CITY OF NORTH BAY

ENGINEERING DESIGN GUIDELINES

March 2021

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NORTH BAY ENGINEERING DESIGN GUIDELINES

1 INTRODUCTION

1.1 Purpose

01 The City of North Bay Engineering Design Guidelines was prepared for City staff and consulting engineers working on capital improvement projects (typically road, sewer, and water construction and reconstruction) and for consulting engineers working for the development industry preparing engineering designs and drawings for private developments (typically plans of subdivision and site plans).

02 This manual outlines the City's current engineering requirements, guidelines, specifications, and standards that form the basis for the preparation of all engineering submissions presented to the City of North Bay for approval. It will not necessarily be required that maintenance and retrofit activities follow these standards.

03 Prior to beginning the design for any City of North Bay services, the developer and/or the developer's consulting engineer shall meet with City of North Bay staff to obtain or clarify City of North Bay requirements for presentation of engineering submissions.

04 This document will be subject to revisions from time to time. In the interim, the City of North Bay reserves the right to make revisions having due regard for applications already in the review process. The City will notify individuals or groups affected accordingly, and revisions will become effective on the date of notification.

1.2 Intent and Objectives

01 This manual is to be used by residents, City staff, and development industry parties such as land developers, builders, consultants, and contractors. The intent of this manual is to assist the development industry in preparing, and City staff in processing, engineering submissions that form part of a complete development application. This manual is the minimum requirement for the efficient design and approval of engineering related works.

02 The key objectives of the Engineering Design Guidelines are to:

[a] Document existing process information related to engineering submissions;
[b] Outline requirements and standards for engineering designs;
[c] Provide guidance and a framework for applicants submitting engineering designs and reports; and
[d] Provide guidance to City staff when reviewing and commenting on engineering submissions;

03 The design requirements, standards, specifications and guidelines set forth throughout this manual are intended to represent the City's requirements under normal circumstances. The City notes that the design engineer that is responsible for the engineering should use their best professional judgement to find appropriate solutions where abnormal conditions are encountered. If there is a need to deviate from a particular requirement, standard, specification or guideline, the engineer shall provide appropriate justification and the proposed deviation would require City approval.

1.3 Definitions

01 "OPS" means Ontario Provincial Standards

02 "OPSD" means Ontario Provincial Standard Drawing

03 "OPSS" means Ontario Provincial Standard Specification

04 "ROW" means Right of Way

2 ROADS

2.1 General

01 Roads are to be designed, commencing at the draft plan stage, to geometric standards established by the City of North Bay described herein. In situations not covered by the enclosed standards and specifications, the following documents must be referenced:

[a] Municipal Works Design Manual
[b] Geometric Design Guide for Canadian Roads (Transportation Association of Canada)
[c] Geometric Design Standards for Ontario Highways (MTO)
[d] Roadside Safety Manual (MTO)
[e] Ontario Provincial Standards and Drawings

2.1.1 Conceptual Review

01 Conceptual plans will be reviewed prior to draft plan approval, however the concept plan must include proper design criteria, including preliminary road alignments, horizontal curves, super elevation, etc. The more detailed the preliminary design the more accurate the comments.

2.2 Design Criteria

01 The following are the six City of North Bay standard road classes:

[a] Rural Residential

[b] Semi-Urban Residential
[c] Urban Residential
[d] Urban Collector
[e] Urban Arterial – 4 Lanes
[f] Urban Arterial – 5 Lanes

02 For each road class, standard road cross-sections and standard utility locations are as shown in Appendix A. The City of North Bay's Official Plan provides information detailing the location of both rural and urban areas.

2.3 Road Classification

2.3.1 Rural Residential

01 Rural residential streets are those which serve to permit local traffic to immediately access private property and to convey traffic to and from the collector street system. Traffic volumes are typically less than 3000 vehicles per day and the design ROW width is 26 meters.

2.3.2 Semi-Urban Residential

01 Semi-Urban residential streets are those which serve to permit local traffic to immediately access private property and to convey traffic to and from the collector street system. Traffic volumes are typically less than 3000 vehicles per day and the design ROW width is 26 meters. Semi-Urban road classification applies only to residential type lots which have a minimum lot frontage of 24 metres.

2.3.3 Urban Residential

01 Urban residential streets are those which serve to permit local traffic to immediately access private property and to convey traffic to and from the collector street system. Traffic volumes are typically less than 3000 vehicles per day, the design ROW width is 20 meters, and the roadway has a full urban cross-section.

2.3.4 Urban Collector

01 Urban collector roads serve to convey local traffic to the arterial road system and in turn to public transportation routes and recreational facilities. Typical traffic volumes for urban collectors are in the range of 4,000 to 10,000 vehicles per day. The design ROW width is 26 meters and sidewalks shall be provided on one side of the street only.

2.3.5 Arterial

01 Arterial roads provide a direct link for residential, commercial, and public transportation traffic between the collector and the arterial road network. Traffic volumes are typically larger than 10,000 vehicles per day. Generally, the road will support 2-lane traffic with wider pavement widths to provide a combination bicycle lane and emergency stop lane on both sides. Provision for bus bays has also been taken into consideration. Access to low density residential lands is prohibited and access to non-residential lands will be determined on a case by case basis at the draft plan and site plan approval stage. The arterial road is the major transportation route in the City's road system and is designed to accommodate 4-lane traffic. Access to public side streets is restricted. A wider ROW width is required to accommodate 4 or 5 lanes of traffic, bus bays, and bicycle traffic. Design ROW widths of 26 to 30 meters shall be provided and sidewalks are required on both sides.

2.4 Determination of Road Classification

01 The Official Plan and Transportation Study for the City of North Bay must be referenced in addition to the traffic volumes when determining the proposed road classification.

02 Traffic Volumes forecasts at the Draft Plan Stage will be estimated based on ten vehicle trips per dwelling unit plus expected through traffic from the existing road network. Trip generation for various land uses shall be determined using the Institute of Transportation Engineers Trip Generation Manual (current edition) or approved equal publication. Traffic distribution and volume forecast data should be described in conceptual plans.

2.5 Vertical and Horizontal Alignment

01 **Table 2.1** provides vertical and horizontal alignment standards.

Table 2.1 Road Classification/Design Speed/Alignment Criteria

Classification (AADT Range)	Design Speed (km/h)	Posted Speed (km/h)	Min. Grade (%)	Max. Grade (%)	Min. Horizontal Radius	Min. Crest "K" Value	Min. Sag "K" Value
Rural Residential (under 3,000)	80	60	0.5	8.0	250 m 6% max Super-elev.	24	25*
Semi-Urban Residential (under 3,000)	60	50	0.5	8.0	185 m Normal/ Reverse Crown	10	15*
Urban Residential (under 3,000)	60	50	0.5	8.0	185 m Normal/ Reverse Crown	10	8
Urban Collector (3,000 - 10,000)	70	50-60	0.5	6.0	200 m 4% max Super-elev.	16	10
Arterial (>10,000)	80	50-60	0.5	6.0	280 m 4% max Super– elev.	24	12

02 Sag curve values in Table 2.1 marked with an asterisk (*) have been based on poorly illuminated areas with little or no streetlights. These values are for headlight control.

03 Maximum allowable grades may not apply at street intersections.

04 Site specific special conditions may dictate that a higher slope is required.

2.5.1 Vertical Alignment

01 Vertical curves are required where longitudinal grades change by more than 1.0%.

02 Road cross fall is to be adjusted at sag curves and detailed on the plans as necessary to maintain minimum 0.5% grade along gutter line to catch basins. In the case of semi-urban sections, roadside ditch grades shall be designed at 1% minimum slope.

03 For accommodating major storms, the design profiles shall minimize the number of sag curves where possible. The limiting depth of flow on the roadway shall be 300 mm and major overland flow routes are to be directed to coincide with public lands (parks, walkways, etc.).

2.5.2 Horizontal Alignment

01 All road alignments shall be in accordance with geometric design standards (TAC or MTO) to produce safe traffic flow at the design speed. Designs should be based on a normal cross fall, however super elevation will be permitted depending upon road classification.

2.6 Cross Section, Right-of-Way Width, Pavement Structure, & Base Composition

01 All development submissions will require a geotechnical investigation and report prepared by a qualified professional. The final geotechnical report must be submitted to the City of North Bay along with the first submission of drawings.

02 For rural, semi-urban, and urban roadways, the roadway cross-section, right-of-way width, pavement structure, and base composition shall be, as a minimum, in accordance with Appendix A.

2.7 Cul-De-Sacs/Turning Basins

01 Permanent turning basins are to conform to the turnaround detail as per the OPSS and corresponding drawing shown on OPSD 500.020.

02 A minimum grade of 0.5% is to be maintained along gutter line. Gutter line grades to be detailed on drawings.

03 Temporary turning basins, in accordance with the applicable OPSD, shall be provided at the limits of each phase where a temporary dead-end section of roadway would otherwise result. Where feasible, the temporary turning basin should be accommodated on lands beyond the phase boundary. If this is not feasible, the turning basin should be offset to one side of the roadway, so as to impact as few lots as possible.

04 When future phases of any subdivision are not constructed within a one year time frame, all cul-de-sacs will be required to be paved with base course asphalt.

05 Easements are required for the purpose of constructing temporary turning basins outside of the public road system and shall be provided to the City of North Bay to be disposed of when no longer required. The easement shall be deeded the City who will relinquish its interest in the lands at such time as the lands are no longer required.

2.8 Driveway Entrances

01 Access to the public street must comply with the City of North Bay's Private Approach By-Law.

02 Driveway locations are required to be illustrated on the Engineering Plans for multi-residential lots.

2.9 Intersections

01 Intersection spacing shall be established on the basis of providing safe stopping, turning, and crossing sight distances in accordance with the stipulated design speed.

02 An intersection angle of 90 degrees is preferred, but the minimum allowable angle shall be 70 degrees.

03 Gradients on through streets are to have a continuous profile. Maximum and minimum grades at an intersection are 8.0% and 0.5% respectively.

04 Gradients on all other streets must have 12 metres at a maximum of 2% prior to entering into the intersection.

05 Intersections at Collector/Collector, Arterial/Arterial, and Collector/Arterial shall contain a 3.0 meter by 3.0 metre setback from the intersecting property lines to facilitate a day lighting triangle. A larger day lighting triangle may be requested by the City Engineer.

06 The edge of pavement intersection radii for the intersection of the various roadway classes shall be in accordance with **Table 2.2**.

Table 2.2 Intersection Radii (From Street Class to Street Class)

From	To	Edge of Pavement Minimum Radii (m)
Rural Residential Semi-Urban Urban Residential	Local Collector	7.5
Collector	Any higher Class road	12.0
Arterial	Any higher Class road	15.0

*Note: Turning templates are to be used where conditions warrant.

2.10 Emergency Access

01 Phases shall not terminate in dead end streets, or in cul-de-sacs longer than 250 meters measured from the intersecting street line to the widening of the cul-de-sac right-of-way.

02 A temporary roadway longer than 250 meters is acceptable provided that a second temporary access is provided to either loop the street or limit the cul-de-sac length to 250 meters, or the linkage will be made through an adjoining phase in the next development.

2.11 Sidewalks

01 The location of sidewalks within the right-of-way will be determined in consultation with the City of North Bay giving due regard to the pedestrian traffic being generated and the Accessibility for Ontarians with Disabilities Act.

02 Sidewalks are required to facilitate access to neighbourhood schools and at all Canada Post mailboxes.

03 The location of pedestrian crossings at intersections will be governed by pedestrian movements and the need to avoid conflicts with turning vehicles.

04 Generally sidewalks will be required in accordance with the criteria in **Table 2.3**.

Table 2.3 Sidewalk Placement

Road Classification	Adjacent Land Use	Sidewalk Required
Semi-Urban Residential Urban Residential	Low and Medium Density Residential High Density Residential All Other Land Uses	Optional
Urban Collector	All Land Uses	One side of street only
Arterial	All Land Uses	Both sides of Street

05 A sidewalk is not required on dead end roadways less than 150 meters in length unless through pedestrian access is required from the roadway to a park, roadway to roadway, etc. The 150 meters is measured from the intersecting street line to the nearest point of the cul-de-sac right-of-way.

06 Concrete sidewalks are to be 1.5 meters wide, and shall be in accordance with OPSD 310.010 and OPSD 310.020 for sidewalk adjacent to curbs. Residential entrances shall be in accordance with OPSD 351.010. The granular base thickness shall be minimum 100 mm granular A

07 For commercial/industrial frontages, entrance locations shall be determined at the site plan approval stage. All sidewalks and walkways are to be continuous through driveway entrances and shall be in accordance with OPSD 310.050 and OPSD 350.010. Providing commercial sidewalks across each entrance will be evaluated by the City on a case by case basis.

08 Where it has been determined by the City that there is a need, sidewalk ramps and sidewalk stubs shall be constructed to link existing sidewalks to the curb. Any connecting sidewalks and ramps needed on the opposite side of the roadway to provide continuity for the pedestrian shall also be included.

09 The minimum width for asphalt recreational pathways (walkways/bicycle pathways) shall be 3.0 m.

10 Sidewalk ramps at signalized intersections shall include accessible pedestrian pole and tactile walking surface indicators as per OPSD 310.030.

11 Concrete sidewalk ramps at non-signalized intersections shall include tactile walking surface indicators as per OPSD 310.033.

12 Tactile walking surface indicator panels shall comply with the Ontario Accessibility Act and shall conform to OPSD 310.039.

2.12 Curb and Gutter Types

01 Concrete curb and gutter shall be concrete barrier type as per OPSD 600.040.

02 City of Barrie BSD-17 curb can be used in new residential subdivisions where driveway locations have not been determined and in other locations as approved by the City Engineer.

2.13 Pedestrian Walkways

01 Pedestrian walkways shall be located as required to facilitate pedestrian traffic in conjunction with the roadway sidewalk system. The walkway shall link the street system with adjacent parks, schools, and commercial areas. The minimum width of the ROW for the walkway shall be 4 meters, however greater widths may be required to facilitate vehicular access and/or the placement of underground utilities.

02 Chain link fencing shall be installed along each property line of the walkway right-of-way with terminal posts installed at the intersecting property line or in a location approved by the City. The chain link fence for all walkways, complete with top rail, shall be installed in accordance with OPSD 972.130. All fence posts and rails are to be galvanized.

