within may not directly apply to all situations and from time to time, an alternative standard may need to be evaluated. This section outlines the process by which a variance request to a particular standard may be considered.
- 1.11.2** To initiate a variance request, an applicant must first complete and submit a "Proposal for a Variance to the Standards" form along with all pertinent information and data including the

applicable fees, outlined in the "Parkland County Departmental Fees and Charges" schedule. Upon acceptance of a "Proposal for a Variance to the Standards" form, the General Manager will determine if the request is a "Major" or "Minor" variance.

- 1.11.2.1 "Minor" variances shall be approved by the General Manager. Once the variance has been deemed acceptable, a response will be provided in writing, indicating the variance has been approved and the project may continue.
- 1.11.2.2 "Major" variances shall be reviewed and approved by the General Manager after the request has been further evaluated through an internal committee of managers and senior administration. A written response will be provided to the applicant detailing what was considered during the review and the outcome of the decision.
- 1.11.2.3 For "Major" variances, ongoing developments, which may be in the development permit or subdivision application stage, will be suspended until a decision has been rendered by the County.
- 1.11.2.4 The timeline to provide a response for a "Minor" variance shall be a maximum 10 business days. A response for a "Major" Variance will depend on the nature and complexity of the request. Communication shall be provided within the 10 business days of receiving the variance request, with an estimated time for a rendered decision. Expected timeline should be within 30 to 60 business days for a response for "Major" variances.
- 1.11.2.5 Determining the difference between a "Minor" and "Major" variance, is the sole discretion of the General Manager. Upon request, the General Manager will provide a listing of historical "Minor" and "Major" variance requests including decisions rendered.
- 1.11.2.6 Should a request for a "Minor" variance be received and the request is deemed a "Major" variance, in the sole discretion of the General Manager, the applicant shall be notified within 10 business days as to the change in variance level and the same protocol for a decision shall apply for a "Major" variance.
- 1.11.3 Submitting a variance may not result in an approval of that variance. No work shall continue or commence without a response in writing from the County that the variance has been received and approved.
- 1.11.4 An approval of a variance does not set precedence for future requests. Each request shall be reviewed independently and shall be evaluated on its own merits.

1.12 NEW AND/OR UPDATED ENGINEERING DESIGN STANDARDS

- 1.12.1 As represented in other areas of this guideline, the Standards developed within may not directly apply to all situations and from time to time, a standard may need to be established or refined. This section outlines the process by which a new standard may be submitted and considered for acceptance by the General Manager to incorporate into the Engineering Design Standards.

- 1.12.2** To initiate a new standard request, an applicant must first complete a “Proposal for a New and/or Updated Standard”.
- 1.12.3** Written notification accepting the submission and tabling for review will be provided within 10 business days. During that time, an application will be screened and accepted as information or will be returned with questions and/or follow up requirements identified.
 - 1.12.3.1** Upon acceptance, an applicant will be engaged in future discussions to analyse, review and approve the recommended change to a standard.
 - 1.12.3.2** This process is expected to be lengthy, without time being considered the sole priority. A variance request, as outlined in Section 1.11, may be reviewed in conjunction with a new and/or updated standard review.
- 1.12.4** The submission of a new and/or updated standard, may not result in an approval. Design and/or site work shall not commence or continue without a response in writing, granting approval of the new and/or updated standard.
- 1.12.5** Reasons for establishing a new and/or updated standard may include, but not limited to, the following:
 - 1.12.5.1** Address missing elements or develop standards that previously were not required or included in the existing standards
 - 1.12.5.2** Improvements to public safety
 - 1.12.5.3** Improvements to the environment or environmental management practices
 - 1.12.5.4** New or emerging materials and/or technology
 - 1.12.5.5** Improved lifecycle cost implications and potential long term cost savings for the County in regards to asset management
 - 1.12.5.6** Enhanced design, materials or practices that leads to improved maintenance and/or rehabilitation activities
- 1.12.6** Maintaining a current service level at or above existing standards should be the priority when establishing new standards. Cost is an important consideration however all the elements within 1.12.5 should be considered on an equal basis.

2.1 GENERAL

All detailed engineering plans submitted to Parkland County for review and acceptance must comply with the following standards and specifications:

2.1.1 Drawing Size

- 2.1.1.1 The standard A-1 drawing size (594 mm x 841 mm) will be prepared with the profile located at the bottom of the sheet.

2.1.2 Scales

- 2.1.2.1 CADD drawings shall be prepared in 'Real World Metric Coordinates'.
- 2.1.2.2 Drawing shall be prepared using the following scales:

Overall Plan	1:1000
Plans/Profiles	1:500 horizontal/1:50 vertical
Cross-sections & Details	as required

2.1.3 Elevations

- 2.1.3.1 Elevations will be relative to geodetic datum through Alberta Survey Control Marker (ASCM) controls or other agencies. Benchmark locations and elevations may be obtained from Alberta Transportation. Reference benchmarks and their elevations will be identified on the Index Plan.
- 2.1.3.2 A north arrow will be shown on each drawing. In general, north arrows should be directed towards the top of the plan.

2.1.4 Dimensioning

- 2.1.4.1 All dimensions shall be in the metric system.
- 2.1.4.2 Dimensioning of a drawing is extremely important and should be such that it will not be misinterpreted. Dimensions shall be given from an iron pin, lot line, chainage station, a centerline, or any other reference that can be readily established.
- 2.1.4.3 Letters and figures will be clearly legible, 2 mm in size or larger, well-spaced, properly formed, and proportioned.

2.1.5 Title Block

- 2.1.5.1 All drawings must clearly show the following in the title block:
- Developer's/Owner's name;
 - Developer's Engineer or Consulting Engineering name;
 - Subdivision name including staging and/or phasing;

- Drawing name and number and issue date;
- Date format of YYYY/MM/DD;
- Drawing scale, including horizontal and vertical scales;
- Space for the dates and signature of the designer, draftsman, reviewer or checker and approving professional or principal;
- Space for professional stamps and permit; and
- Space for revisions including number, date, description, and authentication.

2.2 DESIGN DRAWINGS

The detailed engineering plans and drawings submitted to the County for review and acceptance shall typically include the items listed below in 2.2.1 through to 2.2.11.

2.2.1 Cover Sheet

This sheet shall show the name of the subdivision, stage of development, and the names of the Developer, planner, consulting engineer and the subdivision file number. In addition, Parkland County shall be identified. A key plan of Parkland County, or a significant portion thereof, shall be included illustrating the location of the development or project.

2.2.2 Index Plan

This plan shall be prepared to fit the standard A-1 sheet and will indicate that portion of the development which relates to a particular plan/profile sheet.

This plan shall also list each drawing included in the set of drawings. Each drawing is to be listed sequentially along with its correspondence drawing number.

Scales are specified in section 2.1.2.

2.2.3 Contour Plan

This plan shall indicate the existing contours at 0.5 m intervals, and shall also indicate the proposed land use and all significant above ground features such as buildings, trees and utilities.

2.2.4 Legal, Easement, and Land Use Plan

This plan shall be prepared to the same scale as all other plans and shall indicate proposed land uses in the project along with existing and/or proposed land use on adjacent properties. All legal and easement information shall be shown on this plan.

2.2.5 Storm Drainage and Sanitary Sewer Basin Plans

Where sanitary and storm drainage studies are available, large scale plans are required depicting the complete sanitary and storm drainage basins in which the development is located and their limits, location of the overall development, the stage to which the drawing set applies, trunk sewers and sizes for the entire basin, storm water management facilities,

receiving channels and drainage courses, and the major drainage system routes for the entire basin (with heavy arrows).

2.2.6 Water and Sanitary Sewer Overall Plan

This plan shall show the location and alignment of the water, sanitary and sewer mains, pipe size, direction of flow, and the location of all related fixtures and appurtenances.

2.2.7 Road and Drainage Plan

This plan shall show all roads, lanes and walkways including road surface and right-of-way widths and alignments, and the storm water drainage system including the local drainage areas, pipe and culvert locations, sizes, inverts, direction of flow, etc. as well as all proposed lot approaches

2.2.8 Lot Grading Plan

This plan shall indicate the following:

- original contours at 0.5 m intervals shown in screened format;
- lots requiring 1.0 m or more of fill material;
- proposed finished lot corner and mid lot elevations;
- proposed finished lot grades (front, back, and mid lot);
- direction of lot surface drainage flows;
- minimum building footing grades;
- alignment of sanitary, storm, and water lines complete with manholes, valves, and hydrants;
- location of lot services at the property;
- invert elevation of sewer service;
- size and material of water, sanitary, and storm services;
- direction of lot surface drainage flows;
- parking lot and building envelope;
- retaining walls, drainage, easements, etc.; and
- access per Engineering Design Standards.

2.2.9 Shallow Utilities Plan

An overall plan shall be prepared compiling the location and alignment of water and sewer lines, power, gas, telephone, and cablevision lines, and including the location of all related surface encumbrances such as power poles, power vaults, street lights, transformers, pedestals, hydrants, valves, manholes, etc.

2.2.10 Signage and Pavement Markings Plan

An overall plan shall be prepared compiling the location and alignment of traffic signs, street name signs, information signs, details of sign types, complete pavement markings as well as installation and construction.

2.2.11 Detail Plan/Profile Drawings

These plans, prepared in accordance with accepted engineering drafting standards and practices, are intended to provide location, alignment and dimensioning detail respecting the proposed Municipal Improvements required to be constructed. Existing infrastructure and other relevant features shall also be shown in detail.

2.2.11.1 GENERAL

- The plan portion shall be positioned at the top of the sheet and the profile portion at the bottom.
- Profiles of all underground utilities and surface improvements shall be shown on the same drawing.
- Stationing and chainages shall be so arranged that both the plan and profile portions align.
- All dimensioning shall be relative to property lines. Wherever possible, all dimensions shall be provided to a minimum of two (2) property lines.

2.2.11.2 PLAN PORTION

Information to be shown on the plan portion shall include, but not be limited to, the following:

- legal subdivision information including lot and block numbers consistent with the rural addressing system employed by the County;
- road and street names and, where applicable, civic addresses;
- horizontal alignment of all roadways, carriageways, curbs, sidewalks, trails, ditches, approaches, culverts, signage, etc., including horizontal curve data (curve arc lengths, chainages of PI, BC, EC, etc.), chainages and dimensions of all items tied to the property lines;
- horizontal alignment of all underground mains and fittings, size and type of materials, valves, hydrants, manholes, catch basins, pipe grades, service connection locations, etc., all dimensioned through stationing and chainages, and offsets to the property lines;
- any other information or data deemed necessary and/or appropriate to the General Manager to make the plans complete; and
- horizontal and vertical alignments, horizontal and vertical curve data, and existing alignments with new alignments (horizontal and vertical).

2.2.11.3 PROFILE PORTION

Information to be shown on the profile portion shall include, but not be limited to the following:

- existing ground profiles of both sides of any rights-of-way; proposed design profiles for centerline of roadway including chainages, vertical alignments and grades, vertical curve data elevations, length, and radius of curves;

- proposed design profile for ditch bottoms including chainages, grades, elevations, culvert inverts, ditch checks, etc.;
- proposed design profile for the underground utilities including chainage, percent grades, size, type and class of pipe, class of bedding, type of trench backfill, invert elevations at all inlets and outlets as well as at all grade changes, manhole rim elevations, existing underground utilities data, etc.;
- this plan shall indicate the alignment and locations of mains and service connections, size of mains, grade and direction of flow, location of appurtenances, and a table presenting the criteria used and the hydraulic design calculations for the sanitary sewer system;
- the storm sewer system, the sump pump discharge collection system, local drainage areas (labeled with size) which contribute to the storm sewer system and tables presenting the criteria and hydraulic design for the storm sewers, sump pump discharge collection lines, catch basins, and catch basin leads; and
- any other information or data deemed necessary and/or appropriate to the General Manager to make the plans complete.

2.2.11.4 LANDSCAPE PLANS

- The landscaping plans are to include all tree planting, sodded or seeded areas, entrance signage, fence locations, trails, trail signage, playground sites, furniture, T-bollards, lighting details, retaining walls and all other details that relate to the final landscape design.
- The Landscape Contractor is responsible for damages and liabilities incurred by damages to site utilities.

2.3 RECORD DRAWINGS

Record Drawings shall be submitted in digital format, suitable for use with the Parkland County AutoCAD and GIS system as outlined in the Parkland County Digital Plan Submission Standards and Procedures and in the development agreement. Additionally, three (3) sets of prints of the as-built drawings shall be submitted to Parkland County.

2.3.1 The timeline for submission of the Record Drawing for all improvements will be within 120 days as per the development agreement.

2.3.2 The drawings must be professionally re-stamped, signed, and dated to indicate as-built information. All original information shall be crossed out and the as-built data written adjacent to the original information (red lining).

2.3.3 Site clearing and grading

- extent of encroachment into adjacent lands for back sloping or other purposes, if applicable
- existing ground contours prior to topsoil stripping
- test hole locations and original ground elevations
- as-built ground contours

- cut/fill as-built elevations and depth of cut or fill
- areas with fills > 12 m in height are to be highlighted on the drawings

2.3.4 Roadways

2.3.4.1 Roadway Record Drawings are to be submitted on completion of all pavement works. Recorded elevations are to be provided at the Edge of Pavement (EOP) at the following locations and shown on the Plan/Profile Record Drawings to confirm centerline grade as shown on the plan drawings:

- Vertical Points of Intersection (VPI's), the elevation at a vertical point of intersection on a vertical curve, is to be the existing pavement elevation plus or minus mid-ordinate distance (M) to theoretical vertical point of intersection
- Beginning of Vertical Curves (BVC) and end of vertical curves (EVC)
- Beginning of Horizontal Curves (BC), Point of Curve to Curve (PCC), and End of Horizontal Curves (EC)
- Beginning (BC), midpoint (MP), and End (EC) for all curb returns
- "K" value for sag and crest vertical curves

2.3.4.2 LOCATION AND RIM ELEVATION OF ANY CATCH BASINS.

- Grade and elevation changes must be noted if the difference from design to recorded elevations is greater than 10 mm.

2.3.4.3 Revisions to pavement cross-section, including location of filter fabric.

2.3.4.4 Revisions to pavement markings.

2.3.5 Utilities

- Revisions to lengths, grades, invert elevations, alignments, locations of vertical points of intersection for sanitary, storm and water mains;
- Revision of "Q" for sanitary and storm water flows;
- All hydrants, valves, fittings, manholes, catch basins and other appurtenances shall be noted and dimensioned in two (2) directions. Also note rim and invert elevations of manholes, catch basins and flange elevations of hydrants; and
- Invert of water, sanitary and storm services and curb stop dimensions in two (2) directions.

2.3.6 Building grade plan

- Revised lowest top of footing elevation

2.3.7 Water and sanitary sewer connections

- Pipe manufacturer, material, and class of pipe installed shall be noted on all plans.

- A table of each plan/profile drawing shall be prepared giving the following information with respect to service connections:
 - Lot number
 - Distance of service saddle from downstream manhole
 - Invert elevation of the sanitary sewer service, the sump pump collector service and the top of the pipe of the water service
 - Service connection provided to each lot shall be shown on the plan and the location shall be referenced to the property lot corner
 - Where the lot is on a curve, the end of the services shall be tied to both front lot corners
 - Riser connections shall be shown on the profile portion of the plan/profile drawing

2.3.8 Subdivision entrance sign

- Detailed construction drawings of the signs are to be provided. These drawings will be used for the future maintenance and repair of the entrance signs.
- For entrance signs or feature signs to be installed on private property, Parkland County will determine where the Subdivision Sign is installed.
- The footprint of the subdivision entrance sign is to be shown on all as-built drawings to identify any conflicts with underground utilities and roadway sight triangles.

2.3.9 COMPLETION DATE

- The month and year of completion of construction shall be shown on each plan for both underground utilities and surface improvements.

3.1 GENERAL

This section provides the design criteria employed in the analysis of the water distribution systems to be provided in all developments.

The standards outlined here are intended to be the minimum standards. It is the Developer's responsibility to develop the subdivision to meet or exceed the standards in accordance with good engineering practices, specific site condition requirements, and/or as may be required by the General Manager, Alberta Environment and Sustainable Resource Development and any other servicing studies that Parkland County has developed.

All materials used in the development shall be new and in compliance with the most recent standards of the American Water Works Association (AWWA), American Society for Testing and Materials (ASTM) or Canadian Standards Association (CSA).

3.2 DESIGN CRITERIA

The water distribution system shall be designed in accordance with recommended standards and the design manual of the AWWA, Alberta Environment and Sustainable Resource Development requirements and/or guidelines.

The system shall be designed as part of the overall or ultimate distribution system to meet maximum day consumption plus fire flows or peak hour flows, whichever is the greater. A design report shall be submitted to the General Manager outlining the calculations for pipe sizing, hydrant flows and pressures, including flow and pressure criteria, when sprinkler systems are required.

3.2.1 Residential area design shall be based on the following per capital consumption:

- Population Density (residential) 3.0 persons/residence
- Average Daily Demand (ADD) 350 litres/person/day
- Maximum Daily Demand 2.0 x ADD
- Peak Hourly Demand 3.0 x ADD

3.2.2 The design population shall be the ultimate for the area under consideration.

3.2.3 Industrial area consumption design shall be based on the following subject to the maximum daily demand and peak hourly demand multipliers.

- Average Daily Demand (ADD) 6000 litres/ha/day
- Maximum Daily Demand 2.0 x ADD
- Peak Hourly Demand 3.0 x ADD

Note: It is assumed that 2% of the gross industrial area will be dedicated to roadways, 3% will be dedicated to storm water management facilities and 10% will be dedicated to environmental reserves.

- 3.2.4** Fire flow requirements shall be in accordance with the Fire Underwriter's Survey publication entitled "Water Supply for Public Fire Protection - a Guide to Recommended Practice", or the latest version thereof. Generally these are:

- Single family residential 60 litres/second (800 igpm)
- Multi-family residential 90 litres/second (1200 igpm)
- Walk-up apartments 115 litres/second (1500 igpm)
- Institutional 90 litres/second (1200 igpm)
- Industrial 230 litres/second (3000 igpm)

In industrial areas, a separate analysis shall also be made to determine what system configurations and sizes would be required to provide direct flow to sprinkler systems in combination with hydrant flows in accordance with National Fire Protection and Fire Underwriter's Survey standards.

- 3.2.5** The minimum size of pipe in a distribution system shall be as follows.

- residential 200 mm diameter
- industrial 300 mm diameter

- 3.2.6** The minimum ground elevation residual pressure at any location in the system shall be between 350 kPa (50 psi) to 550 kPa (80 psi) under a condition of peak hourly design flow, except at the hydrant used to fight a fire. The residual pressure at this hydrant shall be a minimum of 150 kPa (22 psi) peak hourly design flows.

- 3.2.7** Pressure sustaining valve will be required for any development that would have their own fire pump to ensure the Municipal system is not drawn below 150kpa (22psi).

- 3.2.8** Distribution mains shall be continuous (looped) whenever possible. Where a dead end main is approved, the maximum number of single family services shall not exceed twenty (20). For the initial purely residential stages of a large development area the General Manager, at his sole discretion, may temporarily waive this requirement provided the Developer can demonstrate that the necessary fire flows can be delivered via the single water feed. In any event, a maximum of 50 lots may be serviced temporarily without looping of the system. Looping must be provided within two years of temporarily servicing without looping. Where a water main is not looped, provision shall be made to permit flushing of the main by installing a blow off at the terminus of the main.

Refer to Standard Detail Drawing No. 3.10, Blow Off Valve.

- 3.2.9** In the case of cul-de-sacs, distribution lines must all be looped except those serving single residence cul-de-sacs of less than 170 m as measured from the center of the intersection to the center of the bulb.

- 3.2.10** Automatic sprinkler systems are required to be installed in single family dwellings within specific subdivisions within Parkland County where acreage lot sizes are less than 1 acre and where a municipal water system is a requirement of the subdivision approval. Where automatic sprinkler systems are a requirement of a subdivision approval, the sprinkler system shall be installed in accordance with the "Parkland County Residential Sprinkler Standard" attached as Appendix 1 to Section 3 of these Standards
- 3.2.11** The minimum pressure to be maintained in a residential distribution system, where automatic sprinklers are a requirement is 350 kPa (50 psi).
- 3.2.12** A design report shall be provided to the General Manager outlining the minimum service pipe sizing and design pressure requirement at each lot to meet the Residential Sprinkler Standard.

3.3 WATER MAIN PIPE MATERIALS

- 3.3.1** Pipe shall be polyvinyl chloride (PVC) pressure pipe AWWA C900 with a minimum 1035 kPa working pressure unless approved otherwise in writing by the General Manager.
- 3.3.2** High Density Polyethylene pressure (HDPE) pipe shall be DR11 or DR13.5, PE 3408 iron pipe sized (IPS), and shall conform to CSA B137.1, ASTM F714 and ASTM D3350 Standards. Pipe sized from 13 mm through 76 mm shall conform to ANSI/AWWA C901-02 Standard. Pipe sized from 100 mm through 1575 mm shall conform to ANSI/AWWA C906-00 Standard.
- 3.3.3** Fittings (tees, elbows, crosses) up to and including 200 mm diameter shall be molded polyvinyl chloride (PVC) to CSA B137.2 (Class 150) unless approved otherwise in writing by the General Manager.
- 3.3.4** Fittings greater than 200 mm diameter shall be cast iron conforming to AWWA-C110.

3.4 WATER MAIN INSTALLATION CRITERIA

- 3.4.1** All mains shall be installed to a minimum depth of 2.75 m of cover below finished design grade of the surface. Depths in excess of 4.0 m should be avoided unless approved in writing by the General Manager.
- 3.4.2** Where existing conditions dictate that the depth of bury be less than 2.75 m, the main/service is to be insulated using Styrofoam High Load insulation
- 3.4.3** All pipes shall be installed on compacted bedding material. Class B granular bedding material shall be placed and compacted around the pipe to at least 300 mm above the top of pipe unless otherwise approved by the General Manager. The granular bedding material shall typically consist of:
- crushed or screened stone, gravel or sand consisting of hard durable particles free from clay lumps, cementation, organic material, frozen material or other deleterious material; and

- gradations to be within limits specified when tested to ASTM C136 and ASTM C117 and to have a smooth curve without sharp breaks when plotted on semi-log charts.

Sieve Designation (um)	% Passing
10,000	100
5000	95 - 100
2,500	80 - 100
1,250	50 - 85
630	30 - 65
315	10 - 30
160	2 - 10

Refer to Standard Detail Drawing No. 3.1, Classes of Pipe Bedding

- 3.4.4** Mains and service connections shall be installed by augering under existing streets, roadways, railways, sidewalks, curbs, and gutters.
- 3.4.5** All pipe installations shall be in compliance with the manufacturer's recommendations, including vertical and horizontal allowable deflections.
- 3.4.6** Unless approved otherwise, all water mains shall be installed within the road right-of-way.
- 3.4.7** A minimum of 3.0 m horizontal separation shall be maintained between a water main and any sewer (sanitary or storm) the distance being measured center to center and at least 1.8 m horizontally from gas or other shallow utility lines. Final alignments for shallow utilities are to be approved by the General Manager.
- Unless approved otherwise, water mains shall cross above sewers with sufficient vertical separation to allow for proper bedding and structural support of the water and sewer mains.
 - Pipe Restraint Devices shall be used separately or in conjunction with thrust blocks, where identified as being required, and shall be installed in accordance with the manufacturer's recommendations. Restraint Devices for Mechanical Joint or Push-On fittings shall conform to AWWA C111, or the latest version thereof.
- 3.4.8** Timber blocking shall be pressure treated hemlock or fir.

3.5 WATER VALVES

- 3.5.1** Water main valves shall be the same size as the diameter of the corresponding water main.
- 3.5.2** Valves on the distribution mains shall be installed:
- in a cluster at the intersection of the lines; or
 - at the projection of property lines at intersections and at mid-block.

- 3.5.3** Valves on the distribution mains shall be located such that during a shutdown:
- no more than three (3) valves are required to effect the shutdown with two (2) valves at a tee and three (3) at a cross;
 - no more than one (1) hydrant is taken out of service;
 - no more than twenty (20) single family services are taken out of service.
- 3.5.4** For water mains with a diameter up to and including 400 mm, gate valves conforming to AWWA C509 or AWWA C515, latest revision thereof, shall be used and shall include the following supplementary requirements:
- resilient seated;
 - non-rising spindle;
 - to open by turning counter-clockwise direction;
 - minimum operating pressure of 1200 kPa;
 - exterior shall be plant epoxy coated; and
 - all bolts and nuts to be stainless steel coated at installation with Denso Mastic and wrapped with Denso Tape.

Refer to Standard Detail Drawing No. 3.4, Water Valve Installation

- 3.5.5** For water mains with a diameter greater than 400 mm, butterfly valves conforming to AWWA C504, latest revision thereof, shall be used and shall include the following requirements:
- tight-closing, rubber seated type;
 - seat material shall be EPDM, field replaceable;
 - disc material shall be aluminum bronze ASTM B-148 952;
 - shafts shall be solid stainless steel 18-8, type 304;
 - minimum bubble tight differential at 1050 kPa;
 - exterior shall be plant epoxy coated; and
 - all bolts and nuts shall be stainless steel coated at installation with Denso Mastic and wrapped with Denso Tape.
- 3.5.6** Butterfly valves greater than 400 mm shall be installed with appropriate bypass capabilities and shall be installed in a chamber or vault.
- 3.5.7** Valve boxes complete with operating stem and rock disk are required on all valves. Valve boxes shall be a two section, bituminous coated, Type A, cast iron adjustable type with a cast iron lid. Valve boxes shall be sufficient length to provide for adjustments of 300 mm in up and down directions. The rock disk shall be no more than 0.3 m below finished surface grade. In landscaped areas valve boxes shall extend 300 mm above the finished grade.
- 3.5.8** Each valve box shall be marked by a vertical, nominal size of 38 mm x 89 mm timber, set one (1) metre into the ground adjacent to the valve box and extending one (1) metre above the top of the surrounding ground. The top 300 mm of the exposed portion of this marker post shall be painted blue.

- 3.5.9** Pressure reducing valves shall be required at locations as determined by hydraulic modeling, and shall be designed to a standard acceptable to Parkland County.
- 3.5.10** Record Drawings shall be provided by the Developer's Engineer illustrating the exact locations of all valves, complete with their model and make, as per the requirements outlined in Section 2 Engineering Plans and Drawings.

3.6 HYDRANTS

- 3.6.1** Hydrants shall be Canada Valve or McAvity.
- 3.6.2** Hydrants shall be "dry barrel" type conforming to AWWA C502, latest revision therefore, and shall include the following supplementary requirements:
- compression shut-off closing with line pressure;
 - turn to open counter-clockwise;
 - minimum 150 mm I.D. riser barrel;
 - design working pressure of 1035 KPa;
 - 600 mm extension on top with breakaway flange;
 - 150 mm diameter gasketed push-on type bottom connection;
 - two (2) 65 mm hose outlets, Alberta Mutual Aid Thread;
 - one (1) 4.5" NH Thread steamer port connection;
 - must contain drip valve and drain;
 - operating nuts to be 3-sided, with each side being an arc of 36.5 mm long;
 - all bolts and nuts to be stainless steel type 304 coated with Denso Mastic and wrapped with Denso Tape at time of installation;
 - all hydrants to be finished to "fire yellow" color (CC2589 Cloverdale Safety Yellow); and
 - all hydrants greater than 4 m to have in line chamber as manufactured by Clow Canada or approved equal.
- 3.6.3** A 150 mm gate valve complete with valve box located 1.0 metres from the hydrant shall be provided on each hydrant lead.
- 3.6.4** All hydrants along roadways shall be located consistent with Standard Detail Drawings. The front of the hydrant shall face the primary roadway.
- 3.6.5** Hydrants shall be located a minimum of 3 m between hydrant shoulder widening and the proposed access or intersection.

Refer to Standard Detail Drawing No. 3.5, Hydrant Shoulder Widening Layout.

- 3.6.6** Hydrant markers must be placed on all hydrants. Hydrant markers must be Pollard Water Flexi-Flag Hydrant Marker, 72" (68802). They are available for purchase from Parkland County, Public Works Department.

- 3.6.7** A minimum of 0.5 m³ washed rock drainage sump shall be provided around the hydrant base. Top of sump to be 150 mm above the hydrant drain and covered with 6 mil polyethylene to minimize intrusion of silt or clay into the gravel.

Refer to Standard Detail Drawing No. 3.6, Hydrant and Valve.

- 3.6.8** The maximum allowable spacing between the fire hydrants measured in any direction shall generally be consistent with the Fire Underwriter's guidelines and shall not exceed:

- 150 metres for single family residential areas;
- 120 metres for multi-family residential and institutional; and
- 90 metres for industrial.

Furthermore, hydrants shall be located such that the distance to any industrial building shall not be greater than 75 metres.

- 3.6.9** Record Drawings shall be provided by the Developer's Engineer illustrating the exact location of all hydrants and hydrant valves relative to the property line and the main water valves. Refer to Section 2, Engineering Plans and Drawings for details.

3.7 TRENCHING AND BACKFILLING

- 3.7.1** All trenching and backfilling operations shall be carried out in accordance with the Occupational Health and Safety Standards.

- 3.7.2** Prior to trenching and backfilling of water main installations, the construction area shall be stripped of all topsoil and/or organic materials

- 3.7.3** If unsuitable soil conditions are encountered, proper measures for dealing with the conditions shall be identified either on the drawings or as a brief report to the General Manager prior to construction.

- 3.7.4** Excavated material shall be stockpiled at a safe distance from the edge of the trench.

- 3.7.5** Widths of trenches shall be such that pipes and fittings can be laid, jointed properly, and backfilled and compacted properly.

- Minimum trench width - O.D. of pipe diameter plus 450 mm.

Refer to Standard Detail Drawing No. 3.7, Utility Trench

- 3.7.6** The Developer's Engineer shall identify areas where the trench excavation requires shoring or bracing in order to protect workers, property, or adjacent structures.

- 3.7.7** In general, backfilling shall be carried out with approved native material in 300 mm layers, compacted to a minimum of 98% Standard Proctor Density within the road right-of-way and 95% Standard Proctor Density in all other areas. The top 1 m shall be in 150 mm lifts compacted to 98% Standard Proctor Density.

- 3.7.8 Backfill around valves, valve boxes, and hydrants shall be placed in 150 mm layers and compacted with mechanical tampers to a minimum of 98% of Standard Proctor Density.

3.8 THRUST BLOCKS

Thrust Blocking consisting of Type 50 Sulfate resistant concrete with a 28 day compressive strength of 20 MPA shall be provided at all fittings, valves, and hydrants. The size and configuration of the thrust blocking shall be designed for each particular application.

Refer to Standard Detail Drawing No. 3.2, Horizontal Thrust Block and No. 3.3, Vertical Bend Thrust Block.

3.9 CATHODIC PROTECTION

Cathodic protection shall be required on all metallic main valves, fittings, and hydrants.

- 3.9.1 A 2.3 kg zinc sacrificial anode shall be connected to each valve, fitting, and coupling.

- 3.9.2 A single 5.5 kg zinc sacrificial anode shall be connected to a hydrant.

Refer to Standard Detail Drawing No. 3.8, Cathodic Protection and Installation.

3.10 TESTING

Following construction, all water mains shall be flushed, disinfected, and leakage tested. The General Manager shall be notified at least 48 hours in advance of all proposed tests which shall be carried out in the presence of Parkland County.

- 3.10.1 Water main installations shall be pressure and leakage tested in accordance with AWWA standards respecting the pipe material, the latest revision thereof, and the following additional criteria:

- ensure that all main valves and hydrant isolation valves in the test section are open and that the hydrants are closed;
- ensure that all air is expelled from the test section;
- maximum length of distribution main to be tested shall not exceed 400 m;
- maximum length of transmission main to be tested shall not exceed 800 m, defined as 450 mm diameter and larger;
- testing shall be carried out only after concrete thrust blocking has cured - a minimum of 5 days from date of pour;
- apply a minimum hydrostatic and leakage test pressure of 1035 kPa after complete backfill for a period of two (2) hours. Define leakage as amount of water supplied from water storage tank in order to maintain test pressure for two (2) hours; and
- allowable leakage shall be as per AWWA C605, or the latest revision thereof. Leakage allowance for new construction for materials other than PVC shall be in accordance with the applicable AWWA standard.

- 3.10.2** Water Systems which will not provide water main flushing velocities of at least 3.0 m/sec shall be flushed using foam pigs prior to disinfecting of the water mains.
- 3.10.3** Any exposed pipe fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damage or defective pipe, fittings, valves, hydrants or joints that are discovered following the pressure test shall be repaired or replaced with reliable material, and tests shall be repeated until satisfactory results are obtained at the expense of the Developer. All visible leaks are to be repaired regardless of the allowance used for testing, in accordance with AWWA C605, or the latest revision thereof.
- 3.10.4** Disinfection shall be carried out in accordance with standards outlined in AWWA C651, or the latest revision thereof. Minimum residual chlorine after 24 hours shall be 25 mg/L.
- 3.10.5** Where dead ends exist, chlorine samples should be taken at the end of the line.
- 3.10.6** Approved bacteriological sample bottles from the Provincial Laboratory for Public Health must be used. Sample must show the absence of coliform organisms.
- 3.10.7** Under Alberta Environment and Sustainable Resource Development Standards and Regulations, super chlorinated water used for disinfection of the system cannot be directed into a ditch drainage system or open water body. De-chlorination will be required before being discharged into the environment.
- 3.10.8** Extreme care shall be exercised to ensure that no contamination of any adjacent works occurs. In addition, discharge of water during flushing operations shall be undertaken in such a manner as to minimize erosion of, or damage to, adjacent property.
- 3.10.9** All testing results shall be documented and submitted to the General Manager for approval prior to commissioning of the system and the issuance of an Interim Construction Certificate (ICC) and Security & Maintenance Agreement.
- 3.10.10** The duration of each test shall be two hours. The Allowable Leakage formula which forms the basis for the testing of all water mains:

$$L = \frac{ND P_2^{\frac{1}{2}}}{128,225} \text{ For PVC Pipe}$$

$$L = \frac{ND P_2^{\frac{1}{2}}}{32,046} \text{ For Ductile Iron Pipe}$$

Where: L = allowable leakage, L/hr
N = total number of joints
D = pipe diameter in mm
P = the test pressure in kPa

Leakage allowance for new construction for materials other than PVC or ductile iron shall be in accordance with the applicable AWWA standards.

3.11 LOW DENSITY WATER DISTRIBUTION SYSTEMS

3.11.1 General

This section outlines the minimum standards or requirements for water distribution systems required to be provided in rural low density residential developments.

All materials used in the development shall be new and in compliance with the most recent standards of AWWA, ASTM or CSA.

3.11.2 Design Criteria

3.11.2.1 The water distribution system shall be designed in accordance with recommended standards and the design manual of the American Water Works Association (AWWA) and Alberta Environment and Sustainable Resource Development requirements and/or guidelines.

3.11.2.2 Plan/profile drawings, specifications, and a letter report shall be prepared by a qualified Professional Engineer and be submitted to the County and Alberta Environment and Sustainable Resource Development for review and approval prior to construction. The letter report shall include the design parameters and design calculations for sizing the lines based on 1.9 L/min restricted flow at minimum residual pressure of 140 kPa at the property line (700 kPa maximum). A cistern (min 3,400 L capacity) will be required on each lot which should be set back significantly from the road and at an elevation which will maintain positive water pressure. A significant head loss through the required metering chamber at each lot must also be allowed for.

3.11.3 Water Main Pipe Material

3.11.3.1 GENERAL

3.11.3.1.1 The Developer shall supply and install only new materials. All such materials that are defective in manufacture, damaged in transit, or have been damaged after delivery shall be replaced by the Developer at his expense.

3.11.3.1.2 All Standards referred to mean the latest edition of that Standard.

3.11.3.1.3 Where specific products are specified, it is intended that approved equals are also acceptable.

3.11.3.1.4 The "approved as equal" must be obtained from the General Manager before the equal product is used.

3.11.3.1.5 High Density Polyethylene pressure (HDPE) pipe shall be DR11 or DR13.5, PE 3408 iron pipe sized (IPS), and shall conform to CSA B137.1, ASTM F714 and ASTM D3350 Standards. Pipe sized from 13 mm through 76 mm shall conform to ANSI/AWWA C901-02

Standard. Pipe sized from 100 mm through 1575 mm shall conform to ANSI/AWWA C906-00 Standard.

- 3.11.3.1.6 All joints are to be thermal heat fused. Mechanical service connections are not approved.
- 3.11.3.1.7 All components shall be made of corrosion resistant materials.
- 3.11.3.1.8 The interior of the pipe shall be clean and no debris or HDPE shavings shall be trapped inside the pipe.
- 3.11.3.1.9 Pipe age is not to exceed two (2) years at time of installation.

3.11.3.2 FITTINGS

- 3.11.3.2.1 High Density Polyethylene fittings shall be DR 11, PE 3408 conforming to ASTM F714 and CAN B137.1 Standards.
- 3.11.3.2.2 All HDPE molded fittings shall meet the requirements of ASTM D2683 for socket type fittings, ASTM D3261 for butt-type fittings, or ASTM F1055 for electrofusion-type fittings.
- 3.11.3.2.3 Cast iron fittings shall comply with AWWA Specification C-110, C-111 and be supplied with tyton joint, and require a zinc sacrificial anode as per County requirements. The exterior of all fittings shall be coated with asphaltic coating or a fusion bonded epoxy coating conforming to AWWA C213.

3.11.3.3 VALVES

- 3.11.3.3.1 Valves shall be iron body, bronze mounted gate valves with a non-rising spindle, which open by turning in a counter clockwise direction. All valves shall conform to AWWA C500 for bronze mounted solid wedge gate valves or AWWA C509 for resilient seated gate valves.
- 3.11.3.3.2 The interior is to be factory coated with epoxy coating conforming to AWWA C550. The exterior is to be factory applied epoxy coated. Corrosion reduction is to be provided by installation of a zinc sacrificial anode.
- 3.11.3.3.3 Valve ends are to be compatible with pipe joint type (cast iron outside diameter). Flange fittings for PE pipe and bell and spigot for PVC pipe shall be used.
- 3.11.3.3.4 Cast iron valve boxes conforming to ASTM A48, Class 25 of the sliding Type A shall be required on all valves. Coating inside and outside shall be an asphaltic coating or fusion bonded epoxy

conforming to AWWA C213. Set screws are to be galvanized. The top of the box is to be marked "WATER".

- 3.11.3.3.5 Extension stem is to be 25 mm square mild steel with a 50 mm operating nut and flange suitable for a 3.0 m bury. A rock disk nut is required on all valves.
- 3.11.3.3.6 All valves in roadways shall be a Norwood Foundry Type A valve box or an approved equal.
- 3.11.3.3.7 Schedule 40 PVC valve boxes for the bottom boot of Norwood Foundry Type A siding type valve boxes or approved equal are permitted in areas not exposed to vehicle loading or where depths exceed 4.0 m of cover.
- 3.11.3.3.8 Distribution mains shall be located such that in the event of a shutdown no more than 20 single family units are involved in a shutdown. Maximum spacing of valves shall be no more than 1.6 km.

3.11.3.4 SERVICE CONNECTIONS

Each lot unit must have a separate service. Meter chambers shall be installed 1.5 metres inside the private property line, located within a utility easement.

- 3.11.3.4.1 Water service pipe shall be DR 11, PE 3408 and conform to ANSI/AWWA C902- 02 standards. Minimum service diameter is 25 mm.
- 3.11.3.4.2 Main connections shall be made by means of a branch saddle or tapping tee. All fittings and joints must be thermal heat fused, either hot iron heat-joining practice, ASTM D2657 or electrofusion joining method, ASTM F1290 or ASTM F1055. Services are to be one piece. No mechanical connections are permitted between main meter chambers.
- 3.11.3.4.3 Meter chambers shall be located 2 m minimum from shoulder of driveway.
- 3.11.3.4.4 Minimum depth of cover shall be 2.75 m from finished grade to the top of pipe.

3.11.4 Water Mains Installation Criteria

3.11.4.1 GENERAL

- 3.11.4.1.1 Water main alignments shall be approved by Parkland County

- 3.11.4.1.2 Mains shall be at a depth adequate to provide a minimum of 2.75 metre depth of cover from finished grade to top of pipe.
- 3.11.4.1.3 Mains and service connections shall be installed by augering under existing streets, roadways, railways, sidewalks, curbs, and gutters.
- 3.11.4.1.4 In general backfilling shall be carried out with approved native material in 300 mm layers, compacted to a minimum of 98% Standard Proctor Density within the road right-of-way and 95% Standard Proctor Density in all other areas. The top 1 m shall be in 150 mm lifts compacted to 98% Standard Proctor Density.
- 3.11.4.1.5 Repair of any settlements that occur within two years is required.
- 3.11.4.1.6 A separate service line with a metering chamber 1.5 m inside the property line is required for each lot.
- 3.11.4.1.7 Air release facilities and blow off valves are required at ends of lines and high points.

Refer to Standard Detail Drawing No. 3.9, Water Automatic Air-Vent.

- 1.11.4.1.8 A minimum distance of 3.0 m horizontal separation must be maintained between any sanitary or storm sewer and 1.8 m horizontal separation between any gas line or other shallow utility lines. Final alignment for shallow utilities to be approved by the General Manager.
- 3.11.4.1.9 Tracer wire of 14 gauge copper shall be installed simultaneously with the pipe on all mains and services. Splicing the tracer wire can only be done by soldering, with no mechanical connections permitted. The following shall apply:
 - Tracer wire shall not be connected to the steel pipe or transition couplings;
 - Tracer wire shall be brought flush to the ground at every valve box riser, at every road crossing, at every facility location, and at each end of every plastic pipe section. It shall be brought flush to the ground inside a rigid PVC conduit and looped inside a PVC junction box within a Type A valve box marked "Water". Splicing of tracer wire shall be soldered only, no mechanical connections are permitted, and an electrical continuity test is to be performed prior to acceptance.
- 3.11.4.1.10 Marker posts shall be installed perpendicular to all valve and appurtenances locations, adjacent to the property line. Warning signs and painted fence posts shall be installed at the edge of the road right-of-way where water mains cross roadways.

3.11.4.2 SYSTEM INSTALLATION

The system installation standards are intended to address key points only and are not to be considered as a substitute for a detail construction specification to be prepared by the Developer's Engineer.

3.11.4.2.1 All trenching and backfilling shall be completed in strict conformance with Occupational Health and Safety standards

3.11.4.2.2 If unsuitable soil conditions (i.e. organics, high moisture content, rock, etc.) are encountered, the method for dealing with these conditions shall be assessed by a qualified Professional Engineer commissioned by the Developer, and a letter report is to be submitted to the General Manager.

3.11.4.2.3 Class "B" bedding as depicted on the standard detail drawing shall be used for all water mains in suitable soil conditions. If unsuitable pipe foundation conditions exist, the design for a special pipe foundation and bedding shall be prepared by a qualified Professional Engineer and submitted to the General Manager.

Refer to Standard Detail Drawing No. 3.1, Classes of Pipe Bedding.

3.11.4.2.4 Compaction of any trenches and auger pits within the road right-of-way is required to 95% Standard Proctor Density except for the slope of road itself which requires 98%. Repair of any settlements that occur within two years is required.

3.11.4.2.5 If the above compaction standards cannot be achieved because of abnormal weather or wet ground conditions the General Manager may at his sole discretion establish a more appropriate standard for the individual case on receipt of an acceptable proposal from the Developer's Engineer.

3.11.4.3 AUGERING OF ALL SERVICE CONNECTIONS

3.11.4.3.1 All road service connections shall be installed by augering under proposed or existing streets except where augering is not feasible due to adverse soil conditions. Open trenching may be permitted subject to the General Manager's acceptance of the need and acceptance of the backfill material.

3.11.4.3.2 All auger pit excavations shall be backfilled with granular bedding material, and mechanically compacted, in lifts not to exceed 150 mm in depth, to a minimum of 98% Standard Proctor Density to 300 mm above the pipe.

- 3.11.4.3.3 Backfill of auger pit excavation over 300 mm above the pipe shall be compacted in lifts not to exceed 150 mm in depth, to a minimum of 95% Standard Proctor Density within the road right-of-way except on the side slope of the road which requires 98%.

3.11.4.4 **INSTALLATION OF ANODES**

- 3.11.4.4.1 Anodes and leads shall be installed on valves and cast or ductile iron fittings as depicted on the Detail Drawings.

Refer to Standard Detail Drawing No. 3.8, Cathodic Protection and Installation.

- 3.11.4.4.2 Connection of the anode lead shall be by Cad welding. The connection point shall be then coated with Polyken primer and tape.
- 3.11.4.4.3 A minimum of 2 L (0.5 gallon) of water is to be poured on each 2.3 kg (5 lb) anode and 3 L (0.75 gallons) of water is to be poured on each 5.5 kg (12 lb) anode to initiate the anode operation. An alternative is to soak the above anodes in water for a minimum of 10 minutes.

3.11.4.5 **INSPECTION AND TESTING**

- 3.11.4.5.1 Before acceptance of the work, the entire system shall be subjected to a hydrostatic pressure test in the presence of the County representative. The Developer shall provide all necessary labour, materials, and equipment for the test including a suitable pump, measuring tank, pressure hoses, connections, plugs, caps, gauges, and all other apparatus necessary for filling the main, pumping to the required test pressure, and recording the pressure and leakage losses. The Developer shall provide evidence that the gauges used are accurate.
- 3.11.4.5.2 The water distribution system may only be charged through one valve. Only one valve may be operated during pressure and leakage testing as well.
- 3.11.4.5.3 Prior to the start of pressure and leakage, chlorination and bacteria testing, the Developer's Consultant will be required to provide a plan outlining how the testing is to be accomplished. The plan must include the sequence of valve turning, the sections of water main to undergo pressure and leakage testing, how chlorination is to be accomplished, and locations where chlorine residual and bacteria tests are to be taken. Testing will not be allowed to proceed until the above is approved by the County representative.
- 3.11.4.5.4 The Developer will be required to give 24-hours' notice to the County representative.

- 3.11.4.5.5 The system shall be filled with water slowly and air bled off at each air release blow off location. The Developer is required to provide automatic or manual air releases, as specified by the General Manager, along the main at high points within a profile.
- 3.11.4.5.6 When the line has been filled and most of the air expelled, time should be allowed for the remaining air and water to reach a constant temperature.
- 3.11.4.5.7 The test section may be pressured through an air relief valve or a tap may be installed in the line. After testing the pipe shall be plugged at the Developer's expense.
- 3.11.4.5.8 The mains or section of mains shall be subject to a pressure of not less than 1100 kPa. Test sections shall not exceed 450 m of main.

3.11.4.6 LEAKAGE TEST

- 3.11.4.6.1 Leakage tests shall be made only after completion of services, partial or complete backfill, and a minimum of 24 hours after the pipe has been filled with water. No test shall be applied until at least 36 hours after the last concrete reaction or thrust block has been cast with high early strength cement, or at least 7 days after the last concrete reaction or thrust block has been cast with standard cement. The duration of each test shall be two (2) hours.
- The allowable leakage for High Density Polyethylene (HDPE) pipe material shall be determined by the following procedures and table:
 - Expel air from collection system, by slowly filling main with water. High points must have automatic air/vacuum relief valves to vent air when filling, and must be closed when pressure is applied.
 - A hydrostatic test pressure of 1.5 times the rated pressure of the pipe at the lowest point in the system main shall be applied.
 - Pressurized pipe to require test pressure over a 3 hour period and hold required test pressure for an additional hour to allow for pipe expansion and stretching prior to the leakage test.

- 3.11.4.6.2 Test period shall be a for 2 hour duration. Amount of make-up water (leakage) required to return the pipe to required test pressure shall not exceed the allowance given in the following table:

Nominal Pipe Size mm	Allowance for Expansion (Leakage) (litres/100 m of pipe) 2 Hour Test
50	1.6
75	1.9
100	3.1
150	7.5
200	12.5
250	16.2
300	28.7
350	33.7
400	41.1
450	53.6

- 3.11.4.6.3 Total time under test pressure must not exceed 8 hours. If test is not accepted due to leakage or equipment failure, test section must be permitted to "relax" for an 8 hour period prior to the next testing sequence.

3.11.4.7 ACCEPTANCE

- 3.11.4.7.1 Prior to the initial acceptance of the water system, water mains are to be disinfected in accordance with AWWA C651 continuous feed method. Procedural methods of disinfection, including chlorine concentration calculations and contact times, are to be submitted to the County representative for acceptance. The water main valves are to remain closed until such time as the bacteria sample results are approved.
- 3.11.4.7.2 Under Alberta Environment and Sustainable Resource Development Standards and Regulations, super chlorinated water used for disinfection of the system cannot be directed into a ditch drainage system or open water body. De-chlorination will be required before being discharged into the environment.
- 3.11.4.7.3 Prior to initial acceptance of the water system and the system put into service, bacteriological testing shall be carried out on all water mains and acceptable test results must be achieved.

3.12 RESIDENTIAL SPRINKLER SYSTEMS

Parkland County requires automatic sprinkler systems to be installed in single family dwellings within specific subdivisions within the County where acreage lot sizes are less than one (1) acre and where a municipal water system was required as a condition of subdivision approval. The home owners shall be responsible for all aspects and costs of the design, installation, and maintenance of an automatic sprinkler system in accordance with Parkland County Residential Sprinkler Standards (attached as Appendix 1).

3.13 LIST OF STANDARD DETAIL DRAWINGS

Standard details have been provided for the guidance of designers in the interpretation of the standards. Where the standards and the drawings conflict, the standards shall govern. Standard drawings are dimensioned in millimeters unless otherwise noted.

Refer to Section 10 for all Standard Detail Drawings

Appendix 1
PARKLAND COUNTY
RESIDENTIAL SPRINKLER STANDARD

INTRODUCTION

Parkland County requires automatic sprinkler systems to be installed in single family dwellings within specific subdivisions in the County where acreage lot sizes are less than one (1) acre and where a municipal water system was required as a condition of subdivision approval. This standard is enforced through restrictive covenants placed on the title of each lot. The home owner shall be responsible for all aspects and costs of the design, installation, and maintenance of an automatic sprinkler system in accordance with these standards.

The Standard deals with design and installation of automatic sprinkler systems for protection against the fire hazards in single family dwellings. The basis of this Standard is the National Fire Protection Association (NFPA), which is the standard-making organization that sets the guidelines for fire protection systems in Canada, "STANDARD of SPRINKLER SYSTEMS in ONE - and TWO - FAMILY DWELLINGS AND MANUFACTURED HOMES", NFPA 13D, latest edition. **NFPA 13D is to be followed with the following clarifications that are applicable to the subdivisions within Parkland County.**

Parkland County approves and may or may not inspect, or certify, any installations, procedures, equipment, or materials. In determining the acceptability of installations, procedures, equipment, or materials, Parkland County requires evidence of proper design, installation, procedure or use of equipment or material that is in compliance with NFPA 13D. Only equipment or material listed by ULC or UL may be utilized in the installation of any sprinkler system. All designers and installers must be knowledgeable of all the requirements and design philosophy of NFPA 13D.

WATER SUPPLY

Parkland County will provide to the property line of each Country Residential lot, within the subdivision, a service connection connected to a municipal water distribution system in accordance to the system outlined on the attached Figure 2. This service connection will normally be located at the front property line of the lot. The pressure contours or pressure levels indicated on the attached Figure 1 provide the available design water pressure within the subdivision during periods of peak day water use. Figure 1 also provides the size, type of material, and elevation of the service connection.

RESIDENTIAL SPRINKLER SYSTEM

A system employing automatic sprinklers attached to a piping system containing water only, and connected to the municipal water distribution system, so that water discharges immediately from the sprinklers opened by a fire, shall be installed within the dwellings within the subdivision. All systems shall be designed and certified by a Professional Engineer registered in the Province of Alberta.

WATER SERVICE LINE

Parkland County will provide a water connection, at the property line, in accordance with Figure 1. The water service line from this service connection to the residence shall be equal to or greater than the line size provided by Parkland County. Material used for the service line will be in accordance with NFPA 13D.

SYSTEM DESIGN

The residential sprinkler system design shall be in accordance with NFPA 13D and all equipment and material used shall be ULC or UL listed.

The arrangement of connections, piping, valving, and required equipment is shown on Figure 2 and shall be in accordance with the latest version of the regulations of the Safety Codes Act.

TESTING REQUIREMENTS

Completion of Installation

The residential fire sprinkler system is to be tested with a one and two sprinkler head flow test to determine if it performs as determined by design. The tests are to be performed on the most critical and remote head(s). The tests involve flowing one and two heads in calibrated buckets for a duration of 30 seconds to determine the flow rates. The flow rates and pressures are to be checked against the system design to determine if the residential fire system is performing within design values. A RESIDENTIAL SPRINKLER FLOW VERIFICATION REPORT is to be submitted to Parkland County upon completion of the flow test. See attached form (Figure 3).

Monthly Maintenance Program

The home owner should undertake a minimum monthly maintenance program:

- visually inspect all sprinklers to ensure against obstruction of spray
- inspect and operate all valves to assure that they are open
- test all water flow devices
- test the alarm system

Yearly Maintenance Program

On a yearly basis the home owner should, in addition to the monthly maintenance program, operate and open the drain valve for a sufficient period of time to purge the residential sprinkler system.

USE OF WATER

Home owners using water from the sprinkler system drain, other than for testing and draining of the sprinkler system, shall be subject to a penalty as outlined by the County Bylaw.

PARKLAND COUNTY
 HELENSLEA HEATH STAGE 111

SUPPLY PRESSURE AT PROPERTY LINE

		Static Pressure at Property Line kPa	Design Service Elevation metres	Peak Day Pressure at Property Line (1) kPa	Correction Factor kPa	Service Connection Size mm	Type of Material
LOT	1	294	680.87	280	14	40 mm nominal	Polyethylene Series 160
LOT	2	293	680.94	279	14	40 mm nominal	Polyethylene Series 160
LOT	3	300	680.27	286	14	40 mm nominal	Polyethylene Series 160
LOT	4	297	680.50	283	14	40 mm nominal	Polyethylene Series 160
LOT	5	307	679.53	293	14	40 mm nominal	Polyethylene Series 160
LOT	6	315	678.70	301	14	40 mm nominal	Polyethylene Series 160
LOT	7	314	678.83	300	14	40 mm nominal	Polyethylene Series 160
LOT	8	321	678.07	307	14	40 mm nominal	Polyethylene Series 160
LOT	9	322	677.87	309	14	40 mm nominal	Polyethylene Series 160
LOT	10	329	677.25	315	14	40 mm nominal	Polyethylene Series 160
LOT	11	328	678.34	314	14	40 mm nominal	Polyethylene Series 160
LOT	12	338	676.31	324	14	40 mm nominal	Polyethylene Series 160
LOT	13	335	676.65	321	14	40 mm nominal	Polyethylene Series 160
LOT	14	344	675.7	330	14	40 mm nominal	Polyethylene Series 160
LOT	15	344	675.75	330	14	40 mm nominal	Polyethylene Series 160
LOT	16	342	675.91	328	14	40 mm nominal	Polyethylene Series 160
LOT	17	347	675.47	333	14	40 mm nominal	Polyethylene Series 160
LOT	18	342	675.93	328	14	40 mm nominal	Polyethylene Series 160
LOT	19	346	675.50	332	14	40 mm nominal	Polyethylene Series 160
LOT	20	344	675.68	330	14	40 mm nominal	Polyethylene Series 160
LOT	21	345	675.60	331	14	40 mm nominal	Polyethylene Series 160
LOT	22	348	675.29	334	14	40 mm nominal	Polyethylene Series 160
LOT	23	344	675.76	330	14	40 mm nominal	Polyethylene Series 160
LOT	24	351	675.00	337	14	40 mm nominal	Polyethylene Series 160
LOT	25	342	675.94	328	14	40 mm nominal	Polyethylene Series 160
LOT	26	349	675.22	335	14	40 mm nominal	Polyethylene Series 160
LOT	27	343	675.87	329	14	40 mm nominal	Polyethylene Series 160
LOT	28	349	675.24	335	14	40 mm nominal	Polyethylene Series 160
LOT	29	347	675.37	333	14	40 mm nominal	Polyethylene Series 160
LOT	30	350	675.14	336	14	40 mm nominal	Polyethylene Series 160
LOT	31	350	675.13	336	14	40 mm nominal	Polyethylene Series 160
LOT	32	357	674.38	343	14	40 mm nominal	Polyethylene Series 160
LOT	33	350	675.14	336	14	40 mm nominal	Polyethylene Series 160
LOT	34	367	673.40	353	14	40 mm nominal	Polyethylene Series 160
LOT	35	348	675.35	334	14	40 mm nominal	Polyethylene Series 160
LOT	37	350	675.13	336	14	40 mm nominal	Polyethylene Series 160
LOT	39	356	674.45	342	14	40 mm nominal	Polyethylene Series 160
LOT	43	375	672.53	361	14	40 mm nominal	Polyethylene Series 160
LOT	44	323	677.82	309	14	40 mm nominal	Polyethylene Series 160
LOT	45	318	678.36	304	14	40 mm nominal	Polyethylene Series 160
LOT	46	325	677.65	311	14	40 mm nominal	Polyethylene Series 160
LOT	47	321	678.10	307	14	40 mm nominal	Polyethylene Series 160
LOT	48	327	677.49	313	14	40 mm nominal	Polyethylene Series 160

- (1) Based on supply pressure of 483 kPa at Temporary Water Reservoir Site and Peak Day Water Demands of 4.4 litres per second through distribution system consisting of 1464 metres of 200 mm and 808 metres of 150 mm water main. Supply pump elevation of 672.050.
- (2) Service pipe material is Municipal OD Tubing Series 160 PE 3408

Address: _____ Date: _____
 Contractor: _____ Time: _____
 Approved Certificate Number: _____ Permit: _____
 Inspector: _____

SYSTEM DESIGN INFORMATION – NFPA 13D

Piping Drawings Available: Yes _____ No _____
 Sprinkler A Type: _____ Manufacturer: _____ Model: _____
 KFactor: _____
 Sprinkler B Type: _____ Manufacturer: _____ Model: _____
 KFactor: _____
 Design Spacing A: _____ x _____ Static Gauge Pressure: _____ kPa
 @ _____ metre elev.
 Static Pressure @ street: _____ kPa-Peak Day Pressure* _____ kPa=Correction
 Factor** _____ (kPa)
 Design Spacing B: _____ x _____ Static Gauge Pressure: _____ kPa
 @ _____ metre elev.
 Static Pressure @ street: _____ kPa-Peak Day Pressure* _____ kPa=Correction
 Factor** _____ (kPa)

* Refer to Figure 1

** If Correction Factor Negative Use 0.0

TEST #1 ONE HEAD FLOWING 30 SECONDS

Head Location: _____ Reference Pt: _____
 Sprinkler A/B
 Amount of Water Flowed: _____ litres
 Residential Gauge Pressure: _____ kPa-Correction Factor _____ kPa=Correction Pressure
 (kPa) _____

TEST #2 TWO HEAD FLOWING 30 SECONDS

Head 1 Location: _____ Reference Pt: _____
 Sprinkler A/B
 Head 2 Location: _____ Reference Pt: _____
 Sprinkler A/B
 Amount of Water Flowed: Head 1: _____ litres
 Head 2: _____ litres
 Residential Gauge Pressure: _____ kPa-Correction Factor _____ kPa=Correction Pressure
 (kPa) _____

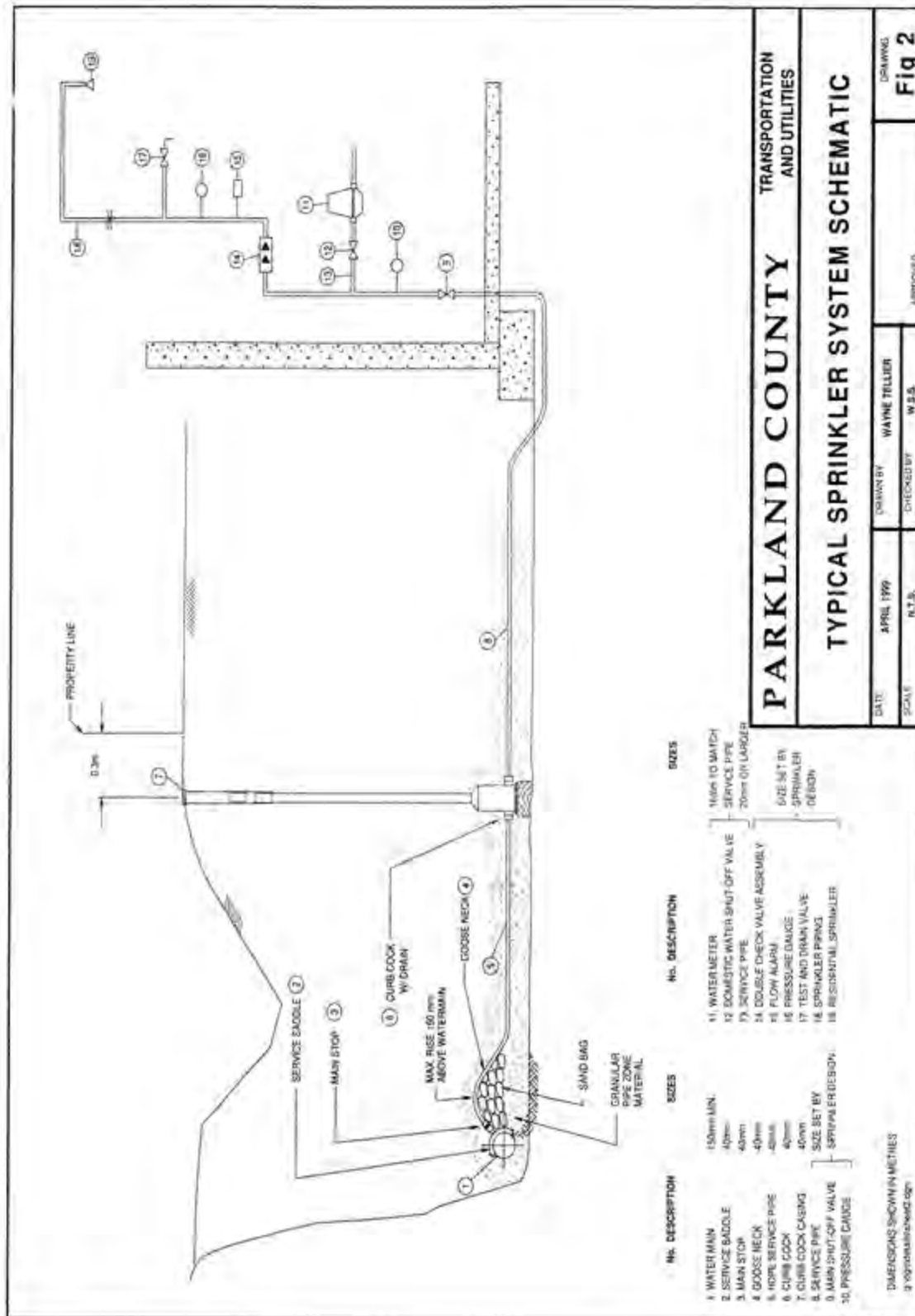
CONCLUSIONS

TEST #1

Required Flow: _____ litres per minute
 Obtained Flow: _____ litres per minute
 Required Pressure _____ kPa
 Corrected Pressure: _____ kPa

TEST #2

Required Flow: _____ litres per
 Obtained Flow: _____ litres per
 Required Pressure: _____ kPa
 Corrected Pressure: _____ kPa



4.1 GENERAL

This section provides the design criteria employed in the analysis of the sanitary sewer collection systems to be provided in all developments.

The standards outlined herein are intended to be the minimum standards, not the standard. It is the Developer's responsibility to develop the subdivision to meet or exceed the standards in accordance with good engineering practices, specific site condition requirements, and as may be required by the General Manager, Alberta Environment and Sustainable Resource Development requirements and/or guidelines and any other servicing studies that Parkland County has developed.

In addition, if connection is proposed to the Alberta Capital Region Wastewater Commission (ACRWC) system, all Commission requirements and criteria shall be met.

All materials used in the development shall be new and in compliance with the most recent standards of the American Water Works Association (AWWA), American Society for Testing and Materials (ASTM) or Canadian Standards Association (CSA).

4.2 DESIGN CRITERIA

The sewer main capacity shall be designed to carry the peak dry weather flows plus an inflow and infiltration allowance. The flow factors listed below shall be used as minimum requirements in the design of the sanitary sewer systems.

4.2.1 Residential Contribution

4.2.1.1 Population to be based on 3.0 people/residence

4.2.1.2 Minimum average contribution of 350 litres per capita per day.

4.2.1.3 Peak hourly flow for each contributing area is calculated at an average flow multiplied by a peaking factor.

$$\text{Peak Factor} = 1 + \frac{14}{4 + p^{1/2}}$$

Where: p = equivalent population in 1000's
the minimum peak factor shall be 2.5

4.2.2 Industrial Contributions

4.2.2.1 Industrial - Since these flows vary greatly with the type of development, each case must be considered on an individual basis

4.2.2.2 Minimum average contribution of industrial flows is to be 6170 litres/ha/d plus Inflow/Infiltration (I/I).

4.2.2.3 The peak hourly flow for each contributing area is calculated at average flow multiplied by a peaking factor of 3.0 minimum.

4.2.3 Extraneous Flow Allowance

- 4.2.3.1 The sanitary sewer shall be designed and installed to be watertight to minimize the amount of infiltration into the system. An Inflow/Infiltration (I/I) allowance of 0.28 litres per second per hectare will be calculated for normal installations.
- 4.2.3.2 Any manholes located in “sags” are subject to an additional allowance of 0.4 litres per second per manhole.
- 4.2.3.3 Foundation weeping tile, roof leaders and sump pumps shall not be connected for discharge into the sanitary sewer.

4.2.4 Design Report

A design report shall be submitted to the General Manager outlining the pipe sizes and capacities, contributing areas, Inflow/Infiltration flows and all other relevant information.

4.3 PIPE

- 4.3.1 Pipe sizing shall be determined by utilizing Manning’s Formula with an “n” value of 0.013.
- 4.3.2 Minimum pipe sizes shall be:
- 200 mm diameter for residential areas
 - 250 mm diameter for industrial areas
- 4.3.3 All sanitary sewers shall be designed to carry the design flow at a flow depth no more than 80% of the sewer diameter.
- 4.3.4 Required full flow sewer capacity = estimated total design peak flow rate / 0.86
- 4.3.5 Minimum pipe slopes shall be in accordance with Alberta Environment and Sustainable Resource Development recommendations. All sanitary sewers shall be designated and constructed to achieve mean velocities when flowing full of not less than 0.6 m/s. The maximum slopes for sanitary sewers will be based on limiting the velocity to 3.0 m/s.
- 4.3.6 Minimum pipe slopes are as follows:

<u>Pipe Size</u> <u>(Diameter in mm)</u>	<u>Min. Slope (%)</u>
200	0.40
250	0.28
300	0.22
375	0.15
450	0.12
525	0.10
600	0.10

- 4.3.7 The minimum slope of the first upstream leg shall not be less than 1.0%.
- 4.3.8 The minimum allowable slope of any sanitary sewer shall not be less than 0.10%.
- 4.3.9 Sanitary sewers may have to be oversized to conform to the current Master Sanitary Sewer Plans.
- 4.3.10 Pipe material shall be:
- PVC Pipe ASTM D3034DR35.
 - Concrete Pipe ASTM C76 or
 C655 sulfate resistant for pipe sizes over 900 mm in size.
- 4.3.11 Materials other than concrete or PVC shall require approval of the General Manager.
- 4.3.12 All pipe installations shall comply with the manufacturer's recommendations.

4.4 MANHOLES

- 4.4.1 Manholes shall be precast reinforced concrete sections conforming to ASTM C478, or the latest version thereof.
- 4.4.2 Concrete for manholes and appurtenances shall utilize Type 50 sulphate resistant cement with 28 day strength of 25 MPa. The maximum allowable slump shall be 75 mm.
- 4.4.3 All manholes shall have an inside diameter of 1200 mm minimum for pipe 900 mm and less. For pipe exceeding 900 mm or manholes having multiple inlets, manhole sizing shall be subject to review by the General Manager.
- 4.4.4 Manhole frames and covers shall be cast iron conforming to Class 20 ASTM A48.
- 4.4.5 Manhole frames and covers shall be type NF-80 in paved areas, type NF-90 gasketed in sags, and all capable of withstanding H-20 loading. Type NF-39 frames and covers may be used in landscaped or natural areas or approved equal.

Each cover shall minimally have the words "SANITARY SEWER" embossed on it.

- 4.4.6 Manhole steps shall be standard safety type, of hot dipped galvanized iron or epoxy coated extruded aluminum.

Spacing of steps should be 300 mm – 400 mm.

For those manholes located in roadways, and where possible, steps should be aligned so that the person exiting from the manhole should do so facing towards oncoming traffic.

- 4.4.7 Manhole bases shall be pre-benched precast slabs.

- 4.4.8 All joints shall be watertight through the use of carefully installed rubber gaskets and hand buttered internal joints.
- 4.4.9 Manholes shall be provided at the end of each line and at all changes in pipe size, grade, and alignment.
- 4.4.10 Aluminum safety platforms shall be required in all manholes with a depth greater than 5.0 metres.
- 4.4.11 Inverts in manholes at changes in direction shall have at least a 50 mm fall across the manhole.
- 4.4.12 To maintain continuous energy gradient through manholes, the obvert elevation of the lowest upstream pipe shall be equal to, or higher than, the obvert of the downstream pipe.
- 4.4.13 An interior drop manhole shall be used where invert levels of inlet and outlet pipes differ by more than 600 mm.
- 4.4.14 Connections to existing manholes shall be cored at the required elevation with a link seal (Kor-n-seal) connection, or approved equal to the new pipe.
- 4.4.15 The maximum spacing between manholes shall not exceed 120 metres on 600 mm pipe, and 150 m on 675 - 1200 mm pipe. The bolt nuts must be on the inside of the pipe.
- 4.4.16 Compact backfill around manholes with mechanical tampers to at least 98% of the Standard Proctor Density.

Refer to Standard Detail Drawing No. 4.1, Standard Manhole.

Refer to Standard Detail Drawing No. 4.2, Pre-benched Manhole Base.

Refer to Standard Detail Drawing No. 4.3, Internal Drop Manhole.

4.5 SEWER MAIN INSTALLATION

- 4.5.1 Mains shall be installed to provide a minimum depth of cover of 2.75 m measured from finished grade to the crown of the pipe.
- 4.5.2 Mains shall be installed to provide adequate sewer service connection depth at the property line.
- 4.5.3 Where existing conditions dictate that the depth of bury be less than 2.75 m, the main/service is to be insulated using Styrofoam High Load insulation. It is required that an engineering design for insulation be shown on the engineering drawings.
- 4.5.4 Unless approved otherwise, all mains shall be installed within the center of the road driving lane.

Refer to Standard Detail Drawings No. 7.1 to 7.7.

- 4.5.5 Sanitary sewers must be located at least 3.0 m horizontally from any water main or storm sewer, and at least 1.8 m horizontally from gas or other shallow utility lines. Final alignment for shallow utilities to be approved by the General Manager.
- 4.5.6 Under normal conditions, water mains shall cross above sewers with a sufficient vertical separation to allow for proper bedding and structural support of the water and sewer mains. Where it is necessary for the water main to cross below the sewer, the water main shall be protected by providing:
- a vertical separation of at least 0.5 m from water main crown to sewer invert;
 - structural support of the sewer to prevent excessive joint deflection and settling; and
 - a centering of the length of water main at the point of crossing so that the joints are equidistant from the sewer.
- 4.5.7 All pipes shall be installed on compacted granular bedding. Class B granular bedding material shall be placed and compacted at a minimum depth of 100 mm below and around the pipe to 300 mm above the top of the pipe. The granular bedding shall be a material approved by the General Manager and shall typically consist of:
- Crushed or screened stone, gravel or sand consisting of hard durable particles free from clay lumps, cementation, organic material, frozen material or other deleterious material.
 - Graduations are to be within limits specified when tested to ASTM C136 and ASTM C117 and to have a smooth curve without sharp breaks when plotted on semi-log charts.

<u>Sieve Designation (um)</u>	<u>% Passing</u>
10,000	100
5,000	95-100
2,500	80-100
1,250	50-85
630	30-65
315	10-30
160	2-10

Refer to Standard Detail Drawing 3.1, Classes of Pipe Bedding

- 4.5.8 Mains and service connections shall be installed by augering under existing streets, roadways, railways, sidewalks, curbs, and gutters.

4.6 CURVED SEWERS

In general, curved sewer installations will only be allowed where the difficulty of avoiding other utilities necessitates such applications. However, the following restrictions shall apply:

- 4.6.1 The sewer shall be laid as a simple curve with a radius equal or greater than 90 m or the manufacturer's minimum recommended radius, whichever is larger.
- 4.6.2 Manholes shall be located at the beginning and end of the curve with the maximum interval between manholes no greater than 90 m along the curve.
- 4.6.3 The curve shall run parallel to the road centre line.
- 4.6.4 The minimum grade for sewers laid on a curve shall be 50% greater than the minimum grade required for straight runs of sewers.
- 4.6.5 Length of pipe shall be such that deflections at each joint are less than the maximum recommended by the manufacturer.

4.7 TRENCHING AND BACKFILL

- 4.7.1 All trenching and backfilling operations shall be carried out in accordance with the Occupational Health and Safety Standards.
- 4.7.2 Prior to trenching and backfilling of main installations the construction area shall be stripped of all topsoil and/or organic materials.
- 4.7.3 If unsuitable soil conditions are encountered, proper measures for dealing with the conditions shall be identified either on the drawings or as a brief report to the General Manager prior to construction.
- 4.7.4 Excavated material shall be stockpiled at a safe distance from the edge of the trench.
- 4.7.5 Widths of trenches shall be such that pipes and fittings can be laid, jointed properly and backfilled and compacted properly.
 - Minimum trench width for sewer mains less than 750 mm in diameter shall be the equal to the outside diameter (O.D.) plus 450 mm.
 - Minimum trench width for sewer mains equal to or greater than 750 mm in diameter shall be the equal to the outside diameter (O.D.) plus 600 mm.

Refer to Standard Detail Drawing No. 3.7, Utility Trench

- 4.7.6 Trench walls shall be vertical to 300 mm above the top of the pipe.
- 4.7.7 All pipes shall be installed on compacted bedding material. Class B granular bedding material shall be placed and compacted around the pipe to at least 300 mm above the top of pipe unless otherwise approved by the General Manager.
- 4.7.6 Trench walls shall be vertical to 300 mm above the top of the pipe.

Refer to Standard Detail Drawing No. 3.1, Classes of Pipe Bedding.

- 4.7.8 The Developer's Engineer shall identify areas where the trench excavation requires shoring or bracing in order to protect workers, property, or adjacent structures.
- 4.7.9 In general, backfilling shall be carried out with approved native material in 300 mm layers, and compacted to a minimum of 98% Standard Proctor Density within the road right-of-way, and 95% Standard Proctor Density in all other areas. The top 1 m shall be in 150 mm lifts compacted to 98% Standard Proctor Density.
- 4.7.10 All compaction testing results shall be provided to the County for review once complete and shall be properly referenced to engineering drawings to facilitate comprehension of where the test was performed. Costs related to compaction testing are the responsibility of the Developer.
- 4.7.11 Backfill around valves, valve boxes and hydrants shall be placed in 150 mm layers and compacted with mechanical tampers to a minimum of 98% of Standard Proctor Density.

4.8 TESTING OF SEWERS

Following their construction, all sewer mains shall be thoroughly cleaned and flushed of any earth, gravel, and other debris. Special care shall be taken to capture and remove all the deleterious material and prevent it from entering the existing system.

All tests shall be done in the presence of Parkland County. The County must be notified 48 hours prior to any testing.

- 4.8.1 Sewer main will be checked for alignment during construction. Any horizontal or vertical deviation shall be corrected prior to backfilling. Sewer main design grade is to be maintained and continuous through the manhole.

4.8.2 Water leakage test:

- The County shall require each section of sewer main and service connections to be tested for water-tightness by either an exfiltration test or an infiltration test.
- In areas where the ground water table rises up to the sewer pipe invert or higher, each section of sewer mains and service connections shall be tested for water tightness by an infiltration test. In all other situations, an exfiltration test shall be conducted. For exfiltration testing, the minimum hydrostatic head on the test section shall be 0.6 metres. Any deficiencies shall be corrected by the Developer and those portions of sewer affected shall be subject to an additional video inspection at the Developer's expense.
- Maximum allowable leakage for an exfiltration or infiltration test of a sewer pipe shall be as follows:

Concrete pipe	20 litres/day/mm of diameter/km
PVC pipe	5 litres/day/mm of diameter/km

4.8.3 Closed Circuit Television (CCTV) Inspection:

- 4.8.3.1 Prior to the issuance of a Construction Completion Certificate (CCC) and Final Acceptance Certificate (FAC), all sewer lines shall be thoroughly flushed and a CCTV inspection carried out.
- 4.8.3.2 All photos and video shall be of a high quality showing details of the pipe in a clear and unobstructed view. Where, in the opinion of the General Manager, the picture quality is not clear and deemed unsatisfactory, the CCTV inspection shall be redone at the Developer's expense. A written report and a digital record of the inspection, on a CD-Rom, DVD or USB Flash Drive, shall be submitted to the County for approval and record purposes.
- 4.8.3.3 A CCTV log shall be maintained during the inspection showing locations of leak, sag, fault, open joint, break, crack, collapse, deflection, settlement, obstruction, infiltration, or any other defect affecting the overall performance of the sewer line. The location of the defect shall be referenced from the manhole.
- 4.8.3.4 A separate log shall be kept of service connections, location, and direction with comments of condition.
- 4.8.3.5 A final report with corresponding photograph secured properly and referenced to the text, along with a copy of the video, shall be submitted with application for Construction Completion Certificate (CCC) and Final Acceptance Certificate (FAC) to the General Manager for review and records.

4.9 LIFT STATIONS**4.9.1 General**

- 4.9.1.1 Wherever possible, every reasonable effort should be made in the design to provide a drainage system for the Development that relies solely on gravity for conveyance. This is done in order to minimize the overall operation and maintenance requirements and life cycle costs of the system.
- 4.9.1.2 Where absolutely necessary, Parkland County may accept design proposals which include lift stations and force mains to convey wastewater out of the Development.
- 4.9.1.3 The Developer's Engineer shall consult with Parkland County while conducting the design to obtain preliminary comments and input regarding any proposed lift station and force main.

4.9.2 Design Criteria

- 4.9.2.1 Watertight gates must be provided on the inlet to the wet well to permit cleaning and maintenance to the wet well piping, bar screens, etc. Whenever possible, an overflow should be built in conjunction with this gate to prevent excessive head.

- 4.9.2.2 Suitable and safe means of access must be provided to all dry wells and all wet wells. All ladders, platforms, grates etc. shall comply with Occupational Health and Safety Standards and provided such that pumping and related equipment and piping accessories can be removed in a safe manner.
- 4.9.2.3 Two or more pumps must be provided in each pump well and provision shall be made to alternate automatically between pumps. The control panel must be so located that it cannot be flooded under any circumstance. All pumps must be capable of handling 75-mm solids and shall be of a “non-clog” type. They shall be placed to work under a positive suction head. For safety reasons the motors must be placed as far as possible above the overflow point of the wet well. Where only two pumping units are provided, they shall have the same capacity. Each shall be capable of handling flows in excess of the expected maximum flow, and designed in accordance with established engineering practice. The pumping cycle shall be long enough to ensure that all sewage in the force main will be replaced during one cycle. Where three or more pumps are provided, they should be designed to fit actual flow conditions and must have capacity that with any one pump out of service, the remaining units will have capacity to handle maximum sewage flows.
- 4.9.2.4 Each pump shall have its own individual intake and all piping shall be at least 100 mm in diameter and 900 kPa pressure rating. Shut-off valves shall be placed on both suction and discharge lines of each pump. Additionally, a check valve must be placed on the discharge line between each pump and the shut-off valve. Each check valve shall be equipped with an outside lever to provide visual indication of valve operation. A bleed off valve shall be provided on each pump flange. All pump venting requirements shall be met.
- 4.9.2.5 Effective capacity of the wet well shall be that each pump shall not exceed the pump manufacturers recommendation for start and stop times in a 1 hour period. Holding time must be minimized. The wet well floor shall be sloped to prevent build-up of solids and grit.
- 4.9.2.6 Wherever possible, the wet well shall have provision of an overflow outlet in case of electrical or mechanical failure. A standby system must be provided. Where a standby engine or engine generator is installed, adequate provision shall be made for the discharge of exhaust fumes to the atmosphere. The ventilation system shall be equipped with an airflow sensing switch to shut off the engine in the event that the ventilation system is not functioning.
- 4.9.2.7 The dry well must be equipped with a sump pump that will discharge into the wet well 300 mm above the top of the overflow. The sump pump must have its own discharge pipe complete with at least two check valves mounted in series.
- 4.9.2.8 The pump discharge must enter the wet well at a point above the overflow.
- 4.9.2.9 A water supply with fittings and hose must be provided for washing down purposes. An approved backwater protection device and cross connection control

shall be installed on the water supply, and in accordance with the current Provincial and County plumbing regulations.

- 4.9.2.10 A minimum of 0.6 metres of clearance all around is required as the working area to do repairs and maintenance to each pump.
- 4.9.2.11 When pump and motor replacement parts are not available locally, extra seals, bearings and impellers shall be provided at the time of purchase.
- 4.9.2.12 All electrical work shall be in accordance with the Canadian Electrical Code and the Provincial and Municipal amendments thereto. Permanent lighting and no fault plug shall be provided on each floor and around each pump and motor. Adequate ventilation shall be provided to prevent excessive moisture build-up in control panels. Part wind motors are required on all pumps larger than 55 KW. Each pump shall be equipped with two “stop – lockout switches”, to prevent pump operation during maintenance. The first switch shall be located within sight of the electric motor. The second switch shall be located adjacent to the pump.
- 4.9.2.13 Continuous mechanical ventilation is required for all dry wells, either at a rate of six (6) complete air changes per hour or in accordance with Alberta Environment and Sustainable Resource Development Standards, whichever is greater. Multiple air inlets shall be provided on all pits over seven (7) metres deep. Provision for heating of cold air shall be made. Fresh air inlets shall be kept remote from control equipment. All heating, ventilation, and electrical equipment shall be in accordance with Alberta Environment and Sustainable Resource Development Standards for non-hazardous locations.

Monitoring equipment shall be installed in each pumping station. Elapsed time meters shall be installed on each motor or engine. Information on pump running times and flows shall be monitored via a SCADA system compatible with the system being used by the County. The pump running times shall be capable of measuring in hours, minutes, and fifteen (15) second intervals.
- 4.9.2.14 An alarm system shall be installed at each pumping station. Alarm points shall be determined in consultation with the County. Provision shall be made for transmission of alarms to a remote location, as directed by the General Manager.
- 4.9.2.15 As part of the responsibility of the design of a wastewater pumping station, the design engineer shall prepare and provide an Operation Maintenance and Service Manual for the facility. Four (4) complete copies of the Manual are to be provided prior to the transfer of the facility operation to the County.
- 4.9.2.16 All bolts, nuts, and other fasteners used in wet well areas are to be stainless steel, and all supports, brackets, gratings, ladders, and other structures shall be made of corrosion resistant materials.

4.10 FORCE MAINS

- 4.10.1 A system head curve shall be provided for each force main. Supplementary information shall be provided with the curves, including population estimates, area served, plan and profile of line, friction coefficients, line head losses, and any other relevant information.
- 4.10.2 Minimum permissible velocity in force mains shall be 0.60 metres per second. Where velocities in excess of three (3) metres per second are attained, special provisions shall be made as required by Parkland County. At high points in the line, gas relief shall be provided.
- 4.10.3 Force mains shall be constructed of polyethylene pipe or PVC pipe. Materials and fitting specifications shall be in accordance with design pressures and shall be subject to Parkland County approval. Testing of all force mains shall be in accordance with the requirements for pressure testing of water mains.
- 4.10.4 Thrust blocks shall be in accordance with Standard Detail Drawings.

Refer to Standard Detail Drawing No. 3.2, Horizontal Thrust Block and No. 3.3, Vertical Bend Thrust Block.

4.11 LOW PRESSURE SANITARY SEWER SYSTEMS

4.11.1 General

The sanitary sewer system shall be of sufficient capacity to service the ultimate population projection of the development area. The flows and factors outlined in the following sections shall be used in the design of rural residential low pressure sanitary sewer systems.

The Developer and the Developer's Engineer are responsible for ensuring that the infrastructure is designed and constructed to achieve manufacturers' design life expectations consistent with good design and construction practice. System proposals must identify disposal means in accordance with Alberta Environment and Sustainable Resource Development regulations and guidelines. Plan/profile drawings, specifications, and a letter report shall be prepared by a qualified Professional Engineer and be submitted to the County and Alberta Environment and Sustainable Resource Development for review and approval prior to construction.

4.11.2 Design Criteria

4.11.2.1 ESTIMATING AVERAGE SEWAGE FLOWS

- 4.11.2.1.1 A sewage generation rate of 250 L/person/day for a low pressure sewer system with no infiltration rate shall be used, unless otherwise determined by the General Manager. Any sewage generation rate other than the above will be dependent upon the disposal system capacity.

4.11.2.1.2 In determining residential flows, a minimum of 3.0 persons per household shall be used unless otherwise determined by the General Manager.

4.11.2.1.3 Recommended pump rate and head for each lot will need to be provided. This information will be included in any plumbing permit issued by the County and will ensure that all residents are aware of this requirement.

4.11.2.2 PIPE SIZING

4.11.2.2.1 A report from the Developer's Engineer must be prepared to ensure that pipe sizing is calculated in consideration with the topography of the serviced lands and the population projections.

4.11.3 System Materials

4.11.3.1 GENERAL

4.11.3.1.1 The Developer shall supply and install only new materials.

4.11.3.1.2 All such materials which are defective in manufacture, damaged in transit, or have been damaged after delivery shall be replaced by the Developer at his expense.

4.11.3.1.3 All Standards referred to mean the latest edition of that Standard.

4.11.3.1.4 Where specific products are specified, it is intended that approved equals are also acceptable.

4.11.3.1.5 The "approved as equal" must be obtained from the General Manager before the equal product is used.

4.11.3.2 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

4.11.3.2.1 High Density Polyethylene pressure (HDPE) pipe shall be DR11 or DR13.5, PE 3408 iron pipe sized (IPS) and shall conform to CSA B137.1, ASTM F714, and ASTM D3350 Standards. Pipe sized from 13 mm through 76mm shall conform to ANSI/AWWA C901-02 Standard. Pipe sized from 100 mm through 1575 mm shall conform to ANSI/AWWA C906-00 Standard.

4.11.3.2.2 Shop only molded pipe fittings shall be used. If unavailable other alternatives must meet County approval first.

4.11.3.2.3 All joints are to be thermal heat fused. Mechanical service connections are not approved.

4.11.3.2.4 All components shall be made of corrosion resistant materials.

- 4.11.3.2.5 Pipe age not to exceed two years at time of installation.

4.11.3.3 LOW PRESSURE SEWER MAINS

- 4.11.3.3.1 In rural residential subdivisions the sewer main alignments shall be as depicted on the Typical Residential Right-of-Way Roadway cross-section drawings.
- 4.11.3.3.2 Mains shall be at a depth adequate to provide a minimum of 2.75 m depth of cover from finished grade to top of pipe.
- 4.11.3.3.3 Auguring or directional drilling is required under all roads. Compaction of auger pit shall be completed to the appropriate standards.
- 4.11.3.3.4 Compaction of any trenches and auger pits, and repair of any settlements that occur within two years, is required.
- 4.11.3.3.5 A separate service line with a curb stop, marked “sewer” at the property line; is required for each lot.

Refer to Standard Detail Drawing No. 4.4, Low Pressure Sewer Service Connection

- 4.11.3.3.6 Flushing pipes are required at the start of each collection main to facilitate removal of main line blockages.

Refer to Standard Detail Drawing No. 4.5, Low Pressure Sewer Flushing Pipe

- 4.11.3.3.7 Manual air/vacuum relief valves are required at all high points for removal of hydrogen sulphide gases from anaerobic decomposition of organics.

Refer to Standard Detail Drawing No. 4.6, Low Pressure Sewer Air and Vacuum Relief Valve Chamber

- 4.11.3.3.8 A minimum distance of 3.0 m horizontal separation must be maintained between any water main or storm sewer and 1.8 m horizontal separation between any gas line or other shallow utility lines. Final alignment for shallow utilities to be approved by the General Manager.
- 4.11.3.3.9 Tracer wire of 14 gauge copper shall be installed simultaneously with the pipe on all mains and services. Splicing the tracer wire can be done by soldering and mechanical connections. The following shall apply:

- Tracer wire shall not be connected to the steel pipe or transition couplings.
- Tracer wire shall be brought flush to the ground at every valve box riser, at every road crossing, at every facility location, and at each end of every plastic pipe section. It shall be brought flush to the ground inside a rigid PVC conduit and looped inside a PVC junction box, within a type "A" valve box marked "Sewer". An electrical continuity test shall be performed prior to acceptance.

4.11.3.3.10 Marker posts shall be installed perpendicular to all valves, air release and flushing standpipe locations, adjacent to the property line. County provided warning signs and painted fence posts shall be installed at the edge of the road right-of-way where low pressure sewers cross roadways.

4.11.3.3.11 Posts shall be Fiberglass Composite Markers, Dual-Flex, Part Number DF66-00 (66 inches long in White) with Orange reflective stickers applied to both sides, or approved alternate posts shall include one composite post anchor and shall be installed 450 mm in depth, thereby leaving 1.2 m visible above ground.

4.11.3.4 FITTINGS

4.11.3.4.1 High Density Polyethylene (HDPE), DR 11 conforming to ASTM F714 and CAN B137.1, shop molded fittings shall be used.

4.11.3.4.2 All HDPE molded fittings shall meet the requirements of ASTM D2683 for socket type fittings, ASTM D3261 for butt-type fittings, or ASTM F1055 for electro fusion type fittings.

4.11.3.5 VALVES

4.11.3.5.1 Gate valves for 75 mm and larger shall be iron body, bronze mounted gate valves with a non-rising spindle, which open by turning in a counter clockwise direction. All valves shall conform to AWWA C500 for bronze mounted solid wedge gate valves or AWWA C509 for resilient seated gate valves. The interior is to be factory coated with epoxy coating conforming to AWWA C550. The exterior is to be factory applied epoxy coated. Corrosion reduction is to be provided by installation of a zinc sacrificial anode. Valves are to be flanged for polyethylene pipe.

Refer to Standard Detail Drawing No. 4.7, Low Pressure Sewer Valve

4.11.3.5.2 Brass inverted key-type curb stops shall be used for valves 50mm and smaller conforming to ASTM B62 compression type. Curb stops

to have adjustable bituminous or epoxy coated cast iron service base with stem to suit 3.0m depth of bury. Top of cast iron box to be marker "SEWER". All curb stops shall incorporate 75mm long stainless steel sleeves for connections to polyethylene pipe.

- 4.11.3.5.3 Valve ends compatible with pipe joint type (Cast Iron Outside Diameter) to be used.
- 4.11.3.5.4 Cast iron valve boxes conforming to ASTM A48, Class 25 of the screw or sliding type shall be required on all valves. Coating inside and outside shall be an asphaltic coating or fusion bonded epoxy conforming to AWWA C213. Set screws to be galvanized. Top of box to be marked "SEWER".
- 4.11.3.5.5 Extension stem to be 25 mm square mild steel with 50 mm operating nut and flange suitable for 3.0 m bury. A rock disk nut is required on all valves.
- 4.11.3.5.6 Schedule 40 PVC valve boxes for the bottom boot of Norwood Foundry Type A sliding type valve boxes or approved equal are permitted in areas not exposed to vehicle loading or where depths exceed 3.5m of cover.

4.11.3.6 SERVICE CONNECTIONS

- 4.11.3.6.1 Each lot must have a separate service.
- 4.11.3.6.2 Curb stops marked "SEWER" shall be installed at the private property line located within a utility easement.
- 4.11.3.6.3 Sanitary sewer service pipe shall be 40 mm, DR 11 polyethylene pipe, Series 160 Municipal tubing.
- 4.11.3.6.4 Main connections shall be made by means of fused in-line tees or saddles. All fittings and joints must be assembled by electro fusion or butt fusion for HDPE piping. Services to be in one piece, no mechanical connections are permitted between main connection and curb stop.
- 4.11.3.6.5 Curb stops shall be non-draining type located adjacent to driveway locations.
- 4.11.3.6.6 Minimum depth of cover shall be 2.75 m from finished grade over top of pipe.

4.11.3.7 SEPTIC TANK/PUMP

- 4.11.3.7.1 Use two-compartment tank or a single-compartment tank with a pump vault, sized and constructed in accordance with Alberta plumbing codes.
- 4.11.3.7.2 Extend tank access risers at least 150 mm above finished ground surface, provide watertight manhole covers, and divert surface runoff away from the manhole cover.
- 4.11.3.7.3 Tank must be large enough to provide:
- 450 mm for pump submergence, minimum;
 - Full day of emergency storage capacity above the high water alarm level, utilizing the septic tank freeboard capacity below ground, and/or below building drain outlet invert;
 - Minimum twelve (12) hour retention time below high water alarm level for proper treatment of the sewage flow;
 - Storage of sludge and scum accumulation;
 - Typically 3800 L (1000 gal) minimum total tank storage for an average three (3) bedroom dwelling; and
 - Reference “Alberta Private Sewage System Standard of Practice latest edition”.
- 4.11.3.7.4 Tank must be a sealed watertight tank (fibreglass, or one piece precast pump tank, or special provisions must be made for assuring a watertight tank).
- 4.11.3.7.5 Anti-buoyancy provisions must be adequate.
- 4.11.3.7.6 All pipe and wire conduits into tank must be through hubs or fittings made during the construction of the tank, and installed in a watertight and gastight fashion.
- 4.11.3.7.7 No drainage or any water other than sanitary wastewater shall be allowed to enter the tank.
- 4.11.3.7.8 The effluent shall enter the pump compartment or pump vault from the clear zone of the tank between the scum and sludge layers.
- 4.11.3.7.9 Pump must be:
- Submersible CSA approved effluent pump.

- Designed by a Professional Engineer to the satisfaction of Parkland County. Pump must be readily removable from the ground surface.

- 4.11.3.7.10 Pump discharge pipe must be of DR 11 HDPE or stronger and include a check valve, disconnect union, and gate valve within the pump tank.
- 4.11.3.7.11 The pump screens shall be no larger than 3 mm in size and occupy a surface area of 1.44 square metres or equivalent product approved by the County.
- 4.11.3.7.12 Pumps must be activated by either mechanical level controllers or Mercury level control switches.
- 4.11.3.7.13 When any pump is located at a higher elevation than the elevation of the terminal end, then a siphon-break valve must be provided for that pump.
- 4.11.3.7.14 Provisions for ventilation should be provided.

4.11.4 System Installation

4.11.4.1 GENERAL

The system installation standards are intended to address key points only and are not to be considered as a substitute for a detailed construction specification to be prepared by the Developer's Engineer.

4.11.4.2 TRENCHING, BEDDING, AND BACKFILLING

- 4.11.4.2.1 All trenching and backfilling operations shall be carried out in accordance with the Occupational Health and Safety Standards.
- 4.11.4.2.2 Prior to trenching and backfilling of water main installations, the construction area shall be stripped of all topsoil and/or organic materials.
- 4.11.4.2.3 If unsuitable soil conditions are encountered, proper measures for dealing with the conditions shall be identified either on the drawings or as a brief report to the General Manager prior to construction.
- 4.11.4.2.4 Excavated material shall be stockpiled at a safe distance from the edge of the trench.
- 4.11.4.2.5 Widths of trenches shall be such that pipes and fittings can be laid, jointed properly, and backfilled and compacted properly.

- 4.11.4.2.6 Minimum trench width – O.D. of pipe diameter plus 450 mm.

Refer to Standard Detail Drawing No. 3.7, Utility Trench.

- 4.11.4.2.7 The Developer's Engineer shall identify areas where the trench excavation requires shoring or bracing in order to protect workers, property, or adjacent structures.
- 4.11.4.2.8 In general, backfilling shall be carried out with approved native material in 300 mm layers, compacted to a minimum of 98% Standard Proctor Density within the road right-of-way and 95% Standard Proctor Density in all other areas. The top 1 m shall be in 150 mm lifts compacted to 98% Standard Proctor Density.
- 4.11.4.2.9 Backfill around valves, valve boxes, and hydrants shall be placed in 150 mm layers and compacted with mechanical tampers to a minimum of 98% of Standard Proctor Density.

Refer to Standard Detail Drawing No. 3.7, Utility Trench.

4.11.4.3 AUGERING OF ALL SERVICE CONNECTIONS

- 4.11.4.3.1 Mains and service connections shall be installed by augering under existing streets, roadways, railways, sidewalks, curbs, and gutters.

4.11.4.4 INSPECTION AND TESTING

- 4.11.4.4.1 Before acceptance of the work, the entire system shall be subjected to a hydrostatic pressure test in the presence of Parkland County. The Developer shall provide all necessary labour, materials, and equipment for the test, including a suitable pump, measuring tank, pressure hoses, connections, plugs, caps, gauges, and all other apparatus necessary for filling the main, pumping to the required test pressure, and recording the pressure and expansion-leakage losses. The Developer shall provide evidence that the gauges used are accurate.
- 4.11.4.4.2 Expel air from collection system by slowly filling main with water. High points must have automatic air/vacuum relief valves to vent air when filling, and be closed when pressure is applied.
- 4.11.4.4.3 A hydrostatic test pressure of 1.5 times the rated pressure of the pipe at the lowest point in the system main shall be applied.
- 4.11.4.4.4 Pressurized pipe requires a test pressure over a three (3) hour period and must hold required test pressure for an additional hour to allow for pipe expansion and stretching prior to the leakage test.

- 4.11.4.4.5 Leakage test period shall be for two (2) hour duration. Amount of make-up water (leakage) required to return the pipe to required test pressure shall not exceed the allowance given in the following table.

TABLE 4.1 - Field Testing of Low Pressure Sewer Systems

Nominal Pipe Size mm	Allowance for Expansion (Leakage) (litres/100 m of pipe) 2 Hour Test
50	1.6
75	1.9
100	3.1
150	7.5
200	12.5

- 4.11.4.4.6 Total time under test pressure must not exceed eight (8) hours. If test is not accepted due to leakage or equipment failure, test section must be permitted to “relax” for eight (8) hour period prior to the next testing sequence.

4.12 LIST OF STANDARD DETAIL DRAWINGS

Standard details have been provided for the guidance of designers in the interpretation of the standards. Where the standards and the drawings conflict, the standards shall govern. Standard drawings are dimensioned in millimeters unless otherwise noted.

Refer to Section 10 for all Standard Detail Drawings

5.1 GENERAL

The requirements for water and sanitary sewer service connections shall be dependent upon the size and type of development to be serviced. The sizes and locations of these services shall be subject to approval by the General Manager.

No installation of services shall be permitted until approved in writing by the County.

5.2 WATER SERVICE CONNECTIONS

5.2.1 Unless calculated otherwise, the minimum size of water service connection to a single family dwelling shall be as follows:

- water service (unsprinklered dwelling) 38 mm
- water service (sprinklered dwelling) 50 mm

5.2.2 Water service connections for industrial, institutional, and multi-family areas shall be made at the time of subdivision development.

5.2.3 Water service connections shall be designed as a single connection from the main to the property. Service connections shall be located such that they do not conflict with potential driveway locations.

Refer to Standard Detail Drawing No. 5.1, Single Service Connection.

5.2.4 Dual Services

5.2.4.1 Dual servicing shall only be permitted where adequate separation to other services, including driveways, can be achieved. Adequate separation shall be considered as having been given if there is at least 1.5 metres horizontal clearance between the franchise utility and the curb stop.

5.2.4.2 Should the Developer wish to install dual services, a compiled plan shall be submitted for approval showing the proposed location of the proposed services, the proposed driveway location, and the location of all other utility services, including the franchise utility services. Dual services shall not be installed until such plan has been approved by the General Manager.

5.2.4.3 Where Dual Services have been installed, the Developer shall ensure that all lot purchasers are aware of the approved location of the driveway for each individual lot.

5.2.4.4 Dual Services may be installed in a common trench.

5.2.5 Where the water service is 50 mm or smaller, the water and sanitary sewer service connections may be installed in a common trench.

5.2.6 Materials

Water service connection material shall be:

5.2.6.1 PIPE & JOINTS

5.2.6.1.1 For industrial and multi-family services, continuous Type K copper conforming to American Water Works Association (AWWA) C800, or Series 160 polyethylene tubing conforming to American Water Works Association (AWWA) C901 and Canadian Standards Association (CSA) B137.1, or the latest version thereof, must be used for all diameters 50 mm and under. For all diameters greater than 50 mm, use water main piping. If using polyvinyl chloride (PVC) pipe it must conform to AWWA Specification C900, Class 150, using flexible Elastomeric Seals for services of size 100mm and larger.

5.2.6.1.2 For residential services, use Type K copper or Series 160 Polyethylene tubing.

5.2.6.1.3 Service box shall be epoxy coated extension type for maximum extension to 3.5 m, complete with Type 304 stainless steel with a stainless steel operating rod, and brass clevis by a cotter pin for connection to curb stop.

5.2.6.2 FITTINGS

5.2.6.2.1 Corporation (main) stops, required to be provided at the mains, shall be Mueller A220, 110 compression type, or approved equal.

5.2.6.2.2 Water service saddles shall be double strapped stainless steel.

5.2.6.2.3 Curb stops, required to be provided with each service connection, shall be Mueller, Oriseal Mark II, 110 compression type, or approved equal.

5.2.6.2.4 When using HDPE Pipe, stainless steel inserts shall be utilized at all compression fittings.

5.2.7 Installation

5.2.7.1 All water service lines shall be installed to provide a minimum depth of 2.75m of cover, including the “goose neck” or bend off the main.

5.2.7.2 The end of the water service connection shall be adequately capped or crimped and sealed.

- 5.2.7.3 If there is an easement for shallow utilities adjacent to the road right-of-way, the water service connection shall be extended one (1) metre beyond the limits of the shallow utility easement.

Refer to Standard Detail Drawing No. 5.1, Single Service Connection.

- 5.2.7.4 Wherever possible, service pipes shall be aligned at right angles to the main. If installation is not at right angles to the main, all connections, bends, tees, curb cocks, elevations, and locations shall be identified on the plan of record drawings.
- 5.2.7.5 For water service connections, up to 50mm, the taping shall be at the 2 to 3 o'clock position on the distribution main. Tapings shall have a minimum spacing of 600mm.

Refer to Standard Detail Drawing No. 5.2, Water Service Connection.

- 5.2.7.6 Curb stops and service boxes shall be supported on concrete block and installed to within 300mm of the property line at a location such that they do not conflict with potential driveway locations.
- 5.2.7.7 Attach curb stop, set service box plumb and adjust to grade. Service boxes to be marked with a 38x89 wood stake or 100mm PVC pipe 600mm above ground.
- 5.2.7.8 The end of the pipe shall be marked by a vertical, nominal size 38 mm x 89 mm timber, set 0.5 metre into the ground and extending one (1) metre above the top surface of the surrounding ground. The top 300 mm of the exposed portion of the marker shall be painted blue.

5.2.8 Backfill

- 5.2.8.1 Minimum service connection trench width shall be the pipe diameter plus 600mm, and wide enough so that the pipe(s) can be laid to alignment and at the depth required and compacted properly.
- 5.2.8.2 In general backfilling shall be carried out with approved native material in 300mm layers, compacted to a minimum of 98% Standard Proctor Density within the road right-of-way and 95% Standard Proctor Density in all other areas. The top 1 m shall be in 150mm lifts compacted to 98% Standard Proctor Density.

5.3 SANITARY SEWER SERVICE CONNECTIONS

- 5.3.1 The minimum size of sanitary sewer service connection to a single family dwelling shall be 150mm diameter with 150x100mm reducer.
- 5.3.2 Sanitary sewer connections for industrial, institutional, and multi-family areas shall be made at the time of subdivision development.. The minimum size sanitary sewer service connection shall not be less than 150mm.

- 5.3.3 Consideration shall be given to the depth requirements for servicing of these lots and the potential impact on the depth requirement for the downstream sewer main.
- 5.3.4 If there is an easement for shallow utilities adjacent to the road right-of-way, the service connection shall be extended one (1) metre beyond the limits of the shallow utility easement.
- 5.3.5 Under no circumstances will roof or surface drainage from buildings be permitted into the service connections of the sanitary sewer system.

5.3.6 Materials

Sanitary sewer service connection materials shall be:

5.3.6.1 PIPE & JOINTS

- 5.3.6.1.1 Polyvinyl chloride (PVC) DR28 building service pipe conforming to CSA specification B182.1, or the latest revision thereof.
- 5.3.6.1.2 Where specific products are specified, approvals must be obtained by the County prior to installation.

5.3.6.2 FITTINGS

- 5.3.6.2.1 Sewer fittings shall conform to the pipe material being used and shall be in accordance with the corresponding manufacturer's recommended standards and specifications.

5.3.7 Installation

- 5.3.7.1 The County must be notified in writing at least 1 week prior to connecting to an existing sewer main and written approval must be received before connections are made. Also to be included are a work plan identifying the necessary flow control and a contingency plan detailing the procedures to be observed in the event of problems during the connection process or in the event of other emergencies.
- 5.3.7.2 The sewer connection shall be by means of an in-line "wye" or "tee" for new installations, or by means of a saddle at the top gradient of the main for tie-ins to the existing lines.
- 5.3.7.3 Service connections to connect into existing mains shall be watertight. Where a saddle is used to connect to the main, any metal components of the saddle shall be stainless steel. Service connections shall not protrude into the main line.
- 5.3.7.4 Sanitary sewer service connections from the main to the property line shall be installed to provide a minimum of 2.75 m of cover below finished grade to the crown of the pipe. If the depth of cover cannot be achieved at all locations of the service length, High Load insulation can be installed.

Refer to Standard Detail Drawing No. 5.6, Insulation for Services.

5.3.7.5 The end of the sewer service connection shall be adequately capped or plugged to prevent the entry of earth, water, or other deleterious material into the pipe.

5.3.7.6 All sanitary sewer service connections shall be designed for gravity flow with a minimum grade of 2.0%.

Refer to Standard Detail Drawing No. 5.3, Sanitary Service Connection.

5.3.7.7 Where services are required to connect to mains in excess of 4.0 m in depth, risers shall be installed and properly plugged. The risers shall be firmly supported and anchored to the trench wall in all cases.

Refer to Standard Detail Drawing No. 5.4, Standard Riser Over 4.0 m.

5.3.7.8 The end of the pipe shall be marked by a vertical, nominal size 38 mm x 89 mm timber, set at the service invert and extending one (1) metre above the top surface of the surrounding ground. The top 300 mm of the exposed portion of this marker shall be painted green.

5.3.7.9 For trench widths and backfill requirements, refer to Section 3.7.

5.3.8 Inspection Chamber Or Manhole

5.3.8.1 A Sanitary sewer inspection chamber 0.5 m from property line shall be provided within the road right-of-way or easement for each service to residential lots.

Refer to Standard Detail Drawing No. 5.5, Inspection Chamber.

5.3.8.2 A sanitary sewer inspection manhole 0.5 m from property line shall be provided within the road right-of-way or easement for each service to industrial and institutional developments.

Refer to Standard Detail Drawing No. 5.7, Inspection Manhole.

5.4 SERVICE CONNECTION RECORD DRAWINGS

5.4.1 The Developer's Engineer shall provide detailed record drawings for all installed service connections.

5.4.2 Plan of record drawings must indicate the locations and elevations of water mains, corporation main stops, curb valves, and pipes in relation to property lines.

5.5 LIST OF STANDARD DETAIL DRAWINGS

Standard details have been provided for the guidance of designers in the interpretation of the standards. Where the standards and the drawings conflict, the standards shall govern. Standard drawings are dimensioned in millimeters unless otherwise noted.

Refer to Section 10 for all Standard Detail Drawings

6.1 General

This document summarizes the procedure and framework developed by Parkland County to ensure adequate drainage is provided for rural and urban areas. It preserves and promotes the general health, welfare, security, and economic well-being of the public and protects and enhances the water quality of receiving water bodies (as defined under the Water Act). All work completed to these standards shall also conform to the Alberta Environment and Sustainable Resource Development requirements outlined in the Environmental Protection and Enhancement Act (EPEA) and the Water Act.

It includes identification and description of the various drainage studies and reports that are required throughout the planning process (Part A). It also outlines methodology and design criteria (Part B) that apply to the design and implementation of storm drainage systems within Parkland County.

Storm Drainage Best Management Practices (BMPs): The determination and ultimately the design of appropriate Storm Drainage Systems shall adequately address the issue of stormwater quality. Specifically, Best Management Practices for stormwater management shall be followed as described in Section 5.3 of the Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems as published by Alberta Environment and Sustainable Resource Development (latest edition thereof).

Constructed wetlands are human-made systems, designed, constructed and operated to emulate natural wetlands or many of their biological processes. They are shallow impoundments, planted with emergent rooted vegetation. The use of constructed wetlands for further water quality enhancement is strongly encouraged prior to discharge to a receiving water body.

Wet ponds are the second most preferred method of treating stormwater. They temporarily store storm water runoff in order to promote the settlement of runoff pollutants and restrict discharge to predetermined levels to reduce downstream flooding and erosion potentials. Wet ponds retain a permanent pool during dry weather.

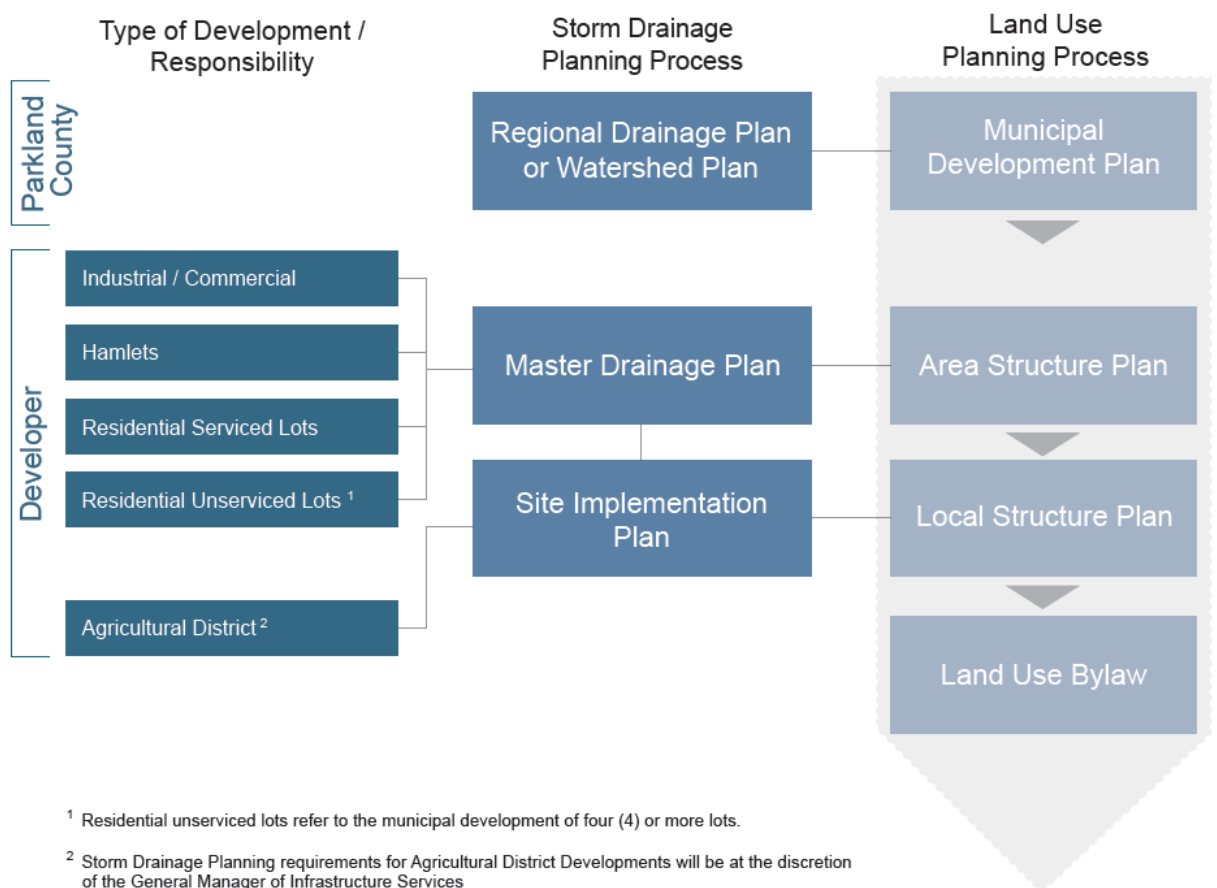
Dry ponds are utilized as a means of attenuating the peak stormwater runoff rates that are experienced in the collection system immediately after a rainfall event. Dry ponds do not address the quality of the stormwater runoff. Best Management Practices shall be used downstream of all dry ponds to properly address the quality of the stormwater being produced by the stormwater management system.

In accordance with Council Policy C-PD08, all storm water management facilities constructed after January 1st 2015 shall be designed and built as a Naturalized Storm Water Facilities.

6.2 PART A: PLANNING STUDIES

6.2.1 Planning Approval Overview

Storm Drainage Planning and responsibility as related to Parkland County's Land Use Planning approval process is illustrated below. Each Storm Drainage Planning stage requires a report to be submitted and accepted as prerequisite to the subsequent stages of planning and development. The ensuing sections identify the level of analysis and report requirements that correspond to each.



6.2.2 Planning and Design Studies**6.2.2.1 REGIONAL DRAINAGE PLAN/WATERSHED PLAN**

Regional drainage / watershed planning includes cooperative local and regional land use planning that recognizes watershed boundaries rather than political or land ownership boundaries. This planning also considers water resources management to be the central planning objective. The study includes:

- Assessment of environmental concerns;
- Assessment of future drainage requirements;
- Assessment of flood protection levels;
- Establishment of environmental constraints; and
- Establishment of policies and criteria for storm drainage systems

This plan will normally specify performance criteria that a Master Drainage Plan should be designed to satisfy. Such performance criteria could include:

- The requirement for lot level controls and site planning techniques to promote infiltration and maintain the water balance;
- Allowable types of end-of-pipe stormwater management facilities;
- Approximate locations for end-of-pipe stormwater management facilities;
- Required levels of control (storage or recharge volumes/retention times) for flood control, water quality maintenance, and erosion protection;
- Special Master Drainage Plan design requirements (that is, thermal mitigation measures, enhanced nutrient control, spill capture/control enhancements); and
- Requirements for special-purpose Master Drainage Plans. (For example, oil/grit separators for specified land uses, disinfection processes, etc.)

This level of planning is typically a joint responsibility between the County and Province.

6.2.2.2 MASTER DRAINAGE PLAN

The Master Drainage Plan includes the development of the proposed drainage servicing scheme to address both short- and long-term requirements of the development area. The study is to outline the development area, evaluation and selection of the optimum stormwater management plan. The storm drainage components of the Master Drainage Plan should be based on the concepts developed in the Watershed Plan and should resolve any specific concerns raised in those studies. These components should also address any significant constraints. If there is no Watershed Plan for the area, the requirements must be agreed in advance with Parkland County.

The Master Drainage Plan includes the development of the proposed drainage servicing schemes that will meet the short- and long-term servicing needs of the development area. The study is to outline the development and selection of design alternatives.

Master drainage planning is carried out by identifying and comparing alternative facility locations, sizes, and types, and will include the selection of the most suitable alternative. While the Master Drainage Plan need not include a rigorous comparison of alternatives considered, the selection of the proposed servicing schemes are to be adequately justified on the basis of relative merit, and must consider constraints identified in previous studies, short-term and long-term economic viability, and equity for those parties who will eventually share in the costs of the facilities.

Master Drainage Plans must be prepared and certified by a qualified Professional Engineer who is registered to practice in the province of Alberta. The following checklist identifies the typical requirements to be addressed in the Master Drainage Plan. This checklist is provided in Appendix A and is to be included in the Master Drainage Plan submission to the County.

- Watershed and development in relation to it;
- Summary of Preliminary Drainage Report or Watershed Study and any other available plans/reports;
- Existing topography (contour plan);
- Details of watercourse crossings, e.g. culverts, bridges, and roads;
- Details of watercourse and valley reaches including typical x-sections;
- Identify existing and proposed drinking water sources including surface and/or groundwater sources;
- Natural storage and drainage;
- Existing land ownership;
- Existing land use;
- Identification of pre-development flows;
- Identification of pre-development and post-development run-off rates (Parkland County will provide this information);
- Proposed development and land use including grading plans, sub catchment boundaries;
- Interim and ultimate servicing plans;
- Proposed storage requirements including storage volume and location, lake overflow alternatives, real time control operating rules and control parameters;
- Proposed major drainage system;
- Proposed minor drainage system;
- Description of constructed wetlands, wet ponds, or dry ponds:
- Dry ponds shall only be used at the discretion of the County as a last resort when constructed wetlands and/or wet ponds are not possible, no new dry ponds shall be considered by the County after January 1st 2015;
- Description of best management practices (BMPs);
- Description of water quality improvements;
- Use of natural features, for example sloughs;
- Identification of unusual factors affecting operation and maintenance costs;
- Identification of potential surcharging;

- Address Erosion and Sedimentation Controls (ESC);
- Flood levels for lakes for design storms simulated;
- 100 year flood levels for ravines;
- Identification of the need for water quality control;
- Provide wetland, (including existing natural wetlands), to watershed ratio;
- Identification of requirements for pollutant control and determination of allowable pollutant loads;
- Review of outlet operating constraints and sufficiency of depth;
- Determine outlet arrangement and review hydraulics to ensure adequate rates of drawdown can be achieved at all levels of storage;
- Hydraulic analysis, by suitable methods, to provide post-development hydrographs for the minor five year design storm event and appropriate major historical design events, considering the following options:
 - 100 year storm (4 hour Chicago and 24 hour Huff distributions)
 - 1937 storm
 - 1978 storm
 - 1988 storm
 - 120mm of runoff over the entire basin assuming zero discharge
- System draw down curve should be provided; and
- Outline the proposed staging and or implementation plan.

Upon acceptance by Parkland County, this information will need to be submitted by the Developer's Engineering Consultant to Alberta Environment and Sustainable Resource Development.

6.2.2.3 SITE PLAN IMPLEMENTATION

Site Implementation Plans shall be prepared in conformance with the criteria and development requirements set out in the Master Drainage Plan where applicable, and must be prepared and certified by a qualified Professional Engineer who is registered to practice in the province of Alberta. Site Implementation Plans deal with the detailed design and implementation of a development.

The design stage includes the preparation and submission of the site implementation plan for County acceptance. The implementation stage requires certification by the developer that the work has been constructed in accordance with the plan and has been accepted by the County.

Design Stage – Plan Submission Requirements

Site Implementation Plans shall be submitted to Parkland County for review and acceptance and subsequently to Alberta Environment and Sustainable Resource Development for Water Act approval. This must be done, prior to undertaking any development work on the proposed site.

On completion of review of the Site Implementation Plans, the applicant will be notified if the plan is accepted or if revisions are required. If revisions are to be

made, a list will be sent to the applicant to address the comments and to re-submit the revised Site Implementation Plan for further review.

If revisions to the accepted Site Implementation Plan are required, a revised drawing (red-line revision) must be sent to Parkland County Engineering Services or Planning Services Departments along with the written consent of the affected property owners for review and approval. An accepted revised Site Implementation Plan will supersede the previously accepted Site Implementation Plan.

Multi Lot Developments (4+): The following check list identifies the typical requirements to be addressed in the Site Implementation Plan for Multi Lot Developments. This checklist is provided in Appendix B and is to be included in the Site Implementation Plan submission to the County. Identification and summary of engineering drawing requirements is also included in Appendix B.

- Outfall points;
- Overland flow routes and flow rates;
- Ponding depths;
- Flood profiles for lakes and ravines for 5 year, 10 year, 25 year, 100 year and critical historical storm events for interim and ultimate development;
- Details of minor drainage system including:
 - Outfall points
 - Alignments
 - Pipe sizes
 - Pipe grades, profiles and invert elevations
 - Pipe capacities
 - Manholes;
- 25 year and 5 year peak flows for interim and ultimate development;
- Road grades;
- Calculation of flows captured by minor system during 100 year storm and associated hydraulic grade lines, with particular attention to locations where there is increased potential for outflows from the system (manholes and inlets at relative low points);
- Unusual factors affecting operation and maintenance costs;
- Proposed flood control;
- Land requirements - easements, public utility lots;
- Controlled discharges from stormwater management facilities;
- Hydrographs at outfalls;
- Pre-development versus controlled post-development flows at outfalls;
- Determination of type of storage, e.g. constructed wetland, wet or dry ponds;
- Details of storage facilities, including landscaping and vegetation in constructed wetlands;
- Proposed stormwater management facilities maintenance;
- Details of constructed wetlands;
- Earthwork balance assessment;
- Vegetation plan for constructed wetlands;

- Vegetation management plan for constructed wetlands;
- Proposed water quality control;
- An Erosion and Sedimentation Control Plan;
- Hydraulic aspects of pond inlets and outfalls - for example spillways;
- Staging/implementation plan;
- Details of any oversizing for adjacent areas;
- Preliminary costs of trunk sewers and major system components; and
- Financing considerations regarding cost shareable trunk sewers and facilities.

Single Lot Industrial Developments: The following check list identifies the typical requirements to be addressed in the Site Implementation Plan for Single Lot Industrial Developments. This checklist is provided in Appendix B and is to be included in the Site Implementation Plan submission to the County.

- A scale drawing of the property in metric units, designed by the Developer's Engineer;
- Existing surface elevations, contours and surface grades of the property based on geodetic datum;
- Proposed geodetic surface elevations at the property corners and at intervals around the perimeter of the property;
- Proposed geodetic surface elevations adjacent to the foundation walls or concrete slab-on-grade for each proposed building;
- Proposed direction of surface drainage flow, indicated by arrows;
- Proposed locations and gradients of swales;
- Cross section details of proposed swales;
- Proposed surface conditions e.g. sod, asphalt, concrete, gravel;
- Provisions for accommodating overland flows from adjacent undeveloped lands;
- Property information: legal description, subdivision or neighbourhood, property address or road names and north arrow; and
- Space near the bottom right hand corner of the plan for the Approval Stamp.

1 to 3 Lot Residential and Agricultural District Development: The following is required as part of the application for detailed design approval:

6.2.2.3.1 Submission of a letter that briefly explains the drainage system and the methodology used. The letter and plan must be sealed and signed by the Developer's Engineer. A coordinated submission with other site plans should be made in order to ensure proper compliance. All utility construction should be in accordance with Parkland County Standards. The report must contain all pertinent information on the stormwater management system, including but not limited to the following:

- Orifice sizing calculations;
- Required storage volume calculations and how they are achieved;
- Calculation showing maximum allowable outflow;

- The equation used to calculate the runoff rate. Areas and associated runoff coefficients; and
 - Calculations showing the depth, velocity and flow in the overflow swale for events exceeding the 1:25 year event.
- 6.2.2.3.2 Overall Utility Plan (showing all utility lines and appurtenances, inverts and rims, type and size of flow control device, materials, etc.). Provide a note stating “No ground water or stormwater shall be discharged to the sanitary sewer.”
- 6.2.2.3.3 Lot Grading Plan (showing ponding depths, storage areas, basin boundaries, overflow location, finished grades, original contours, building main floor elevation, etc.).
- 6.2.2.3.4 Design Requirements include but are not limited to:
- Peak outflow rate based on the receiving storm systems 1:5 year capacity;
 - Minimum orifice 75mm and a minimum pipe size of 150mm;
 - Roof leaders must discharge to a landscaped area wherever possible;
 - The entire site, defined as the legal boundary, must be incorporated into the design. Calculations shall be based on the ultimate development plan including any future building or parking additions; and
 - Consideration should be given to reduce point source pollution.

Implementation Stage – Acceptance of Constructed Lot Grading

As-built grading plans must be certified (signed and sealed) by the Developer’s Engineer. Lot Grading Plans must display the following information listed below. This checklist is provided in Appendix B.

- Name of the company or individual that produced the certificate;
- Proof of Professional Liability Insurance (for errors and omissions) for the corporation or individual named on the certificate;
- Legal description and municipal address of the property;
- Surface condition of the lot such as clay, topsoil, sod, or landscaped;
- A note indicating that the lot grading is subject to the acceptance of the local authority;
- Design and as-built property line, and side-lot internal swale invert elevations referenced to metric geodetic datum, with an asterisk (*) designating existing elevations that exceed the grade tolerance;
- Reference to the Alberta Survey Control Monument that was used to obtain as-built elevations;
- As-built elevations of structures, such as retaining walls, sidewalks, driveways, fences and garage/parking pads;

- As-built property line and any side-lot internal swale invert elevations opposite the corners of the building, for locations that are more than 3 metres from a design point;
- Any break point elevation;
- Corner and rear foundation grade as-built elevations, including an additional elevation 2 metres from the back of the house;
- Rough grading of all lots to be within +/- 50mm of the final grades around the perimeter of the lots;
- Drainage easements and right-of-ways with as-built invert and lip elevations, as required, for any concrete or grass drainage swale;
- Detail survey of lake lot with all structure or feature locations and as-built elevations within the maintenance and overflow area;
- Lot orientation is portrait, with the rear of the lot at the top of the page and the "FRONT" of the lot labelled;
- Date of as-built survey;
- Scale of drawing;
- Building layout;
- Garage/parking pad layout;
- North arrow;
- Legend; and
- Name and information for the applicant's preferred method to receive inspection reports or grading acceptance (mail, fax or email).

6.2.3 Federal and Provincial Approvals and Authorizations

It is the responsibility of the Developer's Consultant to obtain approval from all authorities having jurisdiction, including but not limited to those listed below.

6.2.3.1 FEDERAL

6.2.3.1.1 Navigable Waters Protection Act (NWPA):

Should an improvement involve crossing over or under "navigable water," either a permit or an exemption from the requirement must be obtained from the appropriate federal department.

6.2.3.1.2 Fisheries Act:

The main part of the current Fisheries Act (F-14) dealing with the protection of fish habitat is a straightforward prohibition that states "no person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat". Where work or an improvement could cause harmful alteration, disruption, or destruction (HADD) of fish habitat, legal approval must be obtained from Fisheries and Oceans Canada. The approval may take the form of an Operational Statement, a Letter of Advice, or an Authorization. If an approval is granted, the "alteration, disruption or destruction" of fish habitat will be subject to conditions prescribed in the Operational Statement, Letter of Advice, or Authorization.

- 6.2.3.1.3 Canadian Environmental Assessment Act (CEAA):
The Canadian Environmental Assessment Act (CEAA) is federal legislation that requires environmental assessments for proposed projects or activities that are to be carried out on federal lands, and where the Government of Canada has decision-making authority. The Act ensures that proposed projects and activities do not cause significant adverse effects on the environment, and that there is an opportunity for public participation. The Fisheries Act and the Navigable Waters Protection Act (NWPA) are both triggers for a more detailed federal environmental review under the CEAA.

6.2.3.2 PROVINCIAL

- 6.2.3.2.1 Environmental Protection and Enhancement Act (EPEA):
Pursuant to the Alberta Environmental Protection and Enhancement Act, the Developer will apply, on behalf of Parkland County, for Letters of Authorization from Alberta Environment and Sustainable Resource Development to permit the construction of sewer and drainage infrastructure for the areas of subdivisions approved by the County. Construction of the sewer and drainage infrastructure for a specific development shall not commence by the Developer prior to the issuance by Alberta Environment and Sustainable Resource Development of a Letter of Authorization including the development area.

After EPEA approval the County may require the engineering drawings to be submitted to Alberta Environment and Sustainable Resource Development, further to their requirements under the Alberta Environmental Protection and Enhancement Act and/or the Water Act, and to other authorities whose approval must be obtained prior to commencement of any construction.

- 6.2.3.2.2 Water Act:
Pursuant to the Water Act, a license is required for drainage facilities involving the impoundment of water for the purpose of water management, or the diversion of water, or the discharge of water to a water body, as defined by the Alberta Environment and Sustainable Resource Development and the Water Act. The Consultant shall be responsible for applying to Alberta Environment and Sustainable Resource Development for a drainage license when required and for obtaining the necessary approvals prior to the construction of those facilities.

- 6.2.3.2.3 Public Lands Act:
Where a proposed facility may encroach on crown lands, a License of Occupation would be required under the Public Lands Act. Construction of an outfall discharging to a major watercourse is an example of this.

6.3 PART B: STORMWATER DESIGN STANDARDS

6.3.1 General

Prior to submission of any detailed design, a stormwater management plan shall be prepared by the Developer's Engineer, acceptable to Parkland County and Alberta Environment and Sustainable Resource Development. The stormwater management plans shall be consistent with the standards outlined in this document.

6.3.2 Level of Service

All stormwater drainage systems shall meet the following minimum level of service objectives:

- 6.3.2.1 Avoid all property damage and flooding and minimize any inconveniences to the general public due to runoff from 1:5 year and more frequent rainfall events.
- 6.3.2.2 Avoid property damage from 1:100 year rainfall events.
- 6.3.2.3 Avoid loss of life and injuries and minimize damage to property through the control of runoff during unusual or infrequent storm events with high intensity rainfall and large runoff volumes.
- 6.3.2.4 Avoid degradation of receiving water bodies.

6.3.3 Design Requirements

- 6.3.3.1 The design of the Stormwater Management System shall conform to the Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems as published by Alberta Environment and Sustainable Resource Development (latest edition thereof) and as amended by these Procedures and Design Standards for Development.
- 6.3.3.2 Parkland County may advise of existing Stormwater Master Plans, Water Act Agreements, etc. applicable to the development location and they shall be reviewed by the Developer and their Consulting Engineers to understand any identified system constraints and future servicing strategies that have implications for the proposed development. Stipulated design requirements identified in any Water Act Agreements and their referenced documentation shall form part of these Stormwater Design Standards and in case of conflict, the Water Act Agreement requirements shall apply.
- 6.3.3.3 The storm system shall be designed as an independent system from the sanitary sewer system. Storm system shall be of sufficient capacity to adequately manage the stormwater runoff generated by the ultimate contributing area of the proposed development. Stormwater management systems shall be designed utilizing the major/minor storm drainage system concept.

- 6.3.3.4 The minor storm drainage system in subdivision development areas in Parkland County shall typically follow the rural concept where the collection and conveyance of surface drainage will generally be by way of roadside ditches.
- 6.3.3.5 The major storm drainage system (roadway systems, detention/retention facilities, parks and open space, and any other land required to manage the runoff generated by rainfall events from 1:100 year return period rainfall events) is designed to provide flood control and shall provide sufficient storage volumes so that all properties located within, and adjacent to, the proposed development are protected from flood damage during the 1:100 year rainfall event.
- 6.3.3.6 Sanitary sewer effluent, as well as any drainage/effluent streams from industrial, agricultural, or commercial operations that may potentially be contaminated, shall not be discharged to the stormwater management system. Roof drainage downspouts from residential buildings shall not be directly connected to the storm sewer system.
- 6.3.3.7 Roof drainage downspouts from single and dual family dwellings shall be discharged to grassed or pervious areas. The point of discharge shall be a minimum of 1.2 m away from the building and positively drained away from any building. Roof drainage downspouts from multi-family buildings, commercial areas, and industrial areas are encouraged to be discharged to grassed or pervious areas.
- 6.3.3.8 Properly graded and surfaced roads/lanes, landscaping, and sediment control structures at storage facility inlets and outlets shall be used to minimize sediment discharge into the stormwater collection system and receiving water body.
- 6.3.3.9 Confirmation of pre-development and post-development run-off rates.
- 6.3.3.10 Foundation drain (weeping tile) sump pumps shall discharge collected water to the surface for overland flow.
- 6.3.3.11 The implementation of the principles of the stormwater treatment train is strongly encouraged and must be reviewed and accepted by the General Manager of Infrastructure Services. A typical stormwater treatment train strategy includes:
 - 6.3.3.11.1 Site prevention management: control of smaller and bigger particles that pollute and clog our natural (water) systems. Best Management Practices (BMP's) include erosion and sediment control, pollution prevention, and good housekeeping.
 - 6.3.3.11.2 Source control: reduce runoff flows through capture, attenuation, infiltration and evapotranspiration at the location of rainfall. BMP's include absorbent landscaping, green roofs, permeable pavements, and rainwater re-use at user level (like irrigation, heating/cooling and toilet flushing).

6.3.3.11.3 Site Control: capture, treat and infiltrate first flush of runoff from impervious areas on “street” scale. BMPs include bioretention, bioswales, raingardens, and silva cells.

6.3.3.11.4 Local area control: store and treat runoff flows on larger scale, providing possible natural habitats. BMPs include wet ponds, wetlands, and other forms of stormwater capture and reuse (like neighbourhood scale water treatment and reuse for industries, cooling/heating, and irrigation).

6.3.3.12 The Developer shall provide all detailed design calculations concerning the stormwater management system to the County for review and acceptance.

6.3.4 Stormwater Outfalls

6.3.4.1 Proper outfall structures shall be placed at the end of all stormwater outfall pipes that discharge to open channels or receiving water bodies. The outfall structures shall provide a means for reducing the velocity of the discharge flow and dissipating the associated energy. As well, these structures shall incorporate the necessary design features to prevent erosion of the surrounding environment.

6.3.4.2 Outfall structures must receive written approval from the following federal and provincial regulatory authorities if applicable (Developer shall obtain all necessary regulatory approvals and permits at their own expense):

Federal

- Transport Canada - Navigable Waters Protection Act
- Department of Fisheries and Oceans – Fisheries Act

Provincial

- Alberta Environment and Sustainable Resource Development – Water Act
- Alberta Environment and Sustainable Resource Development – Public Lands Act

Note that the government departments listed above are responsible for the noted legislation at the time of printing and may be subject to change.

6.3.4.3 Outfall structures may be a chute, spillway, stilling basin, or plunge pool with headwall. Cut off walls are required at the end of the outfall apron to prevent undermining support structure.

6.3.4.4 Obverts of outfall pipes shall be at least 150 mm above the 1:5 year flood level for the receiving water body. Inverts of outfall pipes shall be above winter ice level or submerged below the winter ice level. Stormwater outfalls shall be protected against damage from moving ice during spring break-up.

- 6.3.4.5 Outfall structure aprons shall be 150 mm to 225 mm above the invert of the receiving water body to prevent the collection of debris on the apron.
- 6.3.4.6 Weeping tile shall be placed under the structure to reduce the effects of water pressure on the headwall of the outfall structure.
- 6.3.4.7 Safety railings and trash screens shall be installed in the outfall structure to prevent human access.
- 6.3.4.8 Stormwater outfall structures shall be properly landscaped and finished so that they may blend in with the existing topography as much as possible.

6.3.5 Receiving Water Bodies

- 6.3.5.1 Necessary measures shall be incorporated into the design of proposed developments to limit, or prevent, increases in the amount of downstream erosion experienced by receiving water bodies as a result of the development.
- 6.3.5.2 Preservation of receiving water body aesthetics and wildlife habitat shall be a high priority for all erosion protection and bank stability work.

6.3.6 Analysis of Minor Storm Drainage Systems

Runoff Analysis methods outlined herein are considered to be appropriate for most circumstances encountered in Parkland County. The General Manager may, however, approve other methods as deemed to be appropriate.

- 6.3.6.1 For areas less than 65 hectares (ha) in size, computer modelling techniques are encouraged. However, the Rational Method may also be used to develop design flows for the minor stormwater management system. For areas greater than 65 ha, computer modelling shall be used to determine the design flows. The Rational Method formula is as follows:

$$Q \text{ (L/s)} = 2.78 CiA \quad \text{or} \quad Q \text{ (m}^3\text{/s)} = CiA/360$$

Where

- Q = design peak flow rate
- i = rainfall intensity (mm/hr)
- A = contributing area (ha)
- C = runoff coefficient

Note: rainfall intensity corresponds to the time of concentration

- 6.3.6.2 For areas of uncontrolled discharges greater than 30 ha in size, Rational Method design flows must be increased by a factor of 25%, or computer modelling must be used.
- 6.3.6.3 The Intensity Duration Frequency (IDF) design intensities shown on Table 6.1 shall be used. Runoff coefficients shall be according to those shown in Table 6.2.