03 Walkways shall have an asphalt surface 50 mm thick. The minimum width of the walking surface shall be 3.0 metres. The width of the granular base (minimum 150 mm) and the granular sub-base (minimum 300 mm) shall be 0.3 m wider than the asphalt surface. The walkway shall have a minimum side slope of 2% and shall not have a walking slope greater than 4%.

04 Adequate lighting will be required to ensure that the walkway is sufficiently illuminated for pedestrian safety purposes.

2.14 Bicycles

01 Bicycle movement shall generally be accommodated in the road ROW. Consideration shall be given for the inclusion of bicycle lanes, in addition to those which form part of the road system, in the ROW for new arterial and collector roads, and the addition of facilities for bicycles on existing arterial and collector roads where it is feasible to do so.

2.15 Community Mail Boxes (If Required)

01 Pedestrian approaches to community mail boxes shall be incorporated into the design of the works to accommodate the mailboxes provided by Canada Post.

02 At each permanent mailbox location, a concrete pad shall be provided with a concrete walk connecting to both the existing road and sidewalk system. The pad and approaches shall be poured in conjunction with the sidewalk system and shall follow the sidewalk width and thickness dimensions.

03 A mountable curb for pedestrian access shall be provided.

04 The community mailbox location will be determined in consultation with Canada Post and the Developer's Engineer.

2.16 Boulevard Landscaping

01 Where detailed on the City's typical road section or directed by the City Engineer, boulevards shall be finished with 150 mm of topsoil and nursery sod and shall be watered for 30 days. The requirements for hydro-seeding or sodding of other public areas will be determined by the City Engineer.

02 Where indicated on the City's typical road section or directed by the City Engineer, boulevards shall be finished with surface asphalt paving with a minimum 150mm granular base material.

03 The boulevard slope shall be a minimum of 2% and a maximum of 10% within the public right of way.

2.17 Signs and Traffic Control Devices

01 All traffic control devices are to conform to the Ontario Traffic Manual and shall meet the requirements of the Highway Traffic Act.

02 At each intersection, an approved double unit street name blade sign indicating the name of each intersecting street shall be erected. The sign shall be mounted on a galvanized metal post 3.7 meters long embedded 1.2 meters in the ground and shall be painted according to a colour scheme approved by the City.

03 The Developer shall provide all traffic and street signs as required. Signs shall be located in accordance with the Ontario Traffic Manual and shall have diamond grade sheeting.

04 All traffic and street name signs are to be erected prior to completion of the base course asphalt.

05 Warning signs with the text "ROAD NOT ASSUMED – USE AT YOUR OWN RISK" are to be placed at each entrance to the development at such time as the base course

asphalt is applied. The sign shall be sized such that it is legible from the roadway, however it shall not exceed 3.0 square meters in size.

2.17.1 Local Intersections (2 lanes)

01 Signs are to be high intensity grade reflectorized sheeting (3M or equivalent) mounted on 150 mm extruded aluminum blanks (blue - anodized). Lettering shall be 100 mm (125 mm) series "B" Helvetica" (white – upper case).

2.17.2 Major Signalized Intersections

01 In accordance with Ontario Traffic Manual Book 8, Low-Speed Roadway Identification Signs mounted on the primary traffic signal arm are required at all major signalized intersections. Where the crossing roadway is different to the left and right, the front of the Low-Speed Roadway Identification Sign shall display the name of the road to the right and the back shall display the name of the road to the left and both shall include turn-off arrows.

2.18 Traffic Impact Study

01 The need for a traffic impact study shall be determined by the City Engineer on a case by case basis.

2.19 Construction

01 All construction shall be in accordance with the City's Construction Specifications as well as the Ontario Provincial Standard Specifications and Drawings.

2.20 House Numbering

01 A 911 numbering plan for subdivisions shall be submitted to the City for approval. The City will provide the Developer with the numbering format upon request.

3 GRADING CONTROL PLAN

3.1 General

01 Lot grading design shall conform in principle to the site Stormwater Management Plan if applicable. The developer is required to pre-grade all lands affected by the right of ways or drainage easements in order to achieve the approved lines and grades. In addition, they may also be required to pre-grade as the design may dictate, any other designated lands within the plan to limit flood risk-having regard for the pre-development overland flow patterns. The term "flood risk" is to be interpreted as a risk of personal liability and/or property damage as a result of

flooding brought about by the alteration of pre-development flows and/or flow patterns.

3.2 Design Criteria

01 Lot grades shall be 2% minimum and 3:1 maximum on all grassed surfaces. Adequate control measures shall be employed where necessary to control erosion. When stormwater lot conveyance is being utilized as recommended through the approved stormwater management report for the development the minimum slope shall be 1%, except within 1.2 m of a building, where the minimum grade shall be 2%.

02 Retaining walls are to be identified on the plan where the maximum lot slope is exceeded.

03 Entrance slope shall not exceed 10% within the lot boundary.

04 Natural drainage patterns and channels must be respected. Land owners must accommodate runoff from up gradient properties. Surface runoff water shall not be discharged onto adjacent lands in a concentrated amount nor shall it exceed the pre-development flows.

05 Major system drainage is to be directed to public lands, or public drainage system.

06 Rear yard catchbasin leads shall be located in public easements more or less straddling the common lot line.

07 Leads to rear yard catchbasins shall not be less than 250 mm and shall be spaced to coincide with maintenance holes or roadside catchbasins such that access is obtainable from either end.

08 The maximum depth of ponding based on the major (100-year) storm event shall not exceed 300 mm, before outletting through an overland flow route.

09 Minimum easement widths shall be in accordance with the requirements identified in Appendix B.

3.3 Overland Storm Flow Routes

01 All major swales and major system outlets are to be constructed and sodded by the Developer in conjunction with site servicing. While lot grading in general is the responsibility of the building permit applicant, common drainage facilities, as noted in the Subdivision Agreement, are the responsibility of the Developer.

3.4 Subdivision Agreement Lot Grading Requirements

01 The Owner shall submit to the City, for the approval of the City Engineer, a Grading Control Plan prepared by the Owner's Consulting Engineer, establishing the proposed grading of the lands in the project to provide for the proper drainage

thereof and the drainage of all adjacent lands which drain through the lands in the project. All elevations shall be according to geodetic datum.

02 The Grading Control Plan shall be prepared in accordance with the City's current lot drainage specifications and shall not provide for the drainage of surface run-off water onto City-owned parkland, open space, walkways or other private lands not part of the subdivision unless provision is made for the installation by the Owner, at no cost to the City, of suitable swales and catchbasins to manage surface run-off water adequately, in the opinion of the City Engineer.

03 The Owner shall grade all the lands in the project in accordance with the approved Grading Control Plan, ensuring that sufficient topsoil remains as cover on all areas of the project intended for sodding, hydro seeding, or other planting.

04 Prior to commencing any grading, the owner shall install all of the erosion and sediment control measures as identified on the approved Erosion and Sediment Grading Control Plan.

05 If the City determines that:

[a] grading has not been done in accordance with the Grading Control Plan,
[b] grading has been done in accordance with the Grading Control Plan but drainage problems remain, or
[c] sufficient topsoil has not been left in the appropriate areas,

The Owner shall re-grade the project, or part thereof affected, adding a sufficient amount of topsoil if necessary, or construct catchbasins, swales or other structures as may be necessary to correct such problems, as directed by the City Engineer.

3.5 Rear Lot Drainage

01 Rear yard drainage infrastructure (catchbasins, sewers, ditches, swales, etc.) is not permitted unless otherwise approved by the City Engineer.

02 Where approved, rear yard drainage shall meet the following requirements:

[a] The minimum slope for rear yard swales is 2%.
[b] Rear yard drainage systems including piped systems with catchbasins are required for any slope less than 2%.
[c] For slopes 1% to 2%, catchbasin spacing shall be 6 lots or 90 metres (whichever distance is smaller).
[d] For slopes 1% to 0.5%, catchbasin spacing shall be 4 lots or 60 metres (whichever distance is smaller).
[e] Rear lot catchbasins shall be in accordance with OPSD705-010 with birdcage catchbasin grates as per OPSD 400.120

[f] All rear lot drainage storm sewer systems draining to the road network storm sewer shall:

[i] Be installed with Granular A bedding and granular backfill.

[ii] Have a minimum depth of bury of 1.5 m measured from finished grade to top of pipe.

[iii] Have a minimum diameter of 250 mm.

[iv] Be PVC DR 35 or CSA approved high density corrugated exterior and smooth inside walled polyethylene BIG "O" Boss 2000 or equivalent as per OPSS 1840. Corrugated steel pipe is not permitted.

3.6 Lot Grading Compliance

01 Prior to the issuance of a building permit, the builder will submit an individual lot grading plan showing the proposed lot grades and house location complete with setback dimensions to each lot line. This plan will show how the grading is in compliance with the overall subdivision/lot grading plan. As a condition of the issuance of an occupancy permit, the lot grading plan will be checked and certified by an Ontario Land surveyor verifying the lot grades and building set back dimensions. A certification letter and drawing shall be prepared by the OLS and submitted to the City detailing the proposed and as constructed grades.

4 WATER DISTRIBUTION SYSTEM

4.1 General

01 All Water Distribution Systems constructed in the City of North Bay shall be designed to the standards and specifications of the City of North Bay.

02 In situations not covered by the enclosed standards and specifications the following documents must be referenced:

[a] Municipal Works Design Manual

[b] Ministry of the Environment, Conservation, and Parks (MECP) Design Guidelines for Drinking Water Systems (2008)

[c] Ontario Provincial Standard Drawings and Specifications, and

[d] American Water Works Association.

4.2 Watermains

4.2.1 Design Considerations

01 Generally, flows are to be designed to standards established by the City of North Bay described herein. In situations not covered by the enclosed standards and specifications, the MECP Design Guidelines for Drinking-Water Systems document must be referenced.

4.2.2 Design Criteria from the MECP Design Guidelines

01 The Average Day per capita for single family residential use shall be 450 L/(cap·d).

02 Maximum Day Factor and Peak Rate Factor (Peak Hour) shall be in accordance with the MECP Design Guidelines.

03 Water distribution system sizing shall be based on the greater of Maximum Day demand plus fire flow or Peak Rate demand (Maximum Hour).

04 The normal operating pressure in the distribution system should be approximately 350 to 480 kPa (50 to 70 psi).

05 The maximum pressure in the system shall not exceed 700 kPa (100 psi).

06 The minimum pressure in the system shall not be less than 275 kPa (40 psi) under Peak Rate demand (Maximum Hour) conditions.

07 The minimum pressure in the system shall not less than 140 kPa (20 psi) under Maximum Day demand plus fire flow conditions.

08 A Form 1 – Record of Watermain shall be completed and submitted to the City Engineer prior to starting construction. The City of North Bay's Drinking Water Works Permit number is 196-201

4.2.3 Additional Criteria

01 Design fire flows shall be in accordance with the latest edition of Water Supply for Public Fire Protection by the Fire Underwriters Survey. Should insufficient fire flow exist in the system, the Fire Chief shall determine the minimum acceptable fire flow. The minimum fire flow for residential land developments with detached dwellings shall not be less than 75 L/s (1200 US gpm).

02 The following Hazen Williams "C" values shall be used for design:

Table 4.1 Watermain Hazen Williams "C" Values

Diameter (mm)	C
50-150	100
200 to 250	110
300 to 600	120
Over 600	130

03 The minimum pipe size for water mains shall be 200 mm with the exception that dead-end mains on cul-de-sacs of 20 or less dwelling units may be 150 mm.

04 All mains shall be looped including those servicing cul-de-sacs. Alternatives to looping that may be considered are: continuous twin feed loop, "lollipop" and hydrant option, a single 50 mm (2") copper line with no more than 5 service

connections. The approved alternative will be at the sole discretion of the City Engineer.

05 A suitable means for flushing, such as a hydrant or a blow-off, shall be provided on mains larger than 50 mm. Such flushing devices shall not be connected to any sewer. Devices other than hydrants shall be approved on a case-by-case basis.

06 Watermains shall be evenly graded (i.e. successive dips, to work around sewers or other obstacles, are to be avoided) and hydrants shall be placed at high points.

07 The minimum depth of cover measured from the top of a main shall not be less than 2.2 m.

08 Pipe bedding class and compaction requirements shall be determined based on geotechnical recommendations and engineering design.

09 Separation between water and sewer mains shall conform to MECP Separation Guidelines.

4.3 Restraint

01 For watermains with a diameter of 350 mm or less, thrust blocks (OPSD 1103.010 and 1103.020) and mechanical restraints shall be used.

02 For watermains greater than 350 mm in diameter, every joint shall be restrained and shall be designed by a professional engineer.

4.4 Valves

01 Three valves shall be placed on a tee intersection and four valves on a cross intersection. On straight runs, isolation valves spacing shall be not less than the equivalent of isolating 40 family dwellings units.

02 All valves up to and including 400 mm in diameter shall be provided with a valve box and shall be direct bury. Valves greater than 400 mm shall be designed on a case by case basis with consideration for direct bury, valve chamber, and bypass options.

03 Air valves shall be located at all significant high points on feeder mains.

4.5 Service Connections

01 Services shall be sized in accordance with the Ontario Building Code as amended. The minimum shall be 20 mm for lots zoned for single family dwelling units, and 25 mm for lots zoned for low density with an average width greater than 20 m and where the service line between the main and the dwelling exceeds 25 m.

02 Service connections shall have a corporation main stop and be “goose-necked horizontally” at the watermain as per OPSD 1104.010 and OPSD 1104.020. Main

stops will be set between the spring line and 45 degrees to the horizontal to ensure the service maintains the minimum depth of cover.

03 Curb stops will be ball valve type without drain and the associated service box shall be slide type with access at finished grade and be located at the property line. All such service connections shall be in accordance with relevant OPSD. A stainless steel extension rod shall be used.

04 Only one water service per lot is permitted.

05 There shall be no joints between the main stop and the curb stop and no joints between the curb stop and the building interior. Where couplings are required, they shall be copper to copper compression.

06 All services for which the City has distribution rights or maintenance responsibilities become the sole property of the City upon the issuance of the "Certificate of Final Approval".

07 The minimum depth of cover measured from the top of a service connection gooseneck shall not be less than 2.2 m.

4.6 Fire Hydrants

01 The minimum hydrant capacity shall be 30 L/s (500 US gpm).

02 Hydrants shall be installed as per OPSD 1105.

03 Hydrants shall be located such that the maximum road travel distance from hydrant to the center frontage of a lot in a residential area shall not exceed 100 m. Any deviation beyond the maximum allowable spacing shall require the approval of the City's Fire Chief.

04 Hydrants shall be located on lot line where feasible.

05 The maximum allowable hydrant spacing shall be:

[a] 150 m in residential areas;
[b] 75 m in commercial, industrial and institutional areas.

06 Each hydrant shall have an isolation valve with a valve box attached with an anchor tee at the main.

07 The minimum depth of cover measured from the top of a hydrant lead shall not be less than 2.2 m.

08 All hydrants shall be located in an obstruction free zone such that neither their view nor their accessibility is obstructed. In particular, no object shall be permitted within a triangle bounded by a point commencing 1.0 meter behind the hydrant, and extending at a 45º angle to the curb or roads edge. In addition, no object wider in any direction than 250 mm is permitted within an area bounded by a triangle within an apex 1 m behind the hydrant and sides intersecting the road edge or curb at a 10º angle. The Fire Chief shall have the final authority on the

location of structures or other items, which might interfere with the view, or the accessibility of hydrants.

09 Hydrants will be located off the property line as shown on the road cross-sections provided in Appendix A.

10 Where a hydrant is located on the backside of the ditch, access to be determined on a case by case basis.

4.7 Tracer Wire/Cathodic Protection

01 All non-metallic water mains shall have a 12 gauge tracer wire. One 5.4 kg zinc anode shall be installed for every 1000 meters of tracer wire. The location of the anodes shall be shown on the engineering drawings.

02 Tracer wire shall be looped up the outside of all main valve boxes and extended into the valve box by 50 mm through a saw cut 50 mm below the bottom of the cover bell.

03 Valves, metallic fittings and hydrants shall be protected with 5.4 kg zinc anodes for non-ferrous fittings and 14.5 kg anodes for ferrous fittings.

04 All metallic services of 25 mm or smaller and less than 20 m in length shall be protected with a 5.4 kg zinc anode.

05 When connecting a non-ferrous watermain to a ferrous watermain, the ferrous watermain shall be protected by a 14.5 kg magnesium anode.

06 Denso tape or alternatives will be considered on a case-by-case basis as a corrosion prevention measure.

07 Test stations for corrosion monitoring shall be included at each intersection or every 100 to 150 m. The stations shall be located in the boulevard.

5 SANITARY SEWER SYSTEM

5.1 General

01 All Sanitary Sewer Systems constructed in the City of North Bay shall be designed to the standards and specifications of the City of North Bay.

02 In situations not covered by the enclosed guidelines the following documents must be referenced:

[a] Municipal Works Design Manual
[b] Ministry of the Environment, Conservation, and Parks (MECP) Design Guidelines for Sewage Works (2008)
[c] Ontario Provincial Standard Drawings and Specifications, and
[d] American Water Works Association.

5.2 Material Requirements

01 Where the mainline pipe material is pressure pipe the service material must be of similar material. Provide service pipe material transition at the property line using Fernco coupling or approved equal.

5.3 5.02.02 Bedding

01 Pipe bedding shall be as detailed in OPSD Division 802. Bedding and cover shall conform to Granular "A" in accordance with OPSS 1010. For site specific bedding, embedment, and cover recommendations, the geotechnical report prepared for the particular project shall provide the class of bedding.

5.4 Design Considerations

01 Flows are to be designed to standards established by the City of North Bay described herein. In situations not covered by the enclosed standards and specifications the MECP Design Guidelines for Sewage Works must be used.

02 No decrease in pipe size downstream shall be allowed unless otherwise approved by the City Engineer.

03 The minimum sanitary main size shall be 200 mm.

04 The maximum and minimum flow velocities shall be in accordance with MECP Design Guidelines. Under conditions provided in **Table 5.1**, a minimum design flow velocity below 0.6 m/s will be considered provided that the minimum slopes are obtained, subject to the approval of the City Engineer:

Table 5.1 Acceptable Conditions for Minimum Sanitary Sewer Design Flow Velocity Below 0.6 m/s

Size/ Condition	Minimum Slope
First 25 Upstream Dwelling Units	1.0%
Top reach (MH to MH)	1.0%

05 Separation of sewer mains and watermains shall be as per MECP separation guidelines.

06 The minimum depth of cover for sanitary sewers shall be 1.80 metres. The mainline sewer must be sufficiently deep to be able to service the basement elevation of the houses/structures it is servicing.

07 Digital sewer design sheets must be submitted.

08 Hydraulic gradeline calculations shall be provided and a hydraulic gradeline shall be shown on the engineering drawings where there is potential for basement flooding and/or at the discretion of the City Engineer.

09 Sanitary sewers shall be designed using Manning's Formula with a roughness coefficient (n) of 0.013.

10 Design flow calculations shall use 450 L/cap·d. Population design density based on gross population per hectare will be provided by the Planning Department. Industrial, commercial and institutional design flows shall be considered on a case-by-case basis.

11 All design flow peaking factors shall be as per MCEP design guidelines.

12 Infiltration/Inflow (I/I) rates shall be as follows:

[a] For the West Ferris area, the I/I rate shall be 2.0 L/s/ha;
[b] For all other areas constructed more than 20 years ago, the I/I rate shall be 0.44 L/s/ha; and,
[c] For all other areas constructed within the last 20 years, the I/I rate shall be 0.28 L/s/ha.

13 Precast drop structures shall be as per OPSD standards. Internal drop structures shall be used.

14 Weeping tile and storm sump pumps shall not be connected to the sanitary sewer system. If a storm sewer service does not exist at the property line, the sump pump shall discharge to the ground surface. If pumped to the surface, runoff shall be contained onsite and prevented from draining across sidewalks.

5.5 Sanitary Maintenance Holes

01 All maintenance holes shall conform to OPSD Division 700 standards and shall be constructed of precast concrete as detailed on the standard drawings.

02 Maintenance holes shall be provided at each change in alignment, grade, and at all junctions, except where radius pipe is used in size 1050 mm and over.

03 Maintenance holes shall be spaced at a maximum of 120 m for pipe sizes 1200 mm diameter or less, and a maximum of 150 m for pipe sizes over 1200 mm diameter.

04 The OPSD type and size of maintenance hole shall be specified on the profile and a detail of the benching is to be shown on the plan portion of the engineering drawing for cases when the benching differs from the OPSD standard.

05 A drop pipe should be provided for a sewer entering a maintenance hole at an elevation of 610 mm or more above the maintenance hole invert. Whenever feasible, sewer systems shall be designed to avoid the use of drop structures.

06 When the pipe size does not change through a maintenance hole and the upstream flow velocity does not exceed 1.5 m/s, the following allowances shall be made to compensate for hydraulic losses:

Table 5.2 Sanitary Sewer Head Losses through Maintenance Holes

Alignment Change	Drop Required
Straight run	grade of sewer
15 – 45 degrees	0.03 m
45 – 90 degrees	0.06 m
Junctions and Transitions	MECP Design Guidelines

07 The sewer inlet obvert(s) on the upstream side of a maintenance hole shall not be lower than the sewer outlet obvert(s) on the downstream side of the maintenance hole.

08 All maintenance holes shall be benched as per OPSD 701.021. All benching shall be sloped at 2% to the channel and the alignment of the sewer shall extend a minimum of 150 mm into maintenance hole before a change in alignment begins.

Table 5.3 Benching Height above Outlet Pipe Invert (lowest benching shall govern)

Pipe Diameter	Benching Required
Up to 250 mm inclusive	0.5 pipe diameter
300 mm	175 mm
350 mm & 375 mm	0.5 pipe dia. + 50 mm*
400 mm to 600 mm inclusive	0.5 pipe dia. + 75 mm*
Greater than 700 mm	0.5 pipe dia. + 100 mm*

*Note: Channel benching above the 0.5 pipe diameter point shall be vertical.

09 The OPSD's provide details for maintenance holes up to certain maximum depths. The engineer shall analyze individually each application of the standards related to soil conditions, loading, and other pertinent factors, to determine structural suitability. In all cases where the standards are not applicable, maintenance holes shall be individually designed and detailed. When any dimension of a maintenance hole exceeds those indicated on the OPSD's, the maintenance hole shall be individually designed and detailed.

10 Safety gratings shall be required in all maintenance holes greater than 5.0 m in depth. Safety gratings shall not be more than 5.0 m apart and shall be constructed in accordance with the OPSD's.

11 Whenever practical, a safety grating shall be located 0.5 above the drop structure inlet pipe.

12 All maintenance holes located on easements in parks, playgrounds, low areas, or in other locations as deemed necessary, shall be equipped with a locking watertight frame and grate.

13 A circular asphalt collar with a minimum 1 m width and 50 mm depth shall be installed around maintenance holes located in gravel areas.

14 For maintenance holes located outside the roadway, concrete adjustment rings shall have moduloc tape between the units.

15 Sampling maintenance holes shall be installed on a case by case basis at the request of the City Engineer.

16 The maximum change in the direction of flow in any sanitary sewer maintenance hole shall be 90 degrees.

17 The maximum pipe sizes for precast concrete maintenance holes shall be based on manufacturers' standards.

5.6 Sanitary Services (Sanitary Service Connections & Building Sewers)

01 Separate services shall be provided to each building and each unit of a semi-detached or row house residential building. The service will start from the sanitary main and extend to the lot line. Wye type servicing will not be permitted, unless otherwise approved by the City Engineer. If approved by the City Engineer, a backflow preventer is required on each service.

02 The connection to the main sewer shall be made with an approved manufacturer's tee or approved saddle.

03 Building sewers and service connections shall be laid at a minimum grade of 2% from the building line to the main sewer.

04 Building sewers and service connections connected to sewer mains larger than the service size may use a premanufactured tee connection rotated between 22 ½ degrees and 45 degrees to the horizontal.

05 Service connections can be connected directly to maintenance holes provided the installation is completed based on the specified standards.

06 Building sewers from adjacent properties shall not be connected to each other.

07 Sanitary services shall be sized to meet the Ontario Building Code as amended and shall be a minimum of 125 mm. The pipe colour shall be green or white.

08 The minimum cover for sanitary services will normally be a minimum of 1.8 m from the finished grade. Services of less than 1.8 m may be permitted on a case-by-case basis. In such cases frost protection must be equivalent to 1.8 m of cover. Services with less than 1.0 m of cover are not permitted.

09 No foundation drains or building storm drains are permitted to be connected to the sanitary sewer system. Sanitary services shall not be connected to a storm main.

10 Unconnected sanitary and other drain services shall be brought to the property line, properly capped and clearly marked such that an installer will not cross connect services. Capped services shall be appropriately marked to at least 1.0 meter above finished grade level.

11 Inspection chambers on the sanitary service shall be installed at the lot line.

12 For building sewer services, risers shall be used when the obvert depth of the sanitary sewer main exceeds 4.5 m.

13 Sanitary sewer connections for commercial, industrial and institutional properties shall require a maintenance hole located on the property line.

14 Pumped service connections shall have pump chambers located on the exterior of the buildings and measures in place to alert the home owners in the event of a pump malfunction.

6 STORM SEWER SYSTEM

6.1 General

01 For lot planning purposes, conceptual analysis of the storm sewer system (main and major components of drainage) shall be undertaken in discussion with the City of North Bay at the draft plan stage.

02 The storm sewer system shall be designed to standards established by the City of North Bay described herein.

03 In situations not covered by the enclosed standards and specifications the following documents must be referenced:

[a] Municipal Works Design Manual
[b] Ministry of the Environment, Conservation, and Parks (MECP) Design Guidelines for Sewage Works (2008), and
[c] Ontario Provincial Standard Drawings and Specifications.

6.2 Responsibilities

01 City of North Bay approval is required on all storm sewer, drainage and stormwater management systems. Additional approvals may be required, but is not limited to the following list of agencies: MECP, MTO, MNR, DFO, the North Bay-Mattawa Conservation Authority (NBMCA), and Transport Canada. The proponent of the works shall ensure that all pertinent regulatory agencies are consulted during the design phase of the project. The approval will involve the following: surface drainage, including storm frequency, catchbasin location, catchbasin inlet capacity, and runoff coefficients, as well as approval for filling and work around shorelines.

6.3 Storm Sewer Design Considerations

01 Digital sewer design sheets must be submitted.

02 Storm sewer design flows shall be calculated using the Rational Method.

03 Storm sewers (all pipe material) shall be designed using Manning's Formula with a roughness coefficient (n) of 0.013.

04 Storm sewers shall be designed for the peak flow from a 5-year storm.

05 Surcharging may be permitted subject to the peak flow from a 50-year storm not surcharging into any connected building foundation drainage system. Where there is potential for basement flooding and/or at the discretion of the City Engineer, hydraulic gradeline calculations shall be provided and a hydraulic gradeline shall be shown on the engineering drawings.

06 Typical runoff coefficients ("C" values) are provided in the following table. Where there are mixed land uses or where the impervious and pervious areas are known for a site, a weighted runoff coefficient should be calculated. Other runoff coefficients for urban and rural areas are provided in Design Chart 1.07 of the MTO Drainage Management Manual (1995-1997).