- 6.3.6.4 A weighted average of pervious and impervious area runoff coefficients shall be used when the surface characteristics for a specific contributing area are not uniform and of one type. The weighted average runoff coefficient can be computed using the following calculation:

$$C_{WA} = (C_p A_p + C_i A_i) / (A_p + A_i)$$

Where P = pervious surface
 i = impervious surface

Note: $C_p = 0.15$ and $C_i = 0.90$

- 6.3.6.5 The duration of rainfall used to determine the corresponding rainfall intensity is equal to the time of concentration (T_c). The time of concentration is equal to the time for the overland runoff flows from the furthest point in the contributing area to reach the storm sewer inlet plus the time of travel in the sewer.

- 6.3.6.6 Computer modelling shall be used for stormwater drainage design using the following guidelines:

- 6.3.6.6.1 When using computer modelling techniques, the minor stormwater management system shall be designed to convey the runoff from the 1:5 year, 4 hour Chicago and 24 hour Huff design storm shown in Table 6.3 and Table 6.4, respectively.
- 6.3.6.6.2 High density country residential and industrial development areas greater than 40 hectares in size.
- 6.3.6.6.3 Low density country residential development areas greater than 65 hectares in size.
- 6.3.6.6.4 Any system requiring storage or detention facilities in addition to on-line storage such as may be provided by roadside ditches.
- 6.3.6.6.5 Alternatively, computer modelling may be used for areas smaller than those outlined above.

6.3.7 Analysis of Major Storm Drainage Systems

- 6.3.7.1 Computer modelling techniques shall be used to determine design flows for the design of the major stormwater management system. For areas less than 65 ha, the Rational Method may be used to determine design flows for surface conveyance elements only and may not be used to size stormwater management facilities.
- 6.3.7.2 The selection of an appropriate computer model shall be based on a solid understanding of the principles, assumptions, and limitations of each model and methodology in relation to the system being designed. Computer modelling shall be completed using XPSWMM modelling software.

- 6.3.7.3 Wherever possible, the computer model shall be calibrated. In all analyses, the parameters used, the drainage boundaries, and the storm sewer collection network shall be clearly identified on an overall drawing. Computer printouts and a design summary report shall be provided to the General Manager of Infrastructure Services for review.
- 6.3.7.4 4 hour design storms using the Chicago distribution, as shown in Table 6.3, shall be used to design major stormwater management system conveyance elements.
- 6.3.7.5 24 hour design storms using the Huff distribution, as shown in Table 6.4, shall be used to design major stormwater management system storage elements.
- 6.3.7.6 The major stormwater management system shall be analysed using the 1:100 year design storm event and the following design criteria:
 - 6.3.7.6.1 The lowest building opening shall not be inundated with flood waters at any time.
 - 6.3.7.6.2 Continuity of overland flow routes between adjacent developments shall be maintained.
 - 6.3.7.6.3 The velocities and depths of overland flow in the major stormwater management system shall not exceed the values contained in Table 6.5.
- 6.3.7.7 Lot grading shall meet the following design requirements:
 - 6.3.7.7.1 Minimum slope in back and front yards shall be 2%.
 - 6.3.7.7.2 If the backyard slopes towards the house, provisions must be made to keep the stormwater runoff at least 3 m from the house and runoff must be directed to the road for subsequent collection.
 - 6.3.7.7.3 Reverse (back sloping) driveways shall not be permitted.
 - 6.3.7.7.4 Lot grading must not direct drainage flows onto adjacent properties.

6.3.8 Design of Stormwater Management Facilities

6.3.8.1 GENERAL

- 6.3.8.1.1 Stormwater management facilities shall be designed as an integral part of both the minor and major storm drainage systems. These facilities shall attenuate the peak post-development runoff flow hydrograph for the 1:100 year return period storm event to the peak flow calculated under pre-development conditions for the same contributing area.
- 6.3.8.1.2 The pre-development and post-development run-off conditions shall be analysed for the 5 year, 25 year, and 100 year events.

- 6.3.8.1.3 The high water level shall be established based on the runoff, less the outflow, from the 1:100 year, 24 hour Huff storm event.
- 6.3.8.1.4 All stormwater management facilities, and the entire area of land inundated by flood waters during the 1:100 year event, top of bank, 3.0 m wide maintenance access along the top of bank with fence, shall become property of the County (Public Utility Lot).
- 6.3.8.1.5 In assessing the need for a stormwater management facility to be included as part of a proposed development, the applicant must consider the impacts of uncontrolled stormwater drainage on the development itself, and on the surrounding environment as well as any potential impacts on receiving watercourses. The type of facility to be used shall be based on the principles of Best Management Practices (BMP's) for end of pipe treatment of stormwater runoff, and shall be subject to approval by the General Manager of Infrastructure Services.
- 6.3.8.1.6 The design of all stormwater management systems shall adequately address the issue of stormwater quality. Specifically, Best Management Practices for stormwater management shall be followed as described in Section 5.3 of the Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems as published by Alberta Environment and Sustainable Resource Development (latest edition thereof).
- 6.3.8.1.7 Constructed wetlands are human-made systems, designed, constructed and operated to emulate natural wetlands or many of their biological processes. They are shallow impoundments, planted with emergent rooted vegetation. Constructed wetlands are designed to meet specific water quality and quantity objectives. Sedimentation, filtration, biological and chemical processes affect water quality improvement. It has been shown that constructed wetlands effectively lower biochemical oxygen demand, total suspended solids, and total nitrogen concentrations.
- 6.3.8.1.8 Wet ponds are the second most preferred method of treating stormwater. They temporarily store storm water runoff in order to promote the settlement of runoff pollutants and restrict discharge to predetermined levels to reduce downstream flooding and erosion potentials. Wet ponds retain a permanent pool during dry weather.
- 6.3.8.1.9 Soils investigations, specific to the type of stormwater management facility being considered, shall be undertaken to determine the appropriate design factors and field conditions. If a stormwater management facility is to be located above a shallow aquifer, the potential for groundwater contamination must be considered and the necessary measures shall be taken to minimize the potential impacts.

- 6.3.8.1.10 The design of any stormwater management facility shall consider the aesthetic implications of shape, size, grading, and required landscape features.
- 6.3.8.1.11 Sufficient outlet capacity shall be provided to permit post-event drawdown of the water levels in the storage facilities such that the availability of storage capacity is restored within the following time frames:
- 5 year event capacity within 24 hours;
 - 25 year event capacity within 48 hour; and
 - 95% of 100 year event capacity within 96 hours.
- 6.3.8.1.12 Emergency overflow provisions (overflow channels and overland drainage route) shall be provided, where feasible, for stormwater management facilities. If provided, a freeboard depth of 0.6 m shall be required. If emergency overflow means cannot be provided, a freeboard depth of 1.0 m shall be required.

6.3.9 CONSTRUCTED WETLANDS

Constructed wetlands are human-made systems, designed, constructed and operated to emulate natural wetlands or many of their biological processes. They are shallow impoundments, planted with emergent rooted vegetation. Constructed wetlands are designed to meet specific water quality and quantity objectives. Sedimentation, filtration, biological and chemical processes affect water quality improvement. It has been shown that constructed wetlands effectively lower biochemical oxygen demand, total suspended solids, and total nitrogen concentrations.

6.3.9.1 DESIGN STANDARDS FOR CONSTRUCTED WETLANDS LARGER THAN 1 HECTARE IN SIZE:

- 6.3.9.1.1 For details refer to – Schematic Diagram of Large Constructed Wetland in Section 0 and to – Design Summary Guide for Large Constructed Wetland in Section 0.

6.3.9.2 LAND DEDICATION AND EASEMENT REQUIREMENTS FOR CONSTRUCTED WETLANDS

- 6.3.9.2.1 The land required for the constructed wetland will be dedicated to the County.
- 6.3.9.2.2 It is not a part of the municipal reserve provided by the Developer to the County.
- 6.3.9.2.3 It is not part of an environmental reserve.
- 6.3.9.2.4 Generally, the area of land which would be covered by water when the water level is at the most critical design storm event level, high

water level, will be designated as a "Public Utility Lot." This designation will also apply to all rights-of-way for access to and protection of inlets, outlets and flow control facilities, and for maintenance access routes to the wetland.

6.3.9.2.5 Lots abutting the constructed wetland are allowed provided that there are areas around the wetland that are open for maintenance access routes to the wetland and secondary uses to the public.

6.3.9.2.6 A restrictive covenant will be placed upon lots abutting the constructed wetland to control lot development so as not to compromise the design requirements of the stormwater management facility and ensure that an adequate freeboard is maintained. Where overland overflow is available, a minimum of 0.3 m freeboard above HWL is acceptable. Otherwise, a minimum of 0.5m is required.

6.3.9.3 WETLAND DRAINAGE AREA

6.3.9.3.1 Wetland size should be approximately 5 % of the watershed area that it will be servicing.

6.3.9.3.2 The County prefers that fewer, larger wetlands be constructed rather than a series of smaller constructed wetlands.

6.3.9.3.3 The Developer is required to implement an Erosion and Sediment Control Plan during development in the drainage area to minimize sediment loading to the forebay and wetland during the construction phase of the project and during the staged construction of the stormwater management facility.

6.3.9.4 WETLAND SOIL CHARACTERISTICS

6.3.9.4.1 For wetland deep water areas, low soil permeability of 10⁻⁷ m/s is recommended to maintain a permanent pool of water and minimize exfiltration. Compacted sandy clays and silty clay loams may be suitable provided that documented geotechnical testing demonstrates low soil permeability.

6.3.9.4.2 Wetland vegetative zones can be constructed using soils from recently displaced wetlands, sterilized topsoil, or peat from within the drainage basin or region. A layer of 10 cm to 30 cm of soil shall be spread over the vegetation zones of the constructed wetland. Planting will be done in this soil over the 2 years following construction.

6.3.9.5 WETLAND VEGETATION

- 6.3.9.5.1 After construction and placement of soil the entire vegetation area shall be planted with an aggressive water tolerant grass species as the pioneer colonizer to quickly establish a protective canopy and rigorous root development to stabilize the soil. For examples of acceptable plant species refer to APPENDIX C,
- 6.3.9.5.2 Vegetation can be cost effectively transplanted from local donor sites and ditches maintained by the Province and from construction sites where small pocket wetlands are to be removed.
- 6.3.9.5.3 In the spring of the year following construction the entire vegetation zone shall be overseeded with legumes and wild flowers. Also, at approximately the same time, the area above NWL shall be planted with 50% of the woody species. Plants shall be selected for tolerance to flooding and oxygen-reduced environments. For examples of acceptable plant species refer to APPENDIX C.
- 6.3.9.5.4 One year after completion of construction a stable mixture of water tolerant grasses shall be in place.
- 6.3.9.5.5 In the spring of the second year following construction the non-surviving woody plants shall be replaced and the remaining 50% of the woody plants shall be planted. For examples of acceptable plant species refer to APPENDIX C.
- 6.3.9.5.6 Two years after completion of construction a diverse population of water tolerant grasses, native grasses, wild flowers, and water tolerant woody plants shall have taken root.
- 6.3.9.5.7 Manipulation of water levels may be used to control plant species and maintain plant diversity.
- 6.3.9.5.8 Harvesting emergent vegetation is not recommended.

6.3.9.6 UPLAND VEGETATION IN THE EXTENDED DETENTION STORAGE AREA AROUND THE WETLAND

- 6.3.9.6.1 Requirements for screening the constructed wetlands, between NWL and HWL, from adjacent land uses and for visual aesthetics shall be agreed by the Developer and the County.

- 6.3.9.6.2 A mow strip of a minimum of 2 m shall extend from the public utility lot boundary towards the constructed wetland NWL. This is to act as a safety bench and weed barrier to prevent root invasion of adjacent properties by Poplar and Aspen species.
- 6.3.9.7 WETLAND WATER DEPTH
- 6.3.9.7.1 Use a variety of water depths, 0.1 m to 0.6 m with an average permanent water depth of 0.3m, to encourage emergent vegetation.
- 6.3.9.7.2 Deep water areas, i.e. greater than 2 m, are to be limited to less than 25% of wetland surface area.
- 6.3.9.7.3 Water level fluctuation in excess of 1 m above NWL should be infrequent to prevent killing of the vegetation.
- 6.3.9.8 WETLAND SURFACE AREA
- 6.3.9.8.1 The surface area of the constructed wetland shall be a minimum of one hectare at the NWL.
- 6.3.9.9 WETLAND VOLUME
- 6.3.9.9.1 To achieve suspended solids removal for the highest level of protection, it is required to provide 80 m³ of dead storage volume per hectare for a drainage area 35% impervious. For an area 85% impervious, a dead storage volume of 140 m³ per hectare of drainage area is required.
- 6.3.9.10 LENGTH TO WIDTH RATIO
- 6.3.9.10.1 The minimum ratio should provide an effective flow path length at low flow that is three times the relative wetland width in order to increase the residence time.
- 6.3.9.10.2 Incoming water should be well distributed throughout the land and be conveyed as sheet flow to optimize treatment.
- 6.3.9.11 FOREBAY
- 6.3.9.11.1 A forebay is required at each major inlet, to trap suspended solids before stormwater enters the constructed wetland.
- 6.3.9.11.2 A major inlet is one that provides greater than 10% of the total storm inflow to the wetland.

- 6.3.9.11.3 A forebay is to be between 2.4 m to 3.0 m deep for major inlets.
- 6.3.9.11.4 Provide maintenance access at forebays to permit removal of sediments.
- 6.3.9.11.5 Runoff leaving the forebay should pass through shallow areas of emergent vegetation.
- 6.3.9.11.6 Side slopes shall be a maximum of 7 horizontal and 1 vertical (7H:1V) along accessible areas around open and deep water areas at the forebay.
- 6.3.9.11.7 The forebay length to width ratio shall be a minimum of 2:1 measured along the flow path to optimize the flow path and minimize short-circuiting.

6.3.9.12 PERMANENT POOL AT THE OUTLET

- 6.3.9.12.1 The permanent pool requires a depth of 2.4 m to 3.0 m. Size can be variable depending on the wetland's configuration.
- 6.3.9.12.2 Side slopes shall be a maximum of 7H:1V along accessible areas around open and deep water areas at the permanent pool.

6.3.9.13 INLET AND OUTLET

- 6.3.9.13.1 Inlets are to discharge to a forebay.
- 6.3.9.13.2 A variable water level control structure is required on the outlets for maintenance and water management purposes and to assist with the establishment and management of vegetation. The control structure should be capable of maintaining water levels between 0.5 m below NWL and 0.5m above NWL. Variable water level control should be obtained through the manipulation of stop logs or similar overflow devices.
- 6.3.9.13.3 Inlets and outlets should be located to avoid short-circuiting and maximize the flow path.
- 6.3.9.13.4 The maximum depth in the inlet and outlet areas is restricted to 3.0 m.

6.3.9.13.5 Inlets and outlets are to be fully submerged, with the crown of the pipe at least 1.0 m below NWL. Inlet and outlet pipe inverts are to be a minimum of 100 mm above the bottom.

6.3.9.13.6 Provide reinforced grassed maintenance access, with a minimum width of 4 m, to forebay and permanent pool to allow for sediment removal.

6.3.9.14 GRADING

6.3.9.14.1 Slopes shall be 5H:1V or flatter to support larger areas of wetland vegetation. Terraced slopes are acceptable.

6.3.9.14.2 A 2 m wide shallow marsh bench around the wetlands at NWL with a 10H:1V slope and the use of terraced grading is recommended to improve public safety.

6.3.9.14.3 Side slopes around the accessible deep areas in sediment forebay and permanent pool areas shall be a maximum of 7H:1V.

6.3.9.14.4 The 2 m wide mow strip shall have a side slope of either 7H:1V at accessible deep water areas or 5H:1V in other areas around the wetland.

6.3.9.15 FLOATABLES, OIL AND GREASE

6.3.9.15.1 To trap floatable materials, oil and grease, inlets and outlets are to be below normal water level.

6.3.9.16 MAINTENANCE

6.3.9.16.1 The Developer is required to provide an operations and maintenance manual.

6.3.9.16.2 Maintenance and warranty period shall be one year from construction completion certificate (C.C.C.) issuance.

6.3.9.16.3 Removal of accumulated sediment during construction from forebays will be required prior to issuance of the final acceptance certificate (F.A.C.).

6.3.9.16.4 Sediment traps are to be cleaned during the maintenance period.

- 6.3.9.16.5 Sediment removal is required when forebay and permanent pool volumes are reduced by greater than 25%.
- 6.3.9.16.6 Replace or adjust plantings and manage nuisance species during the maintenance period.
- 6.3.9.16.7 During the maintenance period, the facility shall be inspected at least twice each year to determine vegetation distribution and the preservation of design depth. These inspection reports shall be submitted when applying for the F.A.C.
- 6.3.9.16.8 In future years, wetland vegetation regeneration should be possible by lowering the water level in the fall season using the control structure.

6.3.9.17 MONITORING

- 6.3.9.17.1 The Developer shall monitor stormwater quality. If required by the County, effluent from the permanent pool shall be sampled and tested for the following parameters: TSS, TP, NH₃, BOD and faecal coliforms each year during the maintenance period and the data provided to the County.
- 6.3.9.17.2 The Developer shall also monitor wetland and upland vegetation and take any corrective action required during the maintenance period.
- 6.3.9.17.3 At the end of the maintenance period, before the issuance of the F.A.C., the Developer shall ensure that at least 75% of the grass cover and 30% of the non-grass emergent vegetation around the wetland's edge has established given normal seasonal conditions. A vegetation survey by a qualified professional shall be submitted to the County.

6.3.9.18 PUBLIC INFORMATION

- 6.3.9.18.1 The Developer is required to inform the general public by means of signage that the facility is a wetland constructed for stormwater management.

6.3.9.19 RECREATIONAL USES

- 6.3.9.19.1 Planting strategies should deter direct public access to the wetland so as to avoid disturbance of the wetland fauna.
- 6.3.9.19.2 A trail shall be provided beside the mow strip between NWL and the private property boundary.

6.3.9.20 ACCESS

- 6.3.9.20.1 Access is required to all inlets and outlets for maintenance, operation of water control structures, removal of debris and litter and vegetation management.

6.3.9.21 FENCING

- 6.3.9.21.1 The Developer is required to use natural solutions such as grading and planting strategies to provide safety features for the wetland, inlets and outlets.
- 6.3.9.21.2 The Developer shall provide a fence at the public utility lot boundary with openings for maintenance and public access to trails.

6.3.9.22 WILDLIFE

- 6.3.9.22.1 At the discretion of the County and the Developer the design may incorporate features that either encourage or discourage wildlife.

6.3.9.23 MOSQUITO CONTROL

- 6.3.9.23.1 The Developer shall include design features that minimize mosquitoes in a constructed wetlands facility. Features can include system design and vegetation management that would preclude stagnant backwaters and shading of the water surface, providing habitat for purple martin, swallows, baitfish, dragon flies, bats and other predators.

6.3.9.24 OTHER DESIGN CONSIDERATIONS

- 6.3.9.24.1 Shape of the treatment cell(s) can vary and depends on landscaping features required for attracting wildlife and for public enjoyment, and shape of available land.
- 6.3.9.24.2 Incorporate a bypass that will collect first flush flows and divert high flows during extreme rainfall events around the wetland.
- 6.3.9.24.3 Landscaped features will provide an attractive park-like setting.

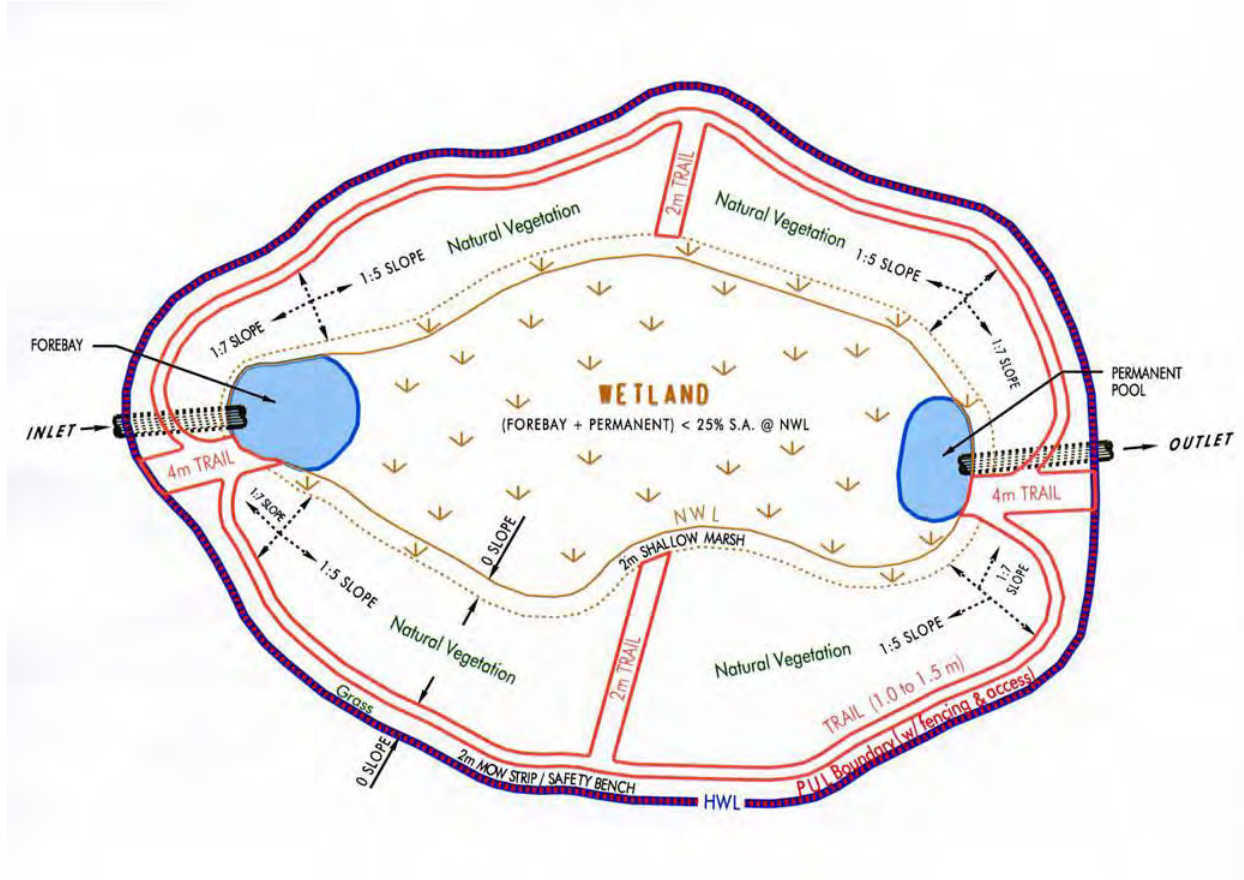
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- 6.3.9.24.4 Ancillary benefits include provision for wildlife habitat, wildlife viewing opportunities, hiking areas, educational opportunities, and restoration of lost wetland areas.
 - 6.3.9.24.5 Odour control is not required since the treatment wetlands, if designed properly, do not generate odours.
 - 6.3.9.24.6 Freezing conditions during the winter months will not adversely affect the treatment wetland.
 - 6.3.9.24.7 Design and implement with designated objectives constantly and clearly in mind.
 - 6.3.9.24.8 Design more for function than for form. A number of forms can probably meet the objectives, and the form to which the system evolves may not be the planned one.
 - 6.3.9.24.9 Design relative to the natural reference system(s), and do not over-engineer.
 - 6.3.9.24.10 Design with the landscape, not against it. Take advantage of natural topography, drainage patterns, etc.
 - 6.3.9.24.11 Design the wetland as an ecotone. Incorporate as much "edge" as possible, and design in conjunction with a buffer and the surrounding land and aquatic systems.
 - 6.3.9.24.12 Design to protect the wetland from any potential high flows and sediment loads.
 - 6.3.9.24.13 Design to avoid secondary environmental and community impacts. Plan on enough time for the system to develop before it must satisfy the objectives. Attempts to short circuit ecological processes by over-management will probably fail.
 - 6.3.9.24.14 Design for self-sustainability and to minimize maintenance.

6.3.9.25 SUMMARY GUIDE FOR THE DESIGN OF LARGE CONSTRUCTED WETLANDS

Design Element	Design Objective	Minimum Criteria
Level of Service/ Volumetric Sizing	To provide appropriate level of protection and adequate volume for quantity (retention) and quality (treatment).	Most critical storm event design and 85% TSS removal of particle size 75µm or greater for water quality. Provide 80 m ³ of dead storage volume per hectare for a drainage area 35% impervious. For an area 85% impervious provide a dead storage volume of 140 m ³ per hectare of drainage.
Land Dedication	To apply appropriate designation for specific areas within the wetlands facility	Public Utility Lot - area covered by water at the most critical design storm event; not part of municipal reserve, nor part of area's natural history, nor part of environmental reserve.
Drainage Area	Maintain the sustainability of the wetlands, provide constant and or periodic flows and prevent stagnant and long periods of dry conditions.	Minimum 5 hectares. Developer to conduct hydrological survey to determine proper wetland size
Wetland Surface Area Number of Wetlands	To provide higher and consistent contaminant removal.	Minimum 1 hectare at NWL. Wetland surface area will typically be 3% to 5% of the drainage area; actual sizing will be determined by the hydrological survey. A series of small wetlands offering higher treatment capability can be provided.
Soil Characteristics	To maintain a permanent pool of water by minimizing exfiltration.	For wetland deep water areas, 10-7 m/s soil permeability; sandy clays and silty clay loams may be suitable when compacted. Construct wetland vegetation zones using soils from displaced wetlands, sterilized topsoil or peat, to a depth of 10-30cm of the bottom of the wetland.
Wetland Vegetation Upland Vegetation	Stormwater quality treatment. For public safety. To act as safety bench and also weed barrier to prevent root invasion of adjacent properties by Poplar and Aspen species. To provide aesthetic buffer to adjacent lands.	Plant diverse species within one year after construction; use soils from displaced wetlands or topsoil or peat to a depth of 10-30 cm of the bottom of the wetland. A 2 m wide shallow marsh area around the wetland at NWL. Screening requirements between NWL and the most critical design storm event to be agreed between the Developer and County. A mow strip, minimum 2 m wide, extending from HWL to NWL.
Water Quality	To provide stormwater treatment	TSS removal is 85% of particle size 75 µm or greater.
Sediment Forebay (inlet)	To provide sediment removal as pre-treatment and have the ability to re-direct incoming flows as sheet flow with a submerged inlet structure.	Required for major inlets. Depth: 2.4 m to 3.0 m. Total deep surface areas < 25% of wetland surface area. Side slopes: maximum 7 horizontal to 1 vertical (7H:1V) around the area.
Forebay Length to Width Ratio	Maximize flow path and minimize short-circuiting.	Minimum of 2:1 measured along flow path.
Permanent Pool (outlet)	To provide a submerged outlet structure and have the ability to regulate water levels.	Depth: 2.4 m to 3.0 m. Total deep areas < 25% of wetland area. Side slopes: maximum of 7H:1V around the area.
Active Storage Detention Time	To enhance treatment and suspended solids settling.	Drawdown time: ≥24hrs for volume equivalent to runoff from a 1 in 2 storm; 48hrs for volume equivalent to runoff from a 1 in 5 storm; ≤96hrs for 90% of total active storage volume above NWL. Dead storage: 80 m ³ of storage volume/ha for a drainage area 35% impervious. 140 m ³ storage volume/ha for a drainage area 85% impervious.
Maintenance Vehicle Access	Access for equipment.	Width: 4 m.

Design Element	Design Objective	Minimum Criteria
Length to Width Ratio	To maximize flow path and minimize short-circuiting. Provide longer contact time over the surface area of the marsh. Optimize treatment capability.	Effective flow path length to be 3 times the relative wetland width. Incoming water should be well distributed throughout the land and conveyed as sheet flow after the forebay.
Wetland Depth	To encourage emergent vegetation.	Variety of water depths: 0.1 m - 0.6 m. Average depth: 0.3 m. Deep water areas, >2 m, only in forebay and permanent pool. Water fluctuation in excess of 1 m above NWL should be infrequent.
Recreational Uses	Public amenity and safety.	A trail shall be provided beside the mow strip between NWL and the private property boundary. Planting strategies should deter direct access of public to wetlands.
Side Slopes	To provide drainage and ensure safety along deep open water. To provide erosion control and accessibility for maintenance.	5H:1V along all edges except at accessible deep water areas in forebay and permanent pool areas where shall be 7H:1V. Terraced slopes are acceptable. The 2 m wide shallow marsh area at the NWL boundary shall be 10H:1V.
Access	For maintenance and operation of water control structures, litter and debris removal and vegetation management.	Required at all inlets and outlets.
Inlet	Safety and maintenance.	Maximum depth: 3 m. Distanced far away from outlet to avoid short-circuiting of flow. Fully submerged: crown 1.0 m below NWL; Invert 100 mm above bottom.
Outlet	Safety, maintenance and assistance in plant species management.	Use variable water level control structures to regulate water levels between 0.5 m below NWL and 0.5 m above NWL. Maximum depth: 3 m. Distanced far away from inlet to avoid short-circuiting of flow. Fully submerged: crown 1.0 m below normal water level; invert 100 mm above bottom.
Fencing	Safety.	Use natural solutions such as grading and planting strategies. Developer shall provide fencing around the PUL with openings for maintenance and public access to trails.
Signage	Safety and public information.	Use signage
Erosion and Sediment Control	Implement appropriate erosion and sediment controls during development in the drainage area during the construction phase and during the staged-construction of wetland.	
Wildlife	At the discretion of the Developer and the County.	
Mosquitoes	Incorporation of design features that minimize mosquitoes.	
Floatables, Oil and Grease	To trap floatables, oil and grease.	Inlets and outlets are to be below NWL.
Maintenance	To properly operate and maintain constructed wetland; to optimize treatment.	Maintenance and warranty period shall be 1 year from the date of the Construction Completion Certificate. Developer to provide an operations and maintenance manual. Replacing and or adjusting plantings, managing nuisance species and cleaning sediment traps are required. Inspect at least twice each year. Sediment removal required when sediment loading reduces forebay and permanent pool volumes by greater than 25%. Provide reinforced grassed maintenance access to forebay and permanent pool, 4m minimum width.
Monitoring	To monitor, make necessary corrective actions, and compile data on the use of constructed wetland as a stormwater management facility.	Developer to monitor stormwater quality during the maintenance period. Developer to monitor wetland and upland vegetation and take corrective actions when necessary during the maintenance period. Before issuance of FAC, the Developer shall ensure at least 75% of the grass and 30% of the emergent vegetation around the wetland's edge is established. A vegetation survey by a qualified professional shall be submitted to the County.

Schematic Diagram of Large Constructed Wetland



6.3.9.26 DESIGN STANDARDS FOR CONSTRUCTED WETLANDS SMALLER THAN 1 HECTARE IN SIZE:

6.3.9.26.1 For details refer to – Schematic Diagram of Small Constructed Wetland in Section 6.3.8.53 and to – Design Summary Guide for Small Constructed Wetland in Section 6.3.8.53.

6.3.9.27 LAND DEDICATION AND EASEMENT REQUIREMENTS FOR CONSTRUCTED WETLANDS

6.3.9.27.1 The land required for the constructed wetland will be dedicated to the County.

6.3.9.27.2 It is not a part of the municipal reserve provided by the Developer to the County.

6.3.9.27.3 It is not part of an environmental reserve.

- 6.3.9.27.4 Generally, the area of land which would be covered by water when the water level is at the most critical design storm event level, high water level, will be designated as a "Public Utility Lot." This designation will also apply to all rights-of-way for access to and protection of inlets, outlets and flow control facilities, and for maintenance access routes to the wetland.
- 6.3.9.27.5 Lots abutting the constructed wetland are allowed provided that there are areas around the wetland that are open for maintenance access routes to the wetland and secondary uses to the public.
- 6.3.9.27.6 A restrictive covenant will be placed upon lots abutting the constructed wetland to control lot development so as not to compromise the design requirements of the stormwater management facility and ensure that an adequate freeboard is maintained. Where overland overflow is available, a minimum of 0.3 m freeboard above HWL is acceptable. Otherwise, a minimum of 0.5m is required.

6.3.9.28 WETLAND DRAINAGE AREA

- 6.3.9.28.1 Wetland size should be approximately 5 % of the watershed area that it will be servicing.
- 6.3.9.28.2 The County prefers that fewer, larger wetlands be constructed rather than a series of smaller constructed wetlands.
- 6.3.9.28.3 The Developer is required to implement an Erosion and Sediment Control Plan during development in the drainage area to minimize sediment loading to the forebay and wetland during the construction phase of the project and during the staged construction of the stormwater management facility.

6.3.9.29 WETLAND SOIL CHARACTERISTICS

- 6.3.9.29.1 For wetland deep water areas, low soil permeability of 10⁻⁷ m/s is recommended to maintain a permanent pool of water and minimize exfiltration. Compacted sandy clays and silty clay loams may be suitable provided that documented geotechnical testing demonstrates low soil permeability.
- 6.3.9.29.2 Wetland vegetative zones can be constructed using soils from recently displaced wetlands, sterilized topsoil, or peat from within the drainage basin or region. A layer of 10 cm to 30 cm of soil shall be spread over the vegetation zones of the constructed wetland. Planting will be done in this soil over the 2 years following construction.

6.3.9.30 WETLAND SOIL CHARACTERISTICS

- 6.3.9.30.1 For wetland deep water areas, low soil permeability of 10-7 m/s is recommended to maintain a permanent pool of water and minimize exfiltration. Compacted sandy clays and silty clay loams may be suitable provided that documented geotechnical testing demonstrates low soil permeability.
- 6.3.9.30.2 Wetland vegetative zones can be constructed using soils from recently displaced wetlands, sterilized topsoil, or peat from within the drainage basin or region. A layer of 10 cm to 30 cm of soil shall be spread over the vegetation zones of the constructed wetland. Planting will be done in this soil over the 2 years following construction.

6.3.9.31 WETLAND VEGETATION

- 6.3.9.31.1 After construction and placement of soil the entire vegetation area shall be planted with an aggressive water tolerant grass species as the pioneer colonizer to quickly establish a protective canopy and rigorous root development to stabilize the soil. For examples of acceptable plant species refer to APPENDIX C.
- 6.3.9.31.2 In the spring of the year following construction the entire vegetation zone shall be overseeded with legumes and wild flowers. Also, at approximately the same time, the area above NWL shall be planted with 50% of the woody species. Plants shall be selected for tolerance to flooding and oxygen-reduced environments. For examples of acceptable plant species refer to APPENDIX C.
- 6.3.9.31.3 One year after completion of construction a stable mixture of water tolerant grasses shall be in place.
- 6.3.9.31.4 In the spring of the second year following construction the non-surviving woody plants shall be replaced and the remaining 50% of the woody plants shall be planted. For examples of acceptable plant species refer to APPENDIX C.
- 6.3.9.31.5 Two years after completion of construction a diverse population of water tolerant grasses, native grasses, wild flowers, and water tolerant woody plants shall have taken root.
- 6.3.9.31.6 Manipulation of water levels may be used to control plant species and maintain plant diversity.

6.3.9.31.7 Harvesting emergent vegetation is not recommended.

6.3.9.32 UPLAND VEGETATION IN THE EXTENDED DETENTION STORAGE
AREA AROUND THE WETLAND

6.3.9.32.1 Requirements for screening the constructed wetlands, between NWL and HWL, from adjacent land uses and for visual aesthetics shall be agreed by the Developer and the County.

6.3.9.32.2 A mow strip of a minimum of 2 m shall extend from the public utility lot boundary towards the constructed wetland NWL. This is to act as a safety bench and weed barrier to prevent root invasion of adjacent properties by Poplar and Aspen species.

6.3.9.33 WETLAND WATER DEPTH

6.3.9.33.1 Use a variety of water depths, 0.1 m to 0.6 m with an average permanent water depth of 0.3m, to encourage emergent vegetation.

6.3.9.33.2 Deep water areas, i.e. greater than 2 m, are to be limited to less than 25% of wetland surface area.

6.3.9.33.3 Water level fluctuation in excess of 1 m above NWL should be infrequent to prevent killing of the vegetation.

6.3.9.34 WETLAND SURFACE AREA

6.3.9.34.1 The wetland surface area is typically about 3% to 5% of the drainage area.

6.3.9.34.2 The surface area of the constructed wetland shall be smaller than one hectare at the NWL.

6.3.9.35 WETLAND VOLUME

6.3.9.35.1 To achieve suspended solids removal for the highest level of protection, it is required to provide 80 m³ of dead storage volume per hectare for a drainage area 35% impervious. For an area 85% impervious, a dead storage volume of 140 m³ per hectare of drainage area is required.

6.3.9.36 LENGTH TO WIDTH RATIO

- 6.3.9.36.1 The minimum ratio should provide an effective flow path length at low flow that is three times the relative wetland width in order to increase the residence time.
- 6.3.9.36.2 Incoming water should be well distributed throughout the land and be conveyed as sheet flow to optimize treatment.

6.3.9.37 FOREBAY

- 6.3.9.37.1 A forebay is required at each major inlet, to prevent erosion as stormwater enters the constructed wetland.
- 6.3.9.37.2 A major inlet is one that provides greater than 10% of the total storm inflow to the wetland.
- 6.3.9.37.3 A forebay is to be lined with rip rap for major inlets.
- 6.3.9.37.4 Provide maintenance access at forebays to permit removal of sediments.
- 6.3.9.37.5 Runoff leaving the forebay should pass through shallow areas of emergent vegetation.
- 6.3.9.37.6 Side slopes shall be a maximum of 7 horizontal and 1 vertical (7H:1V) along accessible areas around open and deep water areas at the forebay.
- 6.3.9.37.7 The forebay length to width ratio shall be a minimum of 2:1 measured along the flow path to optimize the flow path and minimize short-circuiting.

6.3.9.38 PERMANENT POOL

- 6.3.9.38.1 A permanent pool should not take up more than 25% of the total wetland area at NWL, but not less than 15%. Size can be variable depending on the wetland's configuration.
- 6.3.9.38.2 Side slopes shall be a maximum of 7H:1V along accessible areas around open and deep water areas at the permanent pool.

6.3.9.39 INLET AND OUTLET

- 6.3.9.39.1 Inlets are to discharge to a forebay.
- 6.3.9.39.2 A variable water level control structure is required on the outlets for maintenance and water management purposes and to assist with the establishment and management of vegetation. The control structure should be capable of maintaining water levels between 0.5 m below NWL and 0.5m above NWL. Variable water level control should be obtained through the manipulation of stop logs or similar overflow devices.
- 6.3.9.39.3 Inlets and outlets should be located to avoid short-circuiting and maximize the flow path.
- 6.3.9.39.4 Inlets and outlets are to be fully submerged, with the crown of the pipe at least 1.0 m below NWL. Inlet and outlet pipe inverts are to be a minimum of 100 mm above the bottom.
- 6.3.9.39.5 Provide reinforced grassed maintenance access, with a minimum width of 4 m, to forebay and permanent pool to allow for sediment removal.

6.3.9.40 GRADING

- 6.3.9.40.1 Slopes shall be 5H:1V or flatter to support larger areas of wetland vegetation. Terraced slopes are acceptable.
- 6.3.9.40.2 A 2 m wide shallow marsh bench around the wetlands at NWL with a 10H:1V slope and the use of terraced grading is recommended to improve public safety.
- 6.3.9.40.3 Side slopes around the accessible deep areas in the forebay and permanent pool areas shall be a maximum of 7H:1V.
- 6.3.9.40.4 The 2 m wide mow strip shall have a side slope of either 7H:1V at accessible deep water areas or 5H:1V in other areas around the wetland.

6.3.9.41 FLOATABLES, OIL AND GREASE

- 6.3.9.41.1 To trap floatable materials, oil and grease, inlets and outlets are to be below normal water level.

6.3.9.42 MAINTENANCE

- 6.3.9.42.1 The Developer is required to provide an operations and maintenance manual.
- 6.3.9.42.2 Maintenance and warranty period shall be one year from construction completion certificate (C.C.C.) issuance.
- 6.3.9.42.3 Removal of accumulated sediment during construction from forebays will be required prior to issuance of the final acceptance certificate (F.A.C.).
- 6.3.9.42.4 Sediment traps are to be cleaned during the maintenance period.
- 6.3.9.42.5 Sediment removal is required when forebay and permanent pool volumes are reduced by greater than 25%.
- 6.3.9.42.6 Replace or adjust plantings and manage nuisance species during the maintenance period.
- 6.3.9.42.7 During the maintenance period, the facility shall be inspected at least twice each year to determine vegetation distribution and the preservation of design depth. These inspection reports shall be submitted when applying for the F.A.C.
- 6.3.9.42.8 In future years, wetland vegetation regeneration should be possible by lowering the water level in the fall season using the control structure.

6.3.9.43 MONITORING

- 6.3.9.43.1 The Developer shall monitor stormwater quality. If required by the County, effluent from the permanent pool shall be sampled and tested for the following parameters: TSS, TP, NH₃, BOD and faecal coliforms each year during the maintenance period and the data provided to the County.
- 6.3.9.43.2 The Developer shall also monitor wetland and upland vegetation and take any corrective action required during the maintenance period.
- 6.3.9.43.3 At the end of the maintenance period, before the issuance of the F.A.C., the Developer shall ensure that at least 75% of the grass cover and 30% of the non-grass emergent vegetation around the wetland's edge has established given normal seasonal conditions. A

vegetation survey by a qualified professional shall be submitted to the County.

6.3.9.44 PUBLIC INFORMATION

- 6.3.9.44.1 The Developer is required to inform the general public by means of signage that the facility is a wetland constructed for stormwater management.

6.3.9.45 RECREATIONAL USES

- 6.3.9.45.1 Planting strategies should deter direct public access to the wetland so as to avoid disturbance of the wetland fauna.
- 6.3.9.45.2 A trail shall be provided beside the mow strip between NWL and the private property boundary.

6.3.9.46 ACCESS

- 6.3.9.46.1 Access is required to all inlets and outlets for maintenance, operation of water control structures, removal of debris and litter and vegetation management.

6.3.9.47 FENCING

- 6.3.9.47.1 The Developer is required to use natural solutions such as grading and planting strategies to provide safety features for the wetland, inlets and outlets.
- 6.3.9.47.2 The Developer shall provide a fence at the public utility lot boundary with openings for maintenance and public access to trails.

6.3.9.48 WILDLIFE

- 6.3.9.48.1 At the discretion of the County and the Developer the design may incorporate features that either encourage or discourage wildlife.

6.3.9.49 MOSQUITO CONTROL

- 6.3.9.49.1 The Developer shall include design features that minimize mosquitoes in a constructed wetlands facility. Features can include system design and vegetation management that would preclude stagnant backwaters and shading of the water surface, providing habitat for purple martin, swallows, baitfish, dragon flies, bats and other predators.

6.3.9.50 OTHER DESIGN CONSIDERATIONS

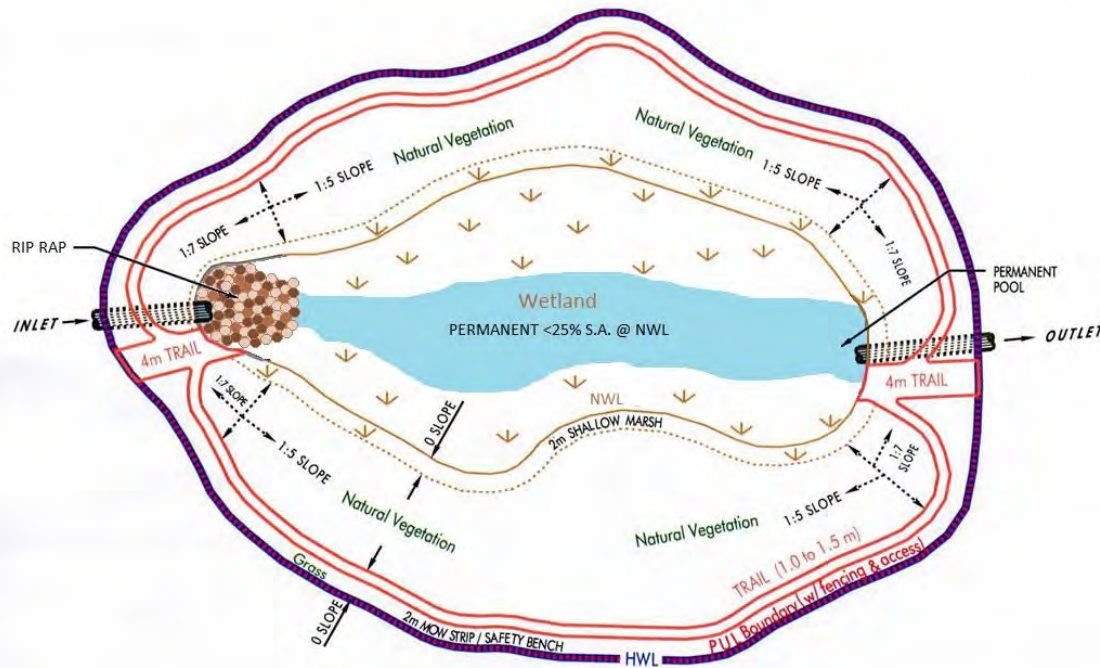
- 6.3.9.50.1 Shape of the treatment cell(s) can vary and depends on landscaping features required for attracting wildlife and for public enjoyment, and shape of available land.
- 6.3.9.50.2 Incorporate a bypass that will collect first flush flows and divert high flows during extreme rainfall events around the wetland.
- 6.3.9.50.3 Landscaped features will provide an attractive park-like setting.
- 6.3.9.50.4 Ancillary benefits include provision for wildlife habitat, wildlife viewing opportunities, hiking areas, educational opportunities, and restoration of lost wetland areas.
- 6.3.9.50.5 Odour control is not required since the treatment wetlands, if designed properly, do not generate odours.
- 6.3.9.50.6 Freezing conditions during the winter months will not adversely affect the treatment wetland.
- 6.3.9.50.7 Design and implement with designated objectives constantly and clearly in mind.
- 6.3.9.50.8 Design more for function than for form. A number of forms can probably meet the objectives, and the form to which the system evolves may not be the planned one.
- 6.3.9.50.9 Design relative to the natural reference system(s), and do not over-engineer.
- 6.3.9.50.10 Design with the landscape, not against it. Take advantage of natural topography, drainage patterns, etc.
- 6.3.9.50.11 Design the wetland as an ecotone. Incorporate as much "edge" as possible, and design in conjunction with a buffer and the surrounding land and aquatic systems.
- 6.3.9.50.12 Design to protect the wetland from any potential high flows and sediment loads.
- 6.3.9.50.13 Design to avoid secondary environmental and community impacts. Plan on enough time for the system to develop before it must satisfy the objectives. Attempts to short circuit ecological processes by over-management will probably fail.
- 6.3.9.50.14 Design for self-sustainability and to minimize maintenance.

6.3.9.51 SUMMARY GUIDE FOR THE DESIGN OF SMALL CONSTRUCTED
WETLANDS

Design Element	Design Objective	Minimum Criteria
Level of Service/ Volumetric Sizing	To provide appropriate level of protection and adequate volume for quantity (retention) and quality (treatment).	Most critical storm event design and 85% TSS removal of particle size 75µm or greater for water quality. Provide 80 m ³ of dead storage volume per hectare for a drainage area 35% impervious. For an area 85% impervious provide a dead storage volume of 140 m ³ per hectare of drainage.
Land Dedication	To apply appropriate designation for specific areas within the wetlands facility	Public Utility Lot - area covered by water at the most critical design storm event; not part of municipal reserve, nor part of area's natural history, nor part of environmental reserve.
Drainage Area	Maintain the sustainability of the wetlands, provide constant and or periodic flows and prevent stagnant and long periods of dry conditions.	Developer to conduct hydrological survey to determine proper wetland size
Wetland Surface Area Number of Wetlands	To provide higher and consistent contaminant removal.	Smaller than 1 hectare at NWL. Wetland surface area will typically be 3% to 5% of the drainage area; actual sizing will be determined by the hydrological survey. A series of small wetlands offering higher treatment capability can be provided.
Soil Characteristics	To maintain a permanent pool of water by minimizing exfiltration.	For wetland deep water areas, 10-7 m/s soil permeability; sandy clays and silty clay loams may be suitable when compacted. Construct wetland vegetation zones using soils from displaced wetlands, sterilized topsoil or peat, to a depth of 10-30cm of the bottom of the wetland.
Wetland Vegetation Upland Vegetation	Stormwater quality treatment. For public safety. To act as safety bench and also weed barrier to prevent root invasion of adjacent properties by Poplar and Aspen species. To provide aesthetic buffer to adjacent lands.	Plant diverse species within one year after construction; use soils from displaced wetlands or topsoil or peat to a depth of 10-30 cm of the bottom of the wetland. A 2 m wide shallow marsh area around the wetland at NWL. Screening requirements between NWL and the most critical design storm event to be agreed between the Developer and County. A mow strip, minimum 2 m wide, extending from HWL to NWL.
Water Quality	To provide stormwater treatment	TSS removal is 85% of particle size 75 µm or greater.
Sediment Forebay (inlet)	To provide erosion control as pre-treatment and have the ability to re-direct incoming flows as sheet flow with a submerged inlet structure.	Required for major inlets. Lined with rip rap Total deep surface areas < 25% of wetland surface area. Side slopes: maximum 7 horizontal to 1 vertical (7H:1V) around the area.
Forebay Length to Width Ratio	Maximize flow path and minimize short-circuiting.	Minimum of 2:1 measured along flow path.
Permanent Pool (outlet)	To provide a submerged outlet structure and have the ability to regulate water levels.	Total deep areas < 25% of wetland area, but > 15% of wetland area. Side slopes: maximum of 7H:1V around the area.
Active Storage Detention Time	To enhance treatment and suspended solids settling.	Drawdown time: ≥24hrs for volume equivalent to runoff from a 1 in 2 storm; 48hrs for volume equivalent to runoff from a 1 in 5 storm; ≤96hrs for 90% of total active storage volume above NWL. Dead storage: 80 m ³ of storage volume/ha for a drainage area 35% impervious. 140 m ³ storage volume/ha for a drainage area 85% impervious.

Design Element	Design Objective	Minimum Criteria
Length to Width Ratio	To maximize flow path and minimize short-circuiting. Provide longer contact time over the surface area of the marsh. Optimize treatment capability.	Effective flow path length to be 3 times the relative wetland width. Incoming water should be well distributed throughout the land and conveyed as sheet flow after the forebay.
Wetland Depth	To encourage emergent vegetation.	Variety of water depths: 0.1 m - 0.6 m. Average depth: 0.3 m. Deep water areas, >2 m, only in forebay and permanent pool. Water fluctuation in excess of 1 m above NWL should be infrequent.
Recreational Uses	Public amenity and safety.	A trail shall be provided beside the mow strip between NWL and the private property boundary. Planting strategies should deter direct access of public to wetlands.
Side Slopes	To provide drainage and ensure safety along deep open water. To provide erosion control and accessibility for maintenance.	5H:1V along all edges except at accessible deep water areas in forebay and permanent pool areas where shall be 7H:1V. Terraced slopes are acceptable. The 2 m wide shallow marsh area at the NWL boundary shall be 10H:1V slope.
Access	For maintenance and operation of water control structures, litter and debris removal and vegetation management.	Required at all inlets and outlets.
Inlet	Safety and maintenance.	Distanced far away from outlet to avoid short-circuiting of flow. Fully submerged: crown 1.0 m below NWL; invert 100 mm above bottom.
Outlet	Safety, maintenance and assistance in plant species management.	Use variable water level control structures to regulate water levels between 0.5 m below NWL and 0.5 m above NWL. Distanced far away from inlet to avoid short-circuiting of flow. Fully submerged: crown 1.0 m below normal water level; invert 100 mm above bottom.
Maintenance Vehicle Access	Access for equipment.	Width: 4 m.
Fencing	Safety.	Use natural solutions such as grading and planting strategies. Developer shall provide fencing around the PUL with openings for maintenance and public access to trails.
Signage	Safety and public information.	Use signage
Erosion and Sediment Control	Implement appropriate erosion and sediment controls during development in the drainage area during the construction phase and during the staged-construction of wetland.	
Wildlife	At the discretion of the Developer and the County.	
Mosquitoes	Incorporation of design features that minimize mosquitoes.	
Floatables, Oil and Grease	To trap floatables, oil and grease.	Inlets and outlets are to be below NWL.
Maintenance	To properly operate and maintain constructed wetland; to optimize treatment.	Maintenance and warranty period shall be 2 years from the date of the Construction Completion Certificate. Developer to provide an operations and maintenance manual. Replacing and or adjusting plantings, managing nuisance species and cleaning sediment traps are required. Inspect at least twice each year. Sediment removal required when sediment loading reduces forebay and permanent pool volumes by greater than 25%. Provide reinforced grassed maintenance access to forebay and permanent pool, 4m minimum width.
Monitoring	To monitor, make necessary corrective actions, and compile data on the use of constructed wetland as a stormwater management facility.	Developer to monitor stormwater quality during the maintenance period. Developer to monitor wetland and upland vegetation and take corrective actions when necessary during the maintenance period. Before issuance of the F.A.C., the Developer shall ensure that at least 75% of the grass and 30% of the emergent vegetation around the wetland's edge has established. A vegetation survey by a qualified professional shall be submitted to the County.

Schematic Diagram of Small Constructed Wetland



6.3.10 WET PONDS

Wet ponds temporarily store storm water runoff in order to promote the settlement of runoff pollutants and restrict discharge to predetermined levels to reduce downstream flooding and erosion potentials. Wet ponds retain a permanent pool during dry weather.

Refer to Standard Detail Drawing No. 6.1, Wet Pond Section.

- 6.3.10.1.1 The maximum water level fluctuation for wet ponds during the 1:100 year storm event shall be 1.5 m measured from the Normal Water Level (NWL) to the High Water Level (HWL) in all areas other than Acheson Zone 5, 6, 7 and 8.
- 6.3.10.1.2 In Acheson Zone 5, 6, 7 and 8 the maximum water level fluctuation for wet ponds during the 1:100 year storm event shall be 2.5 m measured from the Normal Water Level (NWL) to the High Water Level (HWL).

6.3.10.1.3 The design of wet pond stormwater management facilities shall incorporate the following:

- Private property lines and building openings shall be located at or above the freeboard level.
- Invert of the upstream minor system pipe in the inlet manhole of the wet pond and the invert of the downstream pipe in the outlet manhole of the wet pond, shall be at, or above, the NWL elevation to ensure that the NWL elevation can be maintained.

Refer to Standard Detail Drawing No. 6.3, Storm Pond Release Control Manhole

- A minimum horizontal distance of 6 m shall be maintained from all basement walls to the freeboard level.
- Minimum wet pond surface area at the NWL shall be 2 ha.
- Maximum side slopes above the active storage zone (above HWL) are 5:1.
- Maximum side slope from the design HWL to a point 1.0 m below NWL is 7:1.
- Maximum side slope from pond bottom to a point 1.0 m below HWL is 3:1.
- Minimum water depth below the NWL (permanent pool) shall be 2.0 m; the maximum depth shall be 3.0 m.
- Wet pond bottom and side slopes shall be constructed of impervious materials or properly lined to minimize water losses during dry weather periods. Intruding silt or sand deposits shall be properly sealed off to prevent contamination.
- Wetland vegetative zones can be constructed using soils from recently displaced wetlands, sterilized topsoil, or peat from within the drainage basin or region. A layer of 10 cm to 30 cm of soil shall be spread over the vegetation zones of the constructed wetland. Planting will be done in this soil over the 2 years following construction.
- After construction and placement of soil the entire vegetation area shall be planted with an aggressive water tolerant grass species as the pioneer colonizer to quickly establish a protective canopy and rigorous root development to stabilize the soil. For examples of acceptable plant species refer to APPENDIX C.

- In the spring of the year following construction the entire vegetation zone shall be overseeded with legumes and wild flowers. Also, at approximately the same time, the area above NWL shall be planted with 50% of the woody species agreed upon as noted in Section 4.7. Plants shall be selected for tolerance to flooding and oxygen-reduced environments. For examples of acceptable plant species refer to APPENDIX C.
- One year after completion of construction a stable mixture of water tolerant grasses shall be in place.
- In the spring of the second year following construction the non-surviving woody plants shall be replaced and the remaining 50% of the woody plants shall be planted. For examples of acceptable plant species refer to APPENDIX C.
- Two years after completion of construction a diverse population of water tolerant grasses, native grasses, wild flowers, and water tolerant woody plants shall have taken root.
- Manipulation of water levels may be used to control plant species and maintain plant diversity.
- Harvesting emergent vegetation is not recommended.
- Requirements for screening the wet ponds, between NWL and HWL, from adjacent land uses and for visual aesthetics shall be agreed by the Developer and the County.
- A mow strip of a minimum of 2 m shall extend from the public utility lot boundary towards the constructed wetland NWL. This is to act as a safety bench and weed barrier to prevent root invasion of adjacent properties by Poplar and Aspen species.
- Wet pond inlets and outlets shall be located so that short circuiting of the flow through the pond is minimized. A semi-annual pond turnover rate shall be used in the design of the permanent pool based on average annual precipitation data.
- Slope erosion protection measures shall be used when required.
- Submerged inlets and outlets shall be used. Obverts of each inlet and outlet pipe shall be a minimum of 0.6m below the NWL.
- Length to width ratio of the permanent pool shall be from 4:1 to 5:1.

- Sediment traps, pre-treatment sumps, or forebays shall be provided at each inlet.
- Forebay surface area not to exceed one-third of the permanent pool surface area.
- Minimum detention time of the full pond volume shall be 24 hours.
- Trash screens / rodent traps
- Perimeter needs to be fenced.
- 3.0 m wide drive along top of berm for maintenance access.

6.3.10.1.4 Maintenance

- To ensure proper access to the outlet control structure the entire maintenance vehicle access road including the top of the control structure must be at or above the freeboard elevation.
- The engineering department with Parkland County and Alberta Transportation shall be consulted to ensure that pond access road location is not an issue when the pond is located adjacent to or accessed from a major roadway and/or freeway/expressways. Access from major roadways or freeways should be designed to minimize interference with pedestrian activity and public safety. Pathways should not be used as a means of accessing pond maintenance areas (except by 1 tonne trucks or lighter) where possible, and maintenance areas should not impede or interfere with pedestrian activity and public safety.
- The Developer is required to provide an operations and maintenance manual.
- Maintenance and warranty period shall be one year from construction completion certificate (C.C.C.) issuance.
- Removal of accumulated sediment during construction from forebays will be required prior to issuance of the final acceptance certificate (F.A.C.).
- Sediment traps are to be cleaned during the maintenance period.
- Sediment removal is required when forebay and permanent pool volumes are reduced by greater than 25%.

- Sediment removal is required when forebay and permanent pool volumes are reduced by greater than 25%.
- During the maintenance period, the facility shall be inspected at least twice each year to determine vegetation distribution and the preservation of design depth. These inspection reports shall be submitted when applying for the F.A.C.
- In future years, wetland vegetation regeneration should be possible by lowering the water level in the fall season using the control structure.

6.3.10.1.5 Monitoring

- The Developer shall monitor stormwater quality. If required by the County, effluent from the permanent pool shall be sampled and tested for the following parameters: TSS, TP, NH₃, BOD and faecal coliforms each year during the maintenance period and the data provided to the County.
- The Developer shall also monitor wetland and upland vegetation and take any corrective action required during the maintenance period.
- At the end of the maintenance period, before the issuance of the F.A.C., the Developer shall ensure that at least 75% of the grass cover and 30% of the non-grass emergent vegetation around the wetland's edge has established given normal seasonal conditions. A vegetation survey by a qualified professional shall be submitted to the County.

6.3.10.1.6 Recreational Uses

- Planting strategies should deter direct public access to the wet pond so as to avoid disturbance of the wetland fauna.
- The developer shall provide a trail beside the mow strip between NWL and the private property boundary.
- Access gate and parking area.

6.3.10.2 ALTERNATIVE STORMWATER MANAGEMENT FACILITIES

- #### 6.3.10.2.1
- Underground stormwater storage tanks may be used when designs that involve the use of constructed wetlands or wet ponds as storage facilities are not feasible.

- 6.3.10.2.2 Parking lot and rooftop storage of stormwater may be permitted in certain instances but must be approved by the General Manager of Infrastructure Services.
- 6.3.10.2.3 Infiltration and evaporation detention facilities may be used in developments where a suitable receiving water body cannot be found or the location of the water body makes construction of a proper outfall improbable. These types of facilities require detailed field investigations that involve site specific measurements of infiltration rates and a solid understanding of the local groundwater hydrology and what effects the detention facility would have on existing condition.

6.3.11 Rural Service Area Drainage System

6.3.11.1 HIGHWAY AND ROAD DITCHES

Highway and local road ditches shall comply with the latest edition of Alberta Infrastructure *Highway Geometric Design Guide*.

- 6.3.11.1.1 Ditches must have positive grades so that standing water is minimized. The minimum allowable ditch grade shall be 0.6%. Ditch grades in excess of 2.0% shall be protected against erosion through rock ditch checks, silt fences, and/or erosion control blankets.

Refer to Standard Detail Drawing No. 6.6, Rock Ditch Checks

- 6.3.11.1.2 The minimum ditch bottom width shall be 3.0 m sloping away from the roadway at a minimum of 2.0%.
- 6.3.11.1.3 For local road applications (for design speeds up to 90 km/hr) preferred side slope and back slope is 4:1 and 3:1, respectively.
- 6.3.11.1.4 The maximum velocity of runoff in ditches must be less than the scour velocity of the particular ditch lining. Protection must be provided during the establishment of the ditch lining when vegetation is used as ditch lining.

6.3.11.2 CULVERTS AND BRIDGES

If culverts and bridges are required for proposed developments that cross existing water bodies, the designs shall incorporate allowances for backwater effects over a range of flows. The design of culverts and bridges require assessment of both the nominal design capacity and the performance of the structure during 1:100 year flood events. Design calculations shall be performed by qualified Structural and Hydrological Engineers and submitted to the General Manager of Infrastructure Services for approval. Culvert and bridge designs shall comply with the latest edition of Alberta Infrastructure *Highway Geometric Design Guide*.

6.3.11.2.1 Culvert size requirements shall be determined through the stormwater drainage analysis. However, the minimum size culverts shall be as follows:

- Residential approach culvert 400 mm (16 inch)
- Industrial approach culvert 500 mm (20 inch)
- Roadway centre line culvert 600 mm (24 inch)
- Culverts over 1400mm in diameter are considered bridge structures.

6.3.11.2.2 Culverts shall be installed to provide a minimum depth of cover of 500 mm or one-half (1/2) the culvert diameter, whichever is greater, as measured from the finished shoulder grade of the roadway to the top of the culvert. Culverts shall be counter sunk by 1/4 of the pipe diameter.

Refer to Standard Detail Drawing No. 6.5, Culvert Installation

Refer to Standard Detail Drawing No. 6.7, Culvert Installation with Rip -Rap Size 400-1200 dia

6.3.11.2.3 Culverts shall be new galvanized C.S.P. (corrugated steel pipe) with a minimum wall thickness of 1.6 mm, or as required by the loading criteria.

6.3.11.2.4 All culverts shall be installed in accordance with the manufacturer's recommendations.

6.3.11.2.5 All culverts shall be installed complete with beveled end sections on both the inlet and outlet sides with the invert extended to the toe of the side slope.

6.3.11.2.6 Rip rap shall be placed around the inlet and outlet of each culvert, with the rip rap extending a minimum of 1.0 metres beyond the ends of the culvert. Rip rap material shall consist of rock ranging in size from 150 mm to 350 mm with 50% of the rock material being larger than 200 mm.

6.3.12 Surface Runoff Drainage Swales

Bio-swales, grassed and concrete swales are used to convey overland flows during minor and major rainfall events. For rural areas, swales are typically used to drain runoff from minor and major events to roadside ditches or stormwater management facilities. In urban areas swales are typically used to convey flows to CBs and/or overland drainage routes to stormwater management facilities.

6.3.12.1 All surface runoff drainage swales shall be fully constructed prior to any development or subdivision lots.

- 6.3.12.2 Detailed drainage swale calculations and designs shall be submitted to the General Manager of Infrastructure Services for approval.
- 6.3.12.3 All surface runoff drainage swales shall be contained within Public Utility Lots, Right of Ways, Easements and shall become the property of the County.
- 6.3.12.4 The velocities and depths shall not exceed the values contained in Table 6.5.

6.3.11 Design Standards for Bio-Swales

- 6.3.11.1 Bioswales must be designed to fit the unique characteristics of each site. The designer is responsible for ensuring the physical attributes of the site can accommodate a swale.
- 6.3.11.2 To ensure the long-term functionality of bioswales, the facility's physical and performance parameters listed in **Table 6.6** should be considered during the preliminary design process. A bioswale cross section is shown in **Figure 6.1** and accompanying longitudinal profile in **Figure 6.2**. **Figure 6.3** shows a plan view of a bioswale.
- 6.3.11.3 Bioswale designs must filter and convey Parkland County's 1-in-2 year storm event, within the parameters listed in **Table 6.6**. The drainage area to a bioswale is based on the soil type, ponding depth and surface area. Surface flow velocity within a swale at a given slope is determined by the roughness of the channel. Different types of vegetation and surface treatments applied in a bioswale will impact flow velocities. Modelling should be performed by designers to demonstrate the function of the bioswale.
- 6.3.11.4 The drawdown time of bioswales is based on soil type and ponding depth, and must be reported to ensure safety and aesthetics are maintained. Bioswales along roadways must be designed to prevent compromising the road structure with water infiltration. Ponding areas in bioswales are created by using check dams to retain water and reduce the effective slope (**Figure 6.2**).

Effective slope can be determined using the following equation:

$$S_e = S_t - \frac{h}{L}$$

Where: S_e is the effective slope; h is the height of the check dam; and
 S_t is the terrain slope; L is the distance between check dams.

***Effective Slope** – gradient governing flow velocity within a swale. If the slope of the surrounding terrain is too steep for a vegetated swale, the effective slope may be flattened by using check dams or drop structures.*

Other design considerations besides those listed in **Table 6.6** include, but are not limited to:

- 6.3.11.5** Weaving swales around mature trees along boulevards and green spaces rather than removing the trees
- 6.3.11.6** Preventing icing of sidewalks and streets by sizing surface ponding capacity of the swales to accommodate the spring thaw volume of snow, ice and melt water without considerable infiltration by topsoils.
- 6.3.11.7** Designing bioswales that will receive additional snow to account for the added weight because snow piles can cause topsoil compaction
- 6.3.11.8** Providing curb cuts designed to direct the rate of flow and volume of runoff stormwater into bioswales and protect bioswales from plow blades during snow removal;
- 6.3.11.9** Amending topsoil to mitigate, as much as possible, the effects of de-icing compounds on soils and plants;
- 6.3.11.10** Providing a buffer along arterial roads (5 to 35 m vegetated filter strip) and along collector roads (3 to 5 m filter strip or sidewalk) to protect swale vegetation from salt damage;
- 6.3.11.11** Planting salt tolerant grasses and plants as a buffer between the roadway and less tolerant species (Appendix C);
- 6.3.11.12** Considering spring thaw volumes, soil compaction and salt damage to sensitive vegetation when the bioswale is designed specifically for snow storage;
- 6.3.11.13** Equipping bioswales designed to receive high salt loadings with an under-drain to allow salt to leach from the swale;
- 6.3.11.14** Selecting vegetation that will be able to structurally withstand moderate flow velocities and erosive forces of design events; and
- 6.3.11.15** Providing a buffer between facilities with deep infiltration capability and roadways or building foundations to reduce the risk of heaving or foundation damage due to saturated soils.

The details of bioswales planned for the site must be included on design drawings as indicated in **Table 6.7**.

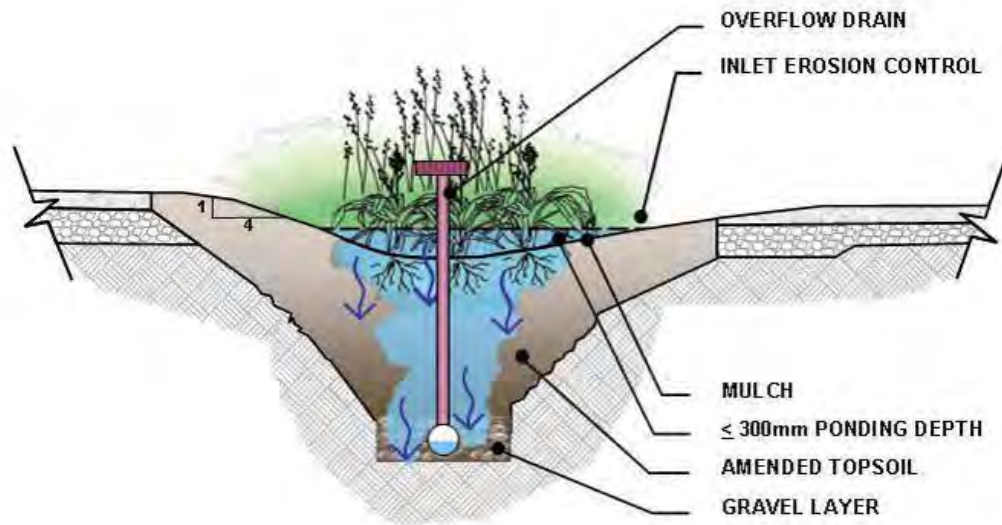


Figure 6.1 Cross-Section of Bioswale

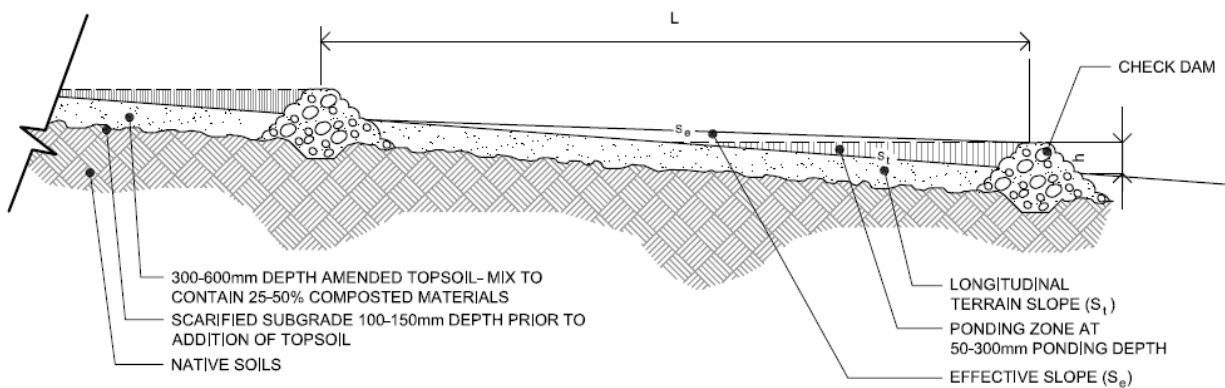


Figure 6.2 Longitudinal profile of a bioswale with check dams

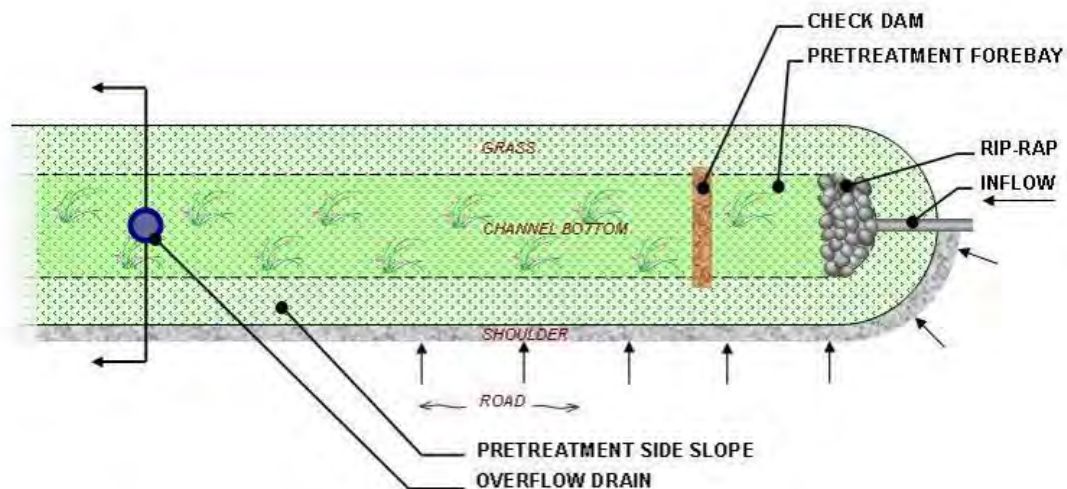


Figure 6.3 Plan view of bioswale

6.3.12 Operation and Maintenance

6.3.12.1 A schedule for operation, maintenance and replacement activities for bioswales is contained in **Table 6.8**. The scheduling for these activities varies depending on location and drainage area characteristics. Facility designers must provide site specific schedules for operation, maintenance and replacement to ensure the long-term functionality of the bioswale facility.

6.3.12.2 Facility inspections should be conducted quarterly during establishment (first 2 years) and semi-annually thereafter. Inspecting after a major storm event will facilitate early detection of erosion or debris blockages occurring during elevated or sustained flows. Snow plows should be careful not to cause damage to bioswales along roadways. Sediments and debris should be removed in the fall before snow covers the facilities and in spring before snowmelt runoff occurs. Bioswale facilities designed to receive runoff from contaminated sites may require more frequent inspections, tests and maintenance activities; sites that remain relatively undisturbed with little potential for contamination or sedimentation may require less maintenance.

6.3.12.5 GRASSED SWALES

Design of grassed swales shall include the following considerations:

6.3.12.5.1 All flows, up to and including the 1:100 year flow, must be contained in the swale.

6.3.12.5.2 Velocities in grass swales must be controlled such that erosion does not occur to the channel. Permissible velocities shall be determined for the soil type. Generally, for easily erodible soils, velocities may be between 0.80 m/s and 1.80 m/s. For erosion resistant soils, velocities may be between 1.10 m/s and 2.40 m/s.

6.3.12.5.3 Grass swale with concrete gutter requirements include:

- Longitudinal slopes must ensure positive drainage and conveyance of flows. A minimum longitudinal slope of 1.5% is required;
- Swale side slopes are to be a maximum of 4H:1V;
- Maximum depth of 150mm; and
- Grassed swales shall be in accordance with Standard Detail Drawings.

Refer to Standard Detail Drawing No. 6.4, Swales.

6.3.12.6 CONCRETE SWALES

Drainage swales located between adjacent lots shall be concrete.

6.3.12.6.1 All flows, up to and including the 1:100 year flow, must be contained in the swale. Grass swale with concrete gutter requirements include:

- V-shape – 75 mm to 150 mm depth, 500 mm to 610 mm wide with 4H:1V maximum side slope;
- Concrete: 150 mm minimum thickness with 3-10 m longitudinal bars and 3.0 m spaced control joints;
- Minimum longitudinal slope of 0.75%;
- The capacity of the swale is to contain the 1:5 year flow within the concrete gutter, and the 1:100 year storm within the easement;
- Bends greater than 45 degrees shall be avoided. Bends are to be no greater than 90 degrees. Bends greater than 45 degrees require a 1.0 m minimum centreline radius and adequate curbing to contain the design flow in the gutter and easement; and
- Concrete drainage gutters shall be in accordance with Standard Detail Drawings.

Refer to Standard Detail Drawing No. 6.4, Swales.

6.3.13 Piped Drainage System

6.3.13.1 MINOR STORM DRAINAGE SYSTEMS

6.3.13.1.1 Storm sewer main sizing shall be determined by utilizing the Manning Equation. The equation is as follows:

$$V = (1/n)R^{2/3}S^{1/2}$$

Where V = velocity of flow (m/s)
 R = hydraulic radius (m)
 S = slope of energy grade line (m/m)
 n = coefficient of roughness

Note: n=0.013 shall be used for the roughness coefficient

6.3.13.1.2 The minimum velocity of flow in storm sewer mains shall be 0.6 m/s. Where velocities in excess of 3 m/s are possible, special provisions shall be made to protect the storm sewer main against displacement by erosion or impact.

6.3.13.1.3 Storm sewer mains shall be designed to flow full when conveying the ultimate design flows. The hydraulic grade line shall be located at the crown of the sewer main. All storm sewer main crown elevations shall match at manhole junctions.

- 6.3.13.1.4 Minimum pipe slopes shall conform to Section 5.2.2.2 of the Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems as published by Alberta Environment and Sustainable Resource Development (latest edition thereof).

6.3.14 Major Storm Drainage Systems

- 6.3.14.1 Minimum diameter of storm sewer mains shall be 300 mm.
- 6.3.14.2 Acceptable storm sewer main materials are as follows and shall conform to the latest edition of the referenced standards:
- Reinforced sulphate resistant concrete pipe (ASTM standard C76);
 - PVC pipe, minimum class DR 35 (ASTM D3040 or ASTM F1760, CSA 182.2 or CSA 182.7); and
 - “Ultra-Rib” PVC pipe, minimum class DR 35, up to 600 mm diameter (ASTM standard D1784).
- 6.3.14.3 Storm sewer pipe joints shall be rubber ring gasket type conforming to the latest edition of the following referenced standards:
- Concrete pipe joints (ASTM Standard C443, CSA B257.3);
 - PVC DR 35 pipe joints (ASTM Standard D3034 or ASTM Standard F1760, CSA B182.2 or CSA B182.7); and
 - “Ultra-Rib” PVC pipe joints (ASTM Standard F477, CSA B182.4).
- 6.3.14.4 Storm sewer pipe classes shall be selected so that the pipes are able to withstand the required superimposed loadings. There are various factors affecting the pipe class selection and they shall be taken into account. The pipe class selection shall be evaluated against standard acceptable engineering practices.

6.3.15 Manhole and Storm Sewer Locations and Installation

See Section 4 Sanitary Sewer Systems

- 6.3.15.1 Each cover shall minimally have the words “STORM SEWER” embossed on it.

Refer to Standard Detail Drawing No. 4.1, Standard Manhole and No. 4.2, Pre-benched Manhole Base.

- 6.3.15.2 Compact backfill around manholes with mechanical tampers to at least 98% of the Standard Proctor Density.
- 6.3.15.3 If an inlet storm sewer main is greater than 525 mm in diameter and is located on a bend that is greater than 45° (degrees), or if the outlet storm sewer main velocity exceeds 1.5 m/s, then minor losses shall be considered in the design calculations.
- 6.3.15.4 Alignment of storm sewer mains shall be approved by the General Manager.

- 6.3.15.5 Storm sewers must be located at least 3.0 m horizontally from any water main or sanitary sewer, and at least 1.8 m horizontally from gas or other shallow utility lines. For horizontal crossing a vertical separation of at least 0.5 m shall be maintained.

6.3.16 Curved Sewers

See Section 4 Sanitary Sewer Systems

6.3.17 Force mains

6.3.17.1 PRESSURE PIPES/FORCE MAINS

- 6.3.17.1.1 Force mains shall be constructed of either PVC or HDPE pipe based on economic considerations and shall be adequately sized for economical pump operation and to provide optimum design velocities in the range of 0.9 to 1.5 m/s.

- 6.3.17.1.2 PVC pipes shall have a minimum pressure rating of 165 psi.

- 6.3.17.1.3 HDPE pipes shall have a minimum pressure rating of 160 psi.

6.3.17.2 VALVES

- 6.3.17.2.1 Plug valves shall be cast iron resilient coated eccentric type and installed so the plug is hinged in the horizontal plane and open to the top.

- 6.3.17.2.2 Air/vacuum relief valves shall be stainless steel and located on high points as required.

- 6.3.17.2.3 All isolation valves 50 mm diameter and smaller shall have lever actuators and all isolation valves larger than 50 mm diameter shall have worm gear actuators.

6.3.18 Trenching, Bedding and Backfilling

See Section 4 Sanitary Sewer Systems

6.3.19 Inspection and Testing

Prior to issuance of the Construction Completion Certificate and Final Acceptance Certificate, all storm sewer mains shall be inspected and tested to ensure proper performance. Inspection and testing may include the following:

- 6.3.19.1 All excavating, laying, and joining of pipes, backfilling, compaction, and completion of all works shall be subject to inspection by authorized representatives of the County. Unsatisfactory conditions shall be remedied immediately upon notification at the Developer's expense.

- 6.3.19.2 Following their construction, all storm sewer mains, manholes, catch basins, and catch basin leads shall be thoroughly cleaned and flushed of any earth, gravel, and other debris. Such material shall be collected and removed to a disposal site approved by the Developer's Engineer.
- 6.3.19.3 All sections of storm sewer mains shall be inspected with closed circuit television camera equipment. A written report and a digital record of the inspection, on a CD-Rom, DVD or USB Flash Drive, shall be submitted to the County for approval and record purposes.
- 6.3.19.4 All sections of a storm sewer system larger than 900 mm in size shall be visually inspected. A written report and a digital record of the inspection complete with photographic or video footage, on a CD-ROM, DVD or USB Flash Drive, shall be submitted to the County for approval and record purposes.

6.4 STORMWATER PUMP STATION GUIDELINES FOR ACHESON BASIN 1

6.4.1 Introduction

These guidelines present a standard of uniformity for new stormwater pump station construction in Acheson Basin 1, as defined in the Acheson/Big Lake Master Drainage Study (AECOM 2011), and are applicable to duplex pump stations. Other requirements are documented in Alberta Environment and Sustainable Resource Development publications.

The new facilities are to meet the highest standards for safety and reliability and provide a well-designed working environment for operations staff over the long term.

These design guidelines are divided into several sections, each of which covers critical design information. The guidelines are addressed to the parties responsible for the design and construction of any new stormwater pump station.

Alberta Environment and Sustainable Resource Development Standards and Guidelines are to be met in all cases. Parkland County guidelines are to be followed if more stringent than Alberta Environment and Sustainable Resource Development requirements. Parkland County will arbitrate any misunderstandings on what requirements are to be met.

6.4.2 General Location

6.4.2.1 The pump station site shall be located adjacent to the SWMF and be complete with a dedicated access road to allow safe and direct access to the facility from a registered public roadway.

6.4.3 Access and Site Layout

6.4.3.1 A 4.5 m (minimum) wide gravel access road shall be constructed in accordance with the applicable Parkland County standards. The approach (portion within the Parkland County right of way) shall be constructed with an asphalt surface to match road structure.

6.4.3.2 The pump station shall be located in an enclosed gravel yard with adjacent designated areas for vaults, electrical equipment, and vehicle access including parking and turnaround.

6.4.3.3 The vehicle area must be sized to accommodate safe turnaround of a SU9 vehicle.

6.4.3.4 Concrete filled steel pipe bollards shall be used to delineate the designated areas. These shall be located as necessary to protect vaults and electrical equipment from any vehicle impacts.

6.4.3.5 The yard shall be enclosed with a 1.8 m high black powdered coated chain link fence with a 5.5 m wide double swing gate with locking closure.

6.4.3.6 An exterior sign (minimum size 0.6 x 1.2 m) shall be placed on the gate containing emergency contact phone information.

- 6.4.3.7 The pumping station yard shall be adequately graded so that it drains freely away from the facility and no ponding of water will occur adjacent to entrances, vaults or around electrical equipment. Site elevations shall be established such that the facility is not subject to flooding due to runoff or ponding under and conditions of rainfall or runoff from snow melt.
- 6.4.3.8 The site shall include a photo cell activated yard light, complete with activation switch, rated for outdoor applications, that illuminates the electrical equipment and the pump and valve vault access hatches.
- 6.4.3.9 All bollards and enclosures shall be painted safety yellow.

6.4.4 Pump Station Configuration

6.4.4.1 GENERAL

- 6.4.4.1.1 The pump station shall comprise separate pump and valve vaults.
- 6.4.4.1.2 Each vault shall be constructed using precast concrete box sections.
- 6.4.4.1.3 All concrete shall be sulphate resistant.
- 6.4.4.1.4 Joints between precast sections shall be sealed with waterproof gaskets.
- 6.4.4.1.5 All concrete surfaces below the high water level shall be sealed with a crystalline concrete waterproofing coating agent.
- 6.4.4.1.6 All inlet/outlet piping installed below the high water level shall be constructed using permanent modular seal assemblies to prevent inflow and or outflow of water around the piping penetrations.

6.4.4.2 PUMP VAULT

- 6.4.4.2.1 The pump vault shall be constructed below grade and appropriately sized for two pumps (duty and standby).
- 6.4.4.2.2 The active volume for the pumps shall be provided by the SWMF and the amount of pump vault storage below the pump off level shall be kept to an acceptable minimum.
- 6.4.4.2.3 The inlet pipe shall be fitted with a knife gate valve to allow isolation of the pump vault for maintenance.
- 6.4.4.2.4 There shall be separate discharge pipes for each pump.
- 6.4.4.2.5 The pump vault shall include granolithic concrete benching to limit dead spaces. Benching shall have a slope of 1:1 minimum.

6.4.4.3 VALVE VAULT

- 6.4.4.3.1 The valve vault shall be constructed below grade and appropriately sized for the discharge piping valves and fittings.
- 6.4.4.3.2 The floor of the valve vault shall be graded to a sump that is in an area below the access hatch that is accessible from the surface so that the vault can be pumped out by a vacuum truck if it becomes flooded.
- 6.4.4.3.3 The valve vault shall include a branch line with an above grade connection. The connection shall be equipped with a plug isolation valve and check valve.

Refer to Standard Detail Drawing No. 6.8, Pump Station.

6.4.5 Pumps

- 6.4.5.1 Each pump vault shall include two (duty and standby) submersible pumps.
- 6.4.5.2 All pumps should be identical and interchangeable.
- 6.4.5.3 Pumps are to be selected to provide optimum efficiency at the actual operating point.
- 6.4.5.4 The capacity of each pump shall be in excess of the flow expected by established engineering practice.
- 6.4.5.5 Each pump shall include a vault flushing valve.
- 6.4.5.6 Pumps shall include a cast iron discharge connection including a quick connect break away discharge elbow mated to a surface on the pump which is held in position by the weight of the pump and guided into position on vertical stainless steel pipe guide bars extending the entire depth of the pump vault. The elbow shall be fastened to the pump vault floor with stainless steel bolts.
- 6.4.5.7 Pumps shall be removable without entering the pump vault or shutting down the station.
- 6.4.5.8 Pumps shall include motors attached directly to the pumps. Motors shall be sized to be non-overloading on any point on the pump curve. Motors shall be nominal 600 volts, 3 phase. Motor service factor shall be 1.15. Power cables are to be provided with the pumps.
- 6.4.5.9 Provide an adjustable lifting davit and hoist on the top of the pump vault for pump removal and emergency rescue of personnel. The hoist shall have a capacity of at least twice the wet weight of a pump.

- 6.4.5.10 The preferred make of pumps and associated equipment is Flygt type N with semi-open impellers. Alternative pump manufacturers may be considered on the basis of a favorable present-worth analysis.

6.4.6 Piping, Valves & Instrumentation

6.4.6.1 PROCESS PIPING

- 6.4.6.1.1 All piping, fittings and fasteners within and between the vaults shall be stainless steel grade 316.
- 6.4.6.1.2 Inlet/outlet piping shall include flange connections for connecting to the site piping.
- 6.4.6.1.3 Flexible couplers shall be provided between the pump and valve vaults/
- 6.4.6.1.4 The discharge piping shall be designed such that the velocity will not exceed 3.0 m/s.
- 6.4.6.1.5 Support all internal piping and valves with adjustable mechanical pipe supports.
- 6.4.6.1.6 Branch piping shall include an above grade twist lock coupling with a chained cover.

6.4.6.2 VALVES

- 6.4.6.2.1 Knife gate valves shall be resilient seated, suitable for submerged applications and come complete with stem and pedestal mounted geared hand wheel actuator.
- 6.4.6.2.2 Plug valves shall be cast iron resilient coated eccentric type and installed so the plug is hinged in the horizontal plane and open to the top.
- 6.4.6.2.3 Check valves shall be cast iron ball check valves with rubber coated metal sinking balls to prevent flow reversal
- 6.4.6.2.4 Air/vacuum relief valves shall be stainless steel and located on high points as required.
- 6.4.6.2.5 All isolation valves 50 mm diameter and smaller shall have lever actuators and all isolation valves larger than 50 mm diameter shall have worm gear actuators.

6.4.6.3 INSTRUMENTATION

- 6.4.6.3.1 Provide pressure gauge taps on both pump discharges upstream of the check valves. Taps shall be complete with twist lock couplings and stainless steel compound pressure/vacuum gauges, diaphragm seals and isolation valves.

6.4.6.4 SITE PIPING

- 6.4.6.4.1 The inlet piping shall be either PVC or HDPE based on economic considerations and shall be sized for a maximum of 0.1m head loss between the SWMF and the pump vault.
- 6.4.6.4.2 The forcemain shall be constructed of either PVC or HDPE pipe based on economic considerations and shall be adequately sized for economical pump operation and to provide optimum design velocities in the range of 0.9 to 1.5 m/s.
- 6.4.6.4.3 PVC pipes shall have a minimum pressure rating of 165 psi.
- 6.4.6.4.4 HDPE pipes shall have a minimum pressure rating of 160 psi.

6.4.7 Access Hatches, Ladders and Lifting Systems**6.4.7.1 ACCESS HATCHES**

- 6.4.7.1.1 All access hatches shall be stainless steel complete with FRP safety grating, and have hold open devices to hold the hatch in the 90 degree open position.
- 6.4.7.1.2 Hatch and safety grating shall be sized for a live load of 14.4 kPa (300 psi).
- 6.4.7.1.3 The pump vault must have a two leaf pump access hatch for the pumps with one leaf above each pump.
- 6.4.7.1.4 The pump vault must also have a separate single access hatch for maintenance access.
- 6.4.7.1.5 The valve vault shall have a single access hatch for maintenance access and removal of equipment.
- 6.4.7.1.6 All surfaces in contact with concrete shall be coated with black bitumastic.
- 6.4.7.1.7 All hatches shall be equipped with padlock receptacles.

6.4.7.2 LADDERS

- 6.4.7.2.1 Provide stainless steel ladders for access to the pump and valve vaults.
- 6.4.7.2.2 Ladders shall meet all applicable health and safety requirements.
- 6.4.7.2.3 Ladders must be permanently attached to the walls.
- 6.4.7.2.4 All ladders must have pull up safety posts at the top that can be extended 1.0 m above the roof.

6.4.7.3 LIFTING SYSTEMS

- 6.4.7.3.1 Pumps shall include stainless steel lifting chains attached to pumps and the chains shall be long enough to be hooked on the pump access hatch plus 3 metres of chain to reach the lifting hoist.
- 6.4.7.3.2 Provide a portable and adjustable lifting davit and hoist system for equipment removal and emergency rescue of personnel.
- 6.4.7.3.3 The system shall be man-rated as well as having a capacity of at least twice the weight of a pump.
- 6.4.7.3.4 Provide two (one at each vault) stainless steel floor mounted sockets complete with sleeve caps.

6.4.8 Ventilation

- 6.4.8.1 Provide each vault with a 150 mm stainless steel vent pipe complete with goose neck and mesh bird screen.

6.4.9 Lighting

- 6.4.9.1 Provide GFI protected sockets at the tops of the pump vault and valve vault where portable lighting (and repair tools) can be plugged in.

6.4.10 Power Service

- 6.4.10.1 Service to be sized based on final load calculations.
- 6.4.10.2 Connection applications must be filed with Fortis to start utility design process.
- 6.4.10.3 Utility service must be underground.
- 6.4.10.4 Provide a manual power transfer switch and a plug that would allow hook up of a portable generator.

6.4.11 Electrical Equipment Housing

- 6.4.11.1 The electrical power distribution and control equipment shall be installed in a 3-compartment heavy-duty metal kiosk, designed to NEMA 3R Standards. The compartments shall be designated as Power, Controls and Hazardous Area.
- 6.4.11.2 The Kiosk shall be equipped with lighting, heating, ventilation and intrusion detection switches.
- 6.4.11.3 A key-switch shall be provided to enable operations crew to bypass security system during authorized entry.
- 6.4.11.4 The equipment shall be installed for easy access, and operator's interface devices and displays shall be installed for ergonomic access.
- 6.4.11.5 All wiring terminations from the pump vault shall be routed through hazardous area compartment. The 'Power' and 'Controls' compartments shall be isolated from 'Hazardous Area' compartment, using EYS seals.

6.4.12 Controls and Instruments

- 6.4.12.1 Motor controls and a PLC panel shall be located in 'Controls' compartment of Kiosk.
- 6.4.12.2 Adjustable speed drives (VFD) shall be provided for pumps motor starting and control.
- 6.4.12.3 The submersible pumps health status shall be monitored by pump-vendor supplied equipment.
- 6.4.12.4 The associated alarm contacts shall be hard-wired in the Pump control wiring scheme.
- 6.4.12.5 The pump vault level shall be measured using an analog level transmitter, along with two (2) back-up float level switches. Intrinsically safe barriers shall be provided for level transmitter and switches located in the pump vault.
- 6.4.12.6 A float switch shall be provided for monitoring flooding situation inside valve vault.
- 6.4.12.7 Provide a UPS for emergency power back-up of controls, instrumentation and SCADA equipment. The UPS batteries shall be sized to provide five (5) minutes of power back-up time to allow alarms dial-out, receive essential SCADA inputs and orderly shutdown of equipment.
- 6.4.12.8 A local operator interface to the control system, including level display, level set-points entry module, hand-switches, pilot lights on the Control panel door, shall be provided. The pilot light shall provide indication of pump status and various alarm conditions.

- 6.4.12.9 Hour-meters to indicate each pump's run-time shall also be added to Control panel door.
- 6.4.12.10 The basic operation of pump vault pumps shall consist of AUTOMATIC / MANUAL mode, selected using an 'HOA' 3-position selector switch for each pump. In MANUAL mode, each pump shall be controlled by an operator using a respective VFD keypad. In AUTOMATIC mode, the pumps shall be controlled by PLC logic based on pump vault level conditions.
- 6.4.12.11 AUTOMATIC mode shall include a 3-position selector switch mounted on Control panel door, that will allow an operator to select duty status as follows:
- Pump 1 duty
 - Pump 2 duty
 - Alternate duty after each cycle or maximum allowed continuous run-time, whichever comes first.

6.4.13 Scada System

- 6.4.13.1 A peer-to-peer radio network shall be established between the pump station and nearest SCADA (running GE Cimplicity platform) nodes (at Acheson Zone 3 Reservoir or Entwistle Water Treatment Plant), using unlicensed frequency 900 MHz radios.
- 6.4.13.2 All SCADA communications between PLC and SCADA node shall be based on MODBUS communication protocol.
- 6.4.13.3 The radio network design, including antennae height and orientation, shall be based on a reliable radio path study. If radio path study indicates that cost-effective radio network could not be established, then alternate means of communication between pump station and SCADA node, such as Internet, shall be provided.
- 6.4.13.4 All pump station alarms shall be managed at the SCADA node, including notification to operations crew.

6.4.14 Configuration, programming and commissioning

- 6.4.14.1 All controls, radio and SCADA system related configuration and programming shall be provided by County appointed systems integrator. This systems integrator shall also provide services for final commissioning of pump station.
- 6.4.14.2 Test all equipment and materials to demonstrate proper operation and set points.
- 6.4.14.3 Provide a written start-up report covering inspection, operation, adjustment and testing of equipment.

6.4.15 Operating, Maintenance and Service Manual

6.4.15.1 Provide four copies and one digital copy of an Operating, Maintenance and Service Manual for the facility. The manual must include complete equipment manufacturer's parts list, operating and repair instructions and calibration and test results for all mechanical and electrical equipment. The manuals shall be bound in hard covered binders.

6.4.15.2 Provide all manufacturers' recommended spare parts for one year of operation.

6.4.15.3 Provide locks as required and four sets of keys for all locks.

6.4.16 Preferred Vendor List

Equipment	Preferred Vendor
Mechanical	
Pumps	Flygt (Xylem)
Knife Gate Valves	Wey
Plug Valves	Valmatic, DeZurik,
Ball Check Valves	HDL
Air release / vacuum	APCO, Vent-O-Mat, Valmatic
Pump Access Hatches	Xylem Safe Hatch
Access Hatches	Xylem Safe Hatch, MSU
Davits Systems	Xylem, UCL
Electrical	
PLC	GE Versamax or 9030 series
VFD	Yaskawa
Radio	Freewave 900 MHz
Analog Level Transmitter	Siemens Milltronics
Float Switches	Flygt (Xylem)
UPS	Always ON

6.5 LIST OF STANDARD DETAIL DRAWINGS

Standard details have been provided for the guidance of designers in the interpretation of the standards. Where the standards and the drawings conflict, the standards shall govern. Standard drawings are dimensioned in millimeters unless otherwise noted.

Refer to Section 10 for all Standard Detail Drawings

Table 6.1: Intensity Duration Frequency (IDF) Design Storm Data

Duration (minutes)	Rainfall Intensity (mm/hour)		
	1:5 Year	1:10 Year	1:100 Year
10	67.8	82.5	129.0
11	64.2	78.1	122.0
12	61.0	74.3	116.0
13	58.3	70.9	110.0
14	55.8	67.9	106.0
15	53.6	65.1	101.0
16	51.5	62.7	97.6
17	49.7	60.4	94.0
18	48.0	58.4	90.8
19	46.5	56.5	87.9
20	45.1	54.8	85.2
21	43.7	53.2	82.6
22	42.5	51.7	80.3
23	41.4	50.3	78.1
24	40.3	49.0	76.1
25	39.3	47.8	74.2
26	38.4	46.6	72.4
27	37.5	45.5	70.7
28	36.7	44.5	69.1
29	35.9	43.6	67.6
30	35.1	42.6	66.2
60	22.7	27.5	42.5
120	14.5	17.6	27.1
360	7.13	8.6	13.2
720	4.54	5.46	8.36
1440	2.89	3.47	5.29

Notes:

1. Based on AES data from Edmonton Municipal Airport for a period of 63 years (1914 to 1995).
2. Maximum initial Time of Concentration is 10 minutes.

Table 6.2: Recommended Minimum Runoff Coefficients

Land Use		Rainfall Event		
		1:5 Year	1:10 Year	1:100 Year
Low Density	• sandy soil	0.10	0.20	0.25
Country Residential	• clay soil	0.15	0.25	0.30
High Density Country Residential		0.25	0.45	0.50
Industrial		0.25	0.45	0.50
Lawns, Parks, Playgrounds		0.15	0.20	0.30
Undeveloped or	• sandy soil	0.05	0.15	0.20
Agricultural Land	• clay soil	0.10	0.30	0.35
Paved Roads		0.90	0.90	0.95
Gravel Roads		0.30	0.35	0.65

Notes:

1. Values recommended for use with the Rational Method.
2. Where specific land uses are known, the runoff coefficients may be determined from the ultimate developed conditions.
3. Runoff coefficients must be determined from the ultimate developed conditions.

Table 6.3: 4-Hour Design Storm, Chicago Distribution

Time (min)	Design Storm			Time (min)	Design Storm		
	1:5 Year	1:10 Year	1:100 Year		1:5 Year	1:10 Year	1:100 Year
0	1.64	1.97	2.99	125	7.60	9.14	14.00
5	3.40	4.07	6.18	130	7.08	8.50	13.00
10	3.55	4.26	6.47	135	6.63	7.97	12.20
15	3.73	4.48	6.80	140	6.26	7.52	11.50
20	3.94	4.72	7.17	145	5.93	7.12	10.80
25	4.17	5.00	7.61	150	5.64	6.77	10.30
30	4.45	5.33	8.11	155	5.38	6.46	9.84
35	4.77	5.72	8.71	160	5.16	6.19	9.42
40	5.16	6.19	9.43	165	4.95	5.94	9.05
45	5.64	6.78	10.30	170	4.77	5.72	8.70
50	6.26	7.52	11.50	175	4.60	5.52	8.39
55	7.09	8.52	13.00	180	4.44	5.33	8.11
60	8.26	9.93	15.20	185	4.30	5.16	7.84
65	10.10	12.10	18.60	190	4.17	5.00	7.60
70	13.50	16.30	25.00	195	4.05	4.86	7.38
75	23.60	28.50	43.90	200	3.94	4.72	7.17
80	68.10	82.90	129.00	205	3.83	4.59	6.98
85	68.10	82.90	129.00	210	3.73	4.47	6.80
90	22.20	26.80	41.30	215	3.64	4.36	6.63
95	16.40	19.80	30.40	220	3.55	4.26	6.47
100	13.30	16.10	24.60	225	3.47	4.16	6.32
105	11.40	13.70	21.00	230	3.39	4.07	6.17
110	10.00	12.10	18.50	235	3.32	3.98	6.04
115	9.02	10.90	16.60	240	1.64	1.96	2.97
120	8.24	9.91	15.10				

Notes:

1. Based on AES data from Edmonton Municipal Airport for a period of 63 years (1914 to 1995).
2. Maximum initial Time of Concentration is 10 minutes.

Table 6.4: 24-Hour Design Storm, Huff Distribution

Time (min)	Time (hours)	Design Storm		
		1:5 Year	1:10 Year	1:100 Year
0	0	0.00	0.00	0.00
15	0.25	0.516	0.619	0.945
30	0.50	1.03	1.24	1.89
45	0.75	1.55	1.86	2.83
60	1.00	2.06	2.48	3.78
75	1.25	2.75	3.30	5.04
90	1.50	4.12	4.96	7.56
105	1.75	5.50	6.61	10.10
120	2.00	6.87	8.26	12.60
135	2.25	8.25	9.91	15.10
150	2.50	9.17	11.00	16.80
165	2.75	9.42	11.30	17.30
180	3.00	9.66	11.60	17.70
195	3.25	9.91	11.90	18.20
210	3.50	10.20	12.20	18.60
225	3.75	10.00	12.00	18.30
240	4.00	9.58	11.50	17.60
255	4.25	9.17	11.00	16.80
270	4.50	8.75	10.50	16.00
285	4.75	8.33	10.00	15.30
300	5.00	7.89	9.49	14.50
315	5.25	7.45	8.95	13.70
330	5.50	7.01	8.42	12.80
345	5.75	6.57	7.89	12.00
360	6.00	6.13	7.36	11.20
375	6.25	5.76	6.92	10.60
390	6.50	5.39	6.48	9.88
405	6.75	5.02	6.03	9.20
420	7.00	4.65	5.59	8.53
435	7.25	4.31	5.17	7.89
450	7.50	4.04	4.85	7.39
465	7.75	3.77	4.52	6.90
480	8.00	3.50	4.20	6.41
495	8.25	3.23	3.88	5.91
510	8.50	3.02	3.63	5.53
525	8.75	2.91	3.50	5.33
540	9.00	2.80	3.36	5.13
555	9.25	2.69	3.23	4.93
570	9.50	2.58	3.10	4.72
585	9.75	2.47	2.97	4.53
600	10.00	2.36	2.84	4.33
615	10.25	2.26	2.71	4.13
630	10.50	2.15	2.58	3.94
645	10.75	2.04	2.45	3.74
660	11.00	1.95	2.34	3.57
675	11.25	1.85	2.23	3.39
690	11.50	1.76	2.11	3.22
705	11.75	1.67	2.00	3.05
720	12.00	1.57	1.89	2.88

Time (min)	Time (hours)	Design Storm		
		1:5 Year	1:10 Year	1:100 Year
735	12.25	1.52	1.82	2.78
750	12.50	1.46	1.76	2.68
765	12.75	1.41	1.70	2.59
780	13.00	1.36	1.63	2.49
795	13.25	1.30	1.57	2.39
810	13.50	1.25	1.50	2.28
825	13.75	1.19	1.43	2.18
840	14.00	1.13	1.36	2.08
855	14.25	1.08	1.29	1.97
870	14.50	1.04	1.25	1.90
885	14.75	1.02	1.23	1.88
900	15.00	1.01	1.21	1.85
915	15.25	1.00	1.20	1.83
930	15.50	0.984	1.18	1.80
945	15.75	0.972	1.17	1.78
960	16.00	0.961	1.15	1.76
975	16.25	0.949	1.14	1.74
990	16.50	0.938	1.13	1.72
1005	16.75	0.926	1.11	1.70
1020	17.00	0.914	1.10	1.68
1035	17.25	0.902	1.08	1.65
1050	17.50	0.890	1.07	1.63
1065	17.75	0.878	1.06	1.61
1080	18.00	0.866	1.04	1.59
1095	18.25	0.854	1.03	1.56
1110	18.50	0.842	1.01	1.54
1125	18.75	0.830	1.00	1.52
1140	19.00	0.818	0.983	1.50
1155	19.25	0.802	0.964	1.47
1170	19.50	0.772	0.928	1.42
1185	19.75	0.742	0.892	1.36
1200	20.00	0.712	0.856	1.31
1215	20.25	0.683	0.820	1.25
1230	20.50	0.658	0.791	1.21
1245	20.75	0.643	0.772	1.18
1260	21.00	0.627	0.753	1.15
1275	21.25	0.611	0.734	1.12
1290	21.50	0.595	0.715	1.09
1305	21.75	0.574	0.690	1.05
1320	22.00	0.550	0.661	1.01
1335	22.25	0.525	0.631	0.963
1350	22.50	0.501	0.602	0.918
1365	22.75	0.476	0.572	0.873
1380	23.00	0.452	0.543	0.828
1395	23.25	0.427	0.513	0.783
1410	23.50	0.403	0.484	0.738
1425	23.75	0.378	0.454	0.693
1440	24.00	0.353	0.425	0.648

Notes:

1. Based on AES data from Edmonton Municipal Airport for a period of 63 years (1914 to 1995).
2. Maximum initial Time of Concentration is 10 minutes.

Table 6.5: Permissible Depths of Flow in Channels

Flow Velocity (m/s)	Permissible Depth of Flow (m)
0.5	0.80
1.0	0.32
2.0	0.21
3.0	0.09

Notes:

1. Based on a 20 kg child standing in the flow. Channel is lined with concrete.
2. Larger persons may be able to withstand greater depths of flow.

Table 6.6: Bioswale Design Criteria:

Design element	Minimum Criteria
Soil Infiltration Rate	>13 mm/hr, under-drain is not required; under-drain required in tighter soils (<13 mm/hr) and with longitudinal slopes (St) less than 1%
Inlet Design	Grass filter buffer (2 m to 30 m) prior to overland entry into swale; filter strips to buffer salt impacts are required as follows: 3-5 m width along collectors (may use sidewalk) and 5-35 m width along arterials
Design Discharge	Flow rate within facility for 2-year, 5-year, 10-year, 25-year and 100-year design events and maximum rate from Parkland County's continuous precipitation record
Overland Flow Velocity	Determine using Mannings equation based on soil type and vegetation density; ensure velocities remain non-erosive during the 10-year, 25-year and 100-year design events
Outlet Release Rate	From under-drain or catchbasin lead; must correspond to on-site release rates defined in Master Stormwater Drainage Plan
Flow Depth	<0.3 m during 2-year design event
Ponding Depth	< 0.15 m during 2-year design event; max. 0.35 m depth
Media Layers	Growing media: (amended topsoil) >300 mm depth
	Filter layer: (16-25 mm clean gravel with <0.1% silt) 100 mm depth
	Infiltration / storage layer: (<40 mm clean gravel with <0.1% silt) >450 mm depth
Vegetation	Grasses and dense vegetation (100% coverage at establishment – 2 years); turf grass recommended on slopes >0.5%
WSE in Design Storms	Show that HWL at 2-year and 100-year design events does not compromise adjacent structures
Captured Volume	Volume of water retained through ponding and surface infiltration during the 2 year design event; additional volume captured during larger events if applicable
Emptying Time	Duration of ponded water following the 2-year design event <24hrs
Surface Area	10% to 20% of contributing impervious area; determined through continuous modelling; facility to be sized by designer based on snowmelt volumes and salt loadings as required
Geometry	Trapezoidal or triangular, provide cross-section detail with dimensions labelled
Facility Width (Surface)	0.6 m to 2.4 m width
Side Slopes	4:1 (H:V) preferred (max 3:1)
Longitudinal Slope	Sufficiently flat to maintain non-erosive velocities in the 10-year design event; typically in the range of 0.5% to 1.0%. Grade control structures required for longitudinal slopes (st) in excess of 1.0% to reduce the longitudinal slopes (se) to 0.5% to 1.0% between grade control structures
Under-drain	Required when longitudinal slope of site (St) <1%; also required when high salt loadings expected
Groundwater Buffer	Bottom of facility located minimum of 0.6 m to 1 m above groundwater table
Structural Buffer	Facility located >3 m from building foundations

Table 6.7: Bioswales Drawing Details

Parameter	Plan (Figure 9.3)	Detail (Figure 9.1)	Profile (Figure 9.2)	Description
Inlet	X	X		Shown on plan view and typical detail provided (curb cut, flow spreader, ribbon curb, off-gas system [OGS])
Materials		X	X	Material specs (soil, drainage, geotextile), depth, hydraulic conductivity, void space
Vegetation	X	X		Planting plan and vegetation details (species, mature density, succession plan)
Slope	X	X	X	Side slopes, longitudinal slope, effective slope, check dams or drop structures
Outlet		X		Under-drain spec & slope, spill elevation, catchbasin type and grate, weir, interface control drawing (ICD)
Catchment	X			Delineated catchment area directed to swale
Surface Area	X			Outlined on drawings and stated in report
Depth		X		Ponding depth and water surface elevation during design storm and maximum prior to spill
Flow Arrows	X			From contributing area, within swale and overflow route
Inundation	X			Extent of inundation during design storms
Erosion control	X	X		Located at inlet, outlet if overland spill

Table 6.8: Bioswale Operation, Maintenance and Replacement Schedule

Operation Activities	Scheduling
Inspect for sedimentation, erosion, plant health, mulch condition	Semi-annually (spring, fall), quarterly during establishment (2 yrs)
Irrigation	As needed during establishment (2 yrs)
Use for snow storage only where sufficient volumetric capacity exists and snow weight can be accommodated	Winter
Strategic application of de-icing and anti-skid material on roadways / parking lots contributing to facility	Winter
Street sweeping to prevent sedimentation	Semi-annually (spring, fall)
Soil contamination testing in areas with high levels of contaminants	Annually
Soil infiltration testing (empty time <48hrs)	Bi-annually
Maintenance Activities	Scheduling
Weed control	Bi-monthly
Mow grass and remove clippings, minimum length (50-250 mm) no shorter than maximum flow depth	Monthly (May-October)
Prune vegetation when access or operation limited	Annually
Litter and debris removal from inlets, vegetation and flow Paths	Bi-monthly
Tilling or deep raking	Bi-annually, prior to infiltration testing
Sand and sediment removal	Annually (spring) or when sediment depth >100 mm
Under-drain flush	Annually (spring)
Erosion repair of soils, mulch, splash pad, rip rap	As indicated by inspection, annually (following spring snowmelt)
Replacement Activities	Scheduling
Grass / plants (unhealthy or dead >10%)	As indicated in inspection (1-10 years)
Mulch, replenish or replace	As indicated by inspection (1-3 years)
Soils	As indicated by contaminant/infiltration testing (2-20 years)
Gravel drainage layer	As indicated by infiltration testing (25-50 years)
Under-drain	When flushing indicates irreparable clogging (25-50 years)

APPENDIX A

Master Drainage Plan		
A1: Submission Requirements	Status	
	Completed	N/A
Watershed and development in relation to it		
Summary of Preliminary Drainage Report or Watershed Study and any other available plans/reports		
Existing Topography (Contour plan)		
Details of watercourse crossings, e.g. culverts, bridges and roads		
Details of watercourse and valley reaches including typical x-sections		
Identify existing and proposed drinking water sources including surface and/or groundwater sources		
Natural storage and drainage		
Existing land ownership		
Existing land use		
Identification of pre-development flows		
Identification of pre-development and post-development run-off rates (Parkland County will provide this information)		
Proposed development and land use including grading plans, sub catchment boundaries		
Interim and ultimate servicing plans		
Proposed storage requirements including storage volume and location, lake overflow alternatives, real time control operating rules and control parameters		
Proposed major drainage system		
Proposed minor drainage system		
Description of constructed wetlands, wet ponds or dry ponds:		
o Dry ponds should only be used at the discretion of the County when constructed wetlands and/or wet ponds are not practical		
Description of best management practices (BMPs)		
Description of water quality improvements		
Use of natural features, for example sloughs		
Identification of unusual factors affecting operation and maintenance costs		
Identification of potential surcharging		
Address Erosion and Sedimentation Controls (ESC)		
Flood levels for lakes for design storms simulated		
100 Year flood levels for ravines		
Identification of the need for water quality control		
Provide wetland, including existing natural wetlands, to watershed ratio		
Identification of requirements for pollutant control and determination of allowable pollutant loads		
Review of outlet operating constraints and sufficiency of depth		
Determine outlet arrangement and review hydraulics to ensure adequate rates of drawdown can be achieved at all levels of storage		
Hydraulic analysis, by suitable methods, to provide post-development hydrographs for the minor 5-year design storm event and appropriate major historical design events, considering the following options:		
o 100 year storm (4 hour Chicago and 24 hour Huff distributions)		
o 1937 storm		
o 1978 storm		
o 1988 storm		
120mm of runoff over the entire basin assuming zero discharge		
System draw down curve should be provided		
Outline the proposed staging and or implementation plan		

APPENDIX B

Site Implementation Plan		
B1: Multi-Lot Development Submission Requirements	Status	
	Completed	N/A
Outfall points		
Overland flow routes and flow rates		
Ponding depths		
Flood profiles for lakes and ravines for 5yr, 10yr, 25yr, 100yr and critical historical storm events for interim and ultimate development		
Details of minor drainage system including:		
o Outfall points		
o Alignments		
o Pipe sizes		
o Pipe grades, profiles and invert elevations		
o Pipe capacities		
o Manholes		
25 Year and 5-Year peak flows for interim and ultimate development		
Road grades		
Calculation of flows captured by minor system during 100-year storm and associated hydraulic grade lines, with particular attention to locations where there is increased potential for outflows from the system (manholes and inlets at relative low points)		
Unusual factors affecting operation and maintenance costs		
Proposed flood control		
Land requirements - easements, public utility lots		
Controlled discharges from stormwater management facilities		
Hydrographs at outfalls		
Pre-development versus controlled post-development flows at outfalls		
Determination of type of storage, e.g. constructed wetland, wet or dry ponds		
Details of storage facilities, including landscaping and vegetation in constructed wetlands		
Proposed stormwater management facilities maintenance		
Details of constructed wetlands		
Earthwork balance assessment		
Vegetation plan for constructed wetlands		
Vegetation management plan for constructed wetlands		
Proposed water quality control		
An Erosion and Sedimentation Control Plan		
Hydraulic aspects of pond inlets and outfalls for example spillways		
Staging/implementation plan		
Details of any oversizing for adjacent areas		
Preliminary costs of trunk sewers and major system components		
Financing considerations regarding cost-shareable trunk sewers and facilities		

Site Implementation Plan		
B2: Single Lot Industrial Development Submission Requirements	Status	
	Completed	N/A
A scale drawing of the property in metric units, designed by an Alberta Land Surveyor, Professional Engineer or Registered Architects or a Professional Technologist.		
Existing surface elevations, contours and surface grades of the property based on geodetic datum.		
Proposed geodetic surface elevations at the property corners and at intervals around the perimeter of the property.		
Proposed geodetic surface elevations adjacent to the foundation walls or concrete slab-on-grade for each proposed building.		
Proposed direction of surface drainage flow, indicated by arrows.		
Proposed locations and gradients of swales		
Cross-section details of proposed swales		
Proposed surface conditions. Ex: Sod, Asphalt, Concrete, Gravel.		
Provisions for accommodating overland flows from adjacent undeveloped lands.		
Property Information: Legal description, subdivision or neighbourhood, property address or road names and north arrow.		
Space near the bottom right hand corner of the plan for the Approval Stamp.		

Lot Grading Plan Submission Requirements	Status	
	Completed	N/A
Name of the company or individual that produced the Certificate		
Proof of Professional Liability Insurance for the corporation or individual named on the Certificate		
Legal description and municipal address of the property		
Surface condition of the lot such as clay, topsoil, sod or landscaped		
A note indicating that the Lot Grading is subject to the approval of the local authority		
Design and as-built property line, and side lot internal swale invert elevations referenced to metric geodetic datum, with an asterisk (*) designating existing elevations that exceed the grade tolerance		
Reference to the Alberta Survey Control Monument that was used to obtain as-built elevations		
As-built elevations of structures, such as retaining walls, sidewalks, driveways, fences and garage/parking pads		
As-built property line and any side-lot internal swale elevations opposite the corners of the building, for locations that are more than 3m from a design point		
Any break point elevations		
Corner and rear foundation grade as-built elevations, including an additional elevation 2 metres from the back of house		
Rough grading of all lots must be within +/- 200mm of the final grades of the lots		
Drainage easements and right-of-ways with as-built invert and lip elevation, as required, for any concrete or grass drainage swales		
Detail survey of lake lot with all structure or feature locations and as-built elevations within the Maintenance and Overflow Area		
Lot orientation is portrait, with the rear of lot at the top of the page and the "FRONT" labelled		
Date of as-built survey		
Scale of drawing		

Engineering Drawings	
The following drawings shall form a complete Engineering Drawing Set.	
Cover Sheet	
Cover Sheets shall show the following information:	• The Parkland County Logo • Overall location of the development within the context of the County • Name of subdivision or project • Stage of development (if more than one stage is planned) • Name of the Developer • Name of consulting engineering firm • Name of consulting landscaping firm • Description of the submission type and listing of previous submissions • Date of issue • List of drawings
Location Plan and Index Plan	
The location plan and index plan may be combined into one drawing or shown on separate drawings depending on the size of the development or project. The following information shall be shown:	• Index plan shall be a copy of the legal plan indicating reference locations for each plan/profile drawing • A complete ordered list of all drawings shall be provided • Street names shall be provided • Phasing/staging boundaries shall be provided
Topography and Land Use Plans	
Topography and land use plans shall include the following information:	• Existing contours at 1 m intervals or less • Existing features • Street names, lot numbers, and block numbers • All existing rights-of-way (ROW's) and easements including widths and alignments and above ground features
Stormwater Plans	
Stormwater plans shall include the following information:	• Label all pipe diameters and materials • Location of all pipes and appurtenances shall be dimensioned to the property lines • Numbering of all manholes in accordance with the County's numbering system • Identify easements as required • Street names
Stormwater Basin and Calculation Plans	
Stormwater basin, and calculation plans shall include the following information:	• Major overland flow directions of proposed and future lands • Stormwater calculation spreadsheet • Stormwater contributing areas, boundaries, and all future flow contributions from adjacent areas • Stormwater pipe sizing

Detailed Plan/Profile Drawings	
All underground utility and surface improvement profiles that have matching alignments shall be shown on the same drawing.	• Location, elevation, and size of all hydrants, valves, tees, crosses, and other appurtenances • Location of all manholes • Types of all manholes (and barrel types if different than 1200mm diameter) • Indicate invert elevations inlets and outlets of all manholes • Manholes shall be properly numbered and identified to conform to the County's numbering system • Indicate size, type, and class of pipe for each pipe as well as the class of the pipe bedding required for proper installation • Profiles of all pipes shall show pipe slopes, lengths, and invert elevations at all grade change locations • Indicate pipe capacity and calculated design flows for all pipes • Indicate offsets of all pipes, curb and gutter, and separate walk from appropriate property lines • Properly identify locations where and how connections must be made to existing utilities • When watermain, sanitary sewer mains, and storm sewer mains are to be installed in a common trench, detail a typical cross section showing distances between pipes, class of each pipe, class of bedding for each pipe, and backfill specification • All rights-of-way (ROW's) and easements including widths and alignments • Street names, lot numbers, and block numbers • All existing infrastructure including pipelines, powerlines, and the like (include diameter, invert, and material, identify minimum depths of cover or clearance) • Cross-references to adjacent plan/profile drawings • All license and agreement references including contact names and numbers for pipelines and other utilities • References to the cadastral coordinate system with appropriate ties to Alberta Survey Control Monuments (ASCM's) for layout purposes • Indicate road and right-of-way (ROW) widths

APPENDIX C

Table C1:
Recommended Vegetation for Bioswales and Constructed Wetlands in Parkland County

	Common Name	Scientific Name	Moisture Regime / Habitat	Morphology	Soil Preference	Soil Stabilizer	Tolerances
Woody Species (Trees & Shrubs)	Thinleaf alder	<i>Alnus crispa</i> syn <i>Alnus Viridis</i>	moist to wet sites	Shrub to small tree		Y	
	River/Water Birch	<i>Betula occidentalis</i>	moist to wet sites	Tree			
	Red-osier Dogwood	<i>Cornus stolonifera</i>	moist to dry; wooded to open sites	Shrub			High: salt, oil & grease, metals
	Common juniper	<i>Juniperus communis</i>	medium dry to moist sites	Mounded Shrub			High: oil & grease, metals; Med-High: salt
	Creeping juniper	<i>Juniperus horizontalis</i>	moist to dry sites	Matted shrub			High: oil & grease, metals; Med-High: salt
	Cottonwood	<i>Populus balsamifera</i>	moist to dry	Large tree			High: salt
	Eastern cottonwood	<i>Populus deltoids</i>	moist to dry sites	Large tree			High: salt, oil & grease, metals
	Pin cherry	<i>Prunus pensylvanica</i>	moist to dry; shaded sites; slopes	Shrub	well drained		
	Choke cherry	<i>Prunus virginiana</i>	moist to dry; shaded sites; exposed slopes	Shrub			Med-High: salt
	Beaked or Bebb's Willow	<i>Salix bebbiana</i>	wet to dry sites				
	Pussy Willow	<i>Salix discolor</i>	moist sites - open forests	Shrub to small tree			
	Drummond's willow	<i>Salix drummondiana</i>	moist to wet sites	Shrub			
	Sandbar Willow	<i>Salix exigua</i> syn <i>Salix Interior</i>	moist to wet	Shrub	well drained		
	Yellow Willow	<i>Salix lutea</i>	moist sites	Shrub			
Herbaceous Species (Forbs & Grasses)	Canada anemone	<i>Anemone Canadensis</i>	moist to dry; shaded to full sun sites	Forb			
	Blue joint reed grass	<i>Calamagrostis canadensis</i> syn <i>Calamagrostis scibneri</i>	moist to wet sites	Graminoid			
	Water sedge	<i>Carex aquatilis</i>	moist to wet sites	Graminoid			
	Awed sedge	<i>Carex atherodes</i>	wet (standing water) sites	Graminoid			
	Bebb's sedge	<i>Carex bebbii</i>	moist to wet sites	Graminoid			
	Long beaked sedge	<i>Carex sprengelii</i>	moist to wet; shaded to partially sunny sites	Graminoid			
	Beaked sedge	<i>Carex stipata</i>	wet to standing water; shaded to partially sunny sites	Graminoid		Y	
	Bottle sedge	<i>Carex utriculata</i>	wet (standing water) sites	Graminoid			
	Tufted hairgrass	<i>Deschampsia cespitosa</i>	moist to wet sites	Graminoid			High: salt, oil & grease, metals

	Common Name	Scientific Name	Moisture Regime / Habitat	Morphology	Soil Preference	Soil Stabilizer	Tolerances
Herbaceous Species (Forbs & Grasses)	Creeping spike rush	<i>Eleocharis palustris</i>	moist to wet (standing water) sites	Graminoid			
	Needle spike rush	<i>Eleocharis acicularis</i>	moist to wet (standing water) sites	Graminoid			
	Fowl mannagrass	<i>Glyceria striata</i>	moist to wet sites	Graminoid	fertile loamy		
	Wire rush	<i>Juncus balticus</i>	moist to wet sites	Graminoid			
	Torrey's rush	<i>Juncus torreyi</i>	moist to wet sites	Graminoid	slightly acid to alkaline		
	River bulrush	<i>Scirpus fluvialis</i>	wet (standing water) sites	Graminoid			
	Small flowered bulrush	<i>Scirpus microcarpus</i>	moist to wet (standing water); shaded to partially sunny sites	Graminoid			
	Soft-stemmed bulrush	<i>Scirpus validus</i>	wet (still or slow moving shallow water) sites	Graminoid			
	Giant bur reed	<i>Sparganium eurycarpum</i>	wet (shallow water) sites	Forb			
Submerged Aquatics	Hornwort	<i>Ceratophyllum demersum</i>	open water				
	Spike water milfoil	<i>Myriophyllum spicatum</i> syn <i>Myriophyllum exalbesens</i>	wet site - still water				
	Sago pondweed	<i>Potamogeton pectinatus</i>	open water				
Grass Seed Mixes (Wet to Dry Sites)	Northern wheatgrass	<i>Agropyron dasystachum</i>	dry slopes; dry open woods	Graminoid			
	Western wheatgrass	<i>Agropyron smithii</i>	moist sites	Graminoid	heavy alkaline, salt		
	Awned wheatgrass	<i>Agropyron trachyculm</i>	moist sites	Graminoid			
	Slough grass	<i>Beckmania syzigachne</i>	wet to dry sites	Graminoid			
	Blue Grama Grass	<i>Bouteloua gracilis</i>	dry sites	Graminoid			
	Blue joint reedgrass	<i>Calamagrostis Canadensis</i>	moist to wet sites	Graminoid			
	Bebb's sedge	<i>Carex bebbii</i>	moist; open sites	Graminoid			
	Red fescue	<i>Festuca rubra</i>	dry sites	Graminoid			
	Tall manna grass	<i>Glyceria grandis</i>	moist to wet sites	Graminoid	non-saline, alkaline	Y	
	Sweet grass	<i>Hierochloe odorata</i> syn <i>Hierochloe hirta</i> ssp. <i>Artica</i>	moist to dry; shaded to full sun sites	Graminoid			
	June grass	<i>Koeleria macrantha</i>	moist to day sites	Graminoid			
	Annual rye grass	<i>Lolium multiflorum</i>	moist to dry	Graminoid			
	Fowl blue grass	<i>Poa palustris</i>	moist to wet sites	Graminoid		Y	
	Green needle grass	<i>Stipa viridula</i>	Dry sites	Graminoid	deep, fertile with heavy clay		

Table C2.
Ornamental Plants for Well Drained, Wet and Frequently Inundated Soils in the Parkland County Region¹

	Common Name	Scientific Name	Moisture Regime /Habitat	Morphology	Soil Preference	Soil Stabilizer	Tolerances
Dogwood spp.	Gold Prairie Fire Dogwood	<i>Cornus alba 'Aurea'</i>	full to part sun	Shrub			
	Ivory Halo Dogwood	<i>Cornus alba 'Bailbalo'</i>	full to part sun	Shrub			Salt
	Bud's Yellow Dogwood	<i>Cornus sericea 'Bud's Yellow'</i>	full sun	Shrub			
	Mottled Dogwood	<i>Cornus alba 'Gouchantii'</i>	full to part sun	Shrub			
	Purple Twig Dogwood	<i>Cornus alba 'Kesselringii'</i>	full to part sun	Shrub			
	Siberian Coral Dogwood	<i>Cornus alba sibirica 'Coral'</i>	full to part sun	Shrub			
	Arctic Fire (native) Dogwood	<i>Cornus stolonifera 'Farrow'</i>	full to part sun	Shrub	moist, well drained		
	Kelsey Dwarf Dogwood	<i>Cornus sericea 'Kelseyi'</i>	full to part sun	Shrub			
Willow spp	Coyote Willow	<i>Salix exigua</i>	full to partial sun	Shrub	dry to occasionally wet	Y	Salt
	Flaming Willow		full to partial sun	Shrub	dry to occasionally wet	Y	Salt
	Tri-Colour Willow	<i>salix integra 'Albomaculata'</i>	full to partial sun	Shrub	dry to occasionally wet	Y	salt
	Shining Willow	<i>salix lucida</i>	full to partial sun	Shrub	dry to occasionally wet	Y	Salt
	Yellow Twig Willow		full to partial sun	Shrub	dry to occasionally wet	Y	Salt
	Dwarf Arctic Willow	<i>salix purpurea 'nana'</i>	full to partial sun	Shrub	dry to occasionally wet	Y	Salt
	Creeping Willow	<i>salix stolonifera</i>	full to partial sun	Shrub	dry to occasionally wet	Y	Salt
	American McKay Willow	<i>salix rigida</i>	full to partial sun	Shrub	dry to occasionally wet	Y	Salt
	Polar Bear Willow	<i>salix salicicola 'polar bear'</i>	full to partial sun	Shrub	dry to occasionally wet	Y	Salt
Perennials, Grasses & Aquatics	Globeflower	<i>Trollius spp.</i>	full to part sun	Forb	average		
	Moor Grass	<i>Molina sp.</i>	full to part sun	Grass	moist to wet		
	Bulbous Oat Grass	<i>Arrhenatherum elatius sp.</i>	full to part sun	Grass	dry to moist		
	Horsetail	<i>Equisetum sp.</i>	light shade	Grass	Moist		
	Ribbon Grass	<i>Phalaris arundinacea sp.</i>	full to part sun	Grass	wet or boggy		
	Alkali Buttercup	<i>Ranunculus cymbalaria</i>		Forb	moist to wet		
	Bulrush	<i>Scirpus spp.</i>	full sun to light shade	Aquatic	wet to moist		

¹ This list is not comprehensive and additional non-invasive species may be acceptable to LID facilities in Parkland County

7.1 GENERAL

Parkland County long term roadway network was developed considering future land use development and forecast traffic volumes. The road network has been derived with consideration to future progression of commercial, industrial, residential and recreation land use in the County. Parkland County encourages developments with designing roadway cross sections that accommodate surface runoff.

Parkland County has over 2,700 kilometers of developed roadways ranging from gravel low-volume local roads to paved high-volume arterial roads. Parkland County has developed a network of roads that are grouped following a road classification system based on daily traffic volumes, traffic types, travel speed, access control, intersection spacing and parking.

7.2 ROADWAY CLASSIFICATIONS

7.2.1 General

The classification of roads assists in establishing road design features, land use planning policy, traffic density, mobility, safety and access requirements. A balance of all road types is needed to achieve mobility for all users.

Individual roadway classifications are further based on their functional use as established by Parkland County.

7.2.2 Local Road

The function of local roads is to provide access to adjacent properties carrying traffic from higher order roads to individual land parcels. Local roads are typically low speed and low volume roadways. They connect to other local roadways or collectors.

Refer to Standard Detail Drawing No. 7.1, Residential Local, Rural Local and Rural Collector Road.

Refer to Standard Detail Drawing No. 7.2, Industrial Local Road.

7.2.3 Collector Road

A collector road is a low-to-moderate-capacity road which serves to move traffic from local roads to arterial roads. Unlike arterials, collector roads may be required to provide access to residential properties. Collector roads are typically broken down into two categories based on the amount of traffic they are expected to carry.

7.2.3.1 MINOR COLLECTOR ROADS

Minor collectors carry relatively smaller volumes of through traffic, as compared to major collectors, at medium speeds.

Refer to Standard Detail Drawing No. 7.1, Residential Local, Rural Local and Rural Collector Road.

Refer to Standard Detail Drawing No. 7.3, Industrial Minor Collector Road

7.2.3.2 MAJOR COLLECTOR ROADS

Major collectors carry significant volumes of through traffic, with origin and destination points outside the general area traversed (beyond this classification), at medium speeds.

Refer to Standard Detail Drawing No. 7.1, Residential Local, Rural Local and Rural Collector Road.

Refer to Standard Detail Drawing No. 7.4, Industrial Major Collector Road (2 lanes)

Refer to Standard Detail Drawing No. 7.5, Industrial Major Collector Road (4 lanes)

7.2.4 Arterial Road

An arterial road is a high-capacity road designed to deliver traffic from collector roads to freeways or expressways, and between urban centers at the highest level of service possible. As such, many arterials have limited-access and features as they must allow greater traffic flow over longer distances and minimal interruptions. Arterial roads may be 2 or 4 lanes wide, with controlled access, with parking not permitted.

Refer to Standard Detail Drawing No. 7.6, Arterial Road (2 lanes)

Refer to Standard Detail Drawing No. 7.7, Arterial Road (4 lanes divided)

7.3 DESIGN CRITERIA

7.3.1 General

All public roads are located within land which is referred to as road right-of-way and generally established by statute. Developed road right of way includes a variety of public facilities which include a driving surface, roadside shoulders, ditches, public utilities, sidewalks, and traffic signs to name a few. Lands within the road right-of-way are reserved for use of the traveling public.

Minimum right-of-way requirements are as follows:

Residential and Industrial Local	30.0 meters
Minor Collector	30.0 meters
Major Collector and Arterial	40.0 meters

7.3.2 Geometric Design

7.3.2.1 Roads shall be designed in accordance with Parkland County Engineering Design Standards and the geometric design standards outlined in the latest edition of the Alberta Transportation Geometric Design Guide. The Transportation Association of Canada manual “Geometric Design Standards for Canadian Roads and Streets” will be used if the information is unavailable in the first 2 documents.

- 7.3.2.2 Geometric design standards established by the Parkland County Engineering Department, as outlined in Table 7.1, shall be incorporated into the roadway designs.
- 7.3.2.3 The designer shall also give due consideration to the soil conditions in the area as derived through geotechnical investigations.
- 7.3.2.4 The geotechnical report must include specific recommendations for pavement structure construction based on in situ conditions and projected traffic volume.
- 7.3.2.5 Posted speed shall be 10km/h less than designed speed.
- 7.3.2.6 Additional shoulder width may be required to accommodate public use.
- 7.3.2.7 Highest classification of intersecting roads will govern design.

Table 7.1 – Roadway Design Standards

Design Criteria	Arterials		Major Collectors		Minor Collectors		Local		
Road Classification	Rural RAU 90 RAD 90	Industrial RAU 90 RAD 90	Rural RCU 90	Industrial RCU 80	Rural RCU 90	Industrial RCU 70	Rural RLU 90	Industrial RLU 60	Residential RLU 60
Drawing Reference	No. 7.6/7.7	No. 7.6/7.7	No. 7.1	No. 7.4/7.5	No. 7.1	No. 7.3	No. 7.1	No. 7.2	No. 7.1
Design Speed (km/hr)	90	80	90	70	90	60	90	60	60
Right-of-Way Width (m)	40	40	40	40	30	30	30	30	30
Pavement ACP Width (m)	10.4/18.0	10.4/18.0	8.5	9.5/17.0	8.0	9.0	7.5	9.0	7.5
Travel Lanes (m)	2 x 3.7m 4 x 3.7m & Median	2 x 3.7m 4 x 3.7m & Median	2 x 3.7m	2 x 3.7m 4 x 3.7m	2 x 3.7m	2 x 3.7m	2 x 3.7m	2 x 3.7m	2 x 3.5m
Max. Gradient (%)	6	6	6	6	6	6	9	6	9
Min “k” Value Crest Curve	55	55	55	35	55	25	55	15	16
Min “k” Value Sag Curve Comfort Control	N/A	21	N/A	17	N/A	13	N/A	10	N/A
Min “k” Value Sag Curve Headlight Control	40	40	40	35	40	25	40	20	20
Max Super Elev. (%)	6	6	6	4	6	2	6	2 Normal Crown	2 Normal Crown
Min Radius of Curve (m)	340	340	340	250	340	190	340	130	130
Min Property Corner Cut at Intersections (m)	10	10	10	10	10	5	10	10	5
Parking	Restricted	Restricted	Permitted	Restricted	Permitted	Restricted	Permitted	Restricted	Permitted
Minimum Access/Intersection Spacing (m)	400	200	200	100	200	60	200	40	40

7.3.3 Gravel Surfacing for Rural Roads

7.3.3.1 Table 7.1 design criteria shall be used for the construction of roadway with a graveled finished surfaced except for the Pavement-ACP Width criterion.

7.3.3.2 The following gravel surface width is required:

7.3.3.2.1 Aggregate Haul Route: 9.1 meters; and

7.3.3.2.2 Local Rural Road (RLU 90): 9.1 meters

7.3.4 Road Intersections

Intersections shall be designed at 90° unless otherwise approved by the General Manager.

Intersection design shall incorporate accepted sight distance based on the roadway classification, turning radius for anticipated vehicle types, and good engineering practice.

The minimum intersection spacing along roadways is as per Table 7.1

Intersectional treatments shall be designed based on estimated 20-year traffic volumes. All necessary widening of existing right-of-ways shall be provided by the Developer.

The minimum setback distance between intersections shall be 150 meters unless otherwise approved by the General Manager.