Table 6.1 Stormwater Runoff Coefficients

Land-Use Type	C
Asphalt, concrete, roof areas	0.90
Granular	0.60
Grassed area, parkland	0.25
Commercial	0.80
Industrial	0.70
Single family housing, lot size ≥ 400 m^2	0.40
Single family housing, lot size ≤ 400 m^2	0.50
Semi-detached housing	0.50
Townhouses	0.60
Apartments	0.60
Institutional	0.55

07 The following City IDF values shall be used in the design (see Appendix C for a chart of the IDF curves):

Table 6.2 City of North Bay IDF Rainfall Depths in mm (1964-2006 Data)

Duration	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5 min	7.8	10.9	12.9	15.5	17.4	19.3
10 min	11.4	15.4	18.1	21.5	24	26.5
15 min	14.1	18.9	22.1	26.1	29.1	32.1
30 min	18.9	24.6	28.4	33.2	36.7	40.2
1 hr	23.8	31.7	36.9	43.5	48.3	53.2
2 hr	29.2	38.8	45.2	53.2	59.2	65.1
6 hr	40.7	52.3	60	69.8	77	84.2
12 hr	48.6	61.5	70	80.7	88.7	96.6
24 hr	55.7	69.8	79.1	90.9	99.7	108.4

Source: Environment Canada Website ("IDF Files" link, February 27 2019)
(https://climate.weather.gc.ca/prods_servs/engineering_e.html)

Table 6.3 City of North Bay IDF Rainfall Rates in mm/hr (1964-2006 Data)

Duration	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5 min	93.8	130.6	155.0	185.8	208.6	231.3
10 min	68.5	92.7	108.7	128.9	143.9	158.8
15 min	56.6	75.8	88.5	104.5	116.4	128.2
30 min	37.8	49.2	56.8	66.3	73.4	80.4
1 hr	23.8	31.7	36.9	43.5	48.3	53.2
2 hr	14.6	19.4	22.6	26.6	29.6	32.5
6 hr	6.8	8.7	10.0	11.6	12.8	14.0
12 hr	4.1	5.1	5.8	6.7	7.4	8.0
24 hr	2.3	2.9	3.3	3.8	4.2	4.5

Source: Environment Canada Website ("IDF Files" link, February 27 2019)
(https://climate.weather.gc.ca/prods_servs/engineering_e.html)

Table 6.4 City of North Bay IDF a, b, c Values

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
a	536	747	880	1055	1176	1309
b	5.7	5.3	5.1	5.0	4.8	4.9
c	0.7440	0.7588	0.7634	0.7688	0.7702	0.7743

Note: Average rainfall intensity in mm/hr, as follows:

where:

$$i = a / (t_d + b)^c$$

i = rainfall intensity, mm/h
td = duration, min
a, b, c are constants as per above table

08 The following minimum allowances for hydraulic losses at maintenance holes shall be provided:

Table 6.5 Storm Sewer Head Losses through Maintenance Holes

Hydraulic Loss Type	C
Straight Run	Grade of Sewer
45°	0.03 m
90°	0.06 m
Junctions and Transitions	MECP Sewer Design Guidelines

09 The maximum and minimum flow velocities shall be in accordance with MECP Design Guidelines.

10 The minimum slope shall conform to the MECP Guidelines.

11 The minimum pipe sizes shall be as follows:

Table 6.6 Minimum Storm Sewer Pipe Sizes

Sewer Type	Minimum Diameter
Storm Sewers	300 mm
Single Catch Basin lead (road)	200 mm
Rear yard catchbasin leads	250 mm
Double Catch Basin leads	250 mm
Foundation and Building Drains	Ontario Building Code Applies
Ditch Inlet Catchbasins	300 mm

12 The minimum depth of cover for storm sewers shall be 1.50 metres. A shallower depth of cover for large diameter pipe (e.g. trunk sewers) will be considered at the discretion of the City Engineer.

13 The design shall ensure that adjacent structures are not jeopardized by extra frost penetration from within a storm sewer, catchbasin, or culvert.

6.4 Storm Maintenance Holes

01 The maximum maintenance hole spacing shall be as follows:

Table 6.7 Maximum Storm Maintenance Hole Spacing

Sewer Diameter	Maximum Maintenance Hole Spacing
250 to 450 mm	120m
500 to 750 mm	150m
Larger than 750 mm	Considered on a case-by-case basis

02 Safety gratings shall be required on all maintenance holes greater than 5.0 meters in depth.

03 All maintenance holes located on easements in parks, playgrounds, low areas, or in other locations as deemed necessary, shall be equipped with a locking watertight frame and grate.

04 All storm maintenance holes shall be precast unless approved by the City Engineer to be cast in place.

6.5 Catchbasins (Storm Inlets)

01 Catchbasins are required at all low points in the road and at low grade points at intersections. Additional catchbasins shall be provided along the roadway as set out in the table below:

Table 6.8 Maximum Catchbasin Spacing

Road Grade (%)	Road Width (m)	Maximum Spacing (m)
0.35 – 0.5%	8.5	45
0.35 – 0.5%	15.0	40
0.6 –3.0%	8.5	90
0.6 –3.0%	15.0	70
3.1 – 5.0%	8.5	75
3.1 – 5.0%	15.0	55
5.1 – 6.0	8.5	60
5.1 – 6.0	15.0	45

02 Double catchbasins shall be used where the inlet capacity of a single catchbasin would be exceeded or where there is a sag in the vertical alignment of the roadway.

03 Catchbasin frames and grates shall conform to OPSD 400.020.

04 For crowned roadways, catchbasins shall be provided on both sides of the roadway.

05 For depths up to 1.8 m (between ground level and invert) catchbasins shall be 600 mm x 600 mm, square, precast concrete conforming to OPSD 705.010. For depths greater than 1.8 m, 1200 mm catchbasin maintenance holes shall be used conforming to OPSD's 701.010 and 704.010.

06 A circular asphalt collar with a minimum 1 m width and 50 mm depth shall be installed around a maintenance hole located in granular areas.

07 Where practical, catchbasins shall be located upstream of pedestrian crossing areas and 1.5 metres clear of any dropped curb at driveways and entrances.

08 Catchbasin leads shall be connected to the main sewer at a maintenance hole wherever possible.

09 Catchbasins shall have a 600 mm sump

6.6 Storm Sewer Outlets

01 Storm sewer outlets shall have riprap treatment in accordance with OPSD 810.010, Type B, with geotextile.

6.7 Storm Services (Storm Service Connections & Building Sewers)

01 Where storm sewers are provided in the design, each dwelling unit shall be provided with an individual storm drainage service connection extending from the storm sewer main to the limit of the City roadway right-of-way. The pipe material colour shall be green or white.

02 The minimum storm sewer service connection size shall be 125 mm and all service connections shall have cleanouts installed at the property line. Backwater prevention valves may be required at the discretion of the City Engineer.

03 At the discretion of the City Engineer, semi-detached units may be serviced by way of a single 150 mm storm sewer service connection with a wye connection at property line and shall include a cleanout and backwater prevention valves on each property.

04 Weeping tile and storm sump pumps shall not be connected to the sanitary sewer system. If a storm sewer service does not exist at the property line, the sump pump shall discharge to the ground surface. If pumped to the surface, runoff shall be contained onsite and prevented from draining across sidewalks.

05 Roof drainage downspouts for single family detached houses shall discharge onto the ground surface and be directed away from foundations and shall not be connected to the storm sewer or sanitary sewer.

06 Storm sewer service connections shall be installed in a common trench with water and sanitary sewer service connections.

07 Where the mainline pipe material is pressure pipe the service material must be of similar material. Provide service pipe material transition at the property line using Fernco coupling or approved equal.

6.8 Ditches and Culverts – Semi-Urban and Rural Roadways

01 All ditches and culverts shall be sized to have capacity for the peak flow from a 25-year storm peak flow using a recognized engineering method such as the Rational Method.

02 The depth below finished centreline grade shall be:

[a] Maximum: 1.5 metres
[b] Minimum: 1.0 metres
[c] 0.5 m below the road subgrade level measured at the ditch

03 The ditch grade shall be:

[a] Maximum: 8.0 percent
[b] Minimum: 1.0 percent

04 The Maximum Permissible Velocity Method or the Maximum Permissible Tractive Force Method, in accordance with the design methods provided in Section 5 of the MTO Drainage Management Manual (1995), shall be used to determine if erosion control measures, such as riprap and geotextile, are required.

05 Ditches through easements requiring design depths exceeding 1.5 meters shall have side slopes no steeper than 3:1, or at the discretion of the City Engineer shall be piped.

06 The minimum ditch protection shall be nursery sod covering, at a minimum, the bottom of the ditch and 0.6 m up each side slope, and 100 mm of imported topsoil and hydro seed on the balance of the side slopes. Subject to steep ditch gradients, the level of sodding (staked) will be determined by the City Engineer.

07 Roadway cross culverts shall be installed where required as follows:

[a] Minimum length: As required per specific road cross section and measured from centre of ditch to centre of ditch.
[b] Minimum size: 600 mm diameter.
[c] Cover: 0.5 meter minimum for road cross culverts and shall meet OPSD Division 800.
[d] Bedding/Embedment/Backfill: Culverts shall be bedded/embedded and backfilled with granular material in accordance with OPSS 1840.
[e] Frost tapers in accordance with OPSD 803.010 and 803.030 are required on all cross culverts where the depth of cover is less than 2.0 metres.
[f] End Protection: Where it is determined that erosion control measures are required, all road and driveway culverts shall have the ends protected with rip-rap or concrete headwalls, as per OPS standards and specifications.

08 Driveway entrance culverts shall be a minimum size of 450 mm diameter and a minimum length of 9 metres with end protection as required. The side slope of the driveway shall not be steeper than 3:1 and the culvert shall extend a minimum of 0.5 metres beyond the toe of slope.

09 Marker posts may be required to indicate the locations of the ends of the culverts as determined by the City Engineer.

6.9 Riprap Requirements

01 Rip Rap shall be made up of a graded mixture in such a way that 50 per cent of the mixture by weight shall be larger than the D50 (median) size selected by the designer.

02 The largest size shall be 1.5 times the D50 size.

03 The smallest size shall be approximately 100 mm.

04 The minimum thickness of the rip rap layer shall be 1.5 times the maximum stone diameter but not less than 150 mm.

05 For the design of riprap, the following diameter and weight relationships shall be used, assuming a rock density of 2400 kg/m3 (150 lb/ft3), the rock is cubic in shape, the dimension is approximately 10% less than diameter specified:

Table 6.9 Relationship between Diameter and Weight for Angular Shaped Rocks

Diameter (mm)	Weight (kg)	Diameter (in)	Weight (lb)
50	0.25	2	0.5
100	2	4	4
150	7	6	15
200	16	8	35
250	34	10	75
300	50	12	110

06 The stone distribution shall be as follows, where K is the specified D50 size:

Table 6.10 Riprap Stone Distribution

Size of Stone	Percent of Total weight smaller than the given size
3K	100
2K	80
K	50
0.1K	10

Example: if a D50 rock = 200 mm or 16 kg is required, 10% of the rocks will weigh 1.6 kg or less, 50% of the rocks should weigh 16 kg or less, 80% of the rocks should weigh 32 kg or less, and all the rocks should weigh less than 48 kg.

07 Geotextile shall be placed under riprap in accordance with OPSS 511, shall conform to OPSS 1860, and shall be nonwoven, Class II, with a filtration opening size (FOS) of 75-150 µm.

6.10 Closed Circuit Television Examination of Sewers

01 The video examination shall extend throughout the entire length of the storm sewer system as identified and shall include the submission of a report both in video and written form. The video examination will extend to a minimum of two reaches downstream until all foreign material is removed.

02 Service connections shall have CCTV examinations.

03 Prior to any video examination, the systems shall be flushed and cleared of all heavy silts, clays, sludge, and other foreign material.

04 The examination shall be carried out prior to the construction of curbs or the application of the first lift of asphalt. A schedule as to the timing of the examination shall be provided to the City one week in advance of the inspection taking place.

05 The report format shall consist of an unedited video DVD together with a written report comprised of the following components:

[a] Size of pipe;
[b] Type of pipe;
[c] Length of pipe (run length to be from maintenance hole to maintenance hole or dead end);
[d] The Municipality's maintenance hole numbering system as identified and where possible a corresponding house number;
[e] Size, type and condition of maintenance holes;
[f] Location of all problem areas referenced to the run's starting point;
[g] A coloured picture of all problem areas;

[h] Location of all intermediate branch connections referenced to the run's starting point;
[i] A key map indicating maintenance hole numbers.
[j] All units to be metric.

7 STORMWATER MANAGEMENT

7.1 General

01 The stormwater management (SWM) system shall be designed in accordance with the following design standards, with the design criteria of other authorities having jurisdiction, and with the latest revision of the MECP's Stormwater Management Planning and Design Manual (SWMP Manual). The design of the works shall follow the appropriate watershed, sub-watershed, and master drainage plans, as applicable. A SWM report shall accompany each design submission and the owner's engineer shall include calculations to support the design of the SWM system and related quality and quantity requirements.

02 In recognition of diverse development conditions, consideration will be given by the City of North Bay to all innovative approaches and/or techniques that can be demonstrated to meet the required stormwater management objectives.

03 Stormwater management areas for subdivisions will be on lands conveyed at no cost to the City in addition to any lands required to be dedicated for park purposes under the Planning Act. Construction costs will be borne by the owner while long term maintenance of the stormwater management facility will be borne by the City. Where a stormwater management facility is located within or adjacent to a public park, the limit of the stormwater facility shall be construed as being the highest elevation of free board.

04 Stormwater management areas for industrial, commercial, and institutional development, subject to site plan approval, will be on lands retained by the owner. All costs associated with the construction and continuing maintenance of stormwater management facilities shall be borne by the owner.

05 It is important that subdivision planning and the design of urban SWM practices are undertaken in an integrated process to ensure that an environmentally responsible planning process is implemented. The recommended strategy for stormwater management is to provide an approach to water management that is premised on controlling pollution at the source. The hierarchy of preferred SWM practices are:

[a] Stormwater lot level controls;
[b] Stormwater conveyance controls; and
[c] End of pipe Stormwater Management facilities.

06 Areas subject to the collection of contaminants or spills shall be fitted with adequate oil/grit separators or suitable alternative.

7.2 Objectives

01 The objectives of SWM are:

[a] preserve groundwater and base flow characteristics;
[b] prevent undesirable and costly geomorphic change in the watercourse;
[c] prevent any increase in flood risk potential;
[d] protect water quality; and ultimately,
[e] maintain an appropriate diversity of aquatic life and opportunities for human uses.

02 SWM solutions should be economically efficient to construct and maintain.

7.3 Major/Minor Systems

01 Generally, minor storms (5-year storm) shall be conveyed through a piped distribution system while major storm events shall be conveyed overland using the roadway system and other public lands as the major flow route.