The grades at intersections for all roadway classifications shall be a minimum 2% for a minimum distance of thirty (30) meters, measured from the shoulder edge of the receiving road.

The Three-Centered-Curve to accommodate a WB-15 design vehicle shall be used when designing Type 1 intersections unless directed otherwise by the General Manager. Three centered curves will be required as per Alberta Transportation Manual, Table D5.2a.

Refer to Standard Detail Drawing No. 7.8, Road Intersections

7.3.5 Expanded Bulb Corners

Expanded bulb corners may be used on local roads.

7.3.6 Dead-end Roads

7.3.6.1 In residential subdivisions, all dead-end roads shall be provided with a paved Cul-de-sac or turnaround consistent with the requirements outlined in the standards.

Refer to Standard Detail Drawing No. 7.9, Residential Cul-de-sac

7.3.6.2 Other than for a temporary solution, dead-end roads shall not be allowed in industrial subdivisions. Temporary Cul-de-sacs will be allowed but must be paved. For the interim situation:

Refer to Standard Detail Drawing No. 7.10, Temporary Industrial Cul-de-sac

7.3.7 Culverts and Drainage

See Section 6 Storm Drainage Systems

7.3.8 Cul-de-sacs

The maximum acceptable length of a cul-de-sac in residential areas is 170 m from the edge of asphalt to the start of the bulb. A cul-de-sac exceeding 170 m in length will require an additional hydrant and water main looping for all development providing water services.

Developer's Engineer must be capable to demonstrate that water looping is not required to maintain adequate fire flow.

Cul-de-sacs with steep grades are to be avoided. If cul-de-sacs cannot be graded to drain towards the intersection then an outlet for the overland flow must be provided by way of a PUL.

The cul-de-sac road surface is to be crowned except the bulb portion which may be cross fall.

7.3.9 Access/Intersection Spacing

Refer to Standard Detail Drawing No. 7.11, Intersection Treatment and Approach Locations

7.3.10 Road Access

7.3.10.1 Residential approaches shall typically be located as follows:

- For low density residential, the approach shall typically be located to provide the best and most direct access to the building site on the lot.
- Road Access to lots located in a high density subdivision will be centered on the lot frontage.

7.3.10.2 Residential approaches shall not exceed 6.0 m in width. Industrial approaches shall not exceed 8.0 m in width.

Refer to Standard Detail Drawing No. 7.12, Residential and Industrial Approaches

7.3.10.3 All approaches shall be constructed to the same structure minimum as the adjoining roadways. For roadways with asphalt surfacing, the approaches will extend to the following limits:

- Industrial and residential – to the property line; and
- Field approaches – 3.5m from edge of surfaced shoulder

- 7.3.10.4 Approaches to each lot within a residential subdivision will be paved as part of the subdivision.
- 7.3.10.5 Approaches to industrial lots are not required to be constructed by the Developer unless the access locations are known. The Owner/Developer of the lot shall be responsible for constructing approach to his property.
- 7.3.10.6 Approaches for corner or double-fronting lots must be constructed onto the roadway with the least road classification.

7.3.11 Roadway Surface Finishes

- 7.3.11.1 Roadways in all subdivisions shall be surfaced with Hot Mix Asphalt Concrete Pavement (HMACP).
- 7.3.11.2 Graveled surface shall be a minimum compacted layer of 50 mm depth of 40 mm crushed gravel scarified into top 150 mm of subgrade plus a final 35mm lift of 20mm crushed gravel, bladed on top.

7.4 CONSTRUCTION STANDARDS

7.4.1 Preparatory Work

The entire road right-of-way (R.O.W.) shall be cleared of all vegetation (trees, shrubs, brush, etc.) including removal of all tree roots and stumps. All such material shall be removed from the site for disposal at approved locations. No burying of this material, or any portion thereof, shall be permitted within the R.O.W.

Organic soils and unsuitable materials are not acceptable as subgrade material and shall be stripped within the roadway, ditch and back slope portion of the new construction. Organic soils (clean topsoil) shall be stockpiled in approved locations for spreading on the ditches and back slopes after completion of the roadway construction.

Refer to Section 1, General Conditions for Erosion and Sediment Control Measures.

7.4.2 Road Grade Construction

This subsection deals with the requirements covering roadway excavation, roadway embankment and subgrade preparation.

7.4.2.1 Roadway Excavation

- All materials excavated for placing in roadway embankment shall be suitable for road construction.
- Where the subgrade is in transition from excavation to embankment (fill), the transition area shall be sub-excavated to a minimum depth of 600 mm and replaced with suitable material.

- Where unsuitable material is encountered at the subgrade level of a cut, the subgrade shall be sub-excavated to an acceptable depth and replaced with suitable material.
- The compaction of subgrade surfaces in excavations and the placement and compaction of materials replacing sub-excavations shall be in accordance with section 7.4.2 (.2) Roadway Embankment and section 7.4.2 (.3) Subgrade Preparation.
- Excavation shall be carried out to conform to the lines, grades and cross section of the approved roadway design.

7.4.2.2 Roadway Embankment

- All material used in roadway embankments shall be approved road construction material free from all wood, brush, roots, topsoil, and other organic materials.
- Where the depth of embankments is less than 1.5 m, all topsoil and/or organic materials shall be excavated prior to embankment placement.
- Where the proposed depth of embankment is less than 1.5 m from the finished subgrade, the stripped surface shall be excavated to a minimum depth of 1 m from the proposed finished subgrade before any embankment material is placed.
- Where embankments are to be placed on a slope or against an existing slope, the sloped surface shall be benched and scarified in a manner that the new material will bond with the existing surface.
- Prior to fill being placed the exposed surface shall be scarified to a minimum depth of 150 mm and re-compacted to 98% of Standard Proctor Density.
- Successive lifts of embankment material shall be placed in uniform layers of 200 mm maximum thickness across the entire width of the embankment.
- Suitable compaction equipment shall be used to thoroughly compact each layer of embankment material.
- The embankment material shall be compacted to not less than 98% of Standard Proctor Density at optimum moisture content.
- Embankment construction shall be carried to the lines, grades and cross section of the approved roadway design.

7.4.2.3 Subgrade Preparation

- The completed subgrade shall be scarified to a minimum depth of 150 mm or as designated in Table 7.2, shown in section 7.4.4.2.
- The loosened material shall be windrowed to the side and the exposed surface shall be thoroughly compacted.
- The windrowed material shall then be uniformly mixed and compacted to obtain 100% Standard Proctor Density at optimum moisture content.
- The finished subgrade shall be shaped to conform to the required lines, grades and cross-section of the approved roadway design.

7.4.3 Base Course Construction

7.4.3.1 Base course shall consist of a mixture of crushed aggregate and water, which is placed in layers upon the previously prepared surface, compacted, and finished to the specified thickness, approved grade, lines, and typical cross-section.

7.4.3.2 Base course material shall be consistent with the City of Edmonton specifications for Aggregate Gradation Designation 2, Class 20 as follows:

<u>Sieve Size (µm)</u>	<u>Percent Passing</u>
20,000	100
16,000	84-95
12,500	60-90
10,000	50-84
5,000	37-62
2,000	26-50
1,250	19-43
630	10-25
160	6-18
80	2-10

7.4.3.3 The depth or thickness of granular base course material will depend upon the soil conditions as per the Consultant's surfacing strategy and shall meet minimum criterion, but should typically not be less than the thickness outlined in Table 7.2, shown in section 7.4.4.2.

7.4.3.4 All granular base course material shall be placed in lifts not exceeding 150 mm and compacted to 100% of Standard Proctor Density at optimum moisture content.

7.4.4 Pavement Structure

7.4.4.1 A geotechnical report with recommended pavement designs shall be prepared and authenticated by the Developer's Engineer, and submitted to the General Manager

for review. Table 7.2 provides the minimum acceptable road structure. If the geotechnical report should recommend anything less, then the minimum road structure will govern as per Table 7.2.

- 7.4.4.2 Paved roadways shall be designed in accordance with the Asphalt Institute method of pavement design using minimum design loadings of 8165 kg (18,000 pound) axle loads for local streets and 10,886 kg (24,000 pound) axle loads for collector streets. All industrial roads shall be designed using a minimum design loading of 10,886 kg (24,000 pound) axle loads. The design parameters such as traffic count, percentage of trucks, California Bearing Ratio (CBR), etc., are to be outlined to the General Manager. The General Manager reserves the right to request the Developer to engage a geotechnical engineering agency to carry out CBR tests on the subgrade prior to paving to confirm adequacy of design.

Table 7.2 – Minimum Roadway Structures

Roadway	Local		Minor/Major Collector		Arterial	
	Rural	Industrial	Rural	Industrial	Rural	Industrial
Subgrade Prep.	150	300	300	300	300	300
Aggregate Base Course	150	300	300	400	300	400
Asphaltic Surface	100	125	100	150	100	150
2 – Lifts	60/40	75/50	60/40	100/50	75/50	100/50

***NOTE:** The final lift of asphaltic concrete shall be placed in the second year of the maintenance period.

7.4.5 Asphaltic Concrete Pavement

7.4.5.1 Description

Asphaltic concrete pavements shall consist of mineral aggregate, filler and asphaltic binder, shall be laid and compacted to specified thickness, and shall conform to the approved lines, grades and typical cross-sections.

Table 7.3 – Asphalt Mix Types
(Refer to Table 7.5 for gradation specifications)

MIX TYPE	USE
ACR (12.5 mm) Asphaltic Concrete Residential	Paving Local Roadways
ACO (12.5 mm) Asphaltic Concrete Overlay	Paving for Arterial and Collector Roadways
ACB (16 mm) Asphaltic Concrete Base	Base Course for Arterial, Industrial Roadways (Heavy truck traffic) and Collector Roadways
Specific areas of each class of asphaltic concrete pavement will be defined on drawings.	

7.4.5.2 Materials

7.4.5.2.1 Asphalt Cement

Asphalt cement to penetration grade 150 - 200A to CGSB-16.3 and possess the properties as shown in Table 7.4 appended to this Section.

Table 7.4 – Properties of Asphalt Cement For Roads
(Refer to Government of Alberta – Transportation, Standards Specifications for Highway Construction, Specification 5.7 – Supply of Asphalt)

TEST	ASTM TEST METHOD	TEST RESULTS
Absolute Viscosity at 60°C (Pascals per second)	D 2171	Penetration (150) 78-155 (200) 50-92
Kinematic Viscosity at 135°C (mm² per second)	D 2170	Penetration (150) 55-360 (200) 205-285
Penetration at 25°C, 100gm, 5 second (dmm)	D 5	150-200
Ductility of Residue at 25°C (minimum cm)	D 113	100
Solubility in Trichloroethylene (minimum %)	D 2042	99.5
Flash Point – Cleveland Open Cup (°C)	D 92	205
Test on residue from thin film oven test (D1754) ratio of absolute viscosity to original absolute viscosity	D 2171	4.0

7.4.5.2.2 Aggregates

Asphaltic concrete aggregate shall be crushed gravel. Gradation shall as specified in Table 7.5.

Table 7.5 – Aggregate Gradation Specifications

Sieve Size (pm)	Percent Passing	
	ACR and ACO (12.5)	ACB (16.0)
20,000		100
16,000		97-100
12,500	100	88-100
10,000	75-90	30-80
6,300		22-45
5,000	50-70	20-35
2,500	35-50	16-26
1,250	25-40	14-22
630	20-30	13-20
315	14-23	12-18
160	7-14	10-16
80	4-8	9-13

7.4.5.2.3 Reclaimed Asphalt Pavement (RAP)

- Unless specified otherwise, the County permits the use suitable RAP in the ACP mixture to a maximum RAP to virgin ration of 20/80, subject to the requirements of this specification 3.16 of Alberta Transportation Standard Specifications for Highway Construction Ed 14, 2010. Suitable RAP shall not contain any other additives including, but not limited to, sulphur, crumb rubber, asphalt rubber, asbestos, produced sand, paving fabrics and reinforcement grids.
- For ACP mixture containing RAP and specified to use penetration grade asphalts, the procedures outlined in Government of Alberta - Transportation Test TLT-300, Recycling of Asphalt Concrete Pavement shall be used to determine the rheology of the RAP and the grade of virgin asphalt to be used. For ACP mixtures containing RAP and specified to use Performance Graded (PG) asphalts, the RAP rheology and the grade of virgin asphalt to be used shall be determined according to Appendix A of AASHTO M323. Rheological testing of the RAP is required for all ACP mixtures with RAP to virgin aggregate ratio in excess 10/90.
- Considering the higher fine contained in the RAP, Parkland County will accept 8 – 20% passing the 160 Sieve and 4-10% passing the 80 Sieve Size.

- Parkland County will also consider the use of 200-300A for low volume roads.

7.4.5.3 Mix Design

- Preparation and submission of asphalt mix design for the General Manager's approval is the responsibility of the Developer. The Developer shall use professional engineering services and a qualified testing laboratory to assess the aggregate materials proposed for use and to carry out the design of the asphalt mixture. The mix design is to be submitted to the General Manager for approval at least two weeks prior to commencing paving operations.
- The asphalt mix design shall follow the Marshall method of mix design as outlined in the latest edition of the Asphalt Institute Manual Series No. 2 (MS-2) and where applicable the Government of Alberta – Transportation mix design procedures TLT - 301. The Mix Design, at the design Asphalt Content, shall meet the requirements shown in Table 7.6, appended to this Section, for the Asphalt Mix Type specified. All samples shall be designed using 75 blows per side of the test specimen with a manual compaction hammer or a mechanical equivalent to 75 blows per side of the test specimen with a manual compaction hammer.
- Physical requirements to be measured as follows:
 - Marshall Stability and flow index to Government of Alberta – Transportation, TLT 301 test method.
 - Air voids to ASTM D3203.
 - Voids in mineral aggregate to ASTM C127 and ASTM C128 with allowance for volume of asphalt absorbed in aggregate.
- Submit the following with mix design:
 - Temperature of asphalt during mixing in plant.
 - Temperature of asphalt immediately prior to compaction.
 - Do not change mix design without prior written approval of the Engineer.

Table 7.6 – Asphaltic Concrete Pavement Mix Types and Characteristics

Aggregate Designation	ACR	ACO	ACB
Aggregate Size	12.5	12.5	16
% Manufactured Fines, -5000 (minimum Note 1)	60	70	75
% Fractures, +5000 (2 faces – minimum)	70	90	90
Asphalt Cement Grade	150-200A	150-200A	150-200A
Minimum Marshall Stability, N	8,500	11,500	11,500
Number of Blows	75	75	75
% Air Voids	3 to 5	3 to 5	3 to 5
VMA % (minimum) by 3% Air Voids	13	13	13
VMA % (minimum) by 4% Air Voids	14	14	14
VMA % (minimum) by 5% Air Voids	15	15	15
Minimum Theoretical Asphalt Film Thickness (Microns – See Note 3)	7.0	7.0	7.0
Voids filled with Asphalt, %	65 to 75	65 to 75	65 to 75
Flow, mm	2 to 3.5	2 to 3.5	2 to 3.5
Minimum Retained Stability, %	70	70	75
MIX TYPES AND CHARACTERISTICS			
Note 1: The percentage of Manufactured Fines in the -5000 portion of the Combined Aggregate. Note 2: All fines manufactured by the process of crushing shall be incorporated into the mix for Asphalt Mix Type 5a. Note 3: The minimum theoretical film thickness value shall be established in accordance with Government of Alberta – Transportation TLT 311 test procedure TLT-311.			
General Requirements for Mix Design: 1. It is recommended that the Design Asphalt Content be determined at 4% air voids, which is the midpoint of the design air voids. The test properties at this asphalt content are then checked to ensure compliance with the respective criteria. 2. A minimum of four specimens shall be prepared at each asphalt content. 3. Theoretical maximum specific gravity shall be determined in duplicate for at least three asphalt contents. 4. Retained stability after 24 hours soaking at 60°C to be run at the recommended Design Asphalt Content.			

- A new mix design, new mix designation documents, and a new Job Mix Formula shall be completed when:
 - A material source is eliminated.
 - A new material source is added.
 - It is not possible to comply with maximum permitted fine aggregates blending ratio.
 - Changes to the material proportions have not resulted in the correction of the problems with the mix.
 - Mix design submissions using RAP shall include the RAP source name(s) and locations all RAP asphalt content and gradation test results, the percentage by weight of RAP to be used in the mixture, and, when required, all RAP rheological test results, the design rheology and all blending charts used.

7.4.5.4 Field Quality Testing

- The Developer shall retain the services of a materials testing firm to carry out field quality tests as follows:
- Aggregate Gradation: One aggregate gradation test for each 300 tonnes of production or at least one per day (ASTM C136).
- Mix Quality: At least one test of three briquettes for each 1000 tonnes of production and at least one test per day for each of:
 - Marshall Stability TLT 301, AASHTO T 245
 - Specific Gravity ASTM D 2726
 - Air Voids and VMA ASTM D 3203
 - Flow Index TLT 301, AASHTO T 245
 - Asphaltic Content Extraction ASTM D 2172
 - Sieve Analysis ASTM C 117 and C 136

7.4.5.5 Field Density, Asphalt Thickness, Asphalt Content and gradation: After asphaltic concrete has been laid and compacted, one pavement core from approximately each 1000 m² of pavement will be obtained at locations determined by the General Manager. Cross sectional depth of core will be measured to determine asphalt thickness. Density of core will be measured and compared with the Marshall density taken from field samples of the asphalt mix placed in the area of the core. Asphalt content and gradation will be determined from either loose mix or cores and compared to the recommended asphalt content and gradation determined in the asphalt mix design.

7.4.5.6 If test results fail to satisfy thickness, density or asphalt content requirements as specified, construction procedures should be modified to produce a uniformly compacted surface which will satisfy density and thickness requirements. Sections with inadequate compaction, thickness or asphalt content shall be subject to a payment reduction as defined under Clauses 7.4.5 (.5, .8 and .9) or rejected, as directed by the General Manager.

- 7.4.5.7 The core test result will be deemed to represent the approximate 1000 m² area from which it was taken depending on location of other cores taken. Boundaries of area represented by the core test results will be determined by the General Manager.
- 7.4.5.8 If initial loose mix or core tests are found to be deficient, two additional cores within each deficient area may be taken by an independent qualified testing firm at the Developer's expense, in locations approved by General Manager. In this case, additional core test results will be averaged with first result to represent the area in question.
- 7.4.5.9 If test results indicate non-compliance with the tolerances specified in 7.4.5 (.5) below, pavement may be rejected by the General Manager. Pavement thus rejected shall be removed and replaced at the Developer's expense.

7.4.6 Asphalt Thickness

All asphaltic concrete pavements shall be of the thickness indicated on the approved design drawings.

7.4.7 Asphalt Concrete Thickness Tolerances

Areas deficient in thickness by more than 10% of the total design thickness shall require the Developer to place an additional 25 mm thickness of asphalt over the portion of roadway deficient.

7.4.8 Staged Asphalt Construction

- 7.4.8.1 All roadways in High Density Residential Developments shall be constructed with the final surface lift placed in the year in which the subdivision is eligible for Final Acceptance. The County may accept cash-in-lieu for the final lift of asphalt if significant development has not occurred at the time of Final Acceptance.
- 7.4.8.2 Asphalt placement shall bring the roadway to its original design crown as shown on the approved engineering drawings.
- 7.4.8.3 An additional one (1) year materials and workmanship warranty shall be required for the final lift after the Final Acceptance Certificate is issued for surface improvements.

7.4.9 Asphalt Density Tolerances

- 7.4.9.1 Each mat of hot-mix asphalt placed shall be compacted to minimum 98% of Standard Proctor Dry Density.
- 7.4.9.2 Asphalt density between 98% and 95% will require a geotechnical consultant to review and provide recommendations for remedial measures at the Developer's cost.

- 7.4.9.3 Asphalt density less than 95% will be rejected; asphalt to be removed and replaced at the Developer's cost.

7.4.10 Asphalt Content

- 7.4.10.1 Asphalt content deviations from the mix design between 0.3% and 0.5% will require a geotechnical consultant to review and provide recommendations for remedial measures at the Developer's cost.
- 7.4.10.2 Asphalt content deviations from the mix design of more than 0.5%, the Developer shall either overlay or remove and replace the previously placed mix at the Developer's cost.

7.5 QUALITY CONTROL AND TESTING

The Developer shall be responsible for quality control and the cost of all testing related to roadway construction, including sieve analysis, densities, mix designs, core sampling, etc. at the Developer's entire cost.

Copies of all quality control testing shall be forwarded for review to the General Manager prior to the issuance of a Construction Completion Certificate.

7.6 LIST OF STANDARD DETAIL DRAWINGS

Standard details have been provided for the guidance of designers in the interpretation of the standards. Where the standards and the drawings conflict, the standards shall govern. Standard drawings are dimensioned in millimeters unless otherwise noted.

Refer to Section 10 for all Standard Detail Drawings

8.1 GENERAL

This section outlines standards, guidelines, and requirements for numerous miscellaneous items that are relevant to the development of subdivisions within Parkland County.

8.2 SURVEY CONTROL MARKERS

8.2.1 Control Markers

8.2.1.1 Every effort shall be made to protect existing markers.

8.2.1.2 The Developer shall provide additional markers as required for the Development.

Refer to Standard Detail Drawing No. 8.1, Bench Mark Installation.

8.2.2 Alberta Survey Control Markers (ASCM)

8.2.2.1 The Developer shall be responsible for replacing any markers which are disturbed, destroyed, or missing, at the Developer's sole expense. Markers are to be replaced only by a licensed legal surveyor.

8.2.2.2 All elevations related to the development must be geodetic and referenced in ASCM near the development area. Elevations for site survey calibrations and site survey control must be derived from or confirmed with an ASCM elevation.

8.2.3 Legal Pins

8.2.3.1 The Developer shall hire a licensed legal surveyor to install legal pins through the Development.

8.2.3.2 Legal pins shall be installed prior subdivision endorsement.

8.2.3.3 The Developer shall be responsible for replacing any markers or legal pins which are disturbed, destroyed, or missing. Legal pins are to be replaced only by a licensed legal surveyor, at the Developer's sole expense. The County will not issue the Final Acceptance Certificate (FAC) until this is completed.

8.3 PROPERTY BOUNDARY MARKERS

The Developer shall install acceptable marker posts to identify and protect all legal survey lot corner pins in the subdivision.

8.3.1 The marker posts shall typically consist of 1200 mm Fluorescent Orange Legal Marker Posts or 1200 mm x 100 mm x 100 mm treated wood posts or as approved by the General Manager.

Refer to Standard Detail Drawing No. 8.10, Lot Pin Marker Installation.

- 8.3.2** The marker posts shall be imbedded to a depth of 600 mm. Care shall be taken not to disturb the legal survey pins.
- 8.3.3** For all front of lot property pins adjacent to a subdivision road, the marker post shall be located a maximum of 300 mm from the pin on the road way. For all back of lot property pins, the post shall be located along the side property boundary a maximum of 300 mm from the pin.
- 8.3.4** A marker post is not required for any pin already provided with a legal survey marker post or an Environmental Reserve Lot marker.

8.4 MUNICIPAL ADDRESSING SIGNAGE

- 8.4.1** The Developer shall supply and erect parcel identification markers in each multiple parcel subdivision based on the municipal addressing system in existence within Parkland County. This will include the address for the main entrance to the subdivision and the assigned parcel numbers for each of the lots in the subdivision. The municipal addressing parcel numbers will be the same as the lot numbers shown on the legal subdivision plan.
- 8.4.2** The two or three digit parcel identification signs must be in an obvious place next to the driveway at the property line. The sign shall be located on the right side of the driveway, minimum 2 m from the approach shoulder, minimum 1 m above ground level and at 90° to the driveway.
- 8.4.3** Municipal Address Signs shall be constructed and installed in accordance with the following minimum requirements:

Refer to Standard Detail Drawing No. 8.5, Municipal Address Sign.

8.4.3.1 SIZE

2 digit	250 mm x 200 mm (min)
3 digit	325 mm x 200 mm (min)

8.4.3.2 SIGN MATERIAL

2 mm high tensile flat aluminum

8.4.3.3 FINISH

3M medium green vinyl with silk screened or die-cut reflectorized white lettering

8.4.3.4 LETTERING SIZE

150 mm (min)

8.4.3.5 POSTS

1.5 m angled aluminum post

8.4.3.6 SIGN ATTACHMENT

The marker sign shall be attached to the post with two (2) steel bolts and nuts.

8.4.4 Municipal Address Signs shall be purchased from Parkland County, Public Works Department.

8.5 SUBDIVISION SIGNS (Excluding Acheson Industrial Park)

The Developer shall supply and erect a subdivision display sign at the identified main entrance of each multiple lot subdivision with the exact location being approved by the General Manager prior to installation. The sign shall show the subdivision name, municipal address of the identified main entrance to the subdivision (sign location), and the subdivision layout with the assigned parcel identification number on each lot in the subdivision including the reserve parcel designations.

No Subdivision sign will be required in the Acheson Industrial area.

The Subdivision Sign shall be constructed by a Commercial Sign Manufacturer in exact accordance with the following minimum requirements:

8.5.1 Wood Option**8.5.1.1 SIZE**

Map Size	1.2 m x 2.4 m (4 ft x 8 ft) (min)
Address Tab	0.304 m x 2.4 m (1ft x 8 ft)

8.5.1.2 MATERIAL

Minimum 19 mm HDO plywood property sealed on the non-printed side

8.5.1.3 LAYOUT

Map Sign	Shall indicate the subdivision municipal numbering layout, subdivision name, County Logo, and north arrow. Subdivision name to be minimum 150 mm lettering and shall include a "You Are Here" arrow, for land lot numbering, use to be minimum 50 mm lettering.
Address Tab	Shall indicate the subdivision municipal address using minimum 150 mm lettering.

8.5.1.4 FINISH

3M white high intensity reflective sheeting with computer cut lettering. Border strip shall be a premium grade vinyl.

8.5.1.5 DATE STAMP

Date of manufacture to be on face of sign.

8.5.1.6 WARRANTY

Manufacturer to provide ten (10) year guarantee against surface deterioration.

8.5.1.7 POSTS

Shall be commercially available pressure treated minimum 100 mm x 100 mm x 3.5 m wooden posts or approved galvanized telespar type metal posts.

8.5.1.8 SIGN ATTACHMENT

The map sign and the address shall be attached to wood posts with a minimum of four (4) 12 mm by 150 mm bolts and nuts complete with minimum 35 mm flat washers front and back. Wood signs attached to metal posts shall use the same size of bolt and hardware with the length adjusted according to the post dimensions.

8.5.1.9 INSTALLATION

Refer to Standard Detail Drawing No. 8.3, Subdivision Sign Installation.

8.5.1.10 LOCATION

As determined and approved on site.

8.5.2 Aluminum Option

Shall be identical to the wood option with the exception of the following:

8.5.2.1 MATERIAL

2mm high tensile flat aluminum minimum grade 5052-H38 completed with aluminum bracing to provide a rigid structure.

8.5.2.2 SIGN ATTACHMENT

As per manufacturer's attachment design, submitted and approved prior to sign installation.

Refer to Standard Detail Drawing No. 8.2, Subdivision Sign.

Refer to Standard Detail Drawing No. 8.4, Subdivision Sign North Arrow.

8.6 LANDSCAPING

All roadway ditch bottoms, side slopes, back slopes and open areas disturbed during construction shall be uniformly topsoiled and seeded to grass following preparation of the seed bed.

8.6.1.1 The topsoil shall be uniformly spread to a minimum depth of 150mm or as specified and be capable of supporting vegetation growth. The upper 50mm shall

be of a fine grade texture and free of rocks, roots, stumps, weeds and other deleterious material.

8.6.1.2 The seed mixture shall be as per Section 9 – Landscape Requirements

8.7 PROTECTION AND/OR COORDINATION OF UTILITIES

The Developer shall be responsible for the identification, location and protection of all utilities which may exist within or adjacent to the proposed subdivision. Utilities commonly encountered on lands within Parkland County may include, but not be limited to:

- Telephone cables
- Fiber Optic cables
- Power cables
- Natural gas distribution lines
- Oil and gas distribution lines

The Developer shall be responsible for contacting all utility agencies and for arranging and coordinating all protection and/or modifications to the utilities during the development of the subdivision at the Developer's entire cost or as agreed upon with the specific utility company.

8.8 PERMANENT TRAFFIC CONTROL SIGNAGE

A permanent traffic control signage plan shall be submitted for review and approval by the General Manager.

All permanent traffic control signage erected within subdivision road allowances shall be of high intensity grade signage and shall be in accordance with the standards contained in the latest edition of the Transportation Association of Canada Manual, "Uniform Traffic Control Devices for Canada".

All sign posts shall be horizontally located a minimum of 3.0 m from the shoulder of the adjacent road and the bottom of the sign shall be 1.5 m above the shoulder elevation of the road.

Refer to Standard Detail Drawing No. 8.11, Traffic Sign Installation

Stop and Yield signs shall be positioned in line with the near property lines of the intersecting road allowance.

8.9 ENVIROMENTAL RESERVE SIGNAGE

8.9.1 The Developer shall supply and erect an Environmental Reserve Marker sign at each property corner within a subdivision where a subdivision lot corner forms a common point with an Environmental Reserve.

8.9.2 Environmental Reserve signs shall be constructed by a commercial sign manufacturer and be installed in accordance with the following minimum requirements:

8.9.2.1 SIZE

90 mm x 205 mm

8.9.2.2 SIGN MATERIAL

2 mm aluminum

8.9.2.3 FINISH

3 m grey vinyl with silk screened black lettering

8.9.2.4 INFORMATION

Refer to Standard Detail Drawing No. 8.6, Environmental Reserve Marker Sign.

8.9.2.5 POSTS

18 gauges galvanized steel U channel 87 mm wide x 31 mm deep x 1.800 m long

8.9.2.6 SIGN ATTACHMENT

The sign shall be attached to the post with a minimum of two (2) 4 mm stainless steel rivets in predrilled holes.

8.9.2.7 INSTALLATION

Refer to Standard Detail Drawing No. 8.6, Environmental Reserve Marker Sign.

8.10 ELECTRICAL POWER SERVICE

- 8.10.1** The Developer shall make arrangements with Fortis Alberta for the installation of underground Electrical Power within a subdivision. The installation shall be carried out in accordance with Standard Drawings.

Refer to Standard Detail Drawings No. 7.1 to 7.7.

- 8.10.2** With underground power in a subdivision, the Developer shall be required to hire an Engineering Consultant, approved by the service provider to design the Electrical System in accordance with the service provider's requirements. The Developer shall be required to hire an Electrical Contractor to install the Electrical System in accordance with the approved electrical system design and service provider. The alignment and location of all electrical facilities within a subdivision shall be subject to the approval of the General Manager. Acceptance of the electrical system within the subdivision shall be subject to the approval of the service provider and the General Manager. Where underground power is being installed, the Developer shall make arrangements for the common installation of telecommunication cables within the underground trench.

8.11 FIBER OPTIC CABLE SERVICE

- 8.11.1 The Developer shall make arrangements for Fiber Optic Conduit to be installed underground within a subdivision. The installation shall be carried out in accordance with the location noted on Standard Drawings

8.12 NATURAL GAS SERVICE

- 8.12.1 The alignment and location of all natural gas facilities within a subdivision shall be subject to the approval of the General Manager.
- 8.12.2 The Developer shall make arrangements with the Gas Franchise Company in the area for the installation of Natural Gas in a subdivision. The installation shall be carried out in accordance with Standard Drawings No. 7.1 to 7.7 Section 7
- 8.12.3 The alignment and location of all natural gas facilities within a subdivision shall be subject to the approval of the General Manager.

8.13 STREET LIGHTING

- 8.13.1 Street lighting may be installed in subdivisions upon Council approval subject to the Developer installing all streetlight infrastructures at the time of development, at the Developer's cost.
- 8.13.2 Street lighting shall be installed in accordance with Standard Drawings.

Refer to Standard Detail Drawings No. 7.1 to 7.7.

- 8.13.3 All developments will be required Dark Sky-compliant luminaries LED for all new street lighting installations as per Policy C-AD-19 Dark Sky Outdoor Lighting. Streetlights must be of steel poles and davits. Details to be included in the engineering plans.

8.14 MAILBOX PULLOUTS

The Developer shall construct, when identified as being required, a mailbox pullout at the entrance to or within the subdivision.

Refer to Standard Detail Drawing No. 8.7, Mail Box Pullout Cross Section

Refer to Standard Detail Drawing No. 8.8, Mail Box Pullout Locations

8.15 OFFSITE ROAD CONSTRUCTION

8.15.1 General

- 8.15.1.1 A subdivision or development approval may require that the Developer reconstruct an existing County road or construct a road within a previously existing County road allowance. This section outlines the Developer's responsibility relative to such a requirement.

- 8.15.1.2 In the construction or reconstruction of a County Road, the Developer shall ensure and be responsible for the safety of the traveling public and access to adjacent landowners.

8.15.2 Coordination of Existing Utilities

8.15.2.1 GENERAL

The Developer shall be responsible for contacting all affected utility agencies and for arranging and coordinating all protection and/or modifications necessitated by the construction or reconstruction of a County road. This section outlines the arrangements and approximate time requirements applicable to the utility agencies commonly involved as well as the responsibilities relating to costs. The information provided is based on conditions normally encountered and may not be applicable where unusual site specific circumstances are involved. The Developer is advised to contact each affected utility agency at the earliest possible time to confirm timing and co-ordination requirements.

8.15.3 Temporary Traffic Control (TTC)

8.15.3.1 GENERAL

- 8.15.3.1.1 Wherever it is considered necessary by the General Manager to accommodate the passage of traffic during construction or reconstruction of a County road, the Developer shall be responsible for ensuring that its Contractor makes all needed and suitable provisions for such traffic, whether pedestrian or vehicular, over or around the work being performed. The Developer shall also be responsible for ensuring that the Contractor supplies and maintains such signs, barriers, fences, lights, and flag persons as may be required for this purpose. No construction project shall start until all necessary construction signs are in place.

8.15.3.2 CONSTRUCTION SIGNS

- 8.15.3.2.1 All construction signs and barricades shall be fully reflectorized and shall conform to the latest Roads and Transportation Association of Canada (RTAC) edition of the manual "Uniform Traffic Control Devices for Canada". Any required oversize signs or special signs for specific circumstances shall be of a design meeting with the approval of the General Manager.

Refer to Standard Detail Drawing No. 8.9, Minimum Construction Signage.

- 8.15.3.2.2 The type and spacing of construction signage shall conform to the requirements for construction signage developed by Parkland

County Traffic Accommodation Manual, except where otherwise specified by the General Manager.

8.15.3.2.3 Signs shall be erected at right angles to the roadway with their bottom 1.5 m above the road and not less than 2 m or more than 4 m from the nearest traffic lane. Signs shall be kept as close to the work as practical. Portable signs on weighted stands may be used where signs must be moved often. All signs must be kept clean and clearly legible at all times.

8.15.3.2.4 When work is not in progress, regulatory and construction signs not essential to the protection of the public shall be removed or covered to reduce inconvenience to a minimum. All construction signs shall be removed as soon as possible after the project is completed.

8.15.3.3 EXISTING SIGNS

8.15.3.3.1 All existing signs and guide posts which must be removed to carry out the work shall be carefully salvaged and turned over to the General Manager. Certain essential existing signs such as railway crossing, intersection warning, or stop signs shall be maintained on the work for the duration of the project.

8.16 LIST OF STANDARD DETAIL DRAWINGS

Standard details have been provided for the guidance of designers in the interpretation of the standards. Where the standards and the drawings conflict, the standards shall govern. Standard drawings are dimensioned in millimeters unless otherwise noted.

Refer to Section 10 for all Standard Detail Drawings

9.1 GENERAL

This section specifies the requirements for placing topsoil, seeding, sodding, watering, fertilizing, cutting of vegetation, and maintenance procedures during warranty period on all Parkland County green spaces and roadway rights-of-way areas.

All roadway ditch bottoms, side slopes, back slopes, and open areas disturbed during construction shall be uniformly topsoiled and be seeded to grass following preparation of the seed bed.

- The topsoil shall be uniformly spread to a minimum depth of 150mm or as specified and be capable of supporting vegetation growth. The upper 50mm shall be of a fine grade texture and free of rocks, roots, stumps, weeds and other deleterious material.
- All seeded areas will be accepted following consistent germination and carrying out of a first cut following 100 mm of growth.

All materials used are subject to inspection, testing, and approval by the County.

9.1.1 Topsoil**9.1.1.1 TOPSOIL REQUIREMENTS:**

- 9.1.1.1.1 It shall be free of subsoil, clay lumps, stones, live plants and other roots, sticks, or other extraneous matter.
- 9.1.1.1.2 It shall be the best of quality and screened.

9.1.2 Seed Mixture**9.1.2.1 REQUIREMENTS:**

- 9.1.2.1.1 Grass seed shall be Canada #1 certified seed meeting the requirements of the “Canadian Seeds Act”. Seed Certificates must be supplied and approved by the County prior to planting.
- 9.1.2.1.2 The mixture shall comply with federal and provincial seed laws and have a minimum germination of 75% and a minimum purity of 97%.
- 9.1.2.1.3 Bags containing the seed mixture shall be clearly tagged, showing the name of the supplier, the contents, the date bagged and location, and the year of seed production.
- 9.1.2.2 Seed varieties shall be mixed and application rate set to suit the planting conditions and location. Acceptable seed mixes and application rates are outlined in Table 9.2. Other mix designs may be used, subject to the approval of the County.

9.1.3 Sod

- 9.1.3.1 Sod shall be certified No. 1 cultivated turf grass sod of the type as specified on the Plant List, grown and sold in accordance with the classification of the Nursery Sod Growers Association of Alberta and Western Canada Turf grass Association standards. At time of sale it shall have a strong, fibrous root system and shall be free from stones and burned or bare spots.
- 9.1.3.2 Sod shall consist of a uniform mixture of the industry standard mix as per Sod Growers Association of Alberta latest manual, or approved equal.
- 9.1.3.3 Sod shall be cut by approved methods in accordance with the recommendations of the Sod Growers Association of Alberta and/or the Canadian Nursery Trade Association. Sod shall be:
- a minimum of eighteen (18) months old;
 - of a quality that satisfies weed tolerance rates as outlined by the Alberta Seed Growers Association (ASGA);
 - 20 - 25 mm in uniform thickness;
 - cut in strips of uniform width;
 - sufficiently moist so that no burning of the edges has occurred; and
 - harvested at 12 mm soil depth, cut uniform free of any holes and tears.

9.1.4 Fertilizers**9.1.4.1 FERTILIZERS**

- 9.1.4.1.1 Shall be packed in standard containers, clearly marked with the name of the manufacturer, mass and analysis. Use only standard commercial fertilizer with guaranteed chemical analysis); and
- 9.1.4.1.2 All fertilizer shall be stored in a weatherproof storage place and in such a manner that it will stay dry and its effectiveness is not impaired.

9.1.4.2 ROOT STARTER

- 9.1.4.2.1 Slow release formulated 16-32-0 or 11-54-0
- 9.1.4.2.2 Polymer coated slow release urea if available.

9.1.5 Peat Moss

- 9.1.5.1 If organic material is required to meet the organic material specifications for topsoil, peat moss shall be added in the field and thoroughly mixed with cultivation equipment. The peat moss shall meet the following specifications:
- free of toxic material, live plants, live roots, seeds, or other deleterious material;

- delivered in a pulverized condition;
- approved prior to mixing with the topsoil; and
- of a pH not less than 4.5 and not greater than 6.0

9.1.6 Trees, Shrubs and Vines

All plant material shall conform to the horticultural standards of the "Canadian Nursery Trades Association" standards for Parkland County area. Nomenclature (plant names) shall conform to the rules of the international code of nomenclature for cultivated plants. All plants shall be nursery grown, unless approved otherwise of sound stock, typical of their species or variety.

9.1.6.1 Stock - They shall be healthy (free from damage, disease and pests, eggs or larvae), well-branched, densely foliated when in leaf with well-developed root systems and of the specified caliper and height. All undersized or girdling root systems will be rejected. Stock shall be free of mechanical damage. Tags shall remain until inspection is complete. Refer to Table 9.1.

9.1.6.2 When in excess of 40 mm, caliper shall be the determining measurement

- Deciduous trees with a caliper up to 100 mm shall be measured no less than 15 cm above the ground
- Deciduous trees with a caliper 100 mm and larger shall be measured no less than 30 cm above the ground

9.1.6.3 Species of trees, shrubs, and vines shall be selected to suit the planting conditions and locations.

9.1.6.4 For parks, open spaces, and naturalization areas, each of the following shall be considered when selecting varieties: diversity of species, aesthetics, hardiness, disease resistance, natural occurrence, rate of growth and growth habit, and ratio of trees, shrubs, and perennials. Acceptable trees, shrubs, and vines are outlined in Table 9.3.

9.1.6.5 Substitutes will not be permitted unless approved in writing by the County.

9.1.6.6 Bare Root Shrubs shall be planted with adequate fibrous roots retained. The minimum size of root balls for trees shall be as specified in Table 9.1.

9.1.6.7 BALLED AND BURLAPPED PLANTS

Such plants shall be dug with firm natural balls of earth to sufficiently include most of the fibrous roots. Ball sizes shall meet the specifications based on the tree size as shown in Table 9.1.

9.1.6.8 CONTAINER GROWN STOCK

Such stock shall be grown in a container long enough for the root system to have developed sufficiently to hold its soil together. No plants shall be loose in the container. Soil shall have sufficient moisture.

9.1.6.9 MATERIALS

9.1.6.9.1 Fertilizers shall be 8-24-24 or approved equal and delivered as specified in standard size, unopened containers, showing the weight, analysis, and manufacturer's name, and will specify as either coniferous or deciduous.

9.1.6.9.2 Tree Stakes shall be 2.0 - 2.5 m in length and of the steel "T" bar type.

9.1.6.9.3 Tree Ties shall be a number ten (#10) gauge galvanized wire inserted into a 200 mm length of 10 mm diameter polyethylene plastic tubing. Tree ties shall be marked with orange flagging type.

9.1.7 Water

Water shall be free of any impurities that would inhibit germination or otherwise adversely affect growth.

9.1.8 Lime

Where the pH of the soil is less than 6.0, lime is to be used. It shall be ground limestone containing not less than 80% of total carbonates combined and ground to such fineness that at least 50% will pass a 100-mesh sieve and at least 90% will pass a 20-mesh sieve. Where limestone is specified it shall be stored in such a manner as to stay dry and free flowing.

9.1.9 Mulching Material

Mulching material, to a minimum compacted depth of 100 mm, shall be deciduous wood cellulose fiber or approved equal, clean, dry and free of weeds and other foreign matter.

9.2 CONSTRUCTION**9.2.1 Weed Control**

The Contractor shall be responsible for the control of existing weeds and all subsequent weed growth within the contract site(s) as shown on the plans or in the list of locations from the date the contract is awarded or the date that the location is made available until the completion certificate has been issued. The "*Alberta Weed Control Act*" shall govern.

9.2.2 Subsoil Preparation

All weeds, roots, and stones larger than 50 mm in diameter and other foreign matter shall be removed from the surface of the subsoil. Immediately before placing topsoil, the subsoil

shall be loosened to a depth of not less than 50 mm by means of a disc, spike tooth harrow or other means satisfactory to the County and leveled to a firm, even surface. The final grade shall be 150 mm below finished grade (or as specified) and sloped so that no ponding or runoff onto adjacent private property occurs.

9.2.3 Existing Appurtenances

All existing utilities shall be adjusted to finished grade elevations and all existing features (trees, hydrants, valves, etc.) shall be protected against any damage.

9.2.4 Topsoil Placement and Cultivation

9.2.4.1 PLACING

9.2.4.1.1 The topsoil shall be uniformly spread on the prepared subsoil to a minimum compacted depth of 150 mm (or as specified). Topsoil shall not be placed when either the topsoil or subsoil is frozen, excessively wet, extremely dry, or in a condition detrimental to proper grading, compaction or cultivation. The upper 50 mm shall be of a fine texture and free of stones or lumps 6 mm or larger. Allowances for settlement shall be provided where necessary. To prevent damage, manually spread topsoil around trees, plantings or the structures.

9.2.4.1.2 If required, lime shall be well worked into the soil before the application of any fertilizers to obtain a minimum pH value of 6.0.

9.2.4.2 CULTIVATION

After topsoil placement, the area shall be thoroughly disced, harrowed, and floated to a minimum depth of 75 mm. All hard lumps shall be broken down and all stones larger than 50 mm in diameter, roots, stumps, and other foreign matter shall be removed and disposed of.

9.2.4.3 FERTILIZER

The application rate shall be 10 kg/100 m² with an approved spreader and be well worked into the upper 75 mm of soil.

9.2.4.4 Compaction Topsoil shall be compacted to 80 - 85% standard Proctor density.

9.2.4.5 Finishing Float the surface until smooth and fine grade to eliminate rough or low areas. Final grade for seeded areas shall be flush with adjacent surfaces, for sod shall be 25 mm below finished grade of adjacent work.

9.2.5 Planting

The location of all trees and shrubs are to be marked and approved prior to installation at the correct grade and alignment, species, spacing, and sizing as noted in Table 8.3.

9.2.5.1 PLANTING LOCATION

The Contractor shall stake the location of all plantings for approval by the County as per Table 9.4.

9.2.5.2 SITE PREPARATION

Rough grading, excavate to required depths, the preparation of subgrade to receive topsoil, tree planting, and fine grading.

9.2.5.3 TREE PLANTING

9.2.5.3.1 Trees larger than 75 mm caliper shall be moved by machine.

9.2.5.3.2 Tree pits shall be excavated 400 mm greater in diameter than the ball of earth or spread of roots of the tree and deep enough to allow for a 150 mm layer of the planting mixture beneath the ball or roots.

9.2.5.3.3 Trees shall be set straight in the centre of the pits, at such a level that after settlement, the crown of the plant will be 25 mm lower than the surrounding finished grade. Trees to be faced to give the best appearance or relationship to adjacent structures, walkways or park features. Top 1/3 of wire basket to be folded back or removed and top 1/3 of burlap to be cut back and removed.

9.2.5.3.4 All plants shall be pruned after planting to the minimum necessary to remove dead or injured branches and to compensate for the loss of roots. Pruning practice according to the International Society of Arboriculture (I.S.A.).

9.2.5.4 TREE STAKING

9.2.5.4.1 All trees shall be supported by two (2) steel bars driven securely into the ground and fastened with a tree tie.

9.2.5.4.2 All plants to be pruned according to industry practices.

9.2.5.5 PROTECTION OF TREE BASE

All newly planted trees are to be protected at the base with a horticultural approved arbor guard.

9.2.5.6 SHRUBS PLANTING

Shrub beds to be prepared to a depth of 450 mm below finished grade. Installation to include 300 mm depth topsoil, optional weed liner and landscape edger where specified, and 100 mm depth wood chip mulch of other specified decorative mulch. Install weed liner and edger as per manufacturer's specifications.

9.2.5.7 FERTILIZER

Fertilizer shall be applied evenly over the pit at the following rate when approximately two thirds of the plant pit has been backfilled with soil:

- vines, groundcover 0.03 Kg/plant;
- herbaceous plants 0.03 Kg/plant;
- small shrubs 0.06 Kg/plant;
- small trees 0.25 Kg/25 mm of caliper;
- shade trees 0.50 Kg/25 mm of caliper; and
- evergreens 0.03 Kg/300 mm of height.

9.2.6 Seeding

9.2.6.1 CONDITION OF SEEDBED

The Contractor shall obtain approval of the seedbed from the County's operation departments before proceeding with any seeding. The seedbed shall be free of frost, snow, or standing water. Seeding shall not occur if the soil temperature is below 13 degrees Celsius for spring planting and above 5 degrees Celsius for fall planting..

9.2.6.2 Wind Seeding shall not be carried out when wind velocities are above 8 km/h.

9.2.6.3 SLOPES THREE HORIZONTAL TO ONE VERTICAL OR LESS

9.2.6.3.1 Grass seed shall be sown at a rate (kg/100m²) as per supplier recommended in two passes of a mechanical spreader at 90o to each other.

9.2.6.3.2 Seed shall be applied by means of an approved mechanical dry seeder "Brillion" or an approved equal that can roll and cover the seed with 3 mm to 6 mm of soil. Where the above type of equipment cannot be used, seeding may be done by a cyclone seeder or equivalent dragged with flexible wire mat and rolled with a light turf roller weighing between 90 and 114 kg into the prepared seedbed in two directions in equal amounts.

9.2.6.4 SLOPES GREATER THAN THREE HORIZONTAL TO ONE VERTICAL

A hydro-seeder of approved design capable of thoroughly mixing water, grass seed, fertilizer, and pulverized wood fiber shall be used at the following rates:

- grass seed 24 kg/1000 m²;
- water 468 L/1000 m²;
- mulch 170 kg/1000 m²; and

- fertilizer 50 kg/1000 m².

OR

In lieu of using a hydro-seeder, seeding may be done as described above, but the seeded slope shall be protected with approved erosion control blanket installed to manufacturer's specifications to prevent erosion.

9.2.6.5 WATERING

If watering is required it shall be with a fine spray which will not create any erosion problems.

NOTE: Any seed which fails to germinate for whatever reasons shall be re-cultivated and reseeded until germination has taken place at the Developer's expense.

9.2.6.6 SUPPLEMENTARY SEEDING & FERTILIZING

Approximately six weeks after germination, the area shall receive a supplementary application of a fertilizer at rates determined by soils tests. If seed fails to germinate within four growing months, re-cultivate and reseed until germination takes place.

9.2.7 Sodding

Sodding is required where specified by the County.

9.2.7.1 Subsoil Preparation shall be prepared as specified above.

9.2.7.2 SOD LAYING

9.2.7.2.1 The Contractor shall obtain approval from the County's operation departments before proceeding with any sodding.

9.2.7.2.2 Sod shall be laid evenly with staggered joints closely butted together and matched to the existing grades or surrounding areas.

9.2.7.2.3 All areas shall be rolled with a medium roller (90 to 114 kg) to provide close contact between sod and topsoil and to produce a smooth and even surface. Sod shall be laid at right angles to the slope along the contours of the slope. On slopes of three horizontal to one vertical or steeper, pegs/staples shall be driven full depth on intervals of 1 m.

9.2.7.3 WATERING

9.2.7.3.1 Sod shall be watered sufficiently to saturate the upper 100 mm of soil immediately after installation. After sod and soil has dried sufficiently to prevent damage, the area shall be again rolled with a

medium roller to ensure a good bond between sod and soil and to remove minor depressions and irregularities.

- 9.2.7.3.2 Adequate watering shall again be applied immediately following rolling to saturate the upper 100 mm of soil. Watering shall be carried out when required to prevent grass and underlying soil from drying out for a minimum period of 15 days after placement or until the sod is well rooted and established.

9.2.7.4 **SUPPLEMENTARY FERTILIZER APPLICATION**

Approximately four weeks after sod laying and after the initial cutting, the sodded area shall receive an application of organic fertilizer, rates of which are determined by soil tests.

9.2.7.5 **WORKMANSHIP**

The finished turf shall be smooth and even. There shall be no sudden irregularities in the final grade.

9.2.8 Growing Season

9.2.8.1 **GRASS PLANTING**

Grass seed shall not be planted between July 1st and September 1st to insure the longest possible germination period or late in the year when germination will not take until spring.

9.2.8.2 **SOD LAYING**

Sod shall not be laid before May 1 or after September 30. Sod laying on slopes 3:1 or steeper shall not be done when temperature is above 23 degrees Celsius. The Developer shall be responsible for the identification, location and protection of all utilities which may exist within or adjacent to the proposed subdivision.

9.3 MAINTENANCE AND WARRANTY

9.3.1 General

9.3.1.1 **MAINTENANCE PERIOD**

Continuously maintain and warranty landscape work as specified for a period of at least one (1) year from the issuance of a Complete Completion Certificate (C.C.C.) and until the issuance of a Final Acceptance Certificate (F.A.C.).

9.3.1.2 **MAINTENANCE LOG**

Keep Daily Maintenance Log (Log) throughout contract and submit Log to the County monthly. In Log, detail activities and dates in which activities were carried out. In addition, detail applications of chemicals and include target weed or

insect, mode, type and rate of application of chemical, date, time, weather conditions, and results of application.

9.3.1.3 SAFETY

The Contractor shall provide, erect and maintain barricades, signs and protection that may be necessary for the preservation of public health and safety.

9.3.1.4 REGULATORY APPROVALS

Provide County with copies of permits and licenses required by regulatory authorities, including current pesticide applicator's license number.

9.3.1.5 DAMAGE TO PROPERTY

The Contractor shall be responsible for all costs incurred related to the liability and damages caused by the Contractor's personnel and equipment during the term of the contract. Report damages immediately to the County. Obtain County approval for repairs and replacements. Return grass areas, plants, equipment, and buildings to their original condition before damage. Scalping of turf and mechanical damage to trees including tearing bark shall be considered as damage and shall be repaired to the County's satisfaction.

9.3.1.6 GENERAL WORKMANSHIP

Schedule the timing of operations with growth, weather conditions and use of site. Provide copy of schedule for County approval. Do each operation continuously and complete within a reasonable time period. Provide equipment and material necessary for maintenance to acceptable horticultural standards. Coordinate maintenance practices with the County. Maintenance schedules may have to be altered to accommodate the County's site activities. Collect and dispose of excess material and debris to municipal disposal site following each day's work. Cleanup shall be a continuous operation and at no time shall topsoil or debris of any kind be allowed to remain on roadways overnight.

9.3.2 Turf Maintenance

9.3.2.1 GENERAL

Maintenance shall include all measures necessary to establish and maintain seeded and sodded areas in an acceptable, vigorous and healthy growing condition during the maintenance and warranty period. Proper grades shall be established and should not have divots, low/high spots.

9.3.2.2 MOWING

Maintain turf with sharp mowers at 60 mm during growing season. Cut as required to maintain specified height. Remove papers, rocks, and other foreign material before cutting. Change direction of cut with each mowing where practical. Do not remove grass clippings from turf areas unless volume is such as

to be harmful to turf areas or unsightly. Remove clippings from sidewalks, roads, parking lots, windows or buildings during the same mowing and remove from site. If growth of turf has exceeded 60 mm, raise mower blades so that not more than 30% of grass blade will be cut at one time. Do not allow turf height to exceed 100 mm.

9.3.2.3 FERTILIZING

Adjust fertilizer requirements according to soil test analysis. Use only mechanical equipment. Check calibration of spreader to ensure that specified rate is used. Spread 50% of fertilizer in one direction, then 50% at right angles. Water, immediately after fertilizing, according to manufacturer's recommendations; obtain moisture penetration of 50 mm minimum. Apply fertilizer at manufacturer's specified rates. Fertilize three times per growing season:

- Year of Start – Starter fertilizer
- Spring – Apply 12-51-0 fertilizer (or approved equal) before May 31;
- Summer – Apply 27-14-0 fertilizer (or approved equal) during the first two weeks of July; and
- Fall – Apply 16-20-0 fertilizer (or approved equal) during the last two weeks of August.

9.3.2.4 WATERING

For sodded areas, supply labour, water truck, pumps, potable sprinkler systems and water necessary to provide adequate watering to maintain plant growth during warranty period. Fire hydrants shall not be used as a source of water supply unless written approval is provided by the County.

9.3.2.5 TOPDRESSING AND RESEEDING

Mow grass to height of 40 mm. After mowing, rake thoroughly, removing loose and dead grass, stones and debris. Spread topsoil to maximum thickness of 15 mm, filling in low areas and bare spots. Over seed area with seed mixture equivalent to existing grasses at manufacturer's specified rates. Rake seed into topsoil, roll lightly and water to ensure penetration of 80 mm, then continue to water at frequent intervals to maintain vigorous growth.

9.3.2.6 SOD REPLACEMENT

Cut out areas of dead or unhealthy sod and replace with new sod. All repair areas to be square or rectangular. Rake topsoil before installing new sod. Butt new sod tightly to adjacent existing sod and grades. Roll lightly to reduce contact with soil. Ensure water penetration of 80 mm and then continue to water at frequent intervals to maintain healthy growth.

9.3.3 Tree and Shrub Maintenance**9.3.3.1 GENERAL**

Tree and shrub maintenance shall include all measures necessary to establish and maintain all plants in an acceptable, vigorous, and healthy growing condition during the maintenance and warranty period.

9.3.3.2 WATERING

Deep water trees and shrubs to maintain adequate moisture level within root systems to meet the plant's requirements. The Contractor is responsible for supplying loading, hauling and distributing water.

9.3.3.3 CULTIVATION AND WEEDING OF PLANT BEDS

Cultivate upper 40 mm of soil monthly. Edge plant beds evenly to depth of 100 mm in lines of original layout. Remove weeds bi-weekly including their roots. Do not damage roots of plants. Collect and dispose of paper, refuse, and dead plants.

9.3.3.4 STAKING

Keep stakes and guy wires taut and plants plumb for duration of maintenance period. Remove flagging/rope from plants at time of planting.

9.3.3.5 PRUNING

The amount of pruning shall be limited to the minimum necessary to remove dead or injured branches. Only clean, sharp pruning tools shall be used. All cuts shall be clean and cut to the branch collar, leaving no stubs. Pruning of trees and shrubs shall be performed by an experienced pruner knowledgeable of horticulture industry standards.

9.3.3.6 PLANT REPLACEMENT

All plant materials found dead or not in a healthy, satisfactory growing condition or which, in any other way, do not meet the requirements shall be replaced immediately by the Contractor at the Contractor's own expense.

9.3.3.7 FERTILIZING

Apply a high phosphorous fertilizer, 10-52-10 (or approved equal) at manufacture's specified rates at the time of planting and each spring prior to June 1. No fertilizer should be applied in July or August. Apply water after fertilizing to ensure penetration of fertilizer level.

9.3.4 Weed, Insect and Disease Control**9.3.4.1 GENERAL CONSIDERATIONS**

Ensure proper, positive identification of infestations and consult with the County before taking corrective action. Before chemical applications, notify the county in writing regarding the chemicals to be used and the area to be treated. Use equipment and containers free of harmful residues not related to specific control measures applicable to situation. Perform disease, weed and insect control, in accordance with Provincial chemical application regulation. Notify the County of intent at least three days before any chemical application. Prepare and apply chemical according to manufacturer's specification by licensed applicator. Minimize drift at all times. Carry out treatment with regard to climatic effect on surroundings and occupants of buildings.

9.3.4.2 WEED CONTROL

Apply chemical to eradicate weeds or perennial grass in turf areas, driveways, inter-locking concrete paving stone areas, along fences, storage areas, parking lots, gravel and rip -rap stone areas with boundary of site. Repair and pay for damage caused by application of herbicides. Effectiveness of treatment programs to be determined through inspection by County. Repeat as required.

9.3.4.3 INSECT AND DISEASE CONTROL

Make weekly inspection of lawns and plants for insect and disease infestations. Laboratory testing may be required for diagnosis of disease. Apply chemicals based on development stage of insects' life cycles. Repair and pay for damages caused by application of chemicals. Effectiveness of treatment programs to be determined through inspection by the County. Repeat as required.

9.3.5 Spring and Fall**9.3.5.1 SPRING**

Complete spring cleanup as soon as working conditions are favourable, and no later than May 15th. Remove sand, gravel, salt, and debris accumulated during winter months and dispose at municipal disposal site.

Contractor to remove and dispose of from site: snow fence, stakes, and sand containers. Clean plant beds and planters of debris and dead plant material. Loosen and lightly cultivate soil without disturbing roots of permanent plantings.

9.3.5.2 FALL

Remove and dispose of annuals from plant beds and planters within one week after first killing frost. Deep cultivate plant beds and planters. Cut back foliage of perennials within one week after killing frost. Stake locations of perennials if required. Deep water trees and shrubs between October 1 to 15.

9.3.6 Final Inspection**9.3.6.1 TURF AREAS**

Final inspection of seeded and sodded areas will be made prior to the end of the warranty period. At the time of inspection, the turf should be mowed and shall be alive and in a healthy satisfactory growing condition, free of weeds. Replace areas that show root growth failure, deterioration, bare or thin spots, or which have been damaged by any means to the satisfaction of the County.

9.3.6.2 TREES AND SHRUBS

Final inspection of trees and shrubs will be made prior to the end of the warranty period. At the time of inspection, all non-mulched beds and tree pits shall be freshly cultivated. Mulched beds and tree pits shall be refilled to original specified depths. All planting areas and tree pits shall be free of weeds and debris. Any plant that is dead, not true to name or specified, or not in satisfactory growth, shall be removed and replaced by the Contractor.

9.3.6.3 CLEANUP

Clean roadway, walkway, and surrounding areas of soil, seed clippings, and other debris and restore all disturbed and damaged areas during execution of work to County standards.

TABLE 9.1 – Minimum Size of Root Balls

Deciduous Trees		
Caliper (mm)	Machine Ball Diameter (mm)	Root Ball Diameter (mm)
25	600	-
50	750	860
75	900	1220
100	N/A	1520
125	N/A	1520
150	N/A	2280
200	N/A	2280
250	N/A	2280
Coniferous Trees		
Height (m)	Machine Ball Diameter (mm)	Root Ball Diameter (mm)
1.50– 2.40	900	1220
2.50 - 3.00	1220	1520
3.00 – 3.50	1220	2280

TABLE 9.2 – Seed Mixture

General Parks Area and Subdivision Ditch Mix	
Suitability	For general use in parks and subdivision ditch areas
Mixture	40% Creeping Red Fescue 40% Kentucky Bluegrass 20% Perennial Rye Mix
Application Rate	Seed Drill = 100kg/ha Broadcaster = 125kg/ha
Highway/Roadside Mix	
Suitability	Highways and roadsides including ditch sides and bottoms
Mixture	40% Meadow Brome 20% Timothy 20% Creeping Red Fescue 20% Perennial Rye Mix
Application Rate	Seed Drill = 30 kg/ha Broadcaster = 60 kg/ha Hydro seeder = 125 kg/ha

TABLE 9.3 – Trees, Shrubs, and Vines (General)

SHRUBS / VINES SPECIES	
Species	Common Name
Amelanchier, alnifolia	Saskatoon
Aronia, melanocarpa	Chokeberry
Caragana, arborescens ‘Sutherland’	Sutherland Caragana
Caragana, arborescens ‘Walker’	Walker Caragana
Caragana, arborescens ‘Pendula’	Weeping Caragana
Caragana, pygmaea	Pygmy Caragana
Caragana, frutex	‘Glosbosa’ Globe Caragana
Cornus, sericea/stolonifera	Red Osier Dogwood
Cornus, alba ‘Sibirica’	Siberian Coral Dogwood
Cornus, alba ‘Bud’s Yellow’	Bud’s Yellow Dogwood
Cornus, alba ‘Aureo-marginata’	Silver Leaf Dogwood
Cotoneaster, integerrimus	European Cotoneaster
Cotoneaster, lucidus/acutifolia	Hedge/Peking Cotoneaster
Euonymus, nana ‘Turkestanica’	Turkestan Burning Bush
Euonymus, alata	Winged Burning Bush
Euonymus, alata	Dwarf Burning Bush
Hippophae, rhamnoides	Sea Buckthorn
Juniperus, squamata ‘Holger’	Holger Juniper
Juniperus, horizontalis ‘Prince of Wales’	Prince of Wales Juniper
Juniperus, horizontalis ‘Blue Rug’	Blue Rug Juniper
Juniperus, horizontalis, ‘Blue Prince’	Blue Prince Juniper
Juniperus, horizontalis, ‘Hughes’	Hughes Juniper
Juniperus, communis ‘Effusa’	Common Juniper
Juniperus, scopulorum ‘Wichita Blue’	Wichita Blue Juniper
Juniperus, scopulorum ‘Gray Gleam’	Gray Gleam Juniper
Juniperus, sabina ‘Blue Danube’	Blue Danube Juniper
Juniperus, sabina ‘Arcadia’	Arcadia Juniper
Juniperus, sabina ‘New Blue Tam’	New Blue Tam Juniper
Juniperus, sabina ‘Calgary Carpet’	Calgary Carpet Juniper
Lonicera, tartarica ‘Arnold Red’	Arnold Red Honeysuckle
Lonicera, tartaria ‘Sunstar’	Sunstar Tatarian Honeysuckle
Lonicera, x xylosteoides Miniglobe	Honeysuckle
Lonicera, x rownie ‘Scarlet Trumpet’	Dropmore Honeysuckle (Climber)
Lonicera, x ‘Mandarin’	Mandarin Honeysuckle (Climber)
Parthenocissus, quinquefolia	Virginia Creeper (Climber)
Philadelphus, lewisii	Mock Orange
Philadelphus, lewisii ‘Waterton’	Waterton Mock Orange
Philadelphus, x virginalis ‘Minnesota Snowflake’	Minnesota Snowflake Mock Orange
Philadelphus, x virginalis ‘Snowbelle’	Snowbelle Mock Orange
Physocarpus, opulifolius ‘Diabolo’	Diabolo Ninebark
Physocarpus, opulifolius ‘Luteus’	Golden Ninebark
Picea, abies nidiformis	Bird’s-Nest Spruce
Picea, abies pumila	Dwarf Norway Spruce

Pinus, mugo mughus	Mugo Pine
Pinus, mugo pumilio	Dwarf Mugo Pine
Potentilla, fruticosa Various Cultivars	Potentilla (Shrubbery Cinquefoil)
Prunus, virginiana melanocarpa	Western Chokecherry
Prunus, x cistena	Purple Leaf Sandcherry
Prunus, tomentosa	Nanking Cherry
Prunus, triloba multiplex	Double Flowering Plum
Prunus, tenella	Russian Almond
Ribes, alpinum	Alpine Current
Ribes, aureum	Golden Current
Rosa, x rugosa 'Various Cultivars' Rose	(Explorer Series)
Rosa, x arkansana 'Various Cultivars'	Rose (Parkland Series)
Rosa, species 'Various Cultivars'	Hardy Shrub Rose
Rosa, acicularis	Prickly Rose
Rosa, rubrifolia	Red Leaf Rose
Salix, purpurea 'Nana'	Artic Willow
Salix, brachycarpa 'Blue Fox'	Blue Fox Willow
Salix, exigua	Coyote Willow
Sambucus, canadensis/nigra 'Aurea'	Golden Elder
Sambucus, racemosa 'Sutherland'	Sutherland Elder
Shepherdia, argentea	Silver Buffaloberry
Sorbaria, sorbifolia	False Spirea
Spiraea, x vanhouttei	Bridal Wreath Spirea
Spiraea, x bumalda 'Anthony Waterer'	Dwarf Pink Spirea
Spiraea, x bumalda 'Froebelii'	Dwarf Pink Spirea
Spiraea, x bumalda 'Goldflame'	Dwarf Pink Spirea
Spiraea, x arguta	Garland Spirea
Spiraea, japonica 'Goldmound'	Goldmound Spirea
Spiraea, japonica 'Little Princess'	Little Princess Spirea
Spiraea, japonica 'Magic Carpet'	Magic Carpet Spirea
Spiraea, japonica 'Shirobana'	Shirobana Spirea
Spiraea, trilobata	Three Lobed Spirea
Symphoricarpos, albus	Snowberry
Symphoricarpos, occidentalis/orbiculatus	Coralberry
Syringa, x prestoniae 'Coral'	Preston Lilac, Coral
Syringa, x prestoniae 'Donald Wyman'	Preston Lilac, Donald Wyman
Syringa, x prestoniae 'James McFarlane'	Preston Lilac, James McFarlane
Syringa, x prestoniae 'Minuet'	Preston Lilac, Minuet
Syringa, x prestoniae 'Miss Canada'	Preston Lilac, Miss Canada
Syringa, x prestoniae 'Royalty'	Preston Lilac, Royalty
Syringa, patula	Miss Kim Lilac
Syringa, vulgaris 'Sensation'	Common Lilac, Sensation
Syringa, vulgaris 'Ludwig Spaethe'	Common Lilac, Ludwig Spaethe
Syringa, vulgaris 'Belle de Nancy'	Common Lilac, Belle de Nancy
Syringa, vulgaris 'Congo'	Common Lilac, Congo
Syringa, vulgaris 'Madame Lemoine'	Common Lilac, Madame Lemoine
Syringa, meyeri 'Palibin'	Little Leaf Lilac

Syringa, x hyacinthiflora 'Pocahontas'	Hyacinth-Flowered Lilac
Thuja, occidentalis 'Brandon'	Brandon Cedar
Thuja, occidentalis 'Wareana'	Wareana (Siberian) Cedar
Thuja, occidentalis 'Techny'	Techny Cedar
Thuja, occidentalis 'Globe'	Globe (Woodwardii) Cedar
Thuja, occidentalis 'Holmstrup'	Holmstrup Cedar
Viburnum, trilobum	American Highbush Cranberry
Viburnum, trilobum 'Compactum'	Compact American Cranberry
Viburnum, opulus 'Nanum'	Dwarf European Cranberry
TREE SPECIES	
Species	Common Name
Abies, balsamea	Balsam fir
Acer, tataricum, ssp.	Ginnala Amur maple
Aesculus, glabra	Ohio Buckeye
Betula, papyrifera	Paper birch
Betula, papyrifera 'Chikadee'	Chickadee birch
Betula, pendula (verrucosa)	European weeping birch
Betula, pendula 'Gracilis'	Cutleaf weeping birch
Betula, pendula 'Youngii'	Young's weeping birch
Crataegus, mordenensis 'Toba'	Toba Hawthorn
Crataegus, mordenensis 'Snowbird'	Snowbird Hawthorn
Crataegus, succulenta	Fleshy Hawthorn
Crataegus, cernis	Chocolate Hawthorn
Fraxinus, mandshurica	Manchurian Ash
Fraxinus, pennsylvanica 'Patmore'	Patmore Ash
Fraxinus, pennsylvanica 'Rugby'	Prairie Spire Green Ash
Fraxinus, pennsylvanica lanceolata	Green Ash
Fraxinus, pennsylvanica 'Heuver'	Foothills Green Ash
Larix, sibirica (russica)	Siberian Larch
Larix, laricina	Tamarack
Larix, decidua	European Larch
Malus, x adstringens 'Thunderchild'	Thunderchild Flowering Crab
Malus, x adstringens 'Dolgo' Dolgo	Flowering Crab
Malus, x adstringens 'Kelsey'	Kelsey Flowering Crab
Malus, x adstringens 'Makamic'	Makamic Flowering Crab
Malus, x adstringens 'Strathmore'	Strathmore Flowering Crab
Malus, x adstringens 'Royalty'	Royalty Flowering Crab
Malus, x adstringens 'Selkirk'	Selkirk Flowering Crab
Picea, glauca	White Spruce
Picea, glauca 'Densata'	Black Hills Spruce
Picea, pungens	Colorado Spruce
Picea, pungens cvs.	Colorado Spruce cvs.
Picea, omorika	Serbian Spruce
Pinus, aristata	Bristlecone Pine
Pinus, contorta latifolia	Lodgepole Pine
Pinus, ponderosa	Ponderosa Pine
Pinus, sylvestris	Scots Pine
Pinus, strobiformis	Southwestern White Pine

Pinus, banksiana	Jack Pine
Pinus, cembra	Swiss Stone Pine
Populus, jackii 'Northwest'	Northwest Poplar
Populus, x canescens 'Tower'	Tower Poplar
Populus, tremula 'Erecta'	Swedish Columnar Aspen
Populus, tremuloides	Trembling Aspen
Populus, x 'Byland Green'	Byland Green Poplar
Prunus, maakii Amur	Cherry
Prunus, mandshurica	Apricot
Prunus, nigra (americana)	Canada Plum
Prunus, x nigrella 'Muckle'	Muckle Plum
Prunus, padus commutate	Mayday
Prunus, pensylvanica	Pincherry
Prunus, virginiana 'Schubert'	Schubert Chokecherry
Prunus, virginiana melanocarpa	Western Chokecherry
Pyrus, ussuriensis Ussurain	Pear
Quercus, macrocarpa	Bur Oak
Quercus, alba	White Oak
Salix, acutifolia	Sharp Leaf Willow
Salix, pentandra	Laurel Leaf Willow
Sorbus, americana	American Mountain Ash
Sorbus, aucuparia	European Mountain Ash
Sorbus, aucuparia 'Fastigiata'	Pyramidal Mountain Ash
Sorbus, aucuparia 'Rossica'	Russian Mountain Ash
Sorbus, decora	Showy Mountain Ash
Syringa, reticulate/amurensis japonica	Japanese Tree Lilac
Tilia, americana	American Linden
Tilia, x flavescens	Dropmore Linden
Tilia, cordata	Little Leaf Linden
Tilia, cordata 'Ronald'	Norlin Linden
Ulmus, americana	American Elm
Ulmus, americana 'Brandon'	Brandon Elm
Ulmus, pumila	Siberian/Manchurian Elm

TABLE 9.4 - Tree Planting Spacing

A) DISTANCE BETWEEN SPECIES

Species	Minimum Spacing (m)	Maximum Spacing (m)
American Elm	15.0	20.0
Brandon Elm	10.0	15.0
Green Ash	9.0	14.0
Prairie Spire Green Ash	8.0	14.0
Foothills Green Ash	8.0	14.0
Patmore Green Ash	7.0	12.0
Swedish Columnar Aspen	3.0	5.0

B) SETBACK - ALL SPECIES

	Minimum Setback (m)
Street Corner	7.5
Light Poles	3.5
Stop & Yield Signs	4.0
Bus Stops	4.0
Other Signs	2.0
Driveways and Walkways	2.0
Fire Hydrants	2.0
Underground and Overhead Utilities, Pedestals, Transformers, and other Street Furniture	2.0

C) SIZE SPECIFICATIONS

	Size
Deciduous Trees	50 mm caliper at 15 cm above ground
Coniferous Trees	2.0 m in height

10.1 GENERAL

Standard details have been provided for the guidance of designers in the interpretation of the standards. Where the standards and the drawings conflict, the standards shall govern. Standard drawings are dimensioned in millimeters unless otherwise noted.