02 Major storm overland flow routes shall be designed for the peak flow from a 100-year storm.

03 The depth of flow in the major flow path, both on public and private lands, shall not exceed 300 mm.

7.4 Watershed, Sub-Watershed, and Master Drainage Plans

01 The following provides a list of the available watershed, sub-watershed, and master drainage plans that have been completed for areas within the City of North Bay:

[a] North Bay-Mattawa Source Protection Area, Source Protection Plan (North Bay Mattawa Conservation Authority, As approved March 5, 2015 Effective Date July 1, 2015)
[b] Lees Creek and Golf Club Creek Tributary: Subwatershed/Stormwater Management Plans (Aquafor Beech Ltd., September 2001);
[c] Jessup's Creek Subwatershed and Stormwater Management Plan (Aquafor Beech Ltd., September 2000);
[d] Trout Lake Watershed Management Study: Watershed Hydrology and Shoreline Development (Conestoga Rovers & Associates Ltd, October 1998);
[e] Trout Lake Watershed Management Study: Summary and Implementation (Conestoga Rovers & Associates Ltd, October 1998);
[f] LaVase River Watershed Management Study – Draft Report (Totten Sims Hubicki Associates, February 1997)

[g] Chippewa Creek Watershed Management Study – Final Report (Proctor & Redfern Ltd., December 1996);

7.5 Floodplain Mapping Studies

01 The following table provides a summary of floodplain mapping that is available for the major watercourses within the City of North Bay:

Table 7.1 North Bay Floodplain Mapping Availability

Watercourse	Tributary To	Floodplain Mapping Available
Duchesnay Creek	Lake Nipissing	X
Pinewood Fingers	Lake Nipissing	
Chippewa Creek	Lake Nipissing	X
Johnson Creek	Chippewa Creek	X
Eastview Tributary	Johnston Creek	X
Parks Creek	Lake Nipissing	X
Jessup's Creek	Lake Nipissing	X
LaVase River	Lake Nipissing	X
Lees Creek	Trout Lake	X
Doran Creek	Trout Lake	
Hogan Creek	Trout Lake	
Four Mile Creek	Trout Lake	X
Laronde Creek	Trout Lake	X

02 Where development is proposed adjacent to a watercourse and where floodplain mapping is not available, suitable hydraulic calculations and/or modelling may be required at the discretion of the City Engineer.

7.6 Chicago Storm

01 For the development of Chicago Storm synthetic storm distributions for North Bay, the a, b, c values in **Table 6.4** shall be used:

02 An r value of 0.38 shall be used for North Bay, where r represents the ratio of the time of peak intensity divided by the storm duration.

7.7 7.02 Environmental Design Criteria

01 The environmental design criteria to be considered shall include water balance, water quality, in-stream erosion control/geomorphology, and water quantity.

7.8 Water Balance

01 The requirement for water balance calculations and groundwater recharge measures will be determined on a site by site basis at the discretion of the City Engineer.

02 Water balance and groundwater requirements of other authorities having jurisdiction, specifically the North Bay-Mattawa Conservation Authority, shall be confirmed, accounted for, and documented in a stormwater management report.

7.9 Water Quality

01 Water quality control requirements shall be based on the watershed, sub-watershed, or master drainage plan for the receiving watercourse or water body. The following table provides a summary of the water quality control requirements for the major watercourses within the City of North Bay:

Table 7.2 Water Quality Control Requirements for Major Watercourses within North Bay

Watercourse	Tributary To	Coldwater or Warmwater	Level of Protection Required	Long-Term Average Suspended Solids Removal Required	Guiding Document
Duchesnay Creek	Lake Nipissing	Coldwater	Enhanced	80%	None Available
Pinewood Fingers (Pinewood Parkway Creek)	Lake Nipissing	Undefined (No Temperature Data Available)	To be Confirm with the North Bay-Mattawa Conservation Authority	To be Confirmed with the North Bay-Mattawa Conservation Authority	None Available
Chippewa Creek (Upstream of O'Brien Street at Golf Club Road)	Lake Nipissing	Coldwater	Enhanced	80%	Chippewa Creek Watershed Management Study
Chippewa Creek (Downstream of O'Brien Street at Golf Club Road)	Lake Nipissing	Warmwater	Normal	70%	Chippewa Creek Watershed Management Study

Watercourse	Tributary To	Coldwater or Warmwater	Level of Protection Required	Long-Term Average Suspended Solids Removal Required	Guiding Document
Johnson Creek	Chippewa Creek	Warmwater	Normal	70%	Chippewa Creek Watershed Management Study
Eastview Tributary	Johnston Creek	Warmwater	Normal	70%	Chippewa Creek Watershed Management Study
Parks Creek	Lake Nipissing	Warmwater	Normal	70%	None Available
Jessup's Creek	Lake Nipissing	Undefined (No Temperature Data Available)	Normal	70%	Jessup's Creek Subwatershed and Stormwater Management Plan
LaVase River	Lake Nipissing	Warmwater	Normal	70%	LaVase River Watershed Management Study
Lees Creek	Trout Lake	Coldwater	Enhanced	80%	Lees Creek and Golf Club Creek Tributary: Subwatershed/ Stormwater Management Plans
Doran Creek	Trout Lake	Coldwater	Enhanced	80%	Trout Lake Watershed Management Study
Hogan Creek	Trout Lake	Coldwater	Enhanced	80%	Trout Lake Watershed Management Study
Four Mile Creek	Trout Lake	Coldwater	Enhanced	80%	Trout Lake Watershed Management Study
Laronde Creek	Trout Lake	Coldwater	Enhanced	80%	Trout Lake Watershed Management Study

02 In the absence of a watershed, sub-watershed, or master drainage plan, water quality requirements of other authorities having jurisdiction, specifically the North Bay-Mattawa Conservation Authority, shall be confirmed, accounted for, and documented in a stormwater management report.

7.9.1 Multiple Residential, Industrial, Commercial, and Institutional

01 New development with a total site area greater than 2,500 m^2 and less than 5 ha, shall be required to implement a privately owned and maintained oil/grit separator for water quality control.

7.9.2 Infill and Redevelopment

01 Infill and redevelopment sites with a total site area greater than 2,500 m^2 and less than 5 ha, shall be required to implement a privately owned and maintained oil/grit separator for water quality control.

7.10 In-Stream Erosion Control/Geomorphology

01 The requirement for in-stream erosion control/geomorphology control will be determined on a site by site basis at the discretion of the City Engineer.

02 In-stream erosion control/geomorphology control requirements of other authorities having jurisdiction, specifically the North Bay-Mattawa Conservation Authority, shall be confirmed, accounted for, and documented in a stormwater management report.

03 Where it has been determined that in-stream erosion control/geomorphology control is required, an acceptable method of control shall be the 24-hour detention of the post-development runoff volume from a 25 mm rainfall event.

7.11 Water Quantity

01 Post-development peak flow rates are to be controlled to pre-development values for the 2 through 100-year storm events.

02 Acceptable flow controls for storage areas (SWM ponds, parking lot storage, etc.) include culverts, weirs, orifices (pipes and plates), or any combination thereof. Inlet control should not always be assumed on storage area outlet pipes.

03 Orifice plates are permitted provided the orifice plate is stainless steel, permanent, tamper-proof, and connects to a 300 mm minimum diameter outlet pipe.

04 The following tables shall be provided in the SWM report:

[a] Pre-development flows for each return period
[b] Uncontrolled post-development flows for each return period

[c] Stage-storage-discharge for storage areas
[d] Controlled post-development flows for each return period

05 A summary table comparing pre-development flows and controlled post-development flows for each return period

06 Rooftop storage shall not be permitted unless otherwise approved by the City Engineer.

7.12 Stormwater Management Ponds

01 Stormwater management ponds shall be designed in accordance with the latest revision of the MECP's Stormwater Management Planning and Design Manual (SWMP Manual).

02 SWM ponds on City of North Bay lands or on lands that the City will assume shall not have permanent full perimeter fencing, unless otherwise approved by the City Engineer. Safety issues for SWM ponds shall be addressed using other techniques, such as gentle side slopes, incorporating trash/safety racks into the pond outlet, community education, etc. With full perimeter fencing installed, reaching a person who requires assistance within the fencing would be impeded by the fence. In addition to safety concerns, ponds that are surrounded by fences are generally not as well maintained as those that are in the open and more visible.

03 All SWM ponds shall have warning signs conspicuously located on all sides of the facility and/or where directed by the City Engineer. Warning signs shall contain the text:

"WARNING
POND NOT MONITORED FOR HAZARDOUS CONDITIONS
THIS STORMWATER MANAGEMENT POND IS SUBJECT TO FLUCTUATING WATER LEVEL, WATER QUALITY AND THIN ICE
THE CITY ASSUMES NO RESPONSIBILITY FOR ITS UNINTENDED USE"

7.12.1 Maintenance Access Roadways

01 A maintenance roadway shall be provided for all SWM ponds.

02 The roadway shall provide access to all areas of the SWM pond in order that accumulated sediment from all areas of the pond bottom can be excavated with an excavator.

03 Where the roadway does not surround the entire SWM pond, a turnaround area shall be provided with a minimum turning radius of 15.0 m.

04 The roadway shall have a minimum width of 4.5 m, a maximum gradient of 10%, and a minimum cross fall of 1%.

7.12.2 Vegetation

01 Native and non-invasive trees, shrubs, ground covers and aquatic plants are required in a low maintenance landscape design, which has regard for the ecology of the site.

02 For Wet Ponds and Wetlands, all slopes 5:1 and steeper ranging from a minimum horizontal distance of 3.0 m from the permanent pool level to the property line (not including walkways and trails) shall be planted.

03 For Dry Ponds, all slopes 5:1 and steeper ranging from a minimum horizontal distance of 3.0 m from the pond bottom level to the property line (not including walkways and trails) shall also be planted.

04 Incorporating a wide range of slopes and ponding depths into facility design that conform to the design principles is strongly encouraged and desirable in order to facilitate a wide range of flora and fauna habitat conditions.

05 Subject to a review on a case by case basis, where trees are to be planted, they must be planted at a minimum rate of 1 tree (40 mm cal.) per 50 square meters. The density of shrub plantings, for safety purposes, shall vary depending on the degree of slope. Shrub plantings shall discourage public access on all 3:1 slopes.

06 100% density equals 1 shrub per square metre, 25% density equals 1 shrub per 4 square meters.

7.12.3 Landscaping and Community Trails

01 Where the Stormwater Management Pond can be integrated in or adjacent to active or passive recreation areas, it shall be suitably designed and landscaped to compliment the overall park concept. The site shall be designed for ease of maintenance and with due regard for safety of the public.

02 A landscape plan of the stormwater management facilities shall be approved by the City prior to the registration of the Plan of Subdivision. All landscaping of areas shall be installed at the developer's cost, in accordance with the approved plan, during the first planting season after occupancy of the first unit. The developer shall maintain the planting for a period of one year from the completion of final planting. Landscape plans are to be prepared by a landscape architect or other qualified individual acceptable to the City.

03 In the event that a community trail has been identified and/or required by the City in the vicinity or adjacent to a stormwater management pond, they shall be implemented above the maximum extended detention level or 5 year storm level, whichever is greater, in order to prevent frequent flooding. Trails shall have a minimum width of 3.0 m.

04 To enhance user comfort and safety, a 3.0 m zone on each side of the community trail shall be designed in such a way that sight lines are preserved. If barriers are

required, they must not interfere with visibility or create entrapment areas. In situations where a community trail is designed within the maximum peak flow depth zone, the 3.0 m separation above the trail shall have a maximum slope of 3:1. Below the trail, the 3.0 m separation shall have a maximum slope of 6:1. This zone shall be planted with low ground covers. Deciduous trees should be planted at a minimum distance of 1.5 m from the edge of the trail. The planting of coniferous trees within this zone is not permitted.

05 Prior to the City accepting the stormwater management pond as shown on the approved landscape plan, the developer shall erect one or more information signs at a public access point(s) detailing the purpose of the pond, phone number for further information and any other relevant information, all at the cost of the developer.

7.12.4 Wet Ponds

01 The permanent pool shall have a maximum depth of 2.5 m and a minimum depth of 1.0 m.

02 The maximum depth for water quality or erosion control active storage/extended detention shall be 1.0 m above the permanent pool (normal water) level.

03 The maximum total active storage depth, including extended detention and water quantity control shall be 2.0 m above the permanent pool (normal water) level.

04 Freeboard of 0.3 m is required above the maximum water level.

05 Side slopes shall be no steeper than 5:1 from the bottom of the pond to 3 m (horizontal distance) upland of the permanent pool level. Above this, the side slopes shall be no steeper than 3:1.

7.12.5 Constructed Wetlands

01 The maximum depth for water quality or erosion control active storage/extended detention shall be 1.0 m above the permanent pool (normal water) level.

02 The maximum total active storage depth, including extended detention and water quantity control shall be 2.0 m above the permanent pool (normal water) level.

03 Freeboard of 0.3 m is required above the maximum water level.

04 Side slopes shall be no steeper than 5:1 from the bottom of the pond to 3 m (horizontal distance) upland of the permanent pool level. Above this, the side slopes shall be no steeper than 3:1.

7.12.6 Hybrid Wet Pond/Constructed Wetlands

01 The maximum depth for water quality or erosion control active storage/extended detention shall be 1.0 m above the permanent pool (normal water) level.

02 The maximum total active storage depth, including extended detention and water quantity control shall be 2.0 m above the permanent pool (normal water) level.

03 Freeboard of 0.3 m is required above the maximum water level.

04 Side slopes shall be no steeper than 5:1 from the bottom of the pond to 3 m (horizontal distance) upland of the permanent pool level. Above this, the side slopes shall be no steeper than 3:1.

7.12.7 Dry Ponds

01 The maximum active storage depth shall be 1.8 m.

02 Freeboard of 0.3 m is required above the maximum water level.

03 Side slopes shall be no steeper than 5:1 from the bottom of the pond to the greater of the water quality or erosion control active storage/extended detention depth. Above this, the side s/opes shall be no steeper than 4:1.

04 The minimum allowable gradient on the bottom of the basin shall be 1.0% and the maximum gradient shall be 5.0%.

7.12.8 Oil/Grit Separators

01 Sizing of oil/grit separators shall be supported with a long-term analysis demonstrating the unit's long-term average removal of total suspended solids.

02 In the absence of detailed long-term rainfall data for North Bay, 15 minute time-step rainfall data for the Toronto Central rainfall station may be used for long-term analysis calculations.

03 Materials acceptable for use for oil/grit separators shall be as per Appendix D.

8 UTILITIES

8.1 General

01 Standards in this section provide guidelines for the design and construction of utility systems as part of typical greenfield urban development. They provide a basis for preparing the related aspects of development agreements. Deviations from these standards will be considered on a case-by-case basis for justifiable engineering reasons.