10.1.1 Water Distribution Systems Standard Detail Drawings

	Drawing Number	Issued
Classes of Pipe Bedding	3.1	2013
Horizontal Thrust Block	3.2	2013
Vertical Bend Thrust Block	3.3	2013
Water Valve Installation	3.4	2013
Hydrant Shoulder Widening Layout	3.5	2013
Hydrant and Valve	3.6	2013
Utility Trench	3.7	2013
Cathodic Protection and Installation	3.8	2013
Water Automatic Air-Vent	3.9	2013
Blow Off Valve	3.10	2013

10.1.2 Sanitary Sewer Systems Standard Detail Drawings

	Drawing Number	Issued
Standard Manhole	4.1	2013
Pre-benched Manhole Base	4.2	2013
Internal Drop Manhole	4.3	2013
Low Pressure Sewer Service Connection	4.4	2013
Low Pressure Sewer Flushing Pipe	4.5	2013
Low Pressure Sewer Air and Vacuum Relief Valve Chamber	4.6	2013
Low Pressure Sewer Valve	4.7	2013

10.1.3 Service Connections Standard Detail Drawings

	Drawing Number	Issued
Single Service Connection	5.1	2013
Water Service Connection	5.2	2013
Sanitary Service Connection	5.3	2013
Standard Riser Over 4.0 m	5.4	2013
Inspection Chamber	5.5	2013
Insulation for Services	5.6	2013
Inspection Manhole	5.7	2013

10.1.4 Storm Drainage Systems Standard Detail Drawings

	Drawing Number	Issued
Wet Pond Section	6.1	2013
Dry Pond Section	6.2	2013

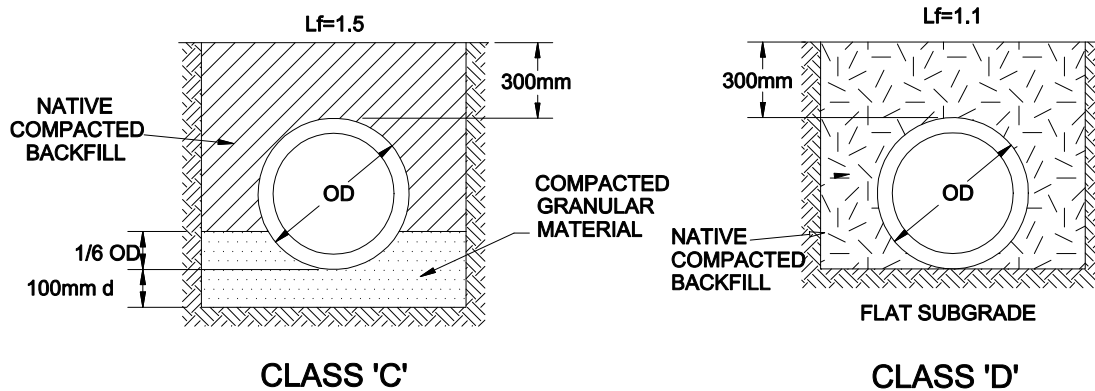
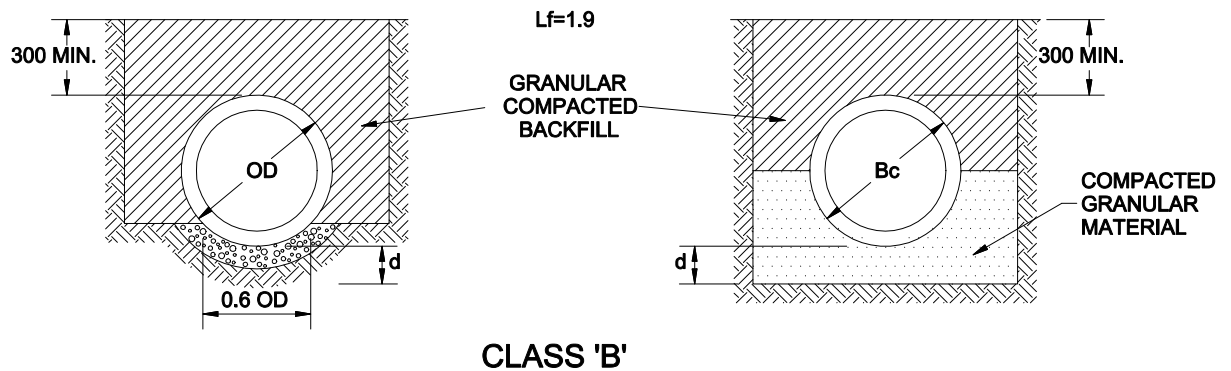
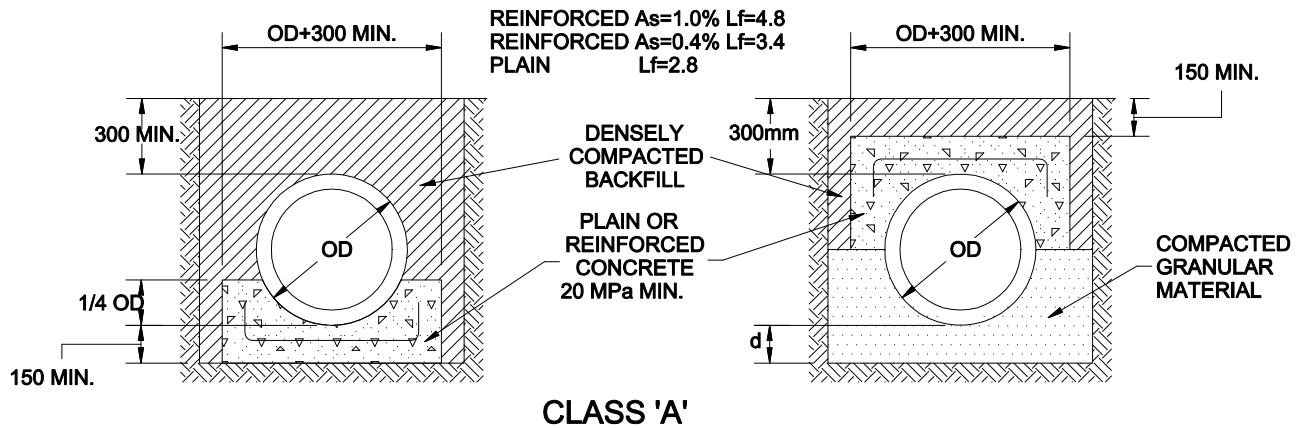
Storm Pond Release Control Manhole	6.3	2013
Swales	6.4	2013
Culvert Installation	6.5	2013
Rock Ditch Checks	6.6	2013
Culvert Installation with Rip Rap Size 400 – 1200 dia	6.7	2013
Pump Station	6.8	2013

10.1.5 Roadway Systems Standard Detail Drawings

	Drawing Number	Issued
Residential Local, Rural Local and Rural Collector Road	7.1	2013
Industrial Local Road	7.2	2013
Industrial Minor Collector Road	7.3	2013
Industrial Major Collector Road (2 Lanes)	7.4	2013
Industrial Major Collector Road (4 Lanes)	7.5	2013
Arterial Road (2 Lanes)	7.6	2013
Arterial Road (4 Lanes Divided)	7.7	2013
Road Intersections	7.8	2013
Residential Cul-De-Sac	7.9	2013
Temporary Industrial Cul-de-sac	7.10	2013
Intersection Treatment and Approach Locations	7.11	2013
Residential and Industrial Approaches	7.12	2013

10.1.6 Miscellaneous Requirements Standard Detail Drawings

	Drawing Number	Issued
Bench Mark Installation	8.1	2013
Subdivision Sign	8.2	2013
Subdivision Sign Installation	8.3	2013
Subdivision Sign North Arrow	8.4	2013
Municipal Addressing Sign	8.5	2013
Environmental Reserve Marker Sign	8.6	2013
Mailbox Pullout Cross Section	8.7	2013
Mailbox Pullout Locations	8.8	2013
Minimum Construction Signage	8.9	2013
Lot Pin Marker Installation	8.10	2013
Traffic Sign Installation	8.11	2013



LEGEND:

OD = OUTSIDE PIPE DIAMETER

d = DEPTH OF BEDDING MATERIAL BELOW PIPE (100mm MIN., 150mm IN ROCK)

A_s = AREA OF TRANSVERSE STEEL IN THE CRADLE OR ARCH EXPRESSED AS A PERCENTAGE OF AREA OF CONCRETE AT INVERT OR CROWN.

L_f = LOAD FACTOR

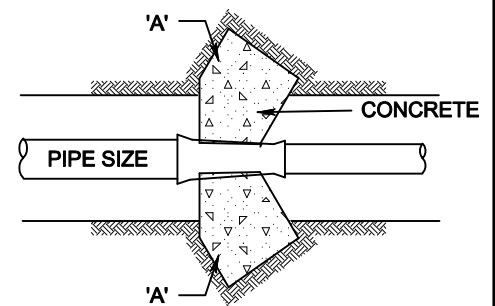
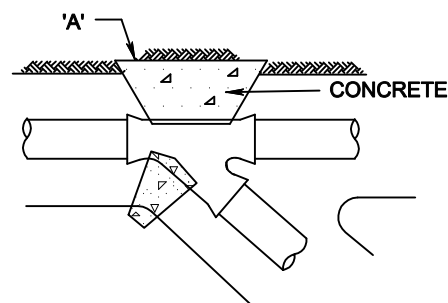
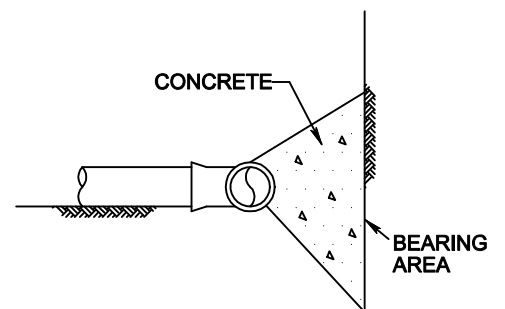
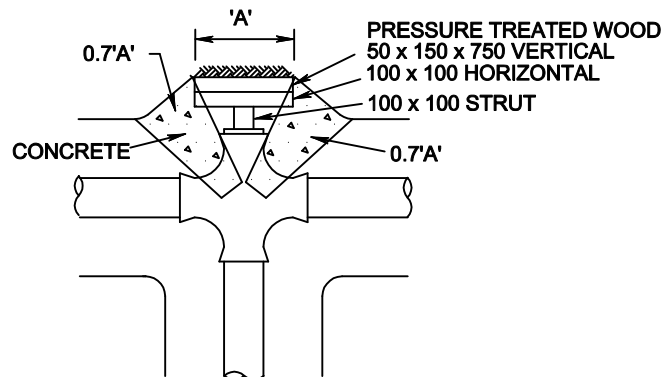
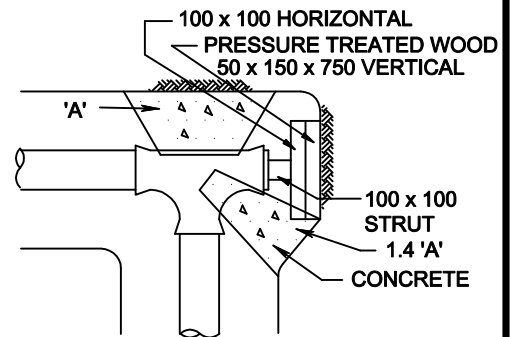
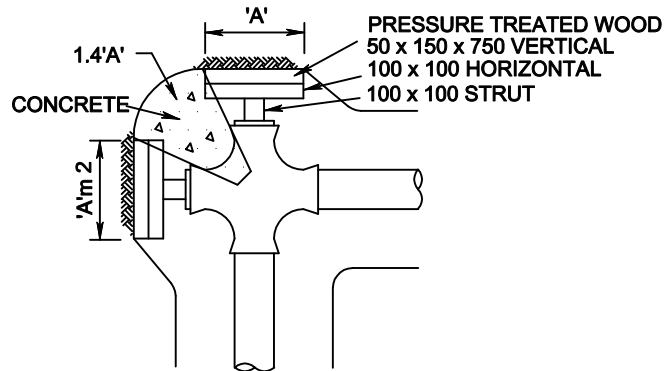
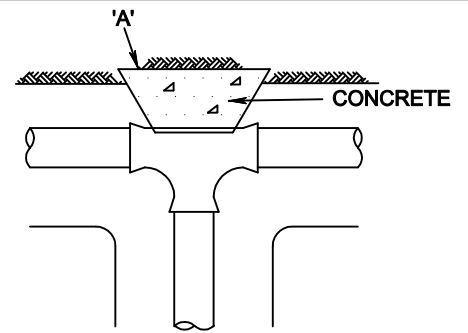
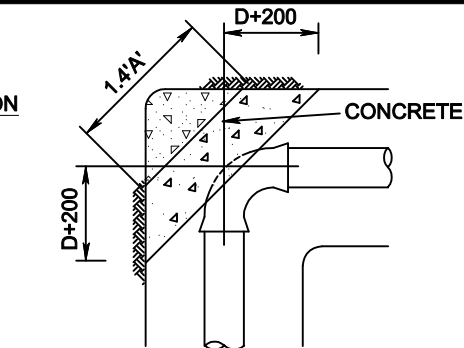


CLASSES OF PIPE BEDDING

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	3.1

BEND DEFLECTION

90 Deg 1.4A
45 Deg 0.7A
22 1/2 Deg 0.35A
11 1/4 Deg 0.18A



THRUST BLOCK DESIGN IS BASED ON :

1. CONCRETE 20MPa TYPE 50 CEMENT
2. THRUST BLOCK DESIGN ASSUMES A MIN. VERTICAL SOIL BEARING OF 100kPa
3. THRUST BLOCK BEARING AREA BASED ON P.V.C. PIPE (AWWA C900 AND C905 DR18)
4. CONCRETE TO BE CLEAR OF BELLS AND PIPE
5. PLACE 6MM POLYETHYLENE BETWEEN CONCRETE AND PIPE

TABLE - FOR CALCULATION OF BASIC THRUST BLOCK BEARING AREA 'A' (IN SQUARE METRES)

PIPE SIZE	150	200	250	300	350	400	450
'A'	0.40	0.68	1.06	1.54	2.08	2.72	3.44



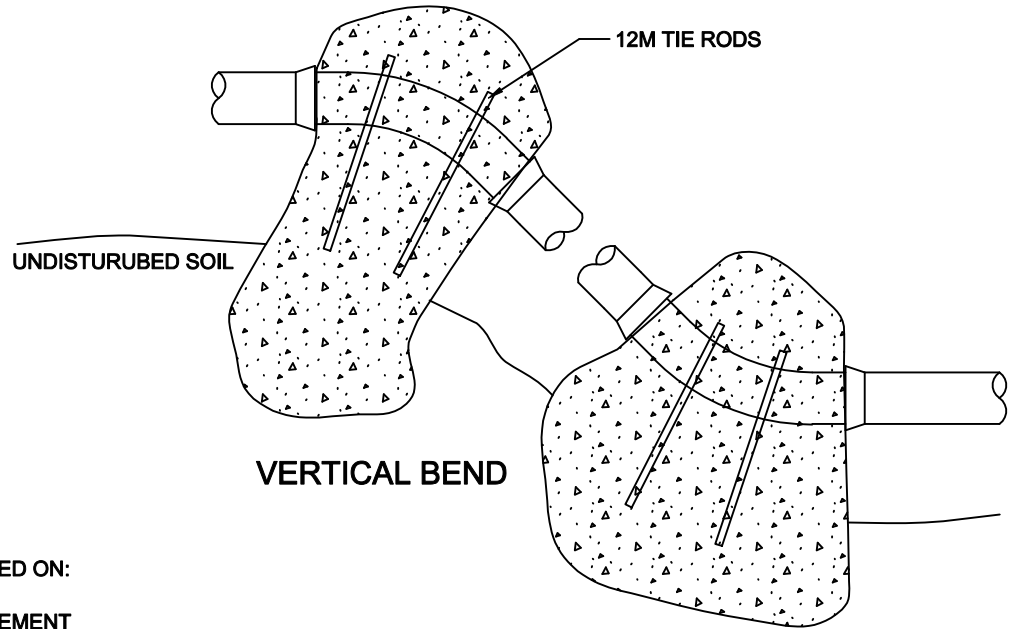
HORIZONTAL THRUST BLOCK

DATE DRAWN
SEPT 2008

DATE REVISED
DEC 2013

DRAWING NUMBER

3.2



THRUST BLOCK DESIGN IS BASED ON:

1. CONCRETE 20MPa TYPE 50 CEMENT
2. THRUST BLOCK DESIGN ASSUMES A MIN. VERTICAL SOIL BEARING OF 100kPa
3. THRUST BLOCK BEARING AREA BASED ON P.V.C. PIPE (AWWA C900 AND C905 DR18)
4. CONCRETE TO BE CLEAR OF BELLS & PIPE.
5. UNIT WEIGHT OF CONCRETE ASSUMED IS 2400kg/m³
6. PLACE 6MM POLYETHYLENE BETWEEN CONCRETE AND PIPE

UPWARD THRUST (GRAVITY)

TABLE - FOR CALCULATION OF BASIC THRUST
BLOCK BEARING AREA (IN SQUARE METERS)
CONCRETE UNIT WEIGHT 2400kg/cu.m

BEND \ PIPE SIZE	150	200	250	300	350	400	450
11.25°	0.16	0.28	0.45	0.64	0.87	1.14	1.44
22.50°	0.32	0.57	0.88	1.27	1.73	2.26	2.82
30°	0.42	0.75	1.17	1.69	2.30	3.00	3.80
45°	0.62	1.11	1.73	2.50	3.40	4.44	5.62

DOWNWARD THRUST

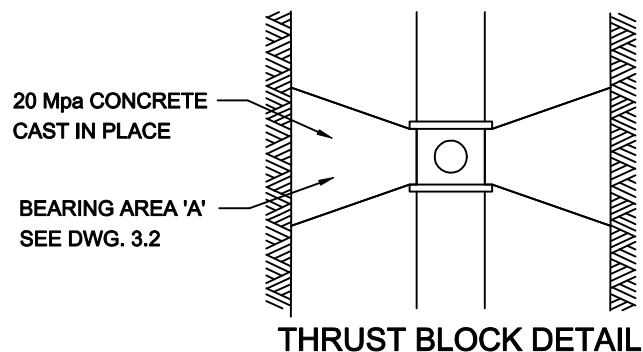
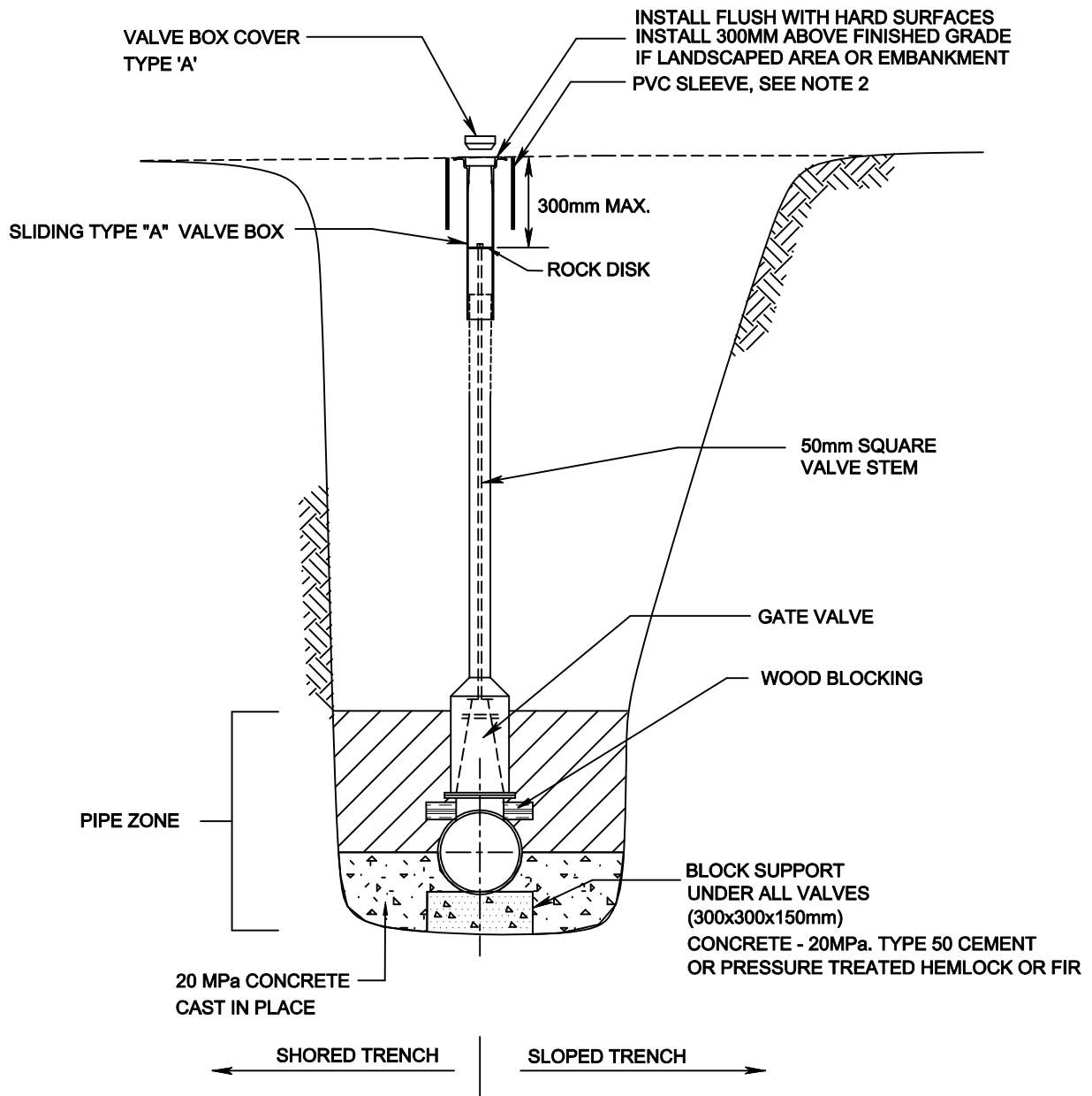
TABLE - FOR CALCULATION OF BASIC THRUST
BLOCK BEARING AREA (IN SQUARE METERS)
CONCRETE UNIT WEIGHT 2400kg/cu.m

BEND \ PIPE SIZE	150	200	250	300	350	400	450
11.25°	0.04	0.07	0.11	0.15	0.21	0.27	0.34
22.50°	0.08	0.13	0.21	0.30	0.41	0.53	0.67
30°	0.10	0.18	0.28	0.40	0.54	0.71	0.89
45°	0.15	0.26	0.41	0.59	0.80	1.05	1.32



VERTICAL BEND THRUST BLOCK

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	3.3



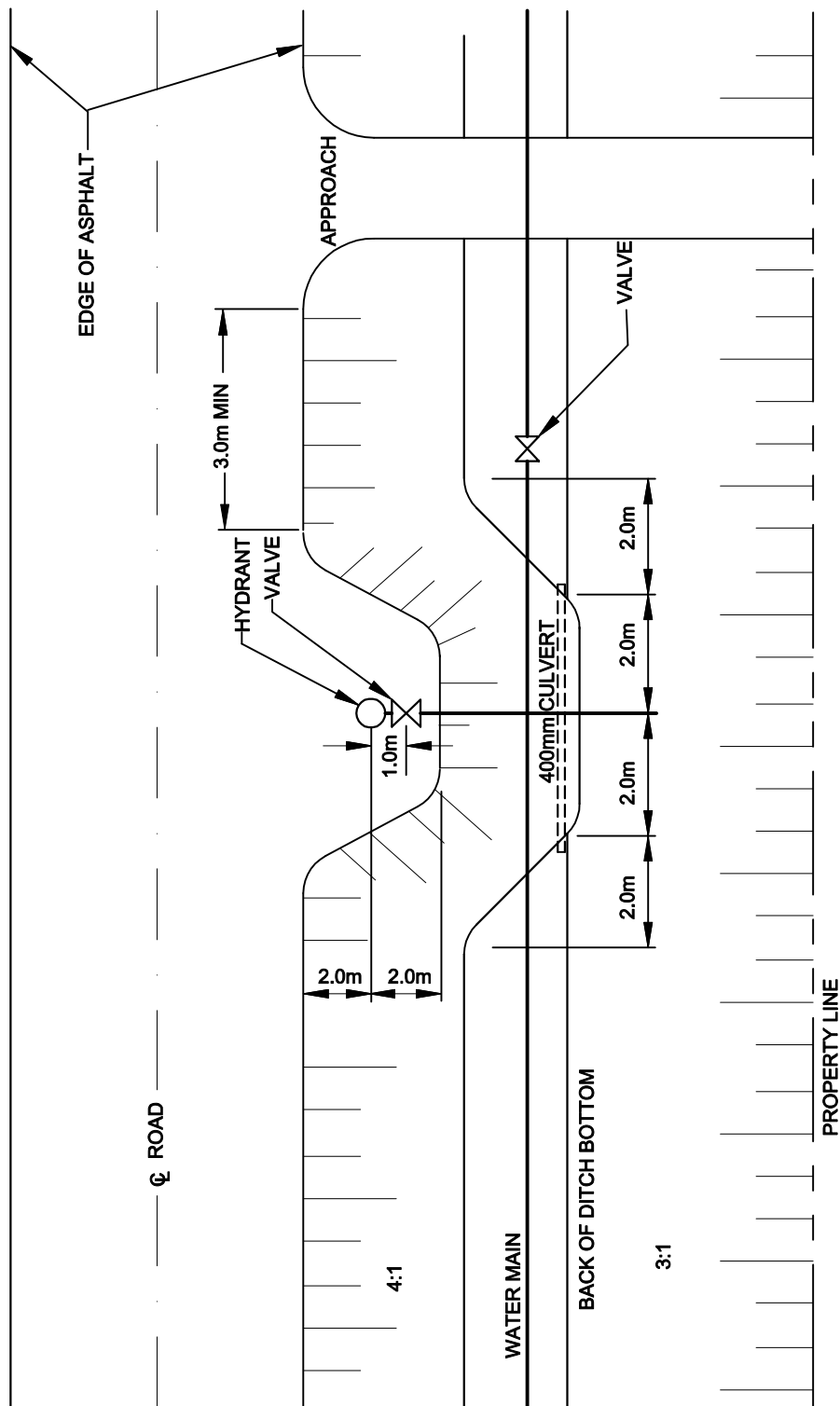
NOTES

1. ALL BOLTS TO BE STAINLESS STEEL
WRAPPED WITH DENSO MASTIC AND DENSO TAPE.
2. PVC SLEEVE TO BE USED WHEN VALVE IS INCORPORATED WITHIN CONCRETE
3. CATHODIC PROTECTION REQUIRED, REFER TO DWG NO. 3.9



WATER VALVE INSTALLATION

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	3.4



NOTES

1. WATER MAIN AND HYDRANTS MAY BE LOCATED EITHER SIDE OF ROAD.
2. STREET LIGHTS TO BE OPPOSITE SIDE TO WATER MAIN.



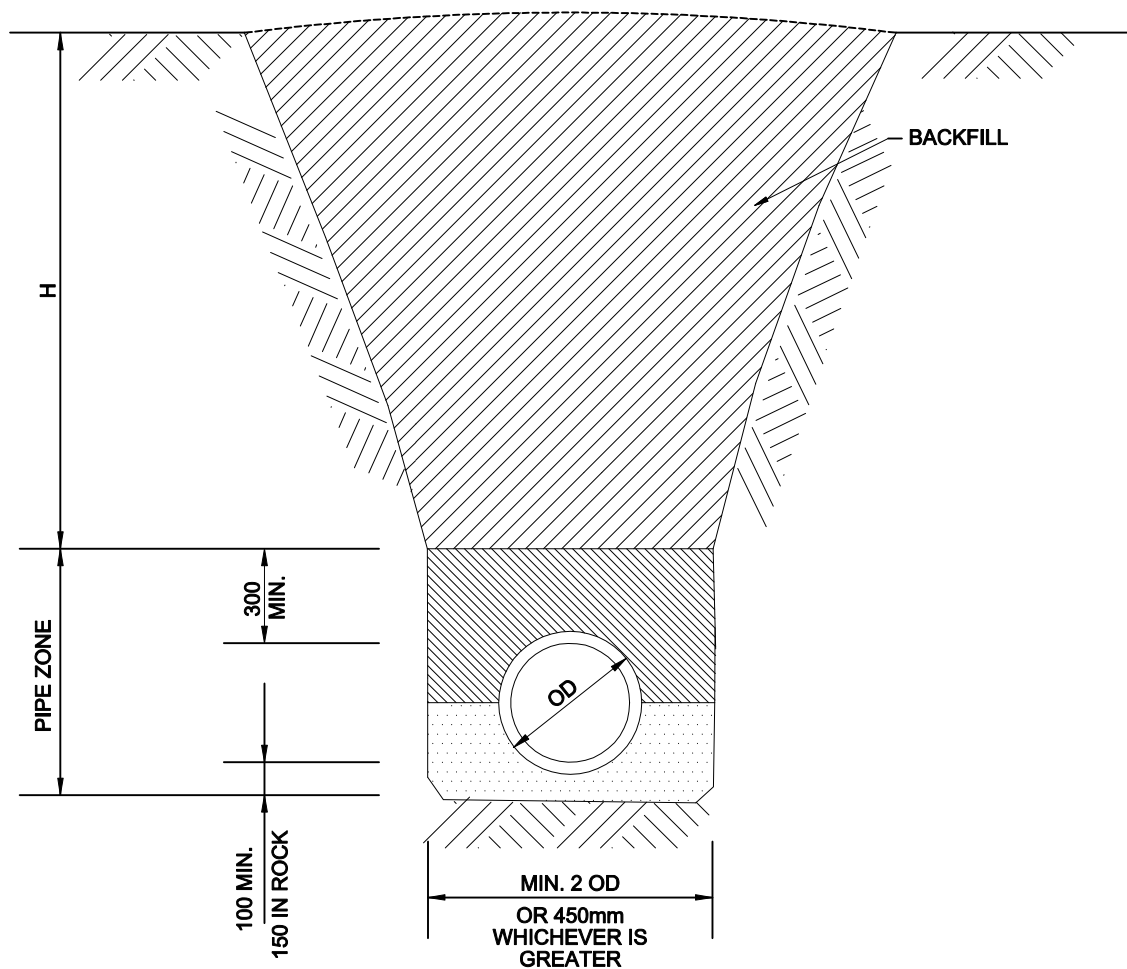
HYDRANT SHOULDER WIDENING LAYOUT

DATE DRAWN
SEPT 2008

DATE REVISED
DEC 2013

DRAWING NUMBER

3.5



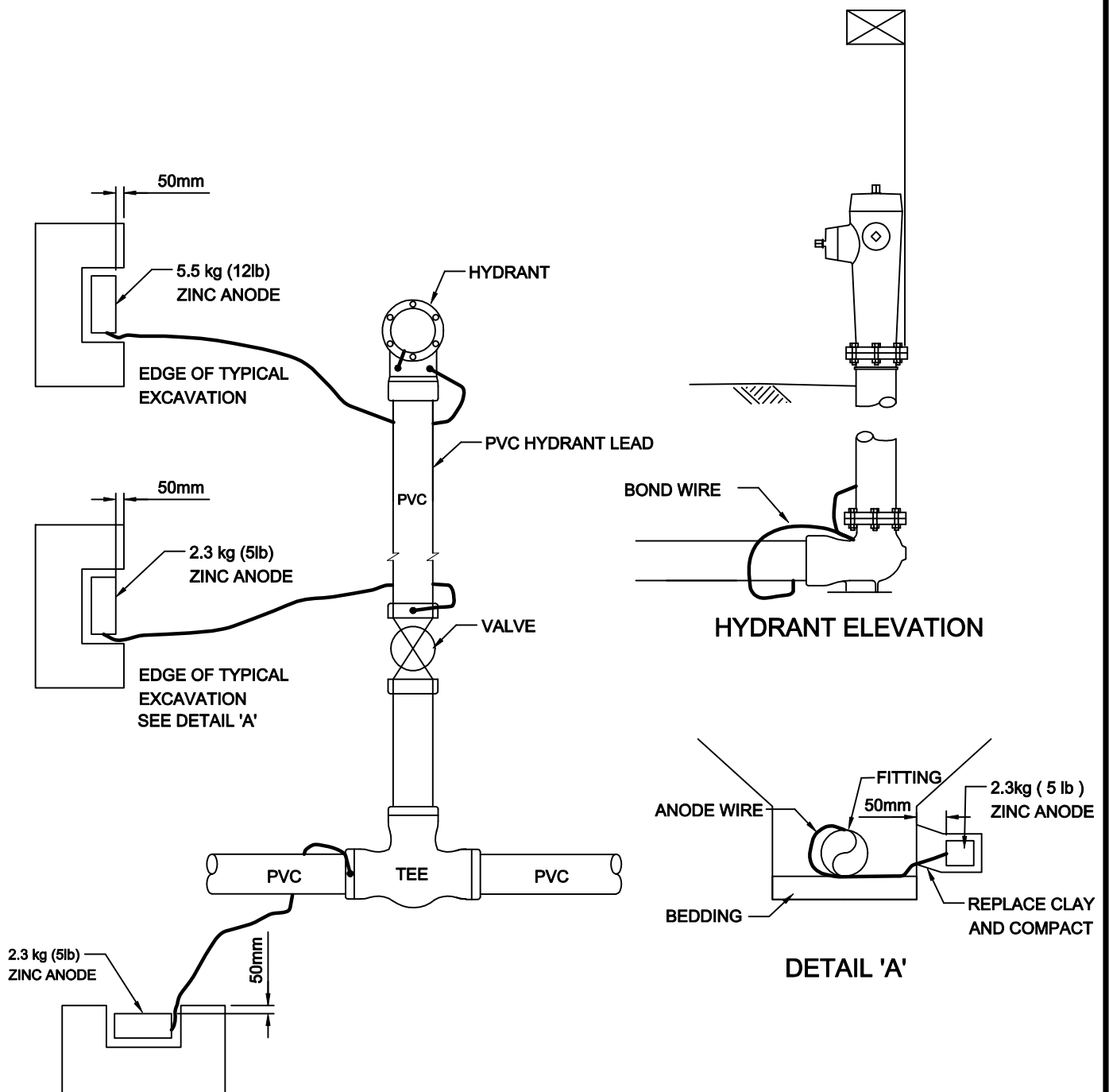
NOTES:

1. WHEN CUT BACK SLOPES ARE TO BE USED IN LIEU OF CAGES AND SHORING, THESE SLOPES ARE TO MEET REQUIREMENTS OF OCCUPATIONAL HEALTH & SAFETY ACT.
2. SEE SPECIFICATIONS FOR MINIMUM COVER ABOVE PIPE.
3. MIN. PIPE ZONE WIDTH IS SPECIFIED TO ALLOW PROPER PIPE ZONE COMPACTION.
4. OD = OUTSIDE PIPE DIAMETER.
5. FOR UNCOMPACTED BACKFILL, CROWN TRENCH BY $0.1 \times H$.



UTILITY TRENCH

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	3.7



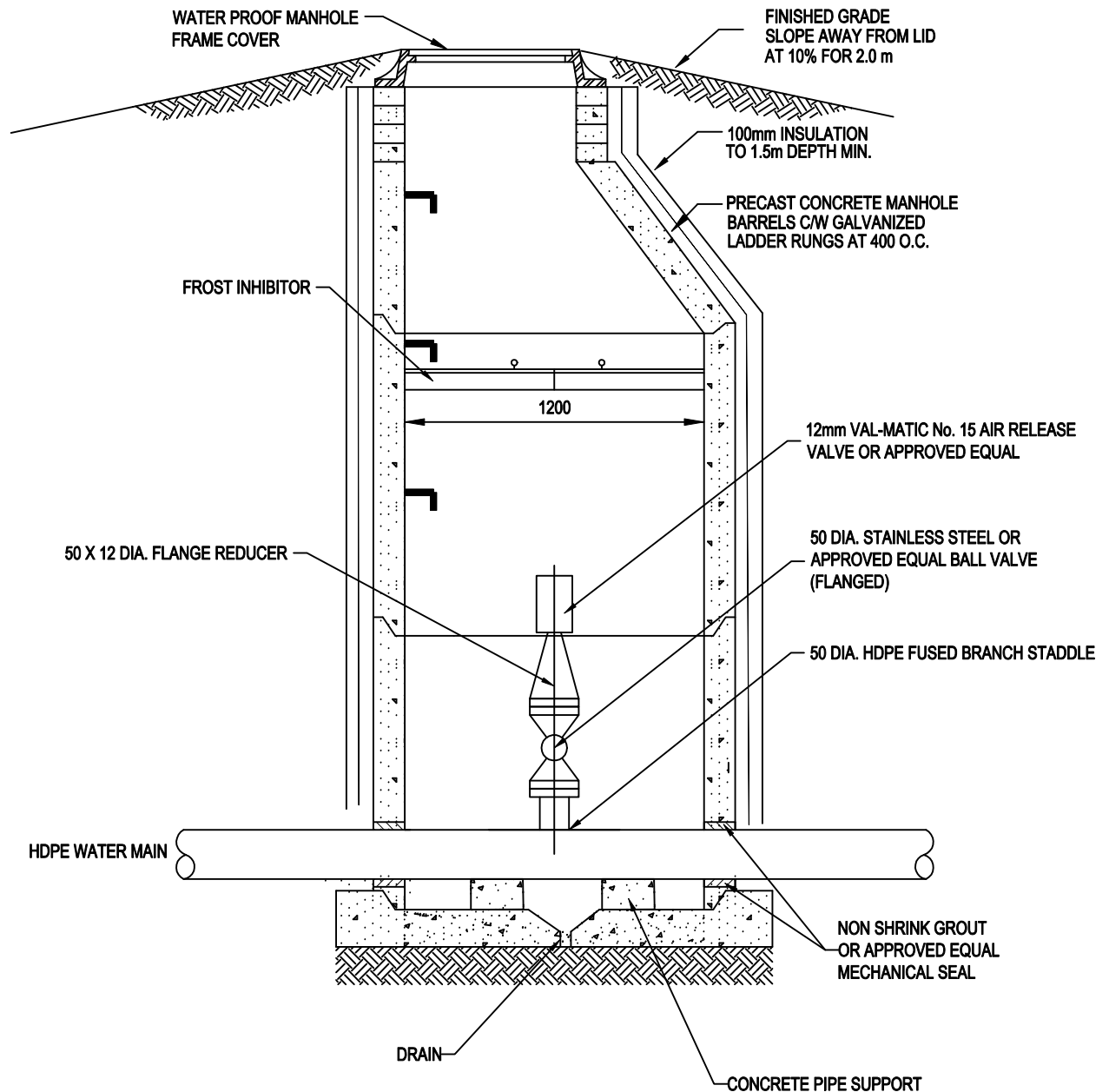
NOTES:

1. MINIMUM DISTANCE FROM ANODE TO PIPE, FITTING, VALVE, OR HYDRANT IS 150mm.
2. INSTALL ANODE AT APPROX. PIPE DEPTH IN NATIVE SOIL.
3. ZINC ANODES TO BE EMBEDDED INTO TRENCH WALL TO PROVIDE FOR A MINIMUM OF 50mm OF NATIVE CLAY COMPLETELY SURROUNDING THE ANODE.
4. ANODES TO BE AT LEAST 300mm CLEAR OF THRUST BLOCK.



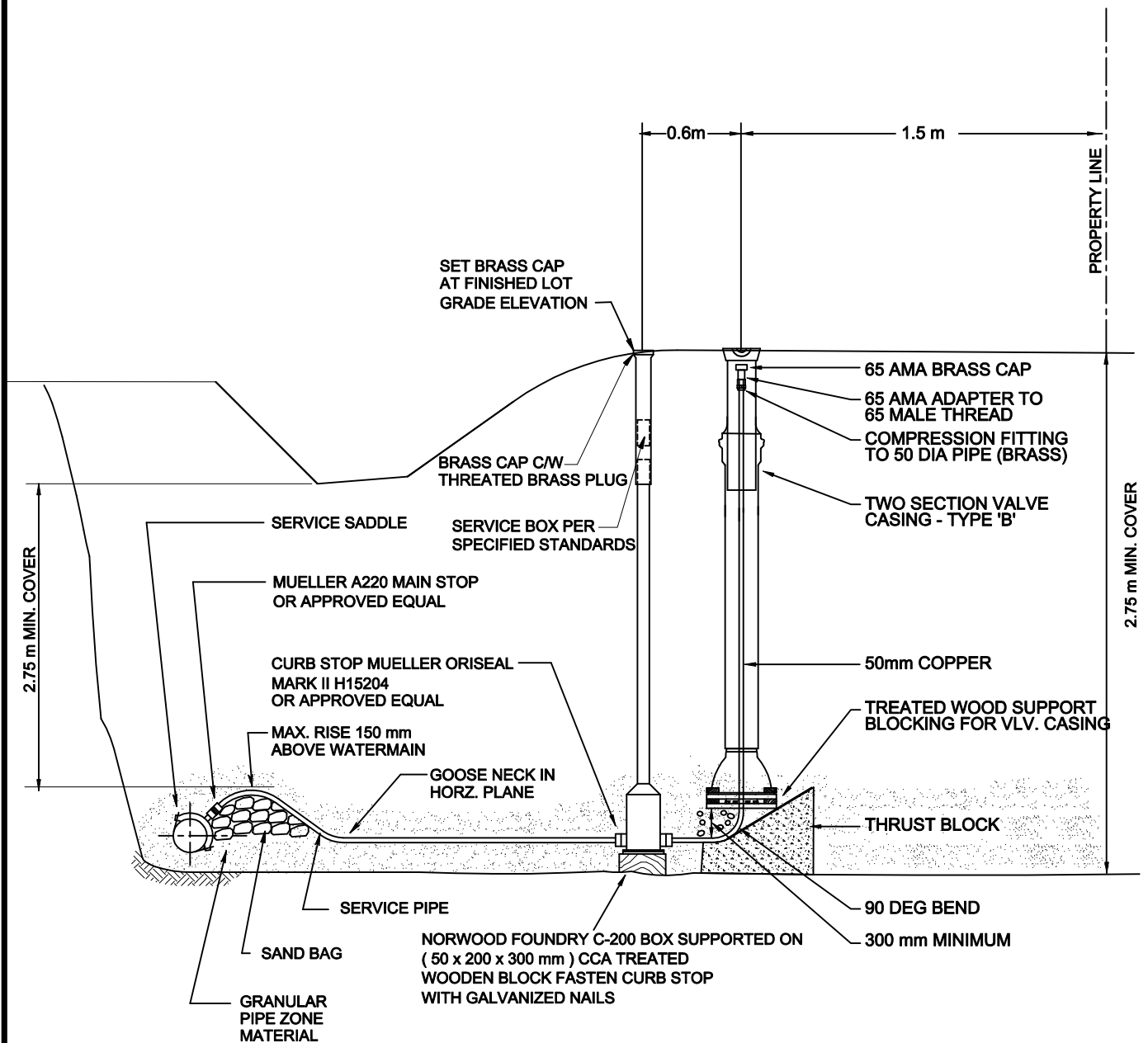
CATHODIC PROTECTION AND INSTALLATION

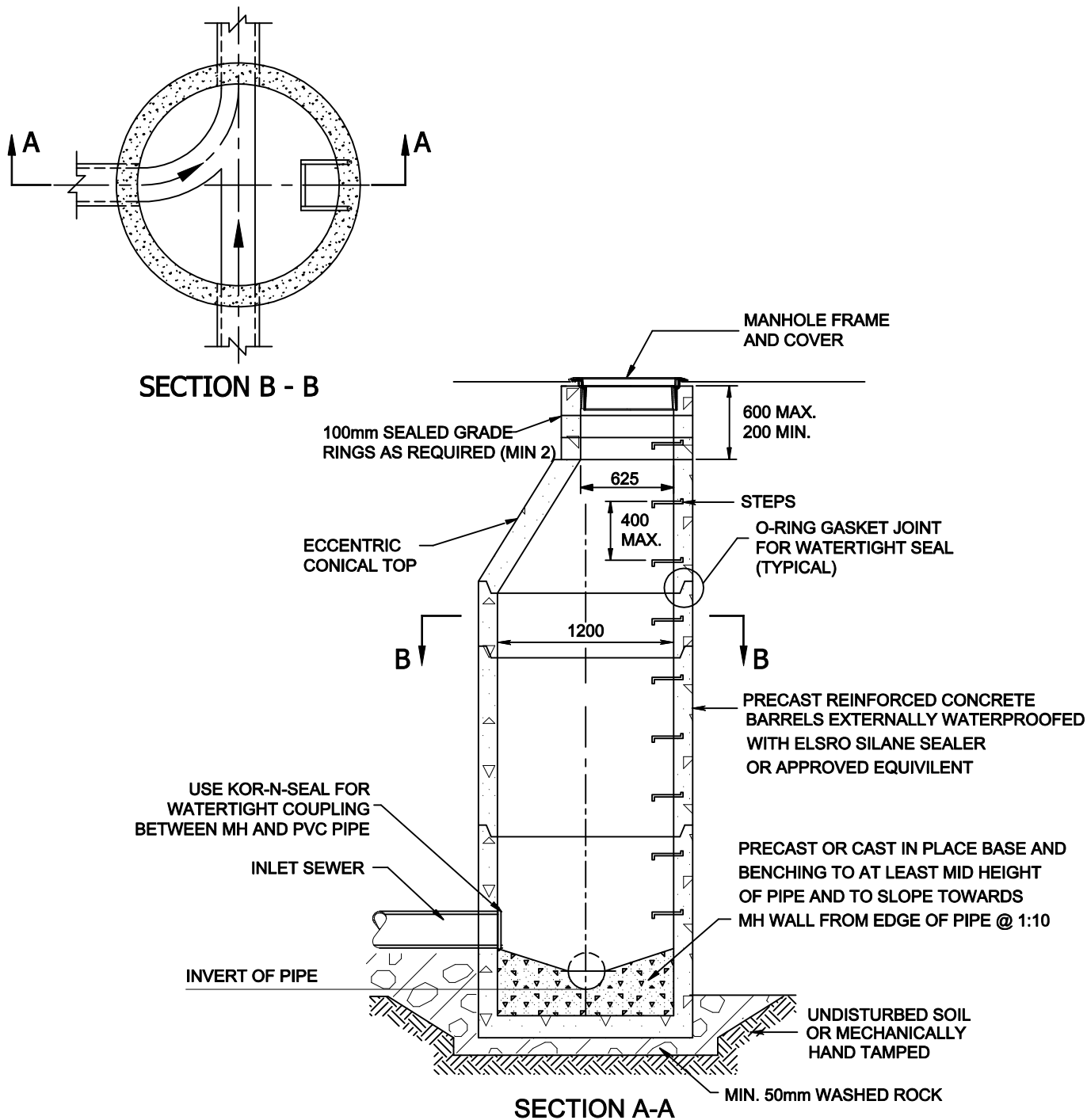
DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	3.8



NOTES:

1. ALL DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS OTHERWISE SPECIFIED.
2. EXTERIOR OF MANHOLE TO BE INSULATED WITH 100mm HIGH LOAD STYROFOAM INSULATION TO AT LEAST 1.5m BELOW GROUND.





NOTE

1. PRECAST RINGS, CONES AND BARRELS TO MEET CURRENT A.S.T.M. C478 STANDARDS, LATEST VERSION THEREOF
2. SPECIAL BASE DESIGN REQUIRED FOR DEPTHS OVER 5.0M
3. CHANNELLING AND BENCHING TO BE FINISHED TO TROWEL SMOOTHNESS (CONTINUE MAIN PIPE WHERE POSSIBLE)
4. CONICAL TOP TO BE USED WHERE DISTANCE FROM BENCH TO MANHOLE COVER EXCEEDS 2M
5. MANHOLE STEPS TO BE FACING TOWARD ONCOMING TRAFFIC
6. INSTALL SAFETY PLATFORMS FOR ALL MH OVER 5M DEEP, LOCATED 2M ABOVE PIPE.
7. FOR PREBENCHED MANHOLE BASE SEE DETAIL 4.2



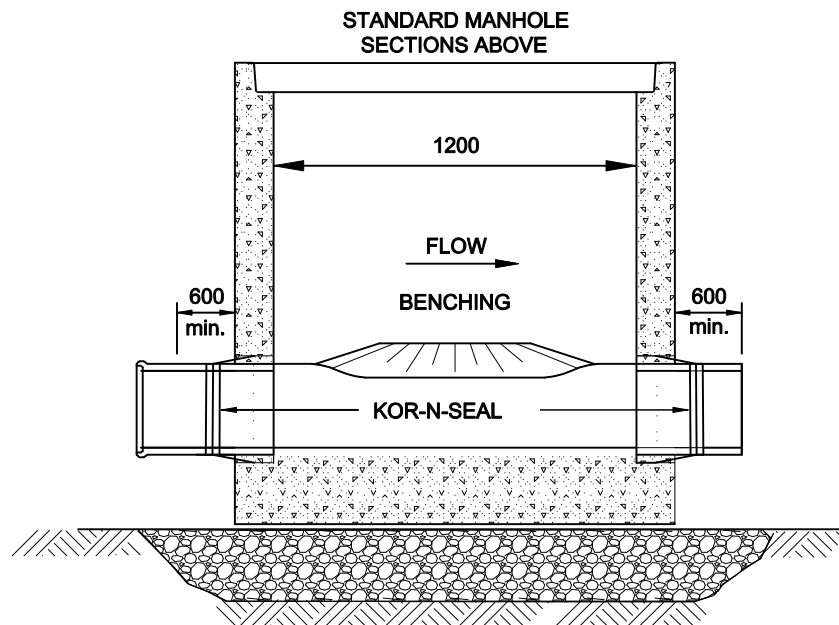
STANDARD MANHOLE

DATE DRAWN
SEPT 2008

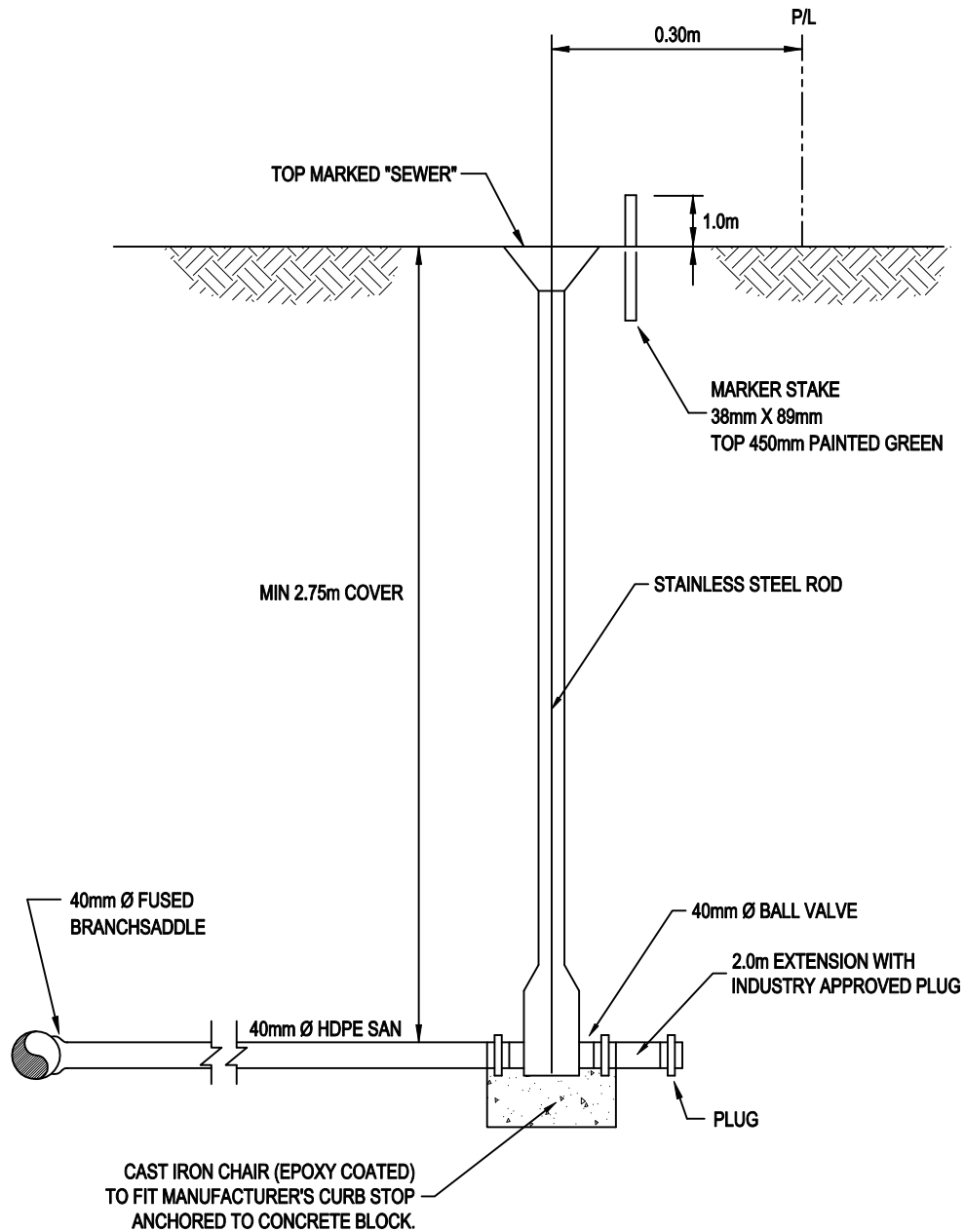
DATE REVISED
DEC 2013

DRAWING NUMBER

4.1



4.2



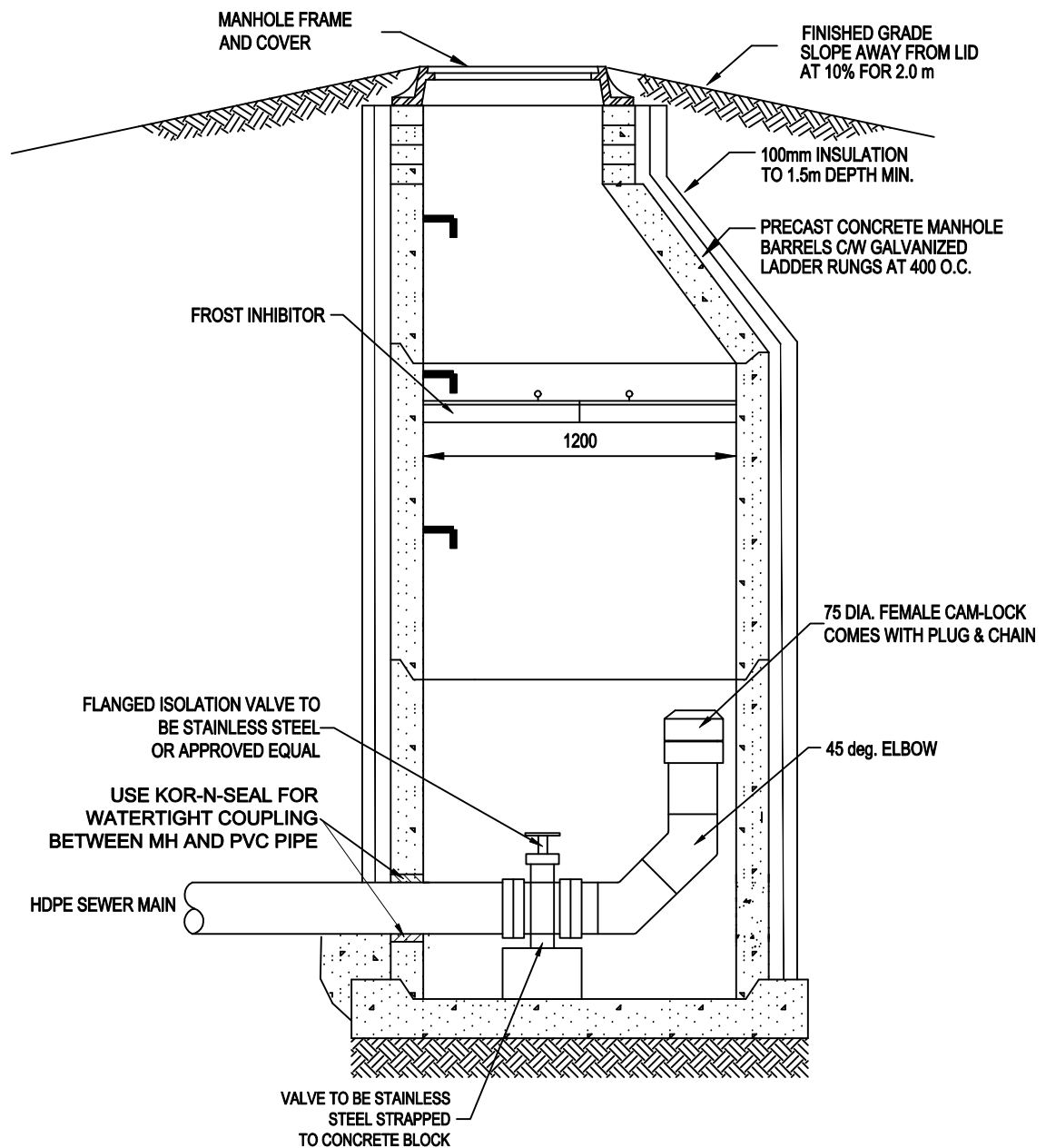
NOTES:

1. CURB STOP AND BOX TO BE EPOXY COATED TO PREVENT CORROSION. ALL TRIM TO BE STAINLESS STEEL.
2. ALL CURB STOPS TO BE NON-DRAINING.
3. TRACER WIRE TO SURFACE ON SELECTED SERVICE BOXES.
4. SERVICES ARE COPPER PIPE SIZE (CPS).



LOW PRESSURE SEWER SERVICE CONNECTION

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	4.4



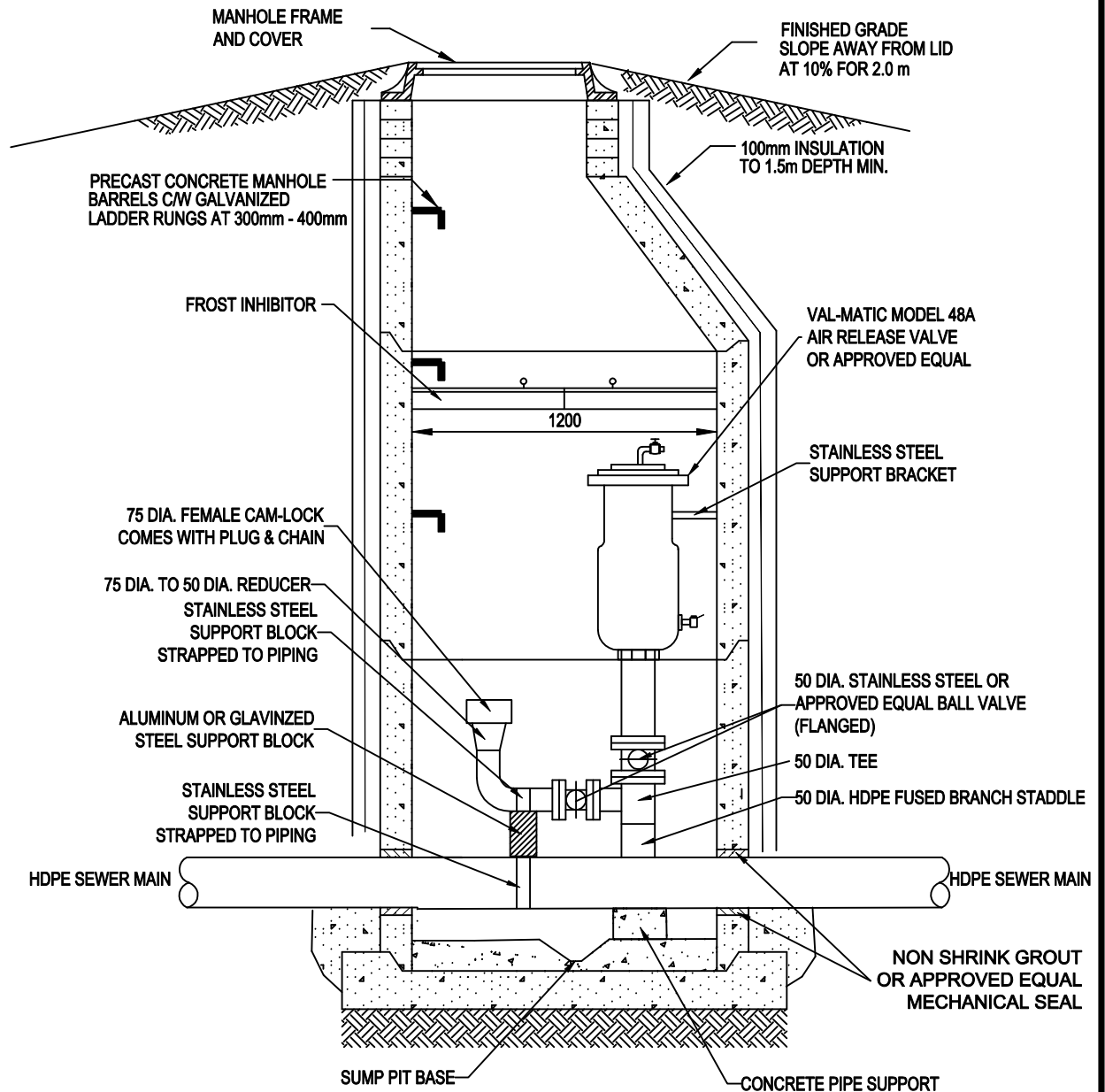
NOTES:

1. ALL DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS OTHERWISE SPECIFIED.
2. EXTERIOR OF MANHOLE TO BE INSULATED WITH 100mm HIGH LOAD STYROFOAM INSULATION TO AT LEAST 1.5m BELOW GROUND.