8.2 Greenfield Development

01 All utility infrastructure shall be located underground, including road crossings and primary and secondary Hydro.

8.3 Infill and Existing Development Servicing and Rebuilds within City Road Allowance

01 Underground road crossings on roads paved within the last five years shall be completed using trenchless technologies – i.e. no open cut shall be allowed.

02 Road crossings on Arterial and Collector shall be located underground.

03 No privately-owned infrastructure shall be allowed within the City road allowance.

04 Works to service, renew, or upgrade services to private property shall be completed through a Service Contract between the City and the private property owner. The private property owner shall be responsible for the Service Contract costs. The Utility shall complete the work in accordance with its Municipal Access Agreement and only after receiving Municipal Consent and authorization to complete the work.

8.4 Owner Responsibilities

01 The owner's responsibilities for the interim maintenance of the underground utilities are as outlined in the subdivision agreement.

02 It is the development owner's responsibility to co-ordinate with utilities and to ensure that their servicing is in compliance with the alignment and property guidelines and standards set forth in these documents. Installation and maintenance of services connected to private utilities shall be in accordance with the utility agreements.

8.5 Engineering Responsibilities

01 Inspection personnel under the supervision of the Owner's engineer shall be on-site at all times when underground infrastructure is being installed.

02 Utilities on typical urban residential streets will normally be aligned in accordance with the applicable standard road cross section. Where the alignment is forced to deviate from those standard locations, it shall maintain the horizontal separation as detailed below. All measurements between structures are the minimum permitted and measured near edge to near edge of structure.

[a] Gas outside the joint utility trench shall be 0.5 metres from the property line, and other utility mains and services shall be separated from gas mains as set out below in joint trench detail.

[b] Joint Utility Trench - 0.3 meters from property line to a distance of 1.5 metres from the property line.

[c] Light Standards – as per standard road cross section.

[d] Where the utility trench crosses through private property, the distribution circuits contained therein shall be in concrete encased duct or mechanically protected by equivalent means agreed to with North Bay Hydro.

03 Clearance between conduit crossings shall normally be a minimum of 300 mm between the outside pipe barrels. Where a clearance of 300 mm or less cannot be avoided, there shall be concrete encasement or non-shrink backfill of the crossing extending one metre in each direction on each pipe.

04 Utilities will inspect works installed by third parties for compliance to specifications. The owner is responsible for any and all corrective measures at the owner's expense.

8.6 Works Ownership

01 All mains and services for which the City has distribution rights or maintenance responsibilities become the sole property of the City upon the issuance of the Certificate of Final Acceptance.

02 All electrical distribution services for which North Bay Hydro has distributor rights as described in North Bay Hydro's Conditions of Service become the sole property of North Bay Hydro upon issuance of Partial and Final Inspection Certificates.

8.7 Easements

01 At draft plan circulation, utilities will provide easement requirements.

02 Easement requirements must be communicated by the owner to the City.

9 STREET LIGHTING SYSTEM

9.1 General

01 This standard is intended to address lighting of local and collector streets only. Illumination of streets of a higher classification will be dealt with on a case by case basis.

02 Street lighting systems shall be designed by a professional engineer.

9.2 Design Considerations

01 Street light intensity shall be as per the following table:

Table 9.1 Required Street Light Intensity

Classification Criteria	Rural Local	Urban Local	Urban Collector
Maintained Intensity in foot-candles at surface	0.2	0.5	0.9

02 Street light intensity shall be installed as per the following tables using a minimum Medium Pedestrian Conflict Area for Collector and Residential Roads. For intersections the Pedestrian Area Classification shall be specified by the City Engineer.

Table 9.2 Required Street Light Intensity

Road	Pedestrian Conflict Area	Pavement Classification R2/R3 (lux/fc)	Uniformity Ratio E_{avg}/E_{min}	Veiling Luminance E_{max}/E_{avg}
Arterial	High	17 / 1.7	3.0	0.3
	Medium	13 / 1.3	3.0	0.3
	Low	9 / 0.9	3.0	0.3
Collector	High	12 / 1.2	4.0	0.4
	Medium	9 / 0.9	4.0	0.4
	Low	6 / 0.6	4.0	0.4
Residential	High	9 / 0.9	6.0	0.4
	Medium	7 / 0.7	6.0	0.4
	Low	4 / 0.4	6.0	0.4

Table 9.3 Intersection Illuminance Design Criteria

Function Classification	Average Maintained Illumination at Pavement by Pedestrian Area Classification (lux / fc) Uniformity Ratio			Veiling Luminance E_{max}/E_{avg}
	High	Medium	Low	
Arterial / Arterial	34.0 / 3.4	26.0 / 2.6	18.0 / 1.8	3.0
Arterial / Arterial	29.0 / 2.9	22.0 / 2.2	15.0 / 1.5	3.0
Arterial / Arterial	26.0 / 2.6	20.0 / 2.0	13.0 / 1.3	3.0
Collector / Collector	24.0 / 2.4	18.0 / 1.8	12.0 / 1.2	4.0
Collector / Collector	21.0 / 2.1	16.0 / 1.6	10.0 / 1.0	4.0
Residential / Residential	18.0 / 1.8	14.0 / 1.4	8.0 / 0.8	6.0

03 The housing bracket shall be die cast aluminium.

04 The bracket shall extend to align over curb edge.

05 Access mechanism shall offer tool free access to the inside fixture.

06 Optical System: (LE2), I.E.S type II (asymmetrical) full cut off. System is rated IP66. Performance shall be tested per LM63 and LM79 (IESNA) certifying its photometric performance. Dark Sky compliant.

07 Each lamp head shall have individual photo control.

08 Lamping shall be a maximum of 65 Watt LED luminaire for local residential roads and a maximum of 90 Watt LED luminaire for collector roads.

09 Luminaire shall carry a full minimum 10 year warranty for full replacement of the luminaire including photo cell if it fails. The Warranty shall be in the name of the City of North Bay.

10 Approved luminaires (cobra heads) for conventional street lighting are the following Philips.

[a] GPLS-65W49LED4K-LE2-120-API-NF
[b] GPLS-90W49LED4K-LE2-120-API-NF
[c] GPLM-105W79LED4K-LE2-120-API-NF
[d] GPLM-130W98LED4K-LEH2-120-API-NF

11 The cover shall be a swing down cover with filter basket.

12 The lens shall be clear tempered glass.

13 The ballast shall be 20V high power ballast.

14 Light poles shall be as follows:

[a] Local urban roads – sectional steel pole, 9 meter, Polefab TB-15D or equivalent

[b] Collector Urban Roads – sectional steel pole, 11 meter, Polefab TB-16D or equivalent

[c] Rural roadways where electrical utilities and telecom circuits are not present – 11 m (35 ft) Class 3 wood poles

15 Each lamp head shall have individual photo control.

16 All wiring shall be placed in ducts between poles in the joint utility trench. Ducts shall be flexible, non-metallic, suitable for direct burial, and sized to suit wire sizes (minimum 50 mm diameter). Wiring shall be sized to suit load and voltage drop and be a minimum #4 RWU, Orange Twin.

17 Developers shall consult with North Bay Hydro with regards to current detailed specifications for all aspects of street lighting hardware.

18 Where services cross roadways, the wiring shall be encased in ducts. Ducts shall be PVC Type 2 DB-10, double walled, 100 mm diameter, coloured grey, suitable for direct burial.

19 Wiring shall be sized to suit load and voltage drop and be single conductor #6 Copper, XPLE, PVC insulated.

20 Duct installation shall conform generally to CSA Standard C22.3, No 7-06 (Underground Systems) and specifically to North Bay Hydro's requirements for underground services.

21 Up to four standards may normally be serviced from one circuit. This length may be extended provided that the Developer submits supporting documentation to validate the extended design and complies with the applicable Electrical Safety Code requirements. Each pole shall house a fuse holder which shall also be the pole disconnect.

22 Each separate streetlight circuit shall be wired through a load center pedestal or similar enclosure for the purpose of isolating it from the main supply transformer, and isolating the individual circuits.

23 Lighting may be required for pedestrian walkways and paths constructed as part of a development. The requirements for such lighting will be considered on a case-by-case basis.

9.3 Spacing of Light Standards

01 Light standards shall have a maximum spacing of 45 m.

02 A standard shall be placed at every intersection.

03 A standard shall be placed at all corners for Collector / Collector intersections or greater.

04 Where warranted the developer's consultant shall determine the correct lighting levels as per Transportation Association of Canada (TAC) guidelines.

10 APPENDICES

10.1 Appendix A – Standard Road Cross-Sections

See following pages.

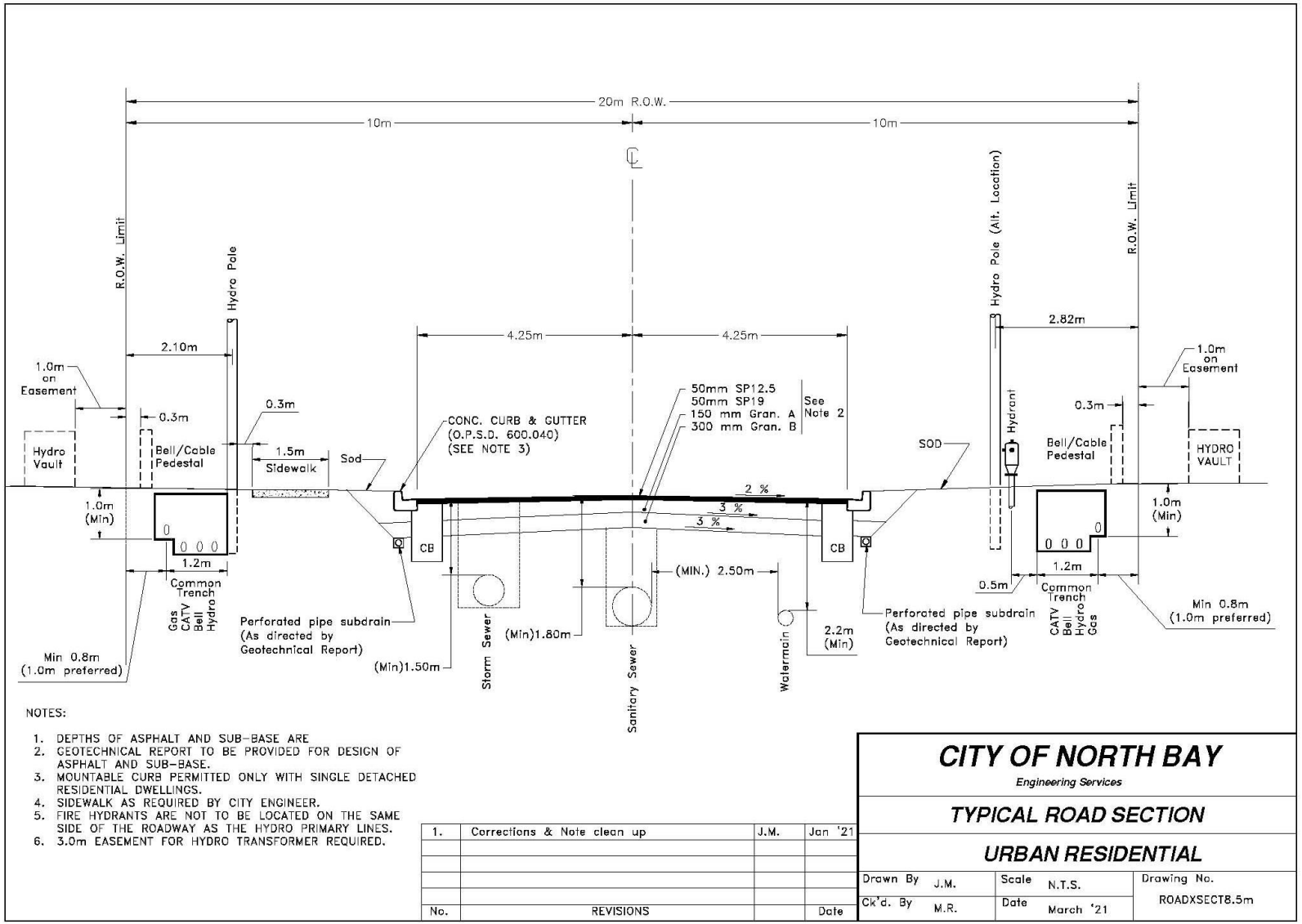
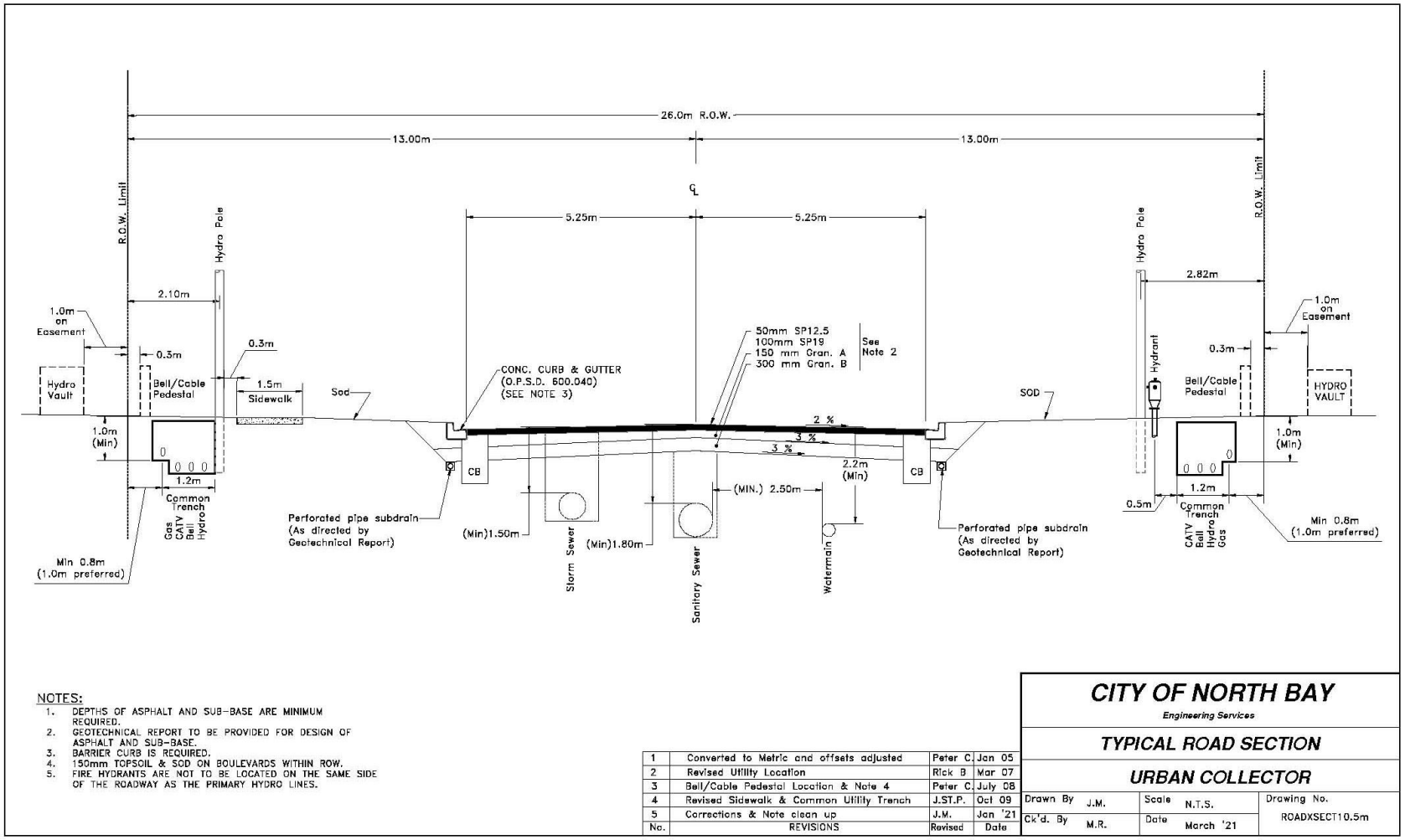