LOW PRESSURE SEWER FLUSHING PIPE

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	4.5



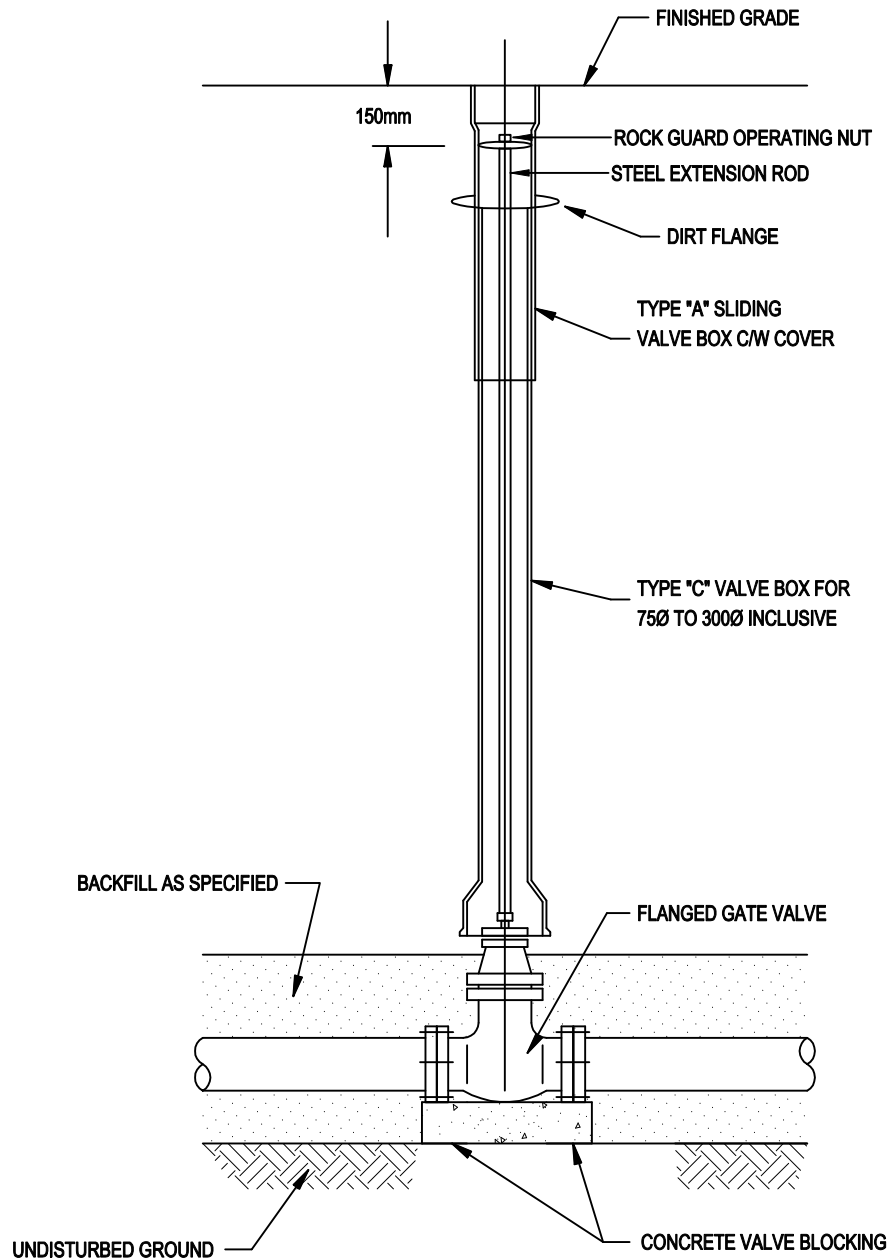
NOTES:

1. ALL DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS OTHERWISE SPECIFIED.
2. EXTERIOR OF MANHOLE TO BE INSULATED WITH 100mm HIGH LOAD STYROFOAM INSULATION TO AT LEAST 1.5m BELOW GROUND.



LOW PRESSURE SEWER AIR AND VACUUM RELIEF VALVE CHAMBER

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	4.6



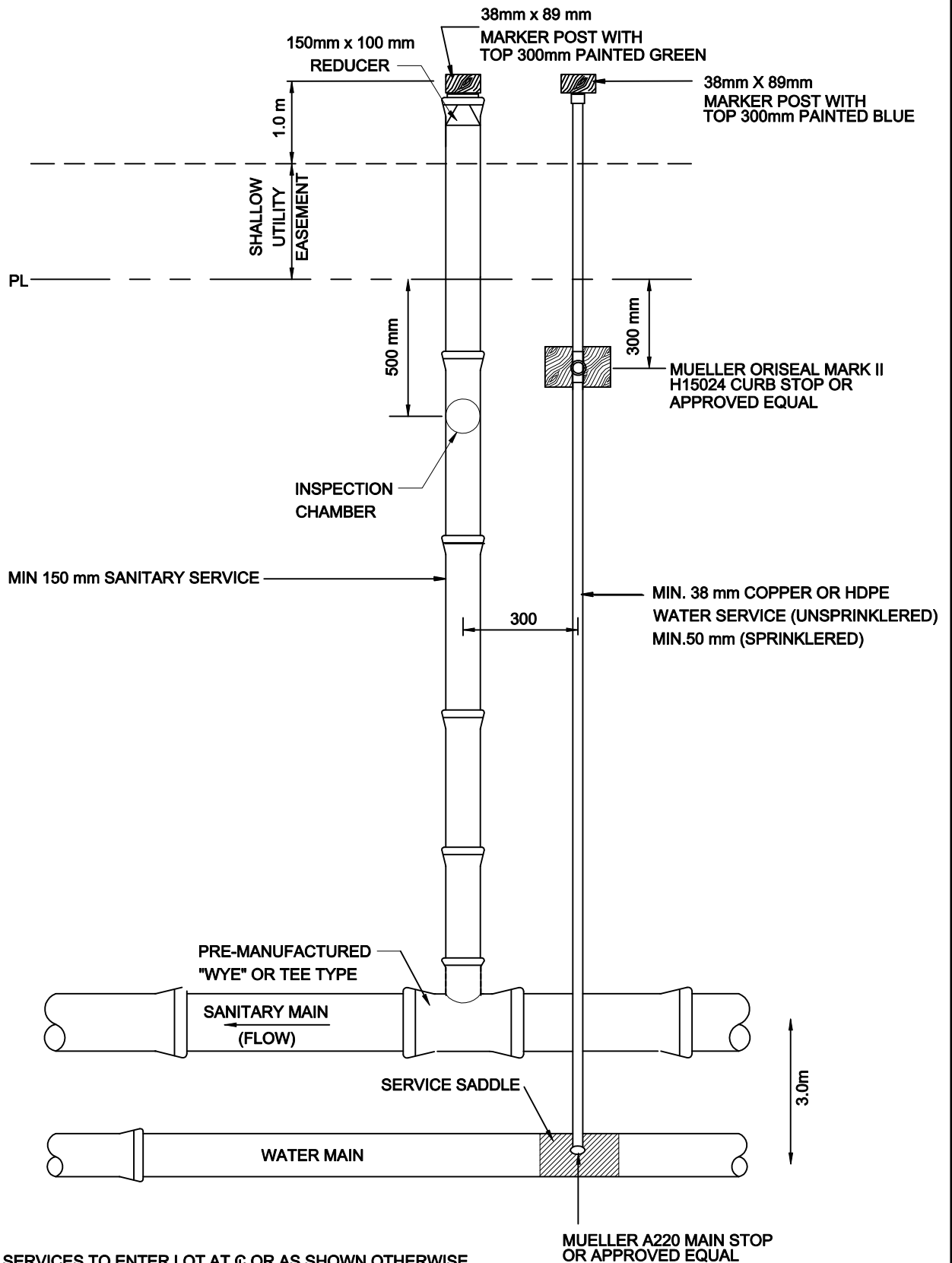
NOTES:

1. VALVE BOX TOPS TO BE SET FLUSH WITH HARD SURFACES, 300mm ABOVE FINISHED GRADE IN ALL LANDSCAPED AREAS
2. VALVE AND VALVE BOXES SHALL BE EPOXY COATED TO PREVENT CORROSION. ALL TRIM TO BE STAINLESS STEEL
3. VALVE BOX TOPS MARKED "SEWER"
4. TRACER WIRE TO SURFACE OF EVERY MAINLINE VALVE



LOW PRESSURE SEWER VALVE

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	4.7



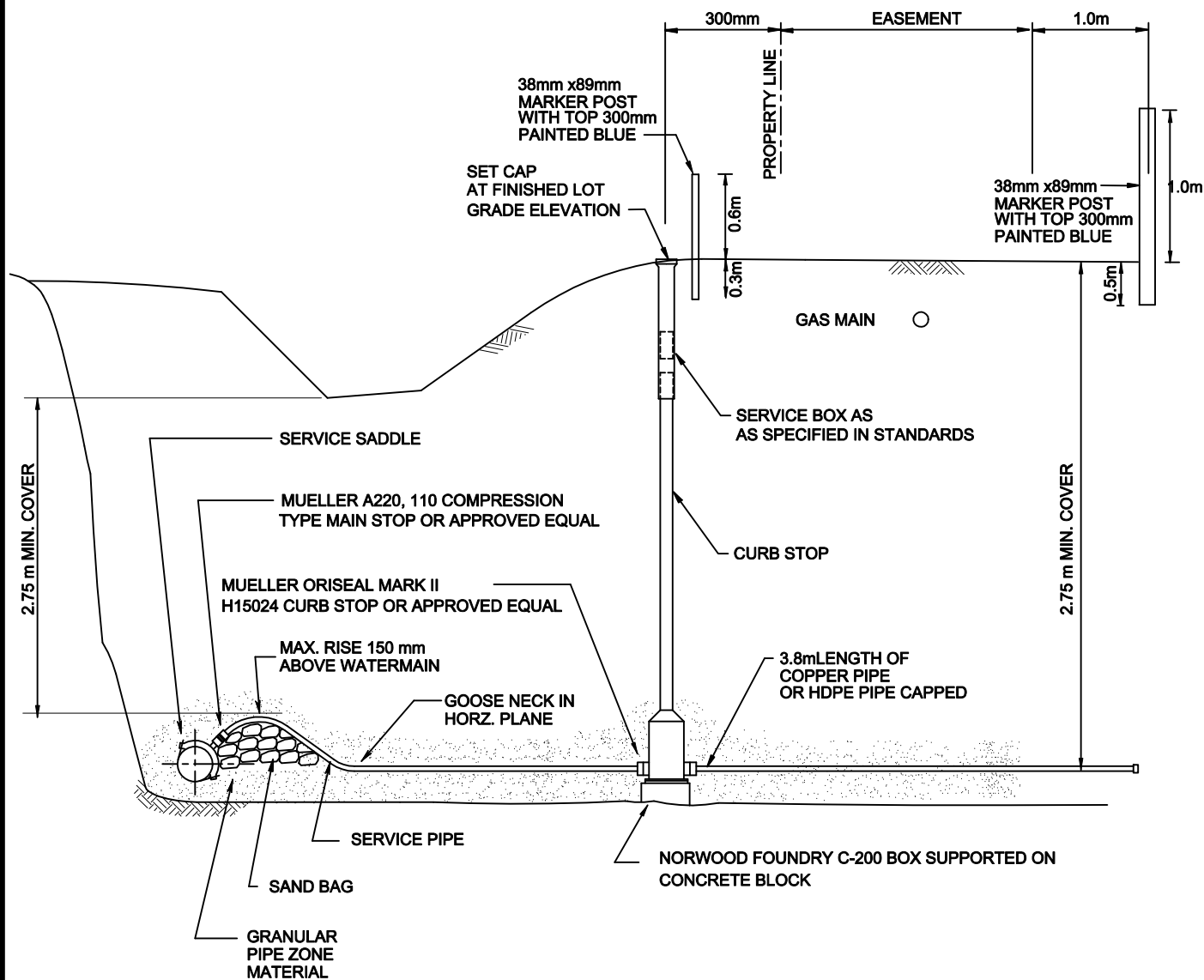
NOTES

1. SANITARY SERVICES TO ENTER LOT AT $\odot$ OR AS SHOWN OTHERWISE
2. MIN. SEWER GRADE 2.0%.



SINGLE SERVICE CONNECTION

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	5.1



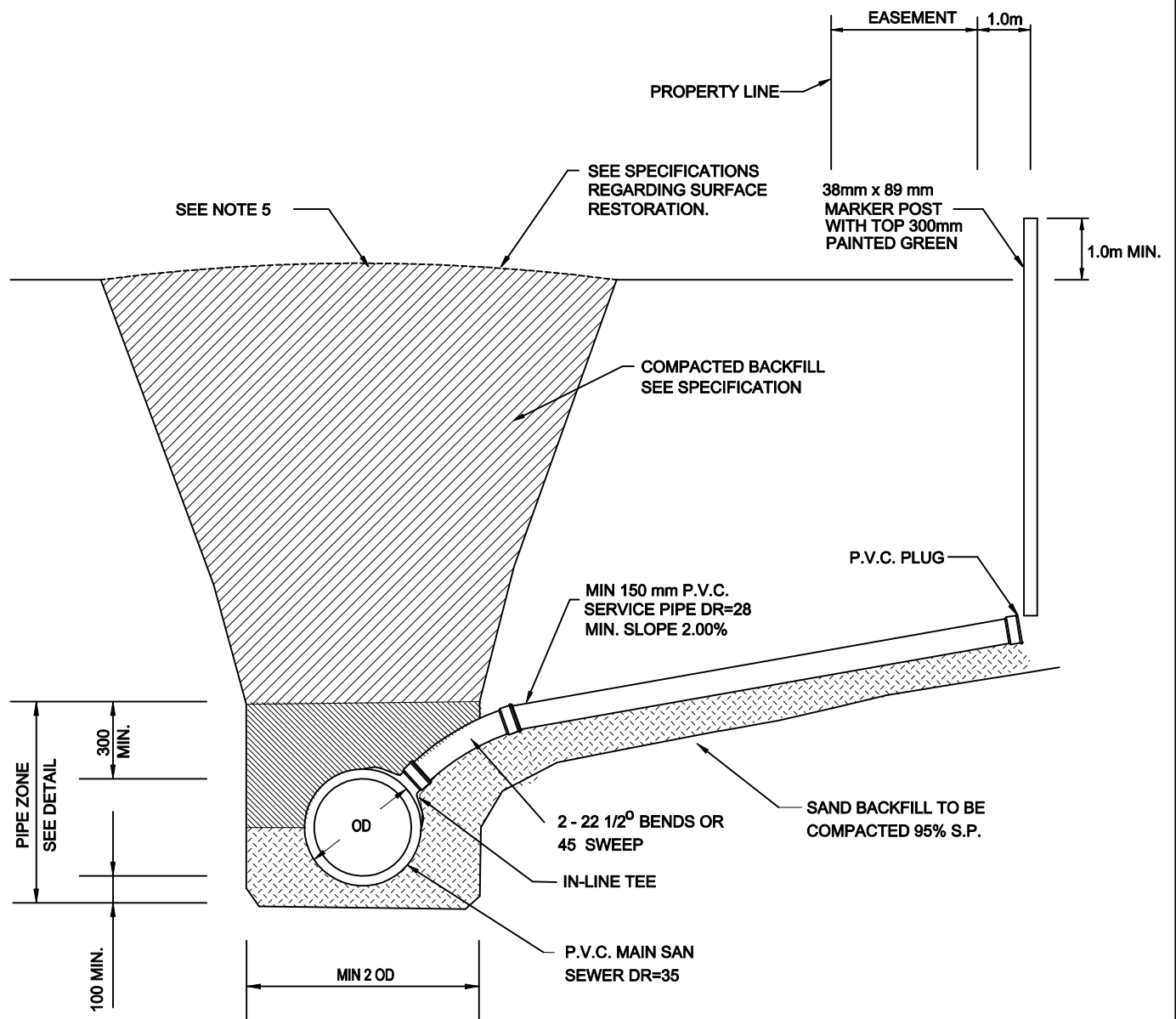
WATER SERVICE CONNECTION

DATE DRAWN
SEPT 2008

DATE REVISED
DEC 2013

DRAWING NUMBER

5.2



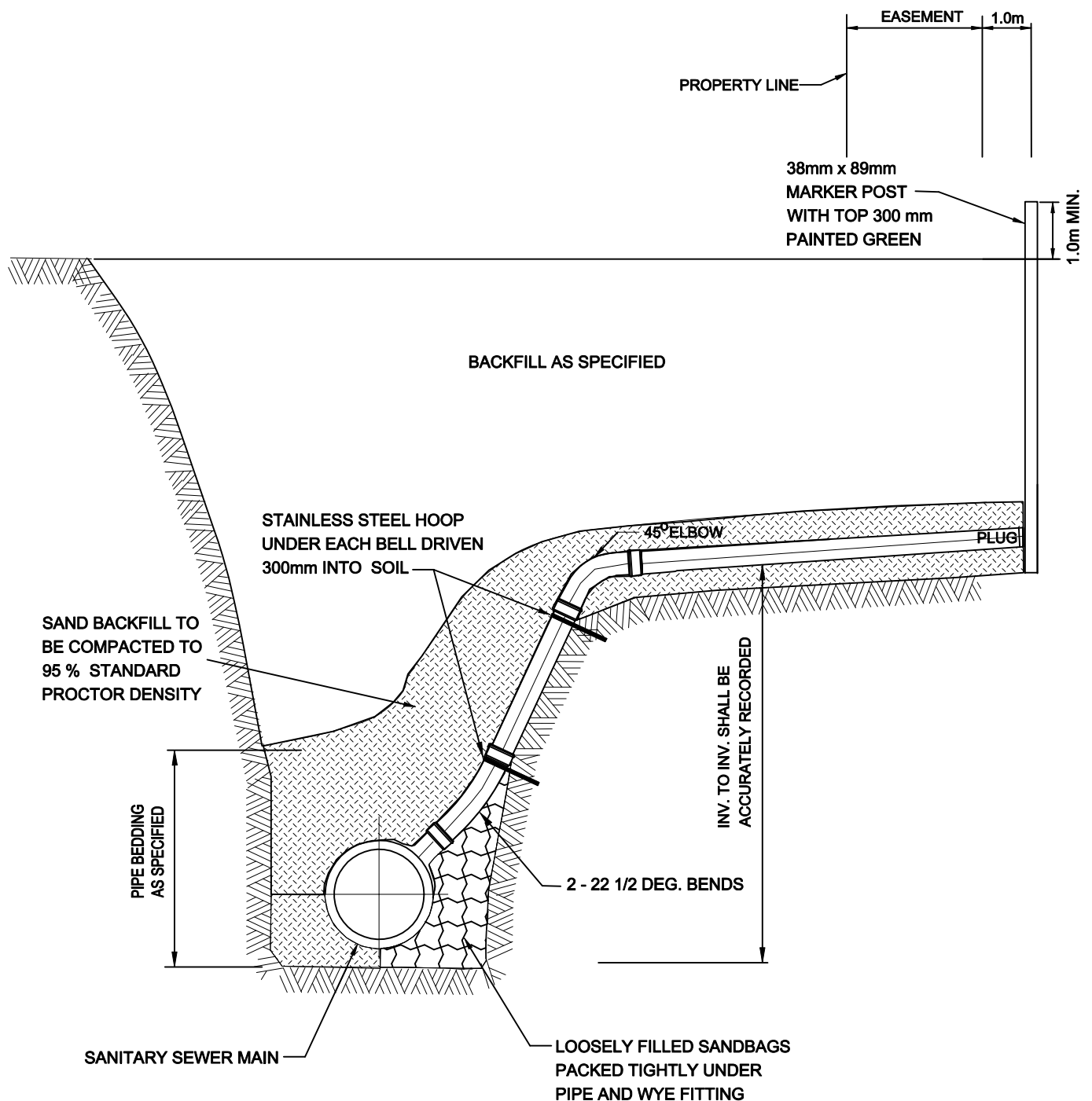
NOTES:

1. WHEN CUT BACK SLOPES ARE TO BE USED IN LIEU OF CAGES AND SHORING, THESE SLOPES ARE TO MEET REQUIREMENTS OF LOCAL CODES.
2. MINIMUM COVER ABOVE PIPE 2.75 m.
3. MIN. PIPE ZONE WIDTH IS SPECIFIED TO ALLOW PROPER PIPE ZONE COMPACTION.
4. OD = OUTSIDE PIPE DIAMETER.
5. FOR UNCOMPACTIONED BACKFILL, CROWN TRENCH BY "H x 0.1.
6. RISERS SHALL BE EMPLOYED WHERE SERVICE CONNECTION AT MAIN IS 4.0m OR DEEPER



SANITARY SERVICE CONNECTION

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	5.3



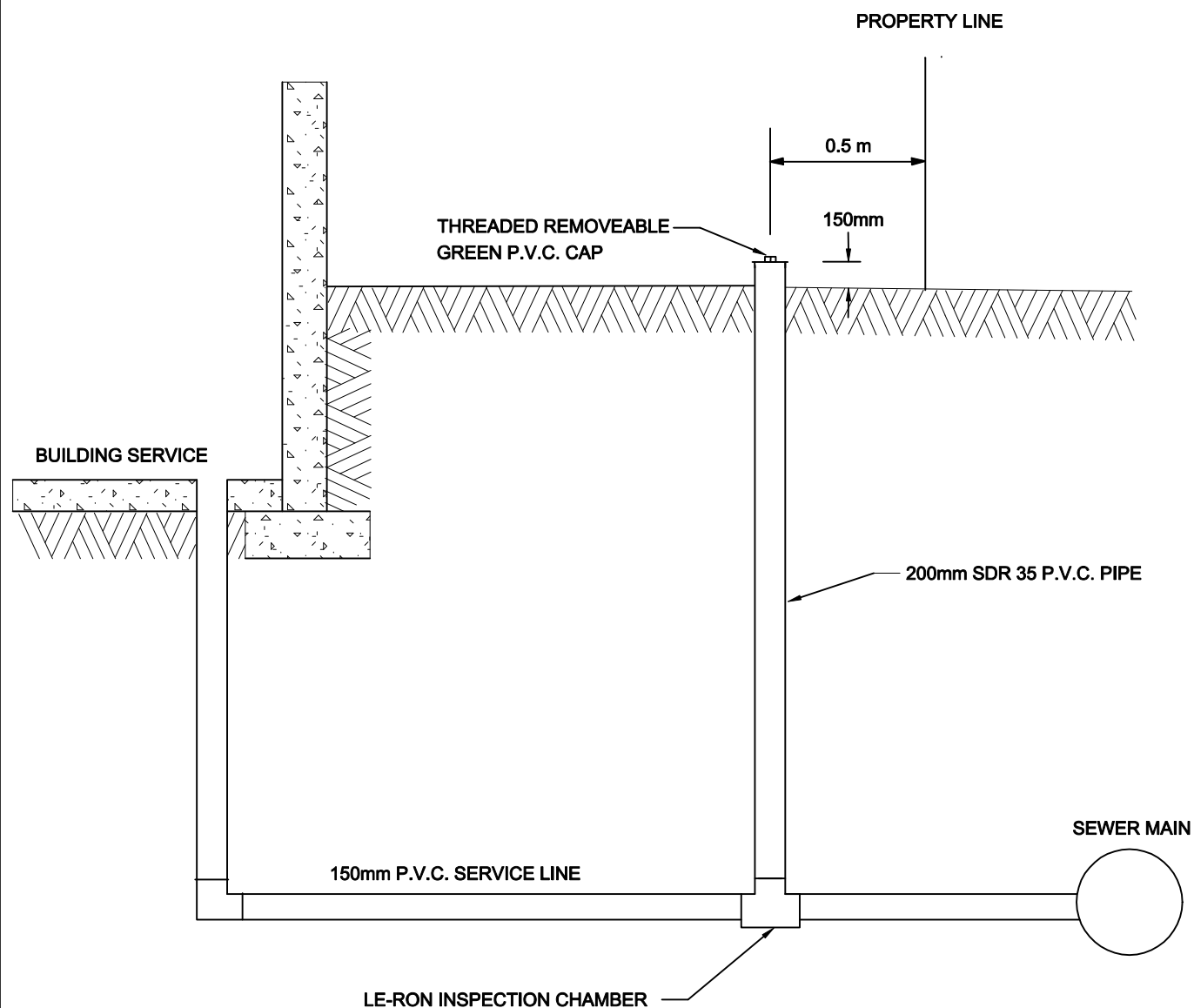
NOTES

1. WHEN CUT BACK SLOPES ARE TO BE USED IN LIEU OF CAGES AND SHORING, THESE SLOPES ARE TO MEET REQUIREMENTS OF LOCAL CODES.
2. MINIMUM COVER ABOVE PIPE 2.75 m.
3. MIN. PIPE ZONE WIDTH IS SPECIFIED TO ALLOW PROPER PIPE ZONE COMPACTION.
4. FOR UNCOMPACTED BACKFILL, CROWN TRENCH BY "H x 0.1.



STANDARD RISER OVER 4.0m

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	5.4



NOTE:
INSPECTION CHAMBER TO BE LOCATED IN A NON-TRAFFIC AREA
AND APPROPRIATELY PROTECTED AND MARKED.



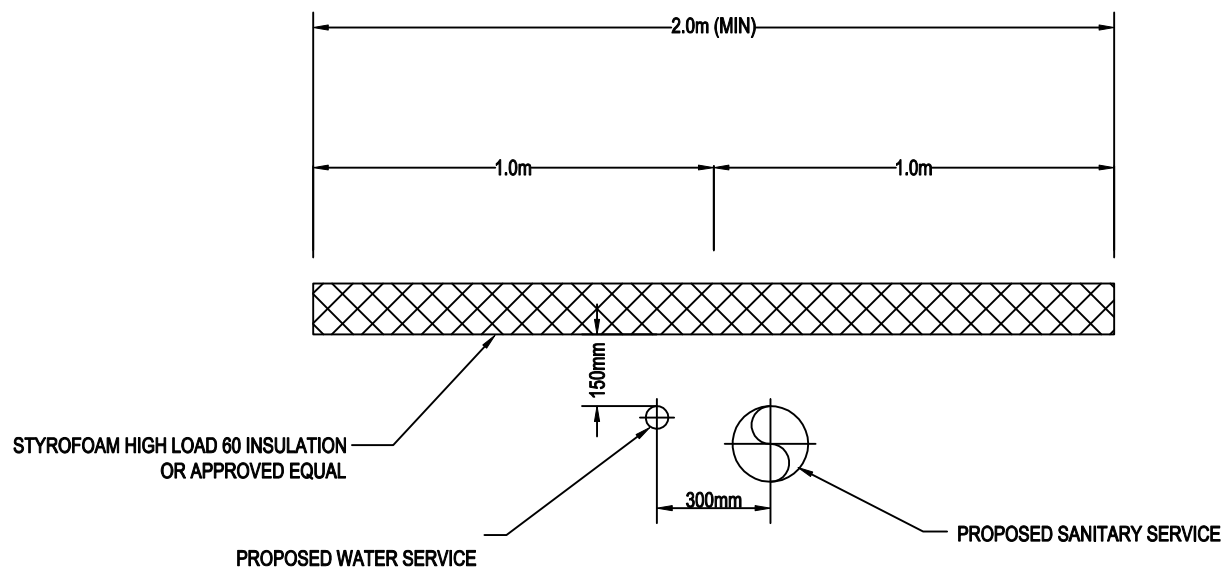
INSPECTION CHAMBER

DATE DRAWN
SEPT 2008

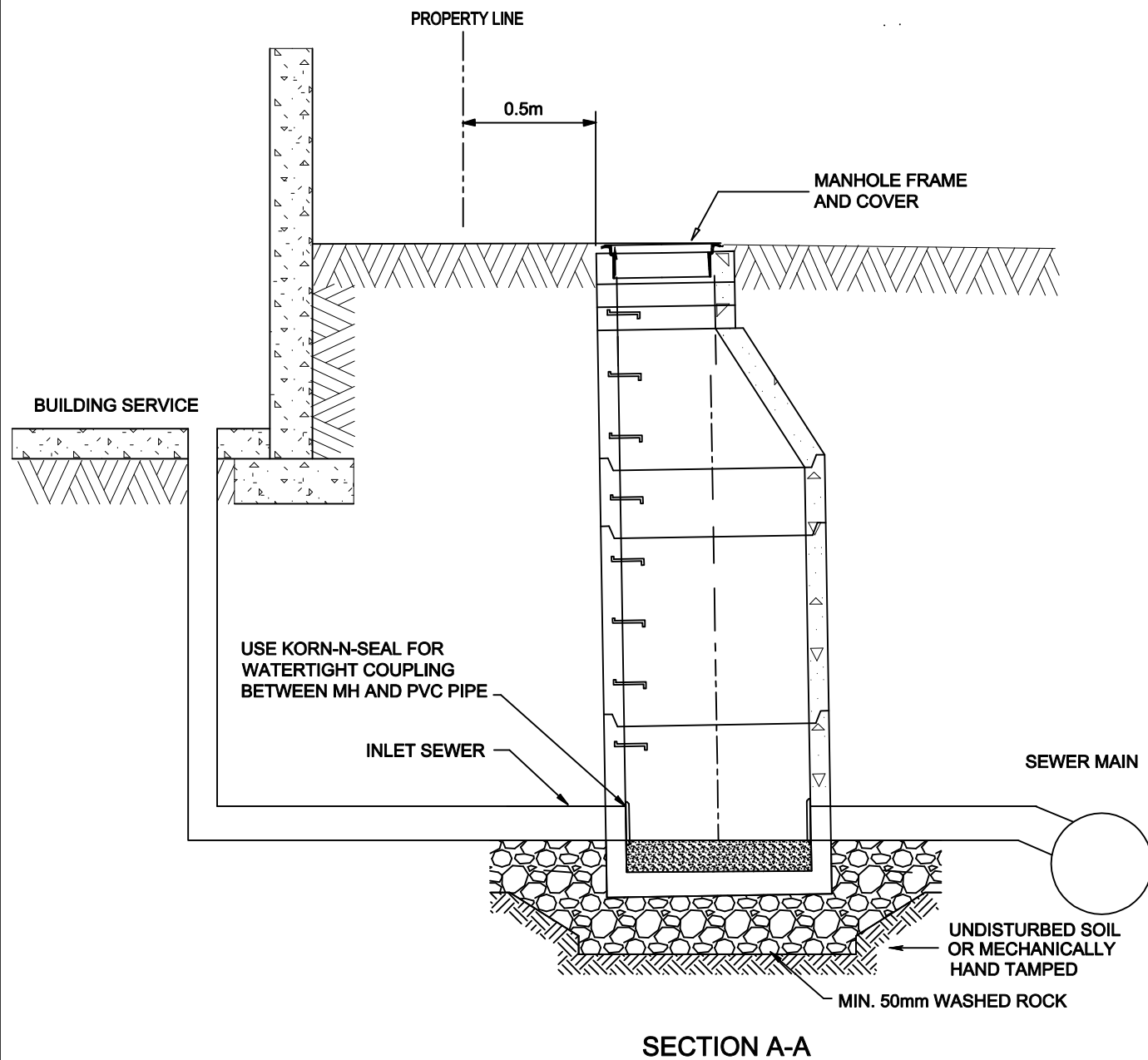
DATE REVISED
DEC 2013

DRAWING NUMBER

5.5



FROST BOX DETAIL



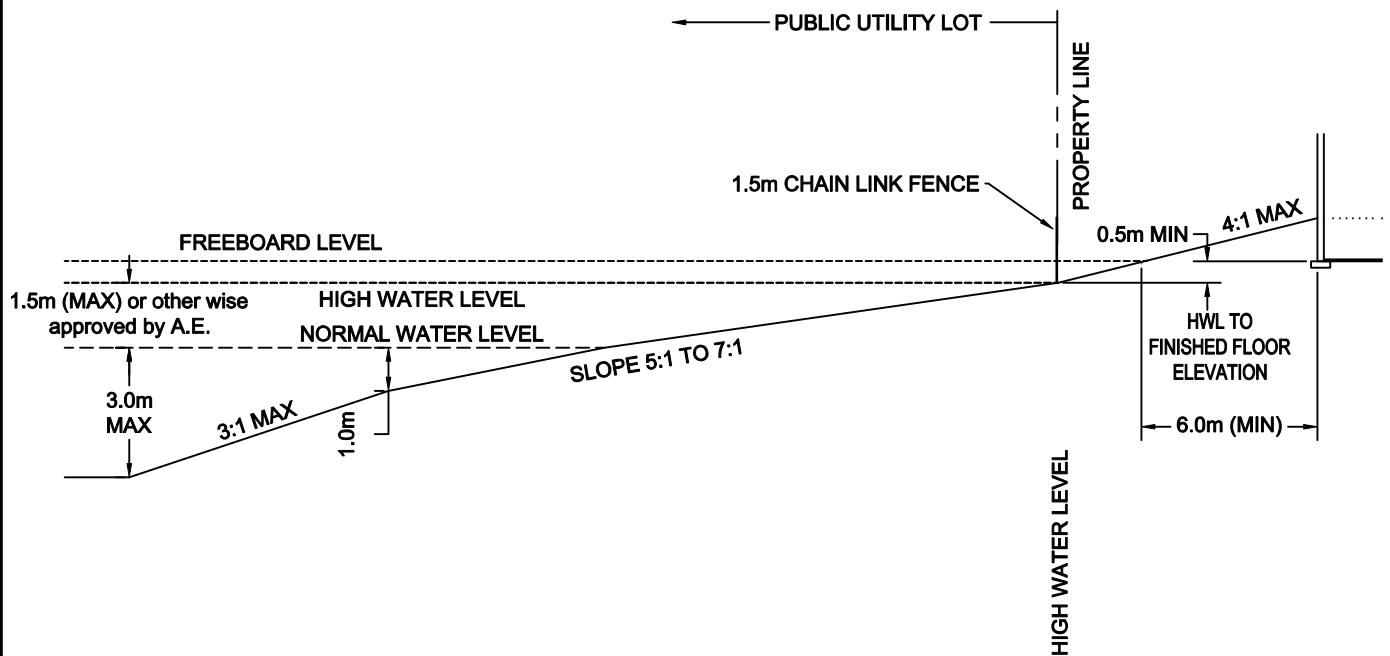
INSPECTION MANHOLE

DATE DRAWN
DEC 2013

DATE REVISED

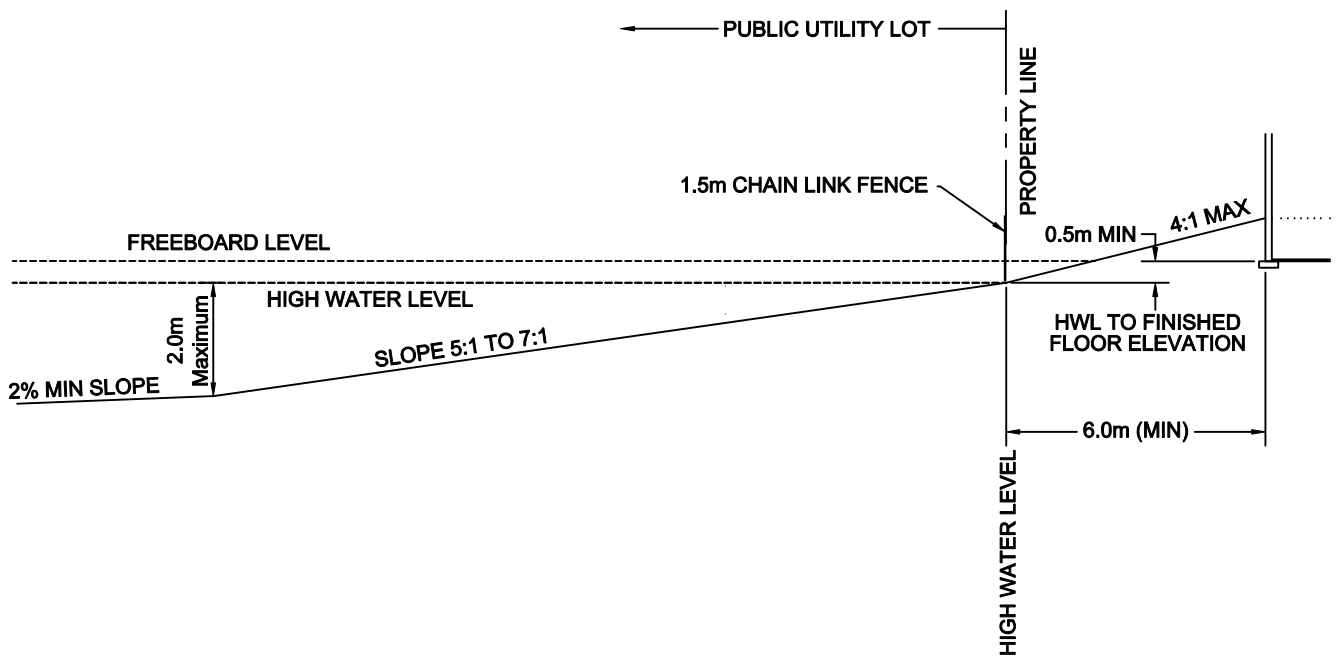
DRAWING NUMBER

5.7



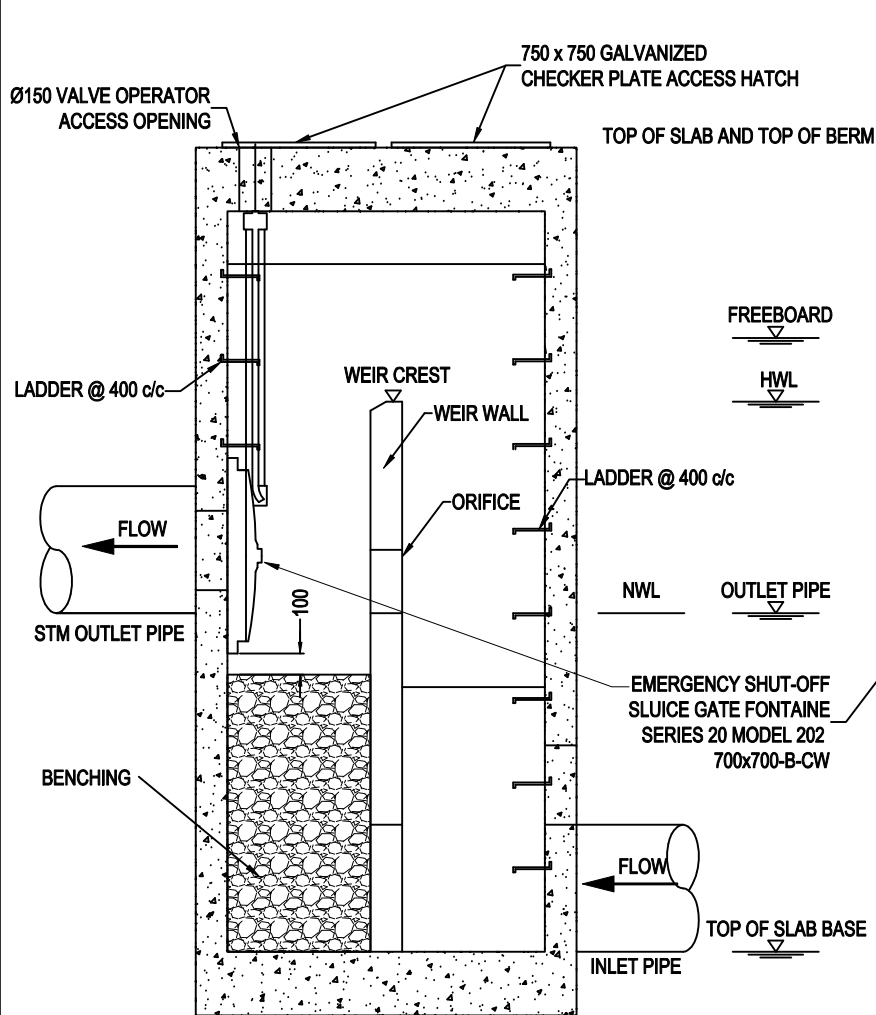
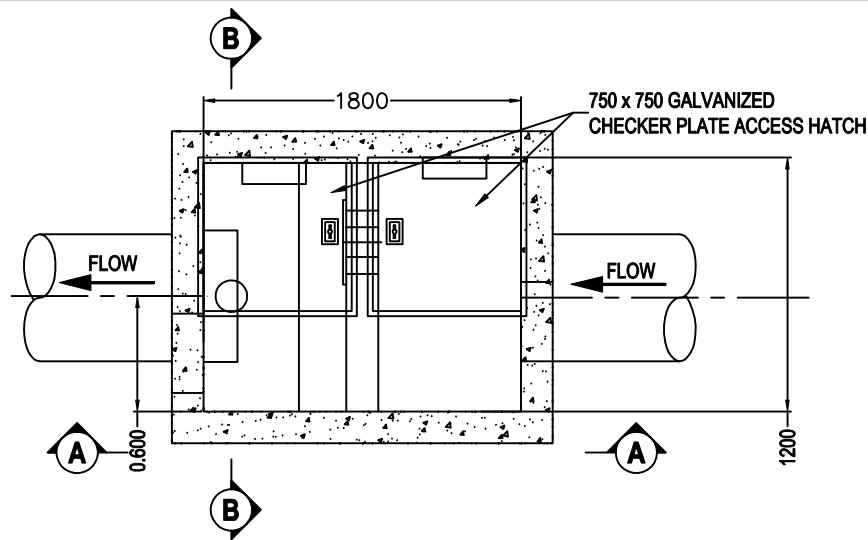
WET POND SECTION

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	6.1

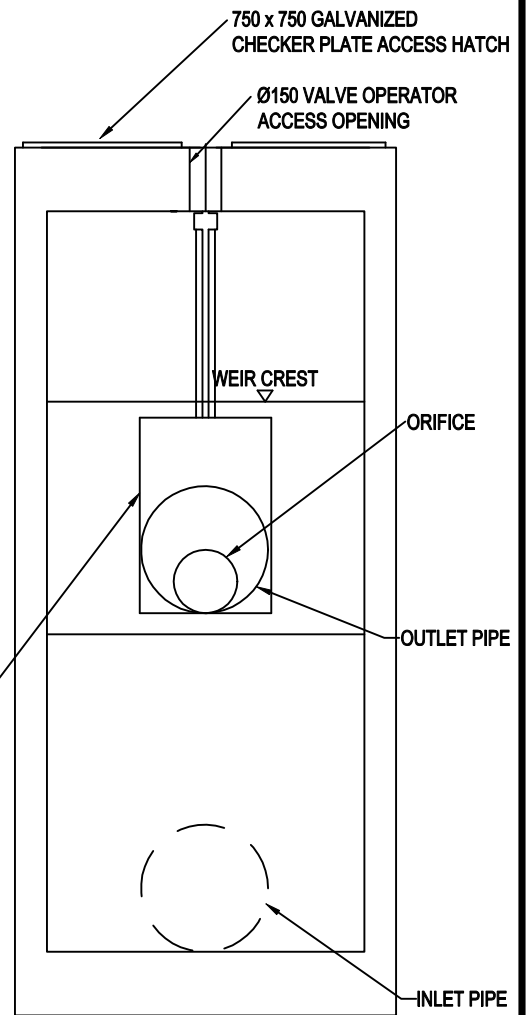


DRY POND SECTION

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	6.2



SECTION A-A



SECTION B-B

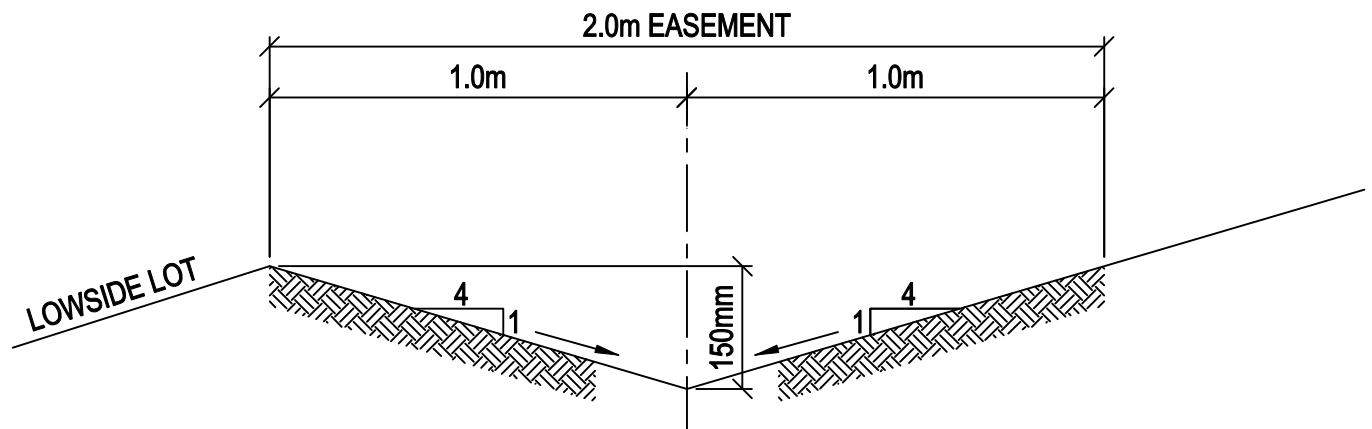
NOTES

1. SLUICE GATE SHALL BE FONTAINE SERIES 20 c/w NON-RISING STEM AND REMOVABLE KEY
2. ALL DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS ARE IN METERS

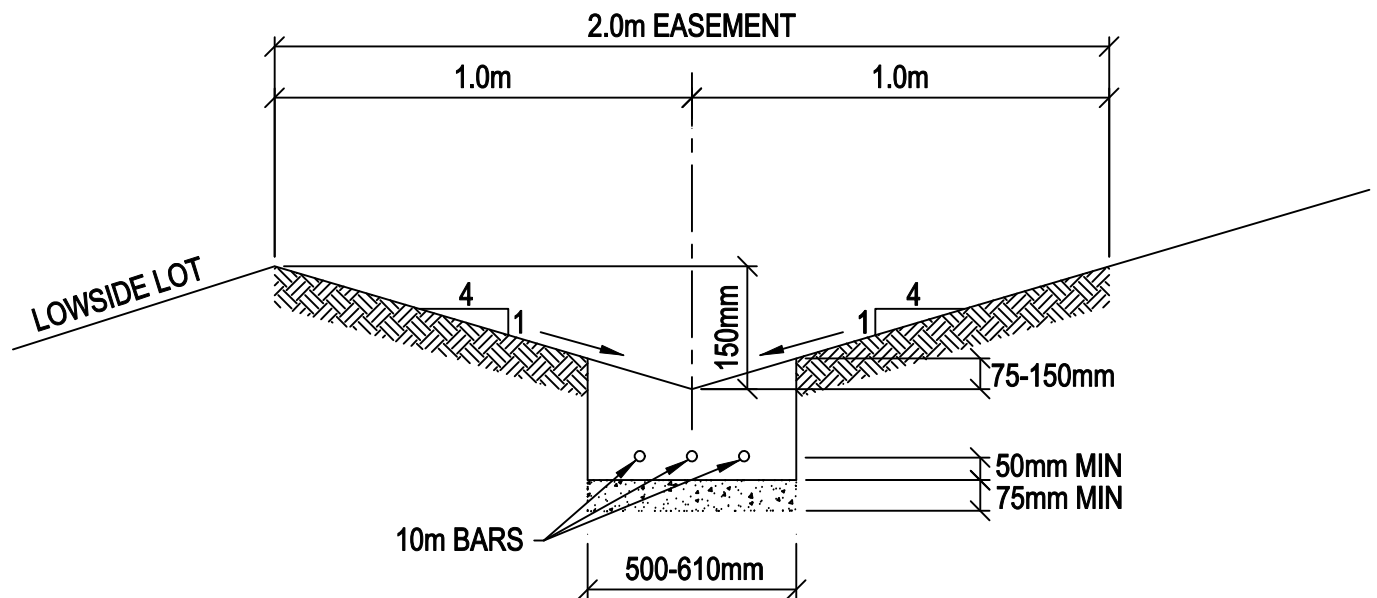


STORM POND RELEASE CONTROL MANHOLE

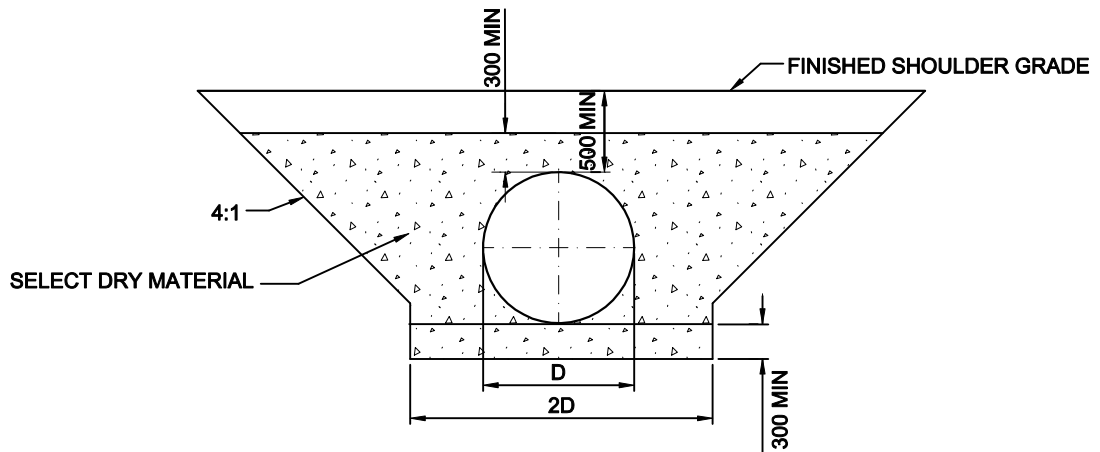
DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	6.3



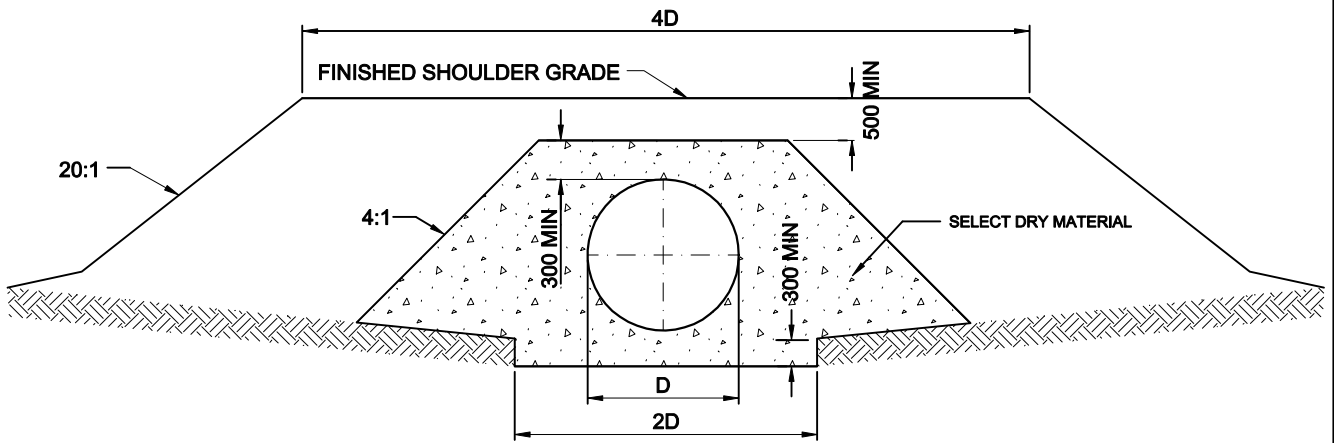
TYPICAL GRASS SWALE SECTION



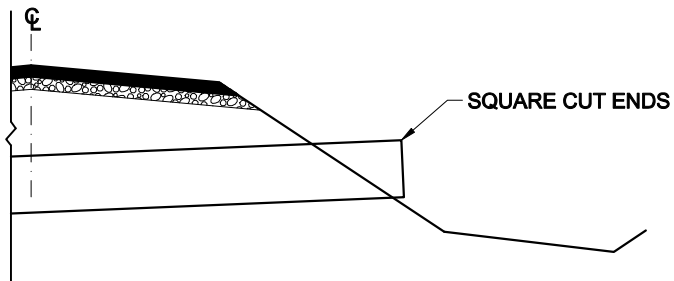
TYPICAL GRASS SWALE SECTION
WITH CONCRETE GUTTER



CUT SENARIO



FILL SCENARIO



END EXPOSURE

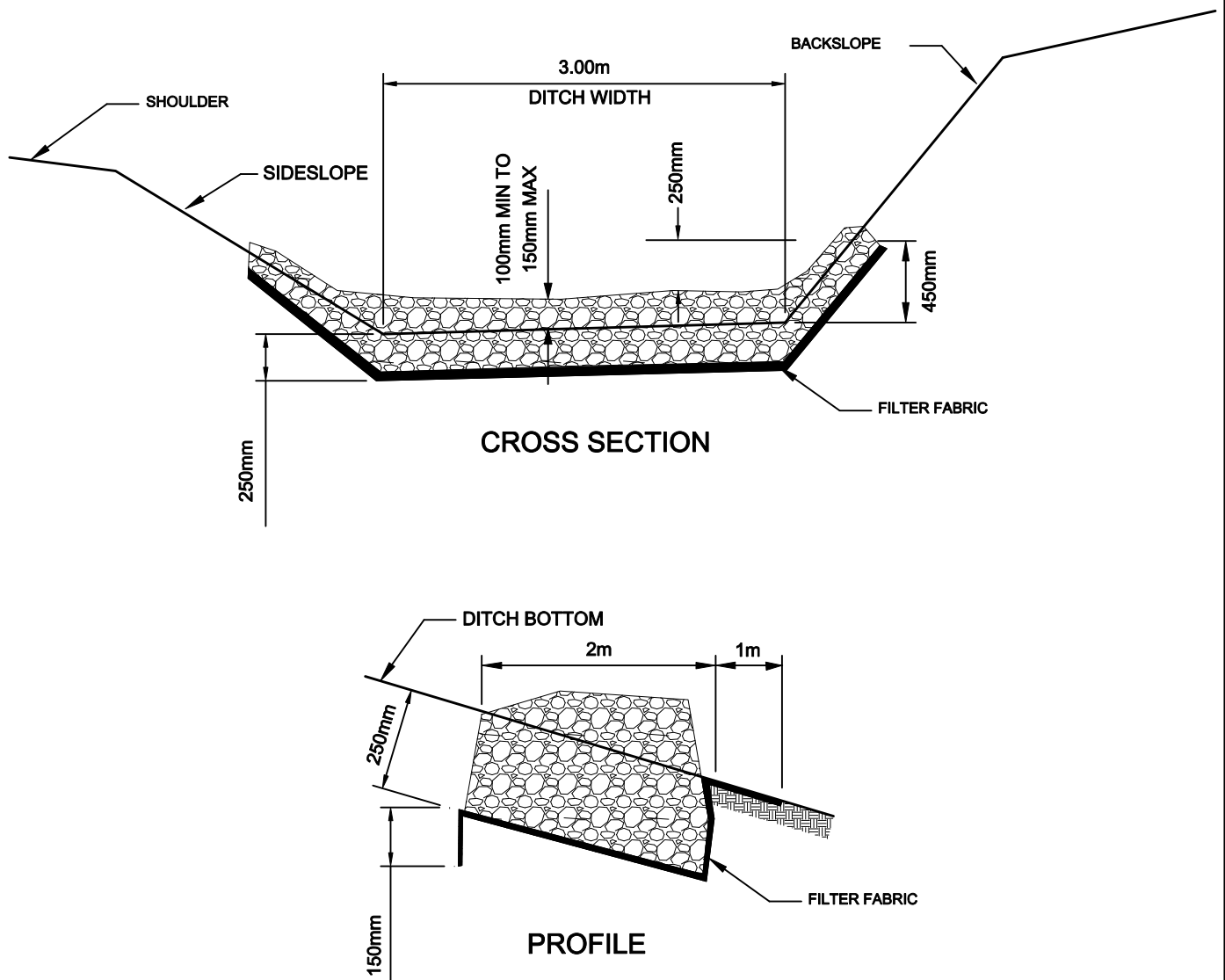
NOTES:

1. SELECT DRY MATERIAL SHALL BE PLACED IN 150mm COMPACTED LIFTS.
A 600mm CLAY PLUG SHALL BE PLACED ON INLET & OUTLET ENDS OF THE PIPE.
2. IN SOFT WET AREAS (ie MUSKEG) DEPTH OF SUBCUT BELOW THE PIPE WILL BE DETERMINED BY THE DEVELOPERS ENGINEER AS APPROVED BY THE COUNTY
3. WHEN PIPES ARE PLACED PRIOR TO EMBANKMENT CONSTRUCTION, A MINIMUM OF 1000mm OF MATERIAL SHALL BE PLACED OVER TOP OF PIPES FOR PROTECTION DURING CONSTRUCTION.
4. ALL CULVERT INVERTS WILL BE STAKED IN THE FEILD BY THE COUNTY.



CULVERT INSTALLATION

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	6.5



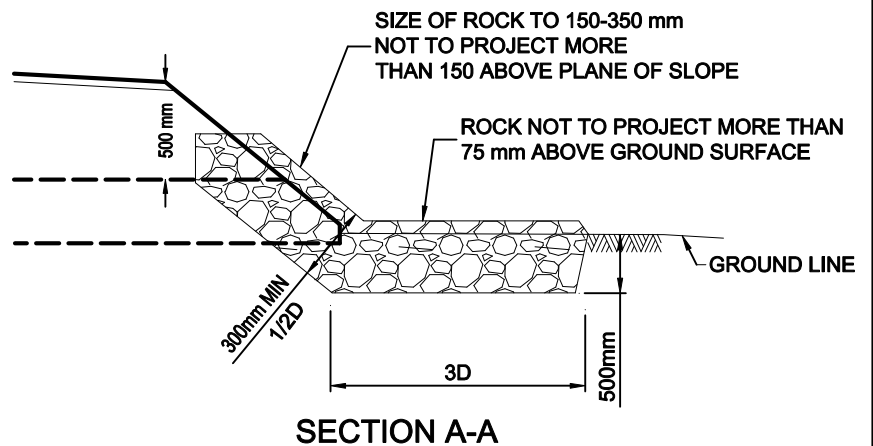
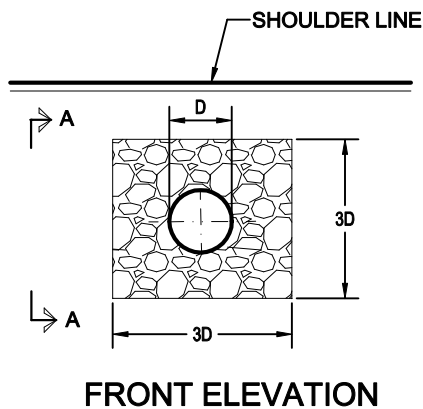
NOTES

1. ROCK SHALL BE TRENCHED INTO THE SIDESLOPE AND BACKSLOPE AT A POINT AT LEAST 450mm ABOVE THE DITCH BOTTOM AND AT LEAST 250mm ABOVE THE LOW POINT OF THE SURFACE OF ROCK IN THE DITCH.
2. THE ROCK SHALL BE TRENCHED INTO THE DITCH BOTTOM AND SLOPES A MIN. OF 250mm. THE LOWEST POINT OF THE DITCH CHECK MUST BE A MIN. OF 100mm TO A MAX OF 150mm ABOVE THE DITCH BOTTOM.
3. ROCKS TO BE USED SHALL BE AS NEARLY CUBICAL IN FORM AS POSSIBLE AND MUST NOT BE SMALLER THAN 150mm.
4. ROCKS SHALL BE LAID IN CLOSE CONTACT SO AS TO BREAK JOINTS WITH THE LARGER STONES ON THE BOTTOM.
5. FILTER FABRIC SHALL BE PLACED IN THE BOTTOM OF THE TRENCH.

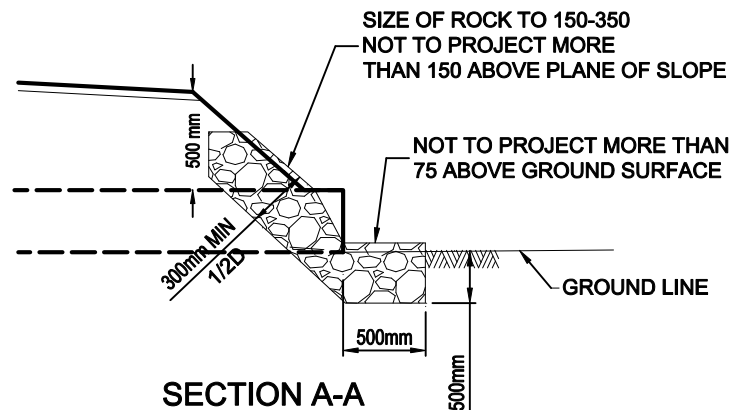
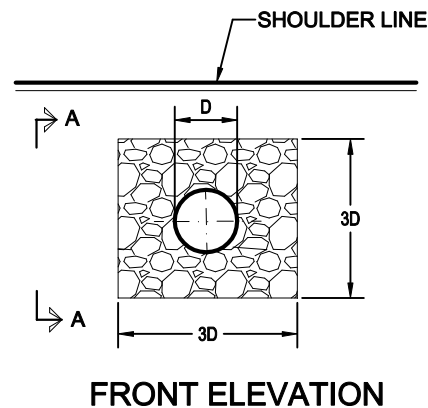


ROCK DITCH CHECKS

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	6.6



OUTLET



INLET

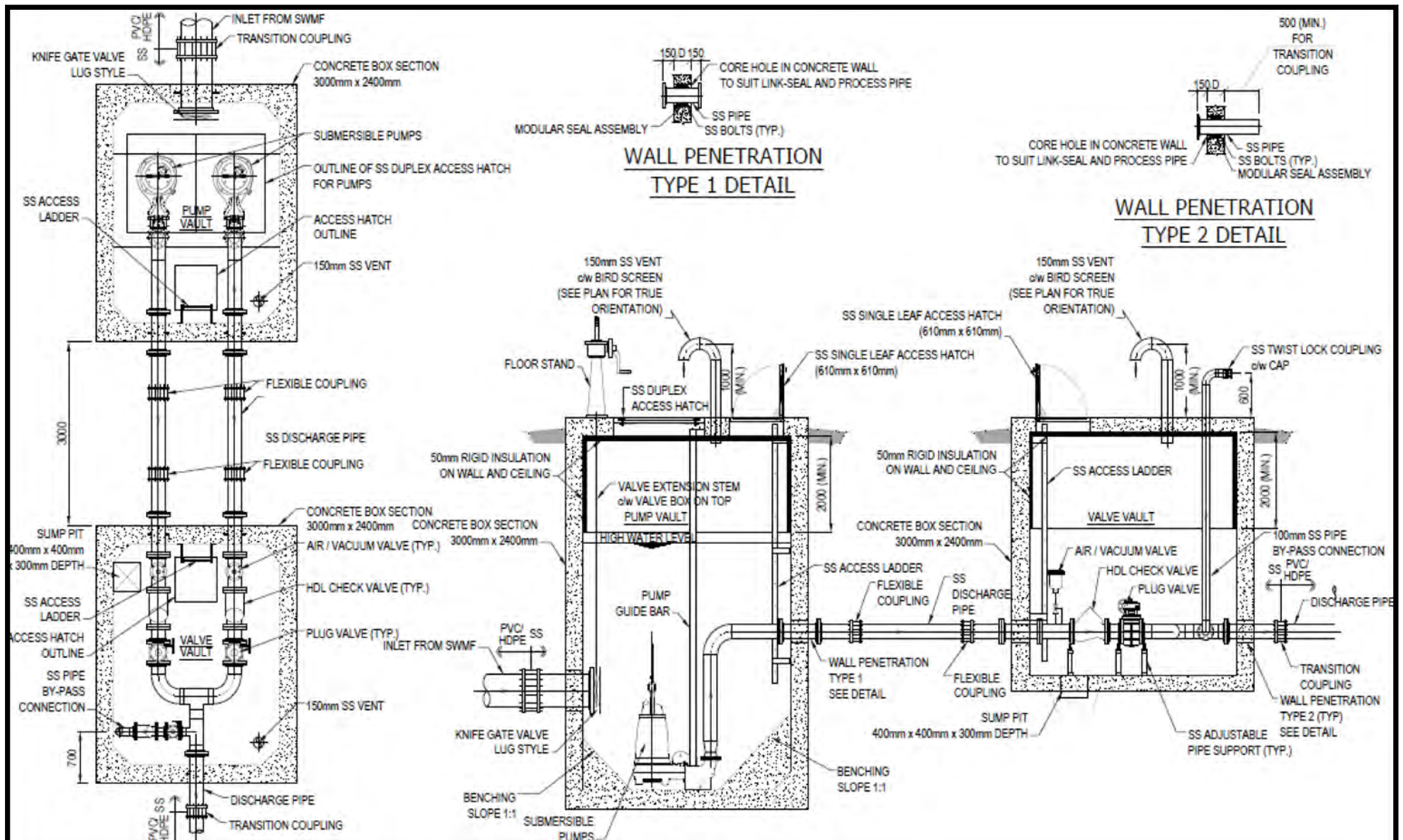
NOTES:

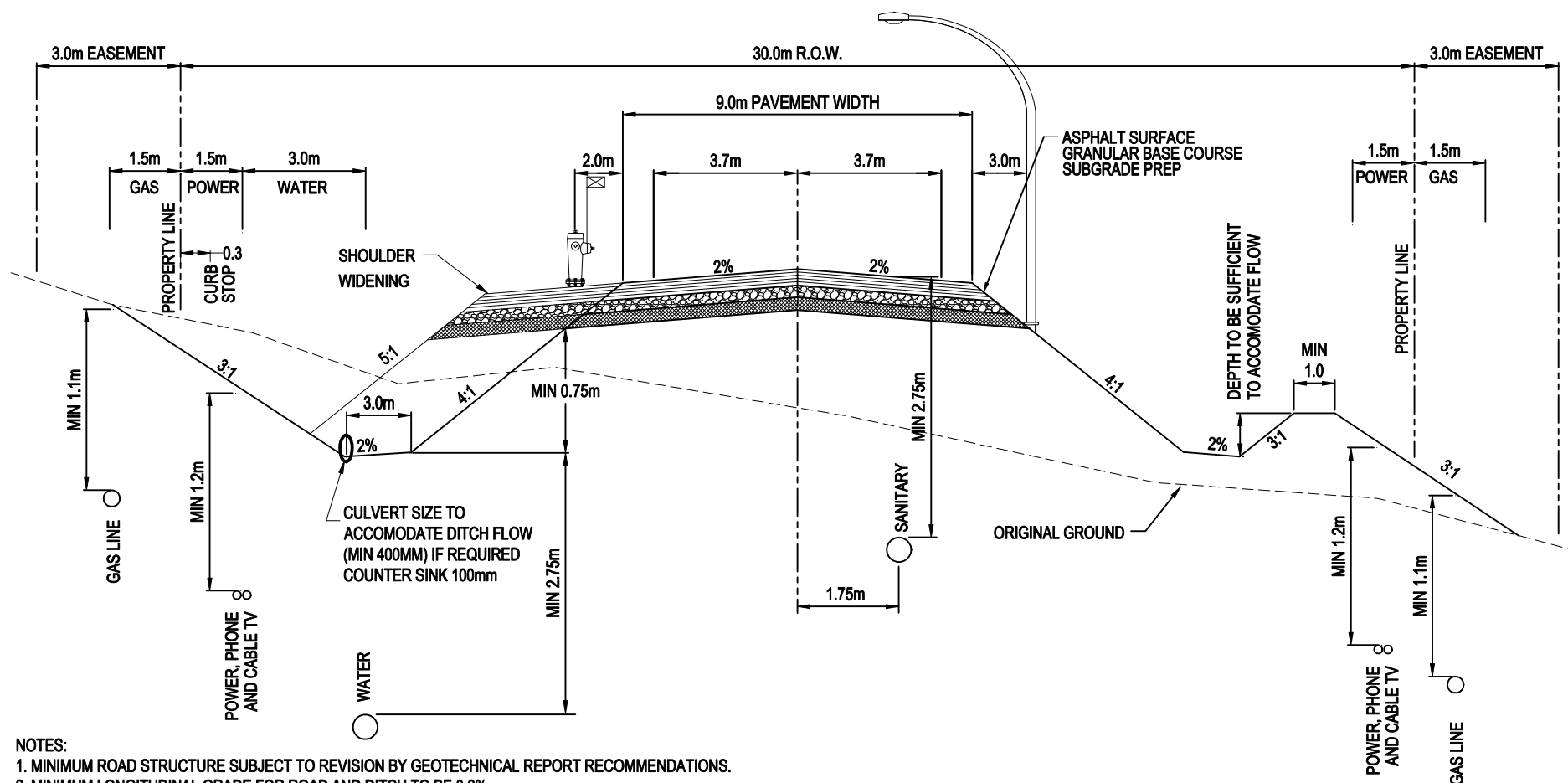
1. SELECT DRY MATERIAL SHALL BE PLACED IN 150mm COMPACTED LIFTS.
A 600mm CLAY PLUG SHALL BE PLACED ON INLET & OUTLET ENDS OF THE PIPE.
2. IN SOFT WET AREAS (ie MUSKEG) DEPTH OF SUBCUT BELOW THE PIPE WILL BE DETERMINED BY THE DEVELOPERS ENGINEER AS APPROVED BY THE COUNTY
3. WHEN PIPES ARE PLACED PRIOR TO EMBANKMENT CONSTRUCTION, A MINIMUM OF 1000mm OF MATERIAL SHALL BE PLACED OVER TOP OF PIPES FOR PROTECTION DURING CONSTRUCTION.
4. ALL CULVERT INVERTS WILL BE STAKED IN THE FIELD AND REVIEWED BY THE COUNTY.