Figure 10.1 Typical Road Section – Urban Residential (8.5m)



NOTES:
1. DEPTHS OF ASPHALT AND SUB-BASE ARE MINIMUM REQUIRED.
2. GEOTECHNICAL REPORT TO BE PROVIDED FOR DESIGN OF ASPHALT AND SUB-BASE.
3. BARRIER CURB IS REQUIRED.
4. 150mm TOPSOIL & SOD ON BOULEVARDS WITHIN ROW.
5. FIRE HYDRANTS ARE NOT TO BE LOCATED ON THE SAME SIDE OF THE ROADWAY AS THE PRIMARY HYDRO LINES.

No.	REVISIONS	Revised	Date
1	Converted to Metric and offsets adjusted	Peter C.	Jan 05
2	Revised Utility Location	Rick B	Mar 07
3	Bell/Cable Pedestal Location & Note 4	Peter C.	July 08
4	Revised Sidewalk & Common Utility Trench	J.ST.P.	Oct 09
5	Corrections & Note clean up	J.M.	Jan '21

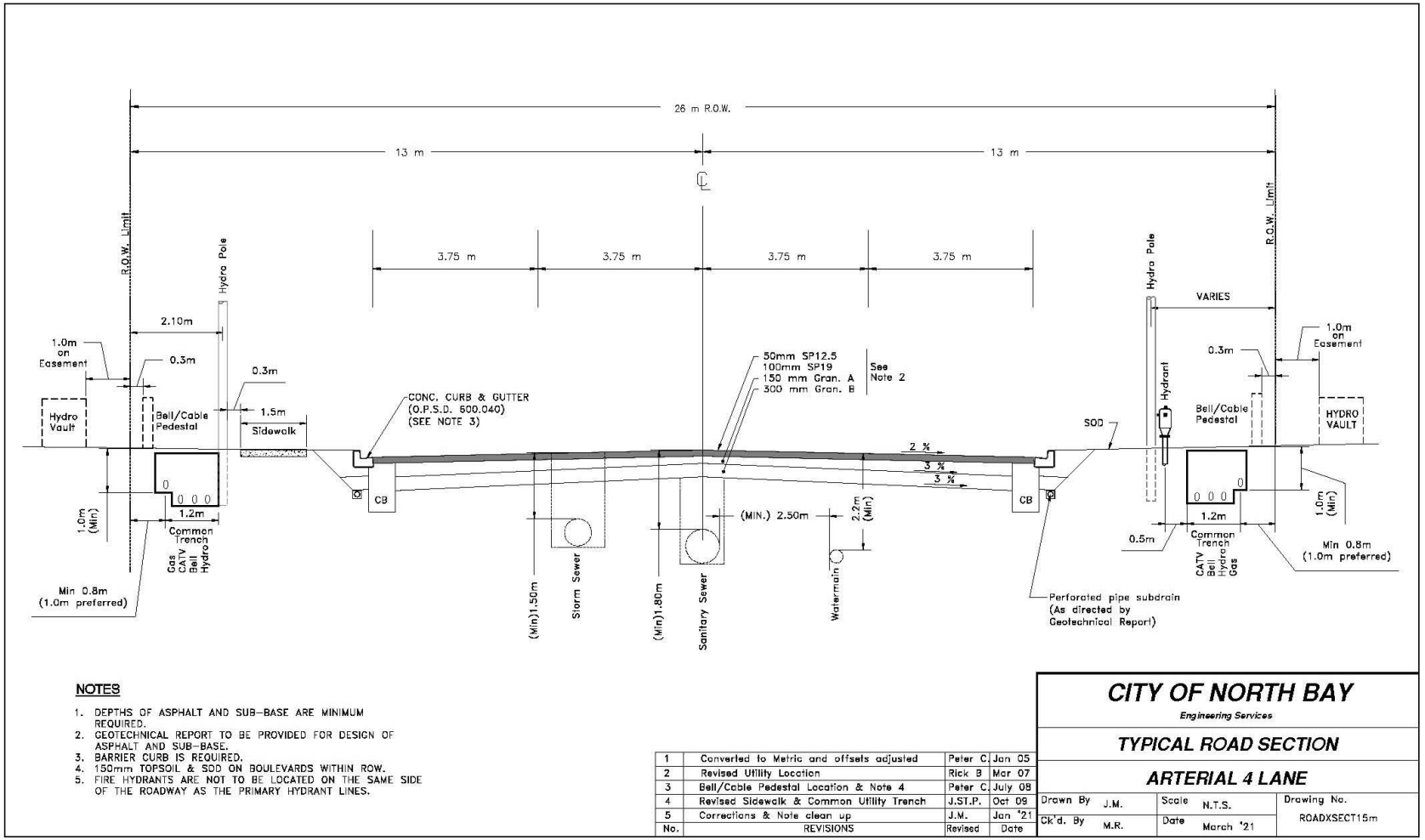
CITY OF NORTH BAY
Engineering Services

TYPICAL ROAD SECTION

URBAN COLLECTOR

Drawn By	J.M.	Scale	N.T.S.	Drawing No.
Ck'd. By	M.R.	Date	March '21	ROADXSECT10.5m

Figure 10.2 Typical Road Section – Urban Collector (10.5m)



NOTES

1. DEPTHS OF ASPHALT AND SUB-BASE ARE MINIMUM REQUIRED.
2. GEOTECHNICAL REPORT TO BE PROVIDED FOR DESIGN OF ASPHALT AND SUB-BASE.
3. BARRIER CURB IS REQUIRED.
4. 150mm TOPSOIL & SOD ON BOULEVARDS WITHIN ROW.
5. FIRE HYDRANTS ARE NOT TO BE LOCATED ON THE SAME SIDE OF THE ROADWAY AS THE PRIMARY HYDRANT LINES.

No.	REVISIONS	Revised	Date
1	Converted to Metric and offsets adjusted	Peter C.	Jan 05
2	Revised Utility Location	Rick B	Mar 07
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5	Corrections & Note clean up	J.M.	Jan '21

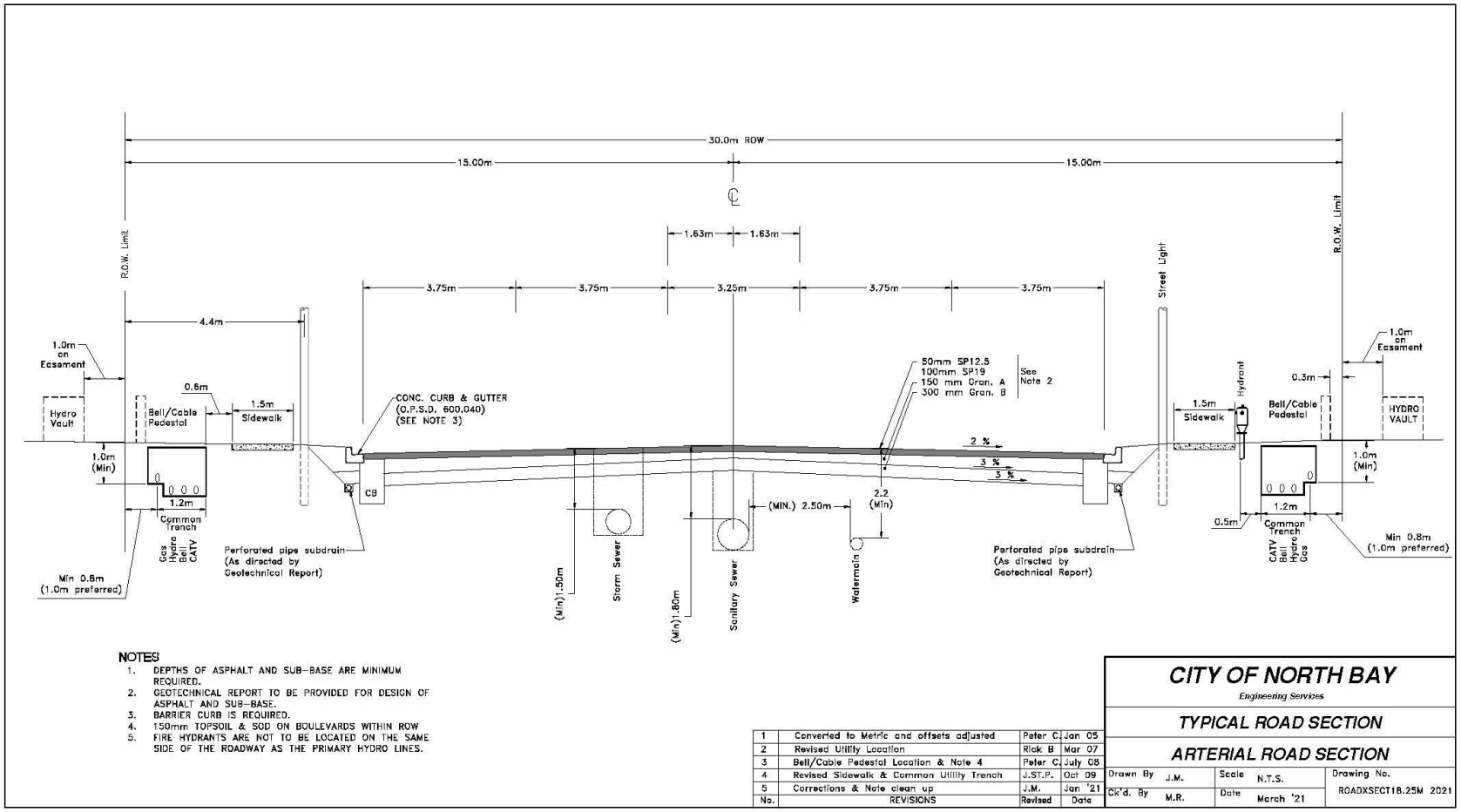
CITY OF NORTH BAY
Engineering Services

TYPICAL ROAD SECTION

ARTERIAL 4 LANE

Drawn By	J.M.	Scale	N.T.S.	Drawing No.
Ck'd. By	M.R.	Date	March '21	ROADXSECT15m

Figure 10.3 Typical Road Section – Arterial Road Four Lane (15m)



NOTES

1. DEPTHS OF ASPHALT AND SUB-BASE ARE MINIMUM REQUIRED.
2. GEOTECHNICAL REPORT TO BE PROVIDED FOR DESIGN OF ASPHALT AND SUB-BASE.
3. BARRIER CURB IS REQUIRED.
4. 150mm TOPSOIL & SOD ON BOULEVARDS WITHIN ROW
5. FIRE HYDRANTS ARE NOT TO BE LOCATED ON THE SAME SIDE OF THE ROADWAY AS THE PRIMARY HYDRO LINES.

No.	REVISIONS	Revised	Date
1	Converted to Metric and offsets adjusted	Peter C.	Jan 05
2	Revised Utility Location	Rick B	Mar 07
3	Bell/Cable Pedestal Location & Note 4	Peter C.	July 08
4	Revised Sidewalk & Common Utility Trench	J.ST.P.	Oct 09
5	Corrections & Note clean up	J.M.	Jan '21

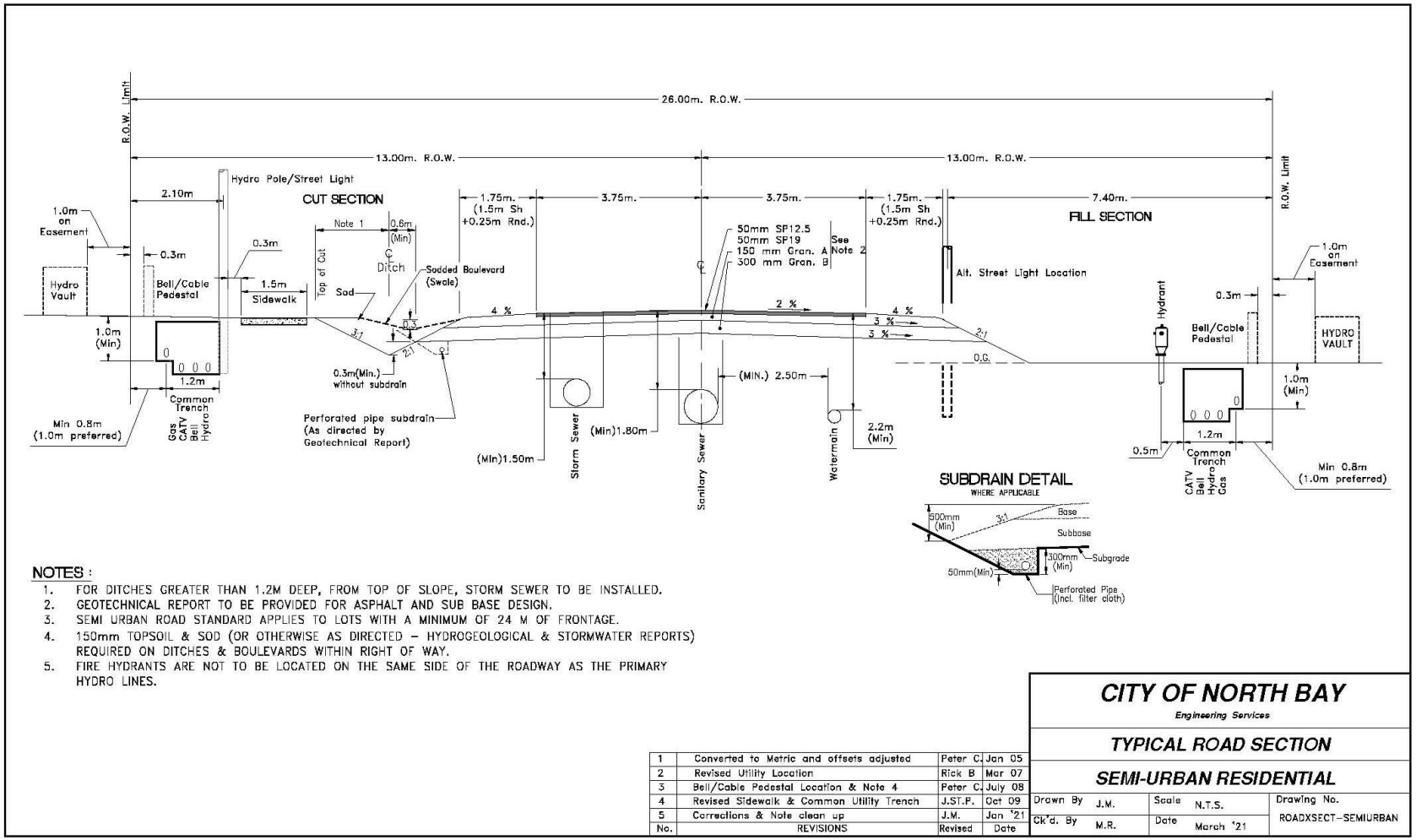
CITY OF NORTH BAY
Engineering Services

TYPICAL ROAD SECTION

ARTERIAL ROAD SECTION

Drawn By	J.M.	Scale	N.T.S.	Drawing No.
Ck'd. By	M.R.	Date	March '21	ROADXSECT18.25M 2021

Figure 10.4 Typical Road Section – Arterial Road (18.25m)



NOTES :

1. FOR DITCHES GREATER THAN 1.2M DEEP, FROM TOP OF SLOPE, STORM SEWER TO BE INSTALLED.
2. GEOTECHNICAL REPORT TO BE PROVIDED FOR ASPHALT AND SUB BASE DESIGN.
3. SEMI URBAN ROAD STANDARD APPLIES TO LOTS WITH A MINIMUM OF 24 M OF FRONTAGE.
4. 150mm TOPSOIL & SOD (OR OTHERWISE AS DIRECTED – HYDROGEOLOGICAL & STORMWATER REPORTS) REQUIRED ON DITCHES & BOULEVARDS WITHIN RIGHT OF WAY.
5. FIRE HYDRANTS ARE NOT TO BE LOCATED ON THE SAME SIDE OF THE ROADWAY AS THE PRIMARY HYDRO LINES.

No.	REVISIONS	Revised	Date
1	Converted to Metric and offsets adjusted	Peter C.	Jan 05
2	Revised Utility Location	Rick B	Mar 07
3	Bell/Cable Pedestal Location & Note 4	Peter C.	July 08
4	Revised Sidewalk & Common Utility Trench	J.ST.P.	Oct 09
5	Corrections & Note clean up	J.M.	Jan '21

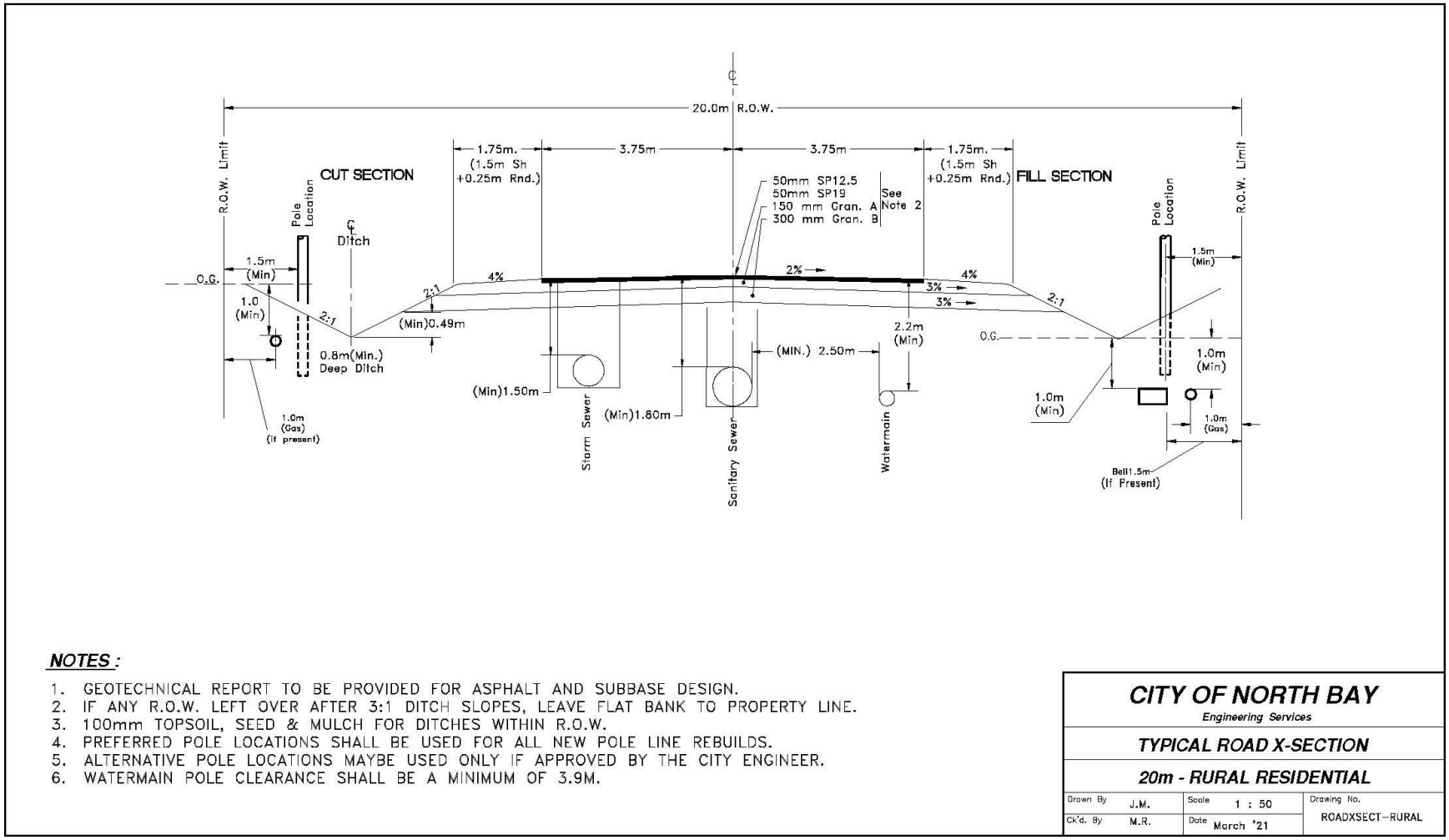
CITY OF NORTH BAY
Engineering Services

TYPICAL ROAD SECTION

SEMI-URBAN RESIDENTIAL

Drawn By	J.M.	Scale	N.T.S.	Drawing No.
Ck'd. By	M.R.	Date	March '21	ROADXSECT–SEMIURBAN

Figure 10.5 Typical Road Section – Semi-Urban Residential (24m)



NOTES :

1. GEOTECHNICAL REPORT TO BE PROVIDED FOR ASPHALT AND SUBBASE DESIGN.
2. IF ANY R.O.W. LEFT OVER AFTER 3:1 DITCH SLOPES, LEAVE FLAT BANK TO PROPERTY LINE.
3. 100mm TOPSOIL, SEED & MULCH FOR DITCHES WITHIN R.O.W.
4. PREFERRED POLE LOCATIONS SHALL BE USED FOR ALL NEW POLE LINE REBUILDS.
5. ALTERNATIVE POLE LOCATIONS MAYBE USED ONLY IF APPROVED BY THE CITY ENGINEER.
6. WATERMAIN POLE CLEARANCE SHALL BE A MINIMUM OF 3.9M.

CITY OF NORTH BAY *Engineering Services*			
TYPICAL ROAD X-SECTION			
20m - RURAL RESIDENTIAL			
Drawn By J.M.	Scale 1 : 50	Drawing No. ROADXSECT–RURAL	
Ck'd. By M.R.	Date March '21		

Figure 10.6 Typical Road Section – Rural Residential (20m)

10.2 Appendix B – Easement Width Requirements

Table 10.1 Easement Width Requirement

INSTALLATION TYPE	DEPTH OF INSTALLATION	MINIMUM WIDTH OF EASEMENT
Surface Drainage Swale	<0.5m	3.0m
Surface Drainage Ditch	<1.0m	4.5m
Surface Drainage Ditch	<1.5m	6.0m
Underground Utilities	<1.0	3.0m
Underground Utilities	>1.0	As Required By Utility
Above Grade Utilities	N/A	As Required By Utility
<450 mm Pipe	<2.0m	5.0m
<750 mm Pipe	<3.0m	7.5m
<1500 mm Pipe	<4.0m	10.0m
>1500 mm Pipe	Any Depth	As Required By City
Any Pipe	>4.0m	As Required By City

Notes:

(1) Installation types that have the minimum width of easement notes as “As Required” indicates that the City or Utility will review the proposed design, for consideration of access and maintenance needs. The easements required by the City in these cases will be no less than 6.0 metres in width.

(2) Easement widths for combined service type will require the minimum separation of 2.5 metres.

10.3 Appendix C – City of North Bay IDF Curves

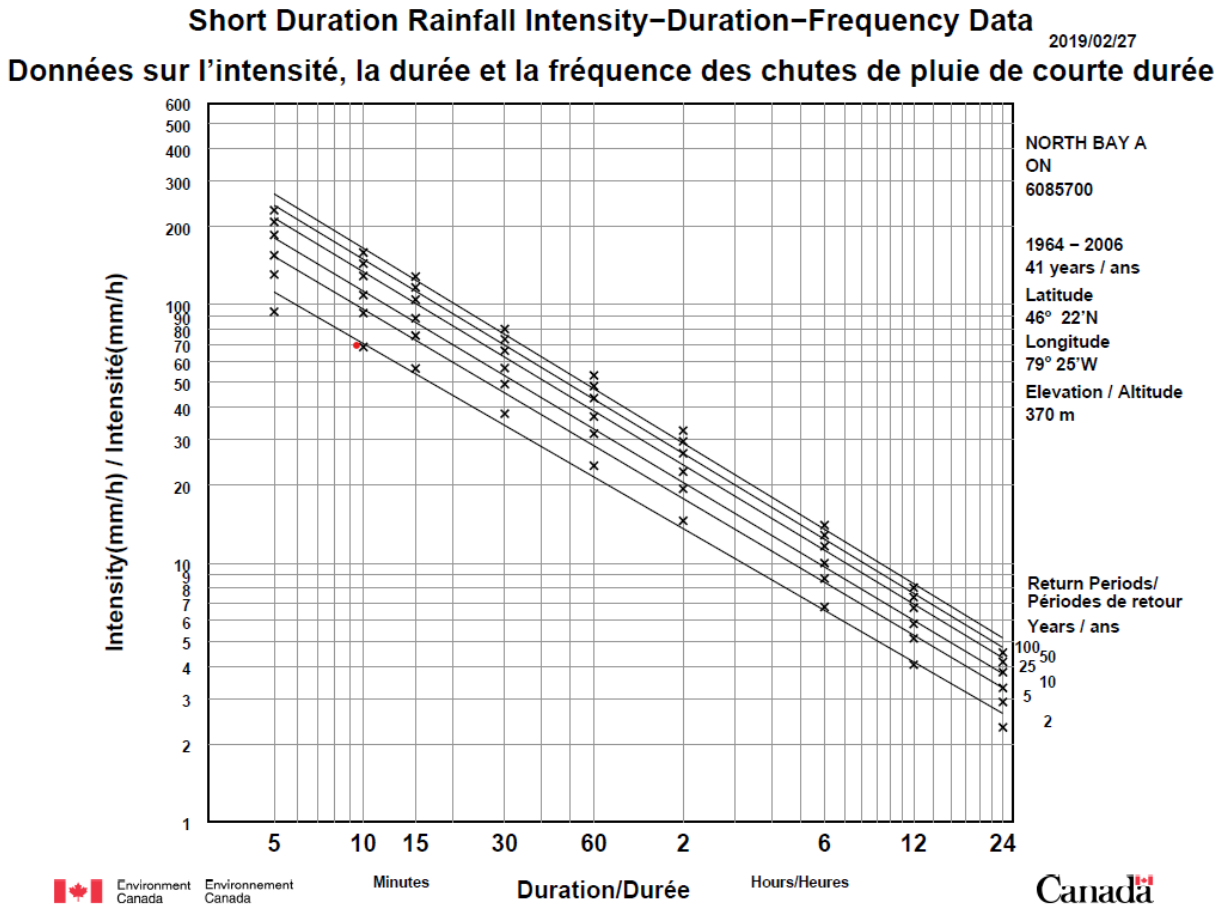


Figure 10.7 Short Duration Rainfall Intensity-Duration-Frequency Data (Environment Canada, 2019/02/27)

10.4 Appendix D – Approved Oil/Grit Separators

Table 10.2 Approved Manufacturers' Products for Storm Sewers

PRODUCT	SPECIFICATIONS	MANUFACTURER	DESCRIPTION/ MODEL
OIL/GRIT SEPARATORS	Sizing shall be supported with a long-term analysis demonstrating the unit's long-term average removal of total suspended solids.	ADS Pipe	ADS Water Quality Units
		Contech	CDS
		Stormceptor	Stormceptor (All Models)