CULVERT INSTALLATION WITH RIP RAP SIZE 400-1200 DIA

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	6.7





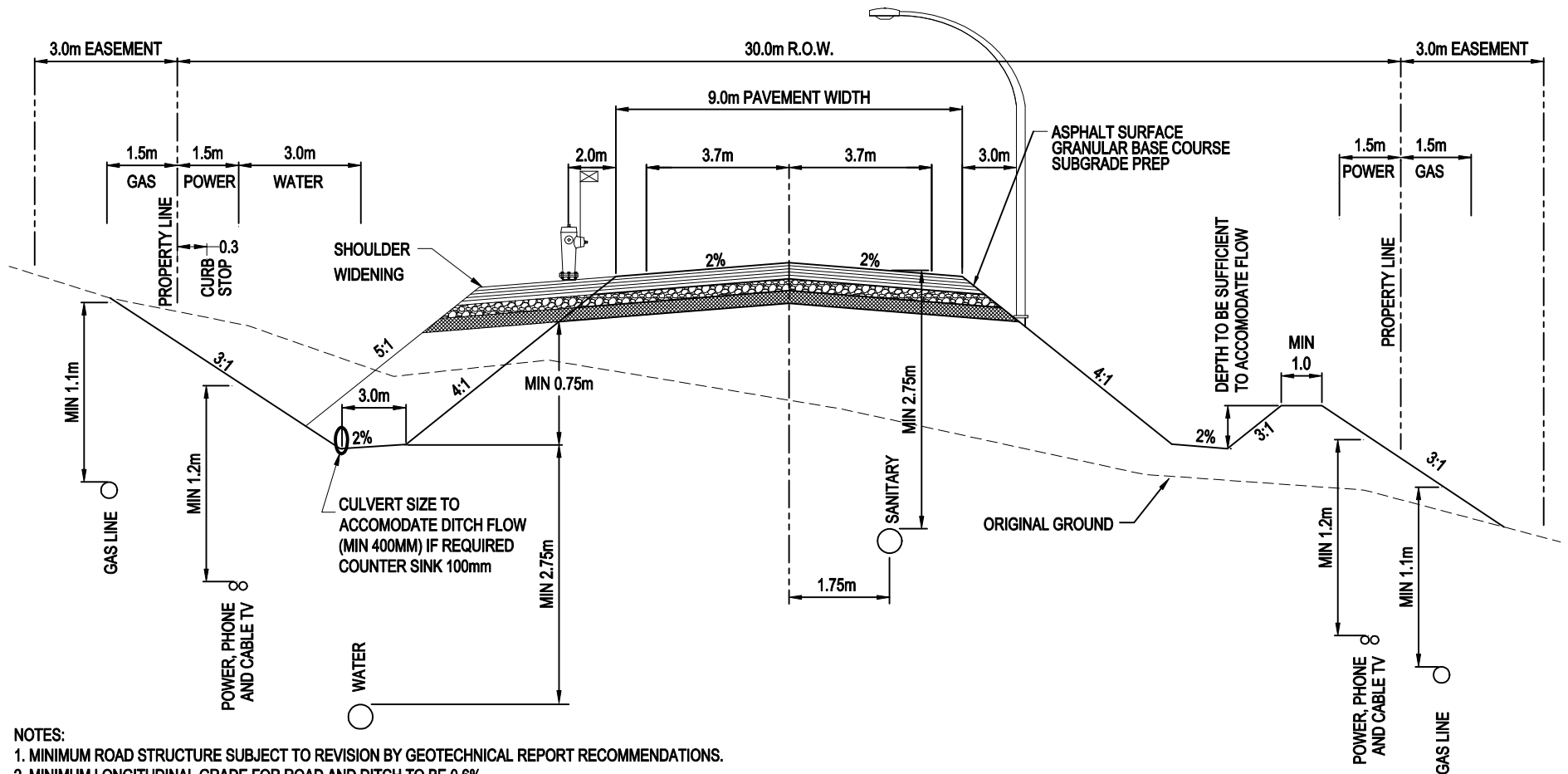
NOTES:

1. MINIMUM ROAD STRUCTURE SUBJECT TO REVISION BY GEOTECHNICAL REPORT RECOMMENDATIONS.
2. MINIMUM LONGITUDINAL GRADE FOR ROAD AND DITCH TO BE 0.6%.
3. POSITIVE DRAINAGE IS TO BE MAINTAINED AT ALL LOCATIONS.
4. DITCH DEPTH TO BE CONFIRMED BY GEOTECHNICAL REPORT.
5. ALL TRENCHES IN ROAD OR SIDESLOPE REQUIRE COMPACTION TO 98% STANDARD PROCTOR DENSITY.
6. ALL TRENCHES IN DITCH BOTTOM OR BACKSLOPE TO 95% STANDARD PROCTOR DENSITY.
7. WATER MAIN AND HYDRANTS MAY BE LOCATED EITHER SIDE OF ROAD
8. STREET LIGHTS TO BE OPPOSITE SIDE TO WATER MAIN
9. STREET LIGHTS AS PER COUNTY POLICY
10. ALL DIMENSIONS SHOWN IN METRES



INDUSTRIAL LOCAL ROAD

DATE DRAWN	March 2013
DATE REVISED	
DRAWING NUMBER	7.2



NOTES:

1. MINIMUM ROAD STRUCTURE SUBJECT TO REVISION BY GEOTECHNICAL REPORT RECOMMENDATIONS.
2. MINIMUM LONGITUDINAL GRADE FOR ROAD AND DITCH TO BE 0.6%.
3. POSITIVE DRAINAGE IS TO BE MAINTAINED AT ALL LOCATIONS.
4. DITCH DEPTH TO BE CONFIRMED BY GEOTECHNICAL REPORT.
5. ALL TRENCHES IN ROAD OR SIDESLOPE REQUIRE COMPACTION TO 98% STANDARD PROCTOR DENSITY.
6. ALL TRENCHES IN DITCH BOTTOM OR BACKSLOPE TO 95% STANDARD PROCTOR DENSITY.
7. WATER MAIN AND HYDRANTS MAY BE LOCATED EITHER SIDE OF ROAD
8. STREET LIGHTS TO BE OPPOSITE SIDE TO WATER MAIN
9. STREET LIGHTS AS PER COUNTY POLICY
10. ALL DIMENSIONS SHOWN IN METRES



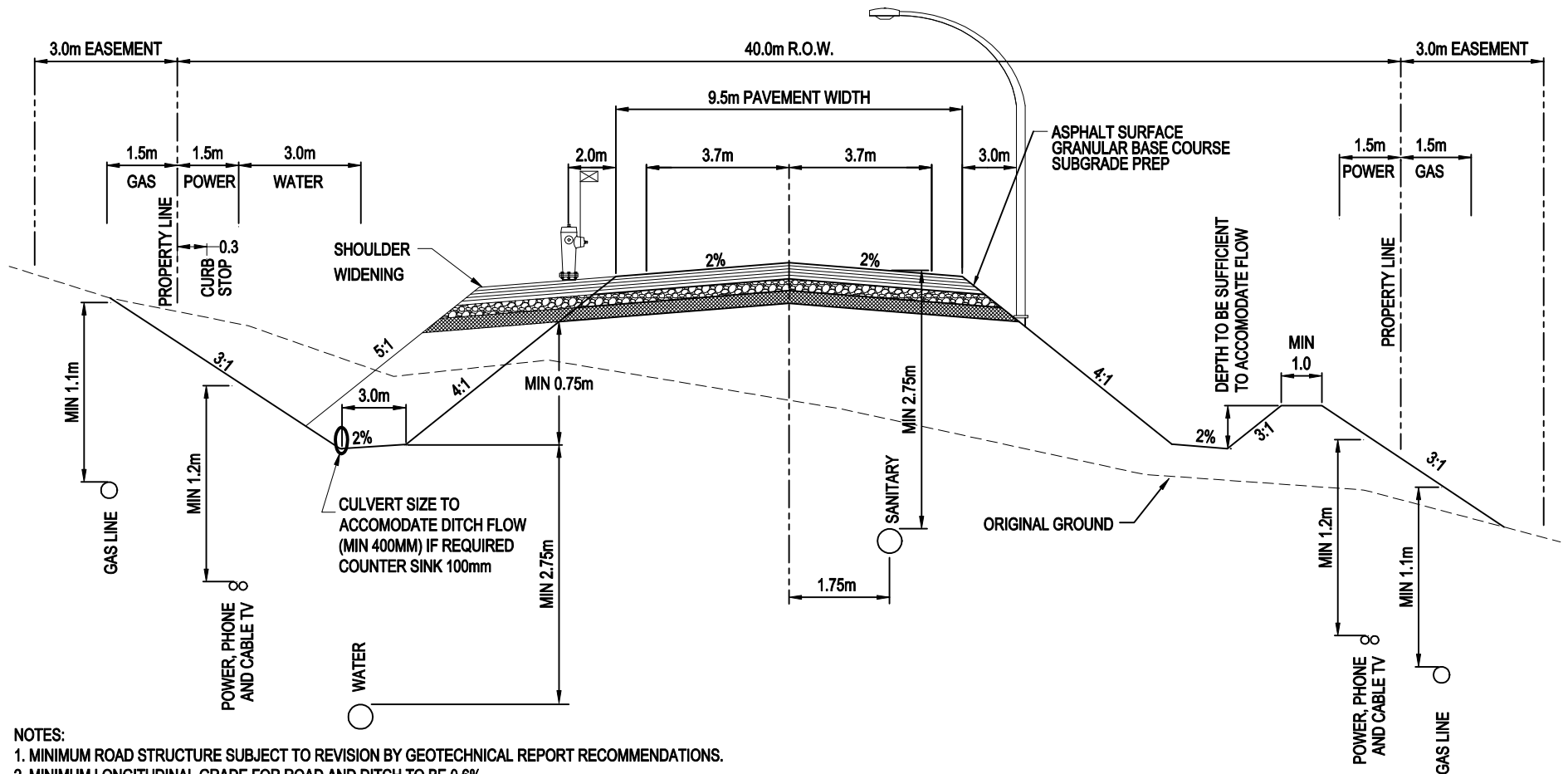
INDUSTRIAL MINOR COLLECTOR ROAD

DATE DRAWN
March 2013

DATE REVISED

DRAWING NUMBER

7.3



NOTES:

1. MINIMUM ROAD STRUCTURE SUBJECT TO REVISION BY GEOTECHNICAL REPORT RECOMMENDATIONS.
2. MINIMUM LONGITUDINAL GRADE FOR ROAD AND DITCH TO BE 0.6%.
3. POSITIVE DRAINAGE IS TO BE MAINTAINED AT ALL LOCATIONS.
4. DITCH DEPTH TO BE CONFIRMED BY GEOTECHNICAL REPORT.
5. ALL TRENCHES IN ROAD OR SIDESLOPE REQUIRE COMPACTION TO 98% STANDARD PROCTOR DENSITY.
6. ALL TRENCHES IN DITCH BOTTOM OR BACKSLOPE TO 95% STANDARD PROCTOR DENSITY.
7. WATER MAIN AND HYDRANTS MAY BE LOCATED EITHER SIDE OF ROAD
8. STREET LIGHTS TO BE OPPOSITE SIDE TO WATER MAIN
9. STREET LIGHTS AS PER COUNTY POLICY
10. ALL DIMENSIONS SHOWN IN METRES



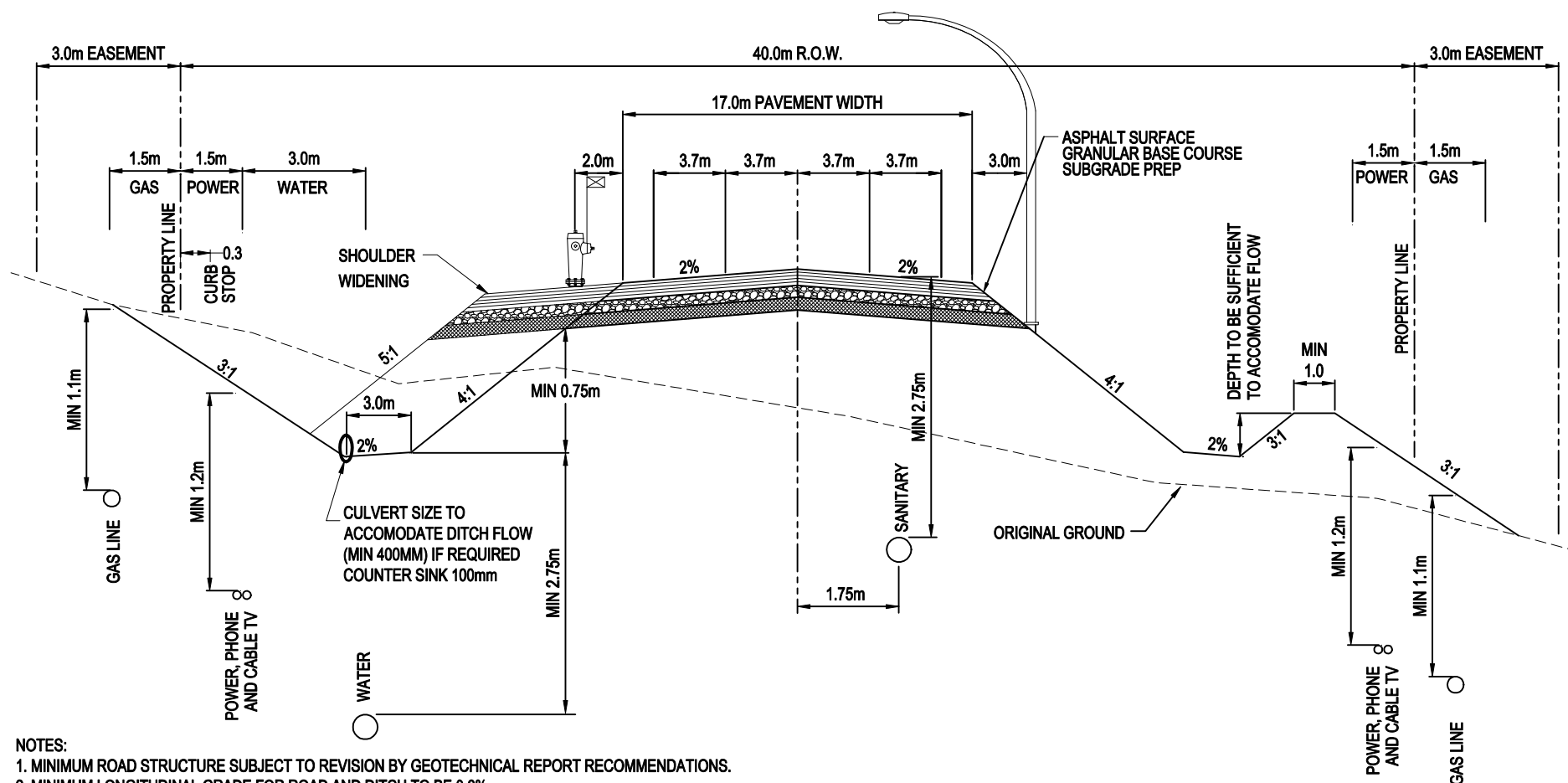
INDUSTRIAL MAJOR COLLECTOR ROAD (2 LANES)

DATE DRAWN
March 2013

DATE REVISED

DRAWING NUMBER

7.4



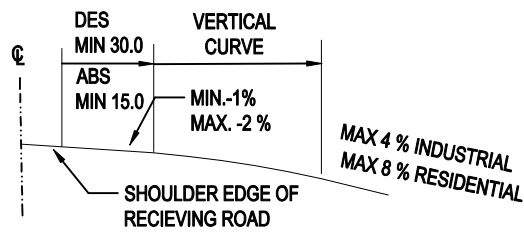
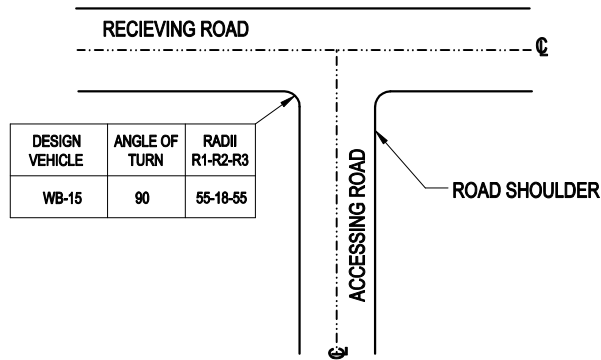
NOTES:

1. MINIMUM ROAD STRUCTURE SUBJECT TO REVISION BY GEOTECHNICAL REPORT RECOMMENDATIONS.
2. MINIMUM LONGITUDINAL GRADE FOR ROAD AND DITCH TO BE 0.6%.
3. POSITIVE DRAINAGE IS TO BE MAINTAINED AT ALL LOCATIONS.
4. DITCH DEPTH TO BE CONFIRMED BY GEOTECHNICAL REPORT.
5. ALL TRENCHES IN ROAD OR SIDESLOPE REQUIRE COMPACTION TO 98% STANDARD PROCTOR DENSITY.
6. ALL TRENCHES IN DITCH BOTTOM OR BACKSLOPE TO 95% STANDARD PROCTOR DENSITY.
7. WATER MAIN AND HYDRANTS MAY BE LOCATED EITHER SIDE OF ROAD
8. STREET LIGHTS TO BE OPPOSITE SIDE TO WATER MAIN
9. STREET LIGHTS AS PER COUNTY POLICY
10. ALL DIMENSIONS SHOWN IN METRES

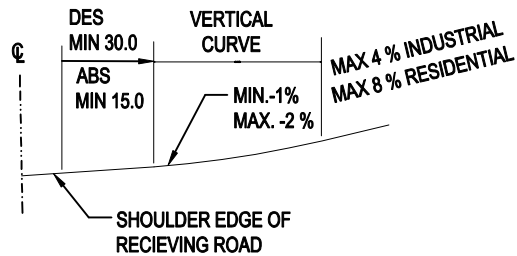


INDUSTRIAL MAJOR COLLECTOR ROAD (4 LANES)

DATE DRAWN	March 2013
DATE REVISED	
DRAWING NUMBER	7.5



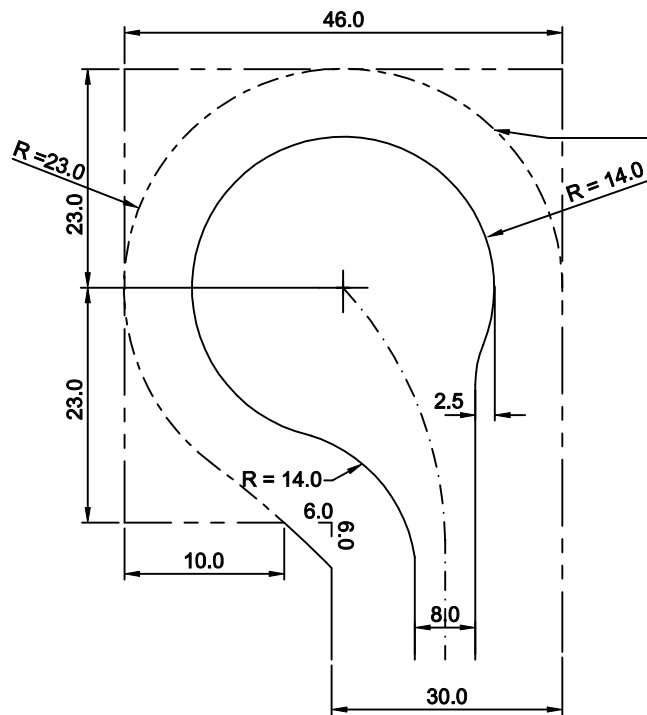
ACCESSING ROAD IN FILL



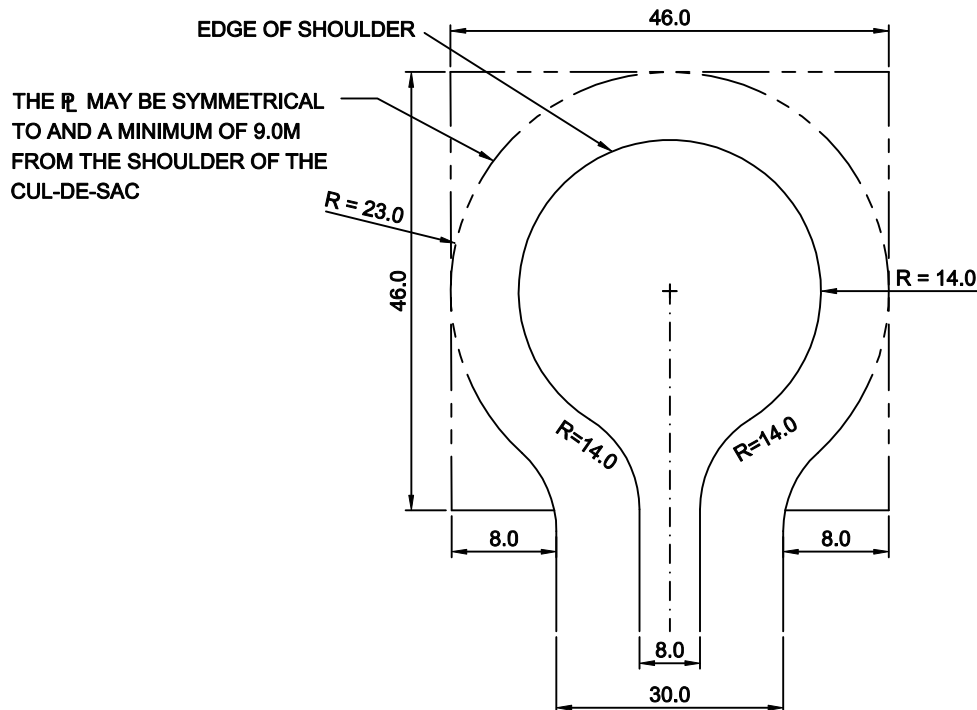
ACCESSING ROAD IN CUT

NOTE

1. LENGTH OF VERTICAL CURVE SHALL BE ACCORDING TO T A C MANUAL
2. ALL DIMENSIONS ARE IN METERS



THE R MAY BE SYMMETRICAL TO AND A MINIMUM OF 9.0M FROM THE SHOULDER OF THE CUL-DE-SAC



THE R MAY BE SYMMETRICAL TO AND A MINIMUM OF 9.0M FROM THE SHOULDER OF THE CUL-DE-SAC

NOTE:

1. THE MINIMUM CROWN SLOPE WITHIN THE CUL-DE-SAC SHALL BE 4%



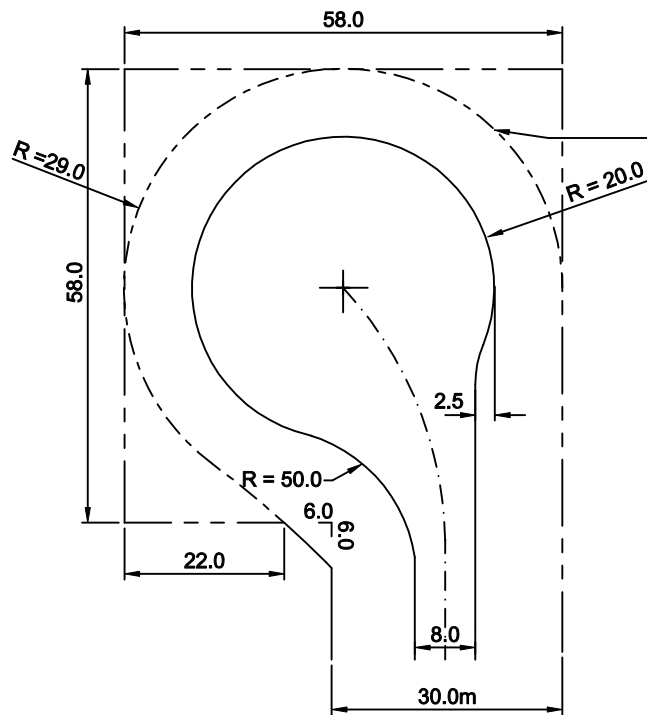
RESIDENTIAL CUL-DE-SAC

DATE DRAWN
SEPT 2008

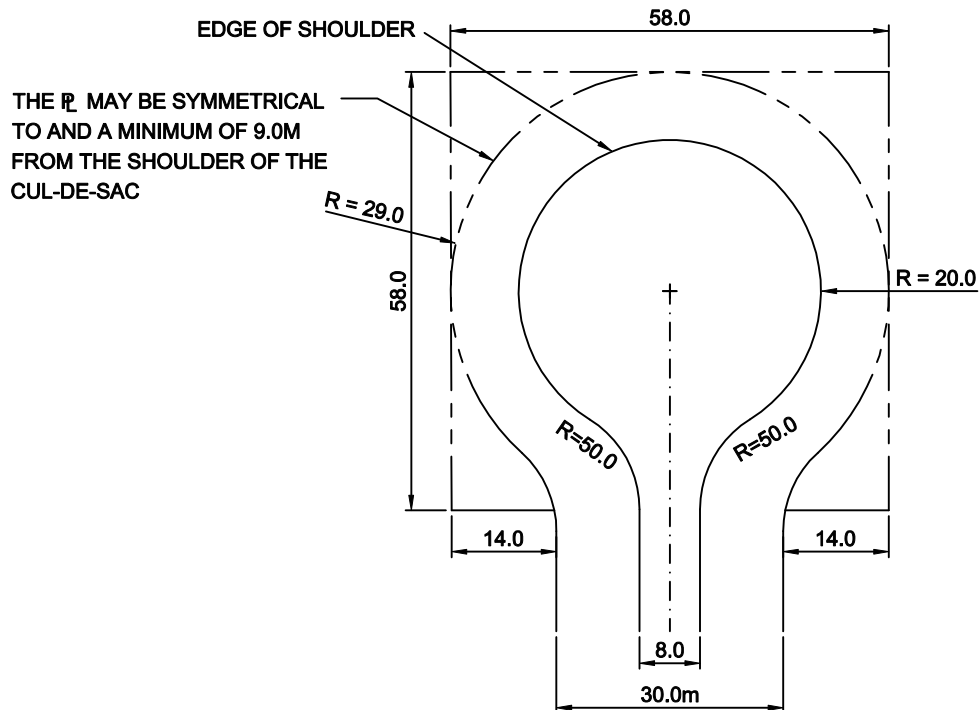
DATE REVISED
DEC 2013

DRAWING NUMBER

7.9



THE R MAY BE SYMMETRICAL TO AND A MINIMUM OF 9.0M FROM THE SHOULDER OF THE CUL-DE-SAC



NOTE:

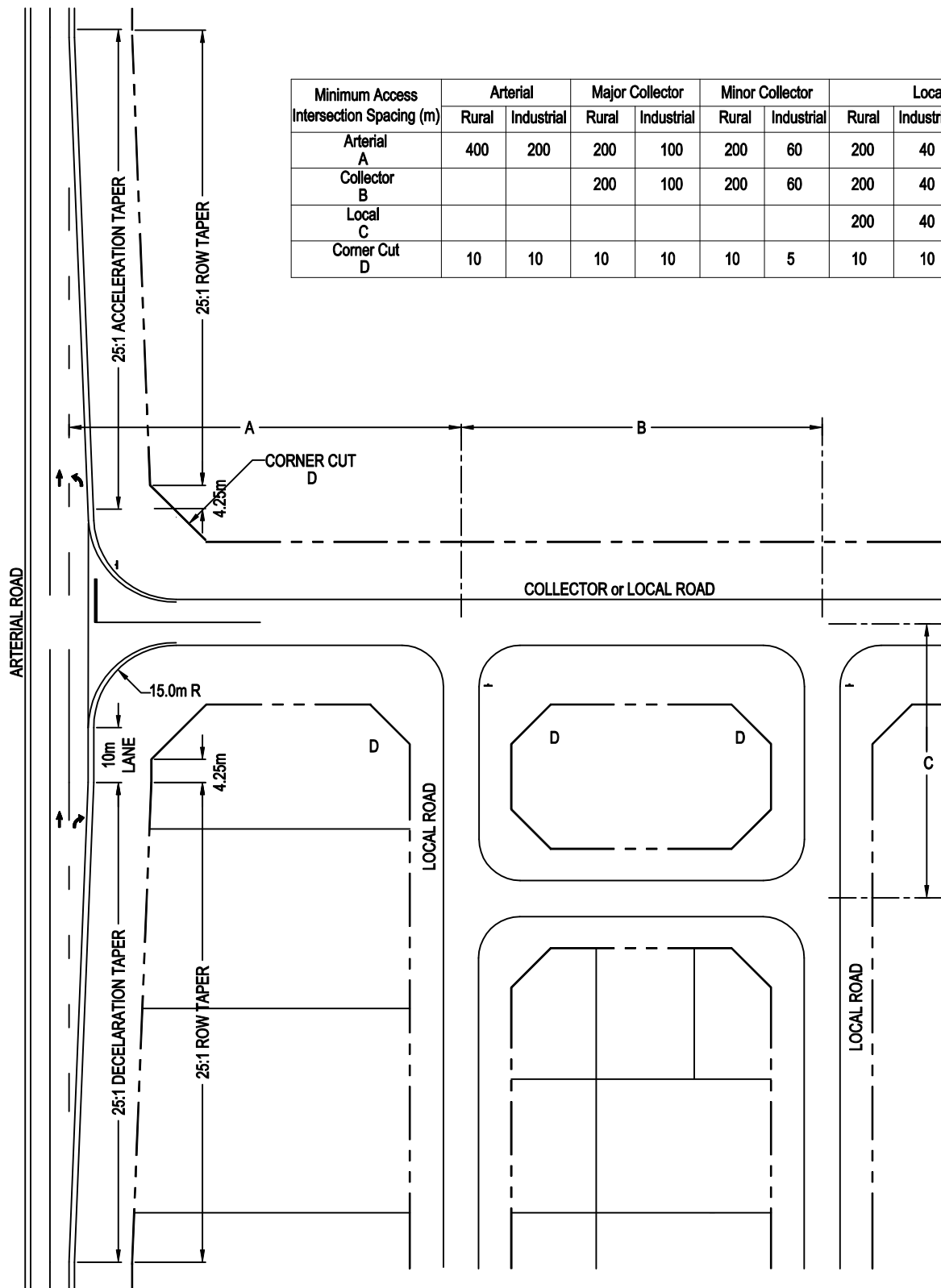
1. THE MINIMUM CROWN SLOPE WITHIN THE CUL-DE-SAC SHALL BE 0.040 METERS/METER



TEMPORARY INDUSTRIAL CUL-DE-SAC

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	7.10

Minimum Access Intersection Spacing (m)	Arterial		Major Collector		Minor Collector		Local		
	Rural	Industrial	Rural	Industrial	Rural	Industrial	Rural	Industrial	Residential
Arterial A	400	200	200	100	200	60	200	40	40
Collector B			200	100	200	60	200	40	40
Local C							200	40	40
Corner Cut D	10	10	10	10	10	5	10	10	5



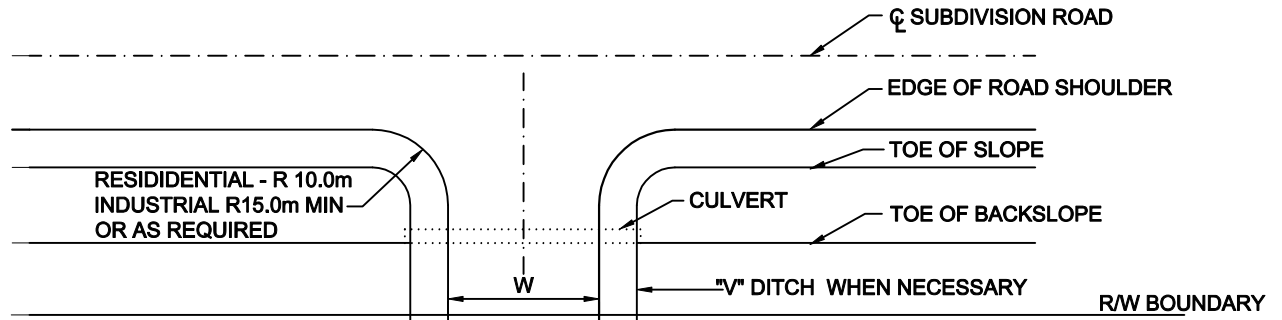
NOTES

1. ALL LOT ACCESS WITHIN SUBDIVISIONS SHALL BE OFF OF INTERNAL SUBDIVISION ROADS
2. ROAD TAPERS MAY BE REQUIRED AS DIRECTED BY THE GENERAL MANAGER.

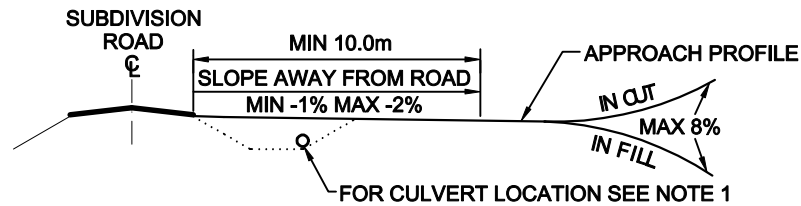


INTERSECTION TREATMENT AND APPROACH LOCATIONS

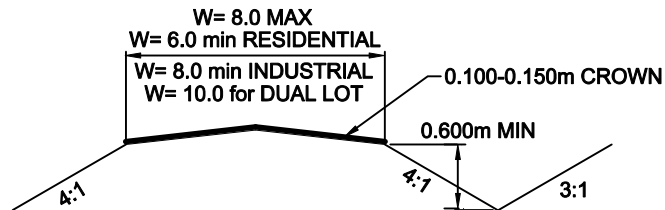
DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	7.11



APPROACH PLAN



DITCH AND CULVERT LOCATION



APPROACH CROSS SECTION

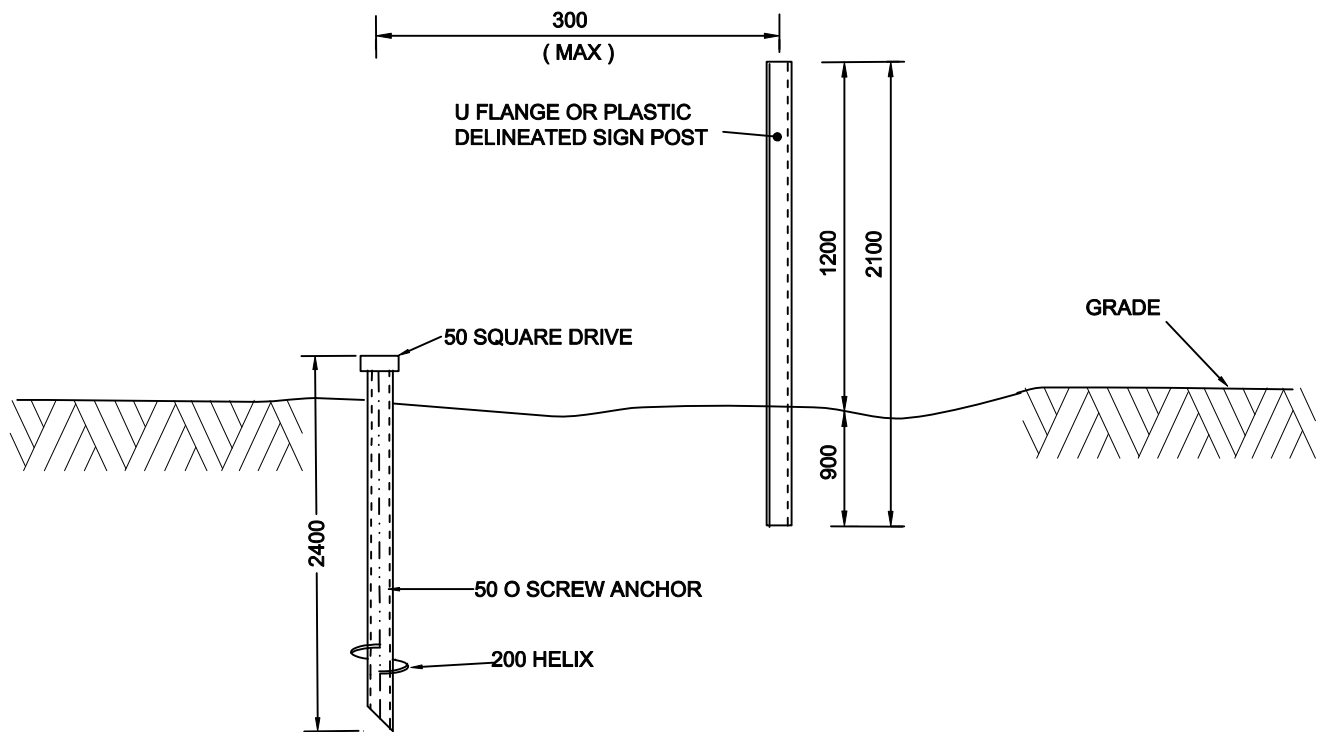
NOTES

1. WHEN CULVERTS ARE REQUIRED THEY MUST BE C.S.P. CULVERTS AND BE THE FOLLOWING MINIMUM DIAMETERS
RESIDENTIAL - 0.400m
INDUSTRIAL - 0.500m
- LENGTH WILL VARY WITH DEPTH OF FILL
- CULVERT TO BE PLACED AT TOE OF BACKSLOPE
2. ALL DEMINIONS SHOWN ARE IN METERS
3. MINIMUM APPROACH LENGTH - FROM EDGE OF ROAD SHOULDER TO R/W BOUNDARY



RESIDENTIAL AND INDUSTRIAL APPROACHES

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	7.12



NOTE

1. MARKER POST TO BE POSITIONED WITH THE OPEN U SECTION OF THE POST OR FLAT FACE FACING THE NEAREST ADJACENT ROAD AND WITH THE POST LOCATED DIRECTLY BEHIND AND WITHIN 300m OF THE BENCH MARK



BENCH MARK INSTALLATION

DATE DRAWN
SEPT 2008

DATE REVISED
DEC 2013

DRAWING NUMBER

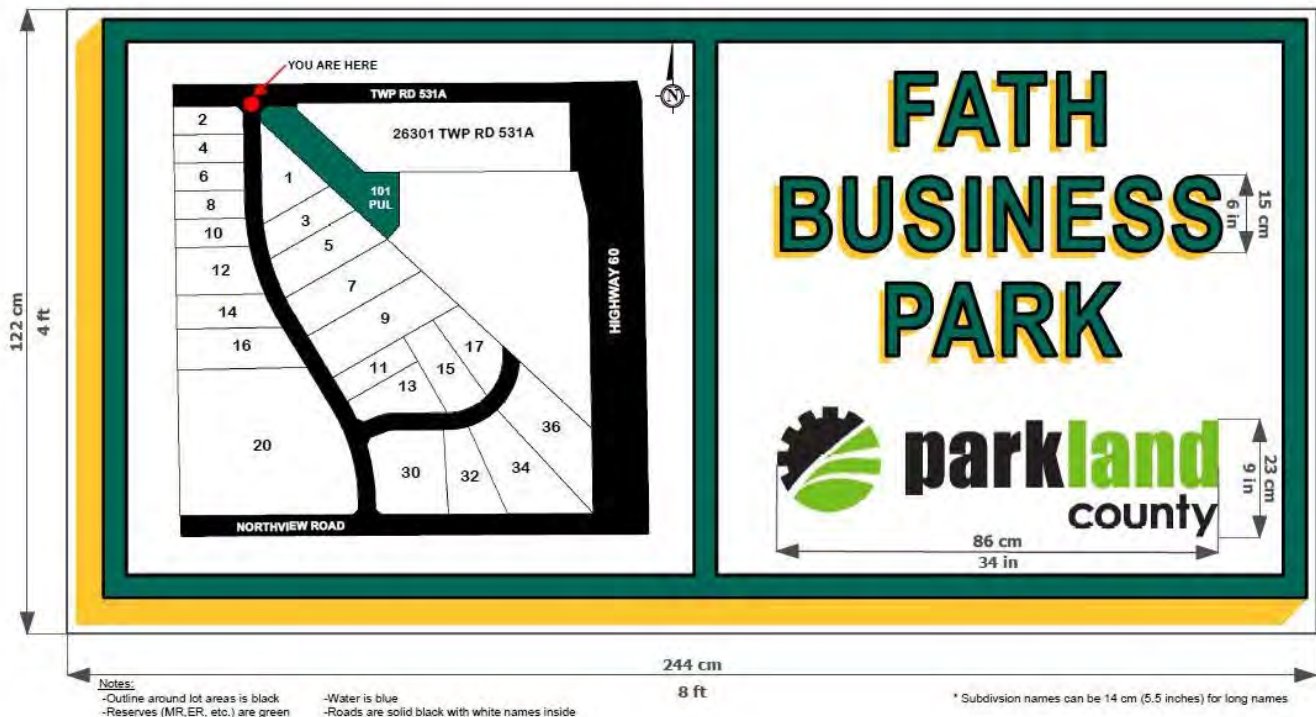
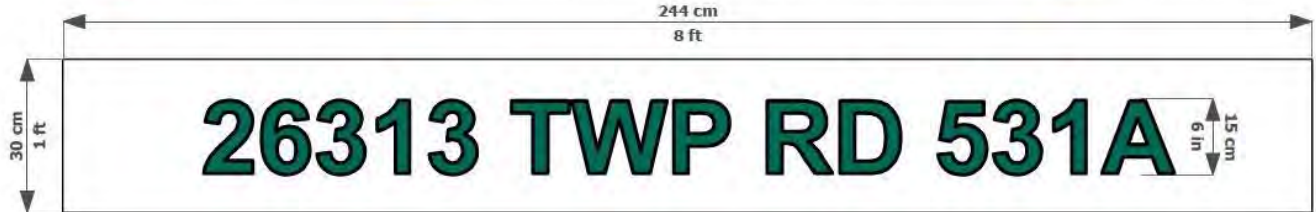
8.1

R0 G104 B87

R255 G199 B47

R35 G31 B32

R120 G190 B32



Notes:

-Outline around lot areas is black
-Reserves (MR, ER, etc.) are green

-Water is blue
-Roads are solid black with white names inside

* Subdivision names can be 14 cm (5.5 inches) for long names

NOTES

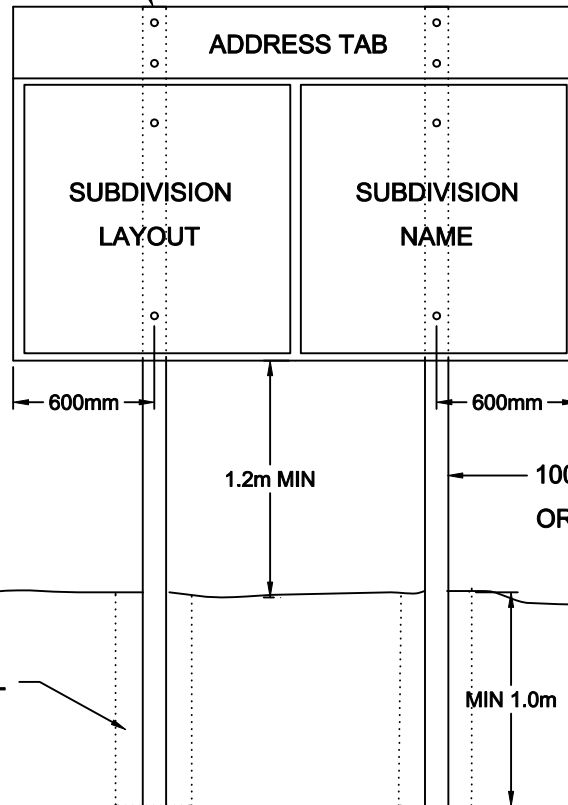
1. ADDRESS NUMBERS TO BE PLACED ON MAP WHERE APPLICABLE



SUBDIVISION SIGN

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	8.2

POSTS TO BE FLUSH
WITH TOP OF SIGN



100mm X 100mm WOOD POSTS
OR APPROVED METAL POSTS

HAND COMPACTED MATERIAL
OR READY-CRETE

MIN 1.0m

SUBDIVISION SIGN INSTALLATION

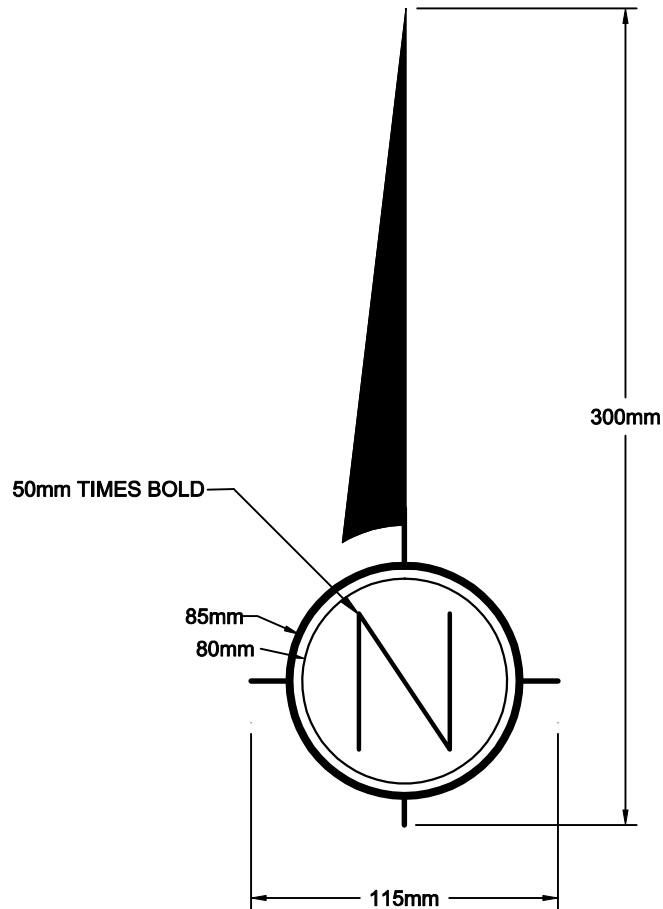


DATE DRAWN
SEPT 2008

DATE REVISED
DEC 2013

DRAWING NUMBER

8.3



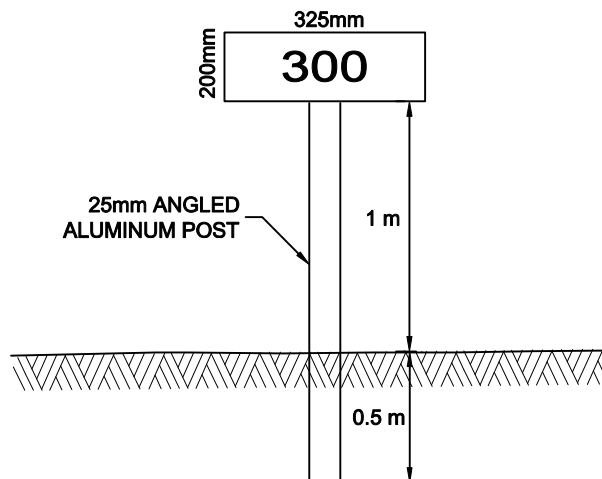
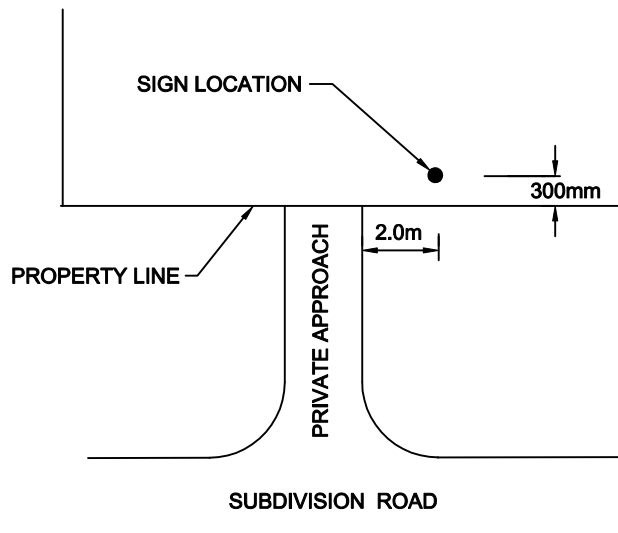
NOTES

1. NORTH ARROW COLOR BLACK
2. COLORS TO BE "3-M " RECOMMENDED INKS OR APPROVED EQUIVALENT



SUBDIVISION SIGN NORTH ARROW

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	8.4



MUNICIPAL ADDRESS SIGN

DATE DRAWN
SEPT 2008

DATE REVISED
DEC 2013

DRAWING NUMBER

8.5

ENVIRONMENTAL RESERVE

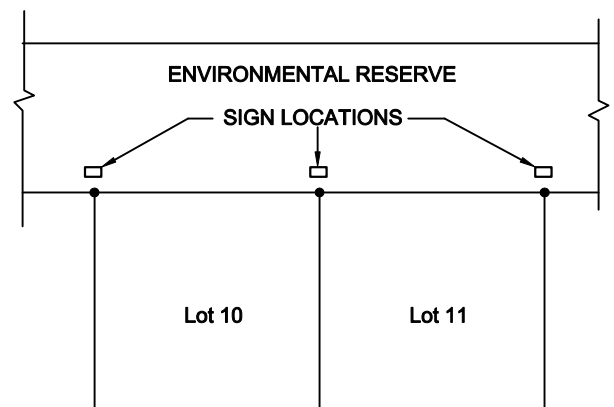
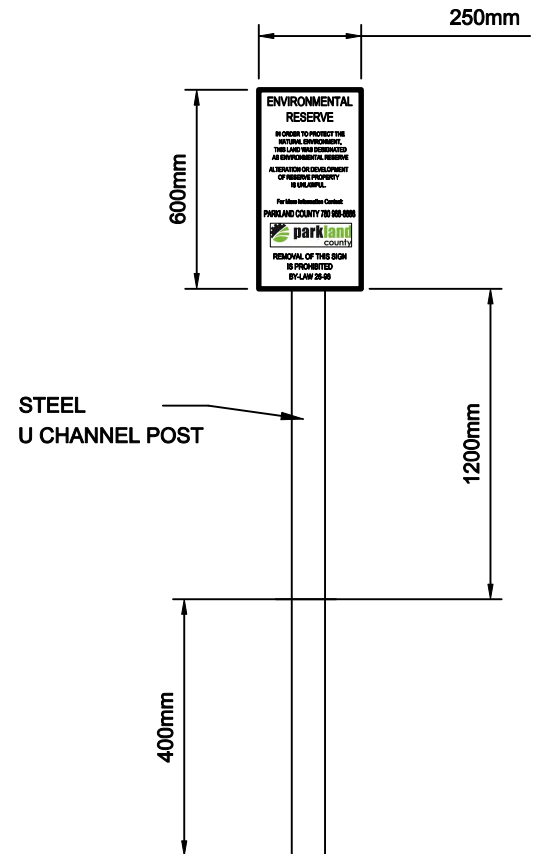
IN ORDER TO PROTECT THE
NATURAL ENVIRONMENT,
THIS LAND WAS DESIGNATED
AS ENVIRONMENTAL RESERVE

ALTERATION OR DEVELOPMENT
OF RESERVE PROPERTY
IS UNLAWFUL.

For More Information Contact:
PARKLAND COUNTY 780 968-8888



REMOVAL OF THIS SIGN
IS PROHIBITED
BY-LAW 26-98



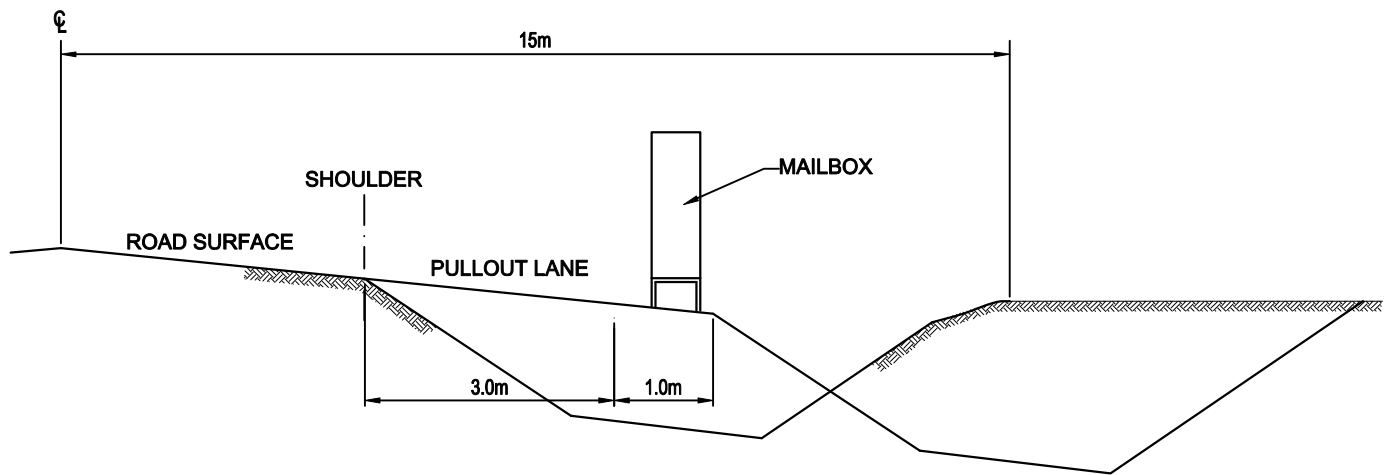
NOTE:

1. SIGNS TO BE LOCATED AT EACH COMMON ENVIRONMENTAL RESERVE AND PROPERTY LOT CORNER.
2. SIGNS TO BE 300mm ON RESERVE FACING PRIVATE LOTS.



**ENVIRONMENTAL RESERVE
MARKER SIGN**

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	8.6



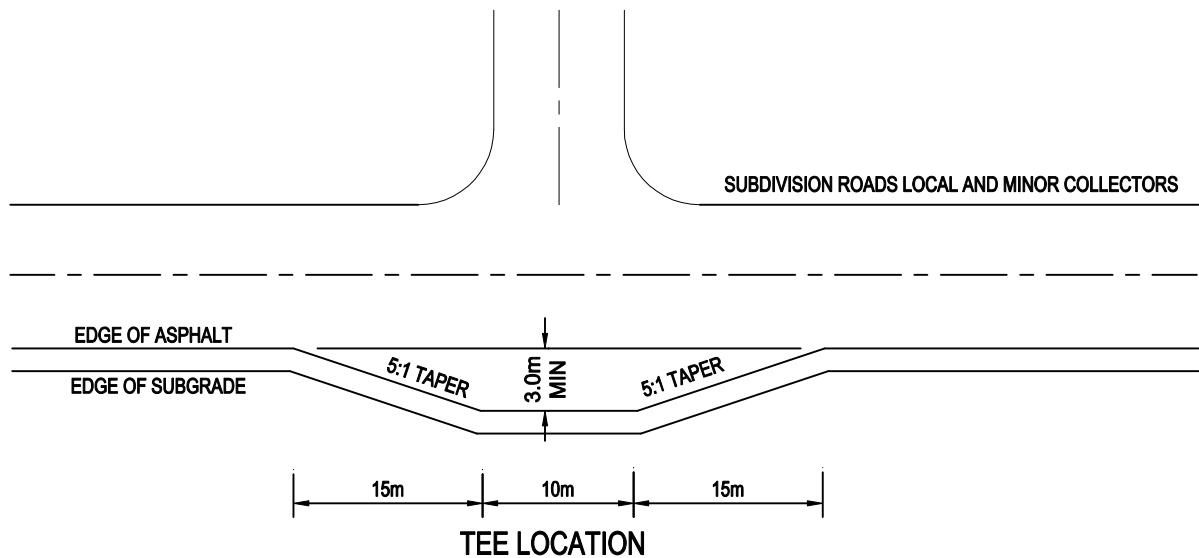
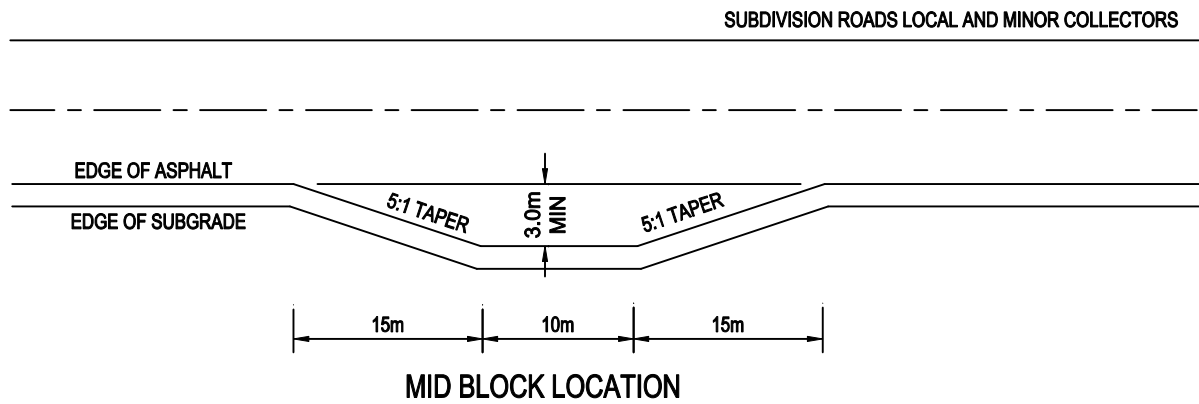
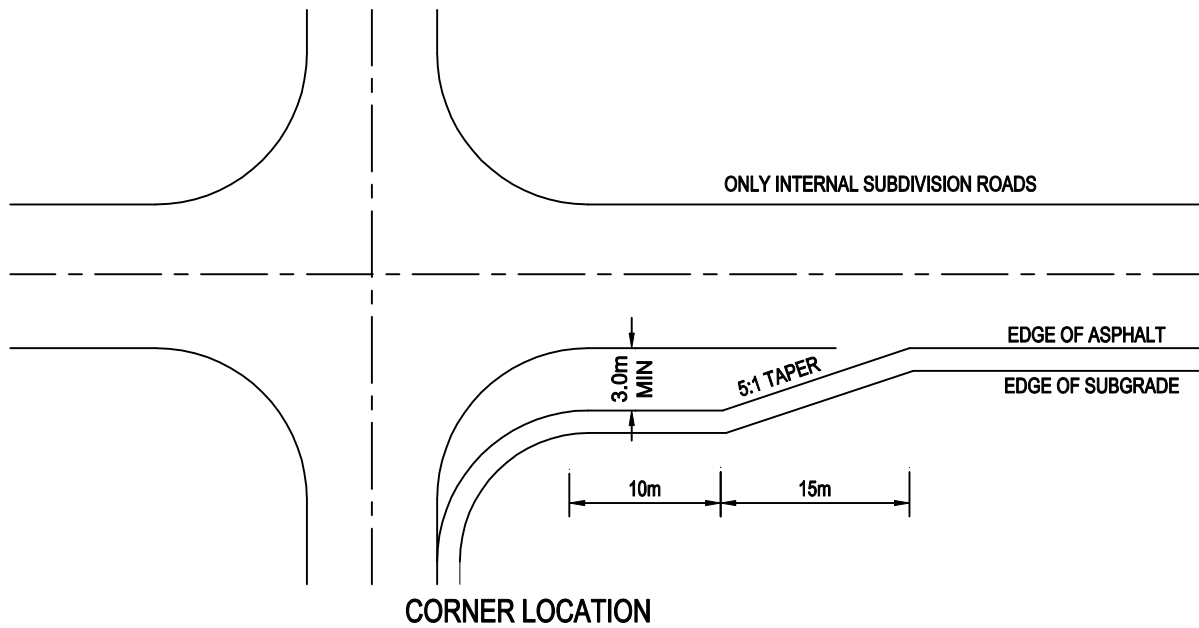
NOTE

1. PULLOUT ROAD STRUCTURE TO MATCH EXISTING ROAD STRUCTURE



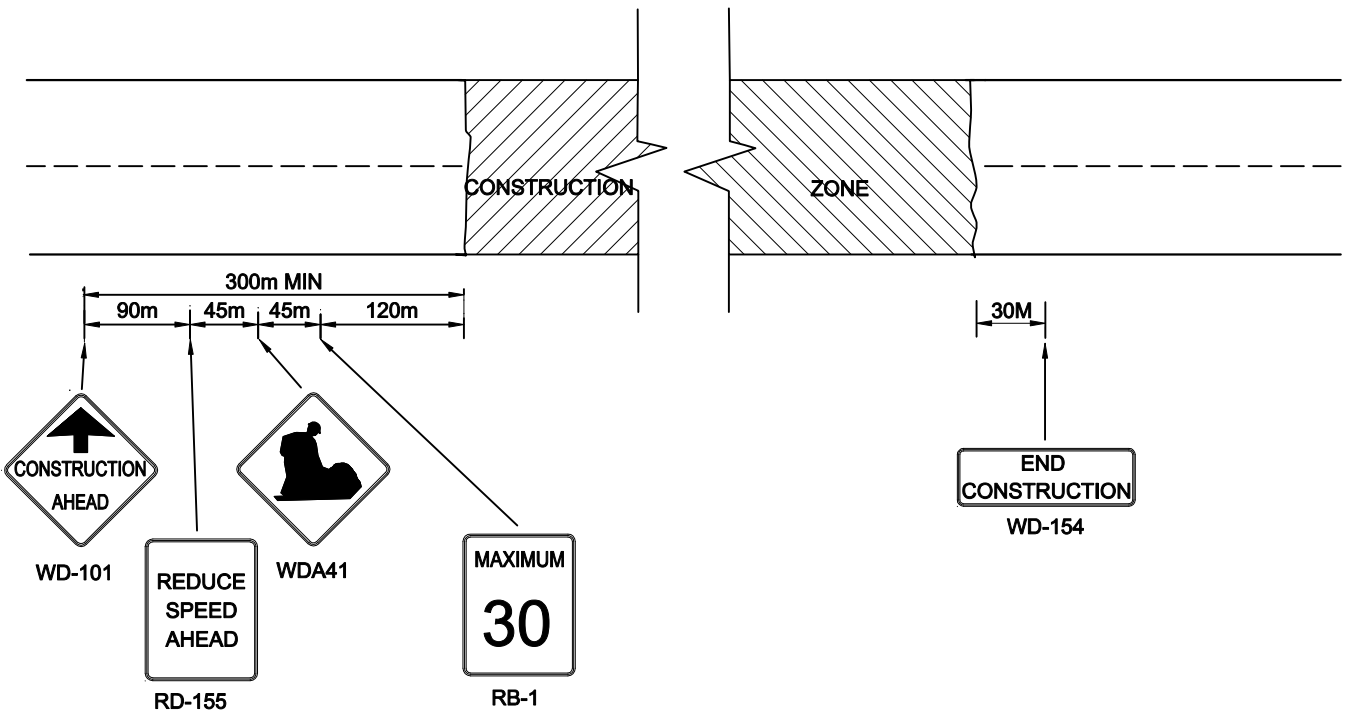
MAILBOX PULLOUT CROSS - SECTION

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	8.7



MAILBOX PULLOUT LOCATIONS

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	8.8



NOTE

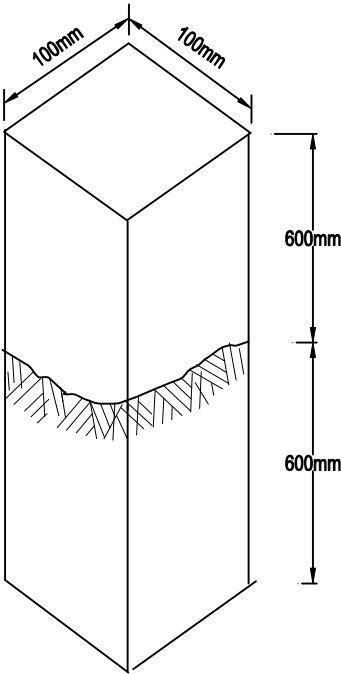
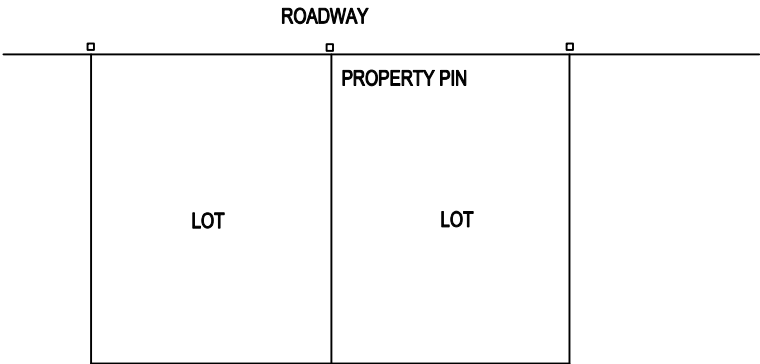
1. EACH SIGN TO BE PLACED 3m FROM EDGE OF TRAVELLED SURFACE WITH BOTTOM OF SIGN 1.5m ABOVE ROAD TRAVEL.
2. REPEAT SIGNING FOR EACH DIRECTION OF TRAVEL
3. ALL SIGNS TO BE INSTALLED ON METAL OR WOOD STANDARDS
4. MIN. STANDARDS FOR SIGNS SHALL CONFORM TO STANDARD SPECIFICATION NUMBERS ABOVE



MINIMUM CONSTRUCTION SIGNAGE

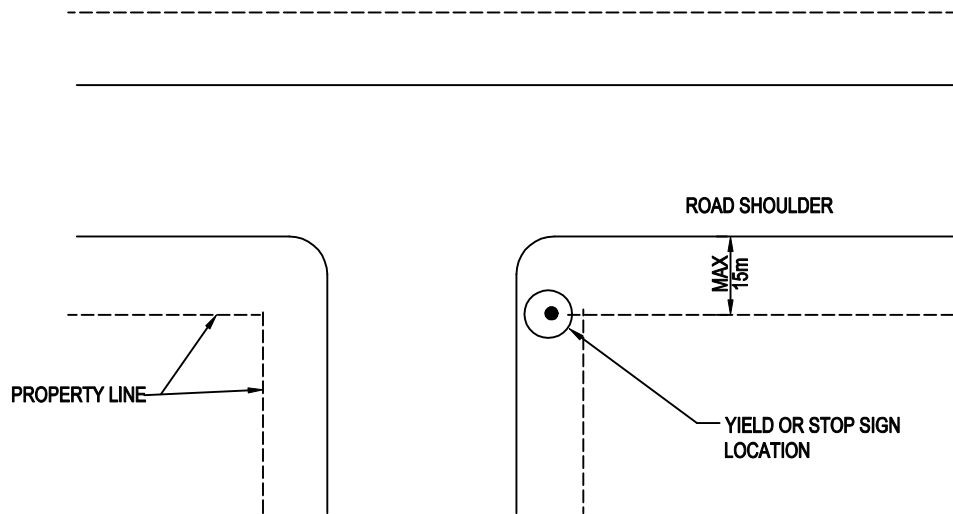
DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	8.9

100mm x 100mm x1 200mm TREATED POSTS
OR APPROVED EQUIVILANT PLACED
300mm ON ROAD ALLOWANCE

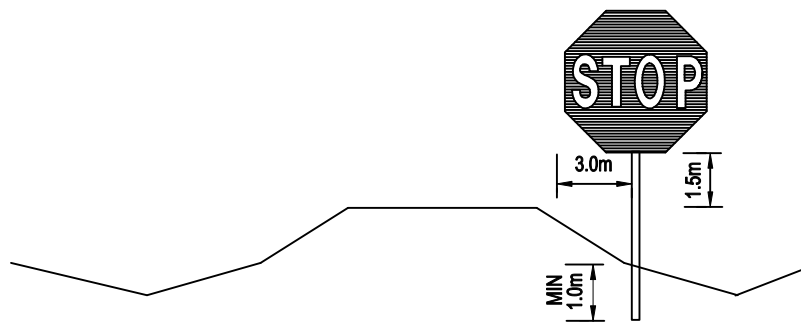


LOT PIN MARKER

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	8.10



PLAN



CROSS-SECTION

NOTE

1. LOCATION AND HEIGHT IS COMMON TO ALL SIGNS PLACED.
2. DIMENSIONS SHOWN IN METRES



TRAFFIC SIGN INSTALLATION

DATE DRAWN	SEPT 2008
DATE REVISED	DEC 2013
DRAWING NUMBER	8.